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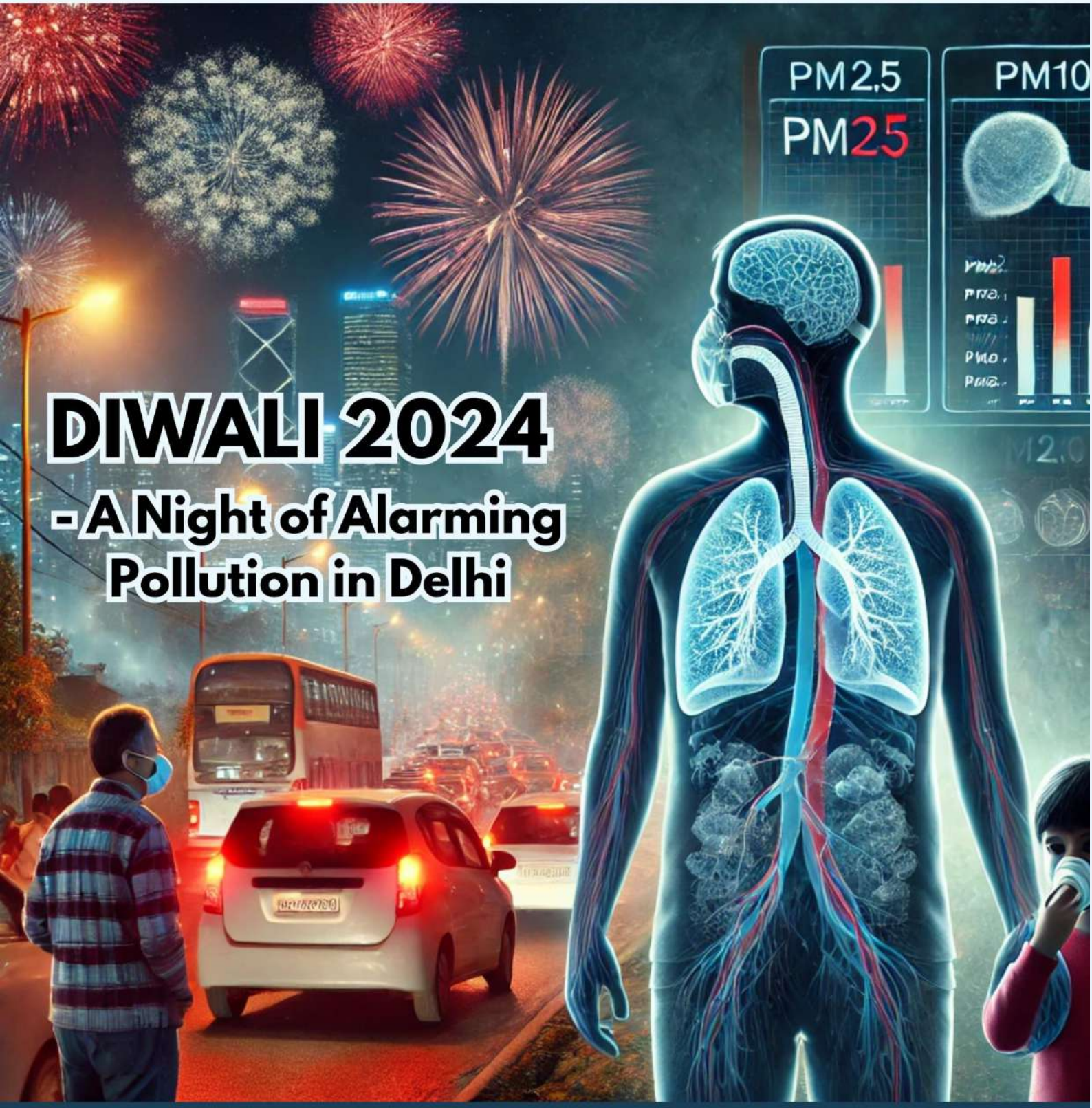

