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The Effects of Greenhouse Gas Emissions on Global Climate Patterns

Lead Author:

Engr. Prof. Theophilus Aku Ugah
Engineer/Environmentalist/Oil & Gas Professional
Highstone Global University, Texas, USA
theogah2004@gmail.com.

2nd Author:

Associate Professor Cynthia Amaka OBIORAH PhD
Centre for Occupational Health Safety and Environment,
University of Port Harcourt, Port Harcourt, Nigeria
cynthia.obiora@cohseuniport.edu.ng

Prof. Okeke Gerald Ndubuisi
(Professor of Climate Change & Environmental Sustainability)
FNisafetyE, FISPON, etc.
Highstone Global University, Texas, USA.

Engr. Prof. Sony Emeka Ali
(Professor of Civil Engineering & Project Management)
FNSE, FNICE, FNisafetyE, FNIStructE.
Highstone Global University, Texas, USA.

Dr. Omatseyione Nesiana
Health Safety & Environmentalist/Geologist/Oil & Gas Professional
Email: otseyione@gmail.com.

Engr. Cletus Onyemhese Agbakhamen
Email ID: cletus.agbakhamen@chevron.com; ceestrides@gmail.com
Phone number: +2348039760095

ABSTRACT

One of the most significant global challenges is the increase in climate change due to the excessive emission of greenhouse gases. Carbon dioxide gas, resulting from the combustion of fossil fuels, and methane are recognized as the primary greenhouse gases and the foremost contributors to climate change. We adopted archival research and related that Population density, increased vehicular traffic, industrial factories, and neglect of environmental concerns are major factors influencing the concentration of greenhouse gases in the atmosphere. We also used content analysis to make our discussion along the lines of greenhouse gases, pollution, its effect and consequences and its effect on climate change and it was recommended that greenhouse gasses must be managed if truly we are to mitigate the effect of climate change on our planet and countries be compelled to adopt measures to manage greenhouse intend spea gases.

Keywords: Carbon dioxide, gas, climate change, emission, greenhouse, atmosphere, global warming.

INTRODUCTION

Although the earth is inhabitable due to the natural greenhouse effect of the atmosphere, human race faces global warming due to the increase in greenhouse gas volume induced by anthropogenic activities that increased with population growth as a result of the industrial revolution and subsequent developments in science and technology. The climate change due to global warming is associated with the increase in average surface temperature and climatic changes as a result of the rapid increase in the greenhouse gas accumulation in the atmosphere due to human activities such as burning fossil fuels, changes in land use, deforestation and industrialization. Significant variations in extreme mean surface temperatures, ice and snow cover, precipitation, ocean temperature and salinity, wind types, drought, heavy precipitation and heat waves have been considered as the causes of climate change (Binboğa and Unal 2018; İkizoğlu 2019)

Human health is significantly endangered by climate change. It impacts the physical environment, as well as the social and economic conditions and the functioning of health systems, in addition to all the aspects of natural and human systems (Hegerl et al., 2019). Therefore, it elevates the risk and has the capacity to revert decades of health advancements. Storms, droughts, floods, wildfires, and extreme heat waves are among the weather and climate events that are escalating in frequency and severity as climatic conditions vary. These weather and climate-related threats have an influence on health indirectly as well as directly by increasing the risks of noncommunicable diseases, infectious illness onset and death, medical emergencies, and transmission (Cipriani, & Menicucci, 2024). Climate change is having an influence on health sector personnel and infrastructure, which makes it more difficult to offer "universal health care (UHC)". The social and environmental factors of both physical and mental health are generally harmed by climatic disturbances and increasing pressures, such as fluctuating temperature and precipitation patterns, floods, droughts, and rising sea levels. To Cipriani, & Menicucci, (2024), Climate change affects numerous health variables, including access to pure soil, water, and oxygen, as well as food systems and livelihoods. By continuing to delay the resolution of climate change, we will undermine decades of progress in promoting global wellness, increase health risks, and violate our shared commitment to guaranteeing the right to optimal health for all (Abouelfadl, 2012).

