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EEFCTS ON AQI DURING LOCKDOWN FORECASTING USING VISUAL ANALYSIS

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ABSTRACT

The COVID-19 pandemic has had a significant impact on India's and the rest of the world's economies and health-care systems, among other things. Despite the monetary, social, and health disruptions, the Coronavirus Disease 2019 (COVID-19) pandemic presented a chance for the environment to mine ambient pollutants. The purpose of this study is to see how lockdown affects ambient air quality in India. In most developing international regions, air pollution is one of the most serious public health and environmental concerns. goals: The objective of this paper is to provide insight into the current condition of air pollution in various Indian cities, as well as the numerous causes and effects of air pollution. The statistics on air pollution are relevant in this context (PM10, PM2.5 NO2, SO2, NH3, CO, and O3). According to the analysis, this pandemic provides classes for strategies for reducing urban air pollution and managing the fitness effect caused by urban air pollution. It has long been recognized that the rate at which urban air pollution has increased in India is worrying, owing to a severe and harmful net of particle matter (PM) and because of the enormous variety of motors, industries, and manufacturing units that have resulted in more assembly of pollutants in the air, air pollution has become a country-wide emergency in various locations across India. Because of the large number of automobiles, factories, and manufacturing units, there is an excess of pollutants in the air, making air pollution a national emergency in many cities around the country.

Keywords—Air quality index, Particular matter, Gases, Effects.

I. INTRODUCTION

In developing countries like India air pollution has a tremendous impact on human energy, agricultural processes, climate diversity, and ecosystem radical change in developing countries like India. Every year, almost six million Indians die as a result of air

pollution, the country's main cause of death due to other factors such as water pollution, nuclear weapons pollution, and so on. In total, 35,000 people were killed. Each industrial area in the national capital, Delhi, has 15,000 rest. Although practically all emphasis is focused on the national capital, some cities and villages suffer as a result. The fatal pollution in Ghaziabad, Punjab, Patna, Raipur, Agra, and other towns has impacted other cities. Particulate Matter (PM) emissions and pollutants such as nitrogen oxides, Sulphur, and other harmful compounds have increased in almost every metropolis, causing considerable environmental damage. Only a few cities can be recognized at the inauguration of Air Quality Monitoring (AQM) because they have improved air quality, but the afflicted areas of small and medium-sized villages are plagued by dramatic pollution in an extremely sensitive manner. The COVID-19 outbreak has resulted in the most severe isolation or isolation in human history, as well as globalization (in different stages). The lockdown has resulted in restrictions on trains, planes, and trucks, as well as temporary industrial closures and other primary and secondary economic operations. Air pollution is closely linked to these activities. A number of recent studies have demonstrated that improvements in air quality are linked to gradual or complete shutdowns, as well as a subsequent drop in jobs and emissions from sources that pollute the air, such as traffic flow and industrial activity. For example, a considerable reduction in the number of automobiles and public transportation vehicles owing to vehicle closures has resulted in a significant reduction in NO2 produced mostly by combustion activities. The changes in PM2.5 and PM10 during the closure, on the other hand, were contentious because their patterns were derived from various ventilation sources. The goal of this paper is to provide a comprehensive review of India's air quality monitoring systems in order to achieve the following goals: identify high-risk areas caused by high levels of air pollution through targeted monitoring; and identify high-risk areas caused by high levels of air pollution through performance assessments and to recommend appropriate development measures that have been implemented.

II. MATERIALS AND METHODS

A. MAJOR AIR POLLUTANTS

Major pollutants present in air are basically categorized into following types:

A.1 Carbon Mono-oxide (CO)

In the urban environment, carbon monoxide (CO) is a significant contaminant. CO is typically produced by incomplete combustion sources. Because of its high toxicity and massive weight in space, it should be included in the AQI system as a significant pollutant. CO rapidly spreads through alveolar, capillary, and placental membranes.

A.2. Nitrogen Dioxide (NO₂)

NO₂ is a key source of concern and is used to refer to a vast category of NO_x emissions. NO_x refers to total nitric oxide (NO) and NO₂. Nitrous acid and nitric acid are examples of nitrogen oxides. Ozone is produced when NO_x reacts with organic materials. Low-grade products connected with the combustion of fossil fuels in automobiles, electronics sectors, industrial resources, and off-road equipment, such as construction vehicles and lawn mowers and garden equipment, are all producers of NO₂.

