CLIMATE CHANGE

Issues, Challenges and Control Measures

Editors

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FOREWORD

Climate change is not just a recent phenomenon but a real and dynamic one since the Earth was formed. Earth's climate has changed dramatically several times and the changes have been triggered by the changing configuration of continents and oceans, changes in the Sun's intensity, variations in the orbit of Earth, and volcanic eruptions. There weren't just the warming alone but ice ages have also happened many times and the latest being 2.6 million years ago during the Pleistocene period as glaciers covered most parts of the earth and reported to have lasted for over 11,500years.

Presently we are confronted with a situation when the population explosion has necessitated industrialization that resulted in high emission of greenhouse gases such as carbon dioxide methane, carbon monoxide, and nitrous oxide in the atmosphere to rise the temperature alarmingly to cause impacts that further accelerated destruction of ecosystems threatening the health of the planet itself. Destruction of forests and the burning of fossil fuels and unscrupulous disposal of waste including plastics have to be reduced considerably to reduce the emission of greenhouse gases. The climate change induced impacts include unseasonal intense storms, frequent drought, intense heat waves, rising sea levels, rise in sea surface temperatures and resultant ocean acidification. These induce loss of habitat and biodiversity and make the communities more vulnerable to the dangerous weather events.

Realizing the real threat and need to mitigate the issue, the United Nations through the UNFCCC initiated negotiations between countries to strengthen the global response to climate change and in 1997 made the countries especially the developed nations agree a protocol on reducing emission targets for a period from 2008 to 2012. Later in December 2015, the Paris Agreement adopted by 196 countries devised strategies to limit global warming closer to pre-industrial levels.

Despite these global efforts, the goal to reduce emissions and to improve health of ecosystems can only be achieved if the general public realize and participate in the process. Basic understanding, responsible behaviour and conscious efforts in our personal habits and life styles can be the best way forward. It cannot be expected from any Government but from public involvement – only such communities have succeeded in such efforts. The pandemic CoVID-19 has taught us lessons on how the ecosystem has the resilience to bounce back upon reduced emissions of greenhouse gases and therefore, it is not too late to get our acts together.

As a part of our commitment towards achieving a healthy environment, the faculty of St. Ignatius College, Palayamkottai made an attempt to compile and collate research findings and ideas on climate change from academicians and researchers and bring out this publication which has to be lauded as it is another effort towards understanding the real threat and educate the educated to make amends.

Best wishes!

22/2/21

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CLIMATE CHANGE: CAUSES AND EFFECTS

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Introduction

This chapter highlights the science of climate change, the effect of Global Climate Change on human health and the well-being of all life on Earth, and the measures to be implemented to combat the impact of climate change on human health. Renewable energy sources are scientifically known as natural and sustainable sources of energy. Excessive energy consumption, however, can lead to detrimental effects on the atmosphere and the climate. Reasonable quantities of secondary waste are created by these sources of energy. Their consumption, therefore, is sustainable to the degree that current and future economic needs are met. We need to change the way we communicate with our surroundings. The vulnerable are likely to be most at risk from the increased effects of severe weather conditions of instability (i.e., floods and droughts). Developing countries are more vulnerable than rich countries to climate change. Climate change is a challenge both for growth and for the world. Climate change over a long period of time is a global change in the climate (from decades to

millions of years). Both regionally and internationally, these changes will occur. We mean the rise in temperature from the middle of the 20th century to the present through climate change.

Causes of Climate Change

In addition to carbon dioxide, the burning of fossil fuels releases sulphur dioxide into the atmosphere, which then combines with water vapour to form tiny droplets (aerosols) that reflect sunlight. Even though climate change may also have natural causes, human activities and greenhouse gases are primarily connected to it. The natural resources which, by providing eco-system services, provide the basis for human sustenance and development are not inexhaustible. Over the years, there has been a major decline and depletion of natural resources and there is an urgent need for sustainable management of natural resources that could have brought improvements to the ecosystem by over-exploiting its ability to meet its needs and demands. The environment can be categorized into;

(I) Natural environment – ocean , lakes, ponds, rivers, forests grasslands and deserts

(ii) Human modified Environment – Orchards, plantations sanctuaries, parks and

(iii) Human-made

- Climate change is a long-term shift characterized by shifts in temperature, precipitation, winds and other measures in the weather conditions.

- By the end of the century, sea levels are expected to rise between 10 and 32 inches or higher (26 and 82 centimeter).
- It is possible that hurricanes and other storms will develop stronger. It will make floods and droughts more frequent. For instance, large parts of the US face a higher risk of decades-long "mega droughts" by 2100.
- There would be less freshwater available, since glaciers store about three-quarters of the freshwater in the world.
- Some diseases can spread, such as malaria transmitted by mosquitoes (and the 2016 resurgence of the Zika virus).
- Ecosystems will continue to change: some species will migrate further north or become more successful; others will not be able to adapt and may become extinct, such as polar bears.

The climate over a period of time can be described as the average weather. Climate change means a drastic change in climate measurements, such as temperature, rainfall, or wind, lasting decades or longer for a prolonged period. During the history of the world, the atmosphere of the Earth has changed several times, with events ranging from ice ages to long periods of hot. What is different in this time in Earth's history is that through our greenhouse gas emissions, human activities are greatly contributing to natural climate change. Increased air and ocean temperatures, drought, melting ice and

snow, increasing sea levels, increased precipitation, floods, and other influences are the result of this intrusion. Climate change can occur from natural processes and causes and, more recently, from our greenhouse gas emissions due to human activities. Natural factors provide examples of;

- Changes in the strength of the light
- Volcanic eruptions or gradual shifts around the sun in the orbit of the Earth

Standard processes within the climate system, such as changes in ocean current circulation. The current global target, however, is to tackle climate change arising from human activities whose emissions of greenhouse gases modify the composition of the earth's atmosphere. The Intergovernmental Panel on Climate Change (IPCC) state that ;

- *'Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic (produced by humans) greenhouse gas emissions'* Examples of human activities contributing to climate change include;
- Emissions of carbon dioxide from the combustion of fossil fuels such as coal, oil and gas and peat,
- Emissions of methane and nitrous oxide from agriculture
- Emissions from land use modifications, such as deforestation, reforestation, urbanisation, desertification,

Greenhouse Effect

The Greenhouse effect is known as the pollutants that affect the composition of the earth's atmosphere. For the past 200 years, the burning of fossil fuels, such as coal and oil, and deforestation have caused the concentrations of heat-trapping greenhouse gases to increase significantly in our atmosphere. These gases prevent heat from escaping to space, somewhat like the glass panels of a greenhouse.

There is a constant release into the environment of a poisonous combination of greenhouse gases, smog, soot and many other unhealthy tonnes of carbon dioxide. The life of human lives globally is challenged by this phenomenon. It is also a brazen attack based on noticeable impacts and numerous findings on our ecosystem, biodiversity, and food security. According to a special report by the Intergovernmental Panel on Climate Change (IPCC), a diplomatic body of the United Nations (UN), human actions resulted in nearly 1.0°C of global warming in 2018. The report further projects global warming will hit 1.5°C between 2030 and 2052 if current trends continue.

Interventions like the Paris Agreement have emerged, which is being championed by the United Nations Framework Convention on Climate Change (UNFCCC) with 195-member states signing the accord and 184 countries becoming party to it since November 2018. Among other ambitions, this pact seeks to keep global temperature increases below 2 °C above

pre-industrial levels to mitigate the impact of global climate change. Despite the initiative, the agreement lacks the requisite legal basis to enforce penalties on inline flouting countries.

The continued burning of fossil fuels and coal for industrial purposes is one of the problems fueling global climate change. Unfortunately, since the inception of the industrial revolution in 1760, the world has largely ignored renewable energy alternatives. Although the advantages of the transition are immense for global economies, the long-term detrimental effects on our environment is beginning to manifest itself to an equal degree. The International Energy Agency (IEA) also faults global apathy towards advanced and sustained energy efficiency policies. The IEA reports that energy related carbon discharges shot up by 1.4% in 2017 after the emission rate slowed tremendously between 2014 and 2016 to hit a record high of 32.5 gigatons in 2018. The global transport system is in desperate need of attention, as it is also plagued by rising carbon emissions. This increases the risks to the health and vulnerability of people, especially public transport users, in developing countries. The polluted air is inhaled from everyday carbon emissions by these individuals and other pedestrians, which fuels outbreaks of communal and associated airborne diseases. According to the World Health Organization (WHO), 4.2 million global premature deaths are linked to ambient air pollution.

As the key cause of disruption in global precipitation patterns, excessive greenhouse gases in the atmosphere have been established. The dropping of snow, sleet, hail and, in particular, rain has made crop production irregularly stifling

and, consequently, global food security. Rural farmers, in the absence of rain, rely on dams and dugouts, which are shared with animals in some cases. When these dams and dugouts dry out, serious hunger occurs because there is no irrigation system in place, let alone healthy drinking water. The United Nations Food and Agriculture Organization reports that 75% of the world's poor and food-insecure citizens are relying on agriculture and natural resources.

Reports concerning the fast melting ice in Antarctica are terrifying. According to Eric Rignot, a Professor of Earth System Science at the University of California, the melting could lead to alarming sea levels in coming centuries. Other researchers have indicated that the Antarctica has lost 252 billion tonnes of ice annually between 2009 – 2017 due to global climate change. This disclosure suggests further deadly superstorms, high sea levels rising, coastal areas flooding, etc. Because of increased soil salinity and acidification of our waters, food development in certain areas is also delayed, leading to the degradation of the marine ecosystem. Greenhouse emissions are caused by climate change, allowing the sun to shine unimpeded on the surface of the Earth. Natural greenhouse gases ensure a temperature suitable for life on Earth as opposed to man-made gases which cause a very high increase in heat.

Most notably, deforestation is prohibited in both developing and developed countries, but sustainable agricultural practices are adopted. However, most nations are still stepping up efforts to curb pollution from the agriculture sector. Most countries encourage rural growth and boost food

security in order to achieve sustainable and environmentally friendly agricultural practices. In addition to industrialization, the ever-expanding world population are the main threats to climate and global warming. They avoid reflecting the heat back into space and redirect it to the Earth. There are several greenhouse gases, but here is a list of 6 Paris Agreement-regulated gases. Carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons are the ones that have the biggest effect on climate change.

Effects

Global Warming

Of course, global warming is the principal consequence of climate change. The temperature of the earth increasingly exponentially rising because of human activities such as deforestation, industrial agriculture, mining or over-consumption.

Air pollution

Since it does not seem to affect health, the main greenhouse gas is not counted as an air pollutant. There are, however, connections between global warming and climate change, such as the atmospheric concentration of certain airborne contaminants.

Water Pollution

Water pollution and climate change, both in the rivers, seas and oceans, are closely related. In particular, this contamination expresses itself by changes in the flows of different rivers, temperature increases, and the accumulation of pollutants in the water.

Land pollution

Equally hard hit by climate change is the soil. The climate and nature of soils, which are both very fragile and much of the time over-exploited, are greatly altered by human activity.

Prevention

1. ***Renewable energies***
   Changing our primary sources of energy to clean and renewable energy sources. The solutions may be solar, wind, geothermal and biomass.
2. ***Sustainable Transportation***
   It is important to match our transport methods with environmental criteria and reduce their carbon footprint. Our transport approaches need to be rethought from the design stage into eco-friendly transport.
3. ***Air pollution prevention***
   There are several strategies for avoiding, regulating and reducing air pollution, in particular by reducing the use of fossil fuels and reducing emissions and waste from the industry. Waste Management & Recycling The easiest approach to waste reduction is to adapt our manufacturing practises to our patterns of use. It is also important to take account of the recycling phase in our consumption patterns.
4. ***Sea and Ocean preservation***

The oceans and seas are the main reservoirs of greenhouse gases and are an outstanding life support system on this planet. It is now necessary to reduce overfishing, unsustainable construction

activities in coastal areas and the consumption of environmentally friendly goods.

Circular economy Use the 3r's of circular economy (Reduce, Reuse and Recycle) to significantly reduce our waste and avoid unnecessary production of new items. Most aspects of climate change will persist for many centuries even if emissions are stopped. Given current concentrations and on-going emissions of greenhouse gases, it is likely that by the end of this century, the increase in global temperature will exceed 1.5°C. The world's oceans will warm and ice melt will continue. Average sea level rise is predicted as 24 – 30cm by 2065 and 40- 63cm by 2100. From 1880 to 2012, average global temperature increased by 0.85°C. The seas have warmed, the amount of snow and ice has decreased and the level of the sea has increased. The global average sea level increased by 19 cm from 1901 to 2010, as oceans grew due to warming and ice melted. Since 1979, the amount of sea ice in the Arctic has shrunk every successive decade, with ice losses of 1.07 million km2 every decade. Since 1990, global carbon dioxide emissions have risen by nearly 50 per cent.

Industrial, transportation, residential and commercial industries are the four largest energy use markets. We can achieve a substantial decrease in carbon emissions if green transportation means are implemented and we can meet half of our household energy demands from renewable sources such as solar energy maintained by either person house hold.

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CLIMATE CHANGE AND ITS EFFECTS

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Introduction

The term climate refers to the general weather conditions of a place over many years. In the United States, for example, Maine's climate is cold and snowy in winter while South Florida's is tropical year-round. Climate change is a significant variation of average weather conditions-say, conditions becoming warmer, wetter or drier-over several decades or more. It's that longer-term trend that differentiates climate change from natural weather variability. And while "climate change" and "global warming" are often used interchangeably, global warming-the recent rise in the global average temperature near the earth's surface-is just one aspect of climate change.

