

## A review on climate change: cause, effect and mitigation strategies

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### ABSTRACT

Climate change is a threat to humanity. Extreme weather conditions have been on the rise across the globe for decades. We experience hotter summers, colder winters, wider temperature swings, rising sea levels, reduction in sea ice levels, shrinking glaciers, increased storm activities and more. Climate change and Global warming are global challenges. The problem is the result of emission of Greenhouse gases that affect the environment. The question arises is that whether the problem is due to human activities or it's just a part of nature's cycle. This paper discusses and compares the factor that contribute to climate change by humans and nature, some effects of climate change and some solutions that have been developed to prevent or slow climate change from processing.

**Key Words :-** Climate change, Threat to humanity, Weather Conditions, Global warming, Greenhouse gases.

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### INTRODUCTION

Climate change is the long term increase in the earth's average surface temperature and the large scale change in global, regional and local weather patterns that result from that increase, caused by a significant increase in the levels of greenhouse gases that are produced by the use of fossil fuels.

Climate change is a threat to humanity. It has occurred for as long as the earth has existed. It is the greatest environmental threat confronting the world. It is one of the major challenges of our time and adds considerable stress to our societies and to the environment. It is a phenomenon that takes place over decades and even centuries. It includes shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding. The impact of climate change is global in scope and unprecedented in scale.

Climate change happens anytime earth's climate patterns change and remain in place for a measurable amount of time. This has been manifested in natural cycles of cooling and warming.



Fig 1. Climate Change (taken from internet)

Before human causes started to shift the global climate, five main factors interacted with one another as climate changes occurred. These five factors include [1]-:

1. Atmosphere (air)
2. Biosphere (living things)
3. Cryosphere (ice and permafrost)
4. Hydrosphere (water)
5. Lithosphere (earth's crust and upper mantle)

Extreme weather conditions have been on the rise across the globe for decades. We experience hotter summers, colder winters, wider temperature swings, rising sea levels, reduction in sea ice levels, shrinking glaciers, increased storm activities and many more.

Climate change refers to a shift in average weather condition including measures such as temperature, humidity, rainfall, cloudiness and wind patterns and changes in the frequency or severity of these conditions.

In climate change there is confusion between weather and climate.

**WEATHER:-** It is the local meteorological condition experienced over short period of time, including temperature, precipitation, wind speed, humidity and visibility.

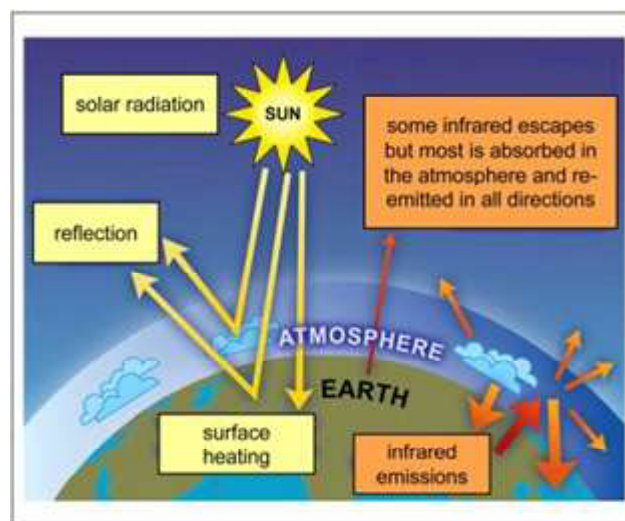
**CLIMATE:-** The long term average of patterns and trends in weather, including day-to-day, year-to-year and even longer time period.

The root cause of this rise in temperature is Global Warming.

#### **GLOBAL WARMING:-**

Global warming is a steady increase in the earth's average temperature, as measured by rising global surface temperatures, caused or influenced by continuous emissions of greenhouse gases, with carbon dioxide and CFCs such as Methane and Nitrous oxide, as well as other air pollutants, polluting over 90% of the atmosphere and affecting climate sensitivity and precipitation levels.

The atmosphere is a layer of gases around the Earth. It protects the Earth's surface from the sun's harmful rays and contains the oxygen we breathe.



**Fig 2. Global Warming (taken from internet)**

Global Warming begins when sun-light reaches the Earth. The clouds, atmospheric particles, reflective ground surfaces and surface of oceans then send back about 30% of sunlight back into the space. While the remaining is absorbed by oceans, air and land. This causes heating of the surface of the planet and atmosphere, making life feasible. Now as the Earth warms up this solar energy is radiated by thermal radiation and infrared rays, propagating directly out to space and thereby cooling the Earth. Some of the outgoing radiation is reabsorbed by carbon-di-oxide, water vapour, ozone, methane and other gases in the atmosphere and is again radiated back to the surface of Earth. And now, these gases are commonly known as Greenhouse Gases due to their heat trapping capacity.

