



**Global Warming and Climate Change an Overview :
Alarmism or Skepticism**



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ABSTRACT

Global warming refers to the increase in the earth's average surface temperature since the Industrial Revolution, primarily due to the emission of greenhouse gases from the burning of fossil fuels and land use change. Global surface temperature has increased by about 0.74 ± 0.18 °C (1.33 ± 0.32 °F) between the start and the end of the 20th century. The rate of warming over the last half of that period was almost double than that for the period as a whole may resulting in melting of ice caps and glaciers, leading to rise in sea level, destruction of habitats of various species of polar bears, penguins and seals among many others, disturbed climate pattern – erratic monsoon activity, extreme weather : hotter summers and colder winters, increased chances of natural disasters like cyclones, tornados and hurricanes. Climate change refers to the long-term change of the earth's climate including changes in temperature, precipitation, and wind patterns over a period of several

decades or longer. Between 1970 and 2004 global greenhouse gas emissions have increased by 70 % and it puts threat to geographical shift, change in timing of different biological events, agricultural impacts, continuous deforestation, More consumption in energy use and poisoning of mother earth, increasing its temperature regularly. Many new things should be adopted to cope with global warming such as mitigation to reduce further emissions, geo-engineering to reverse global warming, signed and strictly follow Kyoto Protocol aimed at reducing greenhouse gas emissions, planting more trees – adequate afforestation, awareness among the common people, deforestation, adopting carbon diet. There is only one wise conclusion to the whole climate change debate – prevention is better than cure. Scientific findings surrounding global warming have resulted in political and economic debate. Some scientists claim that there is no scientific proof that greenhouse gases lead to global warming and that the popular belief is fueled for political and economic gains. They also claim that there was six times as much carbon dioxide in the atmosphere 100 million years ago than present times. Stopping social and economical development is not the answer, the answer lies in Sustainable Development – Development that meets the needs of present generation without compromising on the ability of future generations to meet their needs.

RESEARCH PAPER

Introduction

It is well accepted that climate change is caused by human beings. United Nations Framework Convention for Climate Change (UNFCCC) in which a legal definition of climate change is found in Article 1 that states “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” This will include increased frequency of extreme temperatures, floods, hurricanes, storms, droughts, and sea levels, to name a few. If no immediate action is taken and the concentration of Green House Gases is allowed to increase unchecked, the resulting consequences could be disastrous and humanity could reach a point of no return. The world community has accepted the need to limit the increase in the earth’s temperature to 2°C and initiate changes to achieve this objective. This will require the world to move away from burning fossil fuels and effectively reach a stage of zero carbon emissions.

Objective:

Extensive discussions are taking place throughout the world in all forms of media on the subjects of global warming and climate change. The objective of the paper was to present the views on global warming, climate change, sustainability and mitigation and adaptation to the climate change. The paper also reviews the skepticism approach towards this worldwide phenomenon.

Recognition of Risks:

Due to the nature of the subject, the international discussions on climate change are driven by worldwide climate scientists. As understood from the work done by climate scientists, impacts of climate change will be very wide ranging—extreme climate, increased losses due to floods and storms, rising sea levels, food scarcity, clean water shortage, increased mortality and illness, devaluation of assets, constraints on energy use, and so on.

The Process of Global Warming:

The earth receives energy through radiation from the sun. Green House Gases play an important role of trapping heat, maintaining the earth’s temperature at a level that can sustain life. This phenomenon is called the greenhouse effect and is natural and necessary to support life on earth. Without the greenhouse effect, the earth would be approximately 33°C cooler than it is today. In recent centuries, humans have contributed to an increase in atmospheric GHGs as a result of increased fossil fuel burning and deforestation. The rise in GHGs is the

primary cause of global warming over the last century. It is evident clearly that the earth's climate is undergoing significant and in some cases, alarming changes has accumulated rapidly in recent years, especially during the past three decades. Recent research has demonstrated that the earth's energy budget is out of balance with more energy captured from the sun than is currently radiated back to space. This makes global warming inevitable. This is not due to any measurable increase in the incoming solar energy, but to an increase in the amount of that energy captured and retained by the earth.