Measured Climate Change Overtime

Earth-orbiting satellites, remote meteorological stations, and ocean buoys are used to monitor present-day weather and climate, but it's paleoclimatology data from natural sources like ice cores, tree rings, corals, and ocean and lake sediments that have enabled scientists to extend the earth's climatic records back millions of years. These records provide a comprehensive look at the long-term changes in the earth's atmosphere, oceans, land surface, and cryosphere (frozen water systems). Scientists then feed this data into

sophisticated climate models that predict future climate trends-with impressive accuracy.

Causes of Climate Change

The mechanics of the earth's climate system are simple. When energy from the sun is reflected off the earth and back into space (mostly by clouds and ice), or when the earth's atmosphere releases energy, the planet cools. When the earth absorbs the sun's energy, or when atmospheric gases prevent heat released by the earth from radiating into space (the greenhouse effect), the planet warms. A variety of factors, both natural and human, can influence the earth's climate system.

1. Natural Causes of Climate Change

As we all know, the earth has gone through warm and cool phases in the past, and long before humans were around. Forces that contribute to climate change include the sun's intensity, volcanic eruptions, and changes in naturally occurring greenhouse gas concentrations. But records indicate that today's climatic warming-particularly the warming since the mid-20th century-is occurring much faster than ever before and can't be explained by natural causes alone. According to NASA, "These natural causes are still in play today, but their influence is too small or they occur too slowly to explain the rapid warming seen in recent decades."

2. Anthropogenic Causes of Climate Change

Humans-more specifically, the greenhouse gas (GHG) emissions we generate-are the leading cause of the earth's rapidly changing climate. Greenhouse gases play an important

role in keeping the planet warm enough to inhabit. But the amount of these gases in our atmosphere has skyrocketed in recent decades. According to the Intergovernmental Panel on Climate Change (IPCC), concentrations of carbon dioxide, methane and nitrous oxides "have increased to levels unprecedented in at least the last 800,000 years." Indeed, the atmosphere's share of carbon dioxide-the planet's chief climate change contributor-has risen by 40 percent since preindustrial times.

A waterfront factory pumping out clouds of smoke

The burning of fossil fuels like coal, oil, and gas for electricity, heat, and transportation is the primary source of human-generated emissions. A second major source is deforestation, which releases sequestered carbon into the air. It's estimated that logging, clear-cutting, fires, and other forms of forest degradation contribute up to 20 percent of global carbon emissions. Other human activities that generate air pollution include fertilizer use (a primary source of nitrous oxide emissions), livestock production (cattle, buffalo, sheep, and goats are major methane emitters), and certain industrial processes that release fluorinated gases. Activities like

agriculture and road construction can change the reflectivity of the earth's surface, leading to local warming or cooling, too.

Though our planet's forests and oceans absorb greenhouse gases from the atmosphere through photosynthesis and other processes, these natural carbon sinks can't keep up with our rising emissions. It's estimated that the earth's average temperature rose by about 1 degree Fahrenheit during the 20th century. If that doesn't sound like much, consider this: When the last ice age ended and the northeastern United States was covered by more than 3,000 feet of ice, average temperatures were just 5 to 9 degrees cooler than they are now.

The Effects of Global Climate Change

According to the World Economic Forum's 2016 Global Risks Report the failure to mitigate and adapt to climate change will be "the most impactful risk" facing communities worldwide in the coming decade-ahead even of weapons of mass destruction and water crises. Blame its cascading effects: As climate change transforms global ecosystems, it affects everything from the places we live to the water we drink to the air we breathe.

A view of the Seine river flood in Paris near Bir-Hakeimbridge, which reached a 30-year high in June 2016

1. Extreme Weather

As the earth's atmosphere heats up, it collects, retains, and drops more water, changing weather patterns and making wet areas wetter and dry areas drier. Higher temperatures worsen and increase the frequency of many types of disasters, including storms, floods, heat waves, and droughts. These events can have devastating and costly consequences jeopardizing access to clean drinking water, fueling out - of - control wildfires, damaging property, creating hazardous-material spills, polluting the air, and leading to loss of life.

2. Dirty Air

Air pollution and climate change are inextricably linked, with one exacerbating the other. When the earth's temperatures rise, not only does our air gets dirtier-with smog and soot levels going up- but there are also more allergenic air pollutants such as circulating mold (thanks to damp conditions from extreme weather and more floods) and pollen (due to longer, stronger pollen seasons).

3. Health Risks

According to the World Health Organization, "climate change is expected to cause approximately 2,50,000 additional deaths per year" between 2030 and 2050. As global temperatures rise, do the number of fatalities and illnesses from heat stress, heatstroke and cardiovascular and kidney disease. As air pollution worsens, so does respiratory health–particularly for the 300 million people living with asthma worldwide; there's more airborne pollen and mold to torment hay fever and allergy sufferers, too. Extreme weather

events, such as severe storms and flooding, can lead to injury, drinking water contamination, and storm damage that may compromise basic infrastructure or lead to community displacement. Indeed, historical models suggest the likelihood of being displaced by a disaster is now 60 percent higher than it was four decades ago-and the largest increases in displacement are driven by weather- and climate-related events. (It's worth noting that displacement comes with its own health threats, such as increases in urban crowding, trauma, social unrest, lack of clean water, and transmission of infectious diseases). A warmer, wetter world is also a boon for insect – borne diseases such as dengue fever, West Nile virus and Lyme disease.

4. Rising Sea Level

The Arctic is heating twice as fast as any other place on the planet. As its ice sheets melt into the seas, our oceans are on track to rise one to four feet higher by 2100, threatening coastal ecosystems and low-lying areas. Island nations face particular risk, as do some of the world's largest cities, including New York, Miami, Mumbai and Sydney.

Aerial of the Marshall Islands landscape, which are feeling the effects of rising sea levels

5. Warmer, More Acidic Oceans

The earth's oceans absorb between one-quarter and one-third of our fossil fuel emissions and are now 30 percent more acidic than they were in preindustrial times. This acidification poses a serious threat to underwater life, particularly creatures with calcified shells or skeletons like oysters, clams, and coral. It can have a devastating impact on shellfisheries, as well as the fish, birds, and mammals that depend on shellfish for sustenance. Rising ocean temperatures are also altering the range and population of underwater species and contributing to coral bleaching events capable of killing entire reefs–ecosystems that support more than 25 percent of all marine life.

Fish and corals near Limestone Island, Indonesia

6. *Imperiled Ecosystems*

Climate change is increasing pressure on wildlife to adapt to changing habitats–and fast. Many species are seeking out cooler climates and higher altitudes, altering seasonal behaviors, and adjusting traditional migration patterns. These shifts can fundamentally transform entire ecosystems and the intricate webs of life that depend on them. As a result, according to a 2014 IPCC climate change report, many species

now face "increased extinction risk due to climate change". And one 2015 study showed that mammals, fish, birds, reptiles, and other vertebrate species are disappearing 114 times faster than they should be, a phenomenon that has been linked to climate change, pollution, and deforestation–all interconnected threats. On the flip side, milder winters and longer summers have enabled some species to thrive, including tree-killing insects that are endangering entire forests.

Two polar bears on a small ice floe

Climate Change Facts

Despite what climate deniers and fossil fuel lackeys claim–for instance, that the science on global warming is "far from settled"–there's nothing to debate; climate change is a reality. In its most recent report, the IPCC–the foremost international scientific body for the assessment of climate change–states, "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen." Our last decade–2000 to

2009–was hotter than any other decade in at least the past 1300 years. Analyses indicate that 2016 was the hottest year on record. The previous record year was 2015. Before that 2014.

Climate Change Solutions

We can mitigate global climate change and help stem its detrimental impacts, but doing so will require tackling its root cause: pollution from burning fossil fuels.

Climate Action at Home

Tackling global climate change is a Herculean task, one that depends on international consensus and the efforts of communities, companies, and individuals alike. To that end, California, Illinois, Iowa and other states are championing clean energy industries, such as solar and wind. There are myriad ways that we can help too. Picking up the phone to call congress about environmental policies that matter, supporting renewable energy projects and prioritizing fuel and energy efficiency will not only curb individual carbon emissions but bolster clean alternatives to dirty fossil fuels. We must all step up now.

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EVENTS IN CLIMATE HISTORY OVER THE PAST DECADES

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Introduction

Climate change encompasses not only rising average temperatures but also extreme weather events, shifting wildlife populations and habitats, rising seas, and a range of other impacts. All of these changes are emerging as humans continue to add heat-trapping greenhouse gases to the atmosphere. The last decade was the hottest ever recorded, flashing a warning sign to anyone who was paying attention. On average, the annual temperatures over the years however a little less than 1.8 degrees Fahrenheit (1 degree Celsius) higher now than they did from 1950 to 1980. The last five years alone was the hottest stretch ever recorded. So far, 2019 is shaping up to be the second hottest year ever, about 1.7 degrees F (0.94 degree C) above that long-term average. That number might not sound like much, but its effects are large. Each little shift in the average increases the likelihood of extreme hot events and just little shifts in the overall amount of heat stored in the oceans, air, and water can have huge

effects on the planet. And in the past year, activity has exploded amongst young people. Youth climate activists are gathering millions deep, to bring attention to their stolen futures. Scientific teams are issuing stronger and stronger warnings. Global attention to the problem and the potential solutions is growing. But at the same time, the action that's been taken so far is far from enough.

The Global Carbon Project reported earlier this month that global carbon dioxide emissions from fossil fuels and cement are on track to climb to a record high in 2019. While global emissions growth plateau between 2014 and 2016, it was short-lived: Emissions from fossil fuels grew 1.5% in 2017, 2.1% in 2018 and are projected to grow another 0.6% in 2019. The latest climate science suggests that our best chance of limiting warming to 1.5-2 degrees C will require emissions to peak no later than 2020 and drop to net-zero by mid-century. A critical question is whether we'll see signs next year of emissions peaking and declining afterwards. Global mean sea level rise was roughly 3.3 millimeters (mm) per year (0.13 inch/yr) between 1993 and the present. This trend accelerated significantly this past decade: Between 2010 and 2018, sea level rise grew to about 4.4 mm/yr (0.17 inch/yr), rising almost 2 inches overall in the past decade. In 2018, global mean sea level was the highest in the satellite record.

Eight of the world's 10 largest cities are located in vulnerable coastal areas. Seas rising by even a couple of inches leads to more frequent high-tide flooding, storm surges pushing further inland, and devastating risks to homes, habitat and infrastructure. Glaciers around the world are also losing

ice, accelerating with each passing decade. Glacier melt grew from 460 millilitres of liquid water in the 1990s to 500 in the 2000s to 850 millilitres in 2010-2018. Ice loss can lead to rising seas. It can also change the ocean's surface reflectivity, exposing dark waters that absorb more solar radiation — much like a dark shirt on a hot, sunny day — in turn leading to greater warming and a positive feedback loop.

This past decade has been marked by devastating extreme events, including heat waves on land and in the ocean, record rainfall and flooding, massive fires and heat-charged hurricanes. Communities around the world are already living with the impacts of just 1 degrees C (1.8 degrees F) of warming; our climate will only become deadlier and more devastating with every additional fraction of a degree of temperature rise**.** Among many other examples, the reports found that climate change increased the odds of intense heat waves in northeast Asia in 2018 and in southern Europe in 2017, exceptional precipitation in Mid-Atlantic states in 2018, and an East African drought in 2017, which contributed to food insecurity. In addition, several international research programs came together to develop the World Weather Attribution project to analyze the role of climate change in extreme events.

Reason behind the Climate Change

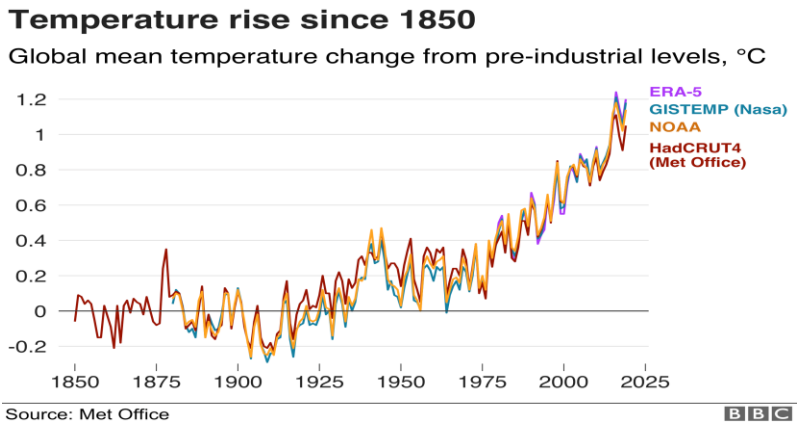
Earth-orbiting satellites and other technological advances have enabled scientists to see the big picture, collecting many different types of information about our planet and its climate on a global scale. The heat-trapping nature of carbon dioxide and other gases was demonstrated in the mid-

19th century. Their ability to affect the transfer of infrared energy through the atmosphere is the scientific basis of many instruments flown by NASA. There is no question that increased levels of greenhouse gases must cause Earth to warm in response.

Ice cores drawn from Greenland, Antarctica, and tropical mountain glaciers show that Earth's climate responds to changes in greenhouse gas levels. Ancient evidence can also be found in tree rings, ocean sediments, coral reefs, and layers of sedimentary rocks. This ancient, or paleoclimate, evidence reveals that current warming is occurring roughly ten times faster than the average rate of ice-age-recovery warming. Carbon dioxide from human activity is increasing more than 250 times faster than it did from natural sources after the last Ice Age.

