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CLIMATE CHANGE MITIGATION FOR SUSTAINABLE ENVIRONMENT: POTENTIAL & PORTENT



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ABSTRACT

Man by nature has the inherent trait of insatiability. His priority for accelerated growth and development for fulfilling his luxuries and desires has exploited the nature to its core. Now it is the nature's turn to bounce back and so there are environmental threats of climate change where the global warming lies at its core reason. Devastating effects of global warming and climate change world over are now a regular phenomenon. Global warming is one of the most discussed and debated issues of the 21st century, concerning the scientific and the humanistic fraternity alike. The repeated scientific discoveries have suggested that

the global warming will significantly change our climate in the next century with an average temperature increase of 1.4–5.8°C which in turn will give for a sea-level rise in the order of a metre, significant changes in weather patterns, and more extreme climate events. It is thus a big concern for our global society that needs to address at many levels. The concern for the effects of climate change is not new but has been there since half a century. Yet we still have many unanswered questions, the prominent being as how to deal with it. First, it is to be ensured that the Third World develops as rapidly as possible, while preventing a massive explosion in production of carbon dioxide and other greenhouse gases. Second is the question of whether the money we plan to spend on stabilizing global warming, \$8 trillion or 2% of the World's GDP, to protect future generations is better spent on alleviating current global human suffering. The answer lies in addressing the climate change more sincerely and by mitigating the global warming.

It is unlikely that global politics will successfully address the menace of climate change in general and global warming in particular. Even the idea of using energy more efficiently seems rather inadequate when there are another five and half billion people in the world aspiring to have the energy use enjoyed by the Western world. So the ultimate solution is for humanity would only be possible in finding out proper alternatives for mitigating the climate change by controlling the CO₂ emission and by developing cheap and clean energy production, as all economic development is based on ever-increasing energy usage.

KEYWORDS : *Climate Change, Sustainability, Greenhouse gas, Mitigation, Environment.*

INTRODUCTION :

The World's population remains concerned about the effects of climate change. Devastating effects of global warming and climate change world over are now a regular phenomenon. Man by nature has the inherent trait of insatiability. His priority for accelerated growth and development for fulfilling his luxuries and desires has exploited the nature to its core. Now it is the nature's turn to bounce back and so there are environmental threats of climate change where the global warming lies at its core reason. It is us who failed to follow Gandhiji's sagacious message "the earth has enough to satisfy people's need but will never have enough to serve their greed". Due to the inequitable use of the natural resources which are non renewable in nature, harmful gases are released in the atmosphere which resulted in climate change in the whole world.

The chief component of climate change is the growing global warming. It has no more remained as a scientific concern, but has encompassed economics, sociology, geopolitics, local politics, and individuals' choice of lifestyle with the chief cause being the massive increase of greenhouse gases, such as carbon dioxide, in the atmosphere, resulting from the burning of fossil fuels and deforestation. There is clear evidence that we have already elevated concentrations of atmospheric carbon dioxide to their highest level for the last half million years and maybe even longer. Scientists believe that this is causing the Earth to warm faster than at any other time during, at the very least, the past one thousand years.

The recent report by the Intergovernmental Panel on Climate Change (IPCC), amounting to 2,600 pages of detailed review and analysis of published research, declares that the scientific uncertainties of global warming are essentially resolved. This report states that there is clear evidence for a 0.6°C rise in global temperatures and 20 cm rise in sea level during the 20th century.

The IPCC synthesis also predicts that global temperatures could rise by between 1.4°C and 5.8°C and sea level could rise by between 20 cm and 88 cm by the year 2100. In addition, weather patterns will become less predictable and the occurrence of extreme climate events, such as storms, floods, and droughts, will increase.

DEFINING CLIMATE CHANGE

As the term itself suggests, Climate Change means a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Many scientists believe that the human-induced or anthropogenic enhanced greenhouse effect usually causes climate change. Even some of the global warming sceptics argue that though global warming may be a minor influence, natural climate change does occur on human timescales and we should be prepared to adapt to it.