DIWALI 2024
-A Night of Alarming Pollution in Delhi

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EDITORIAL

The celebration of Diwali, a symbol of joy and tradition, also brings a concerning rise in air pollution due to extensive use of fireworks. Studies indicate that post-Diwali, PM2.5 levels often reach hazardous levels, exceeding safe limits multiple times over. Fireworks release a cocktail of harmful pollutants, including sulphur dioxide, carbon monoxide, and particulate matter laden with toxic metals like cadmium and lead. These pollutants not only degrade air quality but also pose severe health risks, triggering respiratory ailments, cardiovascular diseases, and worsening conditions like asthma and bronchitis.

Children, the elderly, and individuals with pre-existing health issues are particularly vulnerable to the harmful effects of post-Diwali pollution. Reports highlight increased emergency hospital visits due to breathing difficulties, eye irritation, and cardiovascular stress. The growing awareness around the environmental and health impacts of fireworks calls for stricter regulations, eco-friendly alternatives, and public participation in adopting sustainable celebrations. As we embrace the festive spirit, it is imperative to strike a balance between tradition and environmental responsibility to safeguard public health and ensure cleaner air for future generations.

Diwali 2024 - A Night of Alarming Pollution in Delhi

Source: https://www.cseindia.org/post-diwali-briefing.pdf

The night of Diwali 2024 marked an extreme episode of air pollution in India's capital, Delhi, as festivities unleashed an intense wave of toxic air that reached apocalyptic levels by midnight. The analysis of air quality data reveals a concerning pattern of pollution buildup, peak exposure, and subsequent partial relief—providing insights into the city's ongoing struggle with air quality during the festival season.

1. Pre-Diwali Pollution Build-up

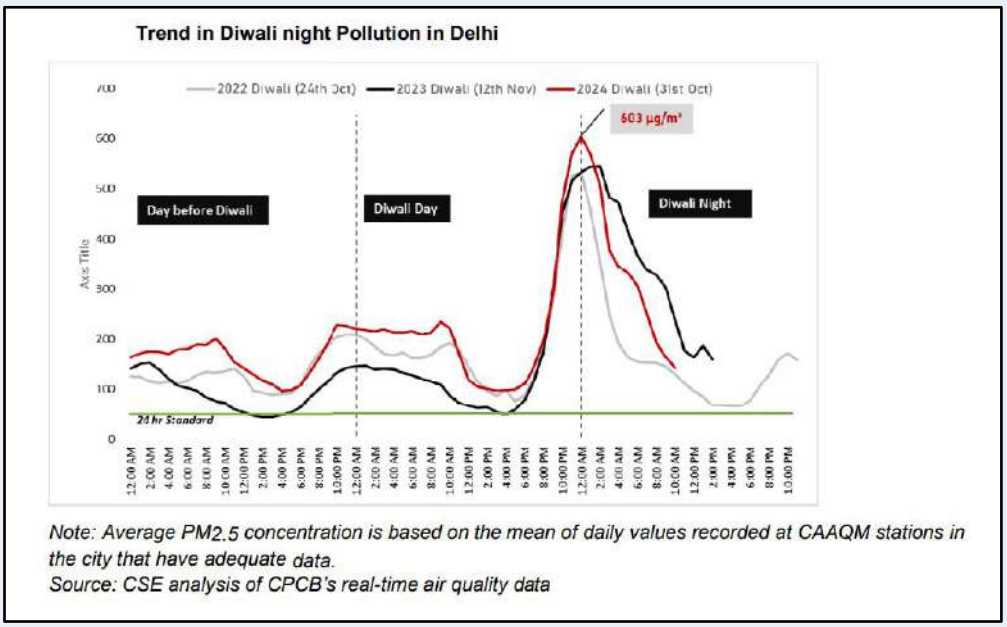
The days leading up to Diwali saw a steady rise in particulate matter levels as emissions from various sources compounded.