The ocean has absorbed much of this increased heat, with the top 100 meters (about 328 feet) of ocean showing warming of more than 0.6 degrees Fahrenheit (0.33 degrees Celsius) since 1969. Earth stores 90% of the extra energy in the ocean. The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 279 billion tons of ice per year between 1993 and 2019, while Antarctica lost about 148 billion tons of ice per year. Glaciers are retreating almost everywhere around the world — including in the Alps, Himalayas, Andes, Rockies, Alaska, and Africa.

Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and the snow is melting earlier.



Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades. The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing, since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events.

Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30%. This increase is the result of humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the ocean. The ocean has absorbed between 20% and 30% of total anthropogenic carbon dioxide emissions in recent decades (7.2 to 10.8 billion metric tons per year).

Climate Risk Index

Climate risk is a concept that reflects countries' vulnerability to the direct consequences – deaths and economic losses – of extreme weather events and is measured annually by the Germanwatch observatory via the Global Climate Risk Index. The 2020 Climate Risk Index was presented in Madrid

during the last United Nations Conference on Climate Change (COP25 Chile) and determines the 10 countries presently most affected by climate change.

Affected Countries Around the World Due to Climate Risk Index

1. JAPAN (Climate Risk Index: 5.5)

Heavy rains, heat waves, the Osaka earthquake and Jebi typhoon, which ravaged Japan in 2018, made it the most threatened country in the world by climate change. Weather events themselves were behind 1,282 deaths on the island – 1.01 per 100,000 inhabitants – and caused economic losses of 35,839 million dollars and a collapse of per capita Gross Domestic Product of 0.64%.

2. PHILIPPINES (Climate Risk Index: 11.17)

Typhoon Mangkhut's passage through the Philippines in 2018 affected more than 250,000 people across the country and left at least 59 dead due to torrential rainfall. According to Germanwatch, extreme weather events caused a total of 455 deaths in the country that year – 0.43 per 100,000 inhabitants – as well as more than 4,540 million US dollars in economic losses and a drop in GDP of 0.48% per capita.

3. GERMANY (Climate Risk Index: 13.83)

The German country ranks the third position of the most affected countries by climate risk due to the heat wave it suffered in 2018, the hottest year in its history with damages of more than 3,500 million dollars for the agricultural sector. The weather events in Germany caused a total of 1,246 deaths –1.5 per 100,000 inhabitants –losses of 5,038 million dollars and a decrease in per capita GDP of 0.12%.

4. MADAGASCAR (Climate Risk Index: 15.83)

Global warming and climate risks threaten the survival of the lemur and other endemic animal species on the island. Adverse weather events have also made the African country one of the most vulnerable to climate change with 72 deaths –0.27 per 100,000 inhabitants –about 568 million dollars in economic losses and a drop in per capita GDP of 1.32%.

5. INDIA (Climate Risk Index: 18.17)

The Indian subcontinent is other major victim of extreme heat, floods and sandstorms, among other devastating natural events. In 2018 caused more than 2,000 deaths –0.16 per 100,000 inhabitants – losses of 37,807 million dollars and a decrease in per capita GDP of 0.36%.

6. SRI LANKA (Climate Risk Index: 19)

This small country in the gulf of Bengala could lose a substantial part of its population due to future climate migrations. Furthermore, weather events in 2018 caused 38 deaths in Sri Lanka — 0.18 per 100,000 inhabitants —, over 3,625 million dollars in losses and a collapse in per capita GDP of 1.24%

7. KENYA (Climate Risk Index: 19.67)

This African country is another of those most vulnerable to climate change due to the droughts of 2018 that, months later, left more than a million people on the brink of famine. The hostile climate of that year in Kenya claimed the lives of 113 people –0.24 per 100,000 inhabitants –and produced losses of more than 708 million dollars and a drop in per capita GDP of 0.4%.

Conclusion

The planet's average surface temperature has risen about 2.05 degrees Fahrenheit (1.14 degrees Celsius) since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere.[4] Most of the warming occurred in the past 40 years, with the six warmest years on record taking place since 2014. Not only was 2016 the warmest year on record, but eight months out of that year — from January through September, with the exception of June — were the warmest on record for those respective months. Addressing climate change will require many solutions—there's no magic bullet. The required changes span technologies, behaviours and policies that encourage less waste and smarter use of our resources. For example, improvements to energy efficiency and vehicle fuel economy, increases in wind and solar power, biofuels from organic waste, setting a price on carbon, and protecting forests are all potent ways to reduce the amount of carbon dioxide and other gases trapping heat on the planet.

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CLIMATE CHANGE: AN OVERVIEW

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Introduction

The world most group in the society are the rural poor as they often depend on natural resources for livelihoods such as agriculture, fishing and forestry. The impact of climate change currently predicted for India include rise of up to 40^{o}C in surface air temperature by 2100. Customized interventions are therefore the need of the hours to cope up with the specific risk's indifferent states and regions.

Definition

"It is abroad range of global phenomena created predominantly by burning fossil fuels. Which add heat – trapping gases to earth's atmosphere? These phenomena include the increased temperature trends described by global warming but also encompass changes such as sea-level rise, ice mass loss in Greenland, Antarctica, the Arabic and Mountain glaciers worldwide shifts in flower \ plant blooming and extreme weather events" said by NASA.

Climate Change and its Impact on Agriculture

Climate is the main factor that influences any agricultural operations starting from filed preparation to harvesting. Tamil Nadu is the 11thlargest and 7th most populous state (6%) in the country. The major crops are rice, jawar, bajra, maize, cotton, ground nut, mung bean, banana and sugar cane. The climate changes most affect by agriculture low level and high-level rain fall are total spoil the crops growth.

Increasing Temperature - Declining Rainfall

For Tamil Nadu as a whole, the projections of maximum temperature show an increase of 1.0, 2.2 and 3.1 °C for the periods 2020s (2005–2035), 2050s (2035–2065) and 2080s (2065–2095), respectively, with respect to baseline period (1970–2000). Similarly, the projections of minimum temperature show an increase of 1.1, 2.4 and 3.5 °C, respectively, for the similar period bands.

The annual rainfall projections for the same periods indicate a general decrease in rainfall of about 2–7, 1–4 and 4–9 %, respectively. There are also indications of increasing heavy rainfall events during the northeast monsoon season and a slight decrease during the southwest monsoon season. The High Altitude acro-climatic zone of the Western Ghats and the Eastern Ghats, and the High Rainfall acro-climatic zone near the tip of the peninsula could have an increase in rainfall from 10% to 25%.

Seasons in Tamil Nadu

Monsoon : The monsoon season in Tamil Nadu starts from late June to December.

Temperature: On an average monsoon day, the temperature can range anywhere between 25 and 30 degrees Celsius in Tamil Nadu.

Summers: Summer starts in the month of March and lasts up to late June.

Temperature: During summers, temperatures range from 28 degrees Celsius to 45 degrees Celsius depending on the place you are visiting in Tamil Nadu.

Winter: This is perhaps the best time to visit Tamil Nadu. Winter in Tamil Nadu begins in the month of November and extends until March, just before the onset of the summer season.

Temperature: The temperature in the state during this time ranges between 22 to 30 degrees Celsius.

Climate Change Knowledge Portal

Each of the last three decades has been successively warmer at the earth's surface than any preceding decade since 1850. The globally averaged temperature data show a warming of 0.85 [0.65 to 1.06] ^{o}C. Cover the period 1880 to 2012.

IPCC Assessment report 5th States the global mean temperatures will be continue to rise over the 21st Century if Green House Gas (GHG) emissions continue unabated and temperature change will not be regionally uniform. It is virtually certain that in most places there will be more temperature. Extremes as global mean temperatures increase (IPCC 2014).

High Frequency – Low Impacts

1. Multiple minor events impact > 1 major events [Cyclone, flood or Server drought]
2. Impacts of strong wind and heavy rain
    - March 30/2012 – 50 lakhs worth 15000 banana trees were lost in Theni District.
    - May 04/2011 – Lot of banana trees in Managuzhi village, coodalore taluk in Nilgiris District were lost.
    - May 07,08/2012 – 1.5 cores of banana trees, drumsticks trees, coconut trees were damaged in sinamanoor area of Theni District.

Effects of Climate Change

It is not scientifically possible to assign individual weather events to the current climate change, however, it can be statistically proven that global warming will increase the probability of extreme weather events. The direct consequences of man-made climate change include;

- rising maximum temperatures
- rising minimum temperatures
- rising sea levels
- higher ocean temperatures
- an increase in heavy precipitation (heavy rain and hail)
- shrinking glaciers
- thawing permafrost

The indirect consequences of climate change, which directly affect us humans and our environment, include;

- an increase in hunger and water crises, especially in developing countries
- health risks through rising air temperatures and heat waves
- economic implications of dealing with secondary damage related to climate change
- increasing spread of pests and pathogens
- loss of biodiversity due to limited adaptability and adaptability speed of flora and fauna
- ocean acidification due to increased HCO3 concentrations in the water as a consequence of increased CO_2 concentrations
- the need for adaptation in all areas (e.g. agriculture, forestry, energy, infrastructure, tourism, etc.)

Climate Changes – Affect Human Health

Extremes in weather and temperature, increased pollutions andenvironmental toxins and changes in food security can all cause physical and mental health including;

- Safety of Shelter
- Air Quality
- Quality, Safety and Supply Of Drinking Water
- Food Availability
- Nutrition Levels in Food.

According to the world health organizations (WHO) researches predict that certain effects of climate change will contribute to an increase of about 250,000 deaths per year between 2030 and 2050 from conditions such as;

- Heat Stress
- Malnutrition
- Diarrhea
- Malaria
- High level body pain
- Dehydrations
- Climate Change

Conclusion

We need to take part and try to stop global warming and other effects on climate change. If the earth's temperatures continue to rise in the future, living things on earth would become extinct due to the high temperatures. If humans contribute to control global warming, this world would be cooler and the high temperatures we currently have would decrease. If everybody as one take stand and try to end most of the climate changes that are occurring, this world would be a safer place to live on.

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CLIMATE CHANGE AND ITS CHALLENGES

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Introduction

The long term alteration of temperature and typical weather patterns in a place is called climate change. It could refer to a particular location or the planet. Temperature and rainfall change in the average conditions in a region over a long period of time is called climate change. It is created predominately by burning fossil fuels which add heat trapping gases to atmosphere. It is a major concern in colder countries. Human activities, variations in sunlight intensity and processes inside the earth can cause climate change. It causes abnormal variations to the climate. It may be due to the long term change in the weather of a region over a significant period of time. It causes melting of ice caps at the south pole and north pole. These changes may take tens, hundreds or millions of years.

Key Terms in Climate Change

Mitigation - It means any actions which are taken to reduce greenhouse gas emissions. It includes planting a tree in our own backyard or investments in clean technology. Individuals, governments and corporations around the world

will need to commit to mitigate their contributions to global change to create an environmentally sustainable society.

UNFCC- United Nations Framework Convention on Climate Change was created in 1992. It addresses the climate crisis. It can prevent human interference of reaching a critical level by mitigating greenhouse gas emissions. The UNFCC signs the Paris Agreement with united nations in 2015 for the cause of global climate effort.

Environmental Justice – Regardless of the person's race, color, national origin or income it includes all people in the development and enforcement of environmental policies. Climate change affects badly the men, women and children living in rural areas of developing countries.

Carbon Footprint – It means in any given time the amount of carbon that an organization or person produces.

Global Warming – It refers to the overall increase in worldwide temperatures caused by rising greenhouse emissions.

Food Security – It means when all people in a given area reach sufficient nutrients at all times. Climate change worsens weather conditions by rising sea levels and drought which leads to a lack of food security.

Methane - Sixty percentage of methane emissions are caused by human activity. Curbing production of methane is at the forefront of climate preservation strategies.

Tipping point- It means that the point at which a series of small changes or incidents become significant enough to cause a larger, more important change. For example coral bleaching and melting of polar ice caps.

Traditional knowledge – It refers to indigenous peoples' systems of recording, communicating and preserving the environment around them. We need to support local leaders who know their ecosystems better.

Dimensions of Climate Change

- *Stealth denial* – Those who accept the reality of man-made climate change but they don't live as though they do.
- *Deep decarbonisation* – We need more and better tools to reduce emissions modestly, quickly and at relatively low cost.
- *Governance trap* – People expect the government to act but government thinks people should care about the issue. So our democracy needs to overcome this.
- *Invest in future* – Our economy needs to spend more money towards renewable.
- *Climate silence* – It means environmentalists will talk only about clean energy or green jobs or clean air.
- *New social contract* – We should establish a new social contract between scientists and society.
- *Constraint on extraction* – We need a legal mechanism to keep fossil fuels in the ground.

Characteristics of Climate Change

The global average temperature has climbed 0.85 degree Celsius which shows impact on flora and fauna, the eco system, health and so on. The climate change will cause some health problems. One degree Celsius warming in summer time could induce 1% demographic death. Climate change also deteriorates the air quality. Regarding the eco system and agriculture rising of temperature could reduce wheat output. Due to global warming heat waves and torrential rains will happen frequently. Transportation could also be disrupted by freezing disaster.

Significance of Climate Change

Climate change will bring big challenges such as food and abitats for animals especially incredible species like snow leopards, turtle and polar bear around the world. Wine and coffee production may also be hit by climate change. Coral bleaching is caused by warmer air and ocean temperature. Climate change is very bad for coral reef. Climate change affects rainfall patterns such as drought and flooding. It will destabilize the water cycle. It will create water scarcity. .Amazon rainforest is threatened by climate change. Human caused emissions to the atmosphere can pollute air which lead to asthma, heart and lung disease. Without harming our environment we can use solar panels, wave energy conversion and wind farms.

Indicators of Climate Change

Melting of glaciers, increasing of air temperatures over land, rising of sea levels, decreasing of arctic sea ice, increasing of ocean heat content, increasing of sea surface temperature, decreasing of snow and increasing earth's lower atmosphere temperature are the main indicators of climate change.

