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Effects of Global Warming On Earth

Neelam Sindhu
Extension Lecturer In Geography Govt College For Women ,Sampla (Hr.)
EMAIL- neelam.sindhu12@gmail.com

ABSTRACT: *Global warming, climate change ,have taken the centre stage of academic research. A raging debate is on apart from the popular writings and research articles published on the theme. According to the Intergovernmental Panel on Climate Change "Warming of the climate system is unequivocal as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice since the mid 20th century". Global warming is the 'talk of the town' in this century, with its detrimental effects already being brought to limelight by the recurring events of massive floods, annihilating droughts and ravaging cyclones throughout the globe. The average global temperatures are higher than they have ever been during the past millennium, and the levels of CO2 in the atmosphere have crossed all previous records. A scrutiny of the past records of 100 years indicates that India figures in the first 10 in the world in terms of fatalities and economic losses in a variety of climatic disasters. Present study focus on the causes and effects of global warming on the planet earth.*

KEY WORDS: Global warming, Climate change, Carbon emission, Temperature rise, Ice-melting & Sea level-rise.

INTRODUCTION: 'Global warming is defined as an increase in the average temperature of the Earth's atmosphere, especially a sustained increase great enough to cause changes in the global climate'. The term global warming is synonymous with Enhanced green house effect, implying an increase in the amount of green house gases in the earth's atmosphere, leading to entrapment of more and more solar radiations, and thus increasing the overall temperature of the earth.

Global warming, also referred to as **climate change**, is the observed century-scale rise in the average temperature of the Earth's climate system and its related effects. Multiple lines of scientific evidence show that the climate system is warming. Many of the observed changes since the 1950s are unprecedented in the instrumental temperature record which extends back to the mid-19th century, and in paleo climate proxy records covering thousands of years.

In 2013, the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report concluded that "It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century." The largest human influence has been the emission of greenhouse gases such as carbon dioxide, methane and nitrous oxide. Climate model projections summarized in the report indicated that during the 21st century, the global surface temperature is likely to rise a

further 0.3 to 1.7 °C (0.5 to 3.1 °F) in the lowest emissions scenario, and 2.6 to 4.8 °C (4.7 to 8.6 °F) in the highest emissions scenario. These findings have been recognized by the national science academies of the major industrialized nations and are not disputed by any scientific body of national or international standing. Global warming is the current increase in temperature of the Earth's surface (both land and water) as well as it's atmosphere. Average temperatures around the world have risen by 0.75°C (1.4°F) over the last 100 years about two thirds of this increase has occurred since 1975. In the past, when the Earth experienced increases in temperature it was the result of natural causes but today it is being caused by the accumulation of greenhouse gases in the atmosphere produced by human activities.

The natural greenhouse effect maintains the Earth's temperature at a safe level making it possible for humans and many other life forms to exist. However, since the Industrial Revolution human activities have significantly enhanced the greenhouse effect causing the Earth's average temperature to rise by almost 1°C. This is creating the global warming we see today. To put this increase in perspective it is important to understand that during the last ice age, a period of massive climate change, the average temperature change around the globe was only about 5°C.

Global warming is no longer just a prediction—it is actually happening. It is undisputed that the average temperature at the surface of the Earth has increased over the past century by about 1°F (0.6°C), with both the air and the oceans warming. Since 1880, when people in many locations first began to keep temperature records, the 25 warmest years have all occurred within the last 28 years. Scientists know with absolute certainty that the observed dramatic increase in the atmospheric concentrations of greenhouse gases since pre-industrial times (to levels higher than at any other time in at least the last 420,000 years) has been caused by human activities, mostly the burning of fossil fuels (coal, oil, and natural gas), and to a lesser extent, deforestation. The ability of greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, to trap heat at the Earth's surface is also scientifically well understood.

What is Causing Global Warming?

The climate of the earth is affected by a number of factors. These factors include output of energy from the sun (warming effect), volcanic eruptions (cooling effect), concentration of GHGs in the atmosphere (warming effect), and aerosols (cooling effect). Since the Industrial Revolution (i.e., 1750), the largest contributor to the increase in global warming is carbon dioxide (CO2), followed by methane (CH4). CO2 concentrations have increased from 278 parts per million (ppm) in 1960 to 401 ppm in 2015—a 44% increase Since 1951, approximately 100% of warming is attributed to anthropogenic forcings, while more than 100% is due to greenhouse gases due to offsets in anthropogenic aerosols . Natural forcings and internal variability are considered to be negligible during this time period. Water vapour has an important indirect effect on temperature increases resulting from increasing GHG concentrations. Increased global temperature resulting from GHGs increases the capacity of the atmosphere to hold water vapour, thus acting as a positive feedback, as

water vapour also produces a greenhouse effect. An increase in global temperature by 1°C results in approximately a 7% increase in atmospheric water vapour. "Therefore, although CO2 is the main anthropogenic control knob on climate, water vapour is a strong and fast feedback that amplifies any initial forcing by a typical factor of between two and three. Water vapour is not a significant initial forcing, but is nevertheless a fundamental agent of climate change".