Impact of Global Warming:

Destructive effects of sea level rise:

Nearly 70 % of Earth's surface comprises of water in the form of seas and oceans. Sea level rise under warming is inevitable. Sea level rise is both due to thermal expansion as well as melting of ice sheets. Thermal expansion would continue for many centuries even after GHG concentrations have stabilized causing an eventual sea level rise much larger than projected for the 21st century. If warming in excess of 1.9 to 4.6°C above pre-industrial level be sustained over many centuries then the final rise in sea level due to melting polar ice could be several meters, because it will be in addition to that of rise of sea level due to thermal expansion. The present scenario clearly indicates that the sea level will definitely rise. A simple calculation shows that the frozen water in the Greenland ice sheet alone would, if melted, raise the global sea level by about seven meters (about 22 feet).

Destruction of species:

A change in temperature due to climate change in the 20th century has profound effects on the Polar Regions. This will affect many animals like mammals, birds and the ice itself. Many Antarctic and Tropical animals are thought to have narrow tolerances to environmental conditions (such as temperature) such that small changes kill them, minimize other life-sustaining activities (such as feeding or predator avoidance) or prevent successful reproduction. From the above discussion it is clear that polar bears are already suffering because of changes in sea ice as a result of climate change and their future is in jeopardy. Polar bears rely on the sea ice as habitat. In 2007, using this fact, a United States Geological Survey research team concluded that two thirds of the world's polar bear could disappear by 2050 if business as usual emissions of greenhouse gases continue.

Erratic impacts on weather- Indian monsoon:

There has been a particularly alarming effect of global warming on the climate of India. According to surveys, in the year 2007-2008, India ranked the third highest in the world regarding the number of significant disasters, with 18 such events in one year, resulting in the

deaths of 1103 people due to these catastrophes. The anticipated increase in precipitation, the melting of glaciers and expanding seas are projected to influence the Indian climate particularly severely, with an increase in incidence of floods, hurricanes, and storms. For example, a moderate-to-strong El Niño event leads to a drought in the Indian summer monsoon season while a strong La Niña (the inverse of El Niño) usually produces good monsoon rains.

Extreme Weather conditions:

The extreme weather events such as heat waves, droughts, floods (localized or larger scale), rainstorms, and tropical cyclone landfalls and so on – are an integral part of the earth's climate system.

Killer heat waves:

Human-caused global warming may have already doubled the chance of killer heat waves like the one that hit Europe in July and August of 2003. That summer was very likely the continent's hottest in 500 years. In April-June 1998, 3,028 people died in the most disastrous heat wave to ever hit India. The relentless heat killed at least 27,000 people, breaking all records worldwide for heat-induced human fatalities.

Torrential rains and flooding

According to the available data, global warming has increased the intensity of precipitation events over recent decades. In December 1999, Venezuela saw its highest monthly rainfall in 100 years, with massive landslides and flooding that killed approximately 30,000 people.

Shrinking snowpack and vanishing glaciers:

The shrinkage of glaciers is already creating water shortages, and threatening tourism in scenic places. In Asia, glaciers are retreating at a record pace in the Indian Himalaya, and two glaciers in New Guinea will be gone in a decade.

Damage to coral reefs:

The past 25 years have witnessed a higher incidence around the world of large-scale coral “bleaching” events, which can lead to coral death. In 1997–98 alone, the largest bleaching event on record seriously damaged 16% of the reefs in the world and killed 1000 years old corals. Corals are also directly threatened by increasing atmospheric concentrations of carbon dioxide, which is acidifying seawater and making it more difficult for corals to build their calcium carbonate skeletons.