Challenges of Climate Change

Thermal Pollution

It is also known as thermal enrichment. It is commonly caused by nuclear and electric power plants, crude oil refineries, steel melting factories, coal fire power plant and boiler from industries where water is used as a coolant and puts it back with an altered temperature. It is the harmful release of heated liquid into a body of water and heat is released into the air as a waste product. It degrades the water quality of ocean, lake, river or pond.

Harmful Effects of Thermal Pollution

Increase in the temperature of water decreases the concentration of oxygen and increases the toxicity present in water. The setting speed of suspended particles are increased due to the decrease in density, viscosity and solubility of gases in water which affects metabolism, respiration rate, digestion, excretion and development of aquatic organisms like juvenile fish, plankton, fish, eggs, larva, algae and protozoa.

Control Measures of Thermal Pollution

Before discharging heated water that can be treated by installation of cooling ponds and towers. That treated water can be recycled for domestic use. Heated water can be discharged at one end of artificial lake and cooling purpose can be done at the other end. Eventually the heat may be dissipated through evaporation.

Sustainable Environment and Agriculture

Agriculture plays a vital role in natural resources and environment. Agricultural practices help to protect the environment. It maintains and improves soil fertility. Farming is sustainable agriculture which has to meet society's present food and fiber needs. Agriculture is based on environmental foot print. It also plays a significant role in causing climate change, water scarcity, land degradation and deforestation. Sustainable agriculture is a base for sustainable food systems. It is necessary to feed a growing population within the changing environmental conditions. Quality of life for farmers and society is enhanced by sustainable agriculture. The economic viability of farm operations is sustained by sustainable agriculture.

Weather Forecast and Scenario

Climate change causes longer droughts in some regions and intense deluges in some other regions. Our planet's surface is made up of seventy percentage of water. Water evaporates from oceans and lakes will be more if the world warms. Rise

of one degree Fahrenheit of temperature will allow the atmosphere to hold four percentage of more water vapour.

Sustainable Environment and Health

All over the world reducing the emission of greenhouse gases is slow in progress. Sufficient investment has not been made for this purpose. Climate related zoonoses may occur. Due to water shortage, food insecurity and climate migration ther may be a chance of increased cardio vascular and pulmonary diseases as well as mental ill health. Our society must respond to this challenge. The health care industry must examine its own carbon footprint. Climate change and its impact will be a new public health challenge and it is surely a major determinant of health.

Renewable Energy and Low Carbon Opportunities

To arrest the proliferation of carbon, investment in renewable is advisable. Government should take necessary steps for this. Renewable energy technologies include solar PV, wind, energy storage; energy efficiency and waste to energy are recommended. Achieving net zero emissions of greenhouse gases is an important target for all businesses and the global economy.

Conclusion

To meet the challenges of climate change we need to develop a mix of strategies like mitigation, adaptation and technological development. Decisions and concerns about

climate change can be posted via social media. We can encourage government to enact laws that limit carbon emissions. Make the polluters to punish or pay for the emissions they produce. We can help to protect public lands and stop offshore drilling. Our home can be powered with renewable energy. A company that generates its power from wind or solar can be chosen. It should be certified by Green-e Energy. Energy-efficient appliances to keep tons of carbon dioxide out of the air can be invested. Energy star label should be noticed while buying electrical appliances. Emission of chloroflurocarbon and hydro chloroflurocarbon can be reduced that can be achieved through the management and destruction of refrigerants already in circulation. Carbon pollution can also be reduced by saving water. Lot of energy spent to pump, heat and treat water can be minimized by saving water. To achieve this water sense labeled fixtures and appliances can be used. LED bulbs can be used because that uses less energy than others. Fully charged devices can be unplugged in our home when they are not in use. Rarely used devices will also be unplugged. Moreover computers and monitors will also be adjusted to the lowest power mode when not in use. Hybrid and fully electric vehicles save fuel and money. New air filter and properly inflated tire can boost miles. Air transport is a major reason for climate pollution. So other type of transport can be used. Carbon offsets can reduce the carbon that we used.

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OUTLINE SURVEY OF CLIMATE CHANGE

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Introduction

Climate change has not stopped for COVID19. Greenhouse gas concentrations in the atmosphere are at record levels and continue to increase. Emissions are heading in the direction of pre-pandemic levels following a temporary decline caused by the lockdown and economic slowdown. The world is set to see its warmest five years on record – in a trend which is likely to continue - and is not on track to meet agreed targets to keep global temperature increase well below 2 ℃ or at 1.5 ℃ above pre-industrial levels.

This is according to a new multi-agency report from leading science organizations, *United in Science 2020*. It highlights the increasing and irreversible impacts of climate change, which affects glaciers, oceans, nature, economies and human living conditions and is often felt through water-related hazards like drought or flooding. It also documents how COVID-19 has impeded our ability to monitor these changes through the global observing system.

Increasing anthropogenic influence on the natural environment over many centuries (Goudie2018) has led to significant global challenges at the nexus of planetary and human health, of which COVID-19 may just be the latest manifestation. Although the COVID-19 crisis is distinct in

contemporary history in bringing simultaneous global health and economic impacts, it shares marked similarities with the climate crisis. The pandemic and climate change both present potentially devastating global problems with need for rapid remediating government intervention. This intervention, while inevitably creating losers, in both cases must be decisive and build on societal consensus.

"Greenhouse gas concentrations - which are already at their highest levels in 3 million years - have continued to rise. Meanwhile, large swathes of Siberia have seen a prolonged and remarkable heat wave during the first half of 2020, which would have been very unlikely without anthropogenic climate change. And now 2016–2020 is set to be the warmest five-year period on record. This report shows that whilst many aspects of our lives have been disrupted in 2020, climate change has continued unabated," said WMO Secretary-General, Professor Petteri Taalas. The overall disruption of observations will introduce gaps in the historical time series of Essential Climate Variables needed to monitor climate variability and change and associated impacts.

A global crisis has shocked the world. It is causing a tragic number of deaths, making people afraid to leave home, and leading to economic hardship not seen in many generations. Its effects are rippling across the world. Obviously, I am talking about COVID-19. But in just a few decades, the same description will fit another global crisis: climate change. As awful as this pandemic is, climate change could be worse.

I realize that it's hard to think about a problem like climate change right now. When disaster strikes, it is human nature to worry only about meeting our most immediate needs, especially when the disaster is as bad as COVID-19. But the fact that dramatically higher temperatures seem far off in the future does not make them any less of a problem—and the only way to avoid the worst possible climate outcomes is to accelerate our efforts now. Even as the world works to stop the novel corona virus and begin recovering from it, we also need to act now to avoid a climate disaster by building and deploying innovations that will let us eliminate our greenhouse gas emissions.

You may have seen projections that, because economic activity has slowed down so much, the world will emit fewer greenhouse gases this year than last year. Although these projections are certainly true, their importance for the fight against climate change has been overstated.

Analysts disagree about how much emissions will go down this year, but the International Energy Agency puts the reduction around 8 percent. In real terms, that means we will release the equivalent of around 47 billion tons of carbon, instead of 51 billion.

That's a meaningful reduction, and we would be in great shape if we could continue that rate of decrease every year. Unfortunately, we can't. Consider what it's taking to achieve this 8 percent reduction. More than 600,000 people have died, and tens of millions are out of work. This April, car

traffic was half what it was in April 2019. For months, air traffic virtually came to a halt.

"What's remarkable is not how much emissions will go down because of the pandemic, but how little."

To put it mildly, this is not a situation that anyone would want to continue. And yet we are still on track to emit 92 percent as much carbon as we did last year. What's remarkable is not how much emissions will go down because of the pandemic, but how little. In addition, these reductions are being achieved at, literally, the greatest possible cost.

To see why, let's look at what it costs to avert a single ton of greenhouse gases. In reality, $100 per ton would still be pretty expensive. But many economists think this price reflects the true cost of greenhouse gases to society, and it also happens to be a memorable round number that makes a good benchmark for discussions.

In the United States, according to data from the Rhodium Group, it comes to between $3,200 and $5,400 per ton. In the European Union, it's roughly the same amount. In other words, the shutdown is reducing emissions at a cost between 32 and 54 times the $100 per ton that economists consider a reasonable price.

"To understand the kind of damage that climate change will inflict, look at COVID-19 and spread the pain out over a much longer period."

If you want to understand the kind of damage that climate change will inflict, look at COVID-19 and spread the pain out over a much longer period of time. The loss of life and economic misery caused by this pandemic are on par with what will happen regularly if we do not eliminate the world's carbon emissions.

How does that compare to climate change? Within the next 40 years, increases in global temperatures are projected to raise global mortality rates by the same amount—14 deaths per 100,000. By the end of the century, if emissions growth stays high, climate change could be responsible for *73* extra deaths per 100,000 people. In a lower emissions scenario, the death rate drops to 10 per 100,000.

In other words, by 2060, climate change could be just as deadly as COVID-19, and by 2100 it could be five times as deadly. The economic picture is also stark. The range of likely impacts from climate change and from COVID-19 varies quite a bit, depending on which economic model you use. But the conclusion is unmistakable: In the next decade or two, the economic damage caused by climate change will likely be as bad as having a COVID-sized pandemic every ten years. And by the end of the century, it will be much worse if the world remains on its current emissions path.

(If you're curious, here is the math. Recent models suggest that the cost of climate change in 2030 will likely be roughly 1 percent of America's GDP per year. Meanwhile, current estimates for the cost of COVID-19 to the United

States this year range between 7 percent and 10 percent of GDP. If we assume that a similar disruption happens once every ten years, that's an average annual cost of 0.7 percent to 1 percent of GDP—roughly equivalent to the damage from climate change.)

"If we learn the lessons of COVID-19, we can approach climate change more informed about the consequences of inaction."

The key point is not that climate change will be disastrous. The key point is that, if we learn the lessons of COVID-19, we can approach climate change more informed about the consequences of inaction, and more prepared to save lives and prevent the worst possible outcome. The current global crisis can inform our response to the next one.

In particular, we should:

1. ***Let Science and Innovation Lead the Way:*** The relatively small decline in emissions this year makes one thing clear: We cannot get to zero emissions simply—or even mostly—by flying and driving less.

   Of course, cutting back is a good thing for those who can afford to do it, as I can. And I believe that many people will use teleconferencing to replace some business travel even after the pandemic is over. But overall, the world should be using more energy, not less—as long as it is clean.

So just as we need new tests, treatments, and vaccines for the novel corona virus, we need new tools for fighting climate change: zero-carbon ways to produce electricity, make things, grow food, keep our buildings cool and warm, and move people and goods around the world. And we need new seeds and other innovations to help the world's poorest people—many of whom are smallholder farmers—adapt to a less predictable climate.

Any comprehensive response to climate change will have to tap into many different disciplines. Climate science tells us *why* we need to deal with this problem, but not *how* to deal with it. For that, we'll need biology, chemistry, physics, political science, economics, engineering, and other sciences.

2. **Make Sure Solutions Work for Poor Countries Too:** We don't yet know exactly what impact COVID-19 will have on the world's poorest people, but I am concerned that by the time this is over, they will have had the worst of it. The same goes for climate change. It will hurt the poorest people in the world the most.

   Consider climate's impact on death rates. According to a recent study published by Climate Impact Lab, although climate change will push the overall death rate up globally, the overall average will obscure an enormous disparity between rich and poor countries. More than anywhere else, climate change will

dramatically increase death rates in poor countries near or below the Equator, where the weather will get even hotter and more unpredictable.

The economic pattern will probably be similar: a modest drop in global GDP, but massive declines in poorer, hotter countries.

In other words, the effects of climate change will almost certainly be harsher than COVID-19's, and they will be the worst for the people who did the least to cause them. The countries that are contributing the most to this problem have a responsibility to try to solve it.

In addition, clean sources of energy need to be cheap enough so that low- and middle-income countries can buy them. These nations are looking to grow their economies by building factories and call centres; if this growth is powered by fossil fuels—which are now the most economical option by far—it will be even harder to get to zero emissions.

When there's a vaccine for the corona virus, organizations like GAVI will be ready to make sure it reaches the poorest people in the world. But there is no GAVI for clean energy. So governments, inventors, and entrepreneurs around the world need to focus on making green technologies cheap enough that

developing countries will not only want them, but be able to afford them.

3. **Start Now.** Unlike the novel corona virus, for which I think we'll have a vaccine next year, there is no two-year fix for climate change. It will take decades to develop and deploy all the clean-energy inventions we need.

   We need to create a plan to avoid a climate disaster—to use the zero-carbon tools we have now, develop and deploy the many innovations we still need, and help the poorest adapt to the temperature increase that is already locked in. Although I am spending most of my time these days on COVID-19, I am still investing in promising new clean energy technologies, building programs that will help innovations scale around the world, and making the case that we need to invest in solutions that will limit the worst impacts of climate change.

   Some governments and private investors are committing the funding and the policies that will help us get to zero emissions, but we need even more to join in. And we need to act with the same sense of urgency that we have for COVID-19.

   Health advocates said for years that a pandemic was virtually inevitable. The world did not do enough to prepare, and now we are trying to make up for lost

time. This is a cautionary tale for climate change, and it points us toward a better approach. If we start now, tap into the power of science and innovation, and ensure that solutions work for the poorest, we can avoid making the same mistake with climate change.

Conclusion

This report has been compiled by the World Meteorological Organization (WMO) under the direction of the United Nations Secretary-General to bring together the latest climate science related updates from a group of key global partner organizations – WMO, Global Carbon Project (GCP), UNESCO Intergovernmental Oceanographic Commission (UNESCO-IOC), Intergovernmental Panel on Climate Change (IPCC), UN Environment Programme (UNEP) and the Met Office. The content of each chapter is attributable to each respective organization.

