



UNVEILING AIR POLLUTION DYNAMICS IN WEST BENGAL

INDEPENDENT AIR QUALITY STUDY THROUGH MONITORING AIR QUALITY IN SCHOOLS ACROSS
DIFFERENT CITIES OF WEST BENGAL BY SWITCHON FOUNDATION

JANUARY 2024



Founded in 2008, the Environment Conservation Society (ECS), also known as SwitchON Foundation, has been actively offering sustainable solutions for the vulnerable Indian population. With a commitment to clean energy, climate-resilient agriculture, and sustainable cities, ECS is working towards creating opportunities for 10 million people by 2030, promoting equitable growth through innovative business models and technologies.

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ABSTRACT

This comprehensive report addresses the critical air quality challenges prevalent in West Bengal, particularly in cities and industrial zones during the winter season. Highlighting Kolkata as the world's second-most polluted city, the findings reveal a concerning deterioration in air quality across schools, emphasizing the dynamic nature of environmental conditions. Utilizing data from an extensive network of independent air quality monitoring systems, the report emphasizes the need for continuous monitoring and region-specific strategies.

The recommendations advocate for a collaborative approach involving government intervention, educational initiatives, community engagement, environmental collaboration, and corporate responsibility. Urgent actions are proposed to enforce strict industrial emissions controls, integrate air quality awareness into education, engage communities for pollution mitigation, expand monitoring initiatives, and encourage corporate responsibility. Implementing these collective measures is essential for a comprehensive strategy to mitigate the escalating air pollution crisis in West Bengal, ensuring a healthier environment for communities and students.

Keywords:

Air Quality Index (AQI), Winter Air Pollution, Independent Air Quality Monitoring, School-based Air Quality Analysis, Pollution Trends in West Bengal, Collaborative Pollution Mitigation, Industrial Emissions Control



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INTRODUCTION

The east Indian state of West Bengal grapples with significant air quality challenges, particularly in its cities, towns, and industrial areas, which become major concerns as the winter has set in once again. Although the focus is often on the capital city, Kolkata, other



cities in the state have also been observed to surpass the pollution levels of the state capital. With winter being the season when air pollution peaks, it is crucial to evaluate the air quality during this period.

The gravity of Kolkata's air quality predicament is strikingly apparent in recent reports. Despite being hailed as the City of Joy and the capital of West Bengal, Kolkata maintains its undesirable position as the world's second-most polluted city, as per 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. The Indian Express, on November 24, 2023, further underscored this worrisome trend, affirming a sustained surge in pollution levels in the city this year. A recent air quality report from the SwitchON Foundation highlights a particularly distressing scenario in Howrah, surpassing Kolkata in alarming air quality conditions. Notably, while Kolkata has experienced a reduction in "Very Poor" Air Quality Index (AQI) days, decreasing from 10% in 2021 to 8% in 2022, Howrah's share in this category is significantly higher. It has seen a rise from 21% in 2021 to 27% in 2022, emphasising the urgent need for focused interventions to address the escalating air pollution crisis in the region.

Numerous reliable air monitoring systems, established by the central and state pollution control boards, operate throughout Bengal. In addition to these official channels, several independent air quality monitoring systems function effectively at the local level, contributing valuable data. These localized systems play a pivotal role in devising targeted measures to combat air pollution.

The research team at SwitchON Foundation presents a comprehensive analysis of the winter air pollution scenario in 2023. Drawing upon their proprietary monitoring system, this report provides insights crucial for understanding and addressing the specific challenges posed by air pollution in the region.

OBJECTIVES

The project aims to create a robust network of independent air quality monitoring systems.

- The primary objective was to deliver timely and reliable data from various areas across Bengal, ensuring its universal acceptance.
- Within this framework, the report's objective was defined: to comprehensively grasp the air quality conditions during the winter (October, November and December) of 2023.

The emphasis was on substantiating these findings by aligning them with government data, drawn from previous reports. By establishing a network that seamlessly integrates independent monitoring with official data, the organization sought to enhance the accuracy and credibility of information concerning air quality in diverse areas of Bengal.



METHODOLOGY

In pursuit of the stated objective, eight schools across West Bengal were meticulously chosen from the organization's affiliated network. Choosing schools for this project is motivated by the following factors. Firstly, school students typically consist of children or teenagers, making them one of the most vulnerable populations to air pollution. Secondly, schools are pervasive institutions found in various parts of a city, allowing for the implementation of a round-the-clock air quality monitoring system. In all the cities, the schools have been chosen strategically to represent the entire city. Airveda air quality monitors were strategically installed in open areas within these schools, continuously capturing data on $PM_{2.5}$ and PM_{10} levels. Monthly data acquisition was conducted, presenting comprehensive parameter information in a half-hourly format.

Analyzing the data spanning from October 2023 to December 2023, the research team performed rigorous statistical analyses. The resultant findings, presented in this report, encapsulate a detailed understanding of the air quality dynamics during the winter period. This methodical approach, which employed advanced monitoring technology and statistical scrutiny, contributed to a nuanced comprehension of the air quality scenario, forming the basis for informed decision-making and targeted interventions in West Bengal.