Climate change can manifest itself in a number of ways, for example changes in regional and global temperatures, changing rainfall patterns, expansion and contraction of ice sheets, and sea-level variations. These regional and global climate changes are responses to external and/or internal forcing mechanisms. An example of an internal forcing mechanism is the variations in the carbon dioxide content of the atmosphere modulating the greenhouse effect, while a good example of an external forcing mechanism is the long-term variations in the Earth's orbits around the sun, which alter the regional distribution of solar radiation to the Earth. This is thought to cause the waxing and waning of the ice ages. So in terms of looking for the evidence for global warming and predicting the future, we need to take account of all the natural external and internal forcing mechanisms. For example, until recently the cooling that occurred globally during the 1970s was unexplained until the 'external' and cyclic variations every 11 years in the sun's energy output, the so-called sunspot cycle, was taken into

consideration.

THE THREAT CALLED GLOBAL WARMING

'Global warming' is an increase in the average temperature of the Earth's atmosphere, especially a sustained increase great enough to cause changes in the global climate.

The term 'global warming' is synonymous with enhanced green house effect, implying an increase in the amount of green house gases in the earth's atmosphere, leading to entrapment of more and more solar radiations, and thus increasing the overall temperature of the earth.

In other words, the temperature of the Earth is controlled by the balance between the input from energy of the sun and the loss of this back into space. Certain atmospheric gases are critical to this temperature balance and are known as greenhouse gases. The energy received from the sun is in the form of short-wave radiation, i.e. in the visible spectrum and ultraviolet radiation. On average, about one-third of this solar radiation that hits the Earth is reflected back to space.

Of the remainder, some is absorbed by the atmosphere, but most is absorbed by the land and oceans. The Earth's surface becomes warm and as a result emits long-wave 'infrared' radiation. The greenhouse gases trap and re-emit some of this long-wave radiation, and warm the atmosphere. Naturally occurring greenhouse gases include water vapour, carbon dioxide, ozone, methane, and nitrous oxide, and together they create a natural greenhouse or blanket effect, warming the Earth by 35°C. Despite the greenhouse gases often being depicted in diagrams as one layer, this is only to demonstrate their 'blanket effect', as they are in fact mixed throughout the atmosphere.

The Earth's atmosphere is composed of 78% nitrogen, 21% oxygen, and 1% other gases. It is these other gases that we are interested in, as they include the so-called greenhouse gases. The two most important greenhouse gases are carbon dioxide and water vapour.

IMPACTS OF GLOBAL WARMING

There is strong evidence to suggest that CO₂ emissions have already started to influence our climate. Most of the researches and studies in this area have suggested that global warming will cause major climatic changes by the end of the 21st century. These changes will potentially have wide-ranging effects on the natural environment as well as on human societies and our economies.

Coastline

The IPCC reports that under a business-as-usual scenario (i.e. continued increase of burning fossil fuels) sea level could rise between 20 and 88 cm in the next 100 years, primarily through the thermal expansion of the oceans.

For small island nations, such as the Maldives in the Indian Ocean and the Marshall Islands in the Pacific, a 1 meter rise in sea level would flood up to 75% of the dry land, making the islands uninhabitable. Interestingly, it is also these countries, which rely on tourism, which have some of the highest fossil-fuel emissions per head of population than any other country in the world.

Last month, i.e the month of July, 2015 witnessed a weird request from a country's Premier that was bizarre ever in the human history. The Prime Minister of an island nation Tuvalu requested the world community to cut short the global greenhouse as he was afraid that the nation of Tuvalu may get fully drowned in the Pacific Ocean due to the rising sea level, at the back of which there is but the CO₂ emission. The global warming threat has small nations on gunpoint at present that is alarming for the big nations in future.