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CLIMATE CHANGE: CAUSES AND CONSEQUENCES

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Introduction

Climate change is the catch-all term for the shift in worldwide weather phenomena associated with an increase in global average temperatures. It's real and temperatures have been going up around the world for many decades. Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Without drastic action today, adapting to these impacts in the future will be more difficult and costly. On Earth, human activities are changing the natural climate. Most of these climate changes are attributed to very small variations in Earth's orbit that change the amount of solar energy our planet receives.

Global Environmental Issues

'Global environmental issues' is a phrase that refers to the effect on the climate of human actions, in particular the

combustion of fossil fuels (coal, oil and gas) and large-scale deforestation, which cause emissions to the atmosphere of large amounts of 'greenhouse gases', of which the most important is carbon dioxide. The major issues are:

i) Acid Rain

Acid rain is precipitation possessing a pH of about 5.2 or below. Acid rain is caused by release of sulfur dioxide (SO_2) and nitrogen oxides (NO_x; the combination of NO and NO_2) from human activities, mostly the combustion of fossil fuels, which then mix with water vapour in atmosphere to form sulphuric acids and nitric acids respectively.

Chemistry of Acid Rain

Normal rainwater is weakly acidic because of the absorption of carbon dioxide (CO_2) from the atmosphere which produces carbonic acid. In addition, volcanic activity can produce sulfuric acid (H_2SO_4), nitric acid (HNO_3) and hydrochloric acid (HCl) depending on the emissions associated with specific volcanoes. Other natural sources of acidification include the production of nitrogen oxides from the conversion of atmospheric molecular nitrogen (N_2) by lightning and the conversion of organic nitrogen by wildfires. However, the geographic extent of any given natural source of acidification is small, and in most cases it lowers the pH of precipitation to no more than about 5.2.

Anthropogenic activities, particularly the burning of fossil fuels (coal, oil, natural gas) and the smelting of metalores, are the major causes of acid deposition.

$$SO_2 + H_2O \rightarrow H_2SO_4 \longleftrightarrow H^+ + HSO_4 \longleftrightarrow 2H^+ + SO_4^{2-}$$

$$NO_2 + H_2O \rightarrow HNO_3 \longleftrightarrow H^+ + NO_3^-$$

These reactions in the aqueous phase (for example, in cloud water) create wet deposition products. In the gaseous phase they can produce acidic dry deposition. Acid formation can also occur on particles in the atmosphere.

Effects of Acid Rain

- Acidification of lakes, streams and soils.
- Direct and indirect effects (release of metals, for example : Aluminum which washes away plant nutrients).
- Killing of wildlife (trees, crops, aquatic plants and animals).
- Decay of building materials and paints, statues and sculptures.
- Health problems (respiratory, burning skin and eyes).
- Eutrophication in lake, coastal marine and estuarine ecosystems.

ii) Ozone Layer Depletion

Ozone layer is a thin layer of ozone (O_3) presents in stratosphere which extents from 10-50km from the earth. The ozone layer is highly beneficial to life on earth as it blocks the sun's ultraviolet radiation (UV-B) from reaching the earth. Any disturbance or depletion of ozone layer would result in an

increase of harmful radiation reaching the earth's surface leading to dangerous consequences.

Ozone, which is highly unstable, is produced and destroyed naturally in the stratosphere and until recently, this resulted in a well-balanced equilibrium. Ozone is formed when oxygen molecules absorb ultraviolet radiation with wavelengths less than 240 nm and its destroyed when it absorbs ultraviolet radiation with wavelengths greater than 290 nm.

Ozone Depletion Process

In recent years, scientists have measured a seasonal thinning of the ozone layer primarily at the South Pole. This phenomenon is being called the ozone layer depletion. It was found that ozone is easily broken down by man-made chlorine and bromine compounds. These compounds are found to be responsible for most of the ozone layer depletion. The main chemical responsible for the problem is identified as Chlorofluro carbons (CFCs) which were used in refrigerator and air conditioners.

The Ozone depletion process begins when Chlorofluro carbons (CFCs) and other ozone-depleting substances (ODS) emitted into the atmosphere reach stratosphere by diffusion. Strong UV radiations break apart the ODS molecules. CFCs, HCFCs, carbon tetrachloride, methyl chloroform release chlorine atoms, and halons and methyl bromide release bromine atoms. It is the chlorine and bromine atom that actually destroys ozone, not the intact ODSmolecule. It is estimated that one chlorine atom can destroy from 10,000 to

100,000 ozone molecules before it is finally removed from the stratosphere.

Chemistry of Ozone Depletion

When ultraviolet light waves strike CFC ($CFCl_3$) molecules in the upper atmosphere, a carbon-chlorine bond breaks, producing a chlorine (Cl) atom. The chlorine atom then reacts with an ozone (O_3) molecule breaking it apart and so destroying the ozone. This forms an ordinary oxygen molecule (O_2) and a chlorine monoxide (ClO) molecule. Then a free oxygen atom breaks up the chlorine monoxide, releasing chlorine. The released chlorine is free to repeat the process of destroying more ozone molecules. A single CFC molecule can destroy 1,00,000 ozone molecules. The chemistry of ozone depletion process is shown in the Figure.

Effects of Ozone Layer Depletion

It affects

- ***Human and animal health:*** Causing eye diseases, skin cancer and infectious diseases.
- ***Terrestrial plants:*** Changing species composition in forest and grassland thus altering the bio-diversity in different ecosystems.
- ***Aquatic ecosystems:*** Affecting the distribution of phytoplanktons, which form the foundation of aquatic food webs. It can also cause damage to early development stages of fish, shrimp, crab, amphibians and other animals, the most severe effects being

decreased reproductive capacity and impaired larval development.

- ***Bio-geo-chemical cycles:*** Affecting terrestrial and aquatic bio-geo-chemical cycles thus altering both sources and sinks of greenhouse and important trace gases.
- ***Air quality:*** Resulting is higher photo dissociation rates of key trace gases that control the chemical reactivity of the troposphere.

Ozone Depletion Counter Measures

International cooperation and agreement was signed at Montreal Protocol in 1974 to phase out ozone depleting chemicals. The ozone depletion counter measures include,

- Tax imposed on use of ozone depleting substances
- Use of ozone friendly substitutes-HCFC and CFC (less ozone depleting potential and shorter life)
- Recycle of CFCs and Halons

iii) Global Warming

The atmosphere is a thin layer of gas which surrounds the Earth. The two most important layers in the atmosphere are known as the troposphere and the stratosphere. The air layer gets thinner and thinner with altitude 90% of all the molecules in the atmosphere are in the troposphere.The atmosphere is composed mainly of 21% Oxygen, 78% Nitrogen, 0.04% carbon dioxide and 0.04% Argon by volume. In addition, water vapour and several gases are present in very small amounts.

The Green house effect

The earth is surrounded by a blanket of gases including greenhouse gases. The greenhouse gases are those gases in the atmosphere which by absorbing thermal radiation emitted by the earth's surface have a blanketing effect over the surface keeping it warmer than it would otherwise. This results in build up of energy, and the overall warming of the atmosphere. This blanket traps energy in the atmosphere much the same way as glass traps heat inside a greenhouse. Without naturally occurring greenhouse gases such as watervapour, carbon dioxide, methane and nitrous oxide, the earth's average surface temperature would be a cold -18°C rather than the tolerable 15°C. This warming of the earth called the greenhouse effect is a natural process which made life on Earth possible.

Enhanced Greenhouse Effect

The natural greenhouse effect is enhanced by the increase of greenhouse gases in the atmosphere especially carbon dioxide from burning of fossil fuels, coal, oil and gas together with wide deforestation over the past 200years and more substantially over the past 50 years. Although, water vapour is also considered as greenhouse gas, its amount in the atmosphere is not changing directly because of human activities. The other important greenhouse gases that are directly influenced by human activities leading to enhanced greenhouse effect are carbon dioxide, methane, nitrous oxide, the chlorofluorocarbons (CFCs) and ozone.

There is now overwhelming evidence that enhanced greenhouse effect from human activities greenhouse effect

from human activities is changing the global climate. It is estimated that the earth's average temperature has risen by 0.75°C since 1880 because of emissions of greenhouse gases from human activity.

Global Warming and Climatic Change

This is strong evidence now that most of the observed warming over the last 50 years is caused by human activities. Climate models predict that the global temperature will rise by about 6°C by the year 2100. The major impacts of global warming are as follows:

- Increasing ocean temperature and rising sea level
- Snow and Ice melting
- Altered rainfall patterns
- Extreme weather events
- More severe heat waves

Conclusion

Ecosystems will change-some species will move farther north or become more successful; others would not be able to move and could become extinct. Most of the world's endangered species (some 25 percent of mammals and 12 percent of birds) may become extinct over the next few decades as warmer conditions alter the forests, wetlands and rangelands they depend on and human development blocks them from migrating elsewhere. The oceans, which are source of great biodiversity, would also be affected. For example the coral reefs, which have limited tolerance for warm waters would be severely affected.

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CLIMATE CHANGE- IMPACT ON FISHING AND FISHERMEN'S LIVELIHOOD IN INDIA

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Introduction

Climate change affects oceans and marine life. Climate change is having a reflective impact on oceans and marine life. Its effects are changing the distribution of fish stocks and their food. Oceans play a major role in climate changes, captivating 93% of heat that accumulates in the Earth's atmosphere, and a sector of the carbon dioxide (CO_2) released from fossil fuels. The impacts of climate change on oceans include shifts in temperature, acidification, deoxygenating and changes in ocean currents.

India, a developing country is a "Peninsula" surrounded by the Indian Ocean and the Himalayas. The climate condition of Indian sub-continent is mostly determined by the monsoon because of the east and west sides of India are respectively covered by the seashore called Bay of Bengal and Arabian Sea. The geological location of the country has made the people very much depended on the environment and open to to natural disasters. When the climate change aggravate, those who are living in rural areas, get affected seriously. Rural livelihood of India is highly dependent on the natural resources which are dependent on the nature and climatic conditions.

India is essentially "a nation of villages" and nearly 70 per cent of total population of India living in villages. The Indian economy is built upon the village economical sectors. In this situation, climate change is a major challenge of village's livelihood activities in India and is viewed the causes for the many social problems particularly multi-dimensional poverty.

Fishery has been the oldest and most important livelihood option for the population of coastal India, since times immemorial. Besides the marine environment, it has significantly contributed to the livelihood security of the coastal population. The life of the coastal community centered on the coastal zone. Fishing is an important economical sector in the South Asian region along with agriculture practice. Both sectors are being mostly undergone into the susceptibility due to climate change. The consequences of climate change is directly or indirectly affecting people who are exclusively dependent on the livelihood occupation "fishing" is facing lot of multi-dimensional and socio-economic problems. It should be notable that fishing is one of the most vulnerable sectors to be affected by the impulsive climate change. Despite the technological advance in the 20th century, weather and climate are still key factors in determining fishing production in the most areas of South Asia. Changing patterns of warming, rain fall and wind are major variables to determine the productivity of fish and their relationship are not simply linear.

Fishing is a human activity and work as an interface between human society and sea. Climate change has a multi-dimensional effect on human activities. Of these, fishing is level to be the

most affected because the important determining variables, that temperature and wind are mainly climate related. When it suddenly undergoes into essential change, the yield of fish is also affected in this case. In this following, the impact of unpredictable climate change has emerged as an important phenomenon in the human livelihood development of fishermen.

Nature of Climate Change

India has been faced episode of tragedy experiences in relation with environmental disasters such as tsunami, cyclone and frequent changes of monsoon pattern which are the results of climate change. In particular, fishing communities of this region are being mostly affected by this disasters leads to profit lose, equipment damages as well as heavy impact on the day to day life of human beings. Climate change is defined a change in the statistical properties of the climate system in particular region when considered over long periods of time, regardless of cause. Beside according to the Intergovernmental Panel on Climate Change (IPCC), climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. The unpredictable climate change is further divided into two sub types by the village dwellers. One is „waves and winds on the sea" seems heavy. Second sub type of unpredictable climate change is „water currents". It may change suddenly and which impacts on fishing activities.

Consequences of Climate Changes on the Fishermen Livelihood

The earlier discussion on the unpredictable climate change has paved the way to analyze the major socio-economic problems faced by the fishermen due to the impact of unpredictable climate change. That is as follows:

- Occupational ambiguity
- Income inadequacy
- Equipments Damages and lost
- Psycho-social problems

Occupational Ambiguity

Fishing is looked upon by the anthropologists as a kind of hunting activity because the fishermen could not determined their harvesting and many fishermen believes that fishing is a fortune. In this regards, their occupation is also considered as an uncertainty. People who are engaging for fishing that is only meant "peasant fishermen" who involve fishing activity in whole year than other works. Hence, they could not properly engage in other works due to the unpredictable climate change. Ambiguity of fishing affects on the life of family dependents. Particularly those who are the day to day laborers' in fishing and who are going to work with other boat members easily trapped into multi-dimensional poverty. Because, their income depends of the catching fishing that is to say, first the total income is divided into two shares, one share would be to be paid for the net and boat that is for the owner, and second part of share is further divided to all members who engage in fishing

by this boat. The amount of sharing income depends on the how many laborers engaged in a particular boat. In this situation the fishermen labors could not manage their family during this off season even the government has given free ration rice. Some people try to change their work into non fishing behavior and some other people try to bring up their children through the college education for the purpose of ensuring their work condition.

