International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 884-888 www.ijaem.net ISSN: 2395-5252

Research Paper on Air Pollution in Lucknow

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Date of Submission: 10-04-2023 Date of Acceptance: 20-04-2023

I. INTRODUCTION

Lucknow is situated on the North western bank of Gomti River, is not only the largest but also the capital of Uttar Pradesh. The city is bounded on the east by Barabanki, on the west by Unnao, on the south by Raibareli, and on the north by Sitapur and Hardoi. Like other cities, Lucknow is also developing very fast due to rapid increase in urbanization, industrialization and population growth. As reported by the census of India, 2011, Lucknow has a population of 2,815,601. There was an increase of 25.3% compared to figures. The initial provisional data suggests a population density of 598 per km square in 2011. As the total area covered by the Lucknow city is only about 470.7 square km., the population density was much higher than the 690 persons per km square recorded at state level. There are 4 designated Industrial sites in and around Lucknow city viz., Amausi Industrial Area, Talkatora Udyog Asthan, Sarojini Nagar Industrial Area and Deva Road Chinhat Industrial Area where 10 large, 15 medium and 15 small industries if Red category are in operation, 3 large, 4 medium and 65 small scale Orange category industries are in operation and 1 medium, 131 small scale Green category industries are in operation. Besides these, different category insuatries including 255brick kilns are also in operation around Lucknow City.

The numerous factors that contribute to air pollution make it a common issue in the modern world. However, it is usually brought on by increased urbanization, industrialization, and transportation. As a result, anthropogenic human actions are the primary contributors to air pollution, which has a negative impact on the environment, vegetation, and human health. Gaseous air pollutants like NO2 and SO2 can change chemically in the atmosphere to create nitrates and sulfates, which are then used as components of aerosols. Nitrogen oxide emissions, mainly nitrogen dioxide (NO2) and nitric oxide (NO) from the burning of biomass and fossil fuels, play a major role in the formation of precursors to acid rain and other air pollution processes. The primary source of nitrogen dioxide (N2O) emissions from agricultural activities is ozone depletion.Nitrogen oxide emissions into the atmosphere have been rising consistently for the past 150 years. Hewitt found that the main sulphur oxide (SOx) released during the combustion of fossil fuels is SO2 [2], which reacts rapidly with water vapour to form corrosive sulfuric. Condensing onto aerosol particles, this sulfuric acid rapidly separates to produce sulphate aerosols. Because SO2 and particulate matter are related, any negative effects on health that are ascribed to SO2 may actually be caused by particulate matter or by substances that have been adsorbed on particulate matter.Materials with harmful or cancer-causing properties may be carried by particulate matter. Pulmonary diseases are brought on by fine particulates penetrating deeply into the airways [3]. They also add to other serious environmental problems like winter smog and acidification.

The exposure-response relationship thresholds for both long-term and short-term impacts on health have significant gaps in their clearly documented documentation. However, there is compelling proof that exposure to air pollutants has both acute and long-term negative effects on human health, having an impact on a variety of bodily systems and organs, from minor upper respiratory irritation to lung cancer, as well as both acute and long-term effects on the heart and respiratory systems, Children with acute respiratory infections and adults with chronic bronchitis can both worsen pre-existing heart and lung conditions or trigger asthmatic episodes. Although there is an obvious correlation between particulate matter and

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mortality, it is still unknown what aspects, such as particle size and chemical composition, are to blame.

Heavy duty diesel vehicles like trucks and automobiles that run on petrol pose the greatest health risks in India due to the significant quantities of gaseous and particulate pollutants that are routinely released by industries, thermal power plants and other sources. In India's heavily polluted urban areas, Upadhyay revealed that the health effects of air pollutants are extremely important [6, 7]. In terms of particulate matter concentrations, Delhi, the nation's capital, is already rated highly (11th globally) among the most polluted cities. Four of the twenty towns with the highest concentrations of aerosol pollution in the world—Allahabad, Firozabad, Lucknow, and Kanpur—are in Uttar Pradesh. The capital of Uttar Pradesh, Lucknow, is presently ranked 18th worldwide.

