

Air Quality Status in Jaipur and Nearby Areas of Rajasthan

Dr Sunil Kumar Sharma

Professor, Department of Geography
SPC Government College, Ajmer, India

Abstract: *The residents of Rajasthan, especially those who live in close proximity to industrial zones, are increasingly concerned about air pollution. Many lung disorders are brought on by gaseous contaminants. Rajasthan is an arid region with strong winds, making it an ideal environment for the rapid dispersal of air pollution. Using data from the central pollution control department, Jaipur's air quality is compared to those of neighbouring cities like Ajmer, Dausa, and Kota. Air pollution is compared on a number of different scales, including its concentration, particle size, the difference in its effects during the day and at night, etc. Cities appear to have far poorer air quality than rural places. There appears to be less traffic at night, which results in less air pollution. Day and night time comparisons are done, and both tabular and graphical representations of the data are provided.*

Keywords: Air Pollution, Air quality index, Suspended Particulate Matter, Pollution Control.

I. INTRODUCTION

Since it affects people's health directly, air pollution is a major environmental problem in both wealthy and developing nations. There are 22 cities in India that are among the 30 most polluted in the world, and they are all located in the state of Uttar Pradesh: Ghaziabad, Bulandshahar, Bisrakh Jalalpur, Noida, Greater Noida, Kanpur, Lucknow, Meerut, Agra, and Muzaffarnagar; in the state of Rajasthan: Bhiwari; in the state of Haryana: Faridabad, Jind, Hisar, Fatehabad, The majority of the cities included in the aforementioned list are major manufacturing hubs. When compared to other cities, those on this list are expanding at a far faster rate in terms of population, technical applications, and economic factors. Among world capitals, New Delhi is the most polluted. Ghaziabad is second only to China's Xinjiang province in terms of pollution levels.

Waste products, especially air pollutants, are produced as a byproduct of the activities, discoveries, and uses of energy that have taken the form of urbanisation, green revolution, industrialization, communication, transportation, and the pleasant manner of living. In addition to these effects, desertification of land causes air pollution because of the increasing amount of dust in the atmosphere. The problem of air pollution is more nuanced than most others in the environment. Pollutants can be dispersed and transported differently depending on the weather and terrain, leading to potentially dangerous ambient concentrations that can harm people and property. According to the WHO, air pollution is responsible for one-third of all premature deaths in western Asia and the Pacific. However, many more are hospitalised or even die from respiratory problems, heart disease, lung infections, or cancer as a result of prolonged exposure to high levels of air pollutants. All of the world's major cities experience more severe forms of these issues. The last ten years have seen the world's major cities with the worst air quality on record.

The high population density of cities leads to increased traffic and thus higher air pollution. Poor car maintenance is another key contributor to poor air quality and pollution. The pollutant's impact on human health is complicated by variables like the population studied, the organs taken into account, the pollutant's kind and concentration, and the length of time that people are exposed to it. In cities, vehicle emissions are a major contributor to air pollution. Numerous studies have linked air pollution from cars to respiratory and cardiovascular problems.

In 2020, during the COVID-19 pandemic, the situation has become catastrophic as the corona virus has spread exponentially across the globe. The World Health Organisation has endorsed a worldwide lockdown to prevent the spread of this disease. As a result, all human activity around the globe comes to a halt. Following the World Health Organization's lead, the Indian government instituted a lockdown across the country on March 23, 2020, with the

nationwide ban going into effect on March 25. Since human-caused activities like transportation and industry were effectively halted during the lockdown, air quality improved. After the lockdown is lifted, however, transportation, industry, and other daily routines resume as usual, worsening air quality in major cities worldwide, especially in metro areas like Delhi, Mumbai, Kolkata, Bengaluru, and many more.

Increased urbanisation, industrial emission, traffic congestion, and poor road conditions affect Jaipur much as they do other Indian towns. Along with this, Jaipur is a popular destination for sightseers. Because of these causes, city air quality deteriorated. The global air quality improved during the COVID-19 shutdown due to the strict regulation of all human activity [16, 17]. During the COVID-19 lockdown period, some authors also noted a dramatic rise in Jaipur's air quality. However, the government-installed monitoring station reveals an increase in all the criterion pollutants in all the main cities, including Jaipur, shortly after the lockdown. This study was conducted to assess the state of Jaipur City's air using the Air Quality Index (AQI) following the COVID-19 quarantine. The findings provide important information about the rate of increase of air pollutants in Jaipur City over time.

