



A comprehensive report on air quality study  
by SwitchON Foundation

A stylized illustration of a city skyline with smoke rising from the buildings. The sky is a mix of teal and yellow, with several birds flying. The overall theme is air quality and environmental impact.

# BREATHLESS CITIES:

## UNVEILING THE AIR QUALITY CRISIS IN EASTERN INDIA

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Founded in 2008, the Environment Conservation Society (ECS), also known as SwitchON Foundation, is a nonprofit organization dedicated to fostering equitable and sustainable development in India. Our vision is to build a sustainable and equitable India, focusing on Clean Energy, **Clean Air**, Sustainable Mobility, Climate Smart Agriculture, Conservation and Integrated Management of Natural Resources, Just Transition, Skilling, and Sustainable Cities. Our mission is to promote sustainable livelihoods and address environmental challenges through innovative business models and technologies, aiming to create opportunities for 10 million people at the bottom of the pyramid by 2030.

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# Abstract

This comprehensive report focuses on the alarming air quality situation in eastern Indian cities, particularly Kolkata, Ranchi, and Bhubaneswar. Kolkata holds the unfortunate title of the world's second-most polluted city, necessitating urgent interventions. Ranchi faces a concerning surge, with potential increases in air pollution. Dhanbad, an industrial town, grapples with significant pollution linked to coal mining. Bhubaneswar registers high PM levels, surpassing Delhi's AQI. The research methodology ensures uniform data collection for thorough analysis. Findings reveal shifting air quality patterns and notable disparities between cities, emphasizing the adverse impact on public health. Victoria Memorial and Howrah in Kolkata, and Ranchi and Dhanbad in Jharkhand, experience distinct air quality challenges. Bhubaneswar, while better than many cities, faces concerns, especially during Diwali. The report concludes with recommendations for ongoing air quality monitoring, policy implementation, and public awareness to address this pressing environmental issue in eastern India.

**Keywords:** Air quality, Eastern India, Kolkata, Ranchi, Bhubaneswar, Dhanbad, AQI (Air Quality Index), PM<sub>2.5</sub>, Diwali impact, Continuous Ambient Air Quality Monitoring Stations (CAAQMs), CPCB (Central Pollution Control Board), Winter air quality, Public health, Environmental impact, Howrah, Victoria Memorial, Climate change, Industrial pollution, Urban air pollution, Policy implementation, Eco-friendly Diwali, Supreme Court guidelines, SwitchON Foundation



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# 1

## Background

Eastern India grapples with challenging air quality as cities reach unprecedented levels of pollution. Kolkata, earning the unfortunate distinction of being the world's second-most polluted city, demands urgent interventions. Ranchi faces a worrisome surge in air pollution, with potential increases anticipated. Dhanbad contends with pollution stemming from coal mining and vehicular traffic. Bhubaneswar registers alarming pollution levels, surpassing **Delhi's AQI**. This situation underscores the imperative for immediate, comprehensive actions to address the escalating air pollution crisis in Kolkata, Ranchi, and Bhubaneswar, emphasizing the adverse impact on public health and the environment.

**Kolkata**, often hailed as the City of Joy and the capital of West Bengal, continues to grapple with its unenviable status as the world's **second-most polluted city**, according to The Air Quality and Health in Cities report by the US-based Health Effects Institute and the Institute for Health Metrics and Evaluation's Global Burden of Disease Project. Recent revelations by **The Indian Express on November 24, 2023**, confirm an ongoing trend of heightened pollution levels in the city this year. This persistent deterioration in air quality demands urgent and comprehensive measures to address its adverse impact on public health and the environment, as highlighted by continuous monitoring from the Central Pollution Control Board and the West Bengal Pollution Control Board, along with insights from their **previous year's assessments**.

**Ranchi**, the administrative capital of Jharkhand, has garnered attention from environmentalists due to a troubling surge in air pollution this year. Known as the City of Waterfalls, Ranchi's allure as a tourist destination is rooted in its picturesque falls and rich historical and cultural heritage. According to **The Telegraph's report on August 28, 2023**, data from the India Clean Air Summit 2023 forecasts a potential increase of over 33% or a reduction of 40% in Particulate Matter (PM)<sub>2.5</sub> emissions in Ranchi by 2030, contingent on the implementation of prioritized measures. On November 13, the JSPCB station in Ranchi recorded the city's worst air quality, with an Air Quality Index (AQI) of 315, indicating a "Very Poor" level. Notably, November 11th and 13th witnessed a substantial 45% increase in AQI over two days, highlighting a swift deterioration linked to Diwali celebrations. Concurrently, Dhanbad, the industrial and mining town in Jharkhand, grapples with a significant air pollution challenge arising from coal mining and vehicular traffic. As reported by **Zee News on November 6, 2022**, Ranchi's air quality notably declined post-Diwali, with PM<sub>2.5</sub> and PM<sub>10</sub> levels reaching 96 and 114 ug/m<sup>3</sup> respectively, escalating to 187 by the weekend. The escalating air pollution in Jharkhand's cities raises serious concerns.

