International Journal of Innovative Research in Computer Science & Technology (IJIRCST)
ISSN: 2347-5552, Volume-10, Special Issue-1, January-2022
Young Researchers' Conference on Indian Literatures, 2022
Organized by Presidency University, Bangalore, India

Climate Change: Impacts, and Adaptation Strategies

Dr. Krishnappa Venkatesharaju
Assistant Professor, Department of Environmental Science And Engineering, Presidency University, Bangalore, India
Email Id-venkateshraju.k@presidencyuniversity.in

ABSTRACT:
An urgent worldwide problem, climate change has a significant influence on human civilizations, ecosystems, and the environment. The main features and effects of climate change are summarized in this chapter. It examines the factors contributing to climate change, such as greenhouse gas emissions from human activity, and emphasises its many effects, including temperature increases, altered precipitation patterns, and sea level rise. The chapter highlights the significance of comprehending and minimizing climate change via group efforts, governmental actions, and environmentally friendly practises. Societies can safeguard the environment, foster resilience, and ensure a sustainable future for future generations by properly tackling climate change.

KEYWORDS:

Atmosphere, Climate, Gases, Greenhouse, Global, Human, Ozone.

I. INTRODUCTION

With only the late 1980s and later seeing the emergence of climate change as a significant policy concern, it is a recent addition to the worldwide political and environmental agenda. Since the 19th century, researchers have discovered that CO2 in the atmosphere acts as a greenhouse gas, helping to keep the sun's heat energy within the atmosphere and raising the earth's surface temperature. It goes without saying that CO2 is only one of many such greenhouse gases in the environment. Others include water vapour, nitrous oxide, and methane. CO2, on the other hand, is the principal greenhouse gas impacted by human activity. There are several methods that produce CO2. Since the Industrial Revolution, when our use of fossil fuels skyrocketed, human activities have contributed enough CO2 to the atmosphere to significantly disrupt the natural carbon cycle [1]–[3]. Prior to the Industrial Revolution, in 1750, there were about 280 parts per million by volume (ppmv) of CO2 in the Earth's atmosphere. It increased by almost 1.5 ppnw year by 1994, when it reached 358 ppmv. By the end of the twenty-first century, the concentration will be about 500 ppmv, roughly double the pre-industrial level, if emissions continue at the 1994 pace.

Rising Concentration

The result is that the atmosphere holds onto the heat from the Sun longer, warming the surface of the Earth. The Earth's surface has warmed, on average, 0.3 to 0.6 °C since the late 19th century, when accurate temperature measurements first started. However, the pattern of future warming is very much up for discussion. Global mean temperatures would increase by 1 to 3.5 °C and the mean sea level would rise by around 15 to 95 cm by the year 2100, according to current predictions of economic growth and development causing greenhouse gas emissions. For many natural and controlled ecosystems, changes of this size and speed might be very problematic. In fact, a one-meter increase in sea level poses a danger to many low-lying, deltaic, and tiny islands, which might result in the total loss of land and the extinction of human existence [4]–[6].

The result is that the atmosphere holds onto the heat from the Sun longer, warming the surface of the Earth. The Earth's surface has warmed, on average, 0.3 to 0.6 °C since the late 19th century, when accurate temperature measurements first started. However, the pattern of future warming is very much up for discussion. Global mean temperatures would increase by 1 to 3.5 °C and the mean sea level would rise by around 15 to 95 cm by the year 2100, according to current predictions of economic growth and development causing greenhouse gas emissions. For many natural and controlled ecosystems, changes of this size and speed might be very problematic. In fact, a one-meter increase in sea level poses a danger to many low-lying, deltaic, and tiny islands, which might result in the total loss of land and the extinction of human existence.

