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Question Mark on Earth in Context of Green House Effect

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Abstract: *The planet Earth where biota live constitutes troposphere whose existence is under question mark. Greenhouse effect, also called as Global Warming, is actually a theory which proposes that pollution by common anthropogenic pollutants such as carbon dioxide, methane, CFC's, NOx , ground ozone etc, may lead to an increased global earth surface temperature . These have caused an increase in approximately 0.74±0.18°C (1.33±0.32°F) temperature between the start and the end of the 20th century. Present review deals with causo-mechanism of global warming (greenhouse effect), its impact on biotic community and possible control measures.*

Keywords:*Green house effect (Global Warming); Greenhouse gases; Surface temperature, Ice-albedo feedback; Infrared-radiation, Negative feedback, Positive feedback; Mitigation; Geo engineering.*

Introduction

Greenhouse effect is a theory so called as Global warming. UNESCO gave a slogan "Global warming is Global Warming". It was discovered by Joseph Fourier in 1824 and was first and foremost introduced quantitatively by Svante Arrhenius in 1986[1]. The phenomenon of global warming and climate change is as old as our knowledge about the earth climatology. The quickening of global warming is attributed basically to anthropogenic pollutants such as CO_2, CH_4, CFCs, ground ozone , fossil fuel burning , deforestation etc. All these may lead to an increased global surface temperature . It shall not been out of place to mention that global surface temperature increased 0.74 ± 0.18°C (1.33 ± 0.32°F) between the start and at the end of the 20th century i.e. from 1906-2005[2]. Climatic Research Unit concluded that 2005 was the second warmest year, behind 1998[3]. The same report i.e. the years 1998 & 2005 has been noted the warmest ones as reported by NASA's Goddarad Institute for Space Studies.

Climate model projection summarized in the latest IPCC report reveals that the global surface temperature is likely to rise a further 1.1 to 6.4°C (2.0-11.5°F) during end of the 21st century[3]. The uncertainty in this estimate arises from the use of models with different sensitivity to greenhouse gases concentrations and the use of differing estimates of future greenhouse gas emission. Some other uncertainties include how warming and related changes will vary from region to region around year 2100. However, warming is excepted to continue beyond 2100 even if emissions stop, because of the large heat capacity of the oceans and the long life time of CO_2 in the atmosphere [4] .

An increase in global temperature will cause sea levels to rise and will change the amount and pattern of precipitation , probably including expansion of subtropical deserts[5] . Warming will be strongest in the Arctic and may be associated with continuing retreat of glaciers , premaforst and sea –ice. Other likely effects include increases in the intensity of extreme weather events, species extinctions and changes in agricultural yields.

It shall not be out of place to mention that oceanic temperatures increased more shortly than the land temperature because of the large effective heat capacity of the oceans and because the ocean losses more heat by evaporation[6] . Also the northern hemisphere warms faster than the southern hemisphere because it has more land and because it has extensive areas of seasonal snow and sea-ice over subject to ice-albedo feedback. Although more greenhouse gases are emitted in the Northern than Southern Hemisphere, this does not contribute to the differences in warming because the major greenhouse gases persist long enough to mix between hemisphere[7] .

General Principle of Global Warming (Greenhouse Effect)

The greenhouse effect is the process by which absorption and emission of infrared radiation by gases in the atmosphere warms earth planet's lower atmosphere and surface i.e. troposphere. In simple words, a greenhouse is such body which permits the short wavelength incoming solar radiation (light energy) to come in but does not permit to long wavelength (heat energy) out going terrestrial infrared radiation to escape due to

CO_2 deposition on troposphere up to the earth's surface due to blanketing effect of man created CO_2 in the atmosphere . In precise form, the greenhouse effect is a phenomenon due to which the earth retains heat .

In nut shell, the principle of the phenomenon of greenhouse effect is based upon the principle of infrared absorption characteristics of greenhouse gases like CO_2, CH_4, N_2O, CFCs, O_3, SO_2, SF_6 and water vapor. Higher the concentration of greenhouse gases, especially radiation, which means that more infrared radiation (heat energy) are reemitted back to the earth's surface resulting in heat trap (increased in global temperature, hence called global warming).