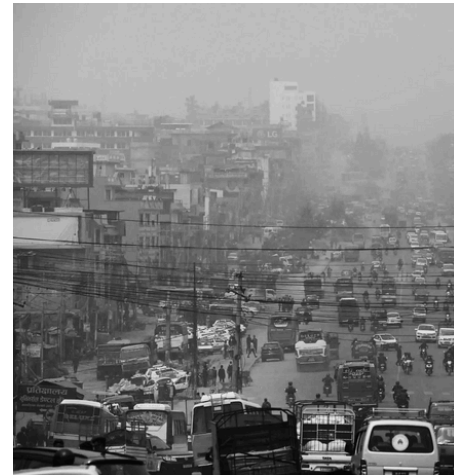
**Bhubaneswar**, the administrative capital of Odisha, has drawn attention from environmentalists due to a concerning surge in air pollution this year. Despite being a prominent education and business destination, as well as a tourism hub in eastern India, the city has recorded alarmingly high levels of PM<sub>2.5</sub> concentration. The readings were a staggering 33 times above the 15 micrograms limit set by the World Health Organization (WHO) as per reporting by **Times of India dated 14th November 2023**. On the other hand, according to the Central Pollution Control Board's bulletin on November 13th at 4 PM, Bhubaneswar's mean Air Quality Index (AQI) reached 380, surpassing Delhi's AQI of 358. These striking digits at the onset of winter are highly concerning.

As winter takes hold, assessing air quality in Bengal and the wider Indian subcontinent is paramount. The SwitchON Foundation's research team endeavours to scrutinize the air quality status in cities as winter begins. This holistic approach seeks to offer valuable insights into the air quality dynamics of these regions, addressing concerns about environmental and public health implications during this season.

# 2

## Aims & Objectives

This report seeks a comprehensive overview of the air quality in eastern Indian cities in recent years. The objective is to comprehend the patterns of air quality changes in Kolkata, Ranchi, and Bhubaneswar within a spatial and temporal framework over the preceding three years. The focus is on gaining insights into the evolving trends and fluctuations in air quality levels in these cities to better understand the environmental dynamics in this region.



# 3

## Methodology

### 3.1

#### Data Source and Data Collection

Following this methodology, data for Kolkata and Bhubaneswar originated from the Continuous Ambient Air Quality Monitoring Stations (CAAQMs) on the CPCB portal, while Ranchi's information was extracted from the Jharkhand State Pollution Control Board's online portal. This approach guarantees a uniform and dependable data collection process for analyzing air quality trends in these eastern Indian cities. The calculation of the Air Quality Index (AQI) for each city considers data from all stations on a 24-hour basis, incorporating  $PM_{2.5}$ ,  $PM_{10}$ , and  $NO^2$  measurements gathered from various sources.



### 3.2

#### Data Analysis

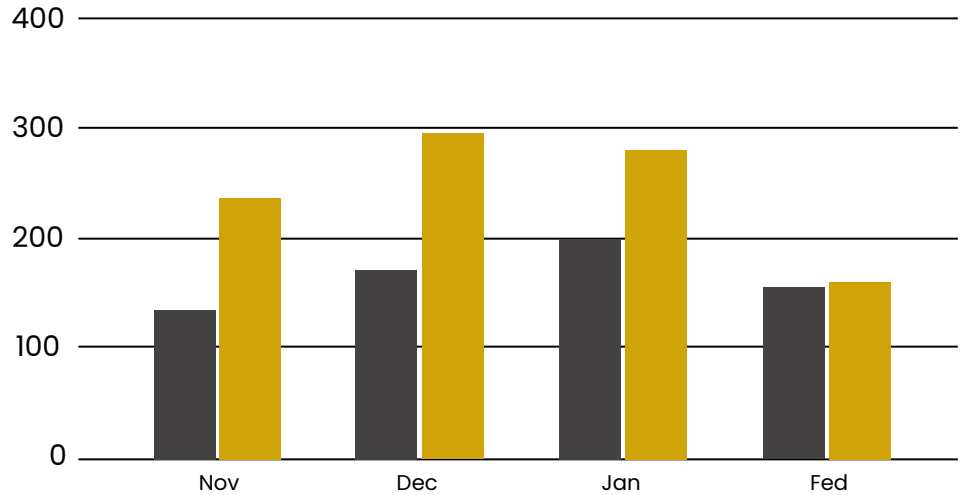
Utilizing  $PM_{2.5}$ ,  $PM_{10}$ , and  $NO^2$  data obtained from various sources, the Air Quality Index (AQI) has been computed following the CPCB AQI calculation methods. Each day's AQI has been categorized according to CPCB standards, and the mean AQI has been calculated for clarity in reporting. The analysis includes daywise, hourly, weekend, and weekday comparisons. Additionally, specific regional trends have been meticulously examined, ensuring a comprehensive assessment of air quality dynamics in the study areas.