The balance of energy coming into and going out of the planet's system controls Earth's temperature. When sunlight hits the surface of the earth, it may either be consumed by it or projected back into space (İkizoğlu, 2019). As the earth absorbs incoming energy, the globe warms up. Earth returns a portion of the energy to the atmosphere as heat, which is frequently referred to as infrared radiation, after it has been absorbed. Solar energy that is deflected back into space does not heat Earth (Erdoğan, Düzgüneş, & Balık. 2008). Heat sent into space is slowed or stopped by particular gases in the environment absorbing energy. "Greenhouse gases" are the label given to these gases. As a result of their blanket-like nature, the earth experiences an increase in temperature. The "greenhouse effect," which is also known as this mechanism, is a fundamental and common component of the preservation of life. But the amounts of greenhouse gases in the atmosphere that humans are now causing have changed the climate of our planet and have dangerous effects on ecological systems, human wellness and welfare (Arif, 2024). It is in light of this, that this study assesses the effects of greenhouse gas emissions on global climate patterns.

Statement of the Problem

The increasing levels of greenhouse gas emissions, primarily resulting from human activities such as burning fossil fuels, deforestation, and industrial processes, are significantly contributing to climate change. This phenomenon is leading to rising global temperatures, changes in precipitation patterns, and increased frequency of extreme weather events. Consequently, ecosystems, human health, and economies worldwide are facing substantial threats, including ecosystem disruption, biodiversity loss, increased health risks, and economic losses. The severity of these impacts underscores the urgent need for mitigation and adaptation strategies to address the root causes of climate change and minimize its far-reaching consequences.

Aim and Objectives of the Study

The main aim of this study is to assess the effects of greenhouse gas emissions on global climate patterns. Specifically, the study:

1. Examine the global emission index of greenhouse gases (GHG).
2. Analyse the air pollution, greenhouse effect, and its consequences.
3. Investigate the effect of greenhouse gases on climate change.
4. Assess the effects of greenhouse gases on natural systems.
5. Examine greenhouse gases composition and characteristics.

Research Questions

The following research questions guided the study

1. What is the global emission index of greenhouse gases?
2. What are the effects and consequences greenhouse gases on atmospheric air.
3. In what way do greenhouse gases affect climate change?
4. How do greenhouse gases affect natural system?
5. What are the composition and characteristics greenhouse gases?

Scope and Limitations of the Study

Scope

This study focuses on:

1. Examining the global emission index of greenhouse gases.
2. Discussing the effects and consequences greenhouse gases on atmospheric air.
3. Exploring potential effect of greenhouse gases on climate change.
4. Assess the effects of greenhouse gases on natural systems.
5. The composition and characteristics greenhouse gases.

Limitations

This study is limited by:

1. Relying on existing literature and research findings.
2. Not conducting primary data collection or analysis.
3. Focusing on general trends and patterns rather than specific case studies or regional analyses

Significance of the Study

This study is significant because it:

1. Highlights the critical role of greenhouse gases in climate change.
2. Raises awareness about the urgent need for mitigation and adaptation strategies.
3. Informs policy and decision-making processes aimed at reducing greenhouse gas emissions.

Review of Related Literatures

Global Emission Index of Greenhouse Gases Effects

GHGs are gases that absorb a quantity of atmospheric radiation which contribute to climate change. The carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs) and Sulphur hexafluoride (SF₆) represents the main anthropogenic GHGs. These GHGs are emitted following human activities where the use of fossil fuels, agriculture, land use change, industry and waste management are implied. According to the Ministère de la Transition Écologique de la France (2021), GHG emissions related to human activities represented the equivalent of 55.3 billion tonnes of CO₂ in 2018, with CO₂ accounting for 75% of these emissions. The global CO₂ emission increased by 1.9% in 2018, reaching a level that was more than 65% higher than in 1990. However, there were significant differences among countries in terms of their emissions levels and trends. China was the largest emitter of CO₂ in 2018, with 30% of the global share, followed by the United States with 14%

and the European Union with 8%. On average, each person in the world emitted 5.0 tonnes of CO₂ per year in 2018, which was 16% more than in 1990. According to Easterling et al. (1997), IPCC (2001) and Sha Zhou et al. (2023), the increase of the atmospheric GHG concentration enhances the natural greenhouse effect, which is the process by which the Earth's surface and lower atmosphere are warmed by the absorption and re-emission of infrared radiation by GHGs. This may cause an increase in the global surface temperature mean, which can affect various aspects of the climate system, such as precipitation patterns, sea level rise, extreme weather events, ice melt, ocean acidification and loss of biodiversity (Zhou, S., Yu, B., & Zhang, Y. 2023).