In precise form, atmospheric gases like CO_2, water vapor, methane etc, are able to alter the energy balance of the planet earth by absorbing long wave radiation emitted from earth's surface. The emission of long wave back to the Earth's surface increases the quantity of heat energy in the earth's climatic system. Without this process, so called as greenhouse effect, the average global temperature of the earth would be -18°C rather than the present (12-18°C).

Greenhouse Gases

The following are the principal gases responsible for greenhouse effect (global warming):

1 Carbon dioxide
2. Methane
3. Nitrous oxide
4. Syntheic Cholorofluro carbons
5 Ozone at ground
6 Sulphur dioxide
7 Sulphur hexafluorides

Among these, CO_2 is the most serious and common greenhouse gas which enters the atmosphere through various anthropogenic activities viz., fossil fuel burning , furnaces, uncontrolled industrial emission , deforestation , automobile emission and breathing of biota. Amongst these CO_2, methane and chloroflurocarbons contribute much in the process of global warming. All the greenhouse gases are increasing at a rapid rate. For example , methane has approached at present at a level of approximately 1.65ppm from pre-industrial value of 0.7ppm, N_2O is increasing @ 0.25% while CFCs @ 5%. It has been reported that one molecule of methane may absorb 20 times more heat than CO_2 molecule and one molecule of CFC may absorb 10,000-20,000 times more heat than CO_2 molecule. Man made CFCs are as follows:

1. Tricholorofluoro methane ($CFCl_3$)
2. Dicholoro difluro methane (CF_2Cl_2)
3. Trichlo trifluro methane ($CF3Cl_3$)
4. Methyl chloroform ($CH3Cl_3$)
5. Difluro Chloromethane ($CHClF_2$)
6. Carbon Tetra chloride (CCl_4)
7. Di fluro chloro bromomethane (CF_2ClBr)
8. Tri fluro bromo methane ($CBrF_3$)

Principal greenhouse gases responsible for global warming and their release source has been cited in. Table -1

Table1: Principal Gases, their source of release and impact % for Greenhouse Effect

S.No.	Greenhouse Gas	Release Source
1.	CO_2	Burning of fossil fuels and firewood, deforestation, factories, automobiles, power stations, reduction in forest cover, animal and plant respiratory end product, cement industries etc**. It is responsible for 50% of global warming**
2.	CH_4	Forest fires are the principal sources of methane and emit one unit of methane for every 100 units of CO_2. Other sources are paddy farming cattle and anaerobic decomposition in biological system**. It is responsible for 18% of global warming.**
3.	CFC_s	It is inert, non toxic , frequently used in air conditioners, refrigerators etc., for cleaning micro chips. **It is responsible for 14% of global warming.**
4.	N_2O	Deforestation, biomass burning , nitrogenous fertilizers and combustion of fossil fuels. **It is responsible for 06% of global warming**
5.	Ozone	At ground level O_3 is used as disinfectant of air and water bleaches, textiles and oils. It is produced as a result of chemical manufacturing processes, electrical discharge and sparking of electrical appliances or lightening during thunder storms. **It is responsible roughly for 03% of global warming**. Rest warming % is by other like water vapor etc.

Besides above, water vapor also but temporarily contributes of great % of greenhouse effect (average 9.0 %). The destruction of stratospheric by CFCs is sometimes maintained in relation to global warming. Soot may cool

or warm depending upon whether is airborne or deposited. Atmospheric soot, aerosols directly absorb solar radiation.

The relative global warming potential of principal greenhouse gasses has been citied in Table 2 .

Table 2 : Global Warming Potential of Principal Greenhouse Gases

Greenhouse Gases	Lifetime (Year)	Global Warming potential (years)		
		20	100	500
CO_2	140	1	1	1
CH_4	12	56	21	6.5
$N2_O$	120	280	310	170
CHF	1.5-50	5000	3000	500
SF_6	3200	16300	24900	35900
CF	3-10000	6000	8000	14000

Human activity since the the industrial revolution has increased the amount of greenhouse gases in the troposphere, leading to increased radioactive forcing from CO_2, CH_4, tropospheric ozone , CFCs and nitrous oxide, particularly the concentration of CO_2 and CH_4 have increased by 36% and 14.8% respectively since 1750[8]. These levels are much higher than at any time during the last 650000 years , the period for which reliable data has been extracted from ice cores.