Income Inadequacy

There is no notion of private property in the sea, even during the fishing season those who desire to engage in the fishing activities may involve. However the income pattern varies person to person based on their equipments, co-workers and when some fishermen may catch large number of fishes, others come back with empty packets. Because they could not deduction sudden change of water current due to the climate change and how much fishes can be catch on a day. So, fishermen could not predicate their income per day. Irregular income is one of the major impacts of climate change and it contributes to the multi-dimensional poverty of the village. That is to say, uncertainty of the income generates the functions of the vicious circle in the fishermen livelihood. For instances, seasonal unemployment created by the climate change leads to the income disorganization. It leads to poverty though for a short term. If this condition continues for long, the affected family is trapped by chronic poverty. It also reflects on the family particularly on children's education, health and hygiene, family psychology, and other family related problems.

Damaged and Lost the Equipments

Damages and loss of fishing equipments is a serious problem made by climate change. Even though, the government has provided a little support to eradicate their problem related to fishing activities after the tsunami, the village dwellers face many challenges regarding the unpredictable climate change in the whole year. The impact of the climate change makes such derogatory consequences on the fishermen livelihood and leads to multi-dimensional poverty.

Psycho-social Problems

The term psycho-social refers to the psychological and social factors that influence mental health. Social influences such as peer pressure, parental support, cultural and religious background, socioeconomic status, and interpersonal relationships all help to shape personality and influence psychological structure. Individuals with psychosocial disorders frequently have difficulty functioning in social situations and may have problems effectively communicating with others. In particular stress, depression, anxiety, unnecessary angry and tension are generally correlated with occupational uncertainty, income disorganization and losing their property. Thus, unpredictable climate change contributes to new psycho-social problems among the fishermen community. Especially the person who is affected by the impact of unpredictable climate change is marginalized and could not survive within the same society.

Conclusion

Impact of climate change on the human life has been continuing since the origin of the human beings in the world. However the dimension of the climate change on the human life varies from time to time. At present it is one of the most important challenges to global economic development as well as village dwellers livelihood development. During the last fifty years, many countries have felt its effects in all sectors. There are many reasons to estimate the effects if climate change on the village life forwarded by many researches. Hence, most of them brought out the impact of predictable climate change on the human life and its related problems for example soil, water, farming, and human health. This work explores the impact of unpredictable climate change in the livelihood developmental activities. Especially, it focuses artisanal fishing community.

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SOCIAL MEDIA AS AN EFFECTIVE COMMUNICATING TOOL FOR CLIMATE CHANGE

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Introduction

Climate change has been singled out as one of the most urgent global challenges (Hoornweg, 2011). The world today is estimated to be about 1°C warmer, on average, than it was in the 1950s, and the effects are being felt (Global Risks Report, 2016). Increasing temperature, irregularities in rain, flood, drought, decreasing underground water levels, shorter or longer range of seasons, changing precipitation patterns, reducing snow cover, changing soil moisture, melting sea ice and glaciers, rising sea-water level, earlier flowering and ripening of flowers and fruits, and migration of plants and animals towards the poles, are the visual signs of global warming (Bates *et al.*, 2008, Ulukan, 2009).

One of the best ways of making people aware of climate change issues is the advanced features of social networking and communication technologies (Hasan and Mokter, 2012). Mass media representational practices have broadly affected translations between science and policy and have shaped perceptions of various issues of environment, technology and risk (Weingart *et al.*, 2000). Zhao *et al*. (2011) found that attention to the science-based news has a positive effect on individual concern and knowledge about climate

change. Reynolds *et al*. (2010) show that in recent years, there has been a significant increase in information available to the public about the topic.

Causes of Climate Change

The causes of climate change can be divided into two categories - Natural and Man Made

Natural Causes

There are a number of natural factors responsible for climate change. Some of the important factors are continental drift, volcanoes, ocean currents and the earth's tilt.

1. Continental Drift

The continents we see today were formed when the landmass began gradually drifting apart, millions of years back. This drift changed the position of water bodies of the landmass and the flow of ocean currents and winds. These changes affect the climate. This drift of the continents continues even today.

2. Volcanoes

When a volcano erupts it throws out large volumes of sulphur dioxide (SO_2), water vapour, dust, and ash into the atmosphere. Although the volcanic activity may last only a few days, yet the large volumes of gases and ash can influence climatic patterns for years. The gases and dust particles partially block the incoming rays of the sun, leading to cooling.

3. The Earth's Tilt

The earth is tilted at an angle of 23.5° to the perpendicular plane of its orbital path. Changes in the tilt of the earth affect the severity of the seasons. More tilt means

warmer summers and colder winters; less tilt means cooler summers and milder winters.

4. Ocean currents

The oceans are a major component of the climate system. They cover about 71% of the Earth. The oceans absorb the sun's radiation about twice as much as the atmosphere.

Human Causes

Greenhouse Effect

The earth receives energy from the sun, which warms the earth's surface. As this energy passes through the atmosphere, a certain percentage (about 30) gets scattered. Some part of this energy is reflected back into the atmosphere from the land and ocean surface. Certain gases in the atmosphere form a sort of blanket around the earth and absorb some of this energy. These gases like carbon dioxide, methane, and nitrous oxide, along with water vapour, comprise less than one per cent of the atmosphere. They are called 'greenhouse gases'. Just as the glass of the greenhouse prevents the radiation of excess energy, this 'gas blanket' absorbs some of the energy emitted by the earth and maintains keeps temperature levels. Hence it is named 'greenhouse effect'.

The green house effect was first recognized by a French scientist, Jean-Baptiste Fourier. He pointed out the similarity in what happens in the atmosphere and in a greenhouse. The blanket of green house gases has been in place ever since the creation of the earth. However, as a result of increased human activities, more and more of these greenhouse gases are released into the atmosphere. This leads

to the blanket becoming thicker and upsets the 'natural greenhouse effect'.

Carbon dioxide is released when we burn such fuels as coal, oil, and natural gas. And, when we destroy forests, the carbon stored in the trees escapes as carbon dioxide into the atmosphere. Increasing agricultural activities, changes in land-use patterns, and other sources lead to rising levels of methane and nitrous oxide. Industrial processes also release artificial and new greenhouse gases like CFCs (chlorofluorocarbons), while automobile exhaust fumes lead to ozone generation. The resulting enhanced greenhouse effect is more commonly referred to as global warming or climate change.

Effects of Climate Change

Climate change destabilizes the Earth's temperature equilibrium and has far-reaching effects on human beings and the environment. During the course of global warming, the energy balance and thus the temperature of the earth change, due to the increased concentration of greenhouse gases, which has a significant impact on humans and the environment.

It is not scientifically possible to assign individual weather events to the current climate change, however, it can be statistically proven that global warming will increase the probability of extreme weather events.

The direct consequences of man-made climate change include:

- Rising maximum temperatures
- Rising minimum temperatures
- Rising sea levels
- Higher ocean temperatures
- An increase in heavy precipitation (heavy rain and hail)

- Shrinking glaciers
- Thawing permafrost

The indirect consequences of climate change, which directly affect us humans and our environment, include:

- An increase in hunger and water crises, especially in developing countries
- Health risks through rising air temperatures and heat waves
- Economic implications of dealing with secondary damage related to climate change
- Increasing spread of pests and pathogens
- Loss of biodiversity due to limited adaptability and adaptability speed of flora and fauna
- Ocean acidification due to increased HCO3 concentrations in the water as a consequence of increased CO_2 concentrations
- The need for adaptation in all areas (e.g. agriculture, forestry, energy, infrastructure, tourism, etc.)

As the global climate is a highly interconnected system that is influenced by many different factors, the consequences usually result in positive or negative feedback effects. This refers to developments that are self-enhancing due to the occurrence of certain conditions.

A common example is the ice-albedo feedback, which refers to the melting of the polar caps. According to this, extensive ice surfaces have a cooling effect on the global climate, as a high proportion of radiation is reflected. As a result of the global rise in the average temperature, however, these ice surfaces begin to melt, the ice surfaces shrink and the

amount of reflected radiation is reduced. At the same time, the area of land or ocean that has a significantly lower albedo will increase, reflecting less radiation and thus intensifying the actual cause of glacier melt.

Furthermore, scientists can calculate the so-called tipping points of individual subsystems of the global climate. The higher the global rise in temperature, the more the climate system is affected, so that at a certain point, despite significant efforts, a reversal in the process is no longer possible. Where exactly these tipping points can be found, however, is currently still unclear and can only be calculated with a great degree of uncertainty. Such tipping points are expected for the melting of the polar caps and for the stability of important ocean currents.

Climate Change and Social Media

Social media connect people all across the globe - via networks of interest - who share messages with each other, joint comment, discuss, rate and create unique social content. They facilitate large-scale conversation and distributed problem solving; creating waves and endless possibilities for collective social action. Social media networks allow sharing of information and news at an incredible speed. Social networking applications such as Facebook, twitter, MySpace, Wikis and Google Documents are emerging technologies that could be used to build many virtual societies.

Because of the severe effect of climate change it is the need of hour to study the reasons, causes and effects of climate change and it is very urgent to create awareness about causes and effects of climate change. In these days media has became the important part of life. However, we know that, mass media

is to inform and educate the people. Awareness is the key role to reduce the impacts of climate change. Media can play a vital role in creating awareness about climate change. Specifically, the communication of climate change from scientists and policy-makers to the public via the mass media has been a subject of major interest because of its implications for creating national variation in public understanding of a global environmental issue. Social Media knows the significance of covering environmental issues. Social media like Facebook, Twitter, MySpace, Wikis and Google Documents spread the news and information at the speed of light. These media share their information helps the people to know the all over the world climate and weather.

Conclusion

Social Media consist of several different types of communications media: Facebook, Twitter, MySpace, Google Documents and Internet-based Web sites. Specifically, the communication of climate change from scientists and policy-makers to the public via the social media has been a subject of major interest because of its implications for creating national variation in public understanding of a global environmental issue.

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CLIMATE CHANGE AND HEALTH IMPACTS

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Introduction

Climate is the creation of connections among the atmosphere, ocean, land surface and ice cover. Shifting global climate occurs because of external factors, such as changes in the balance at the outer edge of the Earth's atmosphere. Climatic factors vary naturally around the world without obvious notice, and at the same time comfortably maintaining the various natural and ecological systems. In the last 2-4 decades, however, this variation has gone beyond natural levels that climatologists are now in general agreement that the world has begun to experience the process of global "climate change.

It is generally accepted that global socioeconomic development and health interventions have improved the general standard of living in the recent times but the resulting deteriorating global environmental conditions or factors are now affecting human health. Major global environmental changes significantly affect health. It is a protective shield to life on earth, preventing much of the sun's ultraviolet (UV) radiation; especially UV radiation with shorter wavelength from reaching the Earth. As a result, any change in atmospheric concentration of ozone causes changes in the radioactive levels. Since the industrial revolution, human activities have increased the atmospheric concentration of

what is known today as greenhouse gases (GHGs). Greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) (WHO, 1996). The photochemical reactions of these greenhouse gases with ozone, "the green house effect", have led to serious human health problem. The effects of this depletion have attainment cause on man and life on Earth.

Impact of Climate Change

1. Climate change has been associated with shift in the composition and geographical distribution of many ecosystems and individual species respond to changed climatic conditions.

2. Climate change will lead to an intensification of the global hydrological cycle and may affect regional water resources.

3. Climate change and the resulting sea-level rise can have a number of negative effects on energy, industry and transportation infrastructure, human settlements and tourism.

The health impact of ozone depletion and climate change cannot be separated because the effects are very likely to be synergistic. Broadly speaking, the various potential health effects of global climate change upon human health can be divided into direct and indirect effects. In healthy individuals, an efficient regulatory heat system enables the body to cope effectively with thermal stress.

Potential Health Impacts of Climate Change

Change in world climate would influence the functioning of many ecosystems and their member species and there would be impacts on human health. Milder winters would decrease the seasonal winter time peak in deaths that occurs in temperate countries, while in currently hot regions a further increase in temperatures might reduce the possibility of disease transmitting mosquito populations. Most of the health impacts of climate change would be adverse. Climatic changes over recent decades have affected some health outcomes. The first detectable changes in human health may well be alterations in the geographic range and seasonality of certain infectious diseases, including vector borne infections such as malaria and dengue fever, and food borne infections (e.g.Salmonellosis) which knock the highest point in the warmer months. Warmer average temperatures combined with increased climatic changeability would alter the pattern of exposure to thermal extremes and resultant health impacts, in both summer and winter. The public health consequences of the disturbance of natural and managed food producing ecosystems, rising sea-levels and population displacement for reasons of physical hazard, land loss, economic disruption and civil conflict.

Today, the world population is encountering unfamiliar human induced changes in the lower and middle atmospheres and world-wide depletion of various other natural systems. The early recognition that such changes would affect economic activities, infrastructure and managed ecosystems, there is now recognition that global climate change poses risks to human health.

Changes in the Environment or Health

It is possible to measure changes in a defined health impact and to attribute this trend to changes in a directly-acting risk factor. However, the monitoring of the impacts of climate change on health is more complex. There are three main issues: (i) Climate always fluctuating naturally and many indices of health show seasonal and inter annual fluctuation confirms that these diseases have a seasonal or climatic dependence. An excess of heat related deaths in a particularly hot summer, or even a progression of hot summers, indicates the potential for climate change to increase mortality, but it does not prove that mortality has increased as a result of climate change. (ii) Attribution of an observed change in population health to an associated change in climate is not straightforward. The influence of concurrent changes in other environmental, social or behavioural factors must be first allowed for. (iii) Effect modification over time, as the climate changes, other changes may also occur that alter the population's vulnerability to meteorological control.