Not all industrial emissions result in a warming bias. Aerosols resulting from industrial emissions have worked to offset about 26% of greenhouse warming due to blocking solar radiation from reaching the earth's surface. There is, however, large uncertainty regarding the extent of influence that aerosols have on climate, mainly due to aerosol interactions with clouds.

GHGs (particularly CO2) have a longer residence time in the atmosphere (~100 years) compared to aerosols (only 10 days). As a result, the short-term effect of industrial pollution can be cooling followed by long-term warming. Aerosols are expected to offset a lower percentage of greenhouse warming in most future scenarios due to residence time, which allows for the possibility of an acceleration of future warming even without an acceleration of GHG concentrations.

The greenhouse effect occurs when solar energy making contact with the earth's surface is retransmitted to the atmosphere in the form of infrared thermal radiation. This radiation has a lower wave frequency than solar energy itself. GHG molecules absorb this thermal radiation at low frequencies, causing these molecules to vibrate. These greenhouse molecules then emit energy in the form of infrared photons, many of which return to the earth's surface. Non-GHGs such as oxygen and nitrogen do not absorb thermal radiation.

The greenhouse effect is measured in terms of Radiative Forcing (RF) in units of watts per square meter (W/m2). Since the Industrial Revolution, the total RF is estimated to have increased by approximately 2.3 W/m2 (1.1 W/m2 – 3.3 W/m2 ; 90% confidence interval) mainly due to the net effect of increased GHG and aerosol concentrations in the atmosphere.

The response of climate to the change in the earth's energy is referred to as climate sensitivity. Equilibrium Climate Sensitivity (ECS) is used to gauge the long-term response (i.e., 100+ years) to a doubling of CO2 concentrations in the atmosphere, and estimates range from 1.5°C to 4.5°C according to the IPCC. This corresponds with an increase in RF of +3.7 W/m2 (+3.0W/m2 to +4.4 W/m2). Alternatively, a Transient Climate Response (TCR) estimate is used to gauge shorter-term impacts (i.e., over 20 years) to a doubling of CO2 concentrations in the atmosphere, and estimates range from 1.0°C to 2.5°C. The shorter term estimates are lower due to the time it takes to heat up the oceans.

EFFECTS OF GLOBAL WARMING

EXTREME EVENTS

Killer heat waves Human-caused global warming may have already doubled the chance of "killer" heat waves like the one that scorched Europe in July–August 2003. Strong evidence indicates that the summer was the hottest in Europe in at least the past 500 years. All-time high temperature records were broken in many countries.

Torrential rains and flooding According to the available data, a significant increase in the intensity of precipitation events occurred over the second half of the 20th century. This increase is consistent with the predicted effects of global warming, since higher temperatures speed up evaporation and increase the amount of water vapor in the air, leading to heavier downpours. Heavier rainfall in turn increases the risk of flooding.

Drought Paradoxically, although flooding events are very likely to increase with global warming, droughts are also expected to be more frequent and severe. Higher temperatures tend to increase the rate of evaporation; if precipitation doesn't soon replenish the lost moisture, soils grow drier. In drier soils, less solar energy is used up in evaporating water, meaning more energy is available to raise the temperature of the soil and the overlying air, leading to even more desiccating conditions; this kind of self amplifying cycle can lead to a lengthy and severe drought.

Forests and wildfires Scientists expect global warming to contribute to an increase in wildfire in several ways. As discussed in the previous section, droughts are expected to become more common and severe in some regions. Desiccating heat and lack of precipitation create ideal conditions for major wildfires. In addition, longer warm seasons often translate into longer fire seasons. Warmer temperatures also promote outbreaks of insects that feed on trees, killing many of the hosts and creating large amounts of dry fuel for forest fires. Insects are even spreading to areas that until recently were too cold for their survival.

SEA LEVEL RISE AND COASTAL FLOODING

Sea-level rise is one of the most certain impacts of global warming. Sea level rose around the world by an average of 4 to 8 inches (10 to 20 cm) over the course of the 20th century, ten times the average rate over the previous three thousand years. The rise in sea level is due to the expansion of ocean water as it warms, and to the addition of water from melting glaciers and ice sheets, both of which are consequences of global warming. The effects of global sea-level rise are amplified in some places due to local geologic and man-made factors. For example, about one-third of the marsh at Black water National Wildlife Refuge in the Chesapeake Bay in the eastern U.S. has become submerged since 1938. Half of the marsh loss is attributed to the sinking of land due to groundwater extraction, and the rest is attributed to global warming. Elsewhere in the Chesapeake Bay, Bloods worth Island is 590 acres (235 hectares) smaller than it was in 1942, a loss of more than 10% of its original land area.