Global warming is an increase in the temperature of Earth's atmosphere; it is getting hotter and hotter. The temperatures are rising because we have dramatically increased the amount of carbon-di-oxide in the Earth's atmosphere, by burning fossil fuels such as coal, gas and oil and also by clearing forests or deforestation, which trap heat that would have escaped from Earth. This type of effect is called Greenhouse Effect.

Fossil fuel coal, oil and gas are the largest contributor to global climate change. As Greenhouse Gas emission blankets the Earth they trap the sun's heat. Accounting for 75% of global greenhouse gas emission and about 90% of all

carbon-di-oxide emission. This leads to global warming and climate change.

The world is now warming faster than at any point in recorded history.

The American Association for the Advancement of Science has stated, "The Scientific evidence is clear : Global Climate change cause by human activities is occurring now and it is a growing threat to Society." [2]

### CAUSES OF CLIMATE CHANGE

A few ways humans are accelerating climate change:-

#### 1. GREENHOUSE GASES

Greenhouse Gases play a vital role in the earth's climate cycles. When the planet gets hit with the sun's rays, some of the energy is absorbed and the rest of that energy and heat gets reflected into space. Greenhouse gases in the atmosphere trap the reflected energy, redirecting it back down to the earth and the result is global warming.

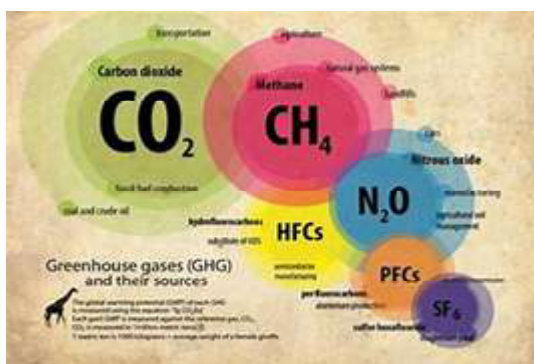


Fig -3 Greenhouse Gases (taken from internet)

The main Greenhouse Gases are :-

#### I. Carbon dioxide (CO<sub>2</sub>)

CO<sub>2</sub> is released through natural processes, such as volcanic eruption, plant respiration and animals and human breathing. The atmospheric CO<sub>2</sub> concentration has increased by 50%. The Industrial Revolution began in 1800. Due to this the human activities like the burning of fossil fuels and large scale deforestation. Due to its abundance CO<sub>2</sub> is the main contributor to climate change. CO<sub>2</sub> is released into the atmosphere from both natural and human- made causes and is one of the leading

contributors to climate change. It has been increasing at an alarming rate and has the potential to stay in the earth's atmosphere for thousands of years unless it gets absorbed by the oceans, lands, trees and other sources.[3]

#### ii. Methane (CH<sub>4</sub>)

Methane is produced naturally through decomposition. The human activities have displaced the natural balance. Large amount of methane are released by cattle farming, landfill waste dumps, rice farming and the traditional production of oil and gas.

#### iii. Nitrous Oxide (N<sub>2</sub>O)

Nitrous oxide is produced through the large -scale use of commercial and organic fertilisers, fossil-fuel combustion, nitric acid production and biomass burning.

#### iv. Water Vapour

Water vapour is the most abundant greenhouse gas. It increases the earth's atmosphere warm, just like CO<sub>2</sub>. Water Vapour are naturally occurring. Water vapour persists for a few days.

v. Natural and Man-made Greenhouse Gases (Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF<sub>6</sub>))

The group of gases are naturally produced but their increasing atmospheric concentration is man-made.

The three industrial fluorinated gases - Hydrofluorocarbons (HFC), Perfluorocarbons (PFC), Sulphur hexafluoride (SF<sub>6</sub>) are solely man-made during industrial processes and do not occur in nature. Although they are present in very small concentration in the atmosphere, they trap heat very effectively, which means they are extremely potent.

SF<sub>6</sub>, is used in high voltage electricity equipment. It has a 'Global Warming Potential' of about 23000times greater than CO<sub>2</sub>. CFCs are synthetic in nature.

#### 2. SOLAR ACTIVITY

Solar activity plays a vital role in the earth's climate. The sun goes through natural cycles, increasing and

decreasing the amount of energy that it emits to the earth, it is unlikely that solar activity is a major contributor to global warming or climate change.

Scientists began to measure the sun's energy hitting our atmosphere, there has not been a measurable upward trend. [6]

### **3. AGRICULTURE**

There are many significant ways in which agriculture impacts climate change. From deforestation in places to the transportation and livestock that it takes to support agricultural efforts around the world, agriculture is responsible for a significant portion of the world's greenhouse emission.

