Scientific Innovation Magazine
ISSN : 2584-1157

Greenhouse Gases: Sources and Its Impact on Climate and Human Health

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Abstract

Global warming and climate change are largely caused by the rising concentration of greenhouse gases (GHGs) in the atmosphere. This review article examines the effects of GHGs on the economy, the environment, and human health. It also looks at the effects of climate change, including rising temperatures, altered precipitation patterns, rising sea levels, and ocean acidification, as well as the cryosphere's vulnerability to climate change and its effects on human populations. Finally, it discusses the effects of climate change on human health, including increased mortality, morbidity, and mental health problems.

Key words: Greenhouse gases, Climate change, Temperature, Sea level, Ocean acidification, Precipitation, Cryosphere, Human health

Introduction:

The most important component of our ecosystem is greenhouse gasses (GHGs). Our planet's temperature could not be maintained without greenhouse gas emissions. Greenhouse gases absorb and emit infrared light. The primary greenhouse gases in the atmosphere include water vapor, carbon dioxide, methane, nitrous oxide, and ozone. It is a long-lived gas in the atmosphere

that was at modest levels 200 years ago. However, industrialization pushed its concentration to dangerous levels. High concentrations of greenhouse gases contribute to rising global temperatures (Lashof, 1989; Kelly and Wigley, 1990). Rather than highlighting the significance of GHGs, their fast expansion endangers people and other living things in a variety of ways. CO2 is the primary driver of global warming (Derwent, 1990). The relationship between greenhouse gas emissions and human activities (such as agriculture, fossil fuel combustion, and energy consumption) is crucial and well understood (Lungarska and Chakir 2018; Rama Rao *et al.,* 2016). Rather than highlighting the significance of GHGs, their fast expansion endangers people and other living things in a variety of ways. The ongoing depletion of freshwater resources is driving the climate to warm. Despite several scientific studies emphasizing GHGs' negative effects, there are some benefits to civilization. Anthropogenic emissions are currently the leading cause of GHG concentrations. Human activities, especially the use of fossil fuels, contribute to rising CO2 levels in the atmosphere. A steady rise in GHG concentrations around the planet causes the greenhouse effect, which causes global warming and climate change (Gopalakrishnan et al. 2019; Tongwane and Moeletsi 2018). Global GHG emissions have increased by 75% over the last 30 years (Chabbi *et al.,* 2017; Outhwaite et al. 2022). These gases are required to maintain a climate on Earth that supports life. When we breathe, we inhale oxygen. The "greenhouse effect" is the method by which trace gases must maintain our planet's temperature constant. Despite their modest amount, trace gases have a substantial impact on global temperature. If these gases were absent, our atmosphere's present temperature would be 30 degrees Celsius hotter. The greenhouse effect is described by three major factors:

a. the gas's capacity to absorb heat

b. the gas's concentration in the atmosphere; and

c. the gases lifetime

Concentration and Sources of Greenhouse Gases

Our atmosphere is made up of a variety of gases with varying atmospheric concentrations, including oxygen (21%), nitrogen (78%), water vapor (0-4%), argon (1%), carbon dioxide (0.04%), and trace amounts of nitrous oxide (trace), methane (trace), halocarbon (trace), and ozone. Since pre-industrial times, greenhouse gas concentrations such as methane (CH4), carbon dioxide (CO2), and nitrous oxide (N2O) have increased by 150%, 40%, and 20%, respectively (IPCC 2014). Rice fields produce around 30% and 11% of global agricultural CH4 and N2O, respectively (Hussain et al. 2015). Important greenhouse gases (GHGs), including carbon dioxide (CO2), nitrous oxide (N2O), and methane (CH4), are absorbed and released by agricultural land. The scientific world has long been concerned about rice paddies because they release persistent and dangerous greenhouse gases, including CH4 and N2O. About 30% and 11% of global agricultural CH4 and N2O emissions, respectively, come from rice fields.

a) **Carbon dioxide:** The amount and type of organic matter added to soil, ambient conditions, and soil processes all affect CO2 creation and emissions. Organic molecules start to break down based on microbial activity, releasing a variety of gasses, chief among them CO2. Therefore, a key factor in influencing soil CO2 emissions is the carbon mineralization of organic matter returning to soils (Rahman 2013). Two issues have dominated scientific discussion since the first IPCC Science Assessment: (a) the rate of land-use change worldwide, particularly deforestation, and (b) carbon fluxes and the mechanisms controlling their release and absorption in the terrestrial biosphere and oceans. 60% of the total greenhouse effect is attributed to carbon dioxide, which also plays a major role in climate change (Liu *et al.,* 2013).

