

## **SEC-2 Factors of Climate Change**

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### **Introduction**

**Climate change** has become one of the most pressing issues of our time, with its effects being felt around the world. Scientists have established that the Earth's temperature has increased by 1°C above pre-industrial levels, and this is primarily due to human activities such as burning fossil fuels, deforestation, and industrial activities. The purpose of this article is to examine the factors that have contributed to recent climate change, including natural factors and human activities.

### **Natural Factors of Climate Change**

The Earth's climate has changed naturally over millions of years. Some of the natural factors that have contributed to climate change include:

#### **Solar Radiation**

The sun's energy is the primary source of heat and light for the Earth. Changes in the amount of solar radiation received by the Earth can cause climate change. For example, when the sun's energy output is low, the Earth receives less heat, which can lead to a cooling of the planet. Conversely, when the sun's energy output is high, the Earth receives more heat, which can lead to a warming of the planet.

#### **Volcanic Activity**

Volcanic eruptions release large amounts of gases and particles into the atmosphere, which can affect the Earth's climate. When a volcano erupts, it releases carbon dioxide, sulphur dioxide, and other greenhouse gases into the atmosphere. These gases trap heat in the Earth's atmosphere and can cause a warming of the planet. Volcanic activity can also release large amounts of ash and other particles into the atmosphere, which can reflect sunlight back into space and cause a cooling of the planet.

#### **Changes in the Earth's Orbit**

The Earth's orbit around the sun changes over time, which can affect the amount of solar radiation received by the planet. These changes in the Earth's orbit are called Milankovitch cycles and occur over thousands of years. Milankovitch cycles include changes in the tilt of the Earth's axis, the shape of the Earth's orbit, and the precession of the equinoxes. These changes can affect the amount and distribution of solar radiation received by the Earth and can cause changes in the Earth's climate.

## **Human Activities that Contribute to Climate Change**

Human activities are the primary cause of recent climate change. The burning of fossil fuels, deforestation, and industrial activities have all contributed to the increase in greenhouse gases in the Earth's atmosphere. Some of the human activities that have contributed to climate change include:

### **Burning of Fossil Fuels**

The burning of fossil fuels such as coal, oil, and gas releases carbon dioxide and other greenhouse gases into the atmosphere. These gases trap heat in the Earth's atmosphere and cause a warming of the planet. The burning of fossil fuels is the primary source of carbon dioxide emissions, which are the largest contributor to human-caused climate change.

- Carbon dioxide levels in the atmosphere have increased by over 40% since preindustrial times, from 280 parts per million (ppm) to over 415 ppm in 2021 (NASA).
- The annual average concentration of carbon dioxide in the atmosphere reached a record high of 412.5 ppm in 2020 (World Meteorological Organization). In 2019, the burning of fossil fuels accounted for 89% of global carbon dioxide emissions from human activities (Global Carbon Project).
- Transportation is a significant contributor to greenhouse gas emissions, as cars, trucks, and planes all burn fossil fuels.
- Transportation is responsible for approximately 23% of global energy-related greenhouse gas emissions (International Energy Agency).
- The production of electricity also contributes to greenhouse gas emissions, as many power plants still rely on fossil fuels to generate electricity.
- Coal-fired power plants are the largest source of greenhouse gas emissions from electricity generation (Environmental Protection Agency).

### **Deforestation**

Deforestation is the clearing of forests for agriculture, urbanisation, or other uses.

- Deforestation contributes to climate change by reducing the amount of carbon that forests can absorb from the atmosphere.
- Trees absorb carbon dioxide from the atmosphere and store it in their biomass. When forests are cleared, the carbon stored in the trees is released into the atmosphere, contributing to the increase in greenhouse gases.

- Deforestation also reduces the number of trees that are available to absorb carbon dioxide from the atmosphere. This can create a positive feedback loop, where deforestation leads to more carbon dioxide in the atmosphere, which leads to more warming, which can cause more deforestation.
- Between 1990 and 2016, the world lost 1.3 million square kilometres of forest, an area larger than South Africa (Global Forest Watch).
- Deforestation rates in tropical countries have increased by 43% since the 1990s (Global Forest Watch).
- The rate of deforestation in the Amazon rainforest increased by 30% between 2018 and 2019 (National Institute for Space Research, Brazil). The loss of forests in the Amazon, due to deforestation and wildfires, resulted in the release of an estimated 2.2 billion metric tons of carbon dioxide in 2019 (Carbon Brief).
- Deforestation is responsible for the loss of approximately 10 billion trees each year (World Wildlife Fund).