- **Escalating Trends:** A continuous 46% increase in PM2.5 concentrations was observed between October 28 and October 31. Factors such as vehicular traffic, construction activities, and seasonal biomass burning contributed to this build-up.
- **Firecracker Impact:** The evening of Diwali intensified the pollution further, as large-scale bursting of firecrackers added significant particulate and gaseous pollutants to the already burdened atmosphere.

2. Midnight Peak: Alarming Pollution Levels

The pollution peaked at unprecedented levels on Diwali night, with PM2.5 concentrations reaching their peak around midnight.

- **Health Implications:** The air quality exceeded safe limits by nearly 10 times, creating hazardous conditions for residents.
- **Geographic Variability:** While PM2.5 levels were severe citywide, hotspots such as Nehru Nagar, Anand Vihar, and Wazirpur recorded near-critical levels close to 1,000 µg/m^3, demonstrating the localized intensity of the pollution crisis.

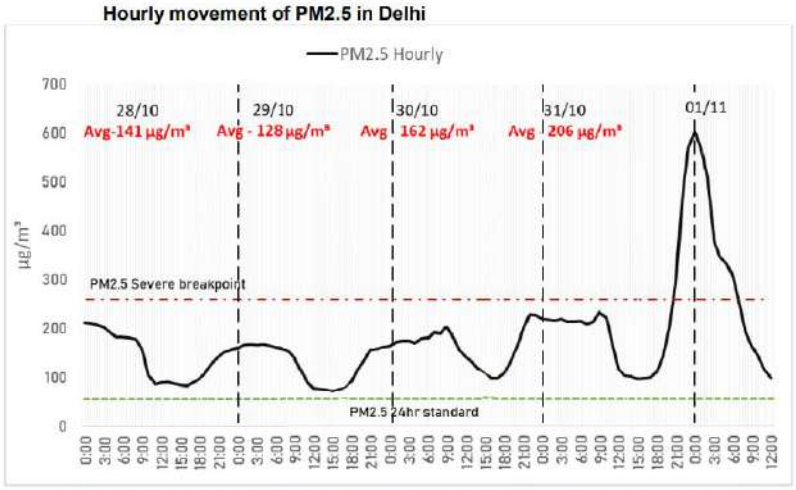


Note: Average PM2.5 concentration is based on the mean of daily values recorded at CAAQM stations in the city that have adequate data.
Source: CSE analysis of CPCB's real-time air quality data

3. Post-Diwali Air Quality Trends

While the pollution surge subsided relatively quickly after its midnight peak, the morning air on November 1 still bore the remnants of the previous night's emissions.

- **Morning Easing:** By noon on November 1, PM2.5 levels dropped to moderate levels, aided by favourable meteorological conditions such as higher temperatures and active wind patterns.
- **Partial Reprieve:** Night-time levels on November 1 showed a slight decline compared to Diwali night, reflecting improved atmospheric dispersion.



