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ROLE OF ANTHROPOGENIC EMISSIONS IN CLIMATE CHANGE

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ABSTRACT

Climate change is any long-term significant change in the expected patterns of average weather of a specific region (or more relevantly to contemporary socio-political concerns, of the Earth as a whole) over an appropriately significant period of time. Climate change reflects abnormal variations to the expected climate within the Earth's atmosphere and subsequent effects on other parts of the Earth, such as in the ice caps over durations ranging from decades to millions of years. Increased carbon dioxide levels are thought to exacerbate the heating effects of the Greenhouse Effect by reducing the re-radiation of heat from the sun and, therefore, increasing the temperature contained in the atmosphere. The climate of the Earth is always changing. In the past it has altered as a result of natural causes. The changes we have seen over recent years and those which are predicted over the next 80 years are thought to be mainly as a result of human behaviour rather than due to natural changes in the atmosphere. The present paper focuses on different type of anthropogenic emissions and how it contributes and its major role in changing our climate.

The climate system is a complex, interactive system consisting of the atmosphere, land surface, ice, ocean and other bodies of water, and living things. The atmospheric component of climate system most obviously characterizes climate; is often defined as 'average weather'. Climate is usually described in terms of mean and variability of temperature, wind and precipitation over a period of time, ranging from months to years. The climate system evolves in time under the influence of its own internal dynamics and due to changes in external factors that effect climate (called 'forcing'). External forcing include natural phenomenon such as volcanic eruption and solar variations, as well as human induced changes in atmospheric changes in atmospheric composition.

The debate on global climate change which until the recent past was restricted to academic and scientific circles has encouragingly shifted to include the common man. For a country like India, the subject of climate change needs to be looked at from many different perspectives-

1 Commercial energy conversion and usage.
2 Providing access to commercial energy to a large section of deprived population.
3 Agricultural and general habitat activities in the rural areas.
4 Increased pressure on land and evolving water.
5 Stress conditions in very large area of the country spanning all regions.

The energy conversion process particularly fossil fuel based is a major cause for CO_2 emission-which constitutes the largest component of greenhouse gases released in the atmosphere. In India this is more profound as bulk of the primary energy resource is coal based.

In computer-based models, rising

concentrations of greenhouse gases produce an increase in the average surface temperature of the Earth over time. Rising temperatures may in turn produce changes in precipitation patterns, storm severity, and sea level commonly referred to as **"climate change".** Assessments by the Intergovernmental Panel on Climate Change (IPCC) suggest that the Earth's climate has warmed between 0.6 and 0.9^{0}C over the past century and that human activity affecting the atmosphere is **"very likely"** an important driving factor. The IPCC's Fourth Assessment Report (Summary for Policymakers) states, **"Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."** It goes on to state, **"The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is extremely unlikely that global climate change of the past 50 years can be explained without external forcing, and very likely that it is not due to known natural causes alone."**

In our solar system, the atmospheres of Venus, Mars and Moon also contain gases that cause greenhouse effects. Greenhouse gases, mainly water vapor, are essential to helping determine the temperature of the Earth; without them this planet would likely be so cold as to be uninhabitable. Although many factors such as the sun and the water cycle are responsible for the Earth's weather and energy balance, if all else was held equal and stable the planet's average temperature should be considerably lower without greenhouse gases. Human activities have an impact upon the levels of greenhouse gases in the atmosphere, which has other effects upon the system, with their own possible repercussions. The most recent assessment report compiled by the IPCC observed that **"changes in atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation alter the energy balance of the climate system"**, and concluded that **"increases in anthropogenic greenhouse gas concentrations is very likely to have caused most of the increases in global average temperatures since the mid-20th century".** Earth's most abundant greenhouse gases are: Water vapor , Carbon dioxide , Methane , Nitrous oxide , Ozone , CFCs. When these gases are ranked by their contribution to the greenhouse effect, the most important are:

1 Water vapor, which contributes 36–70%
2 Carbon dioxide, which contributes 9–26%
3 Methane, which contributes 4–9%
4 Ozone, which contributes 3–7%

The major non-gas contributors to the Earth's greenhouse effect, clouds, also absorb and emit infrared radiation and thus have an effect on radiative properties of the greenhouse gases.