The worsening health effects are caused by all criteria pollutants, but particularly by excesses in respirable particulate matter concentrations (PM10) [9]. On-road transportation is one of the main sources of PM10 pollution, and the growing prevalence of this activity negates the advantages of initiatives to reduce vehicle emissions. Road dust, small-scale industries, coal-fired thermal power plants, and non-road sources like building projects are additional sources of pollution. Local and long-distance transportation can also have a big effect.Evaluation of ambient air quality is essential due to the significant rise in the incidence of respiratory diseases in most of India's main cities, including Lucknow. Verifying the outdoor air quality is one way to make sure thatthe efficacy of the control measures put in place, as well as for the early identification of potentially dangerous changes in atmospheric composition [11]. The following goals of the current research were carried out in consideration of the negative health effects of air quality on Lucknow residents: To assess the present state of Lucknow's air quality,to comprehend the differences in air pollutants from one location to another, to assess seasonal and annual variations in air pollutants, and to build a grasp of the processes causing high particulate matter concentrations. Despite the fact that previous studies on the air quality in Lucknow have been conducted [12,13], it is necessary to periodically estimate the dynamic efficacy of emission management strategies. By assessing the current state of air quality over Lucknow for a recent time period, this research investigates that problem. (2013-2015).

II. METHODOLOGY

Methodology undertaken by Uttar Pradesh Pollution Control Board. The National Ambient Air Quality Standards (NAAQS) for 24-hr averages and annual averages for the relevant air pollutants and procedures of observational data measurements are detailed under:

Field of Study

The biggest and capital city of Uttar Pradesh is Lucknow. After Delhi and Kolkata, it is the third-largest metropolis in north, east, and central India. After New Delhi, it is the second-largest city in north and central India. Lucknow is a multicultural metropolis with a rich history and is referred to as the "city of Nawabs" by locals. The city has a total area of 2,528 square kilometres and is positioned between 260 52N latitude and 80056E longitude. It is elevated about 123 metres above sea level. It is in a seismic zone and positioned in the centre of the Indus-Gangetic Plain. The Gomti River, which separates the area into the trans-Gomti and cis-Gomti regions, is its main geographical feature. The temperature in Lucknow is subtropical, humid, and cool, arid, hot summers from late March to June and arid, cold winters from mid-November to mid-February. From mid-July to mid-September, it rains.

As a result of increased investment in technology, educational institutions, real estate, and other commercial and industrial operations, Lucknow City is now a centre for increased urbanisation. According to Lucknow's Road Transport Office (RTO), the number of registered vehicles is rising along with the populace. We chose five locations for our research that fall under the industrial, residential, and commercial categories because that is how India's air quality standards have been categorised.

Capoors Hotel and SMK Chowk are commercial observation spots, Mahanagar and Aliganj are residential areas, and Talkatora is an industrial area. These commercial areas are located in a metropolis where two- and three-wheeled vehicles are a major source of air pollution. Small and medium-sized businesses in the Talkatora area, like those that manufacture goods or paint, collectively produce a substantial amount of air pollution.

Data accessibility

NO2, SO2, and PM10 were the three criteria air contaminants that were taken into consideration from 2013 to 2015. The information was gathered from the official websites of the Central Pollution Control Board in Delhi

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(http://www.cpcb.nic.in) and the Uttar Pradesh Pollution Control Board in Lucknow. The statistics meet CPCB requirements that an individual site's annual arithmetic mean be based on at least 104 measurements taken twice a week every 24 hours at uniform intervals.

Analysis of Data

Annual, monthly, 24-hour, exceedance count, standard deviation, and wind rose metrics were used to assess the data characteristics at various observational locations.