The effluents from a wide variety of factories and transportation modes are contributing to serious environmental problems. It's clear that many people are afflicted with lung problems. Pollution levels in different parts of the city, at different times of day, and under varying atmospheric conditions, vary considerably. According to the CPCB (central pollution control board), industrialised regions tend to have more severe pollution problems. We've broken down air quality into simple categories like "satisfactory" and "hazardous," and we've included information on the effects on your health. Observers can gauge the concentrations of various gases and the sizes of particles. The levels of toxic gases including nitrogen dioxide, sulphur dioxide, and others are monitored and studied. Particles are sized (PM10, PM2.5, etc.) and compared amongst cities. The most up-to-date information on pollution levels is provided by the AQB (air quality bureau), which is used to make comparisons between cities in Rajasthan. The differences between a city's industrial and residential zones are analysed using a variety of metrics.

The climate of Rajasthan is primarily dry and hot, with strong daytime winds that carry pollution from city to city. In contrast, Kota's high pollution levels may be attributable to the presence of a nuclear power plant in close proximity to the Chambal River, which releases large quantities of ash into the air and has negative effects on human health and agricultural productivity.

Air quality has drastically declined since 2008 as a result of increased pollution caused by the industrial revolution. Because of its many factories, Bhiwadi is well-known throughout Rajasthan as a particularly polluted region. The concentration of numerous pollutants in Jaipur, Rajasthan's capital, and its surrounding districts was analysed for this study due to the high concentration of factories in these locations. To illustrate the contribution of cars, we compare daytime and nighttime AQI readings. There is a comparison being made between the impact of different particle sizes of pollution. Recent years of data collected by the Central Pollution Board are being analysed.

II. METHODOLOGY

2.1 Study Areas

Jaipur and the surrounding cities' air pollution statistics from the past many years and the most recent available data were analysed and examined. Air pollution is measured in particulate matter (PM), nitrogen dioxide (NO₂), and other particles to make a comparison. Both tabular and graphical representations of the data are provided for readability and comprehension. Environmental Protection Agency in USA initiated one of the simplest approaches to measure the quality of air: air quality index. Because of their large populations and thriving industrial sectors, Jaipur and Kota were chosen. There is a thermal power plant in Kota as well.

2.2 Site Description

Comparing residential and industrial regions at various times. Based on population density, the city is split into an inner residential core and an outer industrial ring. Reviewing all of these studies allows for a time-based examination of the data, both during the day and at night. And it turns out that industrial pollution is very different from that in residential areas. While there are more air pollutants in the air near an industrial area, the good air flow and dry climate of Rajasthan mean that there are still plenty of them around residential areas, and some of them are even dangerously high.

The data for the residential and industrial areas near cities, and in Kota in particular the area near the nuclear power plant, are measured and analysed in the reviewed research paper, and it is found that there is a rise in temperature due to that power plant, and that it creates water pollution too.

There is a lot of air pollution in the Alwar district because Bhiwadi is one of the very grand industrial areas of Rajasthan. However, in the name of development, there have been multiple instances where the quality of the air has been ignored, as have the consequences for nearby residential areas and the people who live there.

2.3 Monitoring and Analysis

A large number of samples were taken from various sites in these Rajasthan cities to calculate an air quality index. We review the study and measurement data from these cities, where the main parameters of air quality were measured throughout periods of 24 and 8 hours, respectively. A significant difference between daytime and nighttime air pollution levels was discovered in this study by measuring contaminants in the air at different times of day in different parts of the metropolis.