SNOW, LAND ICE AND SEA ICE

Shrinking snowpack Over the past 30 years, scientists around the world have recorded a steady decline in mountain snowpack, an important reservoir of fresh water, as well as the basis for the ski industry and other winter tourism. In the western United States, where water is scarce, 75% of the water in streams and rivers comes from snowmelt, providing a crucial supply for farms, hydroelectric power plants, aquatic life, and 60 million people—one-fifth of the U.S. population. Spring snowpack has been decreasing in the region:

measurements recorded declines in three-quarters of the mountainous areas between 1950 and 1997.

Vanishing glaciers Glaciers are slow-moving "rivers" of ice formed over many years from compacted snow on sloping land. In almost every mountainous region across the world, long-term monitoring has revealed that the vast majority of glaciers are retreating upslope in response to a warming climate; the glaciers' lower reaches are melting faster than ice flowing down from above can replenish them. Since glaciers, like snowpack, serve to store water and release it steadily over the year, their continued disappearance will have a severe impact on water supplies in some regions.

Polar ice disintegration Polar regions have two kinds of floating ice. Ice shelves are thick plates of ice that form where glaciers flow into the sea. Sea ice forms when seawater gets cold enough to freeze. Unlike land-based glaciers and ice sheets, floating ice does not raise sea level when it melts. It does, however, have serious consequences.

Melting permafrost and damage to infrastructure In cold regions around the world, large reaches of land have been frozen year-round. That permafrost is now melting rapidly in places like the Arctic of North America, Siberia, and the Himalayan/Tibetan region of Asia.

ECOLOGICAL IMPACTS

Damage to coral reefs Around the world, the incidence of large-scale coral "bleaching" events has increased since 1979, and most evidence indicates that this increase in mass bleaching is linked to global warming. The normally brilliant colors of corals are provided by photosynthetic algae, called zooxanthellae, which live inside the corals in a mutually beneficial relationship. Under certain stressful conditions, especially when the surrounding water temperature rises at least 1.8°F (1°C) above the long-term average summer maximum, corals cope by expelling their zoo xanthellae guests. This results in the loss of color that gives rise to the term "bleaching." Prolonged bleaching often leads to death of the coral.

Shifting species ranges and yearly cycles Recent research provides strong evidence that global warming is already having measurable impacts on many wild animal and plant species worldwide. Two different research groups, each of whom synthesized numerous studies of shifts in the geographic range and yearly cycles of over 1,400 species, found a discernible "fingerprint" of global warming on the web of life.

Declining Arctic animal populations The disproportionate warming in the Arctic has had detrimental effects on many Arctic species. The health of polar bears, in particular, is declining due to decreasing ice coverage in the Hudson Bay, at the southern end of the species' range.138 As the total area of Arctic sea ice has declined by close to 6% over the last 20 years, the sea ice season in the Hudson Bay has shortened by three weeks. Polar bears depend on sea ice thick enough to walk on to travel between their dens (which can be on the shore or out on the ice), and their main food source: ice-dwelling ringed seals.

Declining amphibian populations Amphibian populations in highland areas around the globe are declining still more precipitously. In Central and South America, many mountain amphibians, including the golden toad and

most of the 70-odd species of harlequin frogs, have vanished or declined markedly. In the Pacific Northwest of the United States, embryo mortality rates are increasing for species like the western toad and the Cascades frog, which lay their eggs in mountain lakes: fewer of those eggs ever hatch.

CONCLUSION-The earth has been showing a rapidly warming trend. This has been primarily caused by the increasing concentration of the GHGs—particularly carbon dioxide. There is worldwide acceptance for the fact that the largest contributor to the increase in CO2 concentration is the burning of fossil fuels and deforestation. This is causing climate change that will have a very wide-ranging impact on life on earth. This will include increased frequency of extreme temperatures, floods, hurricanes, storms, droughts, and sea levels, to name a few. If no immediate action is taken and the concentration of GHGs is allowed to increase unchecked, the resulting consequences could be disastrous and humanity could reach a point of no return. The world community has accepted the need to limit the increase in the earth's temperature to 2°C and initiate changes to achieve this objective. This will require the world to move away from burning fossil fuels and effectively reach a stage of zero carbon emissions. This will require a radical change in the way humanity lives as we move forward.

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