Short-term, seasonal, and long-term changes in air pollutants are revealed by spatiotemporal analysis. The typical long-term impact of the air pollutants is shown by annual averages. Guidelines for air quality based on yearly averages of criteria According to data for the lowest pollutant level linked to observable chronic and largely irreversible negative effects, pollutants with an average time of one year are based on the characteristics of airpollutants in various emission and meteorological patterns. Similar to this, recommendations for air quality based on short-term 24-hour averages of air pollutants with 24-hour averaging times are based on data showing that the lowest pollutant level is linked with observable acute adverse effects during brief exposure.If the long-term (annual averages) and short-term (24-hour averages) threshold values of air pollutants as mandated by CPCB are not met, one method to determine the status of air quality in a region is to evaluate to what degree the standards are violated. This will offer a general idea of how well the aforementioned regions have accomplished their air quality goals.Theunderstanding of seasonal patterns in air quality is improved by using monthly averages as excellent indicators of overall trends over the course of the year.

The term "count of exceedances" refers to days when the 24-hour averaged threshold values for high pollution concentrations were exceeded, and the pollutants that violated the standards were recorded. This shows how many days had those specific air quality values at harmful levels.The calculation of the standard deviation indicates the variability of the data on air pollution and enables comparison of the estimates of variability for the various air pollutants.A wind rose is a graphic that shows the distribution, speed, and direction of the wind at a specific place over a predetermined amount of time. While breeze direction carries air pollutants away from the source, strong winds help dilution and dispersion of air pollutants.

III. CONCLUSION AND RESULTS

Averages per year

In industrial, commercial, and residential regions, the yearly average PM10 concentrations from 2013 to 2015 ranged roughly from 160 g/m3 to 200 g/m3, exceeding the NAAQS, as shown in Figure 2. In none of the five sites, the yearly average PM10 concentrations vary much from year to year, but they consistently exceed national ambient air quality standards for all three years. The industrial site at Talkatora has the greatest annual average PM10 concentrations across all years.The PM10 concentrations at the residential and business locations are comparable. From 2013 to 2015, the yearly averaged values have slightly decreased. However, for each of the three years the annual averages (industrial standard 120 g/m3 and residential standard 60 g/m3) exceeded the national ambient air quality requirements for annual averages. The main causes of air pollution in Lucknow [12] and medium-small size industries are traffic, road dust, and biofuel burning, as seen in Talkatora.The findings, which support the need for better planning strategies to lower PM10 concentrations, are consistent with previous studies [15]. NO2 and SO2 are, however, within allowed levels. This could be as a result of the NOx and SOx emissions from automobile exhausts, which are tangentially harmful. They aid in the creation of second-hand particles. These precursors are the chemicals that, as part of the gas-to-particle conversion process, exit through the exhaust stream of on-road mobile sources to react to create particles. The typical annual SO2 levels for (2013-2015)range between 8 and 30 g/m3 for NO2, demonstrating the use of low-sulfur petrol and advancements in car technology. In the city of Lucknow, industrial NOx and SOx emissions are also at a reduced level.

MAIN CAUSES OF AIR POLLUTION IN LUCKNOW

The primary contributors to Lucknow's atmospheric pollution are:

- Vehicle emissions and the steadily rising number of private cars on the road.
- The rapid urbanisation at the expense of the environment.
- Businesses in the area around the metropolis.
- The public's and government's ignorance of this issue.
- The burning of wood for heat

Literary Analysis

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A major danger to human health today is air pollution, one of the most frequently occurring factors.

• An analysis of the last nine years' worth of air quality data for Lucknow reveals a more or less stable pattern for SO2 and a declining trend for NO2, both falling within the NAAQS. There is a rising tendency for PM10 that exceeds the NAAQS. (As per CPCB,2012 report).
• According to a WHO study, the annual concentration of PM10 in 2014 was 219 ug/m3.
• Lucknow's AQI in December 2015 was 489. The AQI between 401 and 500 is the severe call for the human health danger.
PM2.5 has a significant rate of fluctuation. The research found that the local wind speed and humidity have an impact on how much the PM fluctuates. Particulate matter concentration occurs when the breeze speed is less than 0.3 m/s. Similar to how high humidity makes particulate matter heavier and more likely to stay suspended in the air, creating pollution. According to Talkatora's records for December 2015, on the night between December 9th and December 10th, 2015, Wednesday and Thursday, alarmingly high levels of PM2.5 were observed
At 2.30 am on Thursday, the highest number was 15,080 micrograms per cubic metre. PM2.5 levels on Wednesday at 11.30 p.m. were 12,641 micrograms per cubic metre.The national ambient air quality standard for PM2.5 is 60 microgram per cubic metre and for PM10 is 100 microgram per cubic metre.