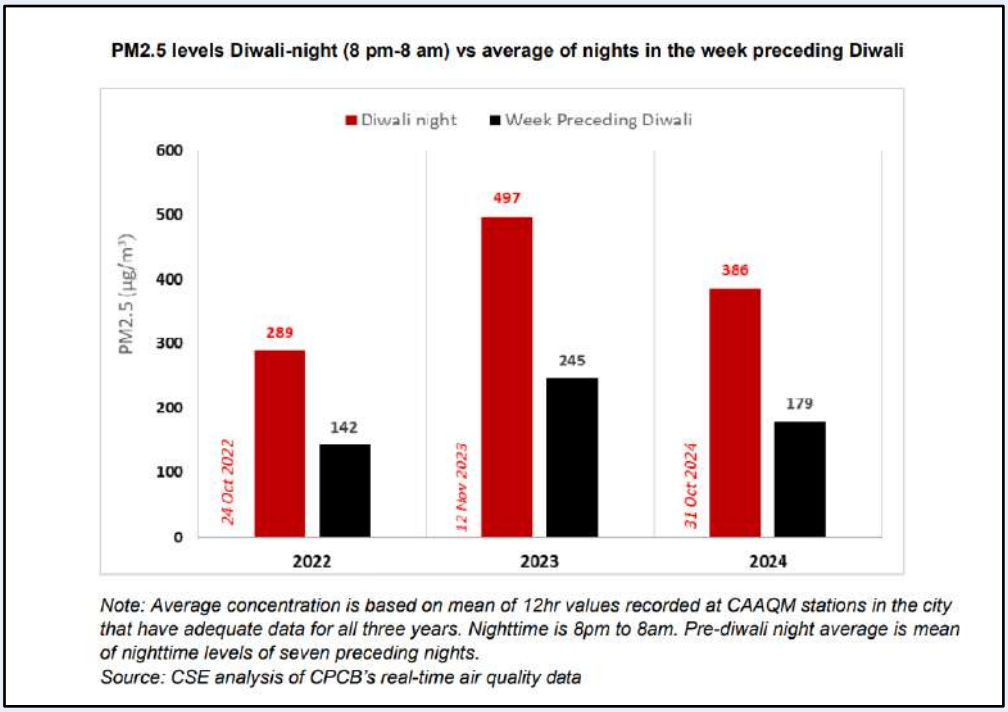
Note: Average PM2.5 concentration is based on the mean of daily values recorded at CAAQM stations in the city that have adequate data. 24-hr average is based on midnight to midnight.
Source: CSE analysis of CPCB's real-time air quality data

Graph 2: PM2.5 levels Diwali-night (8 pm-8 am) vs average of nights in the week preceding Diwali

4. Daytime vs. Night-time Trends

Daytime pollution on Diwali day saw a substantial increase compared to previous years, with PM2.5 levels nearly doubling.

- **High Local Activity:** Increased traffic, market congestion, and early cracker-bursting led to elevated pollution during daylight hours.
- **Night-time Dominance:** The stark contrast between daytime and night time pollution emphasized the significant contribution of Diwali festivities to overall air quality deterioration.