Storms and Floods

Storms and floods are major natural hazards, which between 1951 and 1999 were responsible for 76% of the global insured losses, 58% of the economic losses, and 52% of fatalities from natural catastrophes. Even this year, i.e in 2015, India witnessed massive uncontrolled storms and flood in the areas where the drought used to be the common natural phenomena with Gujarat and Rajasthan being the prominent.

Two-fifths of the world's population lives under the monsoon belt which brings life-giving rains. Monsoons are driven by the temperature contrast between continents and oceans. Climate models indicate an increase in the strength of the summer monsoons as a result of global warming over the next hundred years. There are many reasons to support why this should occur. One most important reason is that the global warming will cause continents to warm more than the ocean in summer and this is the primary driving force of the monsoon system. Also the warmer climate means the air can hold more water vapour, so the monsoon winds will be able to carry more moisture and thus flood like situation would be rampant.

Biodiversity

The IPCC report lists the following species as those most at threat from climate change as a result of global warming: the mountain gorilla in Africa, amphibians that only live in the cloud forests of the neotropics, the spectacled bear of the Andes, forest birds of Tanzania, the Resplendent Quetzal in Central America, the Bengal tiger, and other species only found in the Sundarban wetlands, rainfall-sensitive plants found only in the Cape Floral Kingdom of South Africa, polar bears, and penguins. Natural habitats that are threatened include coral reefs, mangroves, other coastal wetlands, mountain ecosystems found in the upper 200–300 m of mountainous areas, prairie wetlands, permafrost ecosystems, and ice edge ecosystems which provide a habitat for polar bears and penguins. The primary reason for the threat to these species or ecosystems is that they are unable to migrate in response to climate change because of their particular geographical location or the encroachment of human activity, particularly farming and urbanization.

LINKING GLOBAL WARMING WITH CLIMATE CHANGE

We have seen that there is clear evidence that greenhouse gas concentrations in the atmosphere have been rising since the industrial revolution in the 18th century. The current scientific consensus is that changes in greenhouse gas concentrations in the atmosphere do cause global temperature change. However, the biggest problem with the global warming hypothesis understands how sensitive the global climate is to increased levels of atmospheric carbon dioxide. Even if we establish this, predicting climate change is complex because it encompasses many different factors, which respond differently when the atmosphere warms up, including regional temperature changes, melting glaciers and ice sheets, relative sea-level change, precipitation changes, storm intensity and tracks, El Niño, and even ocean circulation. This linkage between global warming and climate change is further complicated by the fact that each part of the global climate system has different response times. For example, the atmosphere can respond to external or internal changes within a day, but the deep ocean may take decades to respond, while vegetation can alter its structure within a few weeks (e.g. change the amount of leaves) but its composition (e.g. swapping plant types) can take up to a century to change. Then, add to this the possibility of natural forcing which may be cyclic; for example, there is good evidence that sunspot cycles can affect climate on both a decadal and a century timescale.

There is also evidence that since the beginning of our present interglacial period, the last 10,000 years, there have been climatic coolings every $1,500 \pm 500$ years, of which the Little Ice Age was the last. The Little Ice Age began in the 17th and ended in the 18th century and was characterized by a fall of $0.5\text{--}1^\circ\text{C}$ in Greenland temperatures, significant shift in the currents around Iceland, and a sea-surface temperature fall of 4°C off the coast of West Africa, 2°C off the Bermuda Rise, and of course ice fairs on the River Thames in London, all of which were due to natural climate change. So we need to disentangle natural climate variability from global warming. We need to understand how the different parts of the climate system interact, remembering that they all have different response times. We need to understand what sort of climatic change will be caused, and whether it will be gradual or catastrophic. We also need to understand how different regions of the world will be affected; for example, it is suggested that additional greenhouse gases will warm up the poles more than the tropics.