Main Health Risk Associated with Climate Change

- Higher temperatures enhance production of various secondary air pollutants. Consequently, there is increase in the regularity of allergic and cardio-respiratory disorders and deaths caused by these air pollutants.
- Increased production of aeroallergens (spores, pollens), thus make worse asthma and other allergic diseases (Bunyavanich et al; 2003).
- Mental health consequences of social, economic and demographic dislocations resulting from environmental deterioration such as flooding, rising sea levels, shortage of water, forest fire leading to population mobility and settlement.
- Emotional stresses and mental health problems inresponses also constitute health problem to affected communities (Horton and McMichael, 2008).
- Mortality (especially cardiopulmonary) increases with cold and warm temperatures.
- Older age group and people with underlying organic diseases are particularly vulnerable.
- Mortality increases sharply during heat wave Vector borne diseases.
- Climate conditions (particularly temperature) necessary for some vectors to thrive and for the microorganisms to multiply within the vectors are relatively well known Water/food-borne diseases.
- Survival of disease organisms (and insects which may spread them) is related to temperature.

- Water-borne diseases most likely to occur in communities with poor water supply and sanitation.
- Climate condition affects water availability.
- Contamination of portable water, particularly following extreme rainfall; seepage of contaminants from illegal dumping of solid waste and other waste into underground aquifers Food production.
- Temperature, precipitation, solar radiation and carbon dioxide are important for crop production.
- The potential indirect effect of increased UV-B level reaching the Earth lead to impairment of photosynthesis on land (food crops) and in the sea (phytoplankton), reducing the world's food production.
- Crop failure may lead to malnutrition.
- Undernourishment may increase susceptibility to infectious diseases.
- Skin cancer is related to UV exposure (both melanoma skin cancer and non-melanoma skin cancer), people with lightly pigmented skin being most susceptible.
- UV radiation damages the eye, more particularly the lens. Different types of cataracts will react differently to changes to UV radiation.
- UV suppresses immune system in animal models, and may adversely affect various infections.

Protecting Health from Climate Change Scientists agree that more severe weather patterns are on the horizon. A range of forecasts expect increased drought and flooding. Rising sea levels and tropical cyclones threaten small island States. Nothing can stop

the march of climate change, but there is still time to temper its effects (Horton and McMichael, 2008).

Conclusion

The major global environmental changes significantly affecting health include climate change and ozone depletion. Climate change is already a threat to community well being. It is not only an economic issue it is a threat to our support systems. In the coming decades, doctors who are interested in the long term health of their patients and communities will have a central role in the mitigation of climate change and in preparing for and managing its adverse health impacts.Human environment is changing is alarming and the impact of climate change on human health is getting troublesome. All tiers of government, health professionals and other stakeholders should be able to tie with the socioeconomic development of our generation and the global ecosystems.

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CLIMATE CHANGE PRESERVATION: AN ESSENTIAL FOR EXISTENCE!

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Introduction

"The Earth Does not Belongs to Us
We Belong to Earth"- Marlee Matlin

The rapid growth of human population united with ways to attain high standards of living through technological development has resulted in an extensive contamination of the environment at the global level. Most of the materials used by humans are supplied by the nature and therefore, we should always be loyal and thankful to Mother Nature. The government has enacted several laws and implemented various policies and amendments to preserve the nature. The real development of any nation is progressing without causing any damage to the environment. Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time. Human activities that cause climate change are: Burning of fuel by humans and coal which release too much greenhouse gasses into the atmosphere like carbon dioxide that traps the heat in the atmosphere that, leads to a faster climate change. Humans and Industries are causing deforestation by cutting a huge amount of trees each year from 3.5 to 7 billion trees and export timber to other countries for the sake of money. It is the responsibility of each one of us to

contribute to our environment. Let's join hands towards a greener and more sustainable future.

Climate Change

Climate change refers to the change in the environmental conditions of the mother earth. This happens due to many internal and external factors. The climatic change has become a global concern over the last few decades. Besides, these climatic changes affect life on the globe in various ways. These climatic changes are having various impacts on the ecosystem and ecology. Due to these changes, a number of species of plants and animals have gone extinct. The climate started changing a long time ago due to the actions of humans but we came to know about it in the last century. During the last century, we started noticing the climatic change and its effect on human life. We started to conduct various researches on climate change and came to know that the earth temperature is rising due to a phenomenon called the greenhouse effect. The warming up of earth surface causes many drastic effects like ozone layer depletion; affect our agriculture, water supply, transportation, and several other problems.

Effects of Climatic Change

Climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones. Changes in rainfall pattern are likely to lead to rigorous water shortages and/or flooding. Melting of glaciers can cause flooding and soil erosion. Rising temperatures will cause shifts in crop growing seasons which affects food

security and changes in the distribution of disease vectors to people at risk by causing diseases such as malaria and dengue fever. Temperature increase will severely increase rates of extinction for many habitats and species. These climatic changes have a negative impact on the global environment. The ocean level is rising, glaciers are melting, CO_2 in the air is increasing, forest and wildlife are declining, and water life is also getting worried due to climatic changes. Apart from that, it is calculated that if this change keeps on going then many species of plants and animals will get extinct. And there will be a great threat to the environment.

Rising fossil fuel burning and land use changes have emitted, and are continuing to emit, increase quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO_2), methane (CH_4) and nitrogen dioxide (N_2O), and a rise in these gases has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, heat that would normally be radiated back into space. This heat enhancement has led to the greenhouse effect, which has resulted in climate change. The main characteristics of climate change are increase in average global temperature (global warming); changes in cloud cover and precipitation particularly over land; melting of ice caps and glaciers and reduced snow cover; and increase in ocean temperatures and ocean acidity – due to seawater absorbing heat and carbon dioxide from the atmosphere. Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is predictable to rise another 1 to 8 feet by 2100.

This is the result of added water from melting land ice and the expansion of seawater as it warms.

Developing countries are the most vulnerable to climate change impacts because they have fewer resources to adapt: socially, technologically and financially. Climate change is predictable to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Millennium Development Goals by 2015 (UN 2007).Air pollution and climate change are interrelated. Many air pollutants contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere, with some pollutants warming and others cooling the Earth.

Sustainable Development Planning and Practices

Climate change has the potential to undermine sustainable development, increase poverty and delay or prevent the understanding of the Millennium Development Goals. An effective way to address the impacts of climate change is by integrating adaptation measures into sustainable development strategies so as to minimize the pressure on natural resources, improve environmental risk management, and increase the social well-being of the poor. Climate change can influence humans directly, through impacts on health and the risk of extreme events on lives, livelihoods and human settlements, and indirectly, through impacts on food security and the feasibility of natural resource-based economic activity.

Humans Play a Huge Role in Climate Change

Human activities are the leading cause of climate change in the global level. Humans using fossil fuels is one of the major causes of climate change, fossil fuel combustion releases harmful chemicals into the atmosphere, negatively affecting it, leading to problems in the atmosphere such as, the hole in the ozone layer (created by CFCs). Pollution is also a huge factor of climate change, air pollutants affect the amount of sunlight coming into the atmosphere, some pollutants warm the Earth, while others cool it down, the most common pollutants are methane, black carbon, ground-level ozone, and sulfate aerosols. Deforestation is another huge leading cause to climate change by reversing the effects of carbon sequestration and releasing greenhouse gases into the atmosphere, deforestation is also responsible for about 18% of all global greenhouse gas emissions from human activities, even more than from transportation. Building houses and other structures affects the environment because it produces a ton of waste and harmful chemicals, which pollutes the land and air. The transportation needed to move supplies and the waste from the construction sites also has a very negative impact on the environment.

Controlling Measures of Climate Change

There are solutions to this problem, as long as we actually use and perform them. We can conserve gas and reduce its emission into the air by avoiding vehicles to travel nearby places. We could also use electric cars, instead of using vehicles that emit gas and other chemicals into the air. Afforestation can help because they take in the carbon dioxide,

removing it from the air and replacing it with oxygen, which is healthy for mankind and the Earth. We should plant as many or more trees than we are cutting down, because we're cutting down a ton of trees without replacing them and we need trees, which are the prime need for life and the air on Earth, without trees we wouldn't have oxygen and our atmosphere wouldn't seem as it is today. We can consume more locally grown food that will reduce gas emissions from transporting food to us from out of town. Avoiding air conditioning in places of moderate temperature can also help, and in hot places it can be enhanced to two degrees in summer that can make a pretty big difference. Saving electricity by turning off all lights, computers, TVs and other electrical devices when they are not in use can also help. Also, if we use less hot water by reducing the temperature on the hot water tank, using low flow shower heads, washing clothes with cold water, and using the energy saving mode on dishwashers can also be very helpful. We could also reduce, reuse, recycle model. There is some technological advancement that could help to overcome climate change in the Arctic regions. One that could really help is building giant walls around glaciers that can prevent warm ocean water from eroding the glaciers' edges, by doing this, we can block the flow of warm water, protecting the glacier from warm water and reducing the melting rate significantly. Another technological advancement that could greatly help is creating cooling tunnels in the ice by drilling holes in glaciers, creating tunnels in the bedrock and pouring cold brine into them, which would freeze some of the water under the glacier,

and slow the moving ice and give the glacier more time to solidify once the brine starts flowing through the glaciers.

Implementing new and improved navigation and communications satellites could contribute to preserve the environment because the current ones are inaccurate and unreliable at higher heights. Everyone can educate others and raise awareness about this problem to the industrialists, donating time and money, posting about it on social media, putting it in the news, writing news articles or blogs about it, and using and attending different programs and training courses relating to it. It is possible to solve this issue, by working together and perform different actions as individuals and society to stop this drastic challenge of climate change.

Conclusion

We need to take part and try to stop global warming and other effects on climate change. If the earth's temperatures continue to rise in the days to come, living things on earth would become extinct due to the high temperatures. If humans contribute to control global warming, this world would be cooler and the high temperatures that we currently face would decrease. If everybody takes a united stand and try to end most of the climate changes that are occurring, this world would be a safer place to live on. We can say that it is the responsibility of every humans to protect our environment and to save our mother earth from being deteriorated.

If we do not do anything and things continue to go on like that happens today then a day in future will come when humans will become extinct from the surface of the earth. But instead of neglecting these problems everyone should start acting

on this serious issue and then we can save the earth and our future. Although human mistakes have caused a great damage to the climate and ecosystem, it is not too late to start again and try to undo what we have done till today to damage the environment. And if every human start contributing to the environment then it is possible to have our existence in the future.

It is Our Collective and Individual Responsibility…
To Preserve and Tend to the World in which We All Live.

- ***Dalai Lama***

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PLANTS AND CLIMATE CHANGE – A PARADIGM SHIFT

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Introduction

In the hustle of the ever pacing world, man is caught between compulsions of a stressful life pattern. 'To walk through the forest and see sunlight shinning through the trees is like a cool, refreshing breeze to the spirit sweltering beneath the heat of worldly troubles' says Justin Farley in his poem on nature. Nature is nurtured by lush vegetations. The green carpet of vegetation that is strewn over the earth's crust is a god's given gift to the living world. Global vegetation is categorized into five major types, based on the type of soil, weather pattern and the distinguishing plants present in the particular area.

The earth's climatic conditions have been changing from time unknown. There has been drastic changes in the earth's temperature, moisture content and carbon dioxide concentration. These changes have had a direct effect on the diversity and distribution of plant species. The climatic changes also affect the plant physiology, phenology, productivity, health status etc. The magnitude of these impacts

would vary depending on the species involved and their growth patterns (e.g. annuals vs perennials; agricultural crops vs natural vegetation). Plants are found all over the earth and they have adapted to the varied climatic conditions. Plants have evolved strategies to adapt and survive the climatic changes and they are coevolving with the ever-changing climate.

Effect of Carbon dioxide

The gradual increase in earth's temperature had resulted in the doubling of carbon dioxide concentration. There has been an increase of carbon dioxide from 270 ppm in 1700 to 355 ppm in the 21st century. A report by NASA in 2016 says that increased carbon dioxide levels help and hurt plants. It helps the plant yield by improving the rate of photosynthesis and decreases transpiration, thence an improved water use efficiency. But on the other hand the elevated levels of carbon dioxide affects the climatic conditions and results in severe water scarcity. The effect of carbon dioxide can be direct or indirect. The direct effect includes the enhanced photosynthetic activity in the plant resulting in thickening of the vegetation (Gifford and Howden, 2001), which indirectly affects the structure of the plant community by competition for survival. The enriched carbon-dioxide environment increases the water use efficiency of plants, increased photosynthetic rate, growth, and yield and decreases the stomatal conductance by 40% of C3 plants. But the enhanced levels of carbon dioxide and lowered rainfall seriously affects the rain-fed agriculture. Enhanced levels of carbon dioxide indirectly

affects the herbivores as it increases the carbon nitrogen ratio in the leaves.

Effect of Temperature

Temperature is a major factor that affects the growth and productivity of plants. The Inter-governmental Panel on Climate Change (IPCC) 2007 has been predicted that there will be a $2\text{-}3^0$ C change in the temperature in next 30-50 years. Heat waves or extreme temperature changes are expected to become more intense in the forthcoming years (Meehl et al., 2007). Each plant has a specific minimum, maximum and optimal temperature range. Extreme climatic changes have shown a drastic effect on the plant productivity. It has been shown that exposure of wheat (*Triticumaestivum*) to extreme heat and frost affected its productivity. Extreme heat reduced the number of grains and extreme frost caused total sterility in the plant (Barlow et al., 2015). The major effect of temperature is on the pollination stage of the plants. High temperature had shown to decrease the viability of pollen grains in plants (Dupuis and Dumas, 1990). The continuously increasing temperature will affect annual crops, most of which are agroenomically important species. An 2.5%-10% decline in the crop yield is expected during the 21^{st} century (Hatfield et al., 2011).

