

Global Warming: An Analysis of Causes, Impacts and Solutions

Raj Kumar¹, Arushi Sharma², Shashwat Sharma³

¹Deputy Director, Geology and Mining Department, Jammu, India

Corresponding Author Email: [rajkumargeologist74\[at\]gmail.com](mailto:rajkumargeologist74[at]gmail.com)

²Pursuing MBBS, GMC Jammu, India

³Pursuing B. Sc. Agriculture, SKUAST, Jammu, India

Abstract: *An attempt has been made to comprehensively review and synthesize information on Global Warming. The paper provides an extensive review of Global Warming, focusing on its Causes, Impacts and potential remedies. It highlights the increasing concentration of CO₂ emissions and the role of various other factors in exacerbating global warming. The paper further discusses the consequences of global warming and suggests potential remedies. Some of the important factors which are aggravating global warming are Automobile Exhaust, Smoke released from Factories, Burning of Coal, Petrol, Diesel, Natural Gas and other Petroleum Products, Aerosol Sprays, Refrigerators, Air Conditioners, Deforestation, Shifting Agriculture, Forest Fire, Burning of Wood and Volcanic Eruptions due to which there is global rise in temperature of earth's atmosphere.*

Keywords: Global Warming, Greenhouse Gases, CO₂ Emissions, Climate Change, Environmental Impact, Remedial Measures

1. Introduction

Sun emits light consisting of Ultraviolet (UV) and Infrared Radiations. The UV radiations are partially absorbed by the Ozone layer whereas a part of these UV rays penetrate through it. As far as infrared radiation is concerned it passes through the earth's atmosphere and strikes the surface of the earth. Some of these infrared radiations are reflected back, while a major part of them is entrapped by CO₂ present in the atmosphere. The Carbon dioxide present in the atmosphere absorbs these entrapped UV and infrared radiations which has a significant heating effect on the earth's atmosphere, essential to sustain life. But on the other hand excessive heating and warming up of the earth's atmosphere by the greenhouse gases which exceed the permissible limits have adverse effects. Thus, the heating or warming up of the earth's atmosphere due to the trapping of sun rays (Infrared/UV radiations) by thick blanket of CO₂ and other associated gases in the earth's atmosphere released naturally as well as due to the anthropogenic sources is *Greenhouse Effect*.

The heating of the earth by the greenhouse effect is important for existence of life on it. It is due to the warming of the earth by greenhouse effect that the earth has become a habitable planet, having millions of different life forms on it. Thus the whole earth would have been extremely cold frozen planet, making it very difficult for life to sustain, if there was no warming effect by the greenhouse gases. The disastrous problem of global warming arose due to increase of CO₂ and other greenhouse gases in the atmosphere beyond their permissible limits, leading to excessive heating of the earth's atmosphere.

The major contributors of CO₂ and other associated greenhouse gases in the earth's atmosphere and due to which

its temperature is increasing day by day, which have an effective role in global warming are given as under:

- Automobile exhaust containing gases like CO₂, CO, SO₂, etc.
- Smoke released from factories comprising of gases like CO₂, CO, NO₂, etc.
- Burning of Coal, Petrol, Diesel, Natural Gas and other Petroleum Products, etc.
- Aerosol Sprays, Refrigerators, Air Conditioners, etc.
- Deforestation and Shifting Agriculture.
- Forest Fire and Burning of Wood.
- Volcanic Eruption.

Release of Greenhouse gases (beyond permissible limits) along with physico-chemical parameters from the above sources in the earth's atmosphere are explained in detail (Fig. 1). The gases which play major role in global warming are given as under:

- Carbon dioxide (CO₂)
- Chlorofluro Carbon (CFC)
- Nitrogen oxide (NO₂)
- Methane (CH₄)
- Sulphur Dioxide (SO₂)
- Carbon monoxide (CO)
- Water vapours (H₂O)
- Dust particles

The increasing release of these greenhouse gases and physico-chemical parameters have given rise to Global Warming, a major threat to entire living beings over the globe at present. **Thus global warming is the undue rise in average temperature of the earth's atmosphere and its oceans, a change that is believed to be permanently altering Earth's climate and is a major challenge to the Scientists all over the world.**