Basic formula to find out air quality index

$$AQI = \frac{1}{3} \{SPM/SPM\ Standard\} + (NOx/NOx\ standard) \times 100 \quad (1)$$

SPM = individual values of suspended particulate matter

SPM standard = standards of embedded air quality of suspended particulate matter

SO₂ = individual values of Sulphur dioxide

SO₂ standard = standards of ambient air quality of Sulphur dioxide

NO_x = individual values of oxygen of nitrogen

NO_x standard = standards of embedded air quality of oxides of nitrogen

Table 1: Standard data by ministry of forest and environment government of India for time weighted average of annual 24 hours:

Pollutant	Concentration In Ambient Air		
	Industrial Area ($\mu\text{g}/\text{m}^3$)	Residential Rural And Others ($\mu\text{g}/\text{m}^3$)	Sensitive Area ($\mu\text{g}/\text{m}^3$)
Sulphur Di Oxide (SO ₂)	80	60	15
	120	80	30
Oxides Of Nitrogen (NO ₂)	80	60	15
	120	80	30
Suspended Particulate Matter (SPM)	360	140	70
	500	200	100
Respirable Particulate Matter(RPM)	120	60	50
	150	100	75
	1.5	1.00	0.75

Table 2: Air quality index in jaipur and nearby areas in day time

Location	SPM($\mu\text{g}/\text{m}^3$)	SO ₂	NO ₂	AQI
Kota	503.6	2.88	13.78	90.87
Jaipur	270.3	17.99	37.1	68
Ajmer	94.67	8.05	35.5	33.92
Dausa	83.45	6.01	14.23	22.34

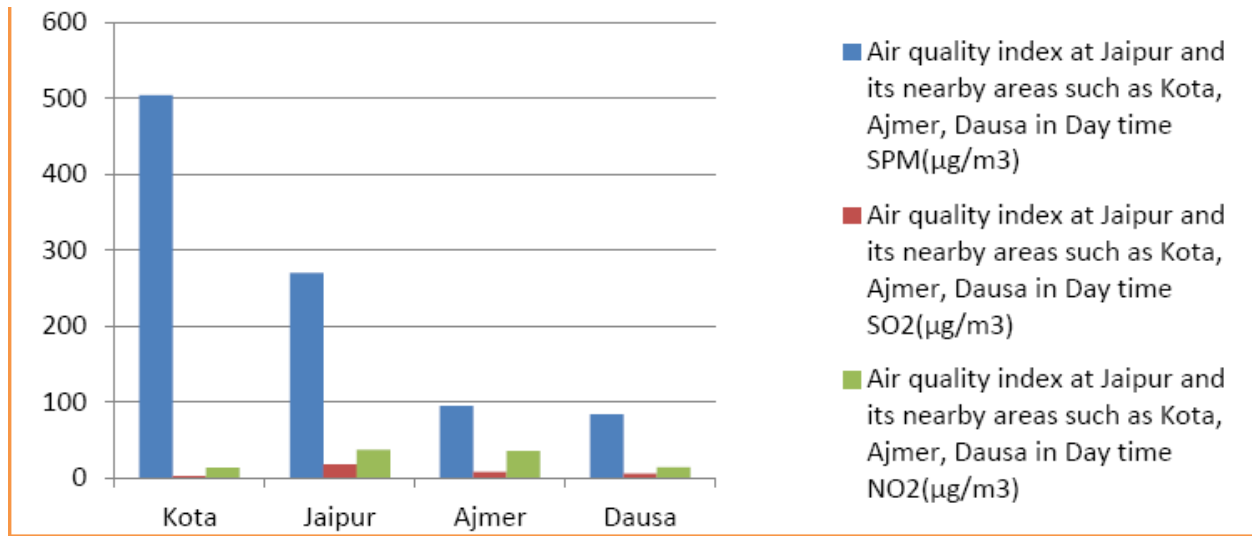


Fig.1. Air quality in Jaipur, Ajmer, kota in day time, compare different constituents of air

A :- air quality index in Jaipur and nearby area such as dosa and Alwar SPM in day time

B:- air quality index in Jaipur and nearby area such as dosa and Alwar NO₂ in day time

C:- air quality index in Jaipur and Rajasthan nearby area such as dosa and Alwar SO₂ in daytime

Table 3. Air quality in Jaipur and nearby area in night time:-

Location	Air quality index at Jaipur and its nearby areas such as Kota, Ajmer, Dausa in night time			
	SPM($\mu\text{g}/\text{m}^3$)	SO ₂	NO ₂	AQI
Kota	403.6	1.85	9.12	71.8375
Jaipur	101.35	9.99	27.06	32.32917
Ajmer	74.67	6.05	22.5	24.34083
Dausa	53.45	4.07	10.13	14.825