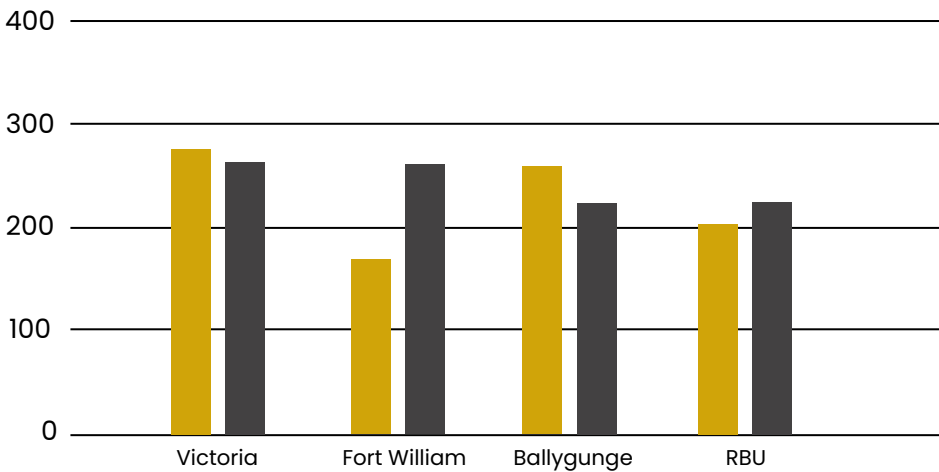
**4**  
Findings

**4.1**  
Victoria's  
Status of AQI

**WINTER AQI AT VICTORIA MEMORIAI**

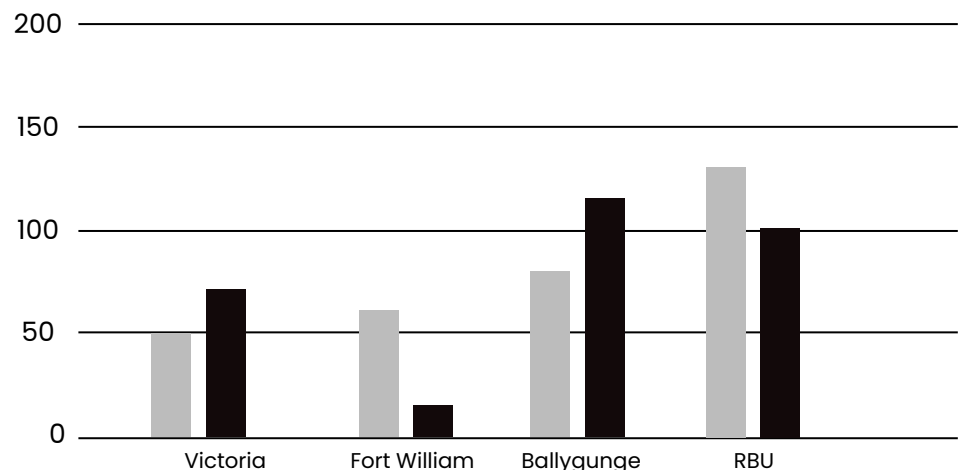


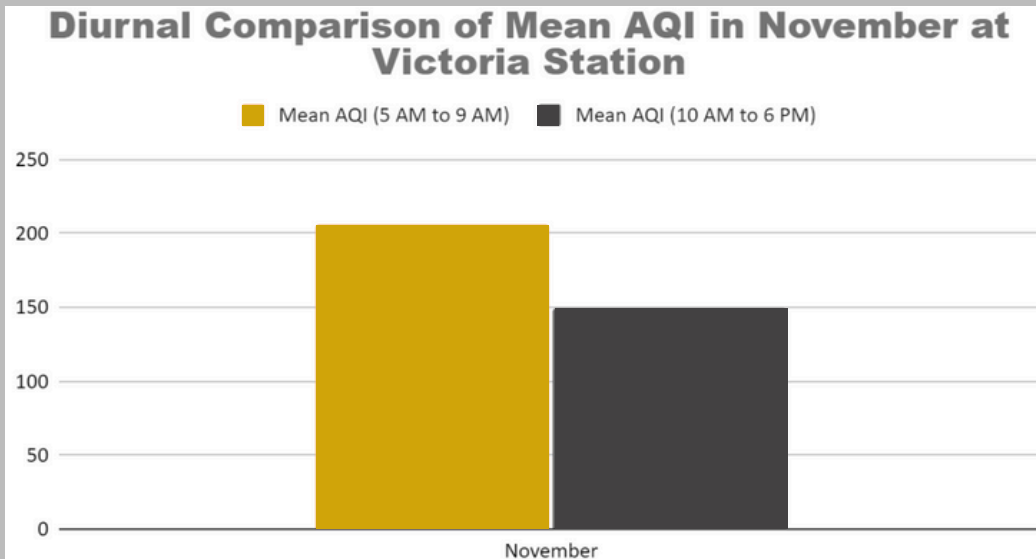
**GOOD , MODERATE AND SATISFACTORY DAY IN KOLKATA (2021-2022)**



Analyzing the air pollution scenario through the mean Air Quality Index (AQI) of this station over the last three years reveals a significant shift. Traditionally, the peak of polluted air was experienced in January, the second half of winter in the city. However, recent trends show that December has now emerged as the month with the highest levels of poor air quality. During the winter season of 2021-2022, January '22 recorded a 201 (poor) AQI, while December registered a 172 (moderate) AQI. In the subsequent winter (2022-2023), December '22 AQI surged to 294, while January '23 AQI decreased to 279.