b) **Methane:** One significant greenhouse gas is methane (CH4). While water vapor is created in the stratosphere through interactions with the hydroxyl radical (OH), ozone can be created in the troposphere through chemical reactions involving CH4. The most CH4 produced in the soil during the rice-growing season is released by the aerenchyma systemized of diffusion or ebullition (Xie and Li 2002). Methane emissions into the atmosphere are caused by the extraction of natural fossil fuels, the production of crude

oil, its processing, transportation, and storage. Coal mining also contributes to CH4 emissions (Legg 2021). Longer half-lives of CH4 and other significant greenhouse gases, such as hydrochlorofluorocarbons (HCFCs), could result from this.

c) **Nitrogen dioxide:** Microbial denitrification and nitrification processes in tropical soils and oceans account for over 80% of the total global N2O pool in the atmosphere (Fowler et al. 2015). Anthropogenic sources of N2O include industrial processes, agriculture, and the combustion of fossil fuels. Human-related activities such energy use, wastewater treatment, industrialization, and agriculture raise the amount of N2O in the atmosphere (Ogunbode *et al.,* 2020). 6% of global human radiative forcing is caused by N2O, an inert gas that has 300 times the potency of CO2 as a greenhouse gas. N2O is a very persistent gas that stays in the atmosphere for nearly a century before vanishing on its own (Sonwani and Saxena, 2022).

d) Fluorinated Gases: From the standpoint of lowering greenhouse gas emissions, the fluorinated gases—sulphur hexafluoride (SF6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs)—are especially problematic since they are extremely persistent in the atmosphere and have the potential to contribute to long-term global warming. There are many uses for HFCs and PFCs in our daily lives, and the trend is only increasing. Among the primary applications for HFCs and PFCs include coolant in air conditioners and refrigerators, fire extinguishers, aerosol products, solvent washing, foam blowing, and other applications. (Saxena and Sonwani, 2022).

e) Sulphur dioxide: The burning of carbon-based fuels such as coal, petroleum, and diesel releases sulphur dioxide (SO2). Power stations and industrial enterprises' combustion of fossil fuels is the primary cause of SO2 emissions. Vehicles that utilize high-sulphur fuels, ships, volcanoes, and metal processing are further sources. High SO2 levels can be detrimental to the environment and human health and are frequently found close to industrial sites (Yoro *et al.,* 2020).

Observed changes in climate due to Greenhouse Gases

Climate change has a significant impact on human habitat as well as livelihood conditions; likewise, our ways of life had a significant influence on climate change (Henry 2020). By including soil erosion and the breakdown of organic matter, these techniques raise CO2 and CH4 emissions (Ngarava *et al.,* 2023). Climate change is the outcome of forestry and woodland management's impact on the amount of greenhouse gases in the atmosphere (Robinson 2020).

a. **Changes in temperature:** The average temperature of our planet is about 15 degrees warmer than it would be otherwise due to the greenhouse effect. It is essential to the existence of life on Earth. Only -18 degrees may be the temperature. The globe's volcanic activity over millions of years is what caused the effect to occur. There is less snow on the continents when air temperatures rise. As the rainy season comes to an end, it starts to evaporate sooner. Because of this, the ground is too dry to cultivate crops. Lack of moisture in the land leads to desertification 100–200 million hectares of forest will be lost for every degree that the average temperature rises over a ten-year period, researchers predict. Eventually, these areas will turn into steppes. The ocean accounts for 71% of our planet's surface area. Water heats up in response to rising air temperatures. Evaporation increases considerably.
b. **Changes in Precipitation:** Human forcing is responsible for the change in regional and global precipitation (Zhang, 2007a). Additionally, shorter snowfall seasons and earlier snowmelt seasons have been seen compared to previous times (Takala et al., 2011). Changes in precipitation patterns brought on by climate change make the problem worse by encouraging carbon (C) and nitrogen (N) processes in terrestrial ecosystems, which raises soil greenhouse gas (GHG) emissions. However, it is still uncertain how soil GHG fluxes in many global ecosystems react to severe precipitation (EP) and increasing precipitation (IP). The environment and ecosystem development will be significantly impacted by changes in precipitation patterns brought on by global warming (Grimm *et al.,* 2013; Wing *et al.,* 2022).

c. **Sea Level Rise:** Sea levels are rising as a result of the polar ice melting. After the phenomenon of global warming was identified, the remaining components about the reason of sea level rise were taken into consideration. The IPCC came to the conclusion in its first assessment report that rising GHG concentrations are the root cause of sea level rise. Sea level rise is mostly caused by land-based ice, claim Church et al. (2011a). Because GHG concentrations are warming the earth and accelerating the melting of sea ice and glaciers, sea levels are rising. Two different mechanisms will cause the sea level to rise if global warming takes place. First, sea levels rise as a result of seawater's thermal expansion brought on by warming temperatures. Second, melting glaciers and ice sheets in Greenland and Antarctica would add water to the ocean. Between 1990 and 2100, the average sea level on Earth is expected to increase by 0.09 to 0.88 meters. (Latake *et al.,* 2015).