Fossil fuel burning has produced about three quarters of the increased in CO_2 from human activity over the past 20 years. Most of the rest is due to land use change, particularly deforestation[9]. The future rate of rise will depend upon uncertain economic , sociological, technological and natural developments . Accordingly , the IPCC special report on emission scenarios gives a wide range of future CO_2 scenarios, ranging from 541 to 970 ppm by year 2100. Fossil fuel reserves are sufficient to reach these levels.

The destruction of stratospheric ozone due to CFCs is sometimes mentioned in relation to global warming. Although there are a few areas of linkage, the relationship between the two is not strong.

Reduction of stratospheric ozone has a cooling influence, but substantial ozone depletion did not occur until the late 1970's[10]. Ozone in the troposphere does contribute to surface warming[11].

Since 1979, land temperature according to climatic research unit report (2007) has increased about twice as fast as ocean temperature (0.25°C per decade against 0.13°C per decade).Climate commitment study reveals that even if greenhouse gases were established at 2000 levels, a further warming of about 0.5°C will still occur [12].

Feedback in Global Warming

In principal form, positive as well as negative feed back exist in global warming. A positive feedback is such a process that amplifies some change . Thus, when a warming trend results in effects that induces further warming , the result is a positive feedback. However, when the warming results in effects that reduces the original warming, the result is a negative feedback. The principal positive feedback in global warming involves the tendency of warming to increase the amount of water vapor in the atmosphere. The principal negative feedback in global warming is the effect of temperature on emission of infrared radiation as the temperature of a body increases, the emitted radiation increased with the fourth power of its absolute temperature.

Water Vapor Feedback

If the atmosphere is warmed, the saturation vapor pressure increases, and the amount of water vapor in the atmosphere tends to increase. Since water vapor is a greenhouse gas, the increase in its content makes the atmosphere warm further; this warming causes the atmosphere to hold still more water vapor (a positive feedback) and so on until other processes stop the feedback loop. The result is a much larger greenhouse effect than due to CO_2 alone. Although this feedback process causes an increase in the absolute moisture content of the

air , the relative humidity occurrence causes an increase in the absolute moisture content of the air , the R.H. stays nearly constant or even decreases slightly because the air is warmer[13].

Cloud Feedback

Warming is expected to alter the pattern of distribution and types of clouds. Watched from below, clouds emit infrared radiation back to the surface and so exert warming effect; watch from above, clouds reflect sunlight and emit infrared radiation to space, and so exert a cooling effect. Whether the net effect is warming or cooling, it depends on details such as the type and attitude of the cloud . These events have been roughly observed before the advent of satellite data and are difficult to represent in climate models[13].

Lapse Rate Feedback

The atmospheric temperature declines with height in the troposphere. Since the emission of infrared radiation varies with temperature, long wave radiation escaping to space from the relatively cold upper atmosphere is actually less than that emitted onwards the ground from the lower atmosphere. Thus, the potency or strength of the greenhouse effect depends on the atmospheric rate of temperature decline with height . Both theories and climate models indicate that global warming will reduce the rate of temperature decrease with height , producing a negative lapse rate feedback that weakens the greenhouse effect[14].

Ice-albedo Feedback

The melting ice contributes to ice-albedo feedback. When ice melts, land or open water takes its place. Both land and open water are on average less reflective than ice and thus absorb more solar radiation. This results in more warming, which in turn causes more melting and cycle continuous[15].

Arctic Methane Release

Warming is the triggering variable for the release of methane in the arcitic also, Its release from thawing permafrost like frozen peat bags in Siberia, and from methane clathrate on the sea floor generates a positive feedback[16].

