



A Review Using Geo-spatial Technology Changes in Delhi's Air Quality

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ABSTRACT: When there is a lot of dust and dirt floating about in the air, that's called air pollution. The amount of air pollution varies with the seasons due to natural and manmade factors. Air pollution throughout the changing seasons in Delhi was the focus of this study. The primary objective of this research is to learn how seasonal changes affect Delhi's air quality. New Delhi, India's capital, is located inside the Delhi union territory. This report focuses on the air pollution situation in and around Delhi, which is monitored by 39 separate stations. An ever-increasing number of factories and automobiles are contributing to a steadily rising air pollution rate, which has negative consequences for both ecosystems and human health. Six different types of pollutants—PM10, PM2.5, NO₂, SO₂, O₃, and CO—serve as the primary foundation for this effort. The saturation maps of such six pollutants have been made using the Air Quality Index (AQI) algorithm. In contrast to the relatively low levels seen during the monsoon season in July, the pollution levels tend to peak in the dead of winter (December). The weathering phenomenon is the major cause of this (fog, mist, dust, etc). It's an essential factor in how much Delhi's air pollution varies.

KEYWORDS: Pollutants, Concentration, Air Quality Index, Weathering phenomena, Vulnerability

I. INTRODUCTION

One of the most pressing problems of the twenty-first century is air pollution, which affects people on a national, regional, and even neighbourhood scale (6). When substances that are detrimental to people, animals, and plants are released into the air, this is known as air pollution (7). The existence of one or more compounds in the air at concentrations above their natural range with the potential to have a negative impact is known as air pollution (45). Rapid population expansion, an increase in the amount of automobiles, and industrialisation have all contributed to one of the world's most critical problems: air pollution (19). Air pollution is a class one carcinogen and the fourth leading cause of death globally, according to the World Health Organization (WHO) (20). Air pollution is a major issue that threatens people's health everywhere in the world. Annually, air pollution is blamed for more than three million fatalities. Common pollutants released by industrial and vehicle combustions include carbon monoxide (CO), nitrogen dioxide (NO₂), nitrogen oxides (NO_x), ozone (O₃), sulphur dioxide (SO₂), particulate matter (PM), metals, and organic compounds, particularly in industrialised and fast growing nations (39). Human activity patterns also fluctuate throughout the year, which means that one season's concentration of air pollution may result in a different exposure than another (35). Environmental monitoring data for the world's largest megacities spanning 100 nations was released in April 2018 by WHO for 2011 and 2016 (WHO 2018). Delhi ranked highly for PM10 pollution (28). Seasonal changes in air pollution have been observed. From January to September, air quality in the study region is normally good, but from October to December, it deteriorates dramatically to poor, severe, or dangerous levels. Winter air pollution is more harmful than monsoon season air pollution because of stubble burning, road dust, vehicle pollution, and cold temperatures. Delhi's megacity winters are notoriously cold, smoggy, foggy, and filthy. When compared to summer, the levels of pollution are roughly two to three times higher in the winter, and their effects can be felt not only in terms of health, but also in terms of transportation, with frequent delays at civil aviation and a string of major and minor accidents all across road corridors (16). Among the most polluted cities in the world is Delhi (2). By taking into account the levels of sulphur dioxide (SO₂), nitrogen dioxide (NO₂), and suspended particulate matter, Sharma, et al. (2001) have created an AQI for use in India (SPM). For the city of Kanpur, Sharma et al. (2003) offer an AQI that uses a maximum operator idea, which calculates an index by adding up the values of individual pollutant indices. The air quality index serves as a better public indication of air quality because to its comparison index function. Further, it is discovered a connection between pollution levels and weather conditions Introduction The AQI's connection to urban weather conditions has also been investigated by researchers such as Cox and Chu (1993) and Kassomenos (1995). That's why there's such a push to create a weather-based AQI (8). Daily air quality is reported using an indicator called the Ambient Air Index (AQI) (31). World Health Organization (WHO) lists six significant air pollutants: PM10, PM2.5, O₃, SO₂, CO, and NO₂. Air quality is measured by calculating the sum of

the AQI values for various contaminants.

II. STUDY AREA

The Indian capital, New Delhi, is located in the union territory of Delhi. Delhi may be found in north India between the coordinates of 28°24'17"N and 28°53'00"N and 77°45'30"E and 77°21'30"E. Haryana surrounds it on three sides, while Uttar Pradesh is next to its eastern edge. With its expansive 1,484 square kilometres, the NCT is a major geographical feature (573 square miles). Delhi is on an elevated plateau between 213 and 305 metres above sea level, on the western bank of the Yamuna River. Both its length and breadth max out at 51.50 and 48.48 kilometres, respectively.

