Recent study on PM2.5 in North India

Why in News?

A recent study published in the journal Nature Communications has investigated the sources and health impacts of PM2.5 in Northern India, particularly in the Indo-Gangetic Plain.

> *PM2.5 describes fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.*

- The study has examined PM2.5 composition and oxidative potential, a key indicator of its health risks.
- Comparative analysis shows that the oxidative potential of PM2.5 in Indian cities is among the ***highest globally***, exceeding levels in Chinese and European cities by ***up to five*** times.

> *Oxidative potential (OP) is a metric that measures the ability of particulate matter (PM) to create reactive oxygen species (ROS).*

- **Samples collected sites -** Urban and roadside locations in Delhi, rural and industrial peripheries, and a suburban site in Kanpur.
- **Causes - Local emission sources –** Local sources and atmospheric processes dominate particulate matter pollution.
    - In Delhi, PM2.5 is dominated by ammonium chloride and organic aerosols from vehicular emissions, residential heating, and fossil fuel oxidation
    - Outside Delhi, ammonium sulfate, ammonium nitrate, and biomass-burning-derived organic aerosols are more prominent.
- **Incomplete Combustion -** PM2.5 oxidative potential is primarily influenced by organic aerosols from incomplete combustion of biomass and fossil fuels, particularly from traffic, residential sources.
    - It is observed across all locations, emphasizing that inefficient local combustion is a major contributor to PM2.5-related health risks.
- **Vehicular tailpipe emissions -** Hydrocarbon-like organic aerosols originate from fresh vehicular tailpipe emissions.
    - The study found that the highest average hydrocarbon-like organic aerosols concentrations (8 micrograms per metre cube) were recorded at the urban roadside site in Delhi.
- Hydrocarbon-like organic aerosols are primarily from traffic and contribute ***up to 20%*** of total organic aerosols mass with higher relative contributions in the warm season.

- From 20%, the contribution from traffic can increase to 40% at urban roadside.
- In all, hydrocarbon-like organic aerosols ***constitute 50%*** of the total fossil (coal, petrol, diesel) organic aerosols.
- **Cow dung combustion** - During winter for heating and cooking contributes to cold-season primary organic aerosols.
- The cold-season primary organic aerosols are highly elevated during the night and exhibit spatially homogeneous contribution.
- Also, concentration of cold-season primary organic aerosols during cold weather are ***up to 10 times higher*** than during warmer weather.
- Urban oxygenated organic aerosols are affected by both fossil emissions from vehicle exhausts and non-fossil emissions from cooking, and have similar concentration levels across seasons.
- While hydrocarbon-like organic aerosols and urban oxygenated organic aerosols are especially important inside Delhi, cold-season oxygenated organic aerosol forms outside Delhi.
- The study provides crucial insights for policymakers to design effective air quality control strategies focused on reducing primary emissions from incomplete combustion.

Reference

The Hindu | Health effects of PM2.5 in northern India