Release of CO_2 from Sea

In fact, cooler water may absorb more CO_2 than the warmer water. As sea temperature rises, some of this CO_2 is released. Basically it is one of the principal reasons why atmospheric CO_2 is lower during an ice age and higher in warmer periods. Undoubtedly there is a greater mass of CO_2 contained in the sea than there is in the atmosphere.

In nutshell, it appears impossible to connect specific weather events to global warming. Instead, global warming is expected to cause alterations in overall distribution and intensity of events, such as changes in the frequency and intensity of heavy precipitations. Broader effects are expected to include glacial retreat, Arctict shrinkage and worldwide sea level rise. Some impacts on both the natural environment and human life are at least in part already being attributed to global warming.

Consequences of Greenhouse Effect

- Glacial retreat.
- Arctic shrinkage
- World wide rise in sea level.
- Ice shelf disruption such as Larsen ice self.
- Changes in rainfall pattern.
- Increased intensity and frequency of extreme weather events.
- Tropical cycloning.

Other Expected Effects

- Water scarcity in some regions.
- Increased precipitation.
- Adverse effect on human health.
- Possible slowing in thermohaline circulation.
- Rise of sea as out 0.18-0.59 meters i.e. 0.59-1.9 ft in 2090-2100 relative to 1980-1999.
- Increasingly intense but less frequent hurricanes.
- Changes in the range of climate dependent disease vectors linked in increase in the prevalence of malaria and dengue fever.
- Oceanic oxygen depletion.
- Oceanic acidification i.e. pH may decrease from 0.4-0.5 units by 2100 as oceans absorb more CO_2 and forms carbonic acid. It may lead to extinction of and disruption of food web.
- According to Mc Langhlin (2002) , 18-35% of animal and plant species would be extinct by 2050 based on future climate projections.
- Laboratory based researches reveals that rise in temperature leads to over production of male fishes which may reach up to as high as 90%. This means almost total loss of female fishes. This would lead to total loss in fish production at various levels.

Impact of Global Warming on Economics

According to UNEP- economic sectors likely to face difficulties related to climate change due to greenhouse effect include- banks, agriculture, transport etc. Developing countries dependent upon agriculture will be particularly harmed by global warming.

Responses to Greenhouse Effect (Global Warming)

The broad agreement among climate scientists that global warming will continue to increase has led some states, nations, corporation and individuals to implement responses. These responses to global warming may be divided into three parts:

I. Mitigation of the causes and effects of global warming.
II. Adaptation to the changing global environment and
III. Geo-engineering to reserve global warming.

Mitigation of the causes and effect of global warming

The basic approach to mitigation is Carbon Capture and Storage (CCS). Emission may be sequestered from fossil fuel power plants, or removed during processing in hydrogen production. When used on plants, it is called as bio-energy with carbon capture and storage . Mitigation of global warming is accomplished through dimensions in the rate of anthropogenic greenhouse gas release. The UN's 1997 Kyoto Protocol, the world's primary international agreement on reducing gas emissions, now covers roughly more than 160 countries and 55% of global greenhouse gas emission[17]. International talks began in May 2007 on a future treaty to succeed the current one. As of June 2009 , only the United States, historically the world's larges emitter of greenhouse gases, has refused to ratify the treaty. The United Nations Climate Change Conference (UNCCC) met in Copenhagen in December 18-19, 2009 to agree on a frame work for climate change mitigation.

UNCCC (Copenhagen Accord)

A furious final two days (18.12.2010 & 19.12.2010) of climate diplomacy and presidential brinkmanship produced two and half thin pages called the Copenhagen Accord (participated by 193 world's leader) a deal vague at times in meaning , rejected by some, lacking any teeth.

Nations agreed to cooperate in reducing emission , " with a view" to scientists warning to keep temperatures from rising more than 2°C (3.6°F) above preindustrial levels, i.e. 1.3°C (2.3°F) above today's average temperature.

Developing nations will report every two years on their voluntary actions to reduce emissions. Those reports would be subjected to " International Consultations and Analysis"- a concession by China to the US.

Wealthy nations will finance a $10 billion a year, three year program to fund poorer nation's projects to deal with drought and other climate change impacts and to develop clean energy.