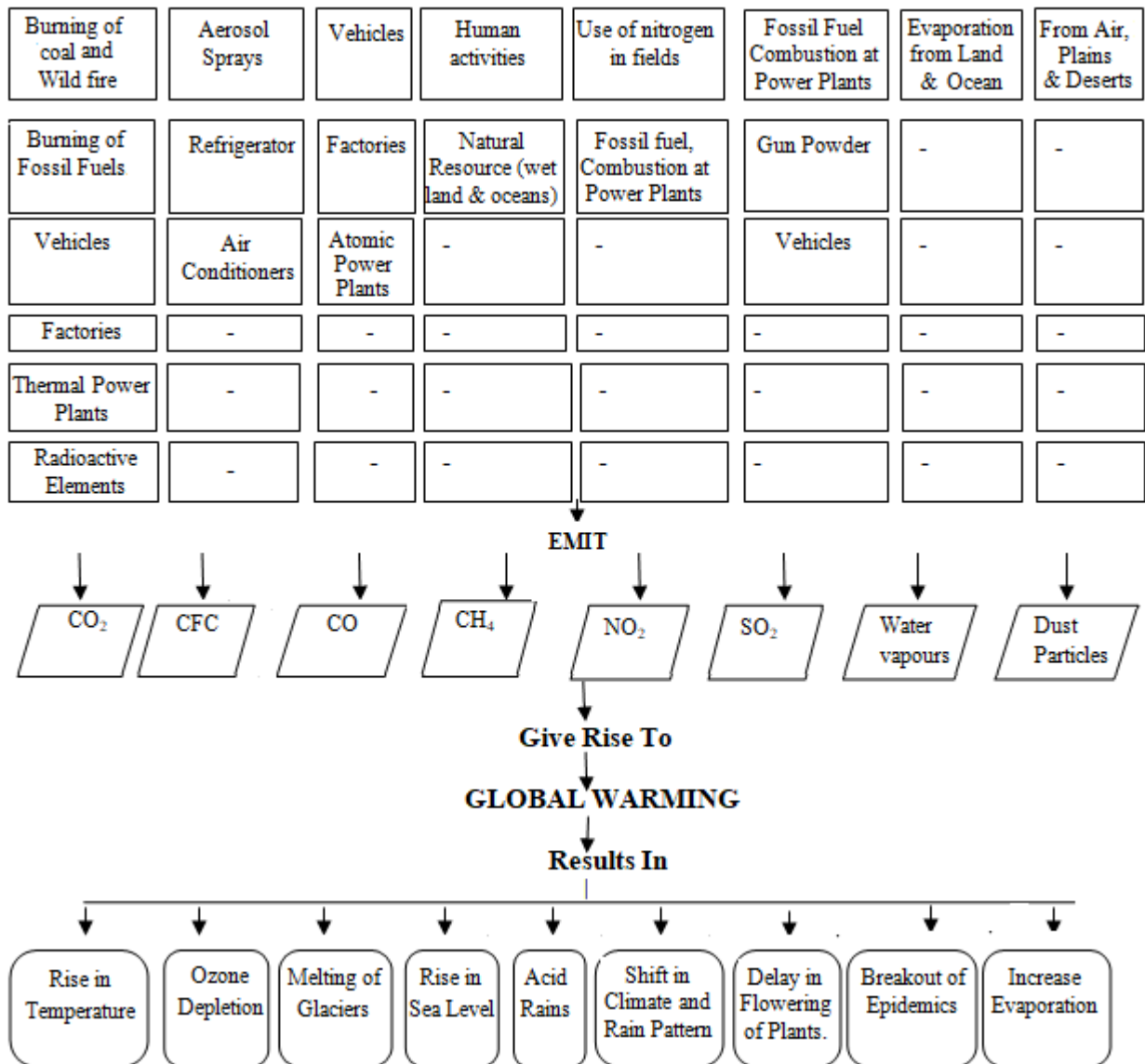


Figure 1: Major contributors of greenhouse gases in global warming.

Global Warming and its Consequences

Carbon Dioxide (CO₂) is the major greenhouse gas in the earth’s atmosphere, the emission of which was estimated to account for 55% in the mid eighty which was quite low when compared with the concentration reported in 2007 and 2015. Similarly Methane 15%, Nitrous oxide 6% besides CFC and others 7% (Fig. 2-a) also have low concentration when compared to data reported in 2007 and 2015.