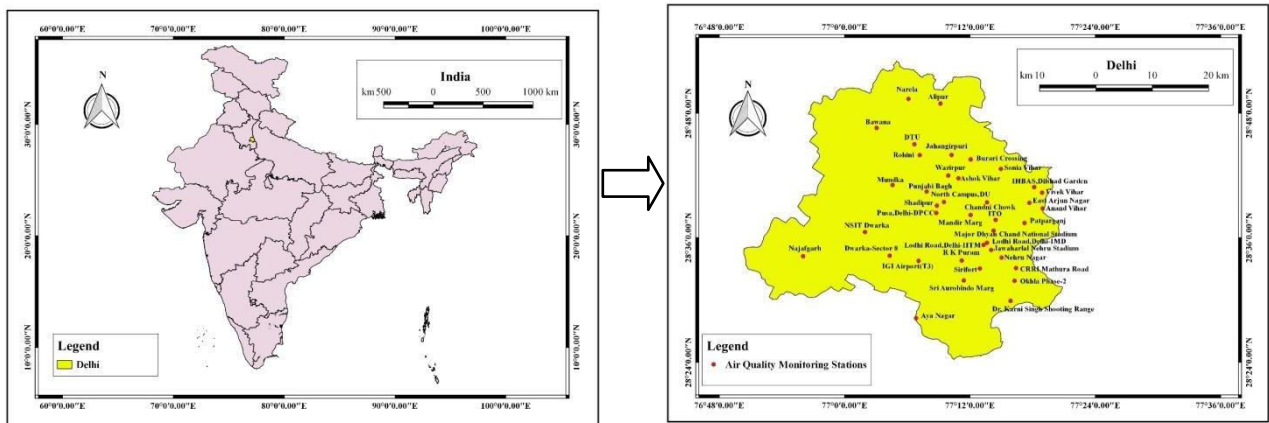


Figure No.1 *Location Map*

II. OBJECTIVE

The purpose of this research is to assess the current state of affairs in Delhi and demonstrate the susceptible zonation by studying the spatial and seasonal fluctuations in air pollution.

III. METHODOLOGY

There are six factors used to examine how air pollution in the Delhi NCR changes throughout the year (PM_{2.5}, PM₁₀, NO₂, SO₂, CO, O₃). Since we're dealing with secondary data, everything we've done comes from already-existing online resources. You may report air pollution quantitatively using a method called the Air Quality Index (AQI), which gives you details about how clean or filthy the air is. The Air Quality Index (AQI) was implemented in India in 2014; it is a six-color scale (Good, Satisfactory, Moderately Polluted, Poor, Very Poor, Severe) designed to make it simple to grasp the current state of air pollution and raise awareness among the general public.

Table No:-1 National AQI classes, range and health impact and health breakpoints for the six pollutants Scale (0-500).

AQI Class (Range)	Health Impact	PM ₁₀ 24 hrs (µg/m ³)	PM _{2.5} 24 hrs (µg/m ³)	SO ₂ 24 hrs (µg/m ³)	NO ₂ 24 hrs (µg/m ³)	O ₃ 24 hrs (µg/m ³)	CO 24 hrs (µg/m ³)
		Concentration Range					
Good (0-50)	Minimal Impact	0-50	0-30	0-40	0-40	0-50	0-1
Satisfactory (51-100)	Minor breathing discomfort in sensitive people	51-100	31-60	41-80	41-80	51-100	1.1-2
Moderately Polluted (101-200)	Breathing discomfort to people with lung	101-250	61-90	81-380	81-180	101-168	2.1-10
Poor (201-300)	Breathing discomfort to the people on prolonged exposure	251-350	91-120	381-800	181-280	169-208	10-17
Very Poor (301-400)	Respiratory illness the people with prolonged exposure	351-430	121-250	801-1600	281-400	209-748	17-34
Severe (401-500)	Respiratory illness the people with prolonged exposure	>430	>250	>1600	>400	>748	>34

Source: Central Pollution Control Board, 2018

The AQI value has been determined using the AQI formula, with all data having been gathered from the Central Pollutant Control Board (CPCB). A large amount of data necessitated dividing it into three distinct phases in order to make managing it more manageable. Working hours are the primary determinant of the shift, which includes (00:00-08:00), (16:00-00:00), and (08:00-16:00). The IDW map of Delhi, illustrating the city's hotspots, was created using the QGIS mapping programme. The land use and land cover pattern has been mapped using satellite pictures captured by the USGS earth explorers during the years 1989 and 2019. The QGIS Semi-Automatic Classification Plugin allowed us to do supervised classification with ease. The Indian Meteorological Department (IMD) has compiled climate data from Delhi's Palam and Safdarjung weather stations in order to better understand weather patterns.