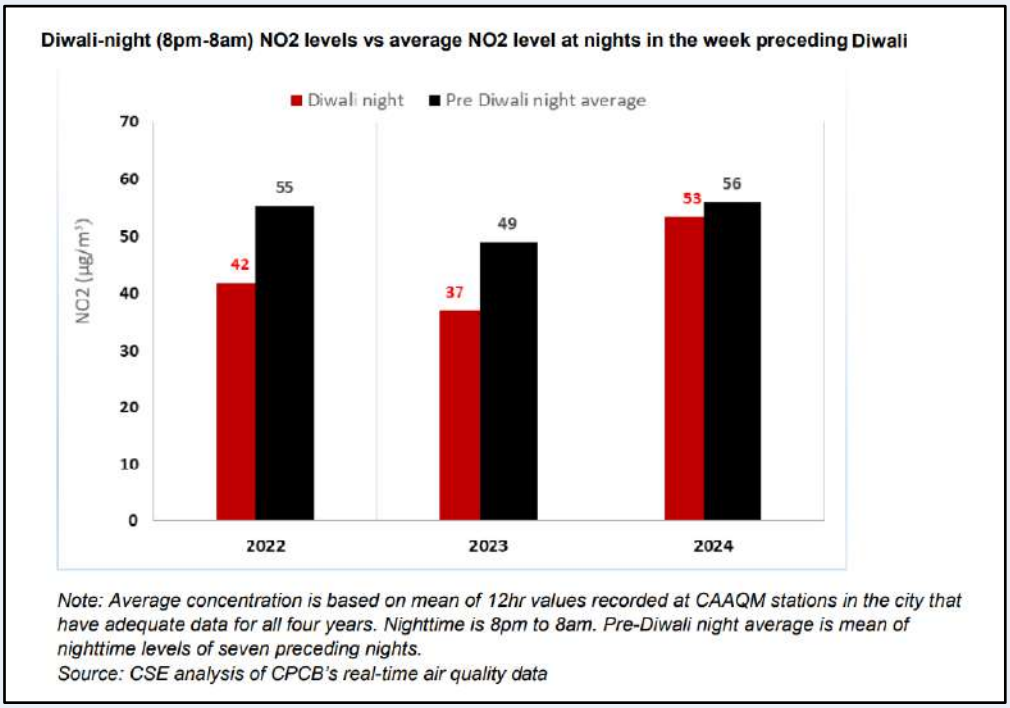


Note: Average concentration is based on mean of 12hr values recorded at CAAQM stations in the city that have adequate data for all three years. Nighttime is 8pm to 8am. Pre-diwali night average is mean of nighttime levels of seven preceding nights.
Source: CSE analysis of CPCB's real-time air quality data

5. Nitrogen Dioxide (NO_2) Spikes:

Beyond particulate matter, NO_2 levels during Diwali highlighted the impact of traffic-related emissions.

- **Congestion Hotspots:** Areas like ITO, JLN Stadium, and Patparganj recorded the highest NO_2 concentrations, underscoring the role of vehicular emissions during the festival rush.
- **Relatively Clean Areas:** Locations such as Lodhi Road, with less traffic and more green cover, recorded minimal NO_2 levels, pointing to the role of urban planning in mitigating pollution.

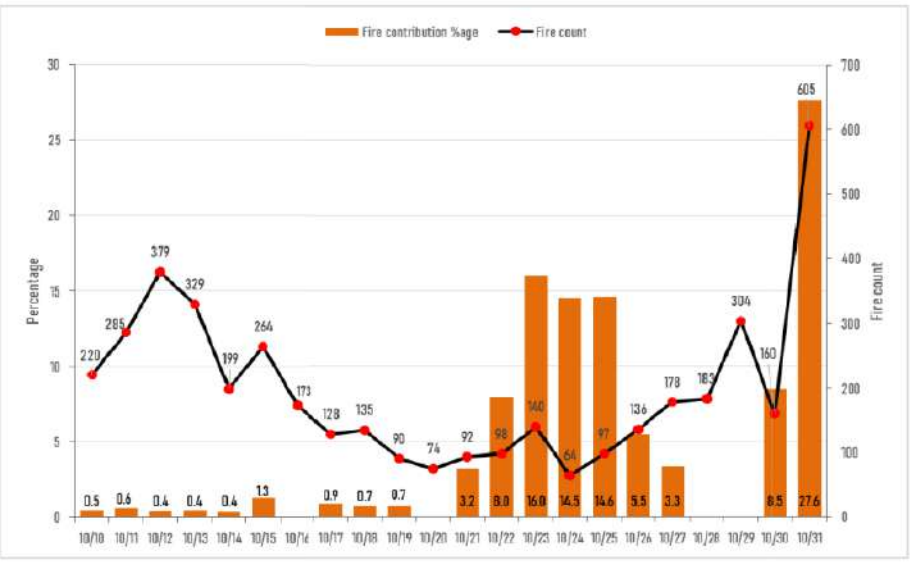


Note: Average concentration is based on mean of 12hr values recorded at CAAQM stations in the city that have adequate data for all four years. Nighttime is 8pm to 8am. Pre-Diwali night average is mean of nighttime levels of seven preceding nights.
Source: CSE analysis of CPCB's real-time air quality data

6. Role of Farm Fires

Stubble burning in nearby states played a critical role in amplifying Delhi's pollution on Diwali night.

- **Sharp Increase in Fires:** Farm fire counts in Punjab, Haryana, and Uttar Pradesh surged dramatically from October 30 to October 31, with Punjab contributing the largest share.
- **Transported Emissions:** North-westerly winds carried smoke from these fires into Delhi, layering an additional source of particulate pollution on top of local emissions.



Note: Farm stubble fire smoke contribution to Delhi's PM2.5 level is based on the SAFAR India publication and Farm stubble fire count data is based on the IARI data. Data from October 10- 31, 2024.
Source: CSE analysis based on the IARI and SAFAR data.