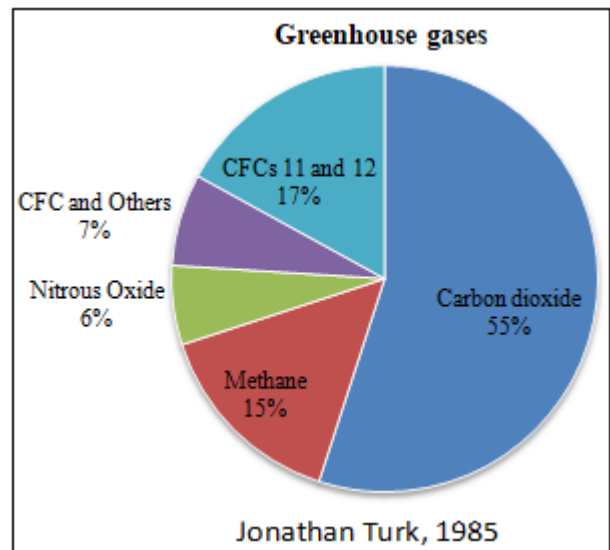


Figure 2 (a): Comparison of Greenhouse gases in the earth’s atmosphere reported in 1985, 2007 and 2015

It is imperative to mention here that there was quite an increase in the concentration reported in the year 2007 where CO₂ was reported 74%, Methane 16%, Nitrous Oxide

9% and CFC 1% (individual) (Fig. 2-b), Himalayan Mail, May 17, 2007, P-06.

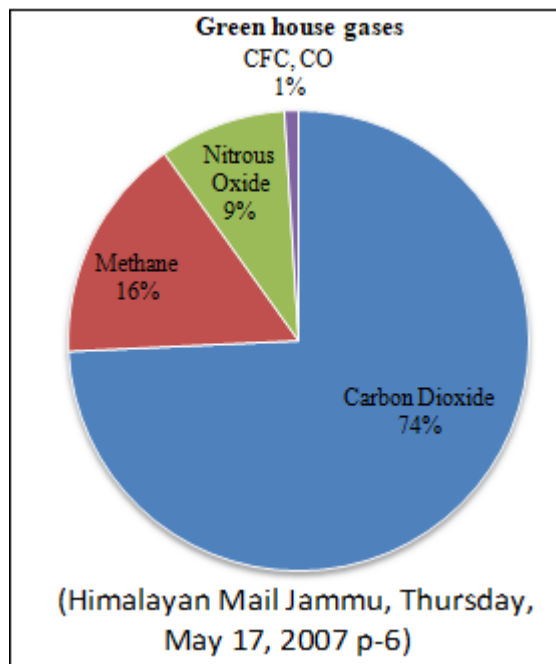


Figure 2 (b): Greenhouse gases in the earth's atmosphere reported in 2007.

Interestingly to know that during the year 2015 CO₂ was reported by Centre for Climate and Energy Solution (CCES) to be 76%, Methane 16%, Nitrous Oxide 6% and HFC, PIC, SF₆ 2% (Fig. 2-c). Further International Energy Agency (IEA) in 2021 has reported a jump of CO₂ by 6% whereas in March 2, 2023 it has reported a rise of CO₂ of 1%. All these greenhouse gases are emitted by the anthropogenic activities as well as natural inputs. The physico-chemical parameters like water vapours and dust particles are the non-anthropogenic source. The concentration of the greenhouse gases compared with the values quoted in "Introduction to Environmental Studies", by Jonathan Turk (1985) and in "Global and General Environment" by H.D. Kumar and Swati Kumar reveals that CO₂ was reported to be 55% in the mid eighties which was quite low when compared with the concentration reported in the year 2007 and 2015 (Fig 2-a, b & c). It all is happening due to unprecedented growth of industries, use of old vehicles, burning of excessive coal and wood. The use of Refrigerators/Air Conditioners release CFC which harms the ozone layer. The UV radiation plays an effective role to deplete the ozone layer, an important shield to all living beings and the flora and fauna for their survival.