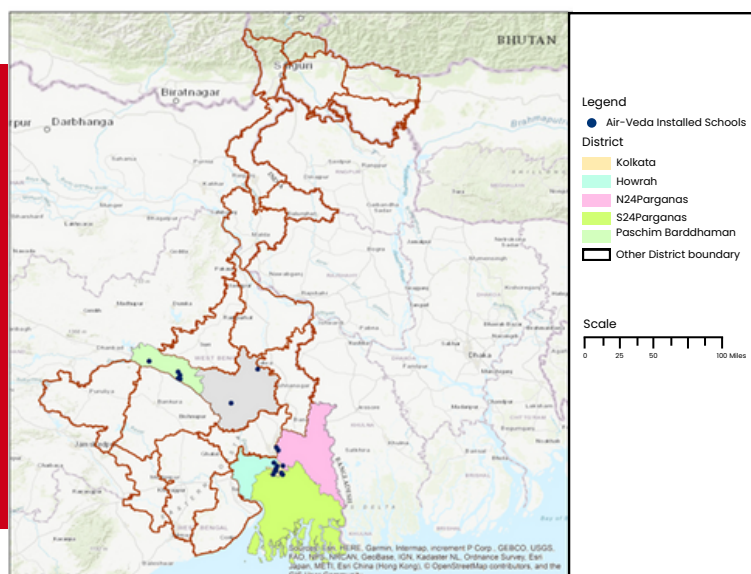


FIGURE: STUDY LOCATIONS OF WEST BENGAL

FIGURE: STUDY LOCATIONS OF KOLKATA AND ITS SURROUNDINGS

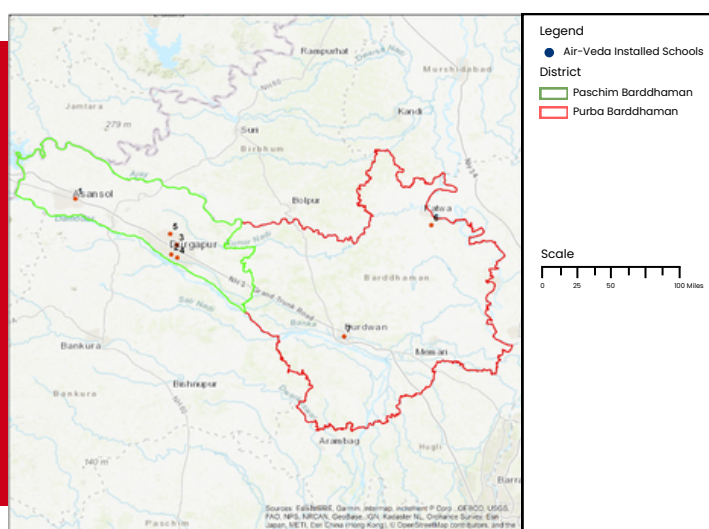
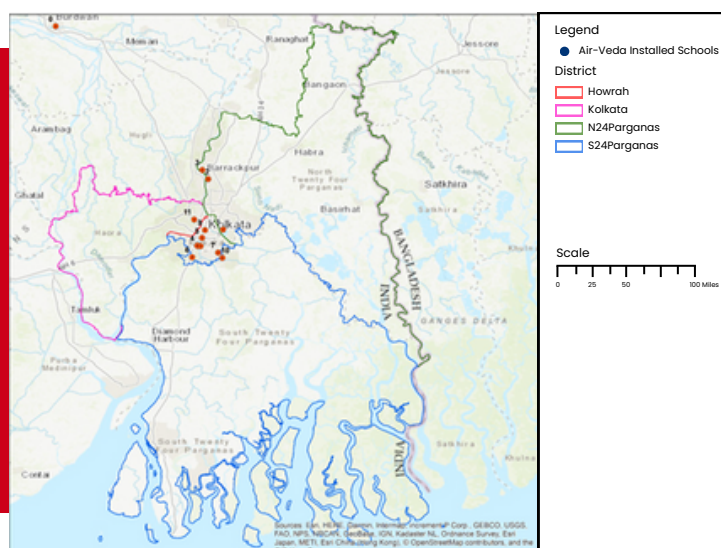
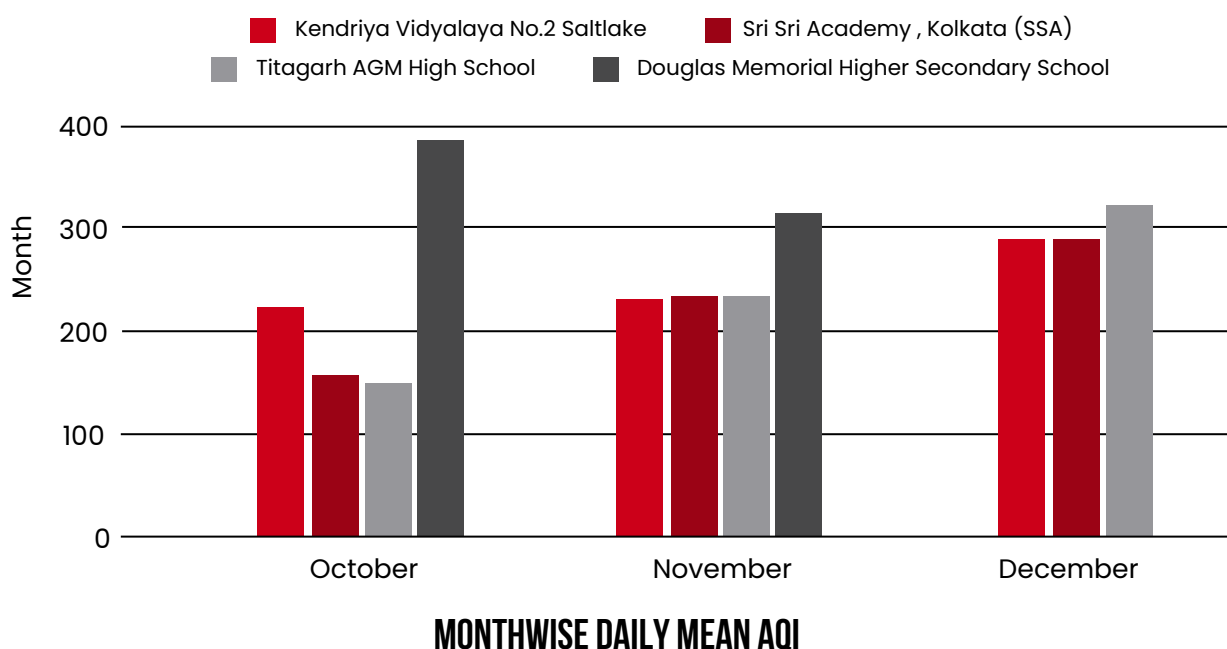


FIGURE: STUDY LOCATIONS OF BARDHAMAN AND ITS SURROUNDINGS

SCHOOL-BASED DAILY MEAN AQI

Utilized for daily air quality reporting, the Air Quality Index (AQI) provides insights into the cleanliness or pollution levels of the air, offering an understanding of potential health concerns. This index specifically highlights the health effects individuals may encounter within a short timeframe, spanning hours or days, after inhaling polluted air. This section delves into the examination of air quality indexes.