Extreme Weather Events

Additionally, the majority of the negative consequences of climate change are associated with severe weather phenomena, such as hot or cold temperature swings, wet or dry rainfall patterns, cyclones, and floods. In a changing climate, projections of the character and distribution of these occurrences are considerably less certain—almost no reliable predictions exist at all. While there are costs and advantages related to climate change, the scientific community is in agreement that these consequences would likely place a heavy burden on the world population as a whole. In contrast to many other environmental problems, such as local air or water pollution or even stratospheric ozone depletion brought on by chlorofluorocarbons (CFCs), global warming presents unique difficulties because of the problem's global scope and time scales of decades to centuries. Analysis and evaluation of the precise actions required to reduce greenhouse gas emissions. A protocol was negotiated as a consequence of this process, and its last elements were worked out during the third Conference of the Parties to the Framework Convention, which took place in Kyoto, Japan, from December 1–12, 1997.

Industrialized countries are required to meet precise, legally binding emission reduction targets for six greenhouse gases under the Kyoto Protocol to the United Nations Framework Convention on Climate Change: carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, per-fluorinated compounds, and sulphur hexafluoride. First, even though India is not presently subject to any requirements to cut its greenhouse gas emissions under the Convention. We must establish a thorough grasp of our emission inventory. In order to reduce CO2 emissions or increase CO2 removal from the atmosphere, we must also track and evaluate our efforts in areas like renewable energy, wasteland development, and forestation. We may be able to use such efforts in the international context given that they are often made for a variety of reasons that are unrelated to global warming but yet have positive effects on climate change. The research community might make a significant contribution in this area. Our capacity to prepare for and respond to severe events like floods, droughts, cyclones, and other meteorological risks has to be considerably improved. No matter how much climate change really occurs, whatever resilience that we build into the system in this area will always put us in a favourable position.

Global Warming and Greenhouse Effect

Researchers began to suspect that the planet could be growing warmer in the late 1900s. There were some warm and chilly years throughout the latter two decades of the 20th century. The notion of global warming was not, however, sufficiently supported by the existing data. However, it is generally recognized that the buildup of a number of greenhouse gases may cause an increase in temperature (global warming). Major alterations in the climate of the whole planet would follow if the global warming phenomena takes hold. The melting of pole-based snow might result from a rise in temperature, which would greatly enrich ocean waters. As a result, the ocean and sea levels would increase, having a significant impact on coastal regions. As seas and oceans grew, they would be submerged beneath coastal waters. In addition, the temperate temperature pattern would change, making the current temperate zones hot and dry. The Earth's climate is controlled in large part by the Greenhouse Effect, a natural phenomenon. Heat and light energy are radiated from the sun's heated surface. A number of atmospheric gases are invisible to visible light yet absorb infrared radiation. These enable sunlights to penetrate the atmosphere and be absorbed by the surface of the planet. This energy is once again released as heat energy, which the gases then absorb. These gases are known as greenhouse gases, and the warmth that results from their accumulation is known as the greenhouse effect. This is because the effect is similar in nature to what occurs in a botanical greenhouse the glass panes enable the light energy to get inside but reduce the loss of heat. Anthropogenic activities contribute to the phenomena that hastens the buildup of greenhouse gases.

It is now widely established that greenhouse gases such as carbon dioxide, nitrous oxide, methane, and chlorofluorocarbons have been increasing globally. In addition to all of these changes, the addition of these gases and the emission of carbon monoxide, nitrogen oxides, and other compounds are altering the chemistry of the troposphere and stratosphere. The growth of the various greenhouse gases was noted by the Office of Policy, Planning, and Evaluation of the United States Environmental Protection Agency in 1989.Since the industrial revolution, the amount of carbon dioxide in the atmosphere has grown by 25%. About half of the current increases in the greenhouse effect are attributed to carbon dioxide, which is growing at a rate of 0.4% annually. Over the last three centuries, the amount of methane has more than doubled. The most major historical drivers to concentration increases have probably been agricultural sources, notably rice farming and animal husbandry. However, future emissions from landfills, coal seams, permafrost, natural gas explorations and pipeline leaks, and biomass burning related to forest removal all have the potential to increase quickly.