The Intergovernmental Panel on Climate Change (IPCC) estimates that the global mean temperature has increased by about 1.1°C since the pre-industrial period (1850-1900), and projects that it will increase by 1.5°C to 4.5°C by 2100 depending on the future GHG emission scenarios.

According to the IPCC (2000), about 270 giga tonnes of carbon were released into the atmosphere from 1850 to 1998 due to fossil fuel use and cement production. The CO₂ concentration increased from 278 ppmv in the pre-industrial period to 410 ppmv in 2019 (WMO, 2020). This increase has accelerated since the mid-1960s, reaching an annual mean increase of 2.6 ppmv from 2018 to 2019.

Since the pre-industrial era (1750), anthropogenic gas emissions have had a significant impact on the greenhouse effect, as they absorb infrared radiation emitted by the Earth's surface and re-emit it back to the atmosphere. The absorption rate of this terrestrial energy depends on the atmospheric GHG concentration and the layer thickness that absorbs it. Among the GHGs, water vapor (H₂O) plays a predominant role and contributes to 62.5% of this effect, but its concentration is variable in the atmosphere with time and space. Other gases such as CO₂, CH₄, N₂O, O₃ and CFCs have a considerable influence on the greenhouse effect in the atmosphere, as they have increased considerably over the past century due to human activities

In recent years, greenhouse gases have emerged as a subject of great concern due to their pivotal role in shaping the changing climate. These gases, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases, possess the capability to trap heat in the Earth's atmosphere, thereby instigating the greenhouse effect (IPCC. 2014). This paper will explore the multifaceted role played by greenhouse gases in climate change, examining their sources, impact, and the urgent need for action. Greenhouse gases permeate the atmosphere through both natural processes and human activities. Natural sources include volcanic eruptions, plant and animal respiration, and the decomposition of organic matter. However, human activities significantly contribute to the surge in greenhouse gas concentrations. Activities such as fossil fuel combustion for energy generation, industrial processes, deforestation, and agriculture serve as primary anthropogenic sources. These activities have considerably elevated the levels of greenhouse gases, propelling us into the current climate crisis. The accumulation of greenhouse gases in the atmosphere has resulted in a phenomenon known as global warming—an increase in global temperatures. The greenhouse effect impedes the escape of heat into space, leading to the warming of the Earth's surface and lower atmosphere. This warming effect disrupts the delicate balance of the planet's climate systems, consequently yielding a range of adverse consequences. Among the most noticeable impacts of heightened greenhouse gas concentrations is the melting of polar ice caps and glaciers.

As temperatures rise, ice formations in the Arctic and Antarctic regions undergo rapid melting, consequently causing rising sea levels. This poses a significant threat to coastal communities and low-lying areas, increasing the risk of flooding and population displacement. Furthermore, due to the changing climate, extreme weather events such as hurricanes, heatwaves, and droughts are becoming more frequent and intense. Greenhouse gases are altering global weather patterns, leading to disruptions in precipitation patterns and exacerbating the severity of natural disasters. These extreme events bear devastating effects on ecosystems, agriculture, and human livelihoods. Addressing the challenges posed by greenhouse gases necessitates immediate and concerted action on a global scale.

It is imperative to reduce greenhouse gas emissions and transition towards sustainable and renewable energy sources. Governments, businesses, and individuals must collaborate to embrace cleaner technologies, enhance energy efficiency, and promote sustainable practices. International agreements, such as the Paris Agreement, seek to limit global warming to well below 2 degrees Celsius above pre-industrial levels. This agreement emphasizes the imperative for countries to reduce their greenhouse gas emissions and provides a framework for international cooperation in combating climate change. However, more extensive efforts are required to fully implement and enforce these commitments.