A.3.Particular Matter

PM 2.5 simply refers to particle size, which can be measured for policy purposes. The PM 2.5 AQI will tell you how many of these tiny particles are in the air. This provides for a wide range of perspectives on air quality. As a result, it's sometimes assumed that it's produced by practically everything on the planet. The air we breathe is packed with solid particles from man-made sources to the elements. a better alternative, especially when combined with specific pollutant concentrations.

A.4.OZONE

Ozone is a secondary pollutant that forms in the atmosphere and has harmful health effects. Ozone is a powerful oxidant that reacts with a wide range of cellular and biological molecules. Bronchitis, heart disease, emphysema, asthma, and lung capacity can all be aggravated by ozone. Irritation of the respiratory system can cause coughing and a burning sensation in the chest (WHO, 2000). It has the potential to impair lung function and make breathing difficult.

Health outcome	Ozone concentration (µg/m ³) at which the health effect(s) is/are expected	
	Averaging time 1 hour	Averaging time 8 hours
Increase in inflammatory changes (neutrophil influx) (healthy young adults at >40 litres/minute breathing rate at outdoors)		
2-fold	400	180
4-fold	600	250
8-fold	800	320

Table 1: Health Outcomes Associated with Controlled Ozone Exposures

A.5 Sulphur Dioxide (SO₂)

It is one of the most common air pollutants, and it is mostly caused by human resources. It is generally made up of industrial elements like coal, oil, and gas. However, the combustion of fossil fuels and volcanic activity are the primary sources of Sulphur dioxide emissions. Inhaling Sulphur dioxide is exceedingly harmful and life-threatening because it causes the lungs to change function, as well as nose and throat stiffness and severe respiratory blockage.

There are also other several health-related problems that are caused of Sulfur dioxide :-

- Corneal Haze, which is the creation of cloudy appearance in the cornea.
- Breathing difficulty is caused.
- Airway inflammation causing a lot burning in the airway.
- Heart Failure.
- Causing higher mortality rates.

A.6. Pb and NH₃

It's worth noting that most countries have only used six contaminants (as indicated above) to create AQI. The NH₃ and Pb crossings have been attempted to be raised, as both pollutants have short-term measurements of 24 hours. Pb levels, on the other hand, can be utilized to analyze the impact of lead contamination in prior AQI estimations. The nose, throat, and respiratory system get irritated when excessive quantities of NH₃ are inhaled. Coughing, increased respiratory rate, and respiratory depression can all be symptoms of expanded breathing air. An There have been reports of interactions between high concentrations of ammonia and cough, phlegm, cough, and asthma.

AQI Category	NH ₃ µg/m ³	Pb µg/m ³
Good (0-50)	200	0.5
Satisfactory (51-100)	400	1.0
Moderate(101-200)	800	2.0
Poor (201-300)	1200	3.0
Very poor (301-400)	1800	3.5
Severe (401-500)	1800+	3.5+

Table

2 -AQI Breakpoints for NH₃ and Pb

Major Pollutants	Air	Major Sources	Harmful Effects
Sulphur Dioxide (SO ₂)		Combustion of fuels, power station, vehicles' emissions, disposal of solid wastes.	Respiratory problems, severe headache, reduction in agricultural yield.
Nitrogen Oxide (NO _x)		Road, Rail and Commercial Transport, Industrial Boilers, Combustion of fuels.	Respiratory problems in mammals, leaf damages, Causes Leukaemia.
Particulate matter (PM ₁₀ , PM _{2.5} , SPM)		Exhaust of diesel vehicles, construction activities, dust from road, domestic wood	Toxic effect in human beings
Major Pollutants	Air	Major Sources	Harmful Effects
Carbon monoxide (CO)		Transportation, Burning of refuse	Respiratory activities are affected, blurring of vision, headache.
Ozone (O ₃)		Pollutants derived by photochemical reactions	Premature Aging, Necrosis and Bleaching.
Organic Compounds		Combustion of oil based fuels, use of solvents	Carcinogenic which may cause leukaemia
Volatile Organic Compounds (VOC)		Solvents used in Industries and for domestic use.	Destroys Ozone layer
Carbon dioxide (CO ₂)		Burning of Fossil Fuels, Deforestation	Global Warming

Table 3 -Major pollutants present in air and their Harmful Effects.