Since pre-industrial times, nitrous oxide concentrations have risen by 5–10%. Although the exact reason for this growth is unknown, it is known that burning fossil fuels, land clearance, and nitrogenous fertilizers have all had a role. Currently, nitrous oxide is growing at a rate of 0.25 percent per year, which indicates a 30% imbalance between sources and sinks. CFCs were first released into the atmosphere this century; the two most prevalent forms are CFC-12 and CFC-II. The CFCs account for around 15% of the current increases in the greenhouse effect and are very concerning due to their propensity to destroy stratospheric ozone. In addition to the variations in the greenhouse gases previously mentioned, the chemistry of the atmosphere is changing as a result of emissions of carbon monoxide, nitrogen oxides, and volatile organic compounds, among other species. The oxidizing power of the atmosphere and the quantity and distribution of ozone are both affected, which impacts the lives of methane and other greenhouse gases. Uncertain global ozone changes may have increased or decreased the world's commitment to reducing greenhouse gas emissions during the last ten years [7], [8].

II. DISCUSSION

Acid Rain

Although the phenomena known as acid rain more accurately, acid deposition was first seen in Manchester, England, in 1852 and further documented in 1872, current scientific investigation has only been conducted since the middle of the 1950s. The issue first attracted public attention in the late 1960s. An environmental risk that is transponder in nature is acid rain. Acid rain is a serious issue in Northeastern America, North Western Europe, and India. Certain rivers, lakes, streams, and forests in the United Kingdom (UK), the United States of America (USA), Germany, and many other nations have been impacted by acid rain.

Literally, abundant acids in rainwaters are what acid rain refers to. Strong mineral acids like sulphuric acid (H_2SO_4), nitric acid (HNO_3), and hydrochloric acid (HCl) are all combined to form acid precipitation. It typically has a pH of less than 5.6, which is the level at which distilled water is in equilibrium with the atmosphere's carbon dioxide. The movie Acid Rain Acid rain is an issue in water because of human activity. The majority of acids originate from factories, residences, automobiles, and power plants, although some are also produced naturally by volcanoes, marshes, and planktons. The main cause of the acid issue is the movement and subsequent deposition of sulphides and nitrogen oxides, as well as their oxidative byproducts. These are created by the burning of fossil fuels, as well as by power plants, car exhaust, house fires, etc.

Formation of Acid Rain

One kind of acid deposition is acid rain, which may be either wet or dry. Snow, dew, fog, frost, and mist are all examples of wet deposition, whereas dust particles containing sulphate and nitrate that fall to the ground are examples of dry deposition.

Wet Acid Rain

Sulphur and nitrogen are found in coal, fuel wood, and petroleum products. These elements are transformed into their corresponding oxides (SO_2 and NO_3), which are very soluble in water, when they are burned in air oxygen. Oxides of Sulphur and nitrogen enter the atmosphere through both manmade and natural sources. The main cause for worry is that acid deposition acidifies streams and leaches lime from coarse, sandy soils Wherever there is a high sulphate loading from human sources, the impact is most noticeable in headwater zones and humid montane habitats. The increased leaching of calcium from terrestrial soils, the mobilization of heavy metals like aluminium, zinc, and manganese, and a rise in the clarity of lake waters are some of the chemical and physical effects of lake acidification. The biological effects include major shifts in aquatic plant and animal populations with a steady decline in their variety. Forest soils grown on sandy substrata deficient in lime may become even more depleted as a result of acid deposition. The productivity of the forest will gradually decline due to the rapid leaching of nutrients including phosphorus, potassium, magnesium, and calcium from these soils. Additionally, since the acid sulphate particles that contribute to acid precipitation are small enough to enter the lung deeply, they may potentially worsen lung conditions and raise death rates.

Ozone Layer Depletion

In the scientific journal Nature, Joseph Farman of the British Meteorological Survey and colleagues reported that between 1977 and 1984, stratospheric ozone concentrations above Antarctica decreased by more than 40% from baseline levels in the 1960s during October, the first month of spring in the Southern Hemisphere. It meant that the ozone layer, which shields living things from ultraviolet solar radiation, produces a hole for a number of months out of the year. Suddenly, it seemed that the ozone-depleting chemical reactions high in the earth's atmosphere were operating more quickly and effectively than anticipated.