Greenhouse gases assume a significant role in the ever-changing climate, prominently driven by human activities. Their accumulation in the atmosphere engenders the greenhouse effect, ultimately leading to global warming and climate instability. The consequences of these changes are already evident, with rising sea levels and increasingly frequent extreme weather events. Urgent action is imperative to curtail greenhouse gas emissions and transition towards a sustainable, low-carbon future. By implementing effective mitigation strategies and adopting clean energy solutions, we can ameliorate the impact of greenhouse gases and safeguard the planet for future generations.

Greenhouse gases are gas molecules that have the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the phenomenon known as the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases, and they have a profound effect on the energy budget of the Earth system despite making up only a fraction of all atmospheric gases. Concentrations of greenhouse gases have varied substantially during Earth's history, and these variations have driven substantial climate changes at a wide range of timescales. In general, greenhouse gas concentrations have been particularly high during warm periods and low during cold phases. A number of processes influence greenhouse gas concentrations. Some, such as tectonic activities, operate at timescales of millions of years, whereas others, such as vegetation, soil, wetland, and ocean sources and sinks, operate at timescales of hundreds to thousands of years. Human activities—especially fossil-fuel combustion since the Industrial Revolution—are responsible for steady increases in atmospheric concentrations of various greenhouse gases, especially carbon dioxide, methane, ozone, and chlorofluorocarbons (CFCs).

Air Pollution, Greenhouse Effect, and Its Consequences

In recent decades, air pollution has emerged as an unwanted byproduct of industrial societies. The primary causes of air pollution are the release of hydrocarbon molecules, nitrogen oxides, and sulfur oxides (McMurry & Robert, 2007). The addition of any substance alters the physical and chemical properties of clean air to some extent; therefore, such substances are considered air pollutants. Pollutants are typically classified as substances that have significant effects on humans, animals, plants, or materials (Dabiri, 2010). In fact, humans are the only beings who consciously and unconsciously harm the environment. The consequences of human activities not only threaten human life but also jeopardize the natural habitats and lives of other creatures on this planet. Deforestation, depletion of production resources, improper waste disposal, and increased industrial activities have created a polluted environment that has made life on Earth difficult for all living beings. Environmental pollution has become a global problem; however, despite significant investments in this area, toxic compounds in various forms are increasing in the environment, making environmental pollution a serious and tangible threat to the survival of living beings.

Consequently, we are witnessing chronic diseases, including respiratory issues due to air pollution, internal infections resulting from water pollution and solid waste, and psychological disorders stemming from physical pain as direct impacts of environmental pollution (Salar, Moattar, & Khazri, 2014). The origins of air pollution during the early industrial revolution were primarily industries and coal fuel, and in the twentieth and twenty-first centuries, urban transportation has been responsible for air pollution in cities. Fossil fuels used in transportation and industry, on one hand, and industrial processes involving raw materials and manufactured products, on the other hand, are major sources of pollution with non-natural origins (Solgi, 2005). Today, one of the most significant problems the world faces is the increasing instability of the global climate due to the excessive emission of gases or the greenhouse effect (Mousavi & Fallah-Tekeh, 2020).

The primary concern regarding the greenhouse effect is the fear that human activities in the past and present may have disrupted Earth's delicate thermal balance. One component of this balance is the solar radiation received at Earth's surface, a portion of which is radiated back into space as infrared energy. Although most of this energy passes through the atmosphere, some of it is absorbed by atmospheric gases, particularly water vapor, carbon dioxide, and methane. This absorbed radiation warms the atmosphere and stabilizes Earth's temperature at a relatively constant level. An increase in absorbed radiation leads to a rise in atmospheric heat and an increase in Earth's temperature (McMurry & Robert C., 2007). The increasing emission of greenhouse gases and remote phenomena are among the factors influencing the speed of climate change (Kaltsas et al., 2007). Greenhouse

gases include a range of carbon dioxide (CO₂), nitrogen oxides (N₂O), methane (CH₄), ozone (O₃), chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs), which, by ascending into Earth's atmosphere and trapping solar energy, contribute to the warming of the planet and its surrounding air (Mozafari et al., 2015). Among these gases, carbon dioxide is recognized as the most important greenhouse gas and the primary factor in climate change, accounting for 50 to 60 percent of the greenhouse effect (Yhe et al., 2015). Although a small amount of these gases naturally exists in Earth's atmosphere, human activities and the resulting pollution have unnaturally increased their levels, trapping heat or thermal radiation from the sun in the atmosphere and consequently raising Earth's temperature (Mozafari et al., 2015). According to reports from the Intergovernmental Panel on Climate Change (IPCC), the iron and steel industry and waste production are identified as the largest global sources of greenhouse gas emissions from human activities. The World Resources Institute (WRI) also identifies the energy, industrial, agricultural, forestry, and waste and sewage sectors as the major producers of various greenhouse gases worldwide

