ENVIS- IITM NEWSLETTER

The Air Quality: A Global Challenge

Urban Pollution & Urban Heat Island

Editorial
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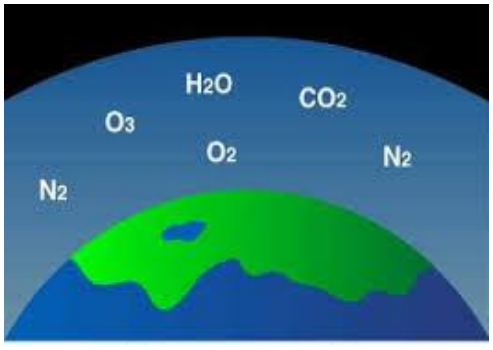
EDITORIAL

ENVIS-IITM centre deals with the very important and sensitive component of the environment "The Air we breathe" and related challenges. In our last series of newsletters under the heading "Air Pollution Chemistry" we have taken a brief knowledge of Earth system, interdependence of different components of environment, the atmosphere, air pollution, criteria air pollutants etc. Alteration in the natural composition of the air can harm not only the health of human being but also it affects the health of environment which will eventually end up with the imbalance in the functioning of Earth System resulting in to the local, regional and global challenges. ENVIS-IITM is introducing a new series "The Air Quality: A Global Challenge", where we will discuss about various local, regional and global impacts resulted due to the atmospheric pollution along with their causes and effects. In the earlier newsletters under this series we have covered the regional and global problems including Acid rain, Global warming and Ozone depletion along with its effects.

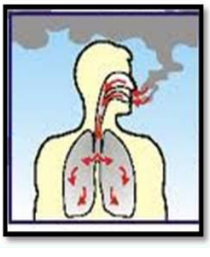
Present issue will deal with the problem of Urban Pollution and Urban Heat Island (UHI), its causes and effects. We hope our attempt to convey complicated scientific information in simple language will help to create awareness amongst the common public which is the first step towards safeguarding our environment.

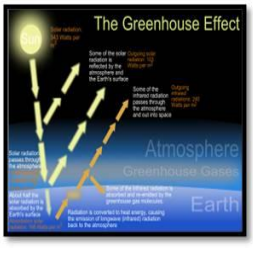
Inside the Issue

What is Air Pollution?