d. **Ocean Acidification:** Increasing atmospheric carbon dioxide (CO2), primarily from burning fossil fuels, lowers the pH of the ocean and completely changes the chemistry of saltwater carbonating substances. A recent trend showing a decrease in the ocean's pH is causing ocean acidification (Keeling *et al.,* 2004). The few studies conducted at climate-relevant CO2 levels make it difficult to predict how ocean acidification would affect marine ecosystems (Fabry *et al.,* 2008). Acidification alters the biogeochemical cycles and chemical speciation of several elements and compounds in seawater. One well-known effect on marine organisms that produce shells, such as plankton, benthic molluscs, echinoderms, and corals, is the decrease of calcium carbonate saturation states. Ocean acidification also causes some photosynthetic organisms—calcifying and non-calcifying—to fix carbon more quickly. The seas are rising as a result of this, even though the oceans are crucial in removing extra CO2 from the atmosphere. Ocean life is also being severely harmed. Since 1960, there has been a recorded drop in stream flow in mid- and low-latitude river basins, such as the Yellow River, where precipitation has reduced (Piao *et al*., *2010).*

e. **Change in Cryosphere:** The term "cryosphere" refers to frozen water. Snow, river ice shelves, lake ice, ice sheets, sea ice, ice caps, and glaciers are some of its constituents. Because of its 95% reflectivity, surface ice is essential to earth albedo. Water supply and glacial hazards are two examples of how climate change affects the 10% of people on Earth who live within 100 kilometers of a glacier area. The cryosphere is typically separated into three categories based on the types of cryospheric elements that are now in existence: continental, marine, and atmospheric (Qin *et al.,* 2017). The cryosphere is particularly susceptible to climatic shifts. Global warming has gradually increased the negative consequences of cryosphere change. There are significant issues with the ecological environment and sustainable development in the areas where high-altitude cryosphere has an immediate influence (Wang *et al.,* 2018).

Impact on Human Health

Greenhouse gases (GHGs) are essential to maintaining the environmental conditions required for human survival on Earth. Not only do greenhouse gases contribute to climate change and global warming, but they also have detrimental effects on human health. Short-term exposure to these gases is safe for human health, but long-term exposure to high amounts is detrimental. The long-term exposure gradually affects several organs, including the digestive system, immunological system, respiratory system, cardiovascular system, central nervous system (CNS), and often the reproductive system. People are concerned about the state of the environment since it affects their health. It is well recognized that the three primary greenhouse gases—ozone, carbon dioxide, and water vapor—have an impact on a person's health and genetic activity because of the greenhouse effect.

The human body temperature is nearly 38 degrees Celsius, and increasing the outside temperature by 40.6 degrees Celsius raises the risk of organ damage and loss of consciousness (Wyndham and Strydom, 1969).

There are three ways by which climate effect the lifestyle; First direct effect, which include extreme weather, heat, drought etc. Second, effects through natural system which include diseases and pollution. Third, effects through human system which include mental stress, under nutrition etc.

Windstorms and flooding are harmful to human health because they can result in cholera, injuries, infectious infections (such vector-borne diseases), and drowning (Jakubicka *et al.,* 2010; Burroughs *et al.,* 2007). Vector-borne illnesses like malaria and dengue fever are increasing in areas with warmer temperatures. Most frequently, the ozone layer is being destroyed by climate change, which makes it possible for UV radiation from the sun to penetrate and cause burns and skin cancer. According to the IPCC's special report SREX, the probability of heat-related death is rising as the number of cold days is declining and the number of hot days is rising (Christidis *et al.,* 2012). An increase in mortality is directly correlated with hot days (Lee *et al.,* 2013). Forest fires are estimated to kill 339,000 people each year, while air pollution causes 260,000 to 600,000 deaths (Reid *et al.,* 2016).

Conclusion:

The increasing concentration of greenhouse gases in the atmosphere has far-reaching effects for the environment, human health, and the economy. Climate change is producing rising temperatures, changes in precipitation patterns, sea level rise, and ocean acidification, all of which are having a disastrous impact on ecosystems, biodiversity, and human populations. The cryosphere is especially vulnerable to climate change, and melting is having a considerable impact on sea levels, ocean currents, and weather patterns. Furthermore, climate change has a considerable impact on human health, resulting in increased mortality, morbidity, and mental health difficulties. To counteract climate change, we must immediately cut our carbon footprint, move to renewable energy, and develop sustainable technology.

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