B. SOURCES

There are numerous sources for occurrence of air pollution some of these sources can be widely classified into following types:

B.1 Industrial Activities

Industrial operations release a variety of pollutants into the atmosphere that have far-reaching consequences for air quality. Particulate matter 2.5 and 10, nitrogen dioxide, Sulphur dioxide, and carbon monoxide are some of the major pollutants released by enterprises that use coal and wood as their principal energy sources.

Type of pollutant	Percentage value
carbon monoxide	70%
hydrocarbons	50%
oxides	30-40 %
SPM	30 %

Table 4. Average Pollutant Percentages Released from Various Metropolitan Cities

B.2. Vehicle

When the car burns gasoline, it emits pollutants in the air which is as harmful as smoking 10 cigarettes a day. Your vehicle emits carbon monoxide, hydrocarbons, nitrogen oxide, and particulate matter. When the vehicle pollution is high in the atmosphere, it creates a hole in the ozone layer contributing to smog and causing various health issues.

B.3. Agricultural Activities

Agricultural activities have had a critical effect at the reducing air excellent. first of all pesticides and fertilizers are the principle supply to contaminate the surrounding air.

B.4. Other sources

Apart from major sources given above, the following activities also play a vital role in causing air pollution:

- Burning up of crop wastes by farmers.
- Stoves and incinerators.
- Refrigeration activities and sprays of aerosol
- The Burning of Fossil Fuels
- Wildfires

C.EFFECTS OF AIR POLLUTION

- Air pollution has a variety of detrimental consequences for both the environment and the living things in the vicinity.
- Improved ageing of the lungs and damage to the lungs, as well as transitory nerve organ irritation.
- The leading cause of asthma, bronchitis, emphysema, and other respiratory diseases.
- Shortening life expectancy Nitrogen dioxide and ozone are two gases that contribute to global warming.
- In rivers and other bodies of water, eutrophication is a problem.
- Soil nutrient depletion as a result of nutritional reactions with acid rain.

D. AIR QUALITY INDEX

An air quality indicator is defined as a A full scheme that turns the measured values of each of the parameters linked to air pollution (e.g., concentration of air pollution) into a single number or group of numbers is defined as an air quality indicator (Ott, 1978). For daily air quality reporting, all air quality indicators (AQI) are used. It's a metric for how much air pollution impacts a person's health in a short amount of time. The goal of the Air

Pollution Index (AQI) is to inform individuals about how local air quality impacts their health. The air quality indicator (AQI) is a figure that is used to report air quality on a specific day, essentially telling you how clean the air is. It detects particles and chemicals in the air that are harmful to human health (and ignores those that do not).The result is a set of rules (i.e a set of calculations) that translate the parameter values into a simple form using the deception of numbers.

D.1.Air Quality Index Calculation

To report air quality, different countries use different point scales. In the United States, for example, a rating of 0 to 50 is considered positive on a 500-point scale. A diameter of 301 to 500 millimetres is deemed harmful. India has a 500-point scale as well. The AQI value of the day is determined by the highest of these AQI readings.

The higher the AQI value, the more polluted the air is and the larger the health risks. Over the last three decades, the idea of AQI has become broadly accepted in many developed countries.

D.2.Air Quality Index Categories

- **Good (0–50)** - Air quality is satisfactory, and air pollution poses little or no risk.
- **Satisfactory (51–100)** -Air quality is acceptable however some pollutants may be a moderate for health concern. May cause minor respiratory distress in sensitive individuals.
- **Moderate pollution (101–200)**- Can cause respiratory distress in people with lung disease such as asthma, and discomfort in people with heart disease, children and adults.
- **Poor (201–300)** - May cause respiratory distress in people with prolonged exposure, as well as discomfort in people with heart disease
- **Extremely Poor (301–400)** - Can cause respiratory illness in people when exposed to prolonged exposure. The effect may be more pronounced in people with lung and heart disease.
- **Severe (401-500)** - It can cause respiratory problems in healthy people, as well as serious health problems in people with lung / heart disease.