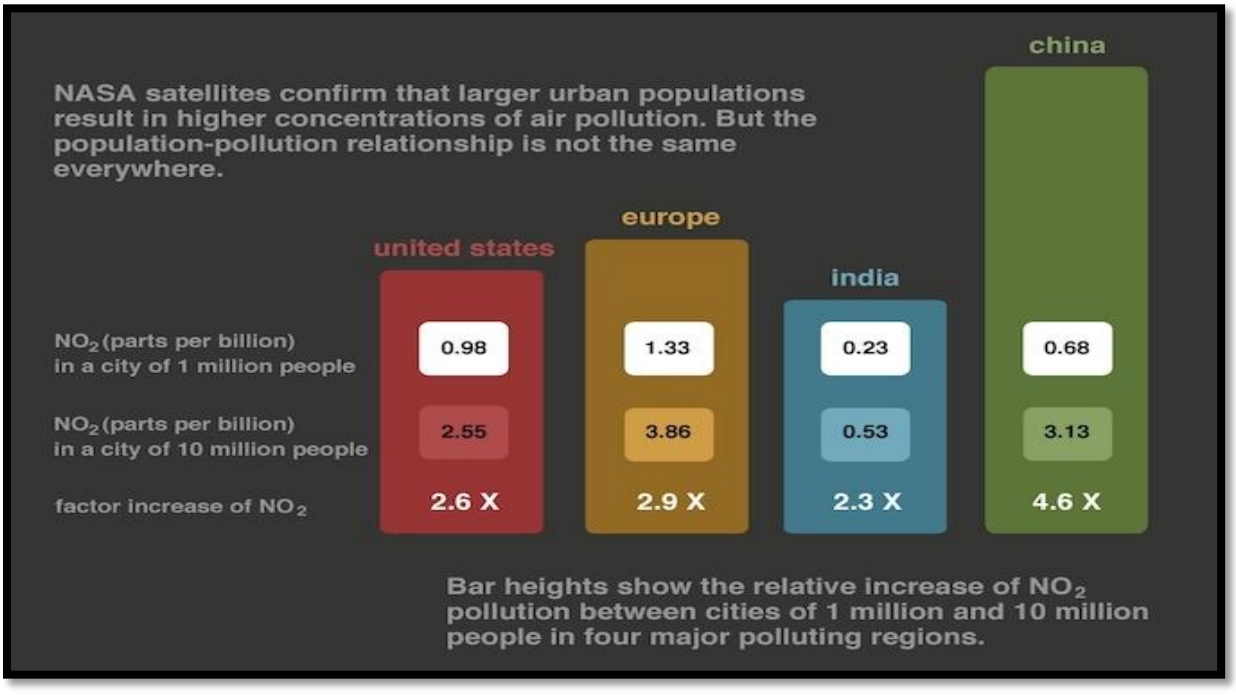


The atmosphere consists of a unique mixture of gases that supports life on the Earth. It consist of 78% Nitrogen, 21% Oxygen, 1% Argon and 1% includes varying amount of gases including Neon, Helium, Methane, Sulphur Dioxide, Carbon Monoxide, Carbon Dioxide etc., which are known as trace gases. It also consists of varying amount of solid particles and water vapor. Out of these gases Nitrogen is biologically inert gas except some specialized conditions and Argon is biologically inactive, hence, apart from Oxygen, other trace gases with very minute concentration plays an important role in atmospheric chemistry and can be a serious pollutants when their concentration become elevated near Earth's surface. We refer these trace gases as air pollutants when they are found in unexpectedly high concentrations which has some detrimental effect on health and environment. This condition is known as Air Pollution. The harmful effects of atmospheric pollution are wide spread and varied from Local impacts of air pollution on health, agriculture, smog formation, visibility reduction, Regional impacts like acid rain and Global impacts like global warming, climate change, ozone depletion. Normally composition of atmosphere remains constant. Some trace compounds are constantly being produced within the atmosphere or released by sources present at the surface of the Earth. Although the composition of air remain almost constant because of the sinks, that removes the gases from the atmosphere and balance overall Input and Output.





Urban Population & Air Pollution



Recently using satellite observations, NASA scientists directly measured air pollution's dependence on population in four of the planet's major air pollution regions: the United States, Europe, China and India. The study shows that the pollution-population relationship varies by region. The observed various depend on various factors such as industrial development, per capita emissions and geography of the region. The study was published in June 13 in Environmental Science & Technology. The researchers focused on nitrogen dioxide (NO_2), which can be considered an indicator of urban air pollution, a common pollutant from the burning of fossil fuels. The gas is a precursor to the formation of near-ground ozone, which can cause respiratory problems and is a problem in many major metropolitan areas. NO_2 is also unhealthy to breathe in high concentrations. Results across the different regions showed divergent NO_2 surface concentrations in urban areas of 1 million people: 0.98 parts per billion (U.S.), 1.33 ppb (Europe), 0.68 ppb (China) and 0.23 ppb (India). The same regions saw various degrees of pollution increases in cities with population of 10 million people: 2.55 ppb (U.S.), 3.86 ppb (Europe), 3.13 ppb (China)

and 0.53 ppb (India). The contribution to air pollution from surface-level NO_2 in each region more than doubled when cities increased in population from 1 million to 10 million people, although in China the increase was much larger, by about a factor of five. Energy usage patterns and per capita emissions differ greatly between India and Europe, despite large populations; Indian cities seem cleaner in terms of NO_2 pollution than the study's other regions.

Indian Economy & Air Pollution

As a result of economic liberalization, started on 24 July 1991, India becomes one of the world's fastest growing economies by 2008. At present the economy of India is the ninth-largest in the world by nominal Gross Domestic Product (GDP) and the third-largest by purchasing power party (PPP). Moreover, the country is one of the G-20 major economies and member of BRICS which is an association of five major emerging national economies, Brazil, Rassia, India, China and South Africa. Although, during past decades rapid economic growth has brought many benefits to India, it has imposed notable adverse impacts on the local and regional air quality and other environmental parameters. The economic and social development in India reflected in the rapid growing industrialization, urbanization, increased transportation etc. which on other hand putting 1.27 billion population at the risk of heart and lung diseases by altering normal composition of air.

In recent study it has been recognized that the annual cost of environmental damage to India is around $ 80 billion, equivalent to 5.7% of the country's GDP. The major problem in India which contributes 28% to the total coast of environmental damage is outdoor air pollution, followed by indoor air pollution (23%), crop lands degradation (19%), water supply, sanitation and hygiene (14%), pastures degradation (11%) and forest degradation (4%). Recent survey shows India ranked 126th overall and last in the Air Pollution effects on human health amongst the 132 countries. Medical studies show that the long term exposure to the air pollution

increases the risk factor of getting stroke and share significant percentage to number of people suffering from heart diseases. It has been estimated that if India could reduce air pollution by 10% then the savings from reduced health damages would come to $24 billion and if it could reduce air pollution by 30% then India can save substantially higher health savings of $105 billion (World Bank Report, June 2013). In India, the problem of air pollution is more intense particularly in metropolitan regions like Delhi, Mumbai, Chennai, Kolkata, Hyderabad, Bangalore, Ahmedabad, Pune etc.

Sources of Urban Pollution

Vehicular activity, cooking activity, heating activity, Industries, Electricity generation, construction activity etc.

