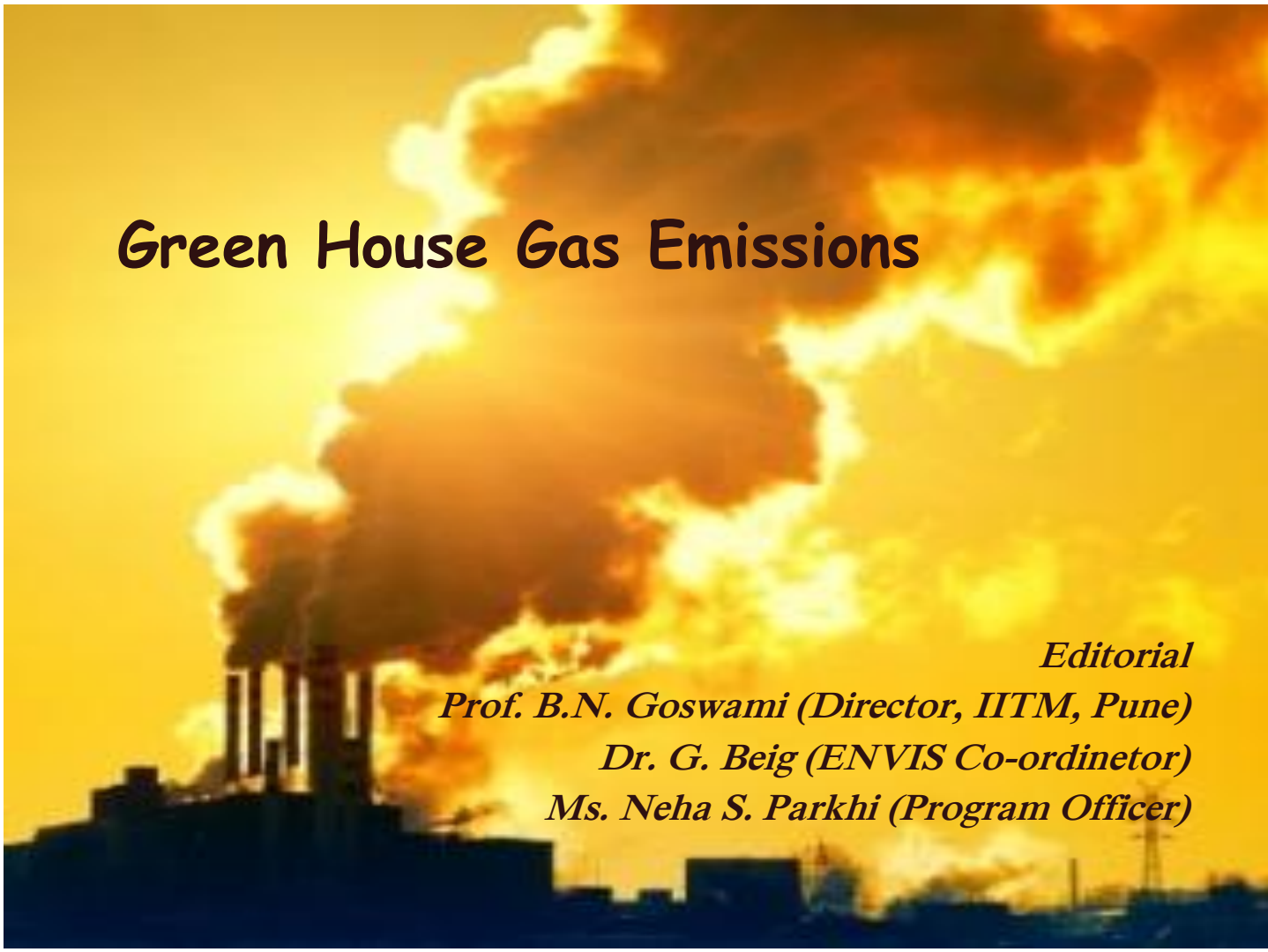
ENVIS- IITM NEWSLETTER

The Air Quality: A Global Challenge



Green House Gas Emissions

Editorial

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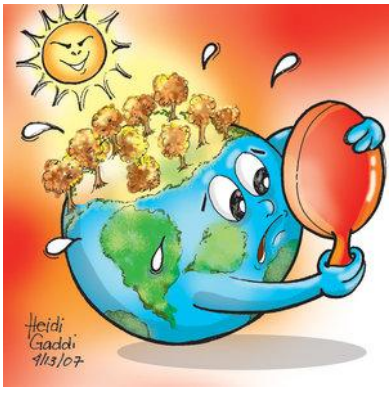
EDITORIAL

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 first parts of the series we have covered the regional and global problems Acid rain and global warming along with its effects.