Agriculture is an area that is making tremendous strides to become more sustainable.

As productivity increases, less carbon is being emitted to produce more food.

Agriculture also has the potential to act as a carbon sink and could absorb nearly the same amount of CO<sub>2</sub> it emits.[7].

### **4. DEFORESTATION**

Deforestation and climate change often go hand in hand. Not only does climate change increase deforestation by way of wildfires and other extreme weathers but deforestation is also a major contributor to global warming.

According to the Earth Day Network, deforestation is the second leading contributor to global greenhouse gases. [8].

Many people and organization fighting against climate change point to reducing deforestation as one of the most important issues that must be addressed to slow or prevent climate change. [9].

### **5. HUMAN ACTIVITY**

According to the Environmental Protection Agency, "the most significant contributor to climate change is the burning of fossil fuels for electricity, heat and transportation. Transportations through cars, trucks, ships, trains and planes emits the largest percentage of CO<sub>2</sub>, which speeds up global warming and remains a significant cause of climate change. [10]

## **6. LIVESTOCK**

Livestock includes cattle, sheep, pigs and poultry. It also plays a significant role in climate change. The livestock around the world is responsible for 51% of annual global greenhouse gas emission. [11]

### **EFFECTS OF CLIMATE CHANGE**

The effects of climate change are being widely felt. Human and wild animals face new challenges for survival because of climate change. More frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers and warming oceans can directly harm animals, destroy the place they live and wreak havoc on people's livelihood and communities. The climate change poses a fundamental threat to the places, species and people's livelihood. The climate change is our planet's greatest existential threat.

#### **1. HOTTER TEMPERATURE**

Warmer temperatures over time are changing weather patterns and disrupting the usual balance of nature. This poses many risks to human beings and all other forms of life on Earth. Nearly all land areas are seeing more hot days and heat waves; 2020 was one of the hottest years on record. Higher temperatures increase heat-related illnesses and can make it more difficult to work and more around. Wildfires start more easily and spread more rapidly when conditions are hotter.

#### **2. SEVERE STORMS**

Changes in temperature cause changes in rainfall. This results in more severe and frequent storms. They cause flooding and landslides, destroying homes and communities and costing billions.

#### **3. INCREASED DROUGHT**

Water is becoming scarcer in more regions. Droughts can stir destructive sand and dust storms that can move billions of tons of sand across continents. Deserts are expanding, reducing land for growing food. Many people now face the threat of not having enough water on a regular basis.

#### **4. A WARMING, RISING OCEAN**

The ocean soaks up most of the heat from global warming. This melts ice sheets and raises sea

levels, threatening coastal and island communities. The ocean also absorbs carbon-dioxide, keeping it from the atmosphere. More carbon-di-oxide makes the ocean more acidic, which endangers marine life.

### 5. LOSS OF SPECIES

Climate change poses risks to the survival of species on land and in the ocean. These risks increases as temperature climb. Forest fires, extreme weather and invasive pests and diseases are among many threats. Some species will be able to relocate and survive but others will not.

### 6. NOT ENOUGH FOOD

Changes in climate and increases in extreme weather events are among the reason behind a global rise in hunger and poor nutrition. Fisheries, crops and livestock may be destroyed or become less productive. Heat stress can diminish water and grasslands for grazing.

### 7. MORE HEALTH RISKS

Changing weather patterns are spreading disease such as malaria. Extreme weather events increases diseases and deaths and make it difficult for health care systems to keep up. Others risks to health include increased hunger and poor nutrition in place where people cannot grow or find sufficient food.

### 8. POVERTY AND DISPLACEMENT

Climate change increases the factors that put and keep people in poverty. Floods may sweep away urban slums, destroying homes and livelihoods. Heat can make it difficult to work in outdoor jobs. Weather-related disasters displace core people a year, leaving many more vulnerable to poverty.

## THE GREENHOUSE EFFECT



Fig 4. The Greenhouse Effect (Taken from Internet)

## THE NATURAL GREENHOUSE EFFECT

The Greenhouse effects is the rise in temperature that the Earth experiences because certain gases in the atmosphere (water vapour, carbon-di-oxide, nitrous oxide, ozone, methane) trap energy that comes from the sun. These gases are usually called Greenhouse Gases since they behave much like the glass panes in a greenhouse. The glass panels of the greenhouse let in the light but keep heat from escaping and this is similar to the effect these gases have on earth. Sunlight enters the Earth's atmospheres, passing through the greenhouse gases. As it reaches the Earth's surface, land, water and biosphere absorb the sunlight's energy. Once absorbed this energy is send back into the atmosphere. Some of the energy passes back into space but much of it remains trapped in the atmosphere by the greenhouse gases. This is the completely natural process and without these gases all the heat would escape back into space and earth's average temperature would be about 30 degrees Celsius colder. The greenhouse effects are very important process because without the greenhouse effect, the Earth would not be warm enough for humans to live. But if the greenhouse effects become stronger, it could make the Earth warmer than usual. Even a little extra warming may cause problems for humans, plants and animals.