Greenhouse gases and their effect on climate change

Climate change has been debated for a while on whether it's real or a myth. With the signing of the Paris climate agreement, it appears that everyone finally agrees it's real and we need start working on it before the planet reaches the danger zone from where it can't recover. Greenhouse gases are gases in the Earth's atmosphere that produce the greenhouse effect. Changes in the concentration of certain greenhouse gases, from human activity (such as burning fossil fuels), increase the risk of global climate change. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane, nitrous oxide, halogenated fluorocarbons, ozone, perfluorinated carbons, and hydro fluorocarbons.

These gases surround and insulate the Earth like a blanket. They allow the sun to reach and warm the Earth's surface then block the warmth from escaping back into space. Human activities, including those mentioned above, have continued to increase and have upset the balance of the natural system for several greenhouse gases: methane, nitrous oxide, fluorinated gases and especially carbon dioxide. As these gases continue to be emitted into the atmosphere, they form a thicker layer. And just like the blanket, the thicker it is, the more heat it holds.

The United States and China are the biggest contributors of these gases with the European Union coming in third. The major culprit of gas emissions is the burning of fossil fuels (coal, oil and natural gas). Other pollution activities include agriculture, deforestation and livestock breeding.

Carbon dioxide is the biggest contributor to the problem. It occurs naturally from a number of sources. In the natural system, CO₂ can be absorbed by oceans and plants taking it in during photosynthesis. The man-made increases of CO₂ have tipped the balance and these natural intake sources cannot absorb these additional amounts. Some CO₂ can remain in the atmosphere for thousands of years.

Even if the oceans could absorb more CO₂ from the atmosphere, it increases the acidity of the oceans and turns it into carbonic acid. This acid uses up the carbonate in the water so it's not available for sea creatures who need it for skeleton and shell building and coral reefs. Methane is the second largest culprit of the greenhouse gases. In addition to the same industrial sources that emit CO₂, landfills and rice cultivation are additional sources of methane gas. While methane does not last as long in the atmosphere as CO₂, it is much better at trapping heat.

Nitrous oxide (N₂O), another greenhouse gas, is part of the Earth's nitrogen cycle. Unfortunately, 40 percent of the nitrous oxide worldwide comes from human activities, including fossil fuel burning, agriculture and wastewater management. It can last in the atmosphere approximately 114 years before it is removed or destroyed by chemical reaction. According the U.S. EPA, "the impact of 1 pound of N₂O on warming the atmosphere is almost 300 times that of 1 pound of carbon dioxide."

Since weather information has been accurately recorded, the temperature trend has been increasing. For example, the ten warmest years on record have occurred since 1998 and so far, 2015 is the hottest year on record and with only a few weeks left in the year, it should end that way.

Effects of Greenhouse Gases on Natural Systems

Rising temperatures lead to reduced rainfall, increased evaporation and transpiration, altered wind patterns, changes in crop patterns, decreased agricultural output, more frequent droughts, expansion of arid regions, and alterations in surface and groundwater resources (Mofidi et al., 2015). Studies show

that the average surface temperature of the Earth and its atmosphere has risen over the past century, with the 2000s being the warmest decade since 1880. Climate change and global warming have the most significant impact on dry and semi-dry regions, including Afghanistan. Various factors influence the distribution of carbon dioxide in the atmosphere, such as topography (due to greenhouse gas transfers and interactions with surface features), rainfall (which washes gases and transfers them to underground areas), air currents, and wind. For instance, an increase in wind speed to 2 meters per second can help disperse and dilute surface carbon dioxide (Mousavi & Flahati, 2020).