MONITORING THE ALTERNATIVES

Until a few decades ago, it was generally thought that significant large-scale global and regional climate changes occurred gradually over a timescale of many centuries or millennia; hence, the climate shifts were assumed to be scarcely perceptible during a human lifetime. The tendency of climate to change abruptly throughout human history has been one of the most surprising outcomes of the study of past climates.

Adaptation and Mitigation

The most sensible approach to preventing the worst effects of global warming would be to cut carbon dioxide emissions. Scientists believe a cut of between 60 and 80% is required to avoid the worst effects of global warming. But many have argued that the cost of significant cuts in fossil-fuel use would severely affect the global economy, preventing the rapid development of the Third World.

The ratification of the Kyoto Protocol at the Bonn meeting in July 2001 amounted to a cut of between 1 and 3% for the developed world, while the developing world will continue to increase their emissions. So the second major aim of the IPCC is to study and report on the potential sensitivity, adaptability, and vulnerability of each national environment and socio-economic system because if we can predict what the impacts of global warming are likely to be, then national governments can take action to mitigate the effects. For example, if flooding is going to become more prevalent in Britain, then damage to property and loss of life can be prevented with strict new laws which limit building on flood plains and vulnerable coasts.

The IPCC believes there are six reasons why we must adapt to climate change.

- a) Climate change cannot be avoided;
- b) anticipatory and precautionary adaptation is more effective and less costly than forced last-minute emergency fixes;
- c) climate change may be more rapid and more pronounced than current estimates suggest, and unexpected events, as we have seen, are more than just possible;
- d) immediate benefits can be gained from better adaptation to climate variability and extreme atmospheric events: for example, with the hurricane risk, strict building laws and better evacuation practices would need to be implemented;
- e) immediate benefits can also be gained by removing maladaptive policies and practices, for example, building on flood plains and vulnerable coastlines; and
- f) climate change brings opportunities as well as threats. Future benefits can result from climate

change.

The IPCC has provided many ideas of how one can adapt to climate change. The major threat from global warming is its unpredictability. Humanity can live in almost any extreme of climate from deserts to the Arctic, but only when we can predict what the extremes of the weather will be. So adaptation is really the key to dealing with the global warming problem, but it must start now, as infrastructure changes can take up to 50 years to implement.

Mitigating CO₂ Emission

The United Nations Framework Convention on Climate Change was created to produce the first international agreement on reducing global greenhouse gas emissions. However, this task is not as simple as it first appears, as carbon dioxide emissions are not evenly produced by countries. The first major source of carbon dioxide is the burning of fossil fuels, since a significant part of carbon dioxide emissions comes from energy production, industrial processes, and transport. These are not evenly distributed around the world because of the unequal distribution of industry; hence, any agreement would affect certain countries' economies more than others. Consequently, at the moment, the industrialized countries must bear the main responsibility for reducing emissions of carbon dioxide to about 22 billion tonnes of carbon per year. North America, Europe, and Asia emit over 90% of the global industrially produced carbon dioxide. Moreover, historically they have emitted much more than less-developed countries.

The second major source of carbon dioxide emissions is as a result of land-use changes. These emissions come primarily from the cutting down of forests for the purposes of agriculture, urbanization, or roads. When large areas of rainforests are cut down, the land often turns into less productive grasslands with considerably less capacity for storing CO₂.

A major issue in the continuing debate is the sharing of responsibility. Non-industrialized countries are striving to increase their population's standard of living, thereby also increasing their emissions of greenhouse gases, since economic development is closely associated with energy production. The volume of carbon dioxide thus will probably increase, despite the efforts to reduce emissions in industrialized countries. For example, China has the second biggest emissions of carbon dioxide in the world. However, per capita the Chinese emissions are ten times lower than those of the USA, who are top of the list. So this means that in the USA every person is responsible for producing ten times more carbon dioxide pollution than in China. So all the draft international agreements concerning cutting emissions since the Rio Earth Summit in 1992 have for moral reasons, were not included in the developing world, as this is seen as an unfair brake on its economic development. However, this is a significant issue because, for example, both China and India are rapidly industrializing, and with a combined population of over 2.3 billion people, they will produce a huge amount of pollution.