Industries

Power

Transport

Domestic

Construction

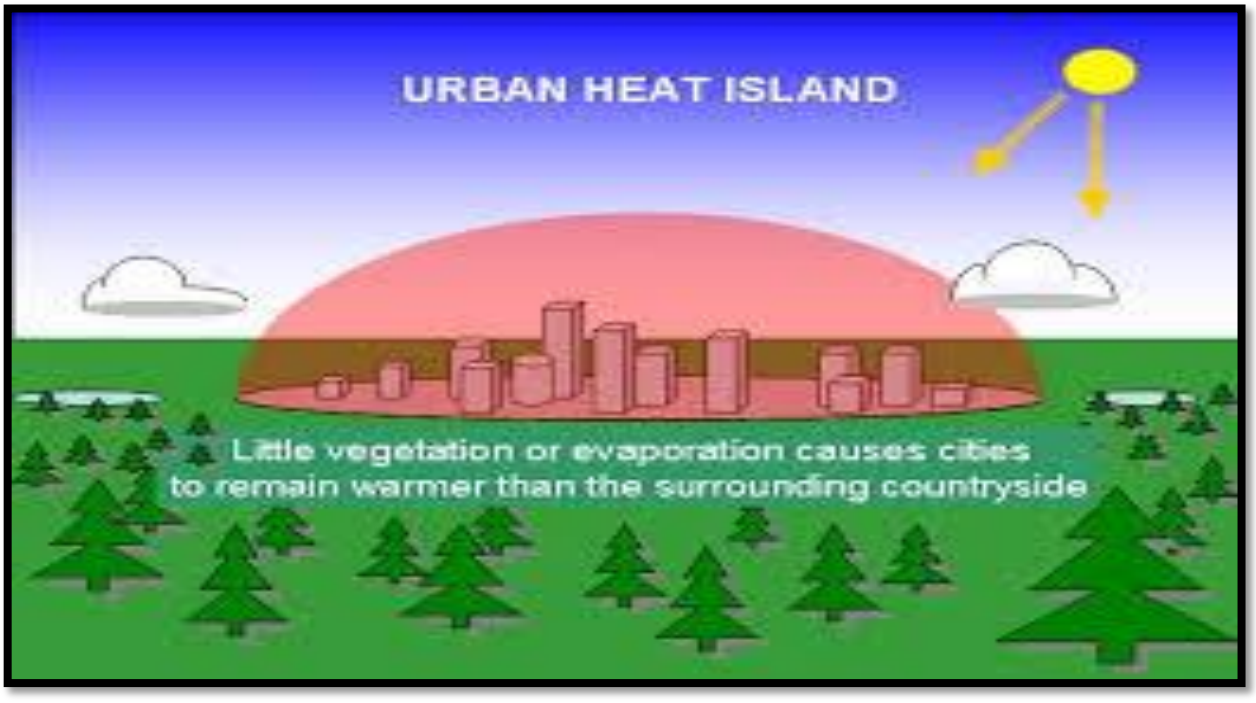
Effects of Urban Pollution

The six commonly found air pollutants in urban environment that carry the health risk are carbon monoxide (CO), particulate matter (PM) (PM2.5 category belong to articles having size less than 2.5 micrometer and PM10 for particles having size less than 10 micrometer), nitrous oxides (NOX), sulphur dioxide (SO2) , ground-level ozone (O3), and volatile organic compounds (VOCs). Prolonged exposure to these pollutants can cause difficulty in breathing, respiratory disease and heart disease. Links between high levels of air pollution and lung disease, cardiovascular disease and even cancer are being established in the medical literature. Apart from health effects some pollutants are responsible for the visibility reduction and smog formation, e.g. PM is responsible for the visibility reduction due to the scattering of light. VOCs contribute to the blue-brown haze associated with photochemical smog. Some of the air pollutants like BC, OC, NOx have significant impact on global radiation balance and, in turn, on the global climate change through direct and indirect radiative forcing.

Urban Heat Island

Urban Heat Island (**UHI**) is a metropolitan area that is significantly warmer than its surrounding rural areas due to human activities. As a population center grows, it tends to expand its area and increase its average temperature. In the UHI the observed temperature difference is larger at night than during the day, and is most apparent when winds are weak. UHI is most noticeable during the summer and winter.

There are several reasons which are responsible for this observed temperature differences in the downtown city area and surrounding suburban and rural areas. In urban areas the materials used for pavement and roofs includes concrete and asphalt. It has a significantly different thermal bulk properties like heat capacity and thermal conductivity and surface radiative properties like albedo and emissivity, than the surrounding rural areas. This results in the change in the energy balance of the urban area, leading to higher temperatures than surrounding rural areas. The concrete and asphalt absorb the short-wave radiation during day time, this energy is



Slowly released during nighttime as long wave radiations, making cooling a slow process and is a major reason of the observed nighttime warming. The reason for UHI is geometric effect caused by tall buildings within many urban areas. They provide multiple surfaces for the reflection and absorption of sunlight, increasing the efficiency with which urban areas are heated, which is known as urban canyon effect. Also they block the winds, which also inhibit cooling by convection and dispersion of pollution. Waste heat from automobiles, air conditioning, industry and other sources also contribute to the UHI. Elevated temperature from urban heat islands, can affect a community's environment and quality of life, hence the issue need to be addressed seriously.

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