Spatial Variation

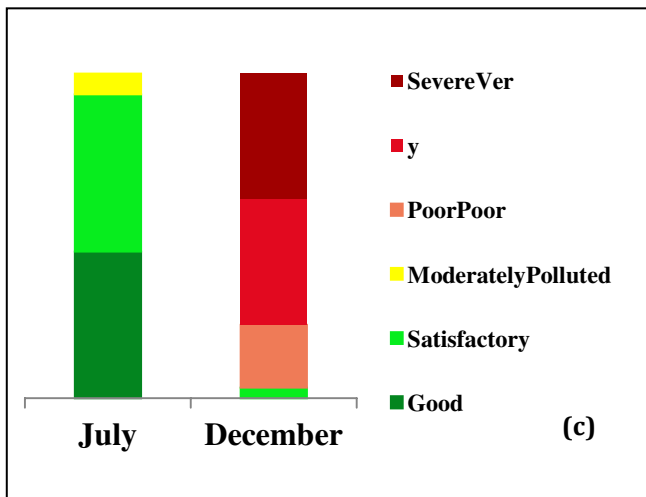
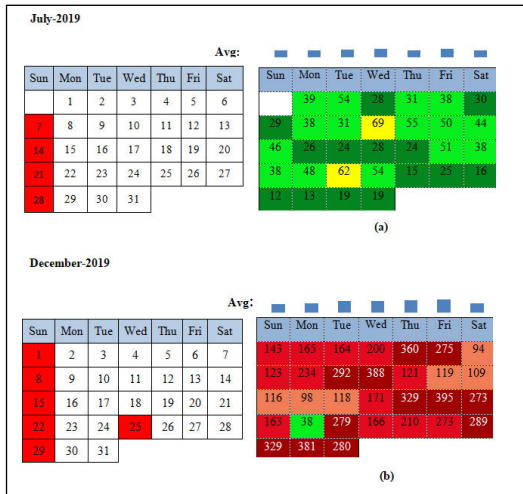
The monsoon season has PM10 concentrations that are generally in a good to excellent range. Moderate levels of pollution are most common between 8:00 a.m. and 16:00 p.m. and 16:00 a.m. and midnight. The major source of particulate matter 10 (PM10) is industrial and car emissions, which are at their highest at those times. PM10 levels are typically lowest overnight and in the early morning, when both vehicle and residential emissions are lower. However, throughout the winter months, PM10 concentrations may vary from excellent to severe. Since Wazirpur station is located in a manufacturing district home to several factories producing anything from chemicals to consumer products, it stands to reason that these factories' emissions would contribute significantly to the area's air pollution levels. This is why pollution levels at Wazirpur station are so high. At this time of year, agricultural stubble burning in neighbouring states like Punjab and Haryana blankets all of Delhi in a thick layer of smog. Because of this, all the pollution-causing particles get trapped in the smoky upper atmosphere, where they contribute significantly to the buildup of pollution thanks to the influence of mist, fog, and other meteorological phenomena. Morning and night shifts have much more PM10 pollution and fog/mist production than other times of the day. Fog's atmospheric layering effect prevented pollution from migrating higher into the sky. Mist and fog are less common during the day shift (Fig No:2).

About 32% of days have ideal circumstances, while 42% have moderate pollution levels.

PM10 pollution is most prevalent on Thursdays and Fridays, the two days of the week when most people are at work (Fig No: 3a, 3b).

In December, the percentage of days with acceptable, moderately polluted, poor, very poor, and severe conditions is around 3%, 35%, 16%, 19%, and 26%, respectively.

High levels of PM10 pollution are expected on Thursday and Friday. PM10 levels are also elevated on weekdays, particularly Monday, Tuesday, and Wednesday while people are at work. That's why it's so polluting to drive and work in such areas: (Fig No: 3a, 3c).



Source: Central Pollution Control Board

Figure No.3 Status of daily (24hrs) average PM10 concentration during monsoon & winter (2019) in Ashok Vihar, Delhi

Asthma, asthmatic coughs, episodes of shortness of breath, etc. are only some of the symptoms that PM10 pollution is responsible for in Delhi. In spite of PM10 being a major cause of lung cancer and chronic obstructive pulmonary disease, very few individuals suffer from these diseases.