**POOR , VERY POOR AND SEVERE DAYS IN KOLKATA (2021-2022)**





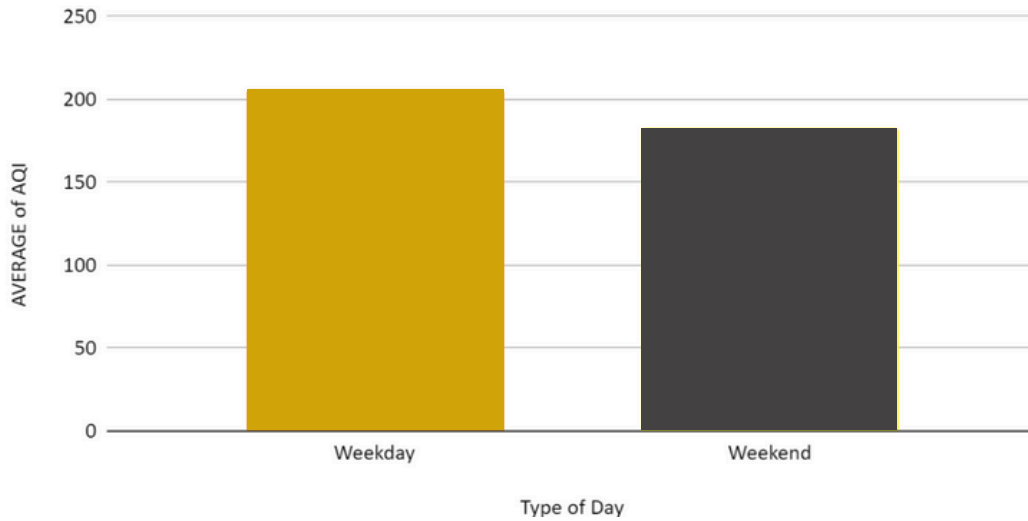
The **November** 2023 data from the Central Pollution Control Board (**CPCB**) distinctly indicates that air quality is notably worse in the early hours of the day, precisely when individuals engage in their morning walks, registering as **"Poor."** Between **10 am to 5 pm**, when vehicles crisscross the thoroughfares of the city, the air quality goes up to the "Moderate" category with an **Air Quality Index (AQI)** of **149**. During the night, lower temperatures contribute to the downward movement of suspended pollutants, and the reduced ground-level air movement results in the stagnation of pollutants in specific areas. This seems to be a major problem for the health enthusiasts coming daily morning in this area.

WEEKENDS ARE LESS POLLUTED AT VICTORIA

The air quality status of Victoria Station in November reveals slightly higher air pollution on weekdays compared to weekends. One potential explanation for the "Poor" (206) Air Quality Index (AQI) during weekdays could be attributed to the vehicular traffic from officegoers observed at the Maa Flyover. The disparity in AQI between weekdays and weekends amounts to a 23-point difference.



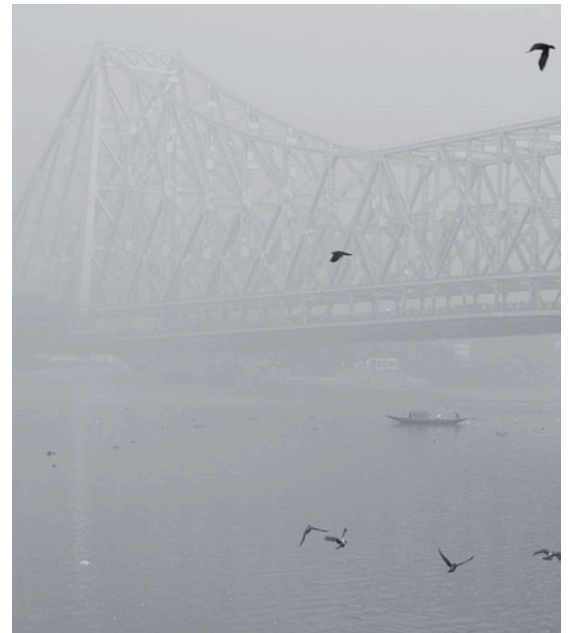
## Average Air Quality in Weekday and Weekend at Victoria in November 2023