Deforestation accounts for approximately 10% of global greenhouse gas emissions. (World Resources Institute)

### **Industrial Activities**

Industrial activities such as manufacturing, mining, and transportation release greenhouse gases into the atmosphere.

- Industrial activities often require the burning of fossil fuels, which is a major contributor to climate change.
- Industrial activities also produce other pollutants that can contribute to climate change, such as black carbon, which absorbs sunlight and contributes to warming.
- Industry accounts for approximately 22% of global greenhouse gas emissions. (Environmental Protection Agency)
- The cement industry is responsible for approximately 8% of global carbon dioxide emissions.
- The steel and iron industry is responsible for approximately 7% of global carbon dioxide emission.
- The chemical and petrochemical industry is responsible for approximately 3% of global greenhouse gas emissions (International Energy Agency).

Methane emissions from oil and gas production have increased by more than 30% since 2000 (Environmental Defense Fund).

## **Agriculture and Livestock Production**

Agriculture and **livestock** production also contribute to climate change. The clearing of land for agriculture also contributes to deforestation, further exacerbating the problem.

- Agriculture is responsible for approximately 24% of global greenhouse gas emissions when indirect emissions from land use changes are included (Food and Agriculture Organization of the United Nations).
- Rice cultivation is responsible for approximately 10% of global methane emissions (Environmental Defense Fund).
- The use of nitrogen fertilisers in agriculture is responsible for approximately 10% of global nitrous oxide emissions (Environmental Protection Agency).

Livestock also produce methane, a potent greenhouse gas that is 28 times more effective at trapping heat than carbon dioxide.

- The production of meat and dairy products requires large amounts of energy, which often comes from the burning of fossil fuels.
- The production of beef is responsible for approximately 41% of agriculture-related greenhouse gas emissions (Food and Agriculture Organization of the United Nations).
- Livestock production accounts for approximately 14.5% of global greenhouse gas emissions, primarily from methane emissions from enteric fermentation and manure management (Food and Agriculture Organization of the United Nations).

## **Land Use Changes**

Land use changes, such as urbanisation and the conversion of grasslands and wetlands into croplands, also contribute to climate change. These changes can result in the loss of carbon storage capacity in soil and vegetation, which can lead to the release of stored carbon into the atmosphere. Land use changes are responsible for the loss of approximately 12 million hectares of forest each year (World Wildlife Fund).

- Urbanisation is responsible for the loss of approximately 1.5 million hectares of land each year (United Nations).
- The conversion of forests into agricultural land is responsible for the majority of land use-related greenhouse gas emissions.
- The conversion of grasslands and wetlands into croplands and pasturelands is responsible for approximately 12% of global greenhouse gas emissions (World Resources Institute).
- Peatland degradation and drainage is responsible for approximately 5% of global greenhouse gas emissions (Global Peatlands Initiative).

## **Waste Generation**

The generation and disposal of waste also contribute to climate change. Landfills are a significant source of methane emissions, which are a potent greenhouse gas. The production and transportation of goods and packaging materials also contribute to greenhouse gas emissions.

- In 2016, the world generated 2.01 billion metric tons of municipal solid waste with a per capita average of 0.74 kg per day with significant variations between countries and regions (World Bank).
- Landfills are responsible for approximately 15% of global methane emissions. (Environmental Protection Agency)
- The production of plastic is responsible for approximately 8% of global oil consumption, and this is projected to double by 2050 (Ellen MacArthur Foundation).
- The improper disposal of plastic waste is responsible for significant environmental damage, including the release of greenhouse gases and pollution of land and water resources (World Wildlife Fund).
- The organic fraction of municipal solid waste is responsible for approximately 5% of global methane emissions (Environmental Protection Agency).