Chemistry of the Ozone Layer

When energized by radiation from the sun, oxygen molecules (O2) which are present in large quantities throughout the atmosphere split apart into individual atoms (O + O). To create ozone (O3), these atoms are free to collide with additional O2 molecules. Ozone molecules' unique arrangement enables them to absorb ultraviolet waves from the sun that would be damaging to life if they reached the earth's surface. The total concentration of stratospheric ozone stays constant because other naturally occurring chemical processes partly eliminate the ozone molecules created by impact. Because of the low gas density in the stratosphere, oxygen atoms seldom ever clash with other molecules, therefore ozone does not develop often. Too little solar energy reaches the atmosphere below the ozone layer to support significant ozone formation. Thus, at latitudes between 10 and 35 km, a stratospheric layer bursting with ozone contains the majority of the planet's ozone [9], [10]. Ozone is a powerful greenhouse gas that is created closer to the ground, in the troposphere, via a sequence of chemical processes combining hydrocarbons and nitrogen oxide emissions from automobiles and industrial activities. As a result, ozone contributes to global environmental change in two very distinct ways: in the stratosphere, where it acts as a barrier against damaging UV radiation, and closer to the earth, where it acts as a greenhouse gas and a health risk.

In 1974, scientists proposed the hypothesis that growing quantities of manmade chemicals known as chlorofluorocarbons (CFCs), which are chemically highly stable in the lower atmosphere, would climb unaltered into the troposphere, the lowest atmospheric layer. Despite the fact that CFCs are mostly manufactured in industrialized nations in Europe and North America, where they are used for a broad range of purposes such as solvents and refrigerants. The scientists hypothesized that as CFCs enter the stratosphere, they come into contact with high-energy UV radiation, which causes them to disintegrate and release chlorine atoms. Before additional chemical reactions remove the chlorine from the environment, the chlorine atoms may then interact with ozone in a catalytic reaction in which each chlorine fragment can obliterate up to 100,000 ozone molecules.

The Antarctic Ozone Hole

The Antarctic ozone hole is now regarded by many scientists as the earliest conclusive proof of ozone depletion caused by chlorine produced by humans as well as one of the first distinctly discernible results of human-induced global change. The ozone levels fall at about the same rate, they discovered latitudes where chlorine monoxide concentrations rise. The loss of the ozone layer is mostly attributed, in the opinion of scientists, to the higher amounts of chlorine and bromine. Ozone molecules are created over the tropics and transported to the Antarctic and Arctic by atmospheric movements together with chlorine. The Antarctic polar vortex, a kind of circulation system, traps ozone above the South Pole for many months. Scientists have seen such startlingly low ozone concentrations in this vortex during the first two weeks of October, just after the start of the Southern Hemisphere spring. These surfaces undergo chemical processes that change chlorine from forms that do not interact with ozone to other, less stable forms that easily disintegrate in the presence of sunshine and then destroy ozone. Sunlight and low temperatures are both essential to the mechanism that causes ozone depletion in the Antarctic. Antarctic ozone depletion occurs in the southern spring, when sunlight has returned but temperatures are still low, as opposed to the winter, when it is coldest and the South Pole is completely enveloped in darkness.

Effect on Line

Life depends on the ozone layer because it protects it from harmful UV light. Researchers are attempting to understand how ozone depletion may impact people, plants, and aquatic environments separately. Direct UV light exposure may weaken the immune system, lead to cataracts, and raise the risk of skin cancer. According to EPA estimates from 1986, the incidence of skin cancer would increase by 2% for every 1% decrease in stratospheric ozone. More than 200 plant species have been evaluated as part of the attempt to understand the impacts on vegetation and crops, and two-thirds of them exhibit sensitivity to increased UV radiation. One of the most important food crops for humankind is the soybean, which is also highly vulnerable to ozone damage, along with other plants in the bean and pea, squash and melon, and cabbage families.