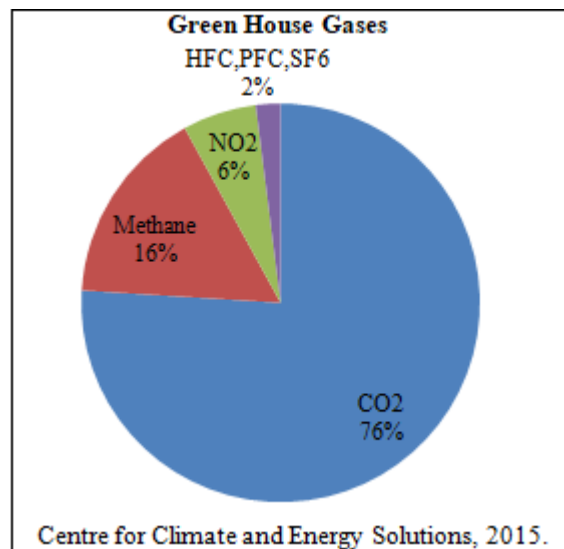


Figure 2 (c): Greenhouse gases in the earth's atmosphere reported in 2015

The uncertain values which are very difficult to accept, comes from the lack of understanding as to what extent CO₂ and CFC has been emitted to cause the greenhouse effect. Emission of Carbon Dioxide (CO₂) and other greenhouse gases from burning and combustion of fossil fuel (Fig. 3 & 4) have increased ever since the establishment of first industry i.e. beginning of industrialization. There is cumulative increase in emission of CO₂ but it started to increase suddenly after Second World War, where a large amount of carbon dioxide have been added to the atmosphere released by using a large amount of ammunition and burning of coal and wood.

Further, the net flux of CO₂ in the atmosphere is also contributed by ways of land cultivation. Earlier it was mainly in the temperate regions of the world where forest area decreased and thereby contributed to increase carbon dioxide concentration in the earth's atmosphere. But today it is mainly felling of the tropical rain forests which is contributing to the net flux of CO₂ to the atmosphere. The shrinking of cultivatable land in India indicates that there is continuous decrease in total area of cultivatable land. In 2007-08 it was reported to be 182.4 million hectares whereas in 2010-11 it became 182.0 million hectares. Overall decrease reported was 406,000 hectares, Times of India, August, 17, 2013, P-08 whereas at present it is 159.7 million hectares. Approximately 4/5th of all CO₂ emissions from anthropogenic activities now released from factories and burning of fossil fuels (Fig. 3 & 4).



Figure 3: Smoke released from factories results in Global warming (Socialistaction.org.in)



Figure 4: Mining Industry causing Global warming by releasing SO_2 , Methane, etc. (Google Pic.)

The remaining 1/5th can be attributed to changes in land use mainly by cutting of trees i.e. deforestation, forest fire and other important related sources. It clearly indicates that the deforestation is occurring at an alarming rate on large scale resulting in progressive increase in CO_2 in the atmosphere, (Fig. 5-a & b) Times of India, August, 17, 2013, P-08.



Figure 5 (a) Deforestation cause of Global Warming



Figure 5 (b): Cutting of Wood on large scale (Google Pic.)

In the Times of India, June 16, 2023 it was stated that 70% of Biodiversity is in forests. Biodiversity loss and conservation is directly interlinked with climate change and global warming, so forest officers are the best to deal with such issues significantly. A global scientific study on the wildlife more losers than winners: Investigating anthropocene defaunation through the diversity of population trend analysed population trend of more than 70,000 species across the world, concluded with worrying trend 48% of species included in the analysis are undergoing population declines, while 49% remain stable. Only and 3% are increasing population size which is due to the deforestation, a cause of Global Warming.

The study stated destruction of wild landscapes has many reasons behind it including climate change which is increasingly having impacts. To effectively manage the overall issues linked with climate change and forestry, their management and regulation under single agency is need of the hour. But Indian Forest Services has not gained autonomy for this. In our country the Air (Prevention and Control of Pollution) Act, 1981, the water (Prevention & Control of Pollution) Act, 1974 and solid waste management Rules, 2016 are being regulated by different agencies, and different sets of civil servants, rather than subject experts.