KOLKATA MONTHWISE DAILY MEAN AQI



1. Kendriya Vidyalaya No.2 Salt Lake experienced a gradual increase in AQI from October (224) to November (233) and further to December (290), indicating a deterioration in air quality over the three months.

2. Sri Sri Academy in Kolkata started with a moderate AQI in October (158), but there was a significant rise in November (235) and a further increase in December (290), suggesting a transition from moderate to potentially unhealthy air quality levels.

3. Titagarh AGM High School witnessed a shift from a moderate AQI in October (149) to higher levels in November (235) and a notable increase in December (322), indicating a worsening of air quality over the three months.

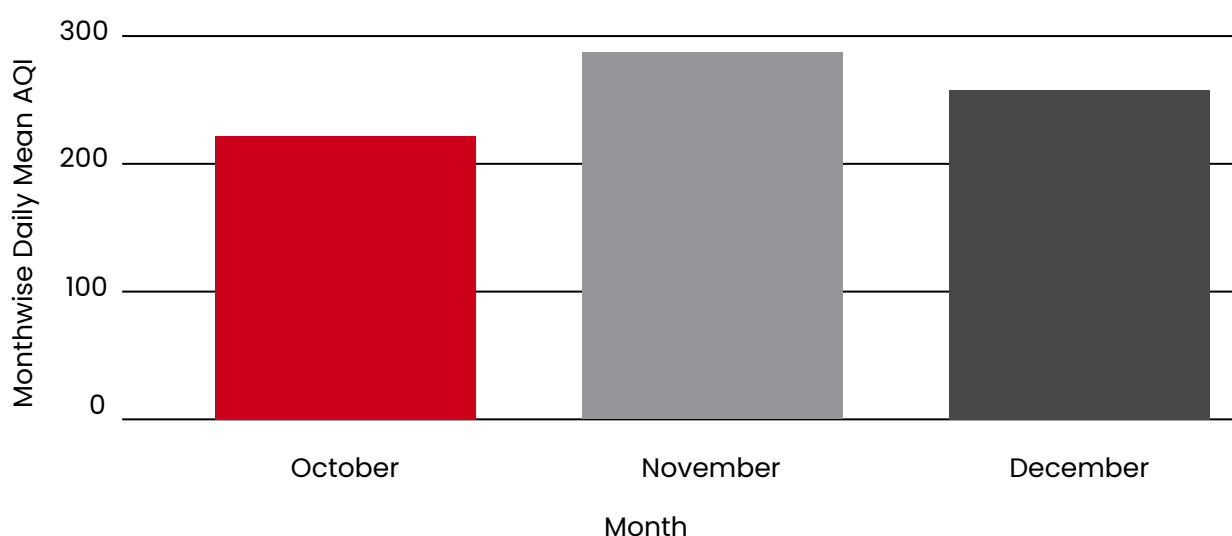
4. Douglas Memorial Higher Secondary School faced very high AQI levels in October (389), followed by a decrease in November (314).

5. Overall, the data reveals varying air quality levels across the mentioned locations, with fluctuations in AQI values from October to December, highlighting the dynamic nature of air quality conditions during this period.

6. The air quality in the suburbs, especially in the industrial zone, is noticed to be more concerning than the city core.



ASANSOL MONTHWISE DAILY MEAN AQI





1. Kendriya Vidyalaya Asansol recorded an AQI of 227 in October, categorizing the air quality as "poor," signalling potential health effects for everyone and increased risks for sensitive groups.

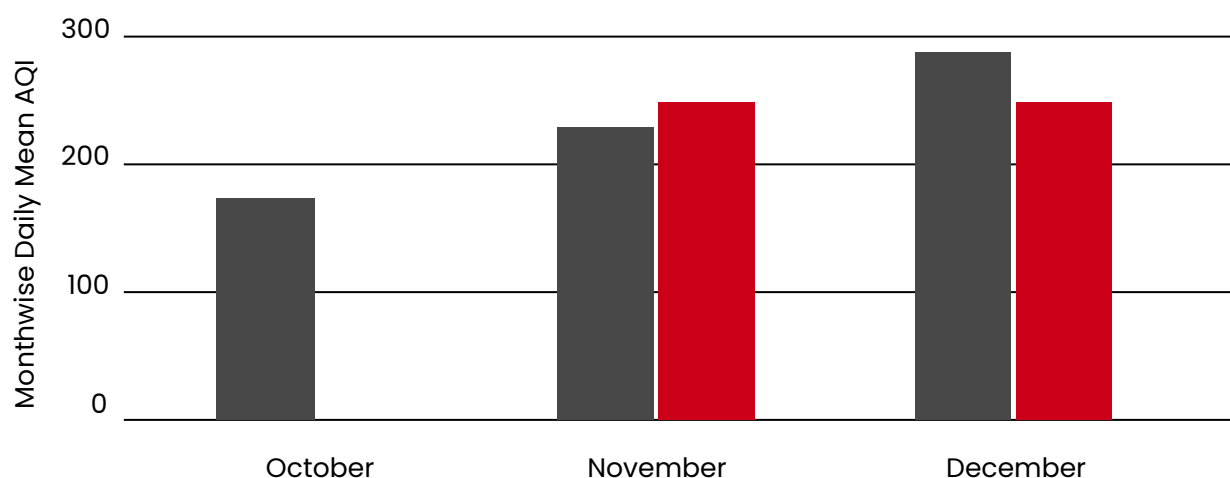
2. November saw a deterioration in air quality, with an AQI of 293, reaching the "poor" category. This indicates a health alert, with a heightened likelihood of adverse effects for the entire population.

3. Despite a slight improvement, December's AQI remained in the "poor" category at 251. While better than November, it still indicates significant health concerns.

4. The data suggests a fluctuation in air quality levels during the three months, with November experiencing the highest level of pollution.

5. As per the Central Pollution Control Board (CPCB) categories, AQI values determining the potential impact on health, maintained the "poor" status.

