

Local Topography and its Contribution to Air pollution

Mains: GS I - Geography

Why in News?

Recently, the air quality in Delhi slips into the “very poor” category, slow winds and dipping temperatures are further expected to push the capital towards an air emergency.

How south Asia acts as a global hotspot for air pollution?

- **Report** - According to the 2024 *World Air Quality report*, published by IQAir, India ranked the fifth most polluted country with an average PM_{2.5} concentration of 50.6 µg/m³.

IQAir is a Swiss company that creates a range of products for air quality management, including high-efficiency air purifiers with HyperHEPA technology and a global air quality monitoring platform called AirVisual

- **Most polluted countries** - Countries with higher pollution levels included
 - Chad (91.8 µg/m³),
 - Bangladesh (78.0 µg/m³),
 - Pakistan (73.7 µg/m³), and
 - The Democratic Republic of Congo (58.2 µg/m³).
 - Tajikistan and Nepal ranked 6th and 7th, respectively.
- This suggests that South Asia has become a global hotspot for air pollution, with many cities recording high AQIs (*Air quality index*), particularly during the winter months.
- **Status of India** - India's capital continues to grapple with worsening air pollution that has remained either in the 'severe' or 'very poor' category for several days now.
- On Monday (November 3), the PM_{2.5} concentration was measured at 168 µg/m³, far exceeding the World Health Organization (WHO) limit of 15 µg/m³ for 24 hours.

New Delhi was ranked the most polluted capital city, while 13 other Indian cities were among the top 20 most polluted cities worldwide.

- Moreover, air pollution can travel long distances and is therefore transboundary in nature.
- **Airsheds** - The World Bank has identified 6 'airsheds' in and around India, characterised by geographical and climatic factors through which the pollutants move.

- These airsheds are:
 - **West/Central Indo-Gangetic Plain** - Punjab (Pakistan), Punjab (India), Haryana, parts of Rajasthan, Chandigarh, Delhi, and Uttar Pradesh.
 - **Central/Eastern Indo-Gangetic Plain** - Bihar, West Bengal, Jharkhand, and Bangladesh.
 - **Middle India 1** - Odisha and Chhattisgarh.
 - **Middle India 2** - Eastern Gujarat and western Maharashtra.
 - **Northern/Central Indus River Plains** - Pakistan and parts of Afghanistan.
 - **Southern Indus Plain and further west** - Southern Pakistan and western Afghanistan, extending into the eastern portion of Iran.
- **Movement of pollutants** - During winters, when the wind moves from northwest to the southeast, pollutants also move across borders from Pakistan's Punjab to the Indian state of Punjab.
- Similarly, many cities in Bangladesh witness pollution that originated from India.

How local topography determines air quality?

- **Location** - Delhi lies in a bowl-shaped area within the Indo-Gangetic plains (IGP), bounded by the Himalayas to the north, the Aravalli hills to the south-west, and the Malwa and Deccan plateaus to the south.
- Such topography makes it harder for pollutants to disperse.
- The Himalayas block the northward dispersal of heavy and polluted winter air, forcing it to travel eastward across the northern plains before reaching the Bay of Bengal.
- **Role of monsoon** - Post-monsoon air is characterised by lower moisture levels, decreased temperatures and reduced wind speeds.
- During this time, pollutants are trapped near the ground, reducing their 'mixing height', the height up to which pollutants can disperse.
- During winters, temperature inversion conditions are also witnessed, when a layer of warm air sits over cold air and fog.
- This fog, when combined with the pollutants, becomes smog that further reduces visibility creates a phenomenon also referred to as *Turbidity island effect*.
- **Seasonal factors** - Agricultural stubble burning and firecrackers during festivals, further exacerbate the already degraded air quality.
- **Persistent factors** - Year-round drivers of air pollution include
 - Coal and biomass burning
 - Vehicular emissions
 - Industrial pollution
 - Brick kilns
 - Improper waste management,
 - Unregulated construction dust,
 - Deforestation and transboundary pollution.
- These sources of pollution also contribute to the public health crisis.