Today top three emitters of greenhouse gases in the atmosphere are China, USA and India which together contribute about 50% of world's emission while top 20 countries emit 80% of world's total emission as per UNCTAD, June 2, 2020.

The low-risk limit for the absolute temperature rise, 1°C above the preindustrial level, has already been crossed. Facing the high-risk will require Global reductions of CO_2 emissions by at least 50-60%. In other words if the developing countries are to be permitted some relaxation for their development, the most dominant industrial countries (Developed) will have to reduce their emissions of (GHG) especially CO_2 , CFC and other related greenhouse gases wherein this idea has been supported by various suggestions that the goal for industrialized nations (developed countries) should be mandatory to reduce their CO_2 emissions by 80% by any means or even more according to the suitability to overcome the effects of global warming for the safeguard of the Mother Earth in general and mankind as well as other living beings over it in particular.

The developed and industrialized nations should step in to formulate policies in consultation with developing countries for implementation at international level with the participation of developing countries to reduce the emission of greenhouse gases considerably within the framework of sustained economic growth, provided that the energy supply structure and the industrial production are to be adopted in a flexible and cost effective manner to overcome this challenge in near future.

It is to mention that the costs and techniques of reducing emissions of greenhouse gases may differ between different countries and regions. In the long run the cost of reducing of the CO₂ and other gases may turn to be greatest in the developing countries because these countries are still at an early stage of development of their industrial set up.

Emission of greenhouse gases causing Global warming will have very harsh and severe effects on entire living beings by various ways as given under:

- Depletion of Ozone
- Sea Level Rise
- Melting of Glaciers
- Floods and Droughts
- Desertification
- Shifting Climate and Rainfall Pattern
- Crop affecting and Delay in Flowering of Plants
- Breakout of Epidemics and Health Hazards
- Increase in Evaporation

Depletion of Ozone:

During the past three decades ozone has depleted 3 to 5 percent globally alluring more UV rays to strike the earth just because of releasing of CFC, an effective greenhouse gas playing major role in depletion of ozone layer. It is the only layer in the atmosphere which plays a significant role to prevent the entry of UV rays on the earth. Every 1% decrease in thickness of ozone layer may lead to 2% increase in skin cancer to the living beings on the earth causing a major threat of health hazards.

Sea level Rise:

Global warming will play destructive role in sea level rise. It will drastically result in melting of a large amount of polar ice caps and glaciers effective in raising the level of water in seas and oceans. The Intergovernmental Panel on Climate Change (IPCC) has prediction of 0.4 inches per year of sea level rise over the next century. This rate of increase is less than, but similar in magnitude, to the average rate during the ice age deglaciation, but considerably smaller than its peak William Menke, 2014. Low lying areas especially located adjoining the rivers and sea shore will be severely affected and submerged due to rise of water level and so many people who have established their houses/colonies along sea shore will be severally effected even the cultivated land will not be used for crop cultivation due to which chances of food scarcity will emerge.

Melting of Glaciers:

All of us are well aware of the fact that a large amount of fresh water is stored in the form of snow and glacial ice, 80% of which is locked up into two major continental glaciers of Antarctica and Green Land, only 3% of fresh

water found in the glaciers of Alps, Rockies, Himalayas and New Zealand (Singh 1992) and (Kumar, 2014). Out of total water on the earth only 3% of water exists as fresh drinking water in various forms i.e water, snow, ice, water vapors, etc. with considerable proportion. Glaciers over the globe are largely affected by the temperature rise, due to which flash floods are occurring and low lying areas adjoining river banks and sea shore are under the grave threat of submergence. The melting of the polar ice caps and glaciers is taking place on large scale at an alarming rate. If the same trend will continue due to rise in temperature, there will be acute shortage of fresh drinking water over the entire globe because the glaciers are the lifeline of all the perennial rivers, the major source of the fresh drinking water to the living beings. The affected glaciers are continuously under the major threat of disappearance.