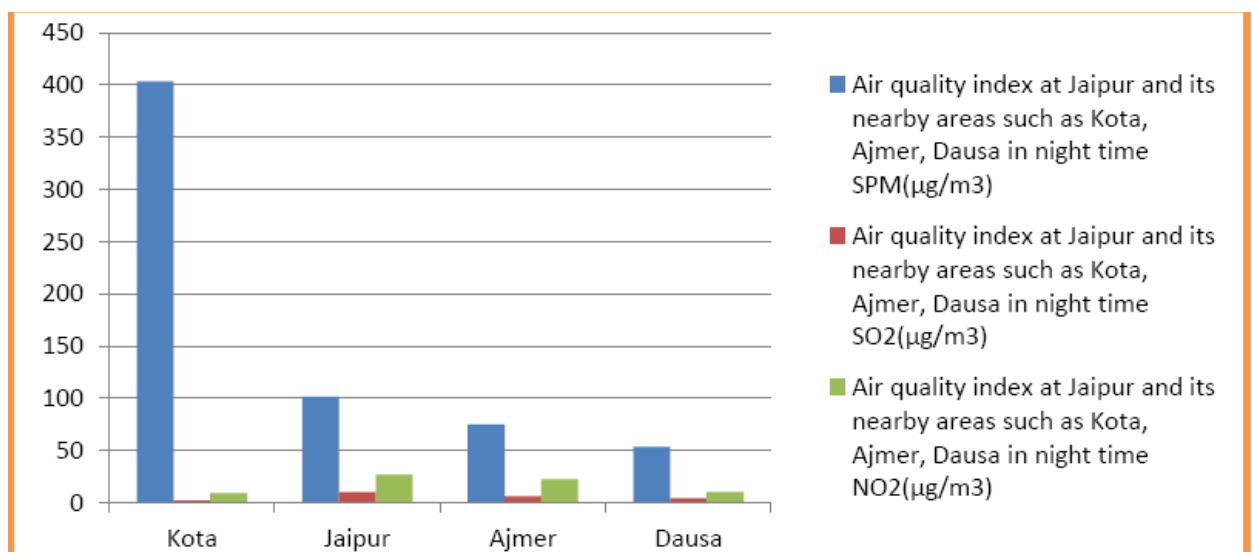


Fig.2:- Air quality in Jaipur, kota, Ajmer in night, compare different constituents of air

A: - Air quality index in Jaipur and nearby areas such as Dausa and Alwar SPM in night time

B: - Air quality index in Jaipur and nearby areas such as Dausa and Alwar SO₂ in night time

C: - Air quality index in Jaipur and nearby areas Dausa and Alwar NO₂ in night time.

According to amount of air pollutant present in air AQI is divided into 6 parts good, satisfactory, moderately polluted, poor, very poor and severe. A Comparison between Air quality index of Jaipur and Kota is shown in a graphical form.

Table 4. Comparative table of AQI in locations:-

Location	AQI night time	AQI day time
Kota	71.8375	90.87
Jaipur	32.32917	68.0
Ajmer	24.34083	33.92
Dausa	14.825	22.34