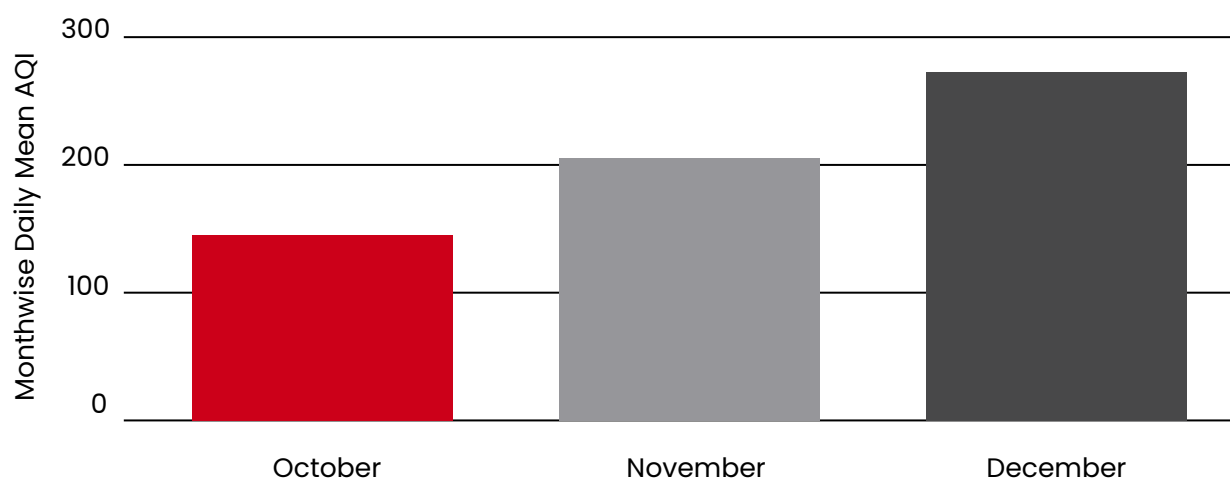
DURGAPUR MONTHWISE DAILY MEAN AQI



MONTHWISE DAILY AQI

1. Nepalipara Hindi High School's air quality increased over three months: starting at a moderate level (AQI 170) in October, worsening to unhealthy (AQI 220) in November, and reaching very unhealthy levels (AQI 294) in December.
2. DAV Model School Durgapur consistently experienced poor air quality in November and December, with AQI values of 235 for both months. The specific AQI for October is not provided.
3. Interpretation is based on the Central Pollution Control Board (CPCB) air quality categories, highlighting the progression from acceptable to potentially harmful air quality levels at Nepalipara Hindi High School, and the consistently unhealthy levels at DAV Model School Durgapur in the later months.

BARDHAMAN MONTHWISE DAILY MEAN AQI



1. Shemford Futuristic School experienced a progression in air quality over three months.

2. Starting with a moderate AQI of 142 in October, the air quality deteriorated to a poor level (AQI 208) in November.

3. By December, the air quality worsened further to an AQI of 266 (poor AQI), indicating potential health effects for everyone and heightened risks for sensitive groups.

• AQI CATEGORY DAYS COMPARISON

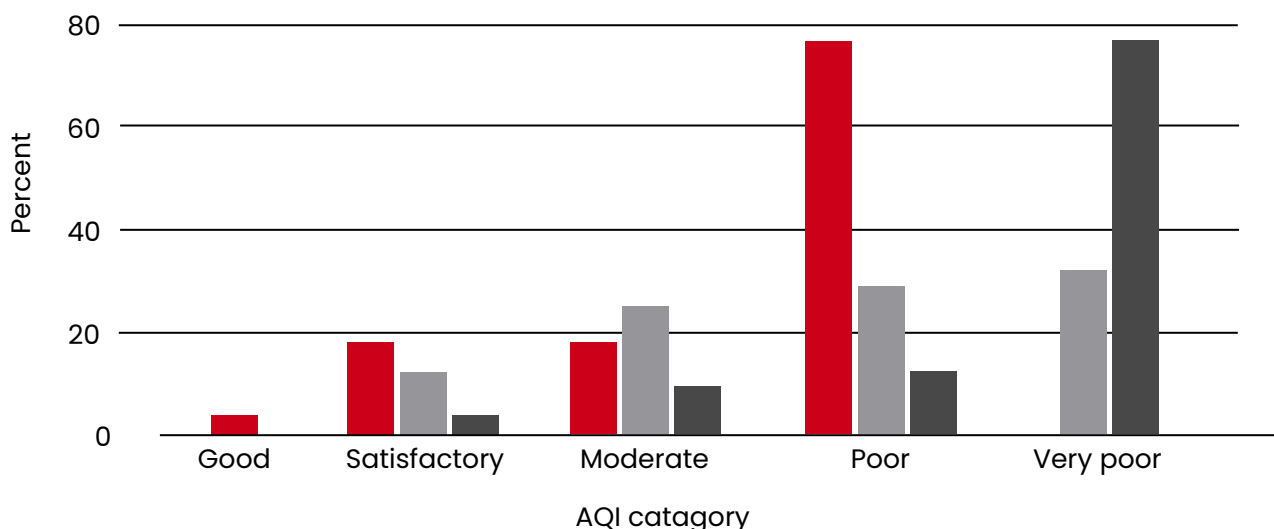
The **CPCB** categorizes air quality based on AQI levels in cities. Ranging from **0 to 50**, it signifies good air quality with minimal health impact. Satisfactory levels (**51-100**) may cause minor breathing discomfort for sensitive individuals. Moderate **AQI (101-200)** brings discomfort to people with heart or lung issues, children, and older adults. **Poor AQI (201-300)** leads to breathing discomfort on prolonged exposure, while **very poor AQI (301-400)** indicates respiratory illness risks. **Severe AQI (>401)** poses respiratory effects, even for healthy individuals. This categorization helps communicate the varying health implications associated with different air quality levels.

