Summer Air Pollution in Indian Cities

Mains: *GS III – Environment*

Why in News?

Recently, many parts of India are heavily affected by the summer air pollution.

How is summer air pollution different from winter pollution?

- **Winter Pollution –** It is primarily dominated by fine particulate matter (PM2.5), which originates from:
  - Vehicular emissions
  - Industrial activities
  - Biomass burning
  - Waste burning
  - Agricultural residue burning
  - Domestic heating requirements
- Meteorological conditions during winter prevent the dispersion of these pollutants, resulting in persistent smog.
- **Summer Pollution –** It is characterized mainly by:
  - PM10 (coarse particulate matter)
  - Ground-level ozone
- While vehicles, industries, construction activities, and waste burning remain year-round pollution sources, summer introduces additional factors:
- Dust storms increase PM10 concentrations.
- Intense sunlight and high temperatures accelerate ozone formation.
- Thus, the nature of summer pollution differs substantially from winter smog, requiring distinct mitigation strategies.

Why does ozone increase during hot weather?

Ozone
• It is a secondary pollutant formed through chemical reactions involving precursor gases. • Unlike particulate matter, ozone is not emitted directly into the atmosphere. • **Sources of Ozone Precursors – NOx and VOCs** • **Nitrogen Oxides (NOx)** - Mainly released from vehicles and industrial activities. • **Volatile Organic Compounds (VOCs)** - Emitted from vehicle exhaust. - Industrial processes. - Paints, solvents, and fuel combustion.

- **Role of Heat and Sunlight –** When NOx and VOCs interact in the presence of strong sunlight, photochemical reactions occur, producing ground-level ozone.
- Therefore, hotter and sunnier conditions during summer create an ideal environment for ozone formation.
- Ground-level ozone poses significant health risks, including:
    - Respiratory irritation
    - Reduced lung function
    - Aggravation of asthma
- Increased vulnerability to respiratory diseases
- Consequently, ozone has emerged as a major urban air quality concern during Indian summers.

What causes PM10 levels to spike during summer?

- **Regional Dust Transport –** During summer, intense heating over the Indian subcontinent creates a low-pressure area extending towards Iran.
- Interactions between this low-pressure zone and surrounding high-pressure systems generate strong winds across the region.
- These winds transport large quantities of dust from, West Asia and The Thar Desert
- The dust travels across northern India towards the Bay of Bengal, causing elevated PM10 concentrations that may persist for several days.
- The severe dust storms of 2018 in North India are a notable example of such long-range dust transport events.
- **Local Dust Storms (Andhi) –** India also experiences localized dust storms known as *andhi*.
- These storms occur when strong downdrafts associated with thunderstorms strike the ground, lifting loose dust particles into the atmosphere.
- Characteristics of andhi storms include:
    - Short duration
    - High intensity
    - Rapid deterioration in visibility
    - Sudden spikes in PM10 levels
- While loo-driven dust storms are common in North India, cities such as Mumbai and Hyderabad often experience dusty conditions associated with local thunderstorms.

What are the human activities and their contribution to summer air pollution?

- **Construction and Demolition Activities –** After winter restrictions under GRAP are lifted, construction and demolition work often resumes at full scale.
- Inadequate dust suppression measures at construction sites lead to significant emissions of particulate matter.
- **Road Dust Resuspension –** Dry summer conditions make dust accumulation on roads more likely.
- Movement of vehicles over broken or poorly maintained roads continuously resuspends dust particles into the atmosphere, increasing PM10 concentrations.
- **Vehicular Emissions –** Growing vehicle ownership contributes both directly and indirectly to pollution through:

    - Emission of NOx and VOCs.
    - Resuspension of road dust.
    - Traffic congestion and idling emissions.
- **Industrial Sources –** Industrial processes continue to emit particulate matter, NOx, and VOCs throughout the year, contributing significantly to both PM10 and ozone formation.
- Thus, natural and anthropogenic factors combine to create severe summer pollution episodes in Indian cities.

What measures could be taken to combat summer air pollution?

- **Strengthening Forecasting and Early Warning Systems –** Although natural dust storms cannot be prevented, their occurrence can be forecasted.
- Delhi's Air Quality Early Warning System (AQEWS), developed following the severe dust storms of 2018 and previous smog episodes, now provides:
    - Multi-pollutant forecasts.
    - Detailed meteorological information.
- Three-day Air Quality Index (AQI) forecasts for 140 Indian cities.
- The system has also been extended to cities such as Jaipur and Mumbai.
- Similarly, the India Meteorological Department (IMD) issues regular weather forecasts that can help authorities prepare for dust storms and pollution episodes.
- Governments should use these systems to issue timely public advisories and exposure warnings.
- **Improving Construction Dust Management –** Construction sites require continuous dust-control measures throughout the year, not only during winter.
- A study by the Council on Energy, Environment and Water (CEEW) found that reducing heavy vehicle movement at construction sites can significantly lower local particulate pollution levels.
- Mumbai's Air Quality Decision Support System (AQDSS), developed in collaboration with CEEW, has enabled authorities to monitor construction activities and take action against more than 1,000 sites since October 2025.
- **Controlling Ozone Precursors –** Reducing ozone formation requires lowering emissions of NOx and VOCs through:
    - Cleaner transportation systems.
    - Improved industrial compliance.
    - Regulation of paints and solvents.
    - Cleaner fuel combustion practices.
- Behavioural interventions can also help.
    - **For example,** Delhi's "Red Light On, Gaadi Off" campaign encourages drivers to switch off vehicle engines during traffic stops, reducing idling emissions that contribute to ozone formation.
- **Developing Comprehensive Summer Action Plans –** Delhi has implemented a *Summer Action Plan since 2022.*
- Plans among Indian cities should include, Air quality forecasting, Public health advisories, Dust storm preparedness, Construction dust control, Road dust management and Reduction of ozone-forming emissions.

What lies ahead?

- Summer air pollution is increasingly emerging as a serious environmental and public health challenge in Indian cities.
- Unlike winter pollution, which is dominated by PM2.5 and smog, summer pollution is characterized by elevated PM10 and ozone levels resulting from dust storms, intense heat, strong sunlight, and anthropogenic emissions.
- As climate change increases the frequency of heatwaves and extreme weather events, the risk of summer pollution episodes is likely to intensify.
- Therefore, Indian cities must adopt season-specific air quality management strategies, strengthen forecasting systems, control construction and road dust, and reduce emissions from vehicles and industries.
- Addressing summer air pollution with the same seriousness as winter smog is essential for safeguarding public health and ensuring sustainable urban development.

Reference

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