AIR QUALITY INDEX (AQI)	CATEGORY
0-50	Good
51-100	Satisfactory
101-200	Moderate
201-300	Poor
301-400	Very Poor
401-500	Severe

Table 5- Air quality Standards

. E. AIR QUALITY INDEX MONITORING IN INDIA

According to WHO guidelines, air pollution is a major concern in India. Green Peace India performed a study on the subject. The National Air Quality Index (NAQI) was established by the government as a reporting standard to monitor air quality levels in order to allow for comparisons across cities and the development of new strategies to reduce pollutant levels in the air. According to the NAQI interface, air pollution is a major concern not just in the National Capital, but also in other parts of the country. According

to the NAQI interface, pollution levels are worrying in numerous parts of India.

F. AIR QUALITY SITUTAIIONS IN VARIOUS CITIES BEFORE AND AFTER LOCKDOWN

The pollution level has increased since the monsoon began. The AQI level is growing in areas with a lot of vehicle activity, according to officials. The use of rickshaws and shuttle-rickshaws has increased. During the lockdown, however, cities' air quality improved dramatically. Nearly all cities in the region show a drop in yearly average PM2.5 measurements in 2020, the year with the most lockout periods.

F.1 DELHI

After the national lockdown was enacted on March 22, 2020, the AQI level began to decline. The sky was crystal clear and bright. When the country was placed under total lockdown, the amount of air pollution dropped dramatically. During the lockdown, there was an unanticipated improvement in air quality Delhi.

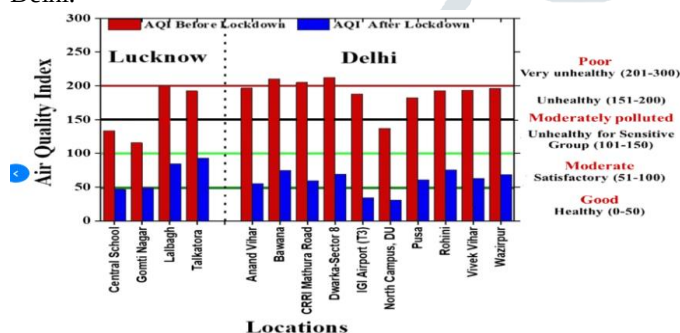


Table 6- AQI level in Delhi and Lucknow before and after lockdown

F.2.AHMEDABAD

The pollution level is rising in anticipation of the beginning of monsoon, according to officials, who noted that areas with high vehicle traffic are seeing an increase in AQI levels. Raikhad's AQI rose to 306. At various points throughout the lockdown, including in September of this year, the metropolis has demonstrated a good improvement in air quality. Furthermore, it has improved climatic conditions.

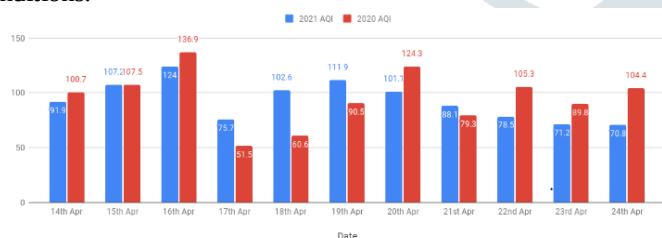


Table 7- AQI level in Ahmedabad before and after lockdown

F.3.MUMBAI

PM2.5 levels in Mumbai began to rise in 2021, surpassing those of 2020. The air quality in Mumbai was substantially worse during the winter months than it was during the summer months, as is customary. During the closure of COVID-19 in 2021, Mumbai's air quality improved slightly. The hurricane season in Mumbai helped to improve PM2.5 readings in the months of July and August.

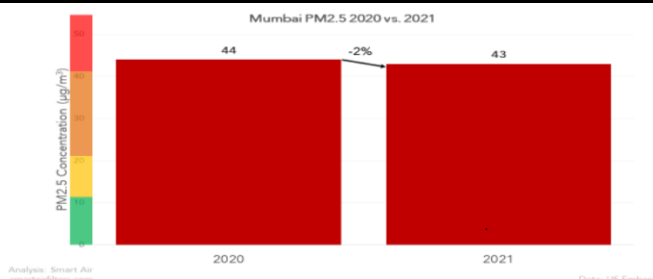


Table 8- Mumbai PM2.5 2020vs 2021

F.4 LUCKNOW

More than half of the days had bad or "very poor" air quality throughout the same time period, with the other days having moderate air quality. Due to the military closure, pollution levels were at their lowest in four years from March 25 to May 14 (50 days), according to a study of Central Pollution Control Board air pollutant data accessible since 2016. According to environmentalist Venkatesh Dutta, "the drop in pollution level is due to the closure of construction activities, suspension of all modes of transportation and industry, and dust suspension from broken roads."