- a. **Environment impact of climate change:** Environmental consequences of climate change, such as extreme heat waves, rising sea-levels, melting glaciers, changes in precipitation resulting in flooding and droughts, intense hurricanes, and degraded air quality, affect directly and indirectly the physical, social, and psychological health of humans.
- b. **Health impact of climate change:** Climate change will have a strong impact on human health.
- c. **Heat related morbidity and mortality:** The recorded temperature in the world in February 2016 was the hottest at 1.3 degrees Celsius followed by February 2017's temperature which was 0.200 C cooler than the previous year. Prolonged exposure to extreme heat can cause heat exhaustion, heat cramps, heat stroke, and death, as well as exacerbate preexisting chronic conditions, such as various respiratory, cerebral, and cardiovascular diseases. These serious health consequences usually affect more vulnerable populations such as the elderly, children, and those with existing cardiovascular and respiratory diseases. Socioeconomic factors, such as economically disadvantaged and socially isolated individuals, are also at risk from heat-related burdens. Hot working environments may decrease the ability to carry out physical tasks at outdoors, yet have direct implication on physical and psychological wellbeing. Moreover, it might have direct effect on productivity through exposure of workers to heat stress.
- d. **Asthma, Respiratory Allergies and Airway Diseases:** Climate change is anticipated to affect air quality through several pathways. Some of these pollutants can directly cause respiratory disease or exacerbate existing conditions in susceptible populations, such as children or the elderly. Some of the impacts that climate change can have the respiratory system include the chest pain, coughing, throat irritation and lung inflammation. Those symptoms occurred due to increase ground level ozone, CO₂ concentration and fine particle concentrations.
- e. **Cancer:** Increased exposure to toxic chemicals, known or suspected to cause cancer, that are released into the environment following heavy rainfall or flooding. Also, depletion of ozone leads to an increase in Ultra Violet (UV) exposure and temperature, leading to increase the risk of skin cancer and cataracts. Alternatively, an increase in exposure to UV radiation can lead to elevated levels of Vitamin D, which has been associated with a decreased risk of some types of cancer. It is said that decline in air quality and rise in concentrations of certain air pollutants increases the risk of lung cancer.
- f. **Cardiovascular Disease and stroke:** Extreme cold and extreme heat directly affect the incidence of cardiovascular diseases such as chest pain, stroke, and cardiac dysrhythmia (irregular heart beat). The elderly and isolated individuals are at the greatest risk for cardiovascular disease and stroke when triggered by temperature extremes. Also, increased ozone formation due to higher temperatures harms pulmonary gas exchange and causes stress on the heart that led to myocardial infarction.
- g. **Food borne Diseases and Nutrition:** Extreme weather events and changes in temperature and precipitation can damage or destroy, produces and interrupt the transportation and delivery of food. Recent experience in heavy flood in 2016 affected to most parts of Sri Lanka destroy yield heavily.
- h. **Mental health:** Climate change affects the psychological wellbeing of a person indirectly, and can be some of the most disturbing effects in terms of human suffering. Extreme weather and other climate related events range from acute traumatic stress to chronic mental disorders, such as depression, post-traumatic stress disorder, sleep difficulties, social avoidance, irritability, and drug or alcohol abuse.

- i. **Vector borne and zoonotic diseases :** Vector borne and zoonotic diseases are infectious diseases whose transmission involves animal hosts or vectors. Changes in temperature and precipitation directly affect the vector borne and zoonotic diseases pathogen-host interaction. The rapid spread of vector borne diseases such as dengue and malaria, has been attributed to a warmer climate favouring the build-up of harmful vectors. Waterborne diseases Climate change is likely to increase diarrheal disease incidence worldwide. High temperature, water scarcity and water abundance due to floods may link to increased diarrheal diseases.

Greenhouse Gases: Composition and Characteristics

The Earth's temperature increases as a result of the fact that greenhouse gases capture heat in the atmosphere. Fluorinated The primary gases that contribute to the greenhouse effect are carbon dioxide, methane, nitrous oxide, and water vapour.gases that are chemically synthesized may also serve as greenhouse gases in addition to these organic materials. Distinct greenhouse gases are removed from the environment via distinct processes and possess unique chemical properties. For example, soil, the ocean, and forests are "carbon sinks" because they absorb carbon dioxide. Only in the upper atmosphere can sunlight destroy fluorinated gases (İkizoğlu, 2020). Greenhouse gases have varied effects on global warming based on these primary factors:

- The quantity of gas contained inside the atmosphere. The concentrations are expressed in "parts per million (ppm), parts per billion (ppb), or parts per trillion (ppt)". For instance, a specific gas has a concentration of one part per million (ppm) in one molecule of air.
- A gas's lifetime is determined by how long it remains in the atmosphere.
- the amount of heat retention that the gas has. The term "global warming potential, or GWP", is the entire energy that a gas utilizes over a specific period of time (typically 100 years) in relation to the emission of 1 tone of carbon dioxide.