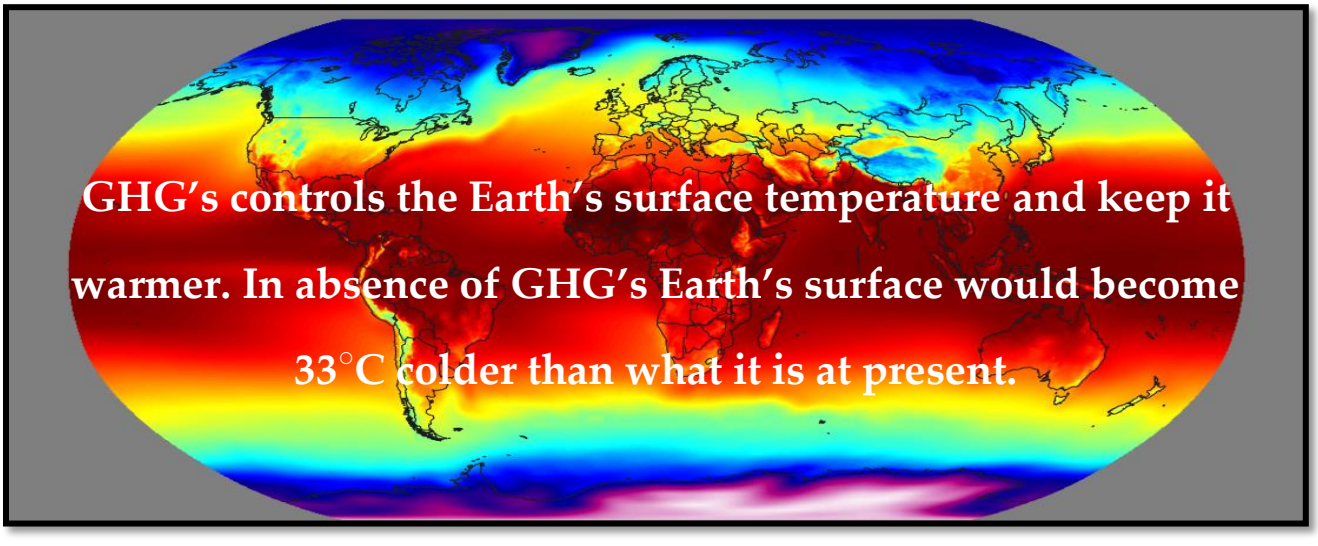
Present issue will deal with the key problem responsible for Global warming i.e. Emission of Greenhouse Gases. We hope our attempt to convey complicated scientific information in simple language will help to create awareness amongst the common public which is the first step towards safeguarding our environment.

Inside the Issue

Greenhouse Gases (GHG's)



A number of trace gases present in the atmosphere allows short-wave solar radiation to pass through it and at the same time they partially absorb long-wave radiations emitted by the warm surface of the earth and reradiated in all directions, downwards as well as upwards. This effect is known as Green House Effect and these trace gases are known as Green House Gases (GHG). Many gases exhibit these "greenhouse" properties.



Important elements responsible for Greenhouse Effect

Water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), ozone (O_3), sulfur hexafluoride, hydroflurocarbons, perflurocarbons

Black carbon (BC) is a solid particle or aerosol, not a gas, but it also contributes to warming of the atmosphere.

Where do they come from?

Domestic

Industries

Transport

Agriculture

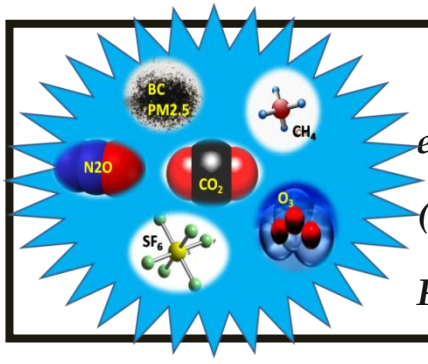
Live stock

In the atmosphere at normal levels GHG's helps to keep Earth's surface warmer and support various live processes on the Earth, but when the concentration of GHGs alters, their contribution to the greenhouse effect also shifts. It may results in the increase or decrease in the temperature of the earth's surface. Climate change caused by an increased concentration of these greenhouse gases has an alarming impact on our environment. It has been found that global surface temperature increased 0.8 °C (1.4°F) during the last century.