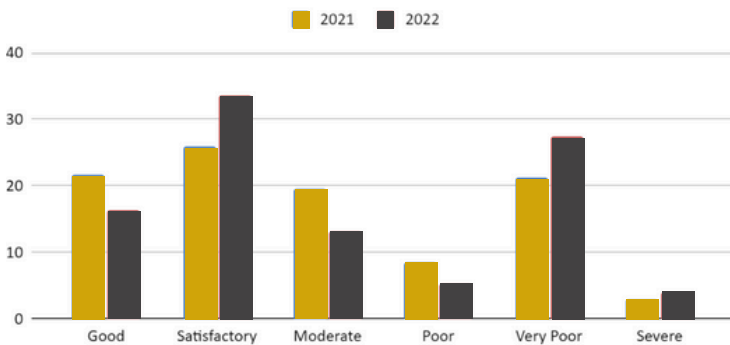
### 4.2

Air Quality is More Serious for the Twin City, Howrah

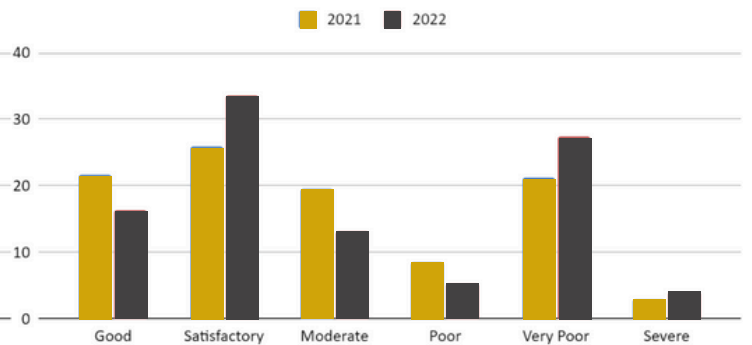
Howrah, an industrial city situated on the western bank of the Hooghly River in West Bengal, exhibits a more alarming air quality scenario compared to Kolkata. While Kolkata has seen a decrease in "Very Poor" Air Quality Index (AQI) days from 10% in 2021 to 8% in 2022, Howrah's proportion in this category is notably higher and has seen an increase from 21% in 2021 to 27% in 2022. Conversely, as Kolkata observes a steady rise in "Good" AQI days, Howrah experiences a decline, and the occurrence of "Severe" AQI days has slightly increased. Notably, the state capital on the eastern bank has not encountered a single severe day during the same period.



Percentage Share of AQI Category Days in Howrah (2021-2022)



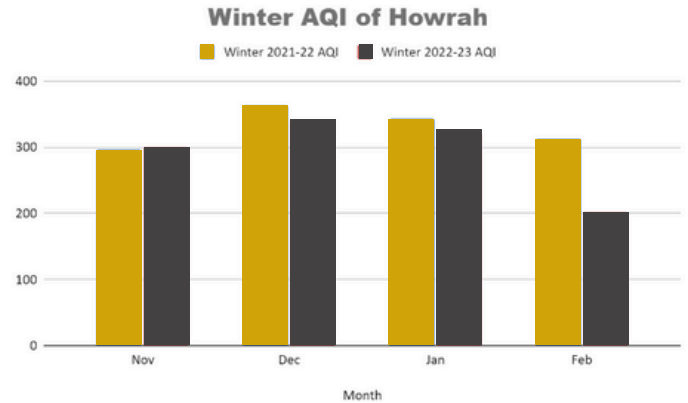
Percentage Share of AQI Category Days in Howrah (2021-2022)



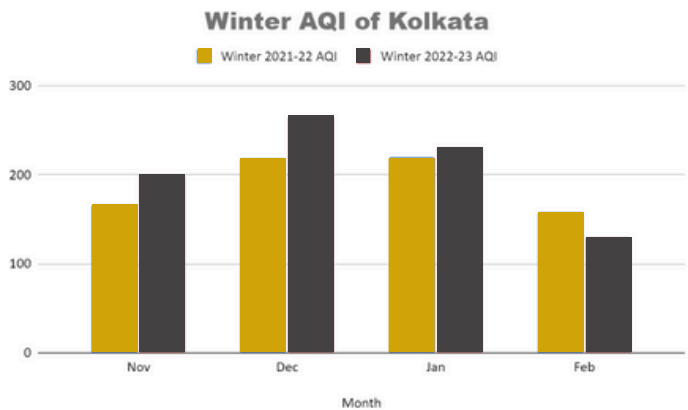


Comparatively Higher Mean AQI at Howrah in Winter

December and January months at Howrah have shown a “Very Poor” mean AQI over the past two years. At this time, the highest calculated mean AQI were 362 and 341 AQI in 2021 and 2022 respectively, which is higher



than any of the single stations at Kolkata as well as it is also higher than the mean AQI at Kolkata in the same period. highest calculated mean AQI in Kolkata was 220 and 265 in the respective years, demonstrating “Poor” air in the city in comparison to Howrah’s “Very Poor” AQI.



### 4.3 November Air Pollution in Ranchi and Dhanbad

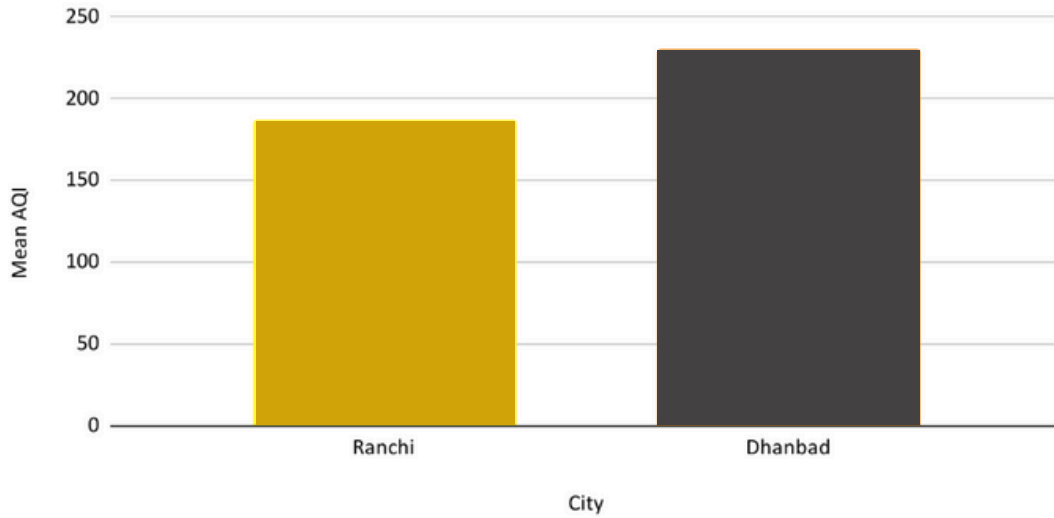
Dhanbad Records Poor Mean AQI Compared to Ranchi's Moderate Mean AQI