Why there is an urgent need to address air pollution?

- **Important factor of mortality** - According to the WHO, 99% of the global population lives in areas that do not meet recommended air quality standards.

Air pollution is now **the second leading risk factor** for death globally.

- **Effect on India** - The recently published Lancet Countdown on Health and Climate Change report estimates that in India 1.7 million deaths were caused by anthropogenic PM2.5 pollution in 2022, a 38% increase since 2010.
- The economic cost of these premature deaths stands at USD 339.4 billion, which translates to 9.5 per cent of the country's GDP.
- Notably, the Indo-Gangetic Plains are one of the most densely populated regions in the world.
- And Delhi's air quality fluctuates during winter, ranging between poor (201-300), very poor (301-400), severe (401-500), and sometimes even exceeding these levels.
- **Health issues** - Exposure to hazardous air exacerbates various health issues, including respiratory disorders like asthma and Chronic Obstructive Pulmonary Disease (COPD).
- Other issues include lung diseases, immune disorders, and cardiovascular diseases and sometimes even neurodevelopmental and mental health disorders and reduced cognitive development in children.
- **Effect on children** - Children have a relatively higher respiratory rate and breathe more air per unit of body weight than adults, which makes them more vulnerable than adults when exposed to the same environment.
- This increases the cost of healthcare, further hindering the country's productive capacity.
- It underlines the urgent need to tackle air pollution.

United Nations General Assembly declared access to a clean, healthy and sustainable environment, a universal human right.

What are the policy and technological responses?

- **GRAP** - Stage II of the Graded Response Action Plan (GRAP) to control air pollution is in force in Delhi.
- The GRAP, prepared in 2016, provides a framework for implementing targeted interventions under different AQI categories.
- **Scrapping of old vehicles** - In addition, the policy mandating the scrapping of 15-year-old petrol vehicles and 10-year-old diesel vehicles (originally directed by the National Green Tribunal in 2015) is now pending before the Supreme Court, awaiting a final verdict.
- **National Clean Air Programme (NCAP)** - It was launched in January 2019, aims to improve air quality in 131 cities through comprehensive monitoring, sectoral emission reductions, and public awareness initiatives.
- **Other measures** - The government has also introduced measures such as anti-smog guns, smog towers, a pilot cloud-seeding project, and curbs on the entry of commercial vehicles running BS III and BS IV engines.

What are the challenges?

- **Limitations of technology** – Measures such as anti-smog guns and smog towers have shown limited effectiveness.
 - For example, Cloud-seeding requires specific meteorological conditions, involves high costs, and covers a limited area, making it unsustainable for addressing current challenges.
- The unsuccessful attempt last month by the Delhi government in collaboration with IIT Kanpur demonstrates the limitations of such short-term, reactive approaches in addressing air pollution challenges.
- **Relaxing of crackers ban** – This year during Diwali, the Supreme Court also partially relaxed the total ban on firecrackers and allowed government-approved green crackers on a test case basis.
- However, the Delhi-NCR region recorded an AQI in the very poor to severe categories the morning after Diwali.
- **Missing of data** – Data from 28 of 39 functioning monitoring stations went missing during the Diwali night, indicating a serious data gap.
- Such instances highlight the need for a more proactive and even rights-based approach to tackle air pollution.

What lies ahead?

- The persistent exceeding of breathable air quality limits presents a serious public health emergency that demands a shift in approach from reactive to preventive strategies.
- It requires countries across South Asia to make coordinated, region-wide, broader policy frameworks.
- This can then be moulded to suit local and specific conditions where needed.
- There is also a need to invest more in clean public transport, cycling and pedestrian infrastructure.
- Coordinated policies for cleaner transportation, improved construction practices, increased renewable energy adoption, sustainable agriculture methods to reduce stubble burning, stricter emission controls, and their proper implementation are necessary.
- These measures are critical for protecting public health, sustaining economic growth, ensuring overall productivity and improving the quality of life.

Reference

[The Indian Express| Contribution of Local topography to air pollution](#)