The main sources of greenhouse gases due to human activity are:

1 Burning of fossil fuels and deforestation leading to higher carbon dioxide concentrations. Land use change (mainly deforestation in the tropics) account for up to one third of total anthropogenic CO_2 emissions.
2 Livestock enteric fermentation and manure management, paddy rice farming, land use and wetland changes, pipeline losses, and covered vented landfill emissions leading to higher methane atmospheric concentrations. Use of chlorofluorocarbons (CFCs) in refrigeration systems, and use of CFCs and halons in fire suppression systems and manufacturing processes.
3 Agricultural activities, including the use of fertilizers, that lead to higher nitrous oxide (N_2O) concentrations.

The seven sources of CO_2 from fossil fuel combustion are (with percentage contributions for 2000–2004):

1 Solid fuels (e.g. coal): 35%
2 Liquid fuels (e.g. gasoline): 36%
3 Gaseous fuels (e.g. natural gas): 20%
4 Flaring gas industrially and at wells: <1%
5 Cement production: 3%
6 Non-fuel hydrocarbons: <1%
7 The "international bunkers" of shipping and

air transport not included in national inventories: 4%

Predicted Climate Change from Increased Greenhouse Gases

Some of the predicted responses to increases in greenhouse gases include increases in mean surface air temperature, increases in global mean rates of precipitation and evaporation, rising sea level, and changes in the biosphere. Many of these predictions are based largely on computer models that simulate fundamental geophysical processes.

8 Most model simulations of Earth's climate indicate that an increase in the atmospheric concentration of a greenhouse gas will lead to an increase in the average surface air temperature of the Earth.

9 An increase in surface air temperature would cause an increase in evaporation and generally higher levels of atmospheric water vapor. The positive feedback associated with this leads to the expectation that an increase in surface air temperatures would lead to a more intense hydrological cycle, with more frequent heavy precipitation events. However, because of the coarse spatial resolution of present general circulation models, simulations of the regional and seasonal distribution of precipitation are poor.

10 Another possible consequence of greenhouse-gas-induced climate change is elevated sea level. The main factors that contribute to sea level rise are thermal expansion of ocean water and the melting of glaciers, both of which are in response to higher air temperatures. Although it has been well established that melt water from the world's small glaciers has contributed to sea level rise during the last century, the mass balance of the ice sheets in Greenland and Antarctica is unknown. However, recent geodetic airborne laser altimeter measurements indicate that between 1993 and 1998 the southeastern part of the Greenland ice sheet thinned overall, with a thickening at a rate of 0.5 ± 0.7 cm/yr at elevations above 2000 m (not corrected for crustal motion) and a thinning at the low elevations at rates up to 1 m/yr.

11 Worldwide measurements from tidal gauges during the last 100 years indicate that mean sea level has risen between 10 and 25 cm (18 cm mean). This rate is greater than would be expected from the archaeological and geological record of sea level from the last two millennia. Most modeling studies, including simulations of the combined effects of increasing greenhouse gases and aerosols, predict that the trend in rising sea level will continue in the future.

12 A possible biological effect may be seen in evidence that there has been an increase in the active growing season at high latitudes in the Northern Hemisphere.

The earth's climate has changed over the last century. There is new and stronger evidence that most of the warming observed the last 50 years is attributable to human activities. Evolving computer models are predicting that, because of greenhouse gas emissions, temperatures should continue to rise over the 21st century, impacting nature and mankind both positively and negatively.

The impacts should vary among regions, but they can not yet be predicted accurately, especially for small-scale areas. However, it is expected that:

1 More the greenhouse gases are emitted, the higher the tendency for the earth to warm,

2 The greater and faster the warming, the more the adverse effects will dominate,

3 And the higher the possibility, although probably remote, of large-scale and possibly irreversible impacts.

Therefore, although an acceptable level for greenhouse gases has not yet been determined, reducing emissions should reduce the risk of adverse effects. Many options for emission reductions are available; their costs need to be balanced with the risks left for future generations.

The overall economic impact of warming due to increased Green House Gas emission needs to be assessed and policy correction steps undertaken to encourage increased use of renewable energy resources, technology development for reducing methane generation and harnessing generated methane for energy production and acceleration of afforestation program.

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