AQI Category	AQI	Concentration range*							
		PM ₁₀	PM _{2.5}	NO ₂	O ₃	CO	SO ₂	NH ₃	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 200	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	201 - 300	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 - 400	301 - 400	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 - 1800	3.1 - 3.5
Severe	401 - 500	401 - 500	250+	400+	748+*	34+	1600+	1800+	3.5+

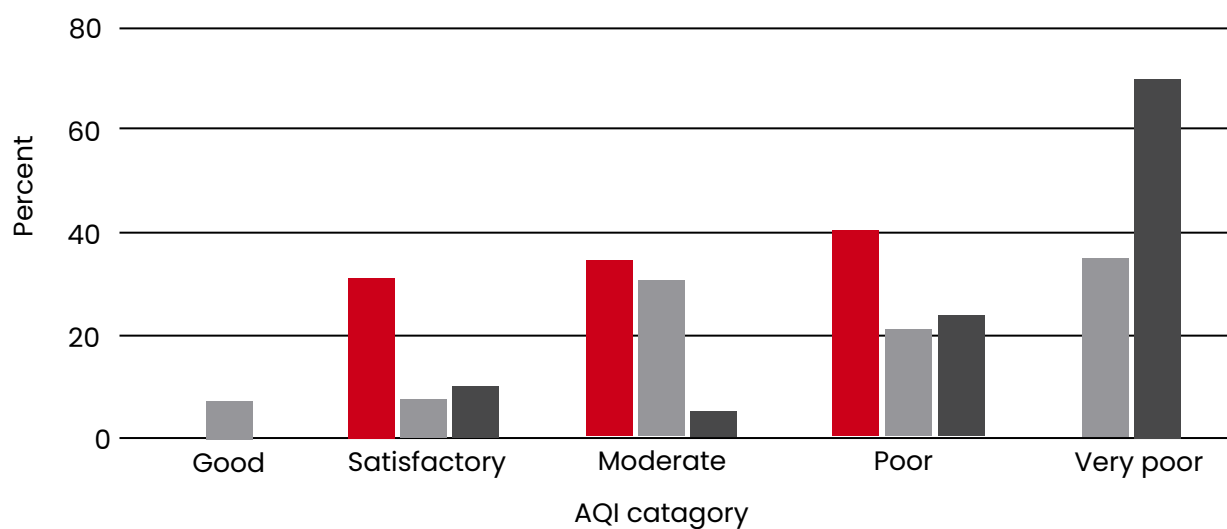
* CO in mg/m³ and other pollutants in µg/m³; 2h-hourly average values for PM₁₀, PM_{2.5}, NO₂, SO₂, NH₃, and Pb, and 8-hourly values for CO and O₃.



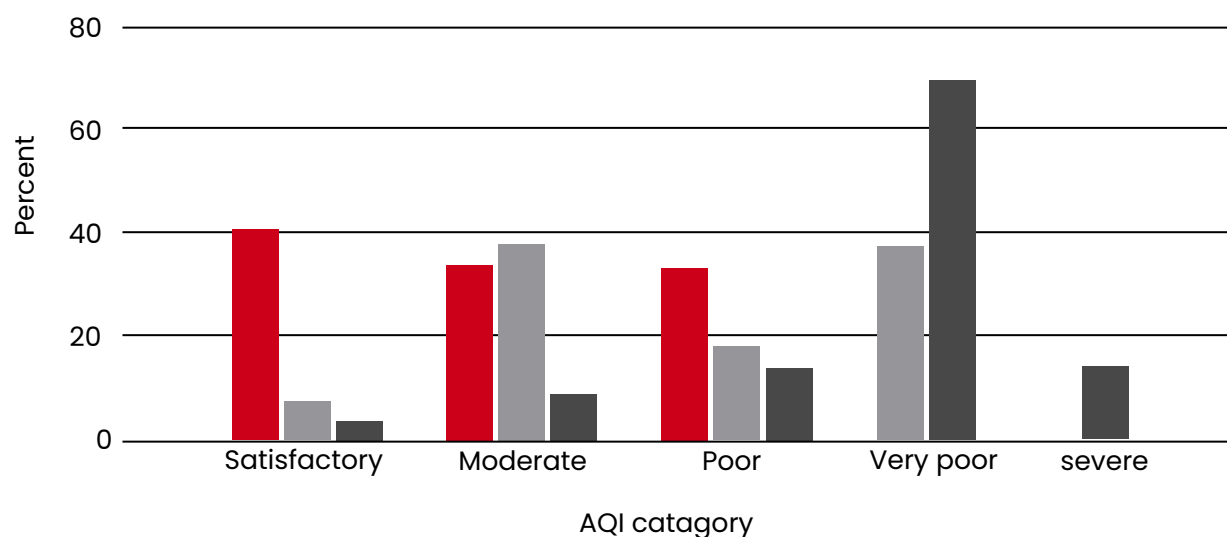
AIR QUALITY DAYS: KENDRIYA VIDYALAYA 2 SALT LAKE



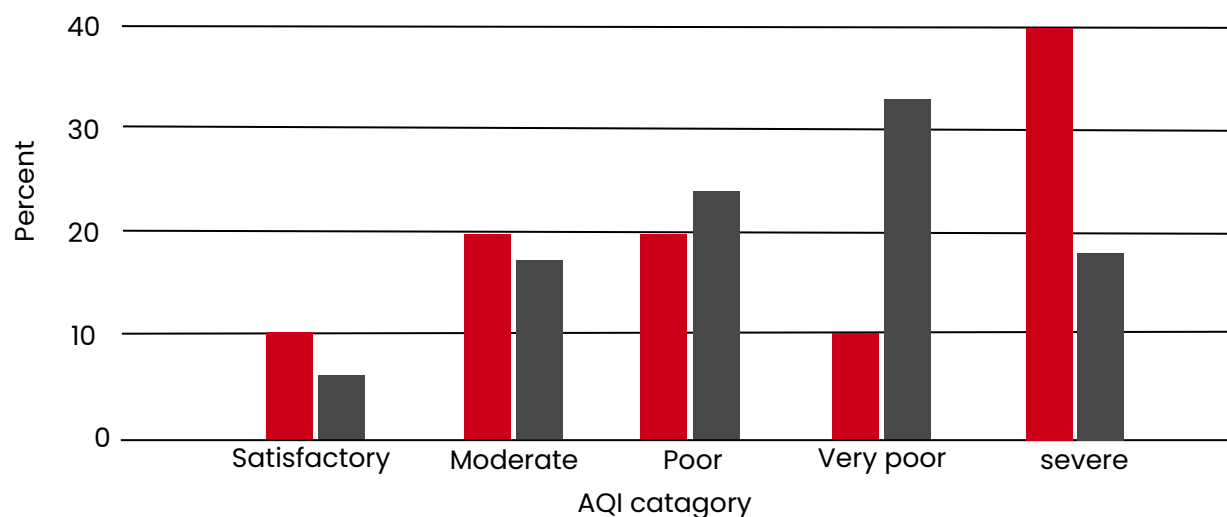
AIR QUALITY DAYS: SRI SRI ACADEMY, KOLKATA (SSA)



AIR QUALITY DAYS: TITAGARH AGM HIGH SCHOOL



AIR QUALITY DAYS: DOUGLAS MEMORIAL HIGHER SECONDARY SCHOOL



1. In October, Kendriya Vidyalaya No.2 Saltlake had predominantly poor air quality days (71%), while Sri Sri Academy had a balanced distribution between moderate (30%) and poor (40%) days.