Floods and Drought

Due to global warming, flash floods and cloud bursts have become common phenomenon. Monsoon will result in floods where as summers in droughts. The change in wind pattern will result in incidence of desertification in tropics and more rainfall in temperate regions whereas on the other hand the tropical and equatorial regions will become dry and receive low rainfall. The low lying areas will be flooded and submerged under water. From June 10, 2023 on ward up to June 20, 2023 more than 100 deaths have taken place due to heat waves as per media reports whereas on the other hand with effect from June 18 up to June 22, 2023 there were unprecedented rains in Rajsthan especially in Jaislmer, Bikaner, Palli and adjoining areas where large areas were submerged in water almost all streets, houses as well as public buildings were filled with water. It all indicates that climate pattern is shifting which will affect both property, prosperity, biodiversity, etc. the shifting of the climate will not only affect the human being but will also affect the entire. Ecosystem and natural habitat as well and adversely impact crop cultivation leading to food scarcity in near future. It is still the right moment to form stringent laws and implement those on ground for the safe guard of mankind to save the mother earth from the total destruction (Fig. 6 & 7).



Figure 6: Floods due to impact of Global Warming



Figure 7: Drought due to the Global Warming (Google Pic.)

Desertification

Some of the areas in Rajasthan are deserts having only sand and sand dunes. Earlier the cultivation of crops was almost negligible since most of the time it remain dry as it is one of the largest desert over the globe. The annual rainfall in some parts was not more than 10 mm per year. It is astonishing to know that for about one decade it has been noticed that Rajasthan has received sufficient rainfall, due to which crop pattern has also been changed. Not only cropping pattern has changed but the deserts areas/part are used for the cultivation of suitable crops. In some areas, there occurs sufficient rainfall even during the month of May-June and variety of crops are being cultivated in the areas which otherwise were desert a decade earlier. On the other hand some of the areas of other states adjoining Rajasthan which were earlier used for the cultivation of crops now have been converted into desert where there is very low amount of ground water as well as cultivation of crops. Those areas were very fertile and productive but due to the impact of global warming scarcity of rain fall the area cannot be used for agriculture hence converted into desert. The adverse impact on the crop cultivation in the area converted into desert will lead to food scarcity in near future. (Fig. 6 & 7).

Shifting of Climate and Rainfall Pattern:

Climatic pattern will be altered altogether resulting in drastic changes. The rainfall periods will be shifted. The temperate regions will receive maximum rainfall whereas on the other hand the tropical and equatorial regions will become dry and receive low rainfall. The change in climate will result desertification of tropics and more rainfall in temperate zones. Even there will be a change in seasons. The winters will be of pretty long duration i.e. September to April. On the other hand the summers very less but at present the summer season has become more longer than the winters. It all is happening due to the impact of green house gases creating global warming.

Crop affecting and Delay in Flowering of Plants:

Increase of CO₂ in the earth's atmosphere will also affect over the flora i.e. (Trees, Plants and Crops) and will definitely cause delay in flowering of plants like cotton, sunflower, besides many others. Plants may produce leaves richer in carbon and deficient in Nitrogen content resulting in thickening of leaves. Insects feeding on such plants might have to consume more leaves. Crop cultivation patterns will be changed and shifted altogether due to uneven rise of CO₂

and other greenhouse gases in the earth's atmosphere (Fig. 8 & 9).



Figure 8: Devastated Corn Field as a result of long time Drought



Figure 9: Flooded Corn Field (Google Pic.)

Break out of Epidemics and Health Hazards:

Due to high concentration of greenhouses gases in the earth's atmosphere different epidemics relating to respiratory and circulatory system in human as well as animals will break out. It will cause epidemic and health hazards among the living beings over the globe. The chances of breaking out of diseases like skin cancer, asthma, poor vision, physical deformities etc. will increase manifold. Even the plants will be adversely affected by the greenhouse gases. Recent COVID-19 epidemic spread claiming so many lives especially higher mortality in developed nations liked USA, UK, Italy, Spain, etc. does indicate polluted environment to be an associated factor in health hazards.

Increase in Evaporation:

Rise in temperature may lead to increase evaporation and reduction of moisture from soil by which Agriculture, Horticulture, Floriculture, etc. will be adversely affected. Production of crops will be affected by the dryness of the soil. The areas which will come under the impact of high rate of evaporation and increased moisture in air will have disastrous effects on the production of certain crops and fruits.