Disease outbreaks:

Higher temperatures accelerate the maturation of disease-causing agents and the organisms that transmit them, especially mosquitoes and rodents. The increase in El Nino events since the mid-1970s has also contributed to new outbreaks of disease.

Climate Change:

Climate change refers to the variation in the Earth's global climate or in regional climates over time. It is the subject of how weather patterns change over decades or longer. Climate change takes place due to natural and human influences. Since the Industrial Revolution (1750), humans have contributed to climate change through the emissions of GHGs, aerosols and changes in land use pattern resulting in a rise to global temperatures. Truly, the present changes in the Earth's climate cannot be explained alone by the natural processes that explain Earth's previous warm periods. There is a broad scientific consensus that most of the warming in the recent decades can be attributed to human activities. If humanity is, in large part, responsible for this change, then whatever choices we make today, will have a significant bearing on the climate of the future. This makes climate change a formidable concern.

Factors responsible for Climate changes:

The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the observed temperature increases since the middle of the 20th century was caused by increasing concentrations of greenhouse gases - resulting from human activity such as fossil fuel burning and deforestation.

Greenhouse Effect:

The solar energy passing through the atmosphere is absorbed by the earth's surface and a significant part of it is reflected back into the atmosphere. However, the atmosphere of the earth contains small quantities of carbon dioxide, methane and nitrous oxide (collectively called greenhouse gases (GHGs) which acts as a partial blanket that trap some of the outgoing infra red radiation and reflect it back to earth thus keeping its surface warmer. In the absence of this greenhouse effect (trapping by GHGs) the earth's mean temperature would be 30°C lower than it is, which would mean that the earth would be an ice covered place. Thus, most of the present life forms on the earth depend on the natural greenhouse effect for their existence. However, increase in the emission of these GHGs due to human activities causes the enhanced greenhouse effect. Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004.

Factors for Carbon Emission:

Carbon dioxide (CO₂):

Fossil fuel use is the primary source of CO₂. Carbon dioxide can also be emitted from direct human-induced impacts on forestry and other land use, such as through deforestation, land clearing for agriculture, and degradation of soils. Likewise, land can also remove CO₂ from the atmosphere through reforestation, improvement of soils, and other activities.

Methane (CH₄):

Agricultural activities, waste management, energy use and biomass burning all contribute to methane emissions.

Nitrous oxide (N₂O):

Agricultural activities such as fertilizer use are the primary source of nitrous oxide emissions. Fossil fuel combustion also generates N₂O.

Fluorinated gases (F-gases):

Industrial processes, refrigeration and the use of a variety of consumer products contribute to emissions of F-gases which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfurhexafluoride (SF₆).

Global Emissions by Economic Sector:

Global greenhouse gas emissions can also be broken down by the economic activities that lead to their production.

Electricity and Heat Production (25% of 2010 global greenhouse gas emissions) the burning of coal, natural gas and oil for electricity and heat is the largest single source of global greenhouse gas emissions.

Industry (21% of 2010 global greenhouse gas emissions)

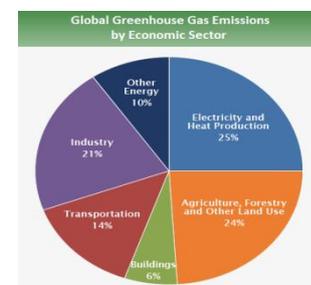
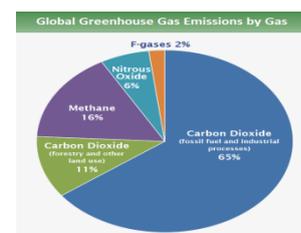
Greenhouse gas emissions from industry primarily involve fossil fuels burned on site at facilities for energy. This sector also includes emissions from chemical, metallurgical and mineral transformation processes not associated with energy consumption and emissions from waste management activities.

Agriculture, Forestry and Other Land Use:

Greenhouse gas emissions from this sector come mostly from agriculture (cultivation of crops and livestock) and deforestation.