## THE ENHANCED GREENHOUSE EFFECT

Some human activities also produce greenhouse gases and these gases keep increasing in the atmosphere. The change in the balance of the greenhouse gases has significant effects on the entire planet. Burning fossil fuel- coal, oil and natural gas - releases carbon-di-oxide into the atmosphere. Cutting down and burning trees also produces a lot of carbon-di-oxide. A group of greenhouse gases called the Chlorofluorocarbons have been used in aerosols such as hairspray cans, fridges and in making foam plastics.

Since there are more and more greenhouse gases in the atmosphere, more heat is trapped, which makes the natural greenhouse effects stronger. If we carry on polluting the atmosphere with greenhouse gases, it will have very dangerous

effect on earth. Today the increase in the earth's temperature is increasing with unprecedented speed.

### **MITIGATING STRATEGIES -**

#### **ADAPTING TO CLIMATE CONSEQUENCES**

Climate change is a huge challenge but we already know many solutions. These can deliver economic benefits while improving our lives and protecting the environment. We also have global agreements to guide progress, such as the UN Framework Convention on Climate Change and the Paris Agreement. Three broad categories of action are: cut emissions, adapt to climate impacts and finance required adjustments.

Switching energy systems from fossil fuels to renewables like solar will reduce the emissions driving climate change. For this we have to start right now. Fossil fuel production must decline by roughly 6% per year between 2020 and 2030.

Adaptation will be required for protecting people, homes, businesses, livelihoods, infrastructure and natural ecosystem. But must be prioritized now for the most vulnerable people with the fewest resources to cope with climate hazards. It covers current impacts and those likely in the future. The rate of return can be high. Early warning system for disaster saves life and property and can deliver benefits up to 10 times the initial cost.

Climate action requires significant financial investments by governments and businesses, but climate inaction is vastly more expensive. One critical step is for industrialized countries to fulfil their commitment to provide billions a year to developed countries so they can adopt and move towards greener economies.

#### **ADAPTING TO CLIMATE CHANGE**

To avoid the worse effects of climate change, we need to reduce global carbon emissions. We must prepare for the significant and unavoidable consequences of carbon emissions such as increasing temperature, shifting precipitation patterns, ocean acidification, sea level rise and the increasing intensity and frequency of extreme weather events.

To do this -

- Increase resilience of communities by promoting new farming techniques, community weather monitoring and creating seed banks.
- Restore beach vegetation to shade marine turtle nests.
- Secure access to fresh water for animals during periods of drought.

#### **How to reduce Greenhouse Gases?**

Greenhouse Gases can be reduced by phasing out fossil fuels such as coal, oil and gas and moving to renewable energy, such as Solar Energy and Wind Energy.

We all can play a part in protecting our planet by changing our habits like reusing and recycling. We can also change our lifestyle decisions like switching to Electric Vehicles.

#### **GOVERNMENT RELEASE VARIOUS INITIATIVES TOWARDS COMBATING AND ADAPTING TO CLIMATE CHANGE**

In the recent past the Government of India has taken number of initiatives to combat the challenge of climate change. Some of the key initiatives of Government of India include the National Action Plan on Climate Change (NAPCC), National Adaptation Fund on Climate Change (NAFCC), Climate Change Action Programme (CCAP) and State Action Plan on Climate Change (SAPCC)

Some of the major initiatives includes:-

1. India's National Action Plan on Climate Change (NAPCC) which covers eight major missions on Solar, Enhanced Energy Efficiency, Sustainable Habitats, Water, Sustaining the Himalayan Ecosystem, Green India, Sustainable Agriculture and Strategic Knowledge on Climate Change.
2. International Solar Alliances (ISA)
3. State Action Plan on Climate Change (SAPCC)
4. FAME Scheme - for E-mobility.
5. Atal Mission for Rejuvenation & Urban Transformation (AMRUT) - for Smart Cities.

6. Pradhan Mantri Ujjwala Yojana - for access to clean cooking fuel.
7. UJALA scheme - for embracing energy efficient LED bulbs.
8. Swachh Bharat Mission.

## CONCLUSION

Climate change is a global problem that is hard to solve by a single Country or Government. So far not many measures have been taken to address climate change. It requires participating countries to reduce their anthropogenic greenhouse gas emission ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ , HFCs, PFCs and  $\text{SF}_6$ ) by at least 5%.

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