The commencement of winter in 2023 proved notably severe for both cities, with Dhanbad exhibiting a more critical situation in terms of mean AQI this November. **Dhanbad registered a higher AQI at 231, while the capital city Ranchi reported a slightly lower value at 187.** This disparity is attributed to Dhanbad's mining activities, serving as a potential factor influencing the air quality in the region.



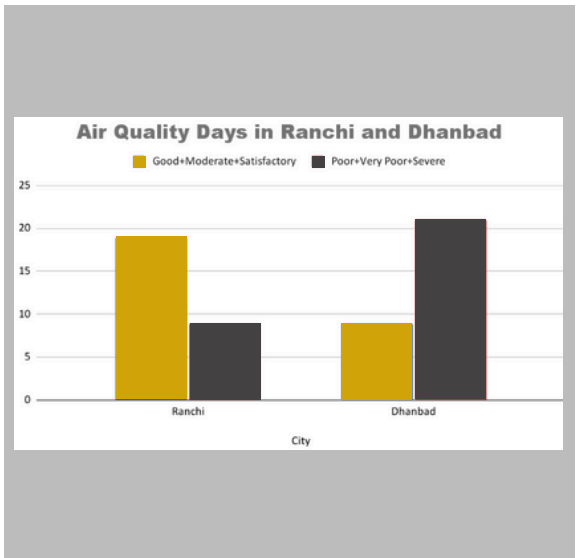


## Mean AQI of November (2023) in Ranchi and Dhanbad



The daily AQI of Dhanbad is prone to "Poor" in comparison to Ranchi's "Satisfactory" days

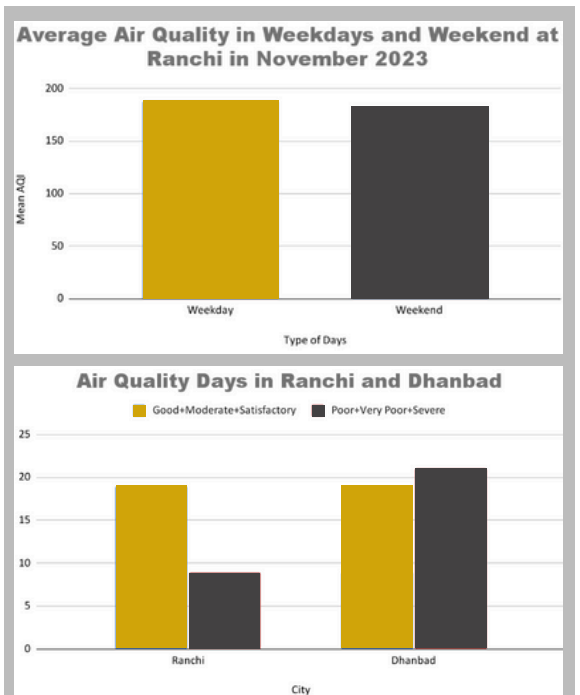
Once again, Ranchi experienced more breathable days than Dhanbad. Ranchi had 19 days with AQI ranging from good to satisfactory, in contrast to Dhanbad's 21 days falling below the mark, encompassing poor to severe air quality. **Ranchi endured only 4 days in poor air quality, the highest count among all categories, while Dhanbad had 19 days** (the highest day count across various categories). Although Ranchi had more very poor days (three more days compared to Dhanbad's two), it compensated with 15 satisfactory AQI days.