7. Favourable Meteorological Conditions

Unlike previous years, the meteorological conditions during Diwali 2024 were more favourable for pollution dispersion.

- **Warmer October:** Higher-than-average temperatures prevented the formation of dense inversion layers, which typically trap pollutants closer to the ground.
- **Active Winds:** Enhanced wind speeds facilitated quicker dissipation of pollutants, offering temporary relief from smog.

8. Regional and Local Contributions

The interplay between local emissions and regional pollution sources became evident during Diwali.

- **Local Emissions Dominate:** Despite the impact of farm fires, the majority of Delhi's pollution was driven by local activities, including firecrackers, traffic, and industrial emissions.
- **Urgent Need for Coordination:** The spike in pollution highlighted the need for collaborative action between Delhi and neighbouring states to address stubble burning and other regional pollution sources.

9. Long-Term Implications

While favourable weather provided temporary relief, the episode underscored the persistent vulnerability of Delhi's air quality to seasonal and activity-based pollution spikes.

- **Winter Smog Threat:** As atmospheric conditions cool and inversion layers develop, pollution is expected to worsen in the coming weeks.
- **Policy Imperatives:** Long-term solutions must focus on strict enforcement of firecracker bans, improved traffic management, promotion of clean energy alternatives, and regional coordination to address crop residue burning.
- **Local Sources Dominate:** Despite a smaller share of pollution from farm fires compared to previous years, local sources such as vehicular emissions, construction dust, and industrial pollution played a dominant role in air quality deterioration. This underscores the need for stricter control measures targeting local emissions.
- **Traffic Management:** Improved traffic flow and reduced congestion during festivals could significantly lower NO_2 levels and particulate pollution.
- **Firecracker Regulations:** Strict enforcement of firecracker bans or eco-friendly alternatives is essential to curb pollution spikes during Diwali.
- **Regional Coordination:** Collaborative measures across states to address stubble burning, including incentivizing alternatives for farmers, are vital to reducing seasonal pollution surges.

Diwali is known as the most famous festival. On the occasion of this festival, people burn crackers and sparkles to express their happiness. The burning of these fireworks leads to metal pollution in air. Metal concentrations in ambient air have been observed to be very high as compared to background values on previous days. Influence of these celebrations on the immediate and long-term air quality and impact on the health is a major area of concern.

Impact of Fireworks on Air Quality and Public Health During Diwali

Source: https://cpcb.nic.in/uploads/healthreports/Health-impact-assessment-of-fire-crackers-2017.pdf

Diwali, the Festival of Lights, is celebrated with grandeur across India. While traditionally centred around lighting lamps, prayers, and family gatherings, the modern celebration often includes the extensive use of fireworks. Though spectacular, fireworks pose serious environmental and health risks due to the release of toxic pollutants. These pollutants not only degrade air quality but also have immediate and long-term implications for public health.

The combustion of fireworks results in a sharp increase in ambient air pollutants, including:

1. Harmful Gases

- **Sulfur Dioxide (SO_2)**: A primary irritant to the respiratory tract, SO_2 can cause breathing difficulties and aggravate conditions like asthma.
- **Carbon Monoxide (CO)**: This odourless and highly toxic gas binds to haemoglobin 200 times more readily than oxygen, reducing the body's oxygen

supply. Prolonged exposure can cause headaches, nausea, and in severe cases, unconsciousness or death.

- **Nitrogen Oxides (NO_x)**: Less soluble than other gases, NO_x penetrates deep into the lungs, affecting the alveoli where gas exchange occurs. This can impair lung function and cause respiratory disorders.

2. Particulate Matter (PM)

- Fireworks produce **fine and ultrafine particulate matter** (PM_{10} and $PM_{2.5}$), which are small enough to be inhaled into the lungs. These particles may contain metals such as aluminium, cadmium, and manganese, making them highly toxic.
- Studies show PM levels during Diwali spike alarmingly, sometimes exceeding national air quality standards by 200–300%.