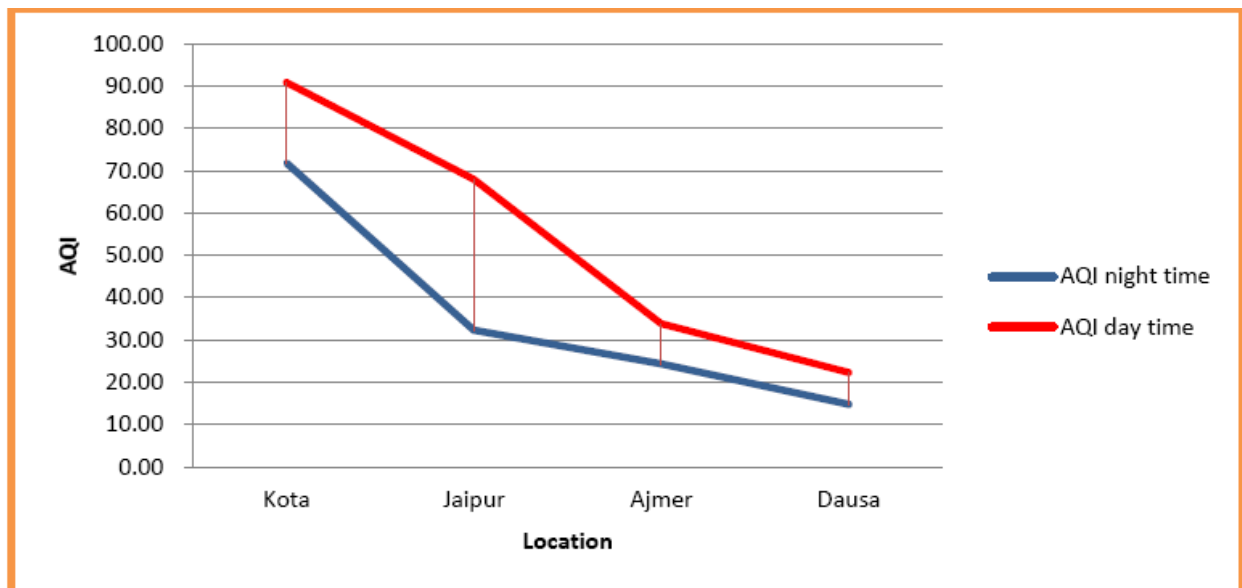


Fig. 3:- Air quality index comparison of different areas of Rajasthan

Residential areas have a highly healthy air quality score, whereas industrial areas are healthy for those with respiratory issues but very unhealthy for everyone else. Commercial areas, like the heart of Jaipur, have a very poor air quality index. The air quality index at night in Kota City is found to be very low, and during the day, it is found to be harmful for sensitive groups in the entire city. However, the air quality index is found to be at a hazardous level in an industrial area of Kota, such as the nuclear power plant, and a specific ash is found in the air, both of which are very harmful to humans and crops. Since the index for air quality changes relatively little from day to night in Ajmer, this indicates that the city's air quality is roughly stable under all conditions, similar to that of Dausa.

III. CONCLUSION

The analysis shows that there are numerous places in cities with better air quality than others. However, there are also many places where the air quality is really low. Because there are fewer cars on the road at night, air pollution is worse during the day. The amount of air pollution is greater in industrial locations than in residential ones. The government ought to enforce stringent regulations on companies, enhance automobiles, and encourage the use of electric vehicles. The government and non-governmental organisations (NGOs) should lead the awareness campaigns. It is important to increase tree planting.

An extremely high level of pollution was discovered in the vicinity of a thermal power plant in the city of Kota; however, the government of India is making good efforts to control air pollution, to stop harming our environment, and to limit the spread of air pollution-related diseases among humans. However, there are still certain deficiencies that need fixing.

IV. RESULTS

Reviewing these publications led us to the conclusion that nighttime IQs are generally low across the board in these locations, which suggests that the government of Rajasthan has to move quickly to improve the state's polluted air. There are sections in all of these cities where the pollution level is quite high, however the average air quality index during the day is roughly at sensitive for some groups. The low levels of industry and population in places like Ajmer and Dausa mean that they have relatively low levels of pollution. And a substantial wooded area. However, the air quality is progressively deteriorating.

V. FUTURE SCOPE

- If these measures are implemented, urban air quality should improve.
- The government must ensure that weekly checks for air pollution are conducted.
- Planting as many trees as possible helps control air pollution levels.
- Those businesses that cause more pollution than is acceptable or permitted should face serious consequences.
- Diesel vehicles and generators should be used as little as possible, while compressed natural gas (CNG) vehicles should be promoted. Additionally, environmentally friendly technology, such as hydrogen gas-powered vehicles, needs to be developed.
- The city's existing air quality should be considered when issuing permits to industries.
- Bicycling and public transport should be encouraged to enhance air quality.
- A system that can gather carbon from our environment and use that as fuel should be created, and there are a lot of opportunities for study in this area.
- There is a pressing need for new technologies tailored to the oil, glass, and other heavily polluting manufacturing sectors; these areas also offer ample opportunity for further study and innovation.

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