A Study on Greenhouse Effect and Global Warming

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ABSTRACT: ***The current study discusses the greenhouse effect, greenhouse gases, and their potential to cause global warming. India has severe climatic conditions, with temperatures ranging from 15 to 52 degrees Fahrenheit. The Himalayan areas have snow glaciers throughout the year, but the Indo Gangetic plains have hot temperatures for the most of the year. Rainfall in areas like Cherrapunji (North-East) can reach 1100 mm, whereas dry regions like Rajasthan receive very little rain throughout the year. The Greenhouse effect is one of the most important factors in keeping the Earth warm because it prevents part of the planet's heat from escaping into space. Greenhouse gases and their influence on global warming are the subject of a study report. The Earth's average global temperature would be substantially cooler without the greenhouse effect, and life on Earth as we know it would be impossible. Water vapour, CO_2, methane, nitrous oxide (N_2O), and other gases are examples of greenhouse gases. CO_2 and other greenhouse gases wrap around infrared radiation like a blanket, preventing it from escaping into space. The obvious consequence of greenhouse gases is a steady heating of the Earth's atmosphere and surface, resulting in global warming. The effects of global warming, such as glacier melting, agricultural effects, health effects, and sea level rise, have been discussed, as well as possible mitigation strategies. The study also demonstrates the significance of greenhouse gases in global warming.***

KEYWORDS: ***Carbon Dioxide, Chlorofluorocarbon, Greenhouse Gases, Greenhouse Effect, Global Warming.***

1. INTRODUCTION

India is a huge country in South Asia with a population of about 1.2 billion people. It is the world's second most populated country. India is located between 6° 44' and 35° 30' north latitude and 68° 7' and 97° 25' east longitude, north of the equator. It has a 7517-kilometer coastline with the Indian Ocean, Arabian Sea, and Bay of Bengal. Pakistan, China, Nepal, Bhutan, Burma, and Bangladesh share land borders [1]. India's vast size allows for a broad range of temperatures, from the bitterly cold winters in the Himalayas to the searing heat of the Thar Desert. The aforementioned two regions have a key influence in influencing India's weather, making it warmer than its latitude would suggest. The Himalayas contribute to this warming by blocking cold winds from entering, while the Thar Desert draws the summer monsoon winds, which are responsible for the bulk of India's monsoon season. The bulk of the regions, however, may be classified as tropical [2].

The fact that Earth's average surface temperature is pleasant between the boiling and freezing points of water, making it suitable for our kind of life, cannot be explained simply by claiming that the planet Earth orbits the sun at just the right distance from it to absorb just the right amount of solar radiation. The mild temperatures are also the result of having the right sort of environment. The atmosphere of Venus would create hellish, Venus-like temperatures on Earth, whereas the troposphere of Mars would leave the Earth shivering in a Martian-style cold freeze [3]. Furthermore, sections of the earth's atmosphere function as a thin shielding blanket, receiving just enough solar radiation to keep the world average temperature in a pleasant range. The blanket on Mars is too thin, whereas the blanket on Venus is far too thick. The 'blanket,' as defined above, is a collection of atmospheric gases known as greenhouse gases, which trap heat in the same way as the glass walls of a greenhouse do. Water vapour, carbon dioxide, methane, and nitrous oxide are the most common gases that act as effective global insulators.

Inbound UV light readily penetrates through the greenhouse's glass walls and is absorbed by the plants and hard surfaces within. Weaker infrared (IR) radiation, on the other hand, has a hard time passing through the glass walls and becomes trapped within, warming the greenhouse. This result allows tropical plants to thrive in a greenhouse, even in the dead of winter. By trapping heat in our atmosphere, the greenhouse effect raises Earth's temperature. This keeps the Earth's temperature higher than it would be if the Sun's direct heating was the only source of warmth. When sunlight reaches the Earth's surface, part of it is absorbed and heats the ground, while the rest is reflected back into space as heat. The majority of greenhouse gases in the atmosphere attract and then radiate part of this heat back to Earth [4]. The greenhouse effect is a multi-million-year-old natural phenomenon. It is an important factor in determining the Earth's total temperature. Joseph Fourier discovered the greenhouse effect in 1827, John Tyndall empirically confirmed it in 1861, and Svante Arrhenius quantified it in 1896 [5].