Air Quality Index for Different Lucknow Regions

The Talkatora District Industrial Centre, Lalbagh Lucknow West, and Central School in Aliganj are the three sites in Lucknow where the Central Pollution Control Board (CPCB) has placed online (live) air quality monitoring stations. These sensors keep an eye on pollutants like lead, oxides of sulphur and nitrogen, hydrocarbons, carbon monoxide, and particulate matter (10 and 2.5). The 24-hour average of the readings made by all the city's sensors is known as the AQI. PM2.5 and PM10 are "invisible and ultrafine" airborne particles that are dispersed in the atmosphere. Tables 1 and 2 list the pollutants that are most commonly measured: PM10, Sulphur Dioxide, and Nitrogen Dioxide.

Lalbagh, West Lucknow, Lucknow: Air Quality Index (AQI) for the local region in real time.

Real-time area air quality index (AQI) for Lalbagh, West Lucknow, and Lucknow
Temp: 29°C
Pollutants plus atmospheric circumstances Minimum and maximum data recorded
PM2.5 132 ug/m 57 197 ug/m ozone 4 ug/m 1 298 ug/m nitrogen dioxide 9 ug/m 4 16 ug/m 1 4 ug/m 19 ug/m carbon monoxide 29 25 33 ug/m pressure 1000 ug/m 996 ug/m humidity 94 72 100.

MEASURES TO REDUCE AIR POOLUTION

Do Your Part to Reduce Air Pollution When Elevated Air Particle Levels are Predicted by:

- Avoid burning foliage, garbage, and other smoky materials.
- Avoid using blowers and other gas-powered lawn and garden tools.
- Delay the amount of motorcycle or automobile trips you make.
- Reduce the use of your wood furnace and fireplace.
- Don't cook food outside.

Reduce idling of your car and motorbike if elevated air ozone levels are anticipated.

- Make fewer journeys and conserve your energy.
- Set air units to no lower than 77 degrees.
- Consider sharing a ride with someone to work or taking public transit rather than driving alone.
- By carefully planning, you can combine tasks into fewer trips.
- When feasible, bike or take a walk.
- Reduce the use of deodorant and hair products.
-

Common Activities You Can Participate in To Reduce Air Pollution In Your City:

- Basically, wherever you are, try to preserve energy as much as you can.
- Make sure that your tyres are inflated correctly.
- Leaves and garden refuse should be mulched or composted.
- When buying personal or company equipment, look for low energy labels.
- When possible, bike, stroll, ride a train or a bus, or carpool.
- Keep the motors in your automobile, boat, and other vehicles tuned up.
- Avoid burning flammable materials in your hearth.

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IV. CONCLUSION

The study's basic fundamental characteristics are summarised by:

- According to a recent analysis of Lucknow's air quality statistics (from 2013 to 2015), both the 24-hour and annual average concentrations of SO2 and NOx are within permissible limits for the national ambient air quality standards.
- All sampling locations, whether they are residential, business, or industrial, surpass the PM10 24-hour and annual standards, but industrial locations have higher levels than the others.
- In the years 2013 to 2015, there aren't many annual variations in NO2 and SO2, but there is a clear seasonal variation, with greater concentrations in the winter and lower concentrations in the monsoon for all pollutants.Significant seasonal and yearly variability exists for PM10.

Since the findings of this study on Lucknow (2013–2015) are similar to those of our assessment of Delhi's air quality (2004–2009), an extended analysis of Lucknow's air quality is advised in order to have a complete picture of the current understanding of particulate matter and its detrimental effects in the Lucknow region. In order to avoid further deterioration of Lucknow's air quality and the development of a dangerous situation that is harmful to human health, policymakers could benefit from this type of analysis.