Transportation (14% of 2010 global greenhouse gas emissions)

Greenhouse gas emissions from this sector primarily involve fossil fuels burned for road, rail, air, and marine transportation. Almost all (95%) of the world's transportation energy comes from petroleum-based fuels, largely gasoline and diesel.



Buildings (6% of 2010 global greenhouse gas emissions)

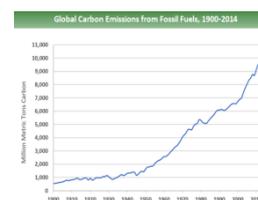
Greenhouse gas emissions from this sector arise from onsite energy generation and burning fuels for heat in buildings or cooking in homes.

Other Energy (10% of 2010 global greenhouse gas emissions)

This source of greenhouse gas emissions refers to all emissions from the energy sectors which are not directly associated with electricity or heat production such as fuel extraction, refining, processing and transportation.

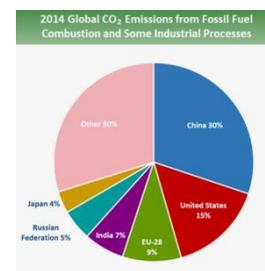
Trends in Global Emissions:

Global carbon emissions from fossil fuels have significantly increased since 1900. Since 1970, CO₂ emissions have increased by about 90%, with emissions from fossil fuel combustion and industrial processes contributing about 78% of the total greenhouse gas emissions increase from 1970 to 2011. Agriculture, deforestation and other land-use changes have been the second largest contributors. Emissions of non-CO₂ greenhouse gases have also increased significantly since 1900.



Emissions by Country:

In 2014, the top carbon dioxide emitters were China, the United States, the European Union, India, the Russian Federation and Japan. Brazil and India are interesting cases given that most of its CO₂ emissions have originated from land use emissions, meaning that deforestation has contributed to Brazil's high ranking. Six countries produce nearly 60 percent of global carbon dioxide emissions. China and the United States combine for more than two-fifths.



Impact of Climate Change:

Biological Shift:

Many studies have reported statistically significant associations between bird migratory phenology and climatic variables consequently it is mostly accepted that recent shifts in migration dates are a reaction to present climate change. Impacts of weather and climate on departure date, progression and stopover frequency and duration have been reviewed in order to explain the current knowledge of climatic mechanisms underlying such phenological shifts.

Agricultural Impacts:

Agriculture sector is the most sensitive sector to the climate changes because the climate of a region/country determines the nature and characteristics of vegetation and crops. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final

yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to outbreaks of pests and diseases thereby reducing harvest ultimately affecting the food security of the country.

Human Health:

Climate change poses a host of threats to the survival of mankind. Climate change has a direct impact on human health. For example, the warmer the climate the likelihood of its impact on human health becomes worse. Available studies suggest that there will be an increase in health problems. It is anticipated that there will be an increase in the number of deaths due to greater frequency and severity of heat waves and other extreme weather events. Poor regions especially poor children are expected to be the most vulnerable to climate-related health risks.

Mitigation and Adaptation for Climate Change:

Keeping Global Warming under 2°C:

An international agreement had been reached at Copenhagen that global warming should be limited to 2°C. This scenario has emissions peaking by the year 2020 and reducing substantially after that approaching zero carbon emissions by 2100.

Mitigation Measures for Reducing Carbon Emissions:

The need for reducing the CO₂ equivalent emissions will affect many sectors of the economy like energy creation, transport, buildings, industry, agriculture, human settlements, etc.

Energy Creation:

Availability of adequate energy supply is fundamental to modern living. Currently, a major portion of the energy is generated using fossil fuels like coal, oil and natural gas (in decreasing order of CO₂ emissions). These will need to be replaced by low or zero carbon fuels such as wind, solar and nuclear. The Carbon Capture and Storage technology captures the CO₂ produced by fossil fuels and stores it permanently underground. Another area for technological advancement will be storage of the electricity generated from renewable sources as the energy supply is intermittent.