Difference in average air quality on weekdays and weekends

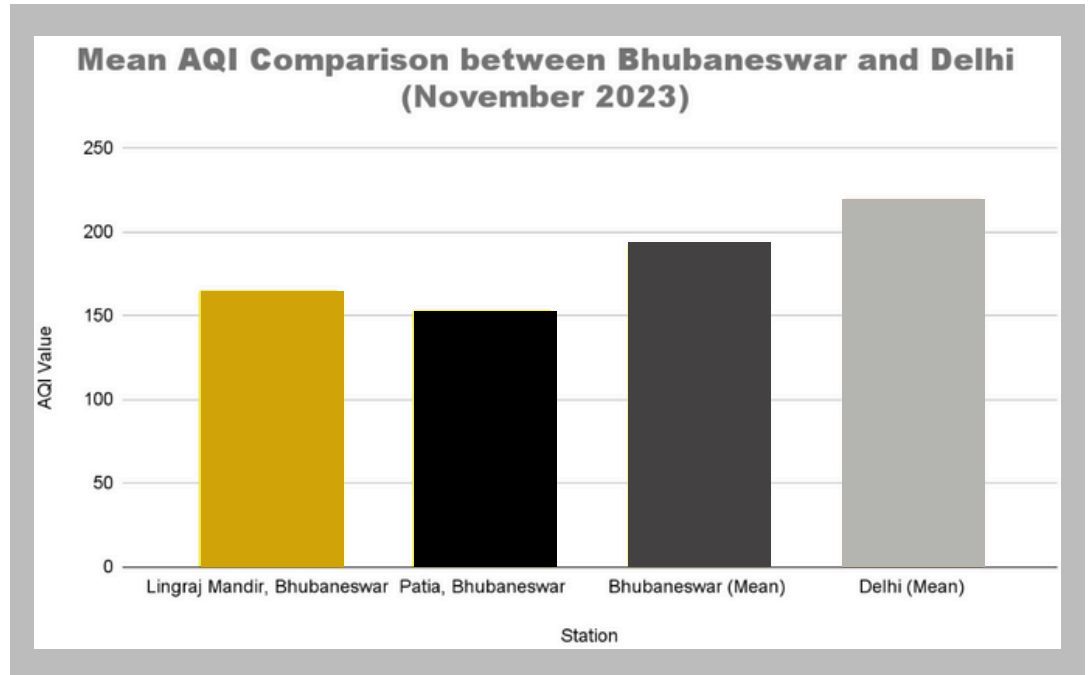
The distinctions in the average Air Quality Index (AQI) between weekdays and weekends for both Jharkhand cities are not notable. In November, the AQIs for Ranchi and Dhanbad remained consistently in the Poor category.

Nevertheless, there is a divergence in the AQI trends between weekends and weekdays. Ranchi exhibited a slightly improved AQI on weekends at 183, compared to weekdays with a slightly higher value of 188. In contrast, Dhanbad showed better air quality on weekdays with an AQI of 226, whereas on weekends, it recorded a higher AQI of 245. A potential factor contributing to this observation is that Diwali celebrations coincided with a Sunday.



## 4.4 Mean Air Quality Status of Bhubaneswar

Overall November  
Scenario in  
Bhubaneswar- Not  
as Concerning as  
Diwali and Delhi



### 1.

The commencement of winter in 2023 proved notably severe for both cities, with Dhanbad exhibiting a more critical situation in terms of mean AQI this November. Dhanbad registered a higher AQI at 231, while the capital city Ranchi reported a slightly lower value at 187. This disparity is attributed to Dhanbad's mining activities, serving as a potential factor influencing the air quality in the region.

### 2.

Shadipur and Burai Crossing exhibit a "Severe" AQI this November, with mean AQI reaching 418 and 412, respectively. In contrast, Bhubaneswar's CPCB monitors at Lingraj Mandir and Patia depict a much lower stage, with mean AQI calculated at 165 and 153, indicating a "Moderate" AQI level.

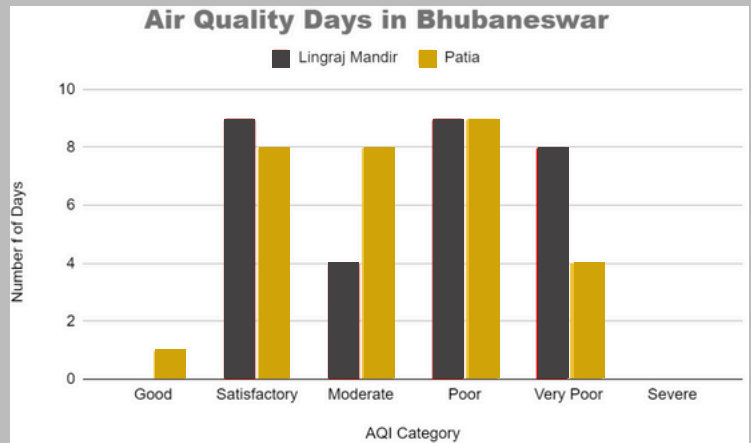
### 3.

Even the November mean AQI value of Delhi was at 219 indicating "Poor" air quality, which is way more bad than Bhubaneswar. **The mean AQI of Bhubaneswar in the month of November was 193 (Moderate) AQI.**



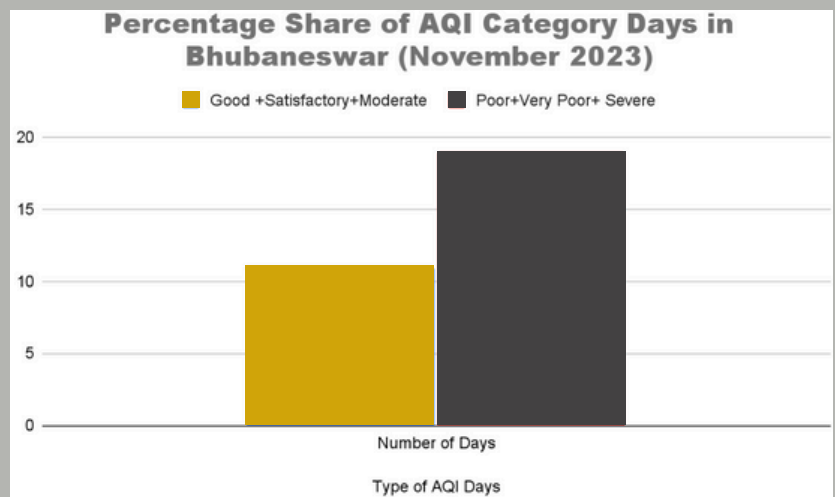
Patia region was slightly better than Lingraj Mandir in November

Despite the intensity of Diwali, Bhubaneswar has not encountered any "Severe" air quality days this November. However, the noticeable scarcity of "Good" AQI days for the city is a concerning aspect. When comparing the two CPCB stations, it can be concluded that the air quality in Patia was comparatively better in the past month.

