

Editorial:

Global Warming and Greenhouse Gases: A Major Public Health Issue in Today's World

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Global warming is one of the major public health issues in today's world because of its effect on environment causing humanitarian crises. This paper briefly describes the causes and effects of global warming, identifies the major greenhouse gases responsible for global warming and its remedial.

The main reason for the global warming is the temperature rise of the planet. Since 1975, the temperature of the earth has increased by about 0.5°C¹. The sun is the main source of energy and heat in the earth. Global warming initiates upon sunlight reaching the earth's surface where it is absorbed in the form of energy by the ocean, air and land while the 30% of it is radiate back into the atmosphere as heat. However, in the atmosphere, some of the outgoing radiation is re-absorbed and trapped by greenhouse gases (GHG) such as carbon dioxide (CO₂), ozone, methane (CH₄), sulphur dioxide (SO₂), chlorofluorocarbon (CFC), nitrogen dioxide (NO₂) and water vapour due to their heat-trapping capacity^{2,3}. This trapping in fact prevents the earth's surface to become very cold and preserve the earth's climate as liveable. Without this, the earth's surface would be an average of about 33°Celsius cooler⁴. This natural process to maintain the temperature of the earth is known as the greenhouse effect as the earth's atmosphere works as the glass panes of greenhouse

by trapping the radiation received from the sun³.

Current consensus is that the greenhouse gases such as CO₂, methane, nitrous oxides and in some cases chlorine and bromine containing compounds are increased very high in the past two centuries causing an increased temperature to be trapped and making the earth warmer^{3,4}. Intergovernmental Panel on Climate Change (IPCC) has estimated that, human activities have caused approximately 1.0°C (0.8°C to 1.2°C) of global warming above pre-industrial levels and it will reach to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate⁵.

The GHG emission comes from natural systems as well as by human or anthropogenic activity. The natural sources are forest fires, oceans, wetlands, permafrost, mud volcanoes, volcanoes, and earthquakes⁶. In addition to carbon, CH₄ released by volcano, wetland, high latitude permafrost also contributes to GHG emission⁶. On the other hand, global GHG emission contributed by the anthropogenic or human activity is around 362 Gt CO₂-eq per year which is approximately 47.9%–66.6% (average 55.4%) of the total global GHG emissions⁶. The major source comes from industrial revolution and the burning of coal and oil which are fossil fuels. Heating calcium carbonate during cement manufacture and generate lime and CO₂ is a major cause of emission of CO₂ to

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atmosphere². The CO₂ emission from both these sources are increased approximately 70% from year 1990 to year 2016⁶. Agricultural practices, deforestation, industrialization, various types of land use changes are the other human activities that causes global warming.

Total anthropogenic or man-made GHG emissions has reached as high as 49 (±4.5) gigatons CO₂-equivalents per year (GtCO₂eq/yr) in 2010⁷ which is at the top of the list. The major contribution of CO₂ comes from burning of fossil fuels, deforestation caused by the removal of trees in the atmosphere, and from cement manufacture and transport vehicles². Among the GHG, CH₄ has a significant role causing global warming. This gas is the primary component of the natural gas, produced significantly by agricultural activities such as livestock digestion, paddy farming, use of manure, improper management of waste, biomass burning and fossil fuel use^{2,8}. It is estimated that approximately 40% of the atmospheric CH₄ comes from natural source and 60% from the human activity⁹. The global concentration of CH₄ has risen from 1866 parts per billion (ppb) in 2018 to 1875 ppb in 2019. Emission of CH₄ was found to be 50% higher between 2013-2018 compared to previous 5-year period¹⁰. Nitrous oxide (N₂O) emits from soil due mainly to microbial activity in nitrogen (N)-rich soils to fertilizer use, and various industrial processes. Nitric oxide (NO) is a GHG which in the troposphere oxidizes to nitrogen dioxide (NO₂) and may react with volatile organic compounds and hydroxyl, resulting in organic nitrates and nitric acid, respectively⁸. Ozone (O₃) is present in both stratosphere and troposphere layer. About 90% of O₃ is present in the stratosphere, with approximately remaining 10% in the troposphere. The stratospheric ozone layer is the natural ozone layer, that has a protective role on humans and ecosystems by shielding the sun's harmful ultraviolet rays¹¹. While the tropospheric ozone absorbs the infrared rays radiating from the earth's surface and work as a powerful greenhouse gas. It is regarded as the third most powerful greenhouse gas in the atmosphere, after CO₂ and CH₄. This tropospheric ozone is influx from the stratosphere as well as formed by photochemical reactions. Human activity has increased the tropospheric ozone layer which is harmful to lives due to its significant air poisoning effect. This tropospheric ozone ingests the infrared beams radiating

from the earth and acts as an effective ozone-depleting substance¹². Fluorinated gases are man-made greenhouse gases produce by the industrial activities³. Water vapour and clouds present in the troposphere layer of earth is the most important absorber of infrared radiation which is 49% and 25% respectively. Although, the lifetime of water vapour is only few days compared to CO₂ which is years, its concentration is indirectly increased by human activity causing global warming⁸.

Global warming causes hotter heat waves, more frequent droughts, heavier rainfall, and more powerful hurricanes and floods. All these adverse effects result in crop failure and famine especially in areas where the temperatures are already high². People suffer from disease, injury and death from all these changes¹³. Global warming has an enormous effect on the earth's ecosystem. High temperature causes the melting of glaciers, sea ice at the poles and rising of sea level. It disrupts the plant and animal habitat and even can destroy the species or habitat¹⁴. The rise of sea level causes the saline sea water to intrude into the farm lands that causes a devastating effect on the agricultural system, food output and jeopardizes the economy of a country¹⁵. Global warming has an enormous effect on human health. The warm weather facilitates the mosquito-borne diseases like malaria, other viral infections, respiratory disease from smog and air pollution, cardiovascular disease and gastroenteric disorders. Infectious disease like dengue fever caused by dengue virus can be another consequence of warmer weather¹⁵. Global warming is the most important environmental problem because of its negative impact on human communities and on ecosystems.

To reduce the emission of CO₂, it is necessary to reduce all carbon emitting activities and introduce clean energy sources rather than the conventional fossil-fuel energy sources that emits GHGs. Thus, move to energy efficiency and to non-fossil-fuel energy sources is urgently needed^{15, 16}. Transport vehicles driven by renewable energy sources and use of electric vehicles are a good alternative to reduce the carbon emission¹⁷. Alternative power sources like solar power should be introduced extensively instead of conventional power sources. All illegal deforestation activities should be strictly dealt with implementation of strict laws in this regard¹⁵. Proper land management

and reducing food waste can contribute greatly as well as individual behavior and lifestyles changes plays a part in this regard¹⁷. Removal of CO₂ from the atmosphere can be done by technologies such as Bioenergy with carbon capture and storage, and CO₂ capture, utilization and storage technologies (CCUS) and carbon sink in land and ocean¹⁷.

A high level of international cooperation among the scientific, political, and social communities

with strict governmental policy are very much needed to reduce the global GHG emission and global warming.

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