Agriculture:

We can do better in agriculture by obtaining improved livestock and manure management, sequestering carbon in soil major comp (89%), improved crop management/agronomic practices, improved water management, rice management practices, zero tillage cropping, balanced nutrient use, agro-forestry etc.

Transportation:

Advancements will need to take place in areas of energy efficiency, improved vehicle performance, hybrid vehicles (fossil fuel electrical), use of bio-fuel, replacing fossil fuels, promoting non motorized transport, encouraging public transport system, improved engine efficiency, prohibitive parking fees, congestion tax, Odd and even numbers per day in Delhi, use of electrical vehicles, integrated urban planning, development of high-speed rail systems, improvement in public transportation systems etc.

Eco-Friendly Building:

Eco friendly buildings are the practice of creating structures and using processes that are environmentally responsible and resource efficient. Eco friendly buildings are designed in such a way to reduce overall impact on environment and human health by reducing trash, constructing highly reflective building materials, high efficiency lighting system and appliances, efficient ventilation and cooling system, passive solar design, solar water heaters and obtaining insulation system in multistoried buildings.

Industry:

Industry is a heavy user of energy. It will be necessary to undertake a wide-scale upgrading, replacement and deployment of new technologies, efficiency of material use, and recycling and re-using of materials and products.

Carbon Pricing:

In order to keep the global warming within the boundary of 2°C, the world has to move towards generating energy from renewable sources. This creates an imbalance in favour of the fossil fuel energy generation. On one hand, the fossil fuel energy is relatively less expensive but entails emissions that generate costs associated with global warming. On the other hand, the energy from renewable sources may be relatively more expensive but does not entail costs associated with global warming. The two major methods of carbon pricing are cap and trade and carbon taxes.

Cap and trade is a carbon pricing system where the government sets a cap on the amount of GHG emissions, and companies can meet the cap by reducing their emissions or paying another entity to do so.

Carbon Tax is a tax on carbon emissions based on the carbon content of the fuel. A carbon tax will increase the price of carbon-intensive fuels which will make low-carbon fuels more attractive.

Adaptation:

Adaptation is the process of adjusting in response to or in anticipation of climate change. It is not a new concept. Traditionally employed by ecologists, it has referred to the evolutionary process by which living organisms mould into a new environment. By broadening the scale of reference, the concept of adaptation can be used to describe how systems, both natural and human, evolve over time when faced with environmental changes.

Soil Management:

It is an approach for increasing the stability and productivity of soil is a general term that involves a range of specific techniques such as fallow cycling, forest buffering, selective planting, managed grazing, etc. Soil management is recognized as central to combating desertification.

Water harvesting:

It is a technique have been used as a drought proofing tool to increase water available for households, irrigation as well as baseline water flow for watershed restoration.

Windbreak Construction:

As wind erosion contributes significantly to the process of desertification, a number of environmental management methods have been applied, both through formal desertification projects and autonomous activities of farmers, to reduce its effect. Replanting of indigenous trees and shrubs for windbreaks, as well as ridging, mulching and rock bunds, are but a few methods.

Intercropping:

The technique of planting selected food crops within stands of trees can provide local communities with added food security and income through livelihood diversification while at the same time reducing deforestation and desertification.

Adaptation to Climate Change:

Different regions are already experiencing the effects of global warming through increased floods, extreme temperatures, droughts, hurricanes, etc. Public and private sectors and communities can adapt to the effects of global warming through disaster risk management, public health measures, livelihood diversification, coastal and water management, environmental protection, ecosystem-based options, land planning, sea-level rise planning, etc. Adaptation will need to be embedded in the various planning processes.

Spheres of change:

Practical:

Social and technical innovations, behavioural shifts, or institutional and managerial changes that produce substantial shifts in outcomes.

Political:

Political, social, cultural, and ecological decisions and actions consistent with reducing vulnerability and risk and supporting adaptation, mitigation, and sustainable development.