Atmospheric GHG's originates from both Natural as well as anthropogenic sources. Natural sources include forests, wetlands, oceans, volcanic activity etc. However, in recent study, The Intergovernmental Panel on Climate Change (IPCC) concludes that "**increasing greenhouse gas concentrations resulting from different human activity are responsible for most of the observed temperature increase since the middle of the 20th century**".

The major anthropogenic sources of GHG's are emissions from fossil fuel, biofuel, biomass burning in domestic, industrial, transport sector, agricultural activities including fertilizers, livestock enteric fermentation and manure management, paddy rice farming, land use etc.

Global Greenhouse Gas Emissions



At the global scale, the key greenhouse gases emitted by human activities are Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O) and Fluorinated gases (F-gases).

Carbon dioxide (CO_2)

Fossil fuel use is the primary source of CO_2. Another major human activity responsible for increased emissions of CO_2 is deforestation.

Methane (CH_4)

The anthropogenic sources of methane include emissions from rice cultivation, animal husbandry (enteric fermentation in livestock and manure management), waste management practices, coal mining and natural gas venting, biomass burning etc. (see Table1).These activities have increased the input of CH_4 in to the atmosphere. It is estimated that 60% of global methane emissions are related to anthropogenic activities.

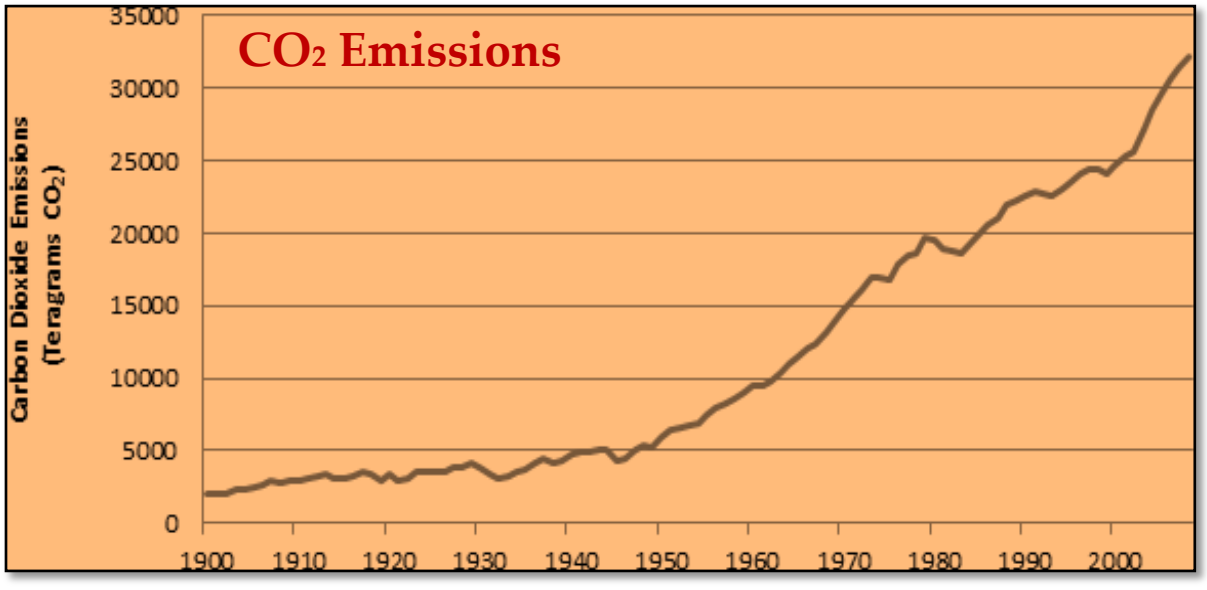
Nitrous oxide (N_2O)

Agricultural activities, such as fertilizer use, are the primary source of N_2O emissions.