Reduced leaf size, slowed development, poor seed quality, and increased vulnerability to weeds, disease, and pests are all reactions of plants to UV light. Additionally, scientists are still learning how UV radiation could impact marine habitats and organisms. Phytoplankton, the tiny marine algae that serve as the foundation of the marine food chain, is the first system about which there should be concern. Studies in the tropics have shown that high levels of UV light may cause them to die, while low levels can reduce photosynthesis and hence output. Small crustaceans higher in the food chain, fish, birds, and marine mammals like seals and whales might all be impacted in Antarctica by this. Although it offers some radiation protection, estimations show that UV radiation may reach depths of 10 to 20 meters. It is known that certain phytoplankton can withstand UV light while others cannot. It's possible that tolerant species may take the place of sensitive ones, but no one is sure how this would affect the fish that consume them.

Nations Joining to Protect the Ozone Layer

In accordance with the Montreal Protocol on Substances that Deplete the Ozone Layer, which was negotiated in September 1987, CFC production must be cut in half from 1986 levels by 1999. The treaty has been ratified by 49 countries, including Canada, the United States, Japan, and numerous European countries, who together use 80% of the substances under regulation. The protocol strikes a careful balance between the most recent scientific knowledge, trustworthy industry competence, and devoted political leadership, all of which are backed by a powerful and educated public interest. As the globe handles shared environmental challenges like greenhouse warming and other types of global change, the Montreal Protocol may prove to be a paradigm for activities that cross national borders and interests.

Conventions

Recent years have seen a number of conferences that have established a worldwide policy framework to be taken into account when dealing with the science of global climate change, including the Vienna Convention for the Protection of the Ozone Layer. At a conference that the UNEP organised, this treaty was ratified by 20 governments as well as the EEC. The convention's goal was to safeguard both the environment and human health from harmful effects caused by or expected to come from human activities that alter or are likely to alter the ozone layer. International conference and follow-up workshops on the evaluation of the role of CO2 and other greenhouse gases in climatic fluctuations and related repercussions. The Viuach Conference, which included 29 nations, recommended that governments and intergovernmental organisations incorporate the findings of the assessment into their environmental programmes and support the expansion of public awareness of issues related to climate change. This meeting dealt with the evaluation of carbon dioxide levels in the atmosphere.

Montreal Protocol on Substances Depleting the Ozone Layer, signed on September 16, 1987, in Montreal, Canada. This convention, which was signed by 24 of the 46 nations present at the conference in Montreal, aims to stop the manufacturing, use, and trafficking of ozone-depleting substances. Group I (certain CFSs) and Group II (certain halons) are the two groups into which the compounds are split, and each is subject to a separate set of restrictions. The agreement also makes a distinction between two sets of nations: those that are more developed and consume the main ozone damaging compounds at relatively high levels and those that are developing and consume them at relatively low levels. 11 March 1989, The Hague, Netherlands: International Conference on the Protection of the Global Atmosphere. The Hague Declaration, which called for the development of a new institutional authority within the UN framework, either by strengthening current institutions or by establishing new institutions, was the result of this conference, which was organised at the initiative of the French Prime Minister and co-sponsored by the French, Dutch, and Norwegian governments.

In the statement, it was also mandated that an Atmospheric Fund be established in order to provide fair and equitable assistance to compensate countries bearing an abnormal or special burden as a result of decisions taken to protect the atmosphere. Rio de Janeiro's 3–14 June 1992 Earth Summit–United Nations Conference on Environment and Development– More than 115 heads of state or government attended the historic Earth Summit that took place in Rio de Janeiro from June 3–14, 1992. The main accomplishment was the approval of Agenda 21, a lengthy document of 800 pages that outlines how nations would pursue sustainable development and includes in-depth chapters on the underlying financial principles and processes. The chapter on technological transfers is also included.