3. Heavy Metals

To create vivid colours and effects, fireworks are loaded with heavy metals and oxidizing agents. Some common additives include:

- **Lead and Cadmium**: Lead affects the central nervous system, causing mental retardation and brain damage in children. Cadmium damages kidneys and bones, leading to diseases like Itai-Itai.
- **Copper and Zinc**: Inhalation causes respiratory irritation and can lead to Wilson's disease in the case of copper. Zinc fumes are linked to vomiting and other gastrointestinal disturbances.
- **Manganese**: Long-term exposure results in neurological disorders, emotional instability, and physical weakness.

- **Sodium and Potassium Compounds**: When ignited, these compounds release toxic fumes, contributing to corrosive air pollution.

4. Oxidizers and Stabilizers

Chemicals like **potassium perchlorate**, **barium nitrate**, and **strontium salts** are used in fireworks to enhance performance. Their decomposition releases highly reactive and toxic compounds that linger in the air for days.

Health Impacts of Fireworks Pollution

Immediate Health Effects

Pollutants from fireworks can cause acute health problems, including:

1. **Respiratory Irritation**: Pollutants irritate airways, causing coughing, wheezing, and shortness of breath.
2. **Cardiovascular Stress**: Increased pollution levels can elevate heart rates and blood pressure, increasing the risk of cardiac events.
3. **Inflammation and Oxidative Stress**: Firework emissions produce reactive oxygen species (ROS), triggering inflammation in the lungs and reducing their capacity.

Long-Term Health Effects

Prolonged exposure to polluted air during Diwali contributes to chronic conditions, such as:

1. **Lung Diseases**: Includes bronchitis, asthma, emphysema, and COPD.
2. **Decreased Lung Function**: Airway damage accelerates lung aging and reduces breathing capacity.
3. **Cancer Risks**: Long-term inhalation of carcinogenic metals like cadmium and lead increases cancer susceptibility.
4. **Shortened Life Expectancy**: Persistent exposure to air pollution is linked to reduced life spans.

Specific Vulnerable Groups

Certain groups are more susceptible to the harmful effects of air pollution:

- **Children**: With developing lungs and immune systems, children are at higher risk of respiratory illnesses.
- **Pregnant Women**: Exposure to pollutants can harm foetus development and lead to complications.
- **Elderly and Individuals with Pre-existing Conditions**: Those with heart or lung conditions are particularly vulnerable.

Noise Pollution from Fireworks

Firecrackers emit sound levels far exceeding safe limits (typically 100–140 dB), resulting in:

- **Hearing Loss**: Prolonged exposure to high decibel levels can damage eardrums.

- **Psychological Effects**: Loud sounds cause stress, anxiety, insomnia, and irritability.
- **Behavioural Changes**: In children, excessive noise can lead to hyperactivity, restlessness, and impulsive behaviour.

Regulatory Action and Recommendations

Recognizing the hazards, the Hon'ble Supreme Court of India has intervened by suspending firework sales in Delhi and NCR. This directive aims to mitigate environmental damage and protect public health. However, individual responsibility is equally critical to minimizing harm.

Suggested Measures

1. **Promote Eco-Friendly Celebrations**: Shift to green alternatives like LED lamps and biodegradable decorations.
2. **Awareness Campaigns**: Educate the public on the health and environmental impacts of firecrackers.
3. **Support Sustainable Practices**: Encourage local artisans and eco-friendly products during Diwali.
4. **Implement Stricter Regulations**: Ensure compliance with air and noise pollution norms.

Fireworks are a common feature of festivals, weddings, and various celebrations, but their environmental and health impacts are significant. They release harmful pollutants, degrade air quality, and contribute to noise pollution, affecting vulnerable groups and long-term ecological balance.

To address these concerns, reducing the use of fireworks and embracing simpler, eco-friendly ways of celebration is essential. Responsible celebrations can preserve the joy of traditions while protecting the environment and public health for future generations.

All queries and feedback addressed to:

Environmental Information Awareness, Capacity Building & Livelihood Programme (EIACP)
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