They also set a "goal" of mobilizing $ 100 billion a year by 2020 for the same adaptation and mitigation purposes.

Abstract of Final deal of Copenhagen Accord

Long term goals: To reduce global emission and bring global temperature below 2°C.

Legally binding deal: A proposal attached to the accord calls for a legally binding treaty by next year.

Emission arts: Details of mitigation plans are included in separate annexes, one for developed nations targets and one for the voluntary pledges of developing nations.

Finance: The deal promises short-term financing pledges from developed nations for 2010-2012, EU: $ 10.6bn, US: $3.6bn.

I. **Adaptation to the changing Global Environment**

A wide variety of measures have been advised for adaption to global warming. These measures range from the trivial such as the installation of air-conditioning equipment to major infrastructure projects, such as abandoning settlements threatened by sea level rise.

Further, measures including water conservation, water rationing, adaptive agricultural practices, construction of flood defenses, changes to medicals care[19] , interventions to protect threatened species, and even colonization of Mars, have all been suggested. A wide ranging study of the possible opportunities for adaptation of infrastructure has been published by the institute of mechanical engineers[20].

II. **Geo- engineering**

Deliberate modification of planet earth's natural environment on a large scale to suit the human needs id geo engineering. An example is global warming remediation due to greenhouse gases, which removes such gases, usually through carbon sequestration techniques such as CO2 air capture[21]. Although solar radiation management reduces absorbed solar radiation such as by addition of stratospheric aerosols[22]. However, no large-scale geo engineering projects have yet been undertaken, through it's the urgent need of the time.

Skepticism & Debate

Flashing of the scientific findings surrounding global warming has resulted in political and economic debate. Poor belts, particularly Africa , appears at greatest risk from the projected effects of global warming. While their greenhouse gases emission have been small as compared to the developed nations. The exemption of developing from Kyoto Protocol restrictions has been used to justify non – ratification by the U.S. & a previous Australian Government. Australia has since ratified the US 1997 Kyoto protocol. Another point of contention is the degree to which emerging economics such as India and China should be expected to constrain their emission[23] . The U.S. contends that if it must bear the cost of reducing emissions, then China must do the same since China's gross national CO2 emissions now exceed those of the U.S. [24] . China has contended that it is less of the U.S. [25] . India , also has made similar contentions.

Gallup Polls in 2007-08 surveyed 127 countries and reported that over a third of the world's population was unware of global warming , with developing countries less aware than developed, and Africa the least aware. Of those aware, Latin America leads in belief that temperature changes are a result of human activities while Africa, parts of Asia and the middle east, and a few countries from the Former Soviet Union lead in the opposite belief[26]. In the western world , views over the concept and the appropriate responses are divided. Nick Pidgeon of Cardiff University finds that " results reveal the different stages engagement about global warming on each side of the Atlantic", where Europe debates the appropriate responses while the U.S. debate weather climate change is happening[1].

Environmental organizations and public figures have emphasized alterations in the current climate and emission reductions[27]. In recent years , some fossil fuel companies have studies link population growth (rate of natality) with emissions of greenhouse gases and the effect of climate change.

Actually some global warming skeptics in the science/political communities dispute all or some of the global warming scientific consensus, questioning weather global warming is actually taking place, whether anthropogenic activity has contributed significantly to the trophospheric, and the magnitude of the threat posed by global warming. Prominent global warming skeptics include, J.P. Shukla , Anuradha Shukla, Kamal Jaiswal,

C.P.M. Tripathi, V.B. Upadhaya, B.M. Shukla, A.K. Karnatak, S.P. Trivedi, B.S. Chandel, John Christy, Nikhil Kant Shukla , M. Misra, D.C. Misra (IPS) , P.N. Pandey, B.N. Pandey, S.S. Dubey etc.

Global Warming (Greenhouse Effect) Solutions

Anthropogenic activities causing global warming is strong , but the question of what to do about it, remains controversial. Political science, sociology and economics are all significant factor in its planning for the future.