1.1 Greenhouse Effect:

Greenhouse gases are gases that absorb and emit thermal infrared light. This procedure is the root cause of the effect, thus it's important to understand. Carbon dioxide, chlorofluorocarbons, methane, and nitrous oxide are the major greenhouse gases in Earth's atmosphere. Most prevalent greenhouse gases in Earth's atmosphere in order of abundance are:

- Carbon dioxide
- Chlorofluorocarbons
- Methane
- Nitrous oxide

The greenhouse gases found in the troposphere that cause an increase in air and earth temperature are described here.

1.1.1 Carbon dioxide:

It contributes roughly 55% of the greenhouse gases produced by human activities to global warming. Fossil fuel combustion (67%) and deforestation, as well as various types of land clearance and burning, are the primary causes (33 percent). In 1990, the CO2 content in the atmosphere was 355 parts per million, and it is growing at a rate of 1.5 parts per million each year[6].

1.1.2 Chlorofluorocarbon:

It is responsible for 24 percent of human-caused greenhouse gas emissions. They also cause ozone depletion in the stratosphere. CFCs are mostly produced by leaky air conditioners and refrigerators, among other things. CFC concentration in the atmosphere is 0.00225 ppm, and it is growing at a rate of 0.5 percent each year.

1.1.3 Methane:

It is responsible for 18% of the increasing greenhouse gas emissions. Methane is generated when bacteria decompose dead organic waste in damp, oxygen-deficient environments such as swamps, natural wetlands, paddy fields, landfills, and cow, sheep, and termite digestive systems. Methane content in the atmosphere is 1.675 parts per million, and it is growing at a rate of 1% per year.

1.1.4 Nitrous oxide:

It is responsible for 6% of human-caused greenhouse gas emissions. It is produced by the breakdown of nitrogen fertilisers in soil, animal wastes, and nitrate-contaminated groundwater, as well as the combustion of biomass and nitrogen-rich fuels (particularly coal). The concentration of N20 in the atmosphere is 0.3 parts per million, and it is growing at a rate of 0.2 percent each year.

1.2 Foundations of Greenhouse Effect:

The interaction of the sun's energy with greenhouse gases such as carbon dioxide, methane, nitrous oxide, and fluorinated gases in the Earth's atmosphere causes the greenhouse effect. The greenhouse effect is caused by these gases' capacity to absorb heat. Three or more atoms make up greenhouse gases. Because of their molecular structure, these gases may retain heat in the atmosphere and subsequently transmit it to the surface, warming the Earth more [10]. This continuous cycle of heat trapping points to an overall rise in world temperatures. The mechanism, which is remarkably similar to how a greenhouse works, is the primary reason why the gases that may cause this result are referred to as greenhouse gases together.

1.3 Reduction of Greenhouse Gases:

In recent years, bioremediation has emerged as one of the most cost-effective and promising methods for reducing GHG emissions into the atmosphere. Other greenhouse effect mitigation strategies may include actions such as increased tree planting, reduced fossil fuel burning, exploitation of inexpensive, clean, and renewable energy, carbon dioxide capture and sequestration, and so on. To eliminate contaminants, the bioremediation process uses microbial metabolism. Hazardous waste, including greenhouse gases, may be removed from the biosphere using a bioremediation technology and approach (phytoremediation improved by endophytic microbes).

1.4 Global Warming;

Global warming is the long-term warming of Earth's climate system that has been seen from the pre-industrial period (between 1850 and 1900) as a result of human activity, particularly fossil fuel combustion, which

raises heat-trapping greenhouse gas levels in the atmosphere. The terms are commonly used interchangeably, however the latter refers to both human- and naturally-caused warming, as well as the consequences for our world. The average rise in Earth's global surface temperature is the most used metric.

1.5 Mechanism of Global Warming:

a) The Sun's incoming radiation is primarily visible light, with wavelengths ranging from 0.2 to 4.1m, equivalent to a radiative temperature of 6,000 K.
b) The earth's surface absorbs about half of the Sun's energy, while the remainder is reflected or absorbed by the atmosphere. The underlying process is unaffected by light reflection back into space.
c) The surface is warmed by the absorbed energy. This heat is lost as thermal radiation in simple depictions of the greenhouse effect, such as the idealised greenhouse model.