Table 9- AQI level in Lucknow during lockdown

Sl. no.	Name	Pre-lockdown	During lockdown (Phase 1)	During lockdown (Phase 2)
1	Delhi	150	80	113
2	Ahmedabad	106	91	90
3	Kolkata	121	105	62
4	Mumbai	105	74	76
5	Hyderabad	77	71	63
6	Chennai	63	51	44
7	Bengaluru	80	57	56
8	Pune	92	55	55

Table 10-Air Quality Index of major cities in India for pre-lockdown and during lockdown scenarios.

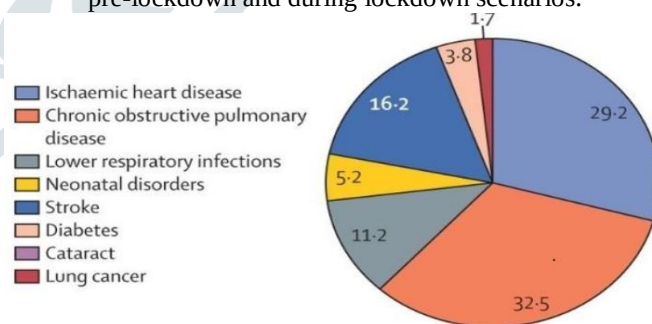


Table 11-Causes of Deaths attributable to Air Pollution in India in 2019

III. NEW INNOVATION TO REDUCE AIR POLLUTION

1. There are microwaves now available in the Indian market to treat infectious waste and eliminate air emissions, including toxic POPs (Persistent Organic Pollutants).
2. Chakr Innovation in Delhi has developed the world's first diesel generator control gadget that can be retrofitted. It catches 90% of emissions from exhaust air without compromising energy efficiency. Ink and paint are made from the diesel auxiliary extracted from the exhaust.
3. NavAlt Solar & Electric Boats' ADITYA, India's first solar-powered boat, combines new technology in naval

construction and engineering, solar electricity, and advanced controls.

4. Coimbatore-based Cellzyme Biotech employs an engineered enzyme to produce antibiotics at room temperature without the need of solvents, which is a major contributor to air pollution.
5. Agnisumukh makes commercial kitchen equipment powered by revolutionary, energy-efficient radiant heat gas burners that enable commercial kitchens combat indoor air pollution.

IV. RESULT AND DISCUSSION

After comparing and analysis of the data for various cities of India it was found that:

1. In 2019, 56 percent of cities fell into the 'Unhealthy' (151–200) category, while just 16 and 28 percent fell into the 'Moderate' (51–100) and 'Unhealthy for sensitive groups' (101–150) categories, respectively. Most cities' air quality improved in 2020, with 36 percent of cities falling into the 'Moderate' category and 49 percent falling into the 'Unhealthy for sensitive groups' category.
2. In Ankleshwar, the biggest drop in NO₂ (80 percent) occurred during phase-2, whereas in Vapi, the greatest drop occurred in NO₂ (91 percent) during phase-4 of lockdown.
3. The city of Kanpur had the lowest NO₂ concentration, while the cities of Delhi and Bangalore had the highest.
4. Pollution concentrations were found to be greater in cold seasons after lockdown limitations were lifted.

V. CONCLUSION

1. The main cause of greenhouse gas emissions was common in all monitored cities such as cars and vehicles
2. One needs to use public transport and try to avoid the use of excessive personal vehicles as it will not only help reduce traffic congestion but also help to reduce pollution.
3. The present study found that air pollutants decreased during lockdown phases, but these decreases were specific to the site(s) and pollutant(s).
4. Existing policies and strategies must be strictly enforced to ensure the best possible results.
5. It is better to prevent air pollution than to allow spread and become familiar with the adage 'compassion starts at home.'
6. In certain regions, pandemic lockdown reduces air pollution by roughly 50-60%.

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