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Studies on Deteriorating Air Quality in some Major Cities of Punjab

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ABSTRACT

The current study assessed the air quality of area 3 most populated cities of Punjab- Ludhiana, Jalandhar and Amritsar. Air quality Index (AQI) parameters- $PM_{2.5}$, PM_{10}, O_2, NO_3, SO_2, CO of recent 3 years (2021, 2020, 2019) of the 3 areas is studied. The highest annual average concentration of $PM_{2.5}$ is found to be 163.5 µg/m³ in December 2021 at Ludhiana, while the lowest value found to be 55.2 µg/m³ in Jalandharin September, 2021. It is important to review the literature regarding pollution in India's polluted areas. Air pollution significantly hurts soil and water resources. The findings of this paper indicate over last few years the rate at which air pollution in India is grown especially in urban areas is alarming. Excessive concentrations of pollutants in air have triggered a state of emergency in polluted areas around the world, particularly in developing countries like India.

Key words: *Air quality Index (AQI), Air concentrates, Air quality, Water, Policies, Management.*

Introduction

Air pollution is a major public health issue that has a significant impact on climatic changes, agricultural practices, human health, and overall eco-system changes around the world. According to various studies, pollution levels in different places vary greatly depending on their location, time, sampling period, and climatic circumstances. Rapid population increase and road traffic emissions are identified to be various sources of air pollution in the analyzed areas. Industrialand manufacturing unit emissions, brick kiln emissions, agricultural residue burning. Common pollutants of major concerns are Particulate Matter ($PM_{2.5}$ and PM_{10}), trace gases- Ozone (O_3), Nitrogenoxides (NOx), Sulphuroxides (SOx), Carbon monoxide (CO). Particulate Matter (PM) is mixture of solid and liquid particles found in air; these are so small of range 2.5-10 µm to be inhaled. Dust and sulphate generated by humans leads to artificial formation of particulate matter. Exposure to high concentration of PM leads to increased chances of respiratory diseases, risk of lung cancer, arteriosclerosis. In addition, high concentration of PM in areas has environmental impact as visibility and staining of buildings. $PM_{2.5}$ and PM_{10} contributes majorly towards Air Quality Index (AQI). NOx is emitted when fuel in burned at high temperature, thus it is mainly emitted by burning fossil fuels by on-road vehicles and various non-road vehicles including construction equipment, mining etc. Study indicates that NOx is main traffic related air pollutants and along with volatile carbons it forms photochemical smog and ground level O_3 which has

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adverse effects on humans. Sulphur oxides (SOx) emitted into atmosphere from electric utilities, especially those Sulphur-containing fossil fuels are combusted (coal, oil, natural gas). SOx are one of major contributor of acidification leads to acid rain. Acid rain effects soil, damage forests and crops make rivers lakes acidic unsuitable for aquatic animals. Carbon monoxide (CO) is released from incomplete combustion of carbonaceous material, automobiles, leaking chimineas and furnaces, generators and other gasoline powered equipment's. Almost all the cities of India are suffering from poor air quality index but only few cities started air quality monitoring shows seriousness of India towards the air pollution check.

Even, several recent studies have reported the sources and processes that contribute to air quality index parameters and gaseous pollutants in North India region especially in Punjab and Delhi. However, we have found no literature regarding comparison of air quality ofcities of Punjab. The comparison may be important for future air quality predictions and to make policies regarding improvement of air quality in cities of Punjab. In most of studies listed $PM_{2.5}$ and PM_{10} are mostly responsible for the deterioration of the air quality index. However, we've observed that, there have been few studies that focused on identifying the origins and processes that lead to PM. The National Air Quality Index (NAQI) allows for comparisons between cities so that new policies can be developed to reduce the amount of particulate matter in the air. The concentrations of various pollutants as well as various dangerous gases for major cities in India have been evaluated in most previous literature based on past NAQI data, indicating those places that are under severe pollution threat. In India, the contribution of emission sources to air pollution is inadequate. Sulphur dioxide (SO_2), nitrogen oxides (NOx), and carbon monoxide (CO) have limited data. While ambient air pollution monitoring has improved, at least in major cities, there are significant gaps in monitoring in many sections of the country, particularly in rural areas.