Fluorinated gases (F-gases)

Industrial processes, refrigeration, and the use of a variety of consumer products contribute to emissions of F-gases, which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

Sector wise Emissions of GHG's



Source: Boden, T.A., G. Marland, and R. J. Andres (2010). Global, regional and national fossil-fuel CO_2 emissions

The major sectors which contribute to the global GHG emissions are Energy, Industry, Land-Use, Land-use change and forestry, agriculture, transportation, commercial and residential and waste. Study shows that, out of the above sectors the major contribution to the global GHG emission is of Power sector (26%) flowed by Industries (19%). Land use land cover change contributes 17%, agriculture sector contributes 14%, transport sector contributes 13% to the global GHG emissions. Whereas, commercial and waste sector contributes 8% and 3% respectively to the global GHG emissions in the year 2004.

Energy, Industrial, Transport, Commercial and Residential Sector: Burning of coal, oil for electricity generation in Thermal Power plants is a dominant source of GHG emissions. Fossil fuel burning in various small scale as well as large scale industries is the major source of GHG emissions. Apart from the above emissions from chemical, metallurgical and mineral transformation processes which are not associated with energy consumption are also responsible for the emissions of a range of GHGs

Biomass, Biofuel and sometime fossil fuel burning for heating and cooking purpose is also a dominant source of GHG emission. Use of petrol diesel for transportation purpose is another important source of GHG emissions.

Considerable amount of CO_2 gets emitted from the sector "Land Use, Land-Use Change, and Forestry" which involves activities like **deforestation, land clearing for agriculture, and fires or decay of peat soils.**

Agriculture Sector: It is a major source of Methane (CH_4) and Nitrous Oxide (N_2O) emissions. The activities responsible for the emission of these gases are management of agricultural soil, rice production, biomass burning, use of fertilizers, live stock management etc.

Rice Fields: The measurements at various locations of the world show that there are large temporal variations of CH_4 fluxes from rice fields. CH_4 flux from rice fields depends on several factors such as climate (temperature, humidity etc.), characteristics of soils and paddy, the type and application mode of mineral fertilizers, addition of organic matter in the form of compost or straw and agricultural practices particularly water regimes. Among all these factors the wetness of the soil and hence the water regimes are the overriding factors in methane emission from rice fields because flooding of the field's whether continuous or intermittent creates anaerobic conditions leading to emission of methane from this source.

Domestic Live stock: Considerable amount of CH_4 emitted because of enteric fermentation and manure management. Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. The type of digestive system has a significant influence on the rate of methane emission. Methane is released as a gas from the stomach through the mouth and normal respiration, and a small quantity as flatus. Both ruminant animals and some non-ruminant animals produce CH_4. The main ruminant animals are cattle, buffalo, goat, sheep and camels. The non-ruminant animals include horses, mules, asses, and swine. The amount of CH_4 that is released depends on the type, age, and weight of the animal, the quality and quantity of the feed, and the energy expenditure of the animal. Another source of livestock CH_4 is animal manure. Livestock manure is principally composed of organic matter. The principal factors that affect CH_4 emissions are the amount of manure produced and the portion of manure that decomposes anaerobically.

The amount of manure produced is dependent on the number of animals while the portion of the manure that decomposes anaerobically depends on how the manure is managed. When the manure is treated as a solid, very little or no methane is produced as it decomposes aerobically. However when treated as liquid, it decomposes anaerobically and produces CH_4. The amount of methane produced during decomposition is also influenced by the climatic conditions (Temperature, humidity etc.).

Waste Sector: This sector is responsible for the emissions of CH_4, N_2O. Incineration of some waste products that were made with fossil fuels, such as plastics and synthetic textiles, also results in minor emissions of CO_2. Waste is an extremely heterogeneous mass, which may originate from household, commercial, industrial or agricultural activities. Disposal of solid waste and industrial waste water treatment are the major sources of methane. The landfill sites and open dumps are collectively referred as Solid Waste Disposal Sites (SWDSs). The construction and operation of SWDSs leads to development of anaerobic conditions. In such conditions methanogenic bacteria break down organic matter present in the waste to produce landfill gas. Landfill gas consists of approximately 50% of methane, 50% of carbon dioxide, and trace volumes of Non-Methane Volatile Organic Compounds (NMVOCs). The composition of landfill gas (LFG) is not constant it depends on the composition and age of land filled waste, as well as landfilling conditions. Gases produced during this process can migrate from SWDSs either laterally or by venting to atmosphere, causing vegetation damage and unpleasant odor at low concentrations, while at concentrations of 5-15 per cent in air, the gas may form

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