2. Titagarh AGM High School experienced a mix of moderate (30%) and poor (30%) air quality days, and Douglas Memorial Higher Secondary School exhibited a mix of moderate (20%) and poor (20%) days, along with a significant presence of severe days (40%).

3. In November, Sri Sri Academy and Titagarh AGM High School witnessed a notable increase in very poor air quality days, reaching 37% and 38%, respectively.

4. Douglas Memorial Higher Secondary School faced an increase in very poor (33%) and severe (19%) air quality days in November.

5. In December, there was a significant shift towards very poor air quality for Kendriya Vidyalaya No.2 Saltlake (73%) and a further increase in very poor air quality for Sri Sri Academy (68%) and Titagarh AGM High School (66%).

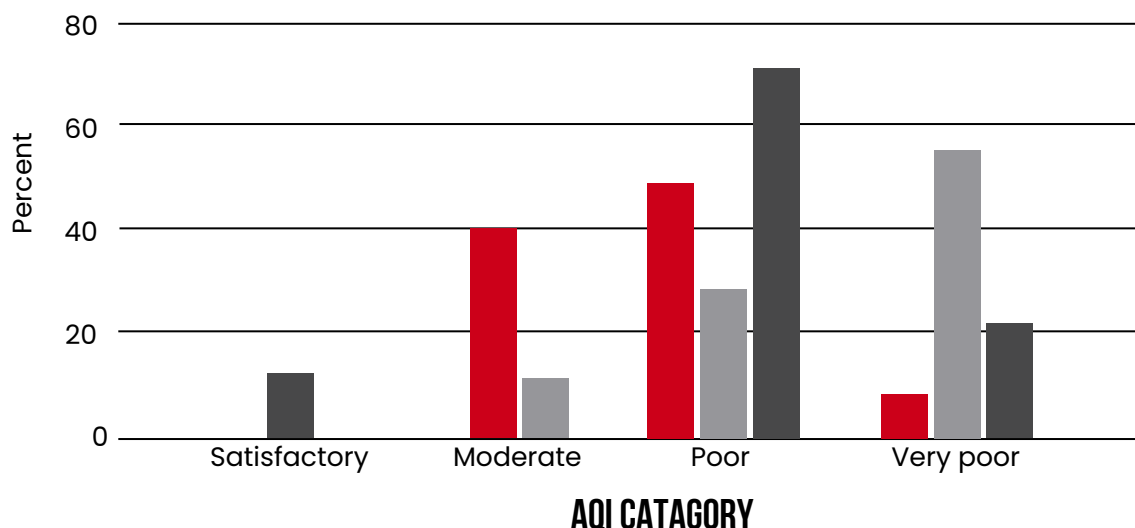
6. The findings underscore the variability in air quality across schools and highlight challenges faced by each in maintaining satisfactory conditions.

7. Continuous monitoring and intervention measures are crucial to address potential health impacts associated with poor and very poor air quality days, especially during the observed fluctuations over the three months.