Through the greenhouse effect, the following gases are the most important contributors to global warming:

a. Carbon dioxide

Almost 80 percent of all emissions produced by people globally are carbon dioxide, which is a persistent gas. Forty percent remains in the atmosphere 100 years after discharge, twenty percent remains after one thousand years, and ten percent remains after ten thousand years. (Since carbon dioxide swings throughout the atmosphere, oceans, and land instead of destroying itself over time, its lifetime cannot be expressed in a single quantity. Certain carbon dioxide molecules are quickly absorbed by the atmosphere, while others remain there for many years.)

b. Methane

Compared to carbon dioxide, methane (CH₄) has a shorter atmospheric half-life of around 12 years, but it has a much stronger greenhouse impact. In actuality, its impact on global warming over a 100-year span is more than 30-fold greater than carbon dioxide's, pound for pound. According to projections from the United States. "Environmental Protection Agency (EPA)", In 2021, methane constituted approximately 12% of the greenhouse gas emissions that were caused by humans in the country. While wetlands and other natural sources may produce methane, human activities like the production of natural gas and livestock-based agriculture account for more than half of all methane emissions worldwide.

c. Nitrous oxide

N₂O, a potent greenhouse gas, has a "global warming potential (GWP)" that is approximately 270 times greater than that of carbon dioxide over a 100-year period. Its normal atmospheric half-life is little over a century. Emissions of greenhouse gases produced by people in the United States, including fertilisers used in agriculture, account for about 6% of total emissions, according to estimates from the Environmental Protection Agency.

d. Fluorinated gases

Fluorinated gases are produced by humans and are released from a range of industrial and manufacturing operations. The four main types are "perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), nitrogen trifluoride (NF₃), and Sulphur hexafluoride (SF₆)."

METHODOLOGY

For the purpose of this study archival research was conducted. Archival research can be used in various fields for building a reliable knowledge base (Tranfield et al., 2003). In this study, archival research provided insight on existing greenhouse gases by congregating available research studies. A literature review of past ten years research (2015 to 2025) was conducted using search engines such as EBSCO, PROQUEST, JSTOR and Google Scholar. And we drew our inferences from aggregating the results of previous researches.

