ISBN: 978-81-972400-4-1

2. Climate Change and Mitigation Strategies

Dr. P. S. Shanmugaboopathi

Principal

Mrs. R. Priyadharshini

Maruthi College of Education,
Manivizhundhan South, Attur, Salem, Tamil Nadu.

Abstract:

The life on Earth is under increasing threat from human-induced climate change. This alarming change in Earth's climate is caused by an increase in carbon dioxide and other greenhouse gases in the atmosphere, primarily due to emissions from burning fossil fuels. In the next two to three decades, the effects of climate change, such as heat waves, wildfires, storms, droughts, and floods, are expected to worsen, posing greater risks to human health and global stability. These trends call for the implementation of mitigation and adaptation strategies. Pollution and environmental degradation exacerbate existing problems and make people and nature more susceptible to the effects of climate change. In this review, we examine the current state of global climate change from different perspectives. We summarize the evidence for climate change in Earth's spheres, discuss emission pathways and drivers of climate change, and analyze the impact of climate change on ecosystems and human health. We also explore strategies for climate change mitigation and adaptation and highlight key challenges for adaptation and adaptation to global climate change.

2.1 Introduction:

The long-term shifts in temperatures and weather patterns refer to the climate change. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas. The average temperature of the Earth's surface is now about 1.1°C warmer than it was in the late 1800s (before the industrial revolution) and warmer than at any time in the last 100,000 years. The last decade (2011-2020) was the warmest on record, and each of the last four decades has been warmer than any previous decade since 1850. The main Green House Gas are carbon dioxide, methane, nitrous oxide, and the fluorinated gases, such as hydro fluorocarbons, per fluorocarbons, and Sulphur hexafluoride.

These are the gas more analyzed in the scientific literature and defined and treated in the Kyoto Protocol and in the Paris Agreement. As there is a direct relation between global average temperatures and the concentration of greenhouse gases in the atmosphere, the key for the solution to the climate change problem rests in decreasing the number of emissions released into the atmosphere and in reducing the current concentration of carbon dioxide (CO2) by enhancing sinks (e.g. increasing the area of forests).

Efforts to reduce emissions and enhance sinks are referred to as "mitigation". This to discuss about the main causes and effects of climate change and its mitigation strategies.

2.2 Causes for Climate Change:

A. Power Generation:

Burning fossil fuels to provide power and heat accounts for a sizable portion of world emissions. Burning coal, oil, or gas releases carbon dioxide and nitrous oxide, which are still used to produce the majority of power.

Only a little over a quarter of the world's electricity is generated by renewable energy sources including wind, solar, and other natural resources.

B. Manufacturing and Industrial goods:

The manufacturing/industrial sector is one of the leading global producers of greenhouse gas emissions. Emissions from manufacturing and industry are mostly the result of burning fossil fuels to create energy for the production of items like textiles, electronics, plastics, cement, iron and steel.

Gases are also released during mining and other industrial activities, as well as during construction. Some products are also manufactured from chemicals derived from fossil fuels i.e., plastics.

C. Deforestation:

A per cent of the world's greenhouse gas emissions is caused by deforestation, along with agriculture and other changes in land use. As per an estimation, nearly 12 million hectares of forests are burned annually. Cutting down forests to make way for farms, pastures, or for other purposes also increases emissions. Forests absorb carbon dioxide, hence cutting or destroying forests reduces nature's capacity to absorb emissions.

D. Transportation:

Fossil fuels are typically used to power transportation machines. As a result, emissions of greenhouse gases, particularly carbon dioxide, are greatly influenced by the transportation sector. In addition, statistics suggest that over the next few years, energy use for transportation will rise significantly.

E. Food Production:

In addition to deforestation and clearing land for agriculture and grazing, digestion by cows and sheep, production and use of fertilizers and manure, and the use of energy to run farm machinery or fishing boats, typically with fossil fuels, all contribute to the production of food.

F. Powering Buildings:

Over half of all electricity used worldwide is consumed by residential and commercial structures. 1Energy-related carbon dioxide emissions from buildings have increased over the past few years as a result of rising energy demand for heating and cooling, rising air conditioner ownership, and increased electricity use for lighting, appliances, and connected devices.

2.3 Effects of Climate Change:

Climate change has devastating impacts on us and the environment. The major effects are,

A. Increase in Temperature:

The global surface temperature rises together with greenhouse gas concentrations. The most recent ten years, 2011 to 2020, have been the warmest on record.