ASANSOL

AIR QUALITY DAYS: KENDRIYA VIDYALAYA ASANSOL

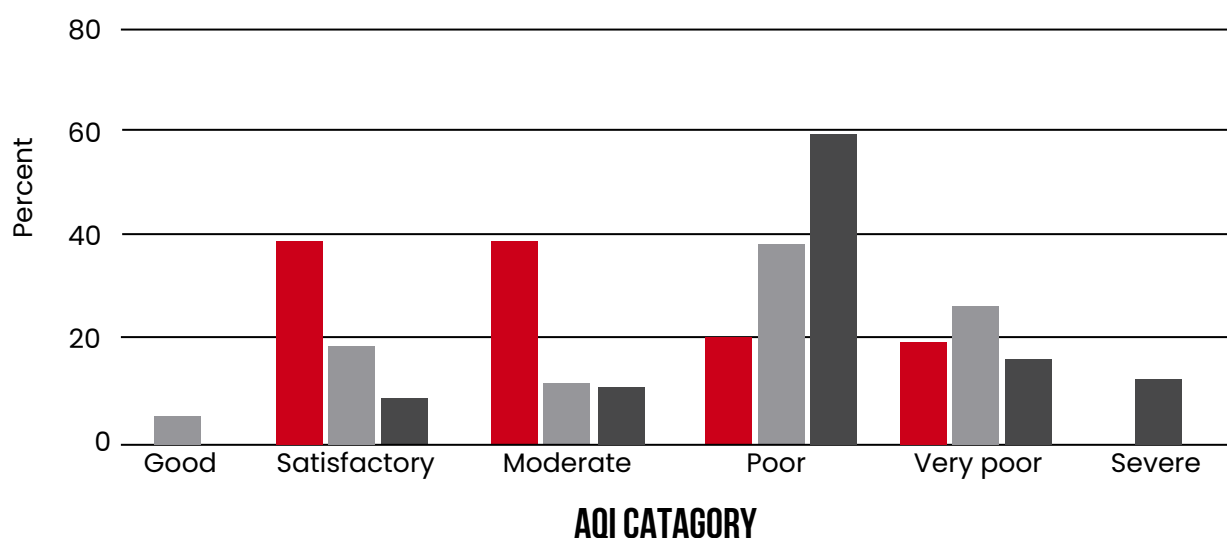


AS PER THE COLLECTED DATA FROM KENDRIYA VIDYALAYA ASANSOL-

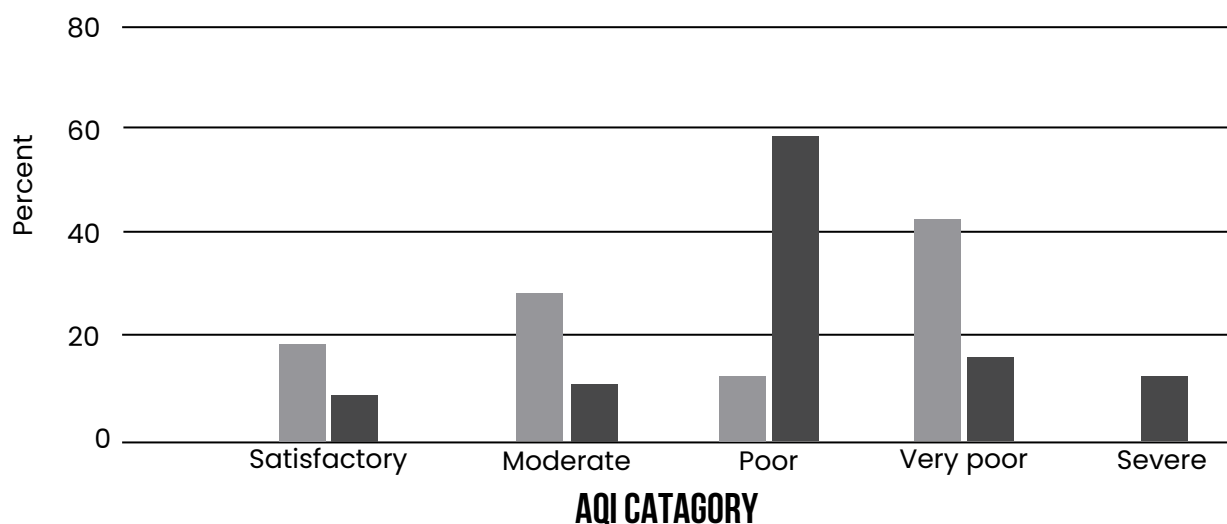
1. October experienced a balance between moderate (40%) and poor (50%) air quality days, with no days falling into the good, satisfactory, or severe categories.
2. November saw a notable increase in very poor air quality days (57%), alongside a considerable portion of days categorized as poor (29%). No days were classified as good, satisfactory, or severe.
3. December exhibited a majority of days with poor air quality (67%), indicating a potential deterioration in air quality. However, a slight improvement was observed, with 11% of days falling into the satisfactory category.
4. The data highlights fluctuations in air quality levels over the three months, emphasizing the dynamic nature of environmental conditions and the importance of ongoing monitoring and mitigation efforts.

DURGAPUR

AIR QUALITY DAYS: NEPALIPARA HINDI HIGH SCHOOL



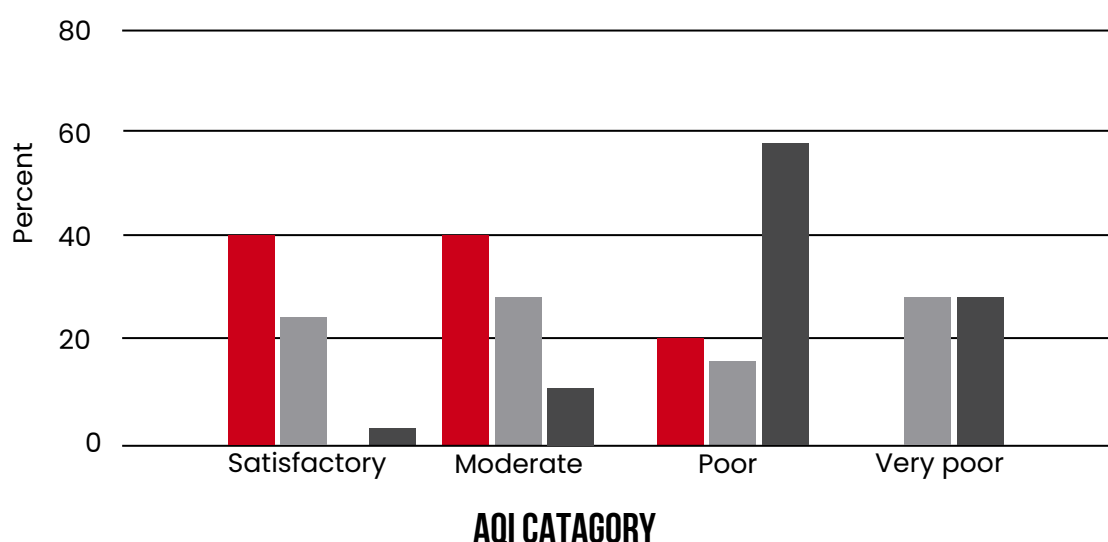
AIR QUALITY DAYS: DAV MODEL SCHOOL DURGAPUR



1. Nepalipara Hindi High School predominantly had satisfactory air quality in October (40%), while DAV Model School Durgapur had a mix of moderate (29%) and satisfactory (14%) days.
2. In November, both schools faced a decline in air quality, with Nepalipara Hindi High School experiencing an increase in very poor air quality days (25%) and DAV Model School Durgapur encountering a significant proportion of very poor days (43%).
3. December posed challenges for both schools, with Nepalipara Hindi High School witnessing a substantial decline in air quality (58%), and DAV Model School Durgapur maintaining a similar trend from November (58%).
4. Both schools had severe air quality days in December, highlighting potential health impacts and the need for intervention measures.
5. The comparison underscores the dynamic nature of air quality conditions and emphasizes the importance of continuous monitoring and proactive measures to address deteriorating air quality.

BARDHAMAN

AIR QUALITY DAYS: SHEMFORD FUTURISTIC SCHOOL



1. In October, Shemford Futuristic School, Barddhaman, exhibited generally favourable air quality with **40%** of days falling into both the satisfactory and moderate categories, while there were no days categorized as good or very poor.

2. November revealed a more varied distribution, witnessing a decrease in satisfactory and moderate days and an increase in both poor (19%) and very poor (29%) air quality days.

3. December marked a significant deterioration, with a majority of days (58%) falling into the poor category and a notable presence of very poor air quality days (29%).