Key findings of the Study

1. The finding of the study with regards to the global emission index of greenhouse gases effects revealed that, GHGs are gases that absorb a quantity of atmospheric radiation which contribute to climate change. According to the Ministère de la Transition Écologique de la France (2021), GHG emissions related to human activities represented the equivalent of 55.3 billion tonnes of CO₂ in 2018, with CO₂ accounting for 75% of these emissions. The study revealed that the global, CO₂ emission increased by 1.9% in 2018, reaching a level that was more than 65% higher than in 1990. However, the study observed that there were significant differences among countries in 2018, in terms of their emissions levels and trends. China was the largest emitter of CO₂ in 2018, with 30% of the global share, followed by the United States with 14% and the European Union with 8%. On average, each person in the world emitted 5.0 tonnes of CO₂ per year in 2018, which was 16% more than in 1990.
2. Conversely, the study with regards to air pollution, greenhouse effect, and its consequences found out that, air pollution has emerged as an unwanted byproduct of industrial societies. The study established that the primary causes of air pollution as observed by McMurry & Robert, (2007) are the release of hydrocarbon molecules, nitrogen oxides, and sulfur oxides. The finding of the study with reference to Dabiri, (2010) states that, pollutants are typically classified as substances that have significant effects on humans, animals, plants, or materials. The study with regards to the consequences of greenhouse gases emission, avered that environmental pollution has become a global problem which according to Salar, Moattar, & Khazri, (2014) has brought about chronic diseases, including respiratory issues due to air pollution, internal infections resulting from water pollution and solid waste, and psychological disorders stemming from physical pain as direct impacts of environmental pollution.
3. Furthermore, the study with regards to the effect of greenhouse gases on climate change found out that, changes in the concentration of certain greenhouse gases, from human activity (such as burning fossil fuels), increase the risk of global climate change. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane, nitrous oxide, halogenated fluorocarbons, ozone, perfluorinated carbons, and hydro fluorocarbons. According to the study these gases surround and insulate the Earth like a blanket thereby allowing the sun to reach and warm the Earth's surface then block the warmth from escaping back into space. The study further noted that, United States and China are the biggest contributors of these gases with the European Union coming in third.
4. With reference to the effects of greenhouse gases on natural systems, the study found out that rising temperatures lead to reduced rainfall, increased evaporation and transpiration, altered wind patterns, changes in crop patterns, decreased agricultural output, more frequent droughts, expansion of arid regions, and alterations in surface and groundwater resources (Mofidi et al., 2015). Further studies have shown that the average surface temperature of the Earth and its atmosphere has risen over the past century, with the 2000s being the warmest decade since 1880. The study with regards to Mousavi & Flahati, (2020) noted that an increase in wind speed to 2 meters per second can help disperse and dilute surface carbon dioxide. Greenhouse gases emission naturally has far reaching effects on the environment and human health. For instance on the environment, extreme heat waves, rising sea-levels, melting glaciers, changes in precipitation resulting in flooding and droughts, intense hurricanes, and degraded air quality are all resultant effects of greenhouse gases on the environment. While on the human angle, asthma, respiratory allergies and airway diseases are products of pollutants which directly cause or exacerbate existing conditions in susceptible populations, such as children or the elderly.

5. The study concluded by finding out that, the primary gases that contribute to the greenhouse effects are carbon dioxide, methane, nitrous oxide, and water vapour gases. For instance carbon dioxide almost constitutes 80 percent of all emissions produced by people globally. While methane (CH₄) has a shorter atmospheric half-life of around 12 years, but it has a much stronger greenhouse impact. Nitrous oxide (N₂O), a potent greenhouse gas, has a "global warming potential (GWP)" that is approximately 270 times greater than that of carbon dioxide over a 100-year period. In the same token, fluorinated gases which are produced by humans and are released from a range of industrial and manufacturing operations. The study observed that there are four main types of fluorinated gases "perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), nitrogen trifluoride (NF₃), and Sulphur hexafluoride (SF₆)."

CONCLUSION

Human activities generate greenhouse gases, and their impact on climate change is well-documented, with energy use being the largest source of these emissions. The entry of gases such as carbon dioxide, methane, and nitrogen oxides into the atmosphere which are also naturally present, leads to their heat being trapped, resulting in Earth's warming and climatic changes. Various human and natural factors, including fossil fuel consumption, land use changes, volcanic activity, photosynthesis, and respiration, affect the levels of carbon dioxide in the atmosphere. One of the most fundamental and crucial measures to reduce greenhouse gas emissions and carbon dioxide is decreasing energy consumption, which directly correlates with the amount of these gases released into the atmosphere. Furthermore, expanding the use of renewable energy as a clean energy source can play a significant role in reducing environmental pollution and major pollutant emissions, such as carbon dioxide and other greenhouse gases, thus preventing substantial societal costs. Therefore, addressing the excessive environmental degradation, thinning of the ozone layer, climate changes, seasonal rhythm shifts, global warming and reduction in agricultural areas underscores the necessity and importance of adopting renewable energy.

RECOMMENDATIONS

It is recommended that,

1. There is the need for global sensitization on the need for countries to engage in practices that mitigate the effect of climate change.
2. There is the need for countries to make and implement laws that are in line with global practices which will mitigate the effect of climate change.
3. Dissemination of renewable energy sources for heating and power generation, employment of electrical energy, expansion of green buildings and new generation hybrid motor vehicles, and reduction of unnecessary energy consumption are quite important for the sustainability of the world.
4. There is need for the discouragement of the burning of fossil fuel.
5. Government should promulgate policies, and put in place climate mitigation strategies to curb activities that has direct implication on the environment.

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