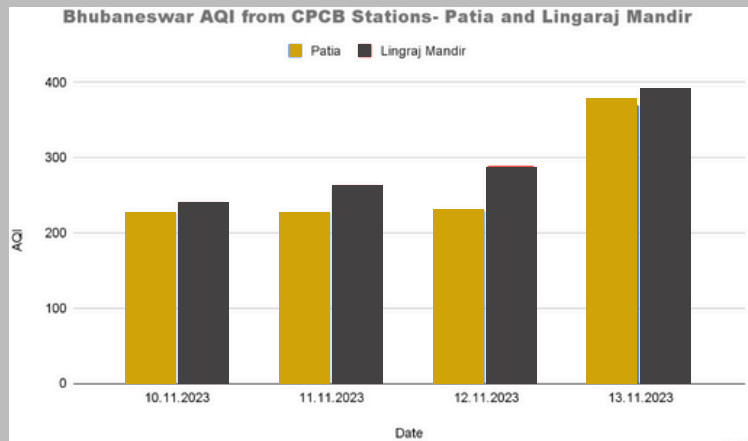


1. In Patia, there was a single day of "Good" AQI.
2. In the Lingraj Mandir area, the number of days with "Satisfactory" air quality may be slightly higher (1 day), but the count of "Moderate" AQI days is twice as much in Patia compared to Lingraj Mandir (8 days and 4 days, respectively).
3. Patia experienced half the number of "Very Poor" air quality days compared to the Lingraj Mandir area (4 days and 8 days, respectively).
4. Both stations recorded a "Poor" AQI for 9 days each individually.

After analyzing the mean Air Quality Index (AQI) categorization for days in Bhubaneswar, it was noted that a ratio of 11:19 emerged for a total of 30 days, encompassing both up-to-the-mark AQI days and below-the-mark AQI days. Days categorized as good, moderate, and satisfactory were considered up-to-the-mark AQI days, while poor, very poor, and severe days were classified as below-the-mark AQI days. This discussion underscores that Bhubaneswar's AQI was notably below the mark in the preceding November.



Diwali 2023- a curse for air quality in Bhubaneswar



1. The air quality of Bhubaneswar consistently declined from "Moderate" to "Very Poor" over a five-day period, covering both pre and post-Diwali periods..
2. On November 13th, Lingraj Mandir station hit an alarming AQI of 389, while Patia station reported 371, both signalling "Very Poor" air quality in Bhubaneswar.
3. On November 12th and 13th, Patia and Lingraj Mandir stations saw a sharp 60.61% and 34.60% increase in AQI, indicating a swift deterioration in the city's air quality during Diwali.

**5.**  
Way Forward

Climate change has remained a foremost concern globally for decades. Constantly deteriorating air quality due to continuous exposure to pollutants especially from the third world nations. World Health Organisation (WHO), has defined air pollution as the contamination of the environment, indoors or outdoors, by chemical, physical, or biological agents altering the natural atmosphere. South Asian countries, especially India and its cities have remained mostly highlighted due to their sheer presence in contributing to air pollution and its impact can be apprehended from regional to global level (The Hindu, 13th November 2023).



- Researchers need to find out the reason behind the sudden hike in air pollution near Victoria Memorial, near the Lungs of Kolkata.
- Air pollution mitigation measures need to come out for Howrah city
- Based on continuous monitoring of AQI, frequent assessment of the air quality status of the cities of Bengal is highly required.
- The air quality monitoring needs to be regular in the cities of Jharkhand
- Policy framing and implementation needs to come out from the government and researchers for the betterment of winter AQI.
- For the city of Bhubaneswar, strict implementation of Supreme Court guidelines on Eco-friendly Diwali will come with better air quality results at the onset of winter
- Reduction in vehicular congestion will lead to better air quality in the most prominent city of Odisha.



## 6. Conclusion

In conclusion, the air quality crisis in Kolkata, Ranchi, and Bhubaneswar demands urgent and coordinated efforts. The findings highlight shifting pollution patterns, with December emerging as a critical month. Specific areas, like Victoria in Kolkata and Howrah, face severe challenges, warranting targeted interventions. Ranchi and Dhanbad grapple with distinct pollution sources, emphasizing the need for tailored strategies. Bhubaneswar, while showing relative improvement, faces concerning trends, notably during Diwali. The way forward involves rigorous monitoring, research into localized pollution spikes, targeted mitigation for industrial areas, and strict adherence to eco-friendly practices. Immediate policy actions and public engagement are imperative to safeguard public health and the environment in these cities.



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