4. The absence of severe air quality days in all three months indicates mitigation of extreme conditions.

5. Continuous monitoring and proactive measures are deemed crucial to address the increase in poor and very poor air quality days observed in the later months and ensure a healthier environment for the school community.



C. SCHOOL DAYS AND NON-SCHOOL DAYS COMPARISON

The Air Quality Index (AQI) displays variations over time, with fluctuations observed on daily, weekly, and monthly scales. Weekdays and weekends emerge as distinct periods, demonstrating significant differences in air quality. Weekends exhibit a consistent trend of worsening air quality. Analysis of collected data reveals this pattern, notably in the Sri Sri Academy region, where weekend average **AQI rose from 202 to 222** in **October-November**. Similar trends were observed in schools like Sri Shikshayatan and Birla High School at Mukundapur. In December, Titagarh AGM High School experienced an increase in weekend average **AQI from 253 to 301**, emphasizing the need for targeted interventions during weekends to enhance overall air quality management efforts. A similar trend was followed by the other AQI monitors from the rest of the cities in Bengal.

OBSERVATIONS

- The analysis of the school-based daily mean Air Quality Index (AQI) in Kolkata, Asansol, Durgapur, and Barddhaman reveals a concerning deterioration over three months. Schools experienced fluctuating AQI levels, with increased pollution during weekends. Kolkata's suburbs faced heightened concerns. Continuous monitoring and interventions are crucial, underscoring the dynamic nature of environmental conditions, and necessitating proactive measures for healthier school environments in Bengal.
- The findings unveil distinct air quality patterns across schools in Kolkata, Asansol, Durgapur, and Barddhaman, reflecting a dynamic scenario with significant fluctuations in AQI values over three months. Notably, the suburbs and industrial zones exhibit heightened air quality concerns compared to city cores. Possible reasons for these variations encompass localized factors such as industrial emissions, meteorological conditions, geographical disparities, and seasonal influences. Moreover, the categorization of AQI levels underscores the potential health impacts associated with different air quality conditions. The data suggests a need for continuous monitoring, intervention measures, and city-specific strategies to mitigate pollution and ensure a healthier environment for school communities.
- The findings across Bengal's schools indicate a concerning long-term deterioration in air quality, particularly in Kendriya Vidyalaya No.2 Salt Lake and Sri Sri Academy. Acute health risks are evident in schools like Douglas Memorial Higher Secondary School, emphasizing the need for immediate intervention. Suburban schools, notably in industrial zones, exhibit higher pollution levels than city cores. The sensitivity of air quality to seasonal changes is highlighted, with a shift to potentially unhealthy levels during winter. Weekends consistently show worsened air quality trends, necessitating targeted interventions. Continuous monitoring and region-specific strategies are imperative to address public health concerns effectively.
- The findings underscore the critical need for tailored air quality management policies in Bengal's schools. Targeted interventions could include stricter industrial emissions control measures, enhanced public awareness campaigns, and specific regulations for construction activities during weekends. Implementing stringent pollution monitoring mechanisms and promoting green practices in industrial zones may mitigate suburban air quality concerns. Collaborative efforts between educational institutions, local authorities, and environmental agencies are crucial for crafting effective policies that address the dynamic nature of air quality conditions, ensuring a healthier environment for students and communities.

RECOMMENDATIONS

The comprehensive recommendations for stakeholders in West Bengal aim to address the escalating air quality crisis in the region:

- 1. Government Intervention:** Enforce stringent industrial emissions controls, tailor regulatory frameworks to specific regions, allocate resources for continuous air quality monitoring, and promote transparent data-sharing for timely interventions.
- 2. Educational Initiatives:** Foster collaboration between educational institutions, environmental organizations, and government agencies for on-site air quality monitoring. Integrate air quality awareness into school curricula, educate students on the health impacts of pollution, and implement eco-friendly practices within school campuses.
- 3. Community Engagement:** Encourage active community participation in initiatives targeting local pollution sources. Advocate for strict regulations on industrial emissions, support awareness campaigns, and promote sustainable lifestyle choices to mitigate overall pollution.
- 4. Environmental Collaboration:** Expand independent air quality monitoring initiatives, collaborate with schools, local authorities, and communities for awareness campaigns, and provide technical expertise and resources for targeted intervention strategies.
- 5. Corporate Responsibility:** Encourage industries to invest in emission-reducing technologies, adopt sustainable practices, collaborate with regulatory bodies and environmental groups, and implement corporate social responsibility initiatives focused on environmental conservation. These collective actions will contribute to a comprehensive strategy for improving air quality in West Bengal, considering the diverse challenges across regions and communities.

LIMITATIONS

The report faced notable limitations, including disruptions and unavailability of data during collection, institutions turning off monitors post-school hours, and technical glitches.

To address this, percentage representation was adopted for an overview. A proactive approach, such as vigilant monitoring, consistent support for monitors, and increased monitor deployment, is essential. Allocating additional funds emerges as a crucial step, in enhancing infrastructure and maintenance. This financial investment would bolster the reliability of air quality data, providing a stronger foundation for decision-making and targeted interventions.



CONCLUSION

The report underscores the severe air quality challenges faced by West Bengal, particularly in its cities and industrial zones during the winter months. Kolkata, despite its stature, remains the world's second-most polluted city, necessitating urgent and targeted interventions. The findings reveal a concerning deterioration in air quality across schools, emphasizing the need for continuous monitoring and strategies.

WAY FORWARD

The recommendations advocate for a collaborative approach involving government intervention, educational initiatives, community engagement, environmental collaboration, and corporate responsibility to address the complex and dynamic nature of air quality issues. Implementing these measures collectively will contribute to a comprehensive strategy for mitigating the escalating air pollution crisis in West Bengal.

The report highlights urgent air quality challenges in West Bengal, emphasizing the need for collaborative strategies. Moving forward, stakeholders must enforce strict industrial emissions controls, integrate air quality awareness in education, engage communities for pollution mitigation, expand independent monitoring initiatives, and encourage corporate responsibility. A comprehensive approach, involving government, education, communities, environmental collaboration, and corporate sectors, is essential for effective and sustained improvement in air quality across the region.

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