Scientific Programmes on Other Activities of International Organizations

Several environmental initiatives, like the UNEP (United Nations Environment Programme) and UNDP (United Nations Development Programme), are actively pursuing this topic. They are joined by the Economic Commission for Europe (ECE), European Economic Community (EEC), European Science Foundation (ESF), Food and Agricultural Organisation (FAO), International Social Science Council (lSSC), World Meteorological Organisation (WMO), Inter-governmental Oceanographic Commission (IOC) (a division of UNESCO), Scientific Committee on Ocean Research (SCOR), and numerous other similar organisations. In addition to these, there are other ongoing scientific projects funded by various institutions, such as the World' Weather Watch (WWW), World Climate Research Programme (WCRP), World Climate Programme (WCP), World Climate Impact Studies Programme (WCIP), Past Global Change (PAGES), Integrated Global Ocean Station System (IGOSS), Human Dimension of Global Change (HDGC), Global Environment Monitoring System (GEMS), and Global' Change and Terrestrial Eco-System. Pollutants brought on by human activity, wasteful and inefficient use of fossil fuels, and the results of fast population increase in many areas are all causing the Earth's atmosphere to change at an unprecedented pace. The buildup of greenhouse gases such as carbon dioxide, methane, nitrous oxide, CFCs (strong greenhouse gases that also deplete stratospheric ozone), and other gases due to the burning of fossil fuels, deforestation, and the production of food for the world's rapidly expanding population is changing the climate.

III. CONCLUSION

The serious problem posed by climate change calls for swift, coordinated global response. The causes and effects of climate change have been covered in this essay, with a focus on the need of methods for adaptation and mitigation. It is obvious that human activity is the main cause of climate change, which has a number of negative repercussions. This includes the combustion of fossil fuels and deforestation, in particular. The effects of rising global temperatures on ecosystems, biodiversity, and human health are significant. Heat waves, droughts, floods, and storms are only a few examples of the extreme weather phenomena that are occurring increasingly often and intensely. This causes huge economic losses and the eviction of vulnerable communities. Rising sea levels increase the danger of erosion and floods in coastal areas and tiny island countries. The shift to clean and renewable energy sources, increased energy efficiency, and the promotion of sustainable practices in fields like transportation, agriculture, and industry are all necessary for mitigating climate change. It also requires the preservation and restoration of ecosystems like forests and wetlands that serve as carbon sinks.

REFERENCES

[1] J. Zinsstag et al., 'Climate change and One Health', FEMS Microbiology Letters. 2018. doi: 10.1093/femsle/fny085.

[2] W. Jenkins, E. Berry, and L. B. Kreider, 'Religion and climate change', Annual Review of Environment and Resources. 2018. doi: 10.1146/annurev-environ-102017-025855.

[3] V. Karimi, E. Karami, and M. Keshavarz, 'Climate change and agriculture: Impacts and adaptive responses in Iran', Journal of Integrative Agriculture. 2018. doi: 10.1016/S2095-3119(17)61794-5.

[4] S. Hallegatte, M. Fay, and E. B. Barbier, 'Poverty and climate change: Introduction', Environment and Development Economics. 2018. doi: 10.1017/S1355770X18000141.

[5] J. C. Semenza and J. E. Suk, 'Vector-borne diseases and climate change: A European perspective', FEMS Microbiology Letters. 2018. doi: 10.1093/femsle/fnx244.

[6] H. Gökçeku and D. Al-Othman, 'Impacts of climate change on human health', Int. J. Innov. Technol. Explor. Eng., 2018, doi: 10.47895/amp.v50i2.862.

[7] A. Connelly, J. Carter, J. Handley, and S. Hincks, 'Enhancing the practical utility of risk assessments in climate change adaptation', Sustain., 2018, doi: 10.3390/su10051399.

[8] K. Bouwer, 'The unsexy future of climate change litigation', J. Environ. Law, 2018, doi: 10.1093/jel/eqy017.

[9] K. O'brien, E. Selboe, and B. M. Hayward, 'Exploring youth activism on climate change: Dutiful, disruptive, and dangerous dissent', Ecol. Soc., 2018, doi: 10.5751/ES-10287-230342.

[10] J. Wang, S. K. Vanga, R. Saxena, V. Orsat, and V. Raghavan, 'Effect of climate change on the yield of cereal crops: A review', Climate. 2018. doi: 10.3390/cli6020041.