So much so , if we any how stop emitting greenhouse gases today, the planet earth would still warm by another degree Celsius or so. But what we perform today forward makes a big difference. Depending upon on choice , scientists predict that the planet earth could eventually warm by as little as 2.5° or as much 10°F incoming next century.

To stabilize greenhouse gas concentration around 450-550 ppm or about twice pre-industrial level is a commonly cited goal. This is the very point at which many believe the most damaging impacts of climate change can be avoided. Current concentrations are approximately 380 ppm, which means there is not much time to lose. According to the inter governmental panel on climatic change , we would have to reduce greenhouse emissions by 50% to 80% of what they are on track to be in the next country to reach this level.

To solve the aforementioned para problem, many people and governments are already working hard to cut greenhouse gases and every one can help. Pacala and Socolon at Princeton University have suggested seven stabilization wedges to reduce greenhouse gas emissions from a variety of sources. There are various often possible wedges, including improvements to energy efficiency and vehicle fuel economy (so less energy has to be produced), and enhancements in wind and solar power, hydrogen produced from renewable sources, bio fuel (produced from different crops), natural gas, and nuclear power . Also there is the potential to capture the CO_2 emitted from fossil fuel and store it underground- a process so called as "carbon sequestration". Plants and tree absorb CO_2 as they grow "Sequestering" carbon naturally.

Measures to control Climate Change

Measures comprises of efforts by individuals, the population and the Governments[28]. Conservation is one of the many steps towards preventing the environmental problem. Alterations in lifestyle and behaviors that favor resources conservation can contribute substantially towards climate change mitigation. Changes in lifestyle and consumption pattern that emphasize resources conservation can contribute in developing a low carbon economy that is both equitable and sustainable. In cities, urban planning and education can reduce car usage and promote efficient driving habits. The ideas are summarized in Table 3.

Table 3

Sector	Key Technologies & Practices for better climate
Energy Supply	• An increase in the price of fossil fuel could make low-carbon alternative more competitive.
Transport	• Hybrid vehicles, cleaner diesel engines, bio-fuel. • Shift from road transport to rail and public transport. • Alternatives such as cycling and walking. • Urban planning that reduces the need for road transport.
Buildings	• Building should be constructed on the concept of **"Green Building"** which are more energy efficient. • HVAC (Heating ventilation & Air conditioning) system be solar based. Recycling or using fluorinated gases in refrigeration.
Industry	• The use of more efficient electrical equipment, heat and power recovery system, recycling of goods which help in checking the CO2 gas emissions.
Agriculture	• Agriculture practices collectively can make a significant contribution at low cost by increasing the amount of carbon stored away in soil (carbon sinks), by reducing methane and nitrous oxide emissions. • By improving fertilizer application to reduce nitrous oxide emissions and manure management to reduce methane emissions.
Forestry/Forests	• A forestation, reforestation, improved forest management, reduce deforestation and use of forestry products to replace fossils fuels can considerably reduce greenhouse gas emission and help capture CO2 from the atmosphere.
Waste	• The post-consumer waste sector is a small contributor to global greenhouse emission (<5%), yet it can contribute to mitigation efforts at low cost through landfill methane recovery, waste incineration with energy recovery, compositing, recycling and waste minimization.

Government Initiatives

Technological initiatives to certain extent by the government would reduce carbon emissions include the following:

- Investing in the reduction of energy consumption rather than in new energy supply infrastructure.
- Switching from coal to gas; Nuclear power, although safety, weapons developments and waste management remaining as constraints.
- Use of renewable energy (hydro, solar, wind, geothermal and bio-energy)

Table 4 suggests some initiatives:

Table 4

Areas	Initiatives
Policies & legislation	• Helps better adherence to the emissions norms.
Carbon price	• A cost of each unit of Greenhouse gas emitted acts as major mitigate to GHG emission. It creates incentives for producers and consumers to significantly gas emissions.
Carbon trading	• Helps in technological advancement, reduction in cost and progress towards stabilization. Also it helps in technology transfer over nations.
Subsidies and tax benefits	• Provide for financial support for new technology and its diffusion.
Awareness campaigns	• Help in climate control by promoting informed choices and pollibly contributing to behavioral changes among people.

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Further Readings

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