Season-wise air quality

Typically, AQI is determined using pollutant criteria, whereby the evaluation of a single pollutant is consolidated into a single index using the most suitable technique (28). The AQI indicates the degree to which air pollution has been reduced. By combining with atmospheric elements like fog, mist, etc., the pollutants alter their contaminating properties. Therefore, there is also a difference in the air quality throughout the year. The monsoon season has seen a steady range of AQI readings from excellent to adequate. East Delhi neighbourhoods including Chandni Chowk and East Arjun Nagar, as well as parts of Lodhi Road, Delhi-IITM, Patparganj, and NSIT Dwarka, are in relatively decent shape this time of year. Because there is less industry and hence less pollution compared to other locations. North-West Delhi, West Delhi, Central Delhi, New Delhi, and sizable chunks of South-West Delhi, North-East Delhi, East Delhi, and South Delhi all enjoy good conditions. During the winter months, however, AQI values often fall between 50 and 100, indicating air quality that is either excellent or highly polluted. Since the amount of fog in the winter combines with smoke and other atmospheric pollutants to create smog, and since the agricultural land areas of the neighbouring states contribute smoke from crop burning, the border areas of Delhi, including North-East Delhi, East Delhi, and South-East Delhi, are more polluted than the rest of the city.

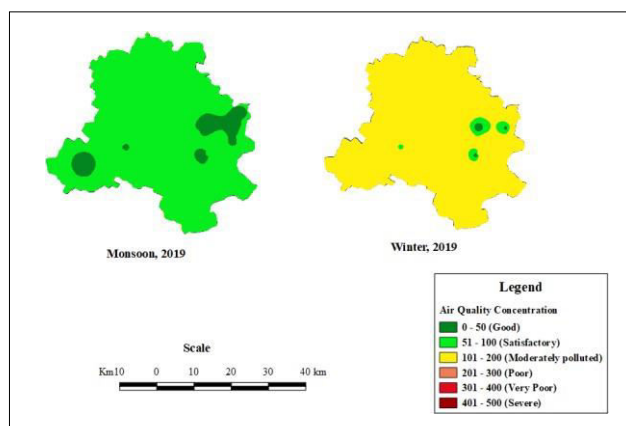


Figure No.14 Air Quality of Monsoon and Winter in Delhi, 2019

Vulnerability Zonation:

Some areas are more susceptible to the effects of pollution than others, and this susceptibility is directly related to the overall concentration rate of all contaminants. Conditions during the monsoon season are preferable to those experienced during the colder winter months. In spite of this, Najafgarh, IHBAS Dilshad Garden, Vivek Vihar, Ashoka Vihar, Chandni Chowk, East Arjun Nagar, Anand Vihar, Mejoor Dhyani Chand National Stadium, Lodhi Road, Nehru Nagar, and Pusa stations are far more polluted than the rest of the city. However, things get more risky during the winter months. Awana, Jahangirpuri, Bawana,

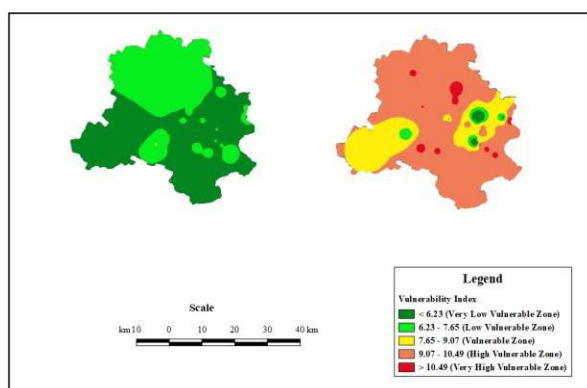


Figure No.15 Vulnerable Zonation of Monsoon and Winter in Delhi, 2019

IV. CONCLUSION

The primary objective of this research is to comprehend the changes in Delhi's air quality that occur with the changing of the seasons. Currently, air pollution is a major problem worldwide. Delhi has long had the dubious distinction of being India's most polluted metropolis. Delhi is not just the capital of India, but also a megalopolis. The high rate of pollution in Delhi has gained worldwide attention. PM₁₀ and PM_{2.5} are two of the chosen pollutants.

Observed the greatest decrease, followed by NO₂, CO, and NH₃ (28). The presence of large-scale industrial facilities and a dense transportation infrastructure contribute significantly to the city's alarmingly high levels of air pollution. Where there is less built-up area, air pollution levels are lower, and where there is a dense network of roads and other modes of transportation, air pollution levels are higher. Delhi's pollution levels change with the seasons. Weather factors (fog, mist, etc.) play a large influence in contributing to winter's elevated pollution levels, as does smoke from stubble burning in the adjacent state. By contrast, July's pollution levels or pollutant concentrations are much lower than those of December. While daytime pollution is worse in July, it's worst at night in December. Historically, throughout the winter months, Delhi has been seen as the most at-risk region. The high levels of pollution in the winter have

devastating effects on human health and the natural world. Asthma, Bronchitis, and other respiratory illnesses have been fatal for some individuals. In an effort to minimise air pollution, Chief Minister Arvind Kejriwal has unveiled a 10-point "winter action plan" that prioritises dust reduction.

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