Higher temperatures worsen heat-related illnesses and make it more challenging to work outside. When the weather is hotter, wildfires start more easily and spread more quickly.

B. More Severe Storms:

In many areas, destructive storms have increased in intensity and frequency. More moisture evaporates as temperature rise, aggravating extremely heavy rains and flooding and resulting in more severe storms.

The warming ocean has an impact on both the intensity and frequency of tropical storms. Warm ocean surface waters are the primary source of cyclones, hurricanes, and typhoons.

C. Frequent Drought:

Water availability is changing due to climate change, becoming scarce in many places. In already water-stressed areas, global warming makes water shortages worse. It also increases the danger of ecological and agricultural droughts, which can harm crops and make ecosystems more vulnerable.

D. Warming and Rising Ocean:

The ocean absorbs carbon dioxide, keeping it out of the atmosphere. However, additional carbon dioxide causes the water to become more acidic, endangering coral reefs and marine life.

It is the property of water that it expands when becomes warmer, therefore as the ocean warms, its volume will rise. Sea levels increase as a result of ice sheet melting, endangering coastal and island communities.

E. Loss of Species:

Both animals on land and in the ocean are at risk from climate change. As the temperatures rise, these risks rise as well.

The rate of extinction on the planet is 1,000 times higher now than it has ever been in recorded human history. Within the next few decades, one million species face extinction. Threats from climate change include invasive pests and illnesses, forest fires, and harsh weather.

F. Food Scarcity:

Global hunger and poor nutrition are on the rise for a variety of reasons, including climate change and an increase in extreme weather occurrences. Crops, animals, and fisheries might all be lost or become less effective. Marine resources that provide food for billions of people are in danger as a result of the ocean's increasing acidity.

Food sources from herding, hunting, and fishing have been hampered in several Arctic regions due to changes in the snow and ice cover Heat stress can reduce available water and grazing areas, which can lower crop output and have an impact on cattle.

G. Health Hazards:

The single greatest hazard to human health is climate change. Air pollution, sickness, harsh weather, forced relocation, stress on mental health, increasing hunger and inadequate nutrition in areas where people cannot grow or get enough food are only a few of the health effects of climate change.13 million individuals every year are killed by environmental conditions. Extreme weather events increase fatalities and make it challenging for healthcare systems to keep up with the growing number of diseases caused by changing weather patterns.

2.4 Strategies to Mitigate Climate Change:

The Strategies to Mitigate Climate Change have been discussed below:

A. Carbon Sequestration:

Carbon capture and storage (CCS), also known as carbon sequestration, encompasses technologies aimed at addressing global warming. These technologies involve capturing CO2 emissions from power plants, industrial facilities, or even directly from the atmosphere, and securely storing it underground for an indefinite period.

Carbon sequestration specifically pertains to the prolonged storage of carbon dioxide or other carbon forms to mitigate and delay global warming effects. This approach has been suggested as a means to decelerate the buildup of greenhouse gases in the atmosphere and oceans resulting from the burning of fossil fuels.

B. Carbon Sink:

A carbon sink is a natural or human-made reservoir that gathers and retains carbon-containing compounds for an extended period, thereby reducing CO2 levels in the atmosphere. The two primary global carbon sinks are vegetation and the ocean. Since the implementation of the Kyoto Protocol, which promotes the utilization of CO2 sinks as a form of carbon offset, there has been a heightened public awareness of their significance.

The term "blue carbon" pertains to carbon captured by marine ecosystems. The majority of marine plant life comprises mangroves, salt marshes, and seagrasses, which store substantial amounts of carbon. Various endeavors are underway to enhance natural carbon sequestration in soils and oceans. Additionally, diverse artificial sequestration projects, including the development of new building materials, carbon capture and storage, and geological sequestration, are in progress.

C. Carbon Credit:

A carbon credit is a permit that authorizes the holder to release a specific quantity of CO_2or other greenhouse gases. Each credit permits the emission of one metric ton of CO_2 or its equivalent in other greenhouse gases. This credit is a fundamental element of a "cap-and-trade" program. Entities with emissions allowances are permitted to emit up to a defined limit, which is progressively reduced over time. Simultaneously, companies have the option to sell any unused credits to other companies in need. This system offers private companies a dual incentive for curbing greenhouse gas emissions. Firstly, if their emissions surpass the established limit, they must invest in additional credits. Secondly, they have the opportunity to generate profits by reducing their emissions and selling any surplus allowances.