Fixing the Global Warming

There has therefore been a lot of interest in 'alternatives' or 'technofixes' for solving the problem of global warming. There are four main areas of technofixes:

1. CO₂ removal from industrial processes can contribute substantially to a reduction in atmospheric CO₂; however, further research and development is required to improve the performance and their application of these methods within the concepts of sustainable development.

2. We can use less energy and thus produce less carbon dioxide. It is feasible to improve energy efficiency by 50% on average over the next three decades, although this will require tough policy measures, like the introduction of a high-energy or carbon tax. An example is that efficiency in power generation can be increased by 60% using advanced technologies in the field of gas turbines and fuel cells.

3. There are renewable/alternative energy sources, i.e. energy sources which do not produce a net amount of carbon dioxide in the atmosphere. Most promising in the short term is biomass, which by the year 2020 could produce a third of the global energy. When the biomass is growing it absorbs carbon dioxide from the atmosphere which is only returned when it is burnt as a fuel and thus there is no net increase in atmospheric carbon dioxide. Most promising for the long term is solar energy, while wind power is thought to be an excellent intermediate solution, particularly in countries such as the UK, where sunlight cannot be guaranteed. Many countries are also discussing renewing their nuclear programmes as a non-carbon-emission energy source, but problems of safety and dumping nuclear waste still remain the main objections.

4. There is the possibility of removing carbon dioxide from the atmosphere either by growing new forests or by stimulating the ocean to take up more. This idea is discussed in greater detail below in the iron hypothesis section.

All of these technologies make sense and a combination of them could be used to combat global warming, although they each have their drawbacks. Removal of carbon dioxide during industrial processes is tricky and costly, because not only does the CO₂ need to be removed, but it must be stored somewhere as well.

The major problem with all of these methods of storage is safety. Carbon dioxide is a very dangerous gas because it is heavier than air and causes suffocation. An important example of this was in 1986, when a tremendous explosion of CO₂ from Lake Nyos in the west of Cameroon, killed more than 1,700 people and livestock up to 25 km away.

CONCLUSION

Global warming as an important component of climate change is one of the few scientific theories which make us examine the whole basis of modern society. It is a theory that has politicians arguing, sets nations against each other, queries individual choices of lifestyle and ultimately asks the questions about humanity's relationship with the rest of the planet. There is very little doubt that global warming will change our climate in the next century; our best estimates suggest an average temperature increase of 1.4–5.8°C, a sea-level rise in the order of a metre, significant changes in weather patterns, and more extreme climate events. This is not, however, the end of the world, as envisaged by many environmentalists in the late 1980s and early 1990s, but does produce some major challenges for our global society, the most important of which are the moral dilemmas that global warming has precipitated. First, how do we ensure that the Third World develops as rapidly as possible, while preventing a massive explosion in production of carbon dioxide and other greenhouse gases? Second, is the question of whether the money we plan to spend on stabilizing global warming, \$8 trillion or 2% of the World's GDP, to protect future generations is better spent on alleviating current global human suffering? Ultimately, 2% of the World's GDP is a very small cost if we can ensure that the world economy continues to grow by 2–3% per year over the next century as predicted. So ultimately global warming is an issue of morals and global economics.

So a more better and feasible solution to the global warming must be found at the earliest. As we have seen, it is unlikely that global politics will solve global warming. Technofixes are dangerous or can cause problems as bad as the ones they are aimed at fixing. Even the idea of using energy more efficiently seems rather inadequate when there are another five and half billion people in the world aspiring to have the energy use enjoyed by the Western world. Thus the ultimate solution is for humanity to develop cheap and clean energy production, as all economic development is based on ever-increasing energy usage. Though great strides forward have been made in alternative energies, it seems unlikely that these will produce energy on the scale we require in the next few decades.

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