Materials and Methods

Study area

The sites are so selected that three most populated and polluted cities of Punjab are chosen, and observations are made based on sites selected. The daily average data for $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, CO is collected from January 2019 to March 2022 from 3 cities of Punjab- Ludhiana, Jalandhar and Amritsar is taken.

Data collection and data quality control

The data has been collected as per standard procedures prescribed by Indian government (as mentioned in provisions of the Air (Prevention and Control of Pollution) Act, 1981, the CPCB has notified fourth version of National Ambient Air Quality Standards (NAAQS) in 2009). For the research work, we use the data available from World Air Quality Index project (2007), China, Singapore, India, Australia, USA, accessed March 2022 (aqicnorg). For sake of better results, data is screened for irregularities. Before further analysis, data is first inspected for zero values and outliers by manual observations. Data missing is removed. Values of excess range are assumed to be error and are removed. We cross-check the data collected with data available on website of Central Pollution Control Board (CPCB) and values above or below the permissible limits are corrected or removed. All the data collected is converted to common units of $\mu g/m^3$. Daily mean average values are calculated for criteria pollutants $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, CO of last 3 years (2021, 2020, 2019) for each 12-hour day-night interval (between 6 am–6 pm and 6 pm–6 am (next day)), using a minimum of one hourly observation for each 12-hour period. To obtain annual average concentrations, we calculate quarterly means and require at least one monthly mean value as input to each quarterly mean concentration.

Results and Discussion

Ludhiana

Talking about AQI parameters, $PM_{2.5}$ remains very unhealthy throughout the study period i.e., 2019-2021. As per data, average yearly $PM_{2.5}$ in 2019 is 119.5 $\mu g/m^3$ and falls to 108.5 $\mu g/m^3$ in 2020 and rises to 124.1 $\mu g/m^3$ in 2021.

The average values of PM_{10} in 2021, 2020 and 2020 is 86.3 $\mu g/m^3$, 71.05 $\mu g/m^3$ and 75.5 $\mu g/m^3$ respectively. PM_{10} daily concentration even reaches 250 $\mu g/m^3$ levels during October-November 2021.

According to data collected O_3, NO_2, SO_2, CO levels in Ludhiana is moderate and not worth to com-

pare the values and plot their graphs. However, according to WHO guidelines, ozone levels should be in range of 60 ppb for peak 6 months and in Ludhiana in most time of studies period it lies in range of 0-50 ppb. For other trace gases- O_3, NO_2, SO_2, CO also lies in green range and is quite acceptable and they pose little or no risk.

Jalandhar

The avearge value of $PM_{2.5}$ of last 3 years is 102.5, 105.5 and 116.6 µg/m³ in 2019, 2020 and 2021 respectively which lies in unhealthy zone. During peak season (October-November) the avearge value of $PM_{2.5}$ is 180 µg/m³, this also give us conclusion that stubble burning is also one of major acuse of unhealthy air in Jalandhar along with urbanization and industrial pollution. In October 2021, Jalandhar got tag of most polluted district in Punjab in AQI Survey.

The challenges of PM_{10} are same as $PM_{2.5}$ as the average annual values are found to be quite high as compared to standards. The average values of PM_{10} in studied years are 87.7 µg/m³, 71 µg/m³, 77.6 µg/m³ in 2021, 2020 and 2019. As $PM_{2.5}$ level rises in October-November, PM_{10} also shows its peak in the same period. During monsoon season (July-August), the average monthly values are decreased due to monsoon rains in the region and suspended particulate matter settles down. Considering AQI parameters O_3, NO_2, SO_2, CO are found be satisfactory like Ludhiana.