D. Carbon Offsetting:

Carbon offsetting is often the fastest way for businesses to achieve substantial reductions in emissions. Additionally, it frequently brings about supplementary benefits at the project location, including job creation, community development initiatives, and opportunities for training and education.

For a carbon offset to be considered credible, it must adhere to key quality criteria, such as:

Demonstrated Additionality: There must be evidence that the emissions reduction would not have taken place without the financial support from carbon offsetting.

Retirement Assurance: The offset must be taken out of the carbon market to prevent it from being counted multiple times.

Addressing Permanence and Leakage: It should ensure that the stated reductions are effectively delivered and that the reduction of emissions in one area does not lead to an increase in emissions elsewhere.

E. Carbon Tax:

A Carbon Tax is a type of pollution levy that charges a fee on the production, distribution, and utilization of fossil fuels, determined by the quantity of carbon emissions generated during combustion. It stands as a potential alternative to the current 'cap and trade' method employed by the protocol. This tax is levied based on the carbon content within fuels, such as coal, for instance. Its objective is to diminish the reliance on fossil fuels while creating an incentive to shift towards alternative energy sources. If implemented, the carbon tax would be introduced gradually, commencing with a modest levy and incrementally rising. This phased approach allows for the advancement of superior industries and technologies.

F. Geo-Engineering:

Geoengineering, a form of climate engineering or deliberate human intervention in the climate, aims to bring about long-term changes in Earth's climate patterns. Its primary goal is to modify and cool the Earth's environment, with the aim of mitigating environmental damage, countering resulting climate shifts, and ultimately creating a more hospitable planet. Various approaches fall under the umbrella of geoengineering, including deploying parasols in space, positioning mirrors in orbit, using sulfate aerosols to brighten the stratosphere, applying reflective coatings to building roofs, and introducing iron filings into the ocean to stimulate carbon-absorbing algae.

G. Measures to Mitigate Climate Change:

- Improving energy efficiency and conservation, as well as establishing a Bureau of Energy Efficiency
- Reforms to the power sector
- Promoting hydro and renewable energy
- Promotion of clean coal technologies
- Coal washing and efficient utilization of coal
- Forest reforestation and conservation
- Reduced gas flaring
- Cleaner, less carbon-intensive transportation fuel
- Encourage the use of Mass Rapid Transit systems
- Management of environmental quality and increased energy efficiency
- Global Initiatives to Reduce Greenhouse Gas Emissions

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Its purpose is to provide policymakers with periodic assessments of the scientific foundation of climate change, including its impacts, future risks, and potential strategies for adaptation and mitigation. The United Nations Framework Convention on Climate Change, signed in 1992 and enacted in 1994, aims to achieve the "stabilization of atmospheric greenhouse gas concentrations at a level that would prevent dangerous anthropogenic intervention with the climate system."

The Kyoto Protocol (KP), adopted at the 3rd COP in 1997, is an international agreement designed to reduce global greenhouse gas emissions by a minimum of 5% compared to 1990 levels by 2012. This agreement targeted a range of greenhouse gases, including CO2, CH4, N2O, Hydro fluorocarbons (HFCs), Per fluorocarbons (PFCs), and Sulfur Hexafluoride (SF6), for reduction.

2.5 Conclusion:

Mitigation efforts will require decades to noticeably influence the rising temperatures. Therefore, it is imperative that we adapt promptly to the changes that are already underway and will persist in the foreseeable future. The sooner we take action to mitigate the impacts of climate change, the more favorable our future will be. While the world has been sluggish in its response thus far, there is a noticeable shift in momentum. Both adaptation and mitigation are equally crucial and time-critical, necessitating simultaneous attention. Climate change is a grave concern, but our planet can endure and flourish if we collaborate to avert the most severe consequences and adjust to our evolving environment.

2.6 References:

1. Fawzy, S., Osman, A.I., Doran, J. *et al*. Strategies for mitigation of climate change: a review. *Environ ChemLett* **18**, 2069–2094 (2020).
2. Hein J et al (2018) Deforestation and the Paris climate agreement: an assessment of REDD+ in the national climate action plans. For Policy Econ90:7–11.
3. Panepinto D, Riggio VA, Zanetti M. Analysis of the Emergent Climate Change Mitigation Technologies. Int J Environ Res Public Health. 2021 Jun 24;18(13):6767. doi: 10.3390/ijerph18136767. PMID: 34202431; PMCID: PMC8297308.

Web Resources:

1. https://doi.org/10.1016/j.forpol.2018.01.005
2. https://rdcu.be/dFxEA