Setting examples:

Influential people (football players) chose to become carbon-neutral, e.g. Ipswich, Manchester United FC appeal to the fans had great influence in reducing carbon footprints.

What is Sustainability?

In a publication in 1966, Professor Kenneth Boulding, a distinguished American economist, employed the image of Spaceship Earth. He contrasted an 'open' or 'cowboy' economy (as he called an unconstrained economy) with a 'spaceship' economy in which sustainability is paramount. Sustainability means is 'not cheating on our children' to that may be added, 'not cheating on our neighbors' and 'not cheating on the rest of creation'. In other words, not passing on to our children or any future generation, an earth that is degraded compared to the one we inherited and also sharing common resources as necessary with our neighbors in the rest of the world and caring properly for the non-human creation.

Crisis of Sustainability:

The human activities of an increasing world population together with the accompanying rapid industrial development are leading to degradation of the environment on a very large scale. Scientists have an important role in ensuring the availability of accurate information about degradation and also in pointing to how humans can begin to solve the problems.

Climate Change Science Skepticism:

Scientific Skepticism:

Skepticism is the practice of raising doubts and questioning. Five areas of concern regarding the reliability of climate change science are addressed below.

Earth's Climate Has Changed Before:

One argument is that the climate has changed before and thus it would not be unreasonable to expect natural variation in the earth's climate. The earth has a long history and has encountered many different climates. Over the past 2 million years, the earth has gone through ice age cycles lasting approximately 100,000 years due to changes in the eccentricity of the earth's orbit around the sun and changes in the earth's axial tilt.

Sun Causes Global Warming:

One of the most intuitive arguments is that the sun controls the ups and downs of the earth's climate as the sun is the primary catalyst of the earth's energy content. There have been varying estimates of the sun's change in radiative forcing. Solar forcing is considered to be somewhat larger in the first half of the 20th century contributing between 0.1°C and 0.2°C of warming during that period and roughly flat since 1950. Thus, the sun is not a good explanation for global warming since then.

Warming Has Slowed Down:

One subject that has been getting a lot more attention in recent years is the so-called "warming hiatus", where there appears to be a slowdown in warming over the last 15–20 years.

There is No Consensus on Climate Change:

One argument that is heard many times is that there is no consensus among climate scientists about the causes of climate change and its impacts in the future. Various surveys have shown that there is a gap between the public and scientific opinions regarding the realities of anthropogenic climate change.

How will climate change in the future?

Scientists have made major advances in the observations, theory and modeling of earth's climate system and these advances have enabled them to project future climate change with increasing confidence. Firstly, we cannot predict how much CO₂ human activities will emit as this depends on factors such as how the global economy develops and how society's production and consumption of energy changes in the coming decades. Secondly, with current understanding of the complexities of how climate feedbacks operate, there is a range of possible outcomes, even for a particular scenario of CO₂ emissions. Finally, over time scales of a decade or so, natural variability can modulate the effects of an underlying trend in temperature.

Conclusion:

Climate change is the defining issue of our times. It is perhaps, the greatest challenge to sustainable development. It should be addressed by all countries with a shared perspective, free from narrow and myopic considerations. The developed countries need to look beyond their narrow self interests and work jointly with the developing countries to evolve cooperative and collaborative strategies on the issue of climate change, which is of immense relevance for the future of mankind. The climate change misinformation campaign is a multi-faceted scheme that has already embedded itself into society today. The only way to prevent

the tyrannical industry from spreading false information is for the public to accept the scientific consensus on climate change. If no immediate action is taken and the concentration of GHGs is allowed to increase unchecked, the resulting consequences could be disastrous and humanity could reach a point of no return. There is only one wise conclusion to the whole climate change debate – prevention is better than cure. Stopping social and economical development is not the answer, the answer lies in Sustainable Development – Development that meets the needs of present generation without compromising on the ability of future generations to meet their needs.

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