Amritsar

The average $PM_{2.5}$ values of $PM_{2.5}$ is 121.9 µg/m³, 111.4 µg/m³, 118.8 µg/m³ in 2021, 2020, 2019 respectively. The $PM_{2.5}$ values suggest unhealthy air of city and lack of air pollution control policies. Like other cities of Punjab, data indicates O_3, NO_2, SO_2, CO values are satisfactory.

The average values of PM_{10} of 3 last 3 years is 71.85 µg/m³, 82.3 µg/m³, 74.5 µg/m³ in 2019, 2020 and 2021 respectively. As per data O_3, NO_2, SO_2, CO levels in Amritsar is moderate and not worth to compare the values and plot their graphs.

Understanding the pollution in Ludhiana, Jalandhar and Amritsar

Ludhiana is surrounded by industrial and commercial zones, and city's rapid growth resulted in increase in gaseous pollutants and particulate matter. Ludhiana, in particular major industry hub in Punjab. Ludhiana district is surrounded by 916 villages therefore around the periphery of main city, crop residue burning adversely effects the air quality in the city especially during the winters. During October-November, the period of stubble burning in Punjab $PM_{2.5}$ even rises to 171.1 µg/m³ monthly value considered to be hazard for humans. According to standards of World Health Organization (WHO), prescribed $PM_{2.5}$ concentration in atmosphere is 5 µg/m³. Interesting fact is that none of major city of India matches trends set by WHO to evaluate air quality. The graph of $PM_{2.5}$ also shows the trend of decreased $PM_{2.5}$ concentration in 2020 may be due nationwide lockdowns and less industrial and transportation emissions which led to decreased concentration of $PM_{2.5}$ in air.

Jalandhar is 3rd largest city and is also the 3rd most populous city in Punjab. Jalandhar is home to many types of industries- automobiles parts, sports, rubber, chemicals, leather etc. leads to one of polluted city in Punjab. Like Ludhiana, Jalandhar district is also surrounded by 965 villages therefore crop residue burning is also one of major problem in Jalandhar. The overall AQI of Jalandhar is very poor. The pollution control action plan in Jalandhar will include elements such as source identification, its identification and its application in sectors such as vehicular pollution, industrial pollution, dust pollution, construction activities, garbage burning, agricultural pollution, including pollution caused by crop residue burning, residential and indoor pollution etc.

Amritsar ranked among the 20 most polluted cities in the country. Apart from other common reasons of pollution, Bhagtawala dumping ground is also one of cause of bad air quality of Amritsar, garbage keeps burning there from years leads to increase in AQI in Amritsar. Amritsar's ambient annual $PM_{2.5}$ pollution is estimated to be 53% and come from outside the city's airshed. According to studies, major cause of $PM_{2.5}$ concentration is brick kiln emissions. While the reason for emissions of the trace gases in city is transport and industrial emissions from small, medium and large industries. Despite lockdown and less industrial activities in 2020, the PM_{10} concentration is higher in 2020 may be due to agricultural stubble burning.

Conclusion

By assessing the levels of Particulate Matter and gaseous air pollutants in the research region, we

able to analyze the ambient air quality of 3 North Indian cities in terms of Air Quality Index (AQI). According to the report, the state of air pollution is serious, and it has intensified the problems to a dangerous level. In cities of Punjab, the air pollution started rising to levels of Delhi. While already showing its worse scenario interms of air quality index. Extrapolating the data collected from cities of Punjab shows, it may catch the AQI levels of Delhi in next 2-3 years if no proper action plans are taken. The action plan will include components such as source identification and allocation, with sectors such as vehicular pollution, industrial pollution, dust pollution, construction activities, garbage burning, agricultural pollution, including pollution caused by crop residue burning, residential and indoor pollution all being considered. In conclusion, air pollution levels must be kept under control in order to protect the environment, and the country's development should not compromise the air, water, or soil. The risks are extremely high, and the world must wake up and act immediately to address the expanding number and scope of environmental issues.

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