Because the quantity of water vapour, a significant greenhouse gas, is falling, radiative energy losses are becoming increasingly important higher in the atmosphere. The greenhouse effect should be thought of as affecting a "surface" in the mid-troposphere that is effectively connected to the surface by a lapse rate.

1.6 Effects of Global Warming:

- *Global Temperature Increase:* If greenhouse gas emissions continue to rise at their current rate, the earth's mean temperature is expected to rise by 1.5 to 5.5°C by 2050.
- *Rise in Sea Level:* As the global temperature rises, sea water expands. The melting of polar ice sheets and glaciers as a result of warming will result in a further rise in sea level. According to current estimates, a 3°C increase in average air temperature will raise global sea level by 0.2-1.5 metres during the next 50-100 years.
- *Effects on Human Health*: Global warming would alter rainfall patterns in many regions, altering the spread of vector-borne illnesses such as malaria, filariasis, and elephantiasis, among others. Areas that are now devoid of illnesses such as malaria, schistosomiasis, and others may become breeding grounds for the diseases' vectors.
- *Effects on Agriculture:* It is responsible for 24 percent of human-caused greenhouse gas emissions. They also cause ozone depletion in the stratosphere. CFCs are mostly produced by leaky air conditioners and refrigerators, among other things. CFC concentration in the atmosphere is 0.00225 ppm, and it is growing at a rate of 0.5 percent each year.

Even a 2°C increase may be disastrous for crops. Soil moisture will drop as evapotranspiration rises, posing a serious threat to wheat and maize output. Increases in warmth and humidity will encourage insect proliferation, as well as the growth of disease vectors.

1.7 Control Measure of Global Warming:

1.7.1 Plant More Trees and Stop Deforestation:

This is by far the most straightforward way to protect our planet from the dangers of global warming. The large-scale concentration of carbon dioxide in the atmosphere is to blame for global warming.

1.7.2 Replace incandescent light bulbs with compact fluorescent light bulbs:

Every home that utilises incandescent bulbs contributes significantly to global warming. By replacing incandescent bulbs with energy-efficient Compact Fluorescent Light bulbs (CFLs), you may reduce carbon dioxide emissions and save up to 60% on electricity costs.

1.7.3 Reuse and Recycle Products:

Reusing and recycling various products that we use on a daily basis can also help you contribute to the fight against global warming. For example, recycling paper will ensure that large-scale tree felling for paper production is halted, and these trees will absorb carbon dioxide from the atmosphere, reducing global warming.

1.7.4 Unplug Appliances:

Another effective approach to solve global warming issues is to unplug appliances to conserve energy. Simply disconnecting all of your electrical gadgets that aren't in use can save you up to 20% on your energy bill.

1.7.5 Prevent Leaving Electrical Appliances on Standby:

Similarly, leaving electronic appliances on standby wastes energy and adds to global warming, therefore it's better to avoid it. It may appear that putting a single computer on standby will not make a significant impact, but when millions of people think in this way, it does.

1.7.6 Encourage the Use of Organic Products:

One of the most effective methods to combat global warming is to encourage the use of organic foods. According to estimates, switching to organic farming for food production may save us 580 billion pounds of CO2.

1.7.7 Drive Vehicles Efficiently:

Vehicles emit a significant quantity of carbon dioxide into the environment, making them one of the major contributors of pollution. If you can't live without your car, you can contribute to global warming by following efficient driving guidelines like shutting off the engine at red lights and driving at moderate speeds.

1.7.8 Use Alternative Energy Sources:

Using alternative energy sources such as solar and wind power is one of the most often discussed global warming solutions. Simply eliminating fossil fuels would assist to reduce the massive quantity of carbon dioxide released into the sky every day. If humans give up the superfluous luxuries in our lives, they can help save the enormous amount of energy that goes into their manufacture.

2. LITERATURE REVIEW

Jun-Young Oh et al. discussed Greenhouse Effects in Global Warming based on Analogical Reasoning in which they explained how using analogies in science and everyday life is a double-edged sword since, in addition to scientific notions, they are accompanied by alternative ideas. Global warming is explained in schools and public education by drawing a common parallel between the phenomena and greenhouse effects. Unfortunately, this similarity can lead to a variety of erroneous explanatory mental models. To create a right knowledge of global warming, first study the characteristics of analogical thinking; second, comprehend these characteristics by restructuring the greenhouse analogy; and third, investigate the difficulties and benefits of the greenhouse analogy. The attributes of relations, not objects, must be mapped according to the concept of systematicity, but the public prefers to maintain the attributes of the base domain, which is comparatively easy to map. Finally, several aspects of the prevalent greenhouse analogy affect public perceptions of climate change [7].