Latest Findings and Evidences:

United Nations Environment Program (UNEP) has declared according to data from World Glacier Monitoring Service

(WGMS) which drew its findings from 30 glaciers in 9 mountain ranges that in 2004-05 and 2005-06 the average rate of melting became more than doubled. The speed at which the glaciers are melting has accelerated from 0.7 m.w.e in 1998 to 1.2 m.w.e in 2021-22.

One of the major causes of increase in CO₂ is California Wildfire, which nearly pumped out 112 million metric tonnes of climate warming CO₂ into the atmosphere in the year 2020 as per California Govt. official website. Alaska alone releases about 35 million metric tons of CO₂ in the atmosphere per year which is a serious concern and causes a major threat of global warming as per news item in PRESS, January 27, 2022.

It is imperative to mention that the Russia-Ukraine war which was started in February, 2022 and a period of nearly 1.5 years is at completion where countless ammunition has been used in the war. It is clear that huge quantity of explosive like bombs, Missiles, besides use of fighter planes, and ammunition in abundance. If this is not regulated/controlled the whole world has to get ready to face the consequences of aggravating global warming.

The “Indian Ocean Brown Cloud” also called as “Asian Brown Cloud” is a form of atmospheric haze containing black carbon, soot, fly ash and numerous toxic chemicals. It appears annually between months of December and March. It consists of emission from burning fossil fuels like Coal, Petroleum or Natural Gas besides Wood and Organic matter on large scale over the Asian Subcontinent. It contributes as much to atmosphere warming as greenhouse gases play role in melting Himalayan glaciers.

Experts warn “Ganga” is under grave threat from global warming. Latest findings show that Himalayan sources of **snow and ice** are drying and eliminating nearly 10 times faster in last four decades than during previous seven centuries. In dry summer months the “Gangotri Glacier” provide up to 70% of water in Ganga. In the year 2007 United Nations Climate Report on the Himalayan Glaciers revealed that the source of water in River Ganga i.e “Gangotri Glacier” could disappear by 2030 due to temperatures rise, (Indian Express, June 20, 2007, P-03).

The researchers of IOP Institute of Physics, Chalmers University of Technology, Sweden had published in “**Environmental Research letter**” in July, 2013 that **Bio-energy with Carbon Capture and Storage (BECCS)** can reverse the global warming trend and push temperature back below the global target of 2⁰C above pre-industrial levels, even if current policies fail and they initially overshoot this target. Co-author of the study **Prof. Christian Azar** said: “what they demonstrate in their paper is that even if they fail to keep temperature increases below 2⁰C, then they can reverse the warming trend and push temperatures back below the 2⁰C target by 2150”. “To do so requires both large-scale use of (BECCS) and reducing other emissions to near-zero levels by using other renewable sources of energy—mainly solar energy or nuclear power”. As per my observation the Tidal as well as Wind Energy is also an important and viable option which will definitely play key

role to down size the contribution of CO₂ addition in the atmosphere.

Due to Warming of water of Indian Ocean it is predicted that origin of cyclone Biprjoy is one of the effect of global warming. Interestingly the speed of the cyclone has reduced and duration prolonged. It is to mention that as per media news that in Bay of Bengal there is recession in the origin of the cyclones. It all has happened due to the impact of Global warming.

Steps to Curb Global Warming:

On large scale, over the globe, various conferences, workshops, seminars symposia, etc. are being organized besides, a lot of awareness campaigns are being planned to enlighten and aware the common masses in general and people directly associated with industries in particular regarding rising and control of this deadly venom which would destroy the entire fauna and flora, on the earth. But the finding of various scientists and researchers will remain in files, until implemented practically to overcome this great challenge. It is still not late for both Developed and Developing Countries to be awakened from their deep slumber for immediate action to implement remedies practically and adhere to the guidelines and findings of the Scientists and Researchers of various Institutes/Universities all over the Globe to save the entire mankind and living beings over the “**planet earth**” for our future generations by the ways which are given as under:

- Stringent Rules and Regulations should be formulated and implemented globally in letter and spirit. The outcome of those should be monitored twice a year if not possible at least once a year.
- Vehicles must be switch over to cleaner fuels like unleaded petrol and CNG not only in the Developed nations but over the entire Globe. It is pertinent to mention here that phased manner the diesel driven domestic/commercial vehicles should be eliminated from the roads by its substitute as electric vehicles
- Latest Scientific equipment and advanced Technology must be adopted in the factories/industries to have regular check and control on the emission of the greenhouse gases besides metering to measure and maintain the daily emission record.
- Use alternative source of energy instead of fossil fuels e.g. Solar Energy, Wind Energy, Tidal Energy, Hydropower Energy, etc. at Micro, Meso and Macro scales.
- Aware the common masses in general and people associated with factories/ industries in particular to follow Rules and Regulations and adopt the Measures suggested to reduce the emission of greenhouse gases.
- Plant more and more trees and avoid Deforestation and Forest fire.
- Ban Shifting/Jhum cultivation and Slash/Burn agriculture.
- A serious thought may be given to the concept of Bio-energy with Carbon Capture and Storage (BECCS) put forth by the Researchers of Chalmers University of Technology, Sweden.

- Awards and Appreciation program should be started to honour those who have made outstanding contribution for the safe guard of mankind from the effect of global warming.

The suggestions and findings which when implemented globally can bring a wider change in the conception of our modern society since **Global Warming is a serious threat to all living beings on the earth**. It has become prime need of both developed as well as developing nations to take a Firm Resolution to put off this range of terror which is clinging like a sword on entire **Mankind and all other living beings over the Globe**.

2. Conclusion

On the basis of an extensive review and synthesizing information from various sources like Research papers, Media Reports, News Papers, Research and Academic Articles, besides performing in-depth analysis and the observations recorded on Global Warming, it has been concluded that Global Warming presents a significant threat to mother earth. The paper has reviewed its Causes, Impacts and Potential remedies. It is clear that immediate action is required to mitigate the effects of global warming and safeguard our future. The increase in the concentration of the Greenhouse Gases especially Carbon Dioxide (CO₂) is aggravating Global warming. The remedies worked out by the assiduous efforts of Scientists as well as Researchers should be implemented in letter and spirit to overcome this phenomenon of heating of atmosphere of mother Earth the only planet yet known to have life.

Acknowledgement

The authors are thankful to Director and Joint Director, Geology and Mining Department J&K UT for their help from time to time for compilation of paper. Thanks are also due to Ms. Monika Sharma for valuable suggestions while writing this paper. Suggestions and help rendered by Dr. J.S. Pawar, Geologist Grade-I is also acknowledged. Help in typing the manuscript by Sh. Brijesh Mehta, Head Assistant is also acknowledged.

References

- [1] Greenhouse Gases in the Earth's Atmosphere. Himalayan Mail, May 17, 2007, P-06.
- [2] Jonathan, T. 1985. Introduction to Environmental Studies. 2nd Edition, Holt Saunders Publication. P. 1-330.
- [3] Kumar, H.D and Kumar, S. Global and General Environment. P. 1-490.
- [4] Shrinking Cultivable Land in India. The Times of India, August 17, 2015, P-08.
- [5] Impact of Deforestation on Carbon Dioxide in the Atmosphere. The Times of India, August 17, 2013, P-08.
- [6] Is the IFS Missing the Woods for Trees in a time of Climate Change, Global Warming? The Times of India, June 16, 2023.
- [7] Top Three Emitters of Greenhouse Gases. UNCTAD Report, June 2, 2021.
- [8] William M., 2014. Environmental Data Analysis. MatLab eBook.
- [9] Kumar, R., 2014. Impact of Climate Changes on Groundwater Resources in Jammu, J&K. Published in the proceedings of the workshop organized by the Central Groundwater Board, North Western Himalayan Region, Jammu, J&K.
- [10] Singh, V.P., 1992. Concept of water management. Published in seminar Volume on Irrigation, water management, WMF, New Delhi, P. 3-17.
- [11] United Nations Environmental Program on data from World Glacier Monitoring Services.
- [12] California Wild Fire Pumps out 112 million metric tons of climate warming CO₂ per year. California Govt. Official Website, 2020.
- [13] Alaska Release 35 million metric tons of CO₂ in the atmosphere per Year. As per News item in Press, January 27, 2002.
- [14] United Nations Climate Report on the Himalayan Glaciers. Indian Express, June 20, 2007, P-03.
- [15] Christian, A. 2013. Environmental Research Letter on Bio-energy with Carbon Capture and Storage (BECCS).