O'Brien S discussed Greenhouse effect and global warming in which the author explained how the term "greenhouse effect" refers to the increasing warming of the Earth as a result of rising amounts of carbon dioxide and other greenhouse gases in the atmosphere (GHGs). GHGs trap heat and warm the globe in the same way as glass in a botanical greenhouse captures heat for growing plants. For billions of years, the greenhouse effect, a natural phenomenon, has been an important part of Earth's history. The greenhouse effect is caused by a delicate and ever-changing balance between life and the environment. Nonetheless, the greenhouse effect may be bringing the world to its knees. The existence of increased amounts of GHGs has threatened to alter global climate since the Industrial Revolution, and the expected implications of this rise are currently being disputed among experts [8].

ThomasR Anderson et al. discussed the greenhouse effect and global warming in which they discussed how based on the ensemble-mean results of state-of-the-art Earth SystemModels, climate warming over the next century is expected to range between 1.0 and 3.7 degrees Celsius, depending on future greenhouse gas emissions (ESMs). The early history of climate study reveals the knowledge and science required to respond to this topic. We look at Svante Arrhenius's (1859–1927) and Guy Stewart Callendar's (1898–1964) mathematical quantifications of the planetary energy budget and build an empirical approximation of the latter, which they demonstrate to be successful in retroactively predicting global warming over the twentieth century [9].

M. Zulfequar Ahmad Khan et al. discussed Impact of global dimming and brightening on global warming in which they discussed Concerns about the impact of variations in surface solar radiation on global warming range from claims that solar dimming has largely masked the full magnitude of greenhouse warming to claims that the observed warming is the result of the recent reversal from solar dimming to brightening rather than the greenhouse effect. Trends in diurnal temperature range are examined to separate surface solar and greenhouse impacts on global warming. They claim that solar dimming was successful in hiding greenhouse

warming until the 1980s, when it progressively turned into brightness. Since then, the newly discovered greenhouse effect has revealed its full extent, as evidenced by a fast rise in global temperatures [10].

3. DISCUSSION

This paper solely focuses on greenhouse effect and global warming. It discusses several aspects of greenhouse effect which lead to global warming. Carbon dioxide, chlorofluorocarbons, methane, and nitrous oxide are the major greenhouse gases in Earth's atmosphere. The interaction of the sun's energy with these greenhouse gases in the Earth's atmosphere causes the greenhouse effect. This paper discusses causes of greenhouse effect and global warming. This paper discusses major greenhouse gases which affect the environment. It discusses foundation and reductions methods for greenhouse effect. It discusses several control measures and effects of global warming. Several other important concepts have been discussed.

The most successful bioremediation technology for removing greenhouse gases is phytoremediation. Living green plants in situ are utilised in phytoremediation. Contaminants in soil, air, water, and sediments can be reduced or removed by living green plants. Endophytic microbes that have been chosen or manipulated have recently been utilised to improve phytoremediation processes. Endophytic microbes have been shown in several studies to be effective at speeding up these processes by interacting directly with their host plants. Another method for minimising the greenhouse effect's negative impacts is to employ methanotrophic endophytes found in Sphagnum Spp. as a natural methane filter. It has the potential to cut CH4 and CO2 emissions from peatlands by up to 50%. Depending on the season and the host plant, studies have shown that plant–methanotrophic bacteria systems have the potential to reduce methane emissions by up to 77 percent.

4. CONCLUSION

The major goal of this research was to look at the greenhouse effect, greenhouse gases, and their potential to cause global warming. Various greenhouse gases have been found to raise global temperatures and have an impact on human health and agriculture. Global warming is thought to be caused by a strengthening of the greenhouse effect, mostly as a result of human-caused increases in atmospheric greenhouse gases. It may be concluded that recycling paper will prevent large-scale tree felling for paper production, and that these trees will absorb carbon dioxide from the atmosphere, reducing global warming.

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