Climatic changes also affect the perennial cops which have a more complex relationship with the temperature. Most of the perennial crops that include fruit and nut tress which need a chilling requirement for flowering are badly affected. Increasing winter temperatures prevent chilling hours which drastically affect the fruit production in the tree species

(Luedeling et al., 2009). Increasing temperatures also affect the quality of fruits. An increased temperature although improves the fruit size in apples it reduces its firmness, decreasing its quality (Warrington et al., 1999). Extreme temperatures also affect the fruit yield by affecting pollination. The increasing global temperature also indirectly affect the water table which in turn affects the plants.

Effect of Rainfall Patterns

Water is indispensible for plant growth. Climatic changes resulting in changing rainfall pattern affects the plant growth and productivity. The changes in the rainfall pattern although is not as drastic as temperature, it also shows an impact on the plants. Higher or lower rainfall in a particular season may cause significant problems to plants from drowning to drought. Rainfall not only affects the crop yields, it is a major factor that governs plant health. Rainfall has a direct effect on the agricultural cropping pattern globally. The changing patterns of rainfall may strengthen the current scenario, that is making the wet regions wetter or the dry regions drier. Or it may drastically affect the agricultural patterns by the way of cyclones and storm. While reduced rainfall leads to drought and decreased productivity, increased rainfall poses a number of problems. The coastal flooding may lead to reduction in the available agricultural land

Effects of Climate Change on Plants

Agriculture

There is a direct impact of global warming on food productivity across the globe. The increase in the average seasonal temperature tends to reduce crop yield in the next few

years. The continuously increasing temperature is predicted to result in a 3%-16% decline in agriculture by 2080. In developing countries like India where the temperature had already reached the maximum tolerance levels, the productivity is envisaged to decline up to 25% by 2080 (Mahato, 2014). In countries like India where 60% of the agriculture is rain fed, the unpredicted patterns of rainfall has drastic impact on the agricultural productivity. The delay in seasonal rain have altered the cropping pattern of many crops. A 0.5^0C raise in winter temperature is predicted to reduce the rain fed wheat yield by 0.4 ton per hectare in India (Mahato, 2014). A recent study by The India Agricultural Research Institute documents that there will be a 4-5 million tons yield loss of wheat for every 1°C raise in the temperature and rice production is estimated to decrease by 1 ton/hectare if the temperature goes up by 2°C. Not only the temperature but other climatic factors like raise in the sea level, raise in the carbon dioxide level, precipitation, storminess and climatic variability are also predicted to influence the agriculture and food productivity.

Forest

The forests ecosystem is a gift of nature. The forests are carbon dioxide sinks that sequester the CO_2 and releases oxygen and cleans the environment. By absorbing the CO_2 they reduce the green house effect, thereby reducing the temperature of the earth. They influence the weather patterns and cause rain. They prevent erosion and block heavy winds. They are great resources of medicinal plants. Forests cover 30% of total earth's surface area. About 4 billion Cubic meter

of wood has been removed from these forests in 2005 for industrial and fuel requirements (KirilenkoandSedjo, 2007). Apart from the human activities the changing climatic factors like increased CO_2 concentrations, fluctuating temperature and precipitation levels have a great impact on the natural as well as modified forests. It has been reported that these changing environmental conditions have had a positive rather than a negative impact on the climatic conditions.

Albeit the ambiguous effects of the undulating conditions of CO2 concentration, nutrients availability, temperature, and precipitation, the rate of growth of forest have shown a steady increase since the 20th century (Boisvenueand Running, 2006). This increase in the forest growth rate is because of changing the trend in land-use, warmer climate, extended growing seasons and carbon fertilization effect (Caspersen, 2006).

Indirect effects of climate change on forest are the forest fires, outbreaks of insects and pathogens and heavy winds. Although these are not considered major factors they severely limit the forest growth rate and productivity. Frequency of wild forest fire outbreaks have been increasing recently due to continuous dry spells of the forest. In 2003 a forest fire had resulted in a loss of $337 million worth wood (Kirilenko and Sedjo, 2007). The wild fire in California in 2020 burning 100 million acres of forest, the wild forest fires in Australia and Amazon are few other examples of recent episodes of forest fire outbreaks. These forest fires not only affect the forest productivity, they also kill a number of

endangered and critically endangered plant and animal species, affecting their biodiversity very badly.

Plant Health

The changes in the climatic conditions affect the pattern of plant pathogen interactions. The long term impact of the climate can make a plant to become pathogen susceptible from pathogen resistant variety and vice versa. A change in plant disease pattern have been long considered as markers of climatic changes (Garret et al. 2009). A change from the normal climatic conditions of a region affects the host pathogen interaction drastically. For instance dry weather increases the frequency of pathogens of tree species. It also increases the probability of invasion of exotic species of insect. The invasive attack of *Heterobasidionirregulare* in Central Italy is a good example (Garbelotto et al., 2010). A mild increase in the average temperature which resulted in the reduction of frost, consequently increased the invasion of pathogens like *Fusariumcicinatum*, for which frost is the limiting factor, putting a large area of plantation of pine at risk in Europe (Watt et al. 2011). Vector borne disease incidences are also at raise due to the increasing environmental temperature. Warmer temperatures induce the insect breeding and hence enhance their capacity of disease transmission (Robinet et al., 2011).

Plant Biodiversity

One of the adverse effects of climate change is its impact on the biodiversity. It affects biodiversity from organismal level to biome level. This affects the individual, population, species, ecological network and ecosystem. Loss

of biodiversity adversely affects the food chain. Climatic changes decreases genetic diversity of populations due to directional selection and rapid migration, which could in turn affect ecosystem functioning and resilience. Climate change has directly affected the forest biodiversity. The direct effect of biodiversity is due to the changes in temperature, CO_2 concentration, rainfall, precipitation, disease outbreaks etc. The indirect effect dwells on the changing trends of forest management policies. Changing climates not only tend to abolish plant diversity, it also causes extinction of endangered species of plants (Thomas et al. 2004). Tree species are likely affected by the climatic changes which in turn disrupt their abundance and phenology.

Approaches to Mitigate the Effects of Climate Change on Crop Plants (Raza et al., 2019)

1. Adoption of conventional cultural practices like selection of plant varieties with short life cycle, selection of drought resistant and salinity resistant cultivars, crop rotation, altering plant density, changing the pattern of sowing and harvesting time, modern irrigation techniques and variation in cropping schemes.
2. Genomic approaches have to be carried out to identify genetic markers for stress tolerance and develop molecular breeding strategies coupled with genomic approaches to improve plant adaptability and productivity.
3. Genome wide association studies can be taken up to completely understand the genetic variation among the cultivars and to exploit it for breeding strategies (Manolio, 2010)

4. Genomic selection (GS) by high-throughput phenotyping and marker densities can be deployed to screen the elite germplasm, improve the polygenic traits and economical breeding line development (Kumar et al., 2018).
5. Genetic engineering of drought, salinity stress, heat and cold tolerance by inter-kingdom and intra-kingdom gene transfer and develop transgenics with better agronomic traits (Shah et al., 2016).
6. Genome editing strategies by altering genes in their endogenous positions in the gnome is the most potent strategy to manipulate plant genome. This can be used very efficiently exploited to develop a climate - smart agriculture system globally (Liu et al., 2013)

Conclusion

The current trend of climatic change is alarming and indicates that in a few decades it is going to drastically affect the plants, food security and in turn the human population. Industrialization and poisonous gases cause global warming, which ultimately disturbs the world's environment. Climate change has devastating effects on plant growth and yield. Abiotic stresses are the major type of stresses that plants suffer. Although there are a few examples of a positive impact of the climate change in plants, a steep decline in the plant productivity and distribution is clearly stated by the ecologists. This is a matter of concern that every individual should be aware of. The ecological foot prints we leave have a great impact on the climate and the plants. Plants are the primary producers of the ecosystem and an impact on the primary producer, in the long run will severely affect the food chain.

The climatic changes not only affect the food productivity, it also affects the forest eco system and the biodiversity of plants. Let usjoin hands to keep the environment clean, reduce pollution, control drastic climate change and protect plants.

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POTENTIAL MITIGATION STRATEGIES OF CLIMATE CHANGE

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Introduction

Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Without drastic action today, adapting to these impacts in the future will be more difficult and costly. Human activity has caused climate change is not disputed by any scientific body of national or international standing. he largest driver has been the emission of greenhouse gases, of which more than 90% are carbon dioxide (CO_2) and methane. Temperature rise is accelerated or tempered by climate feedbacks, such as loss of sunlight-reflecting snow and ice cover, increased water vapour (a greenhouse gas itself), and changes to land and ocean carbon

sinks. In this way, humanity is "committed" to some level of climate change.

Climate Change Mitigation

Climate change mitigation consists of actions to limit the magnitude or rate of global warming and its related effects.This generally involves reductions in human emissions of greenhouse gases Individuals. Municipalities, businesses and nations have started to adapt to the ongoing and expected state of climate change. Climate change adaptation and climate change mitigation face similar barriers. To best deal with the situation, there needs to be a balanced approach between climate change mitigation and climate change adaptation. Because of inertia with both the climate and socio-economic systems upon which greenhouse gas emissions depend, we are bound to face a degree of climate change and its related negative impacts, regardless of the mitigation strategy chosen. However, the sooner the mitigation activities begin, the lower the likely impacts. Nonetheless, adaptation will be needed to protect livelihoods and food security in many developing countries that are expected to be the most vulnerable, even under moderate climate change.

Potential Mitigation ways of Climate Change

- ***Pricing System of Carbon***

Carbon pricing systems such as emissions trading systems that cap emissions or carbon taxes that charge per ton send a long-term signal to companies by creating an incentive to reduce polluting behaviours and to invest in cleaner energy choices and low-carbon innovation. A price on carbon is the

single most important thing we have to get out of a Paris agreement. It will unleash market forces," President Kim said when asked about expectations for the international climate agreement expected in December 2015 in Paris.

- ***Low-Carbon Infrastructures Cities***

There will be more infrastructure built in the next 20 years than in the past 6,000, the president told the audience. Cities are growing fast, particularly in the developing world. Just over half the global population is urban today; by 2050, cities are expected to hold two-thirds of the world population. With careful planning of transportation and land use, and the establishment of energy efficiency standards, cities can build in ways that avoid locking in unsustainable patterns. They can open up access to jobs and opportunity for the poor and reduce damaging air pollution. Investing in new infrastructure, or radically upgrading existing highways and transmission lines, would help cut greenhouse gas emissions and drive economic growth in developing countries.

- ***Use of Renewable Energy***

Worldwide, about 1.2 billion people lack access to electricity and 2.8 billion rely on solid fuels for cooking, such as wood, charcoal, and coal, which cause harmful indoor air pollution. Through the Sustainable Energy for All initiative, the World Bank Group supports three goals for 2030: to achieve universal access to modern energy, double the rate of improvement in energy efficiency, and double the share of renewable energy in the global energy mix.

Energy efficiency improvements are crucial. Every gigawatt saved is a gigawatt that didn't have to be produced. Globally,

energy use is about one-third lower today than it would have been without the past 20 years of energy efficiency improvements. Renewable energy, meanwhile, is becoming increasingly affordable as prices fall. In many countries, developing utility-scale renewable energy is now cheaper than or on par with fossil fuel plants.

- ***Climate-smart Agriculture and Nurture Forest Landscapes***

The fifth area for action takes in both mitigation and adaptation. Climate-smart agriculture techniques help farmers increase their farms' productivity and resilience to the impacts of climate change, such as droughts, while also creating carbon sinks that help reduce net emissions. Forests, too, are valuable carbon sinks that absorb carbon and store it in soils, trees, and foliage.

- ***Go Vegetarian***

Corn grown in the U.S. requires barrels of oil for the fertilizer to grow it and the diesel fuel to harvest and transport it. Some grocery stores stock organic produce that do not require such fertilizers, but it is often shipped from halfway across the globe. And meat, whether beef, chicken or pork, requires pounds of feed to produce a pound of protein. Choosing food items that balance nutrition, taste and ecological impact is no easy task. Foodstuffs often bear some nutritional information, but there is little to reveal how far a head of lettuce, for example, has travelled

- ***Stop Cutting Down Trees***

Every year, 33 million acres of forests are cut down. Timber harvesting in the tropics alone contributes 1.5 billion

metric tons of carbon to the atmosphere. That represents 20 percent of human-made greenhouse gas emissions and a source that could be avoided relatively easily. Improved agricultural practices along with paper recycling and forest management—balancing the amount of wood taken out with the amount of new trees growing—could quickly eliminate this significant chunk of emissions. When purchasing wood products, such as furniture or flooring, buy used goods or, failing that, wood certified to have been sustainably harvested. The Amazon and other forests are not just the lungs of the earth; they may also be humanity's best short-term hope for limiting climate change.

- ***Replacing Fossil Fuels***

Replacing fossil fuels may prove the great challenge of the 21st century. Many contenders exist, ranging from ethanol derived from crops to hydrogen electrolyzed out of water, but all of them have some drawbacks, too, and none are immediately available at the scale needed. Bio-fuels can have a host of negative impacts, from driving up food prices to sucking up more energy than they produce. Hydrogen must be created, requiring either reforming natural gas or electricity to crack water molecules. Biodiesel hybrid electric vehicles (that can plug into the grid overnight) may offer the best transportation solution in the short term, given the energy density of diesel and the carbon neutral ramifications of fuel from plants as well as the emissions of electric engines. A recent study found that the present amount of electricity generation in the U.S. could provide enough energy for the

country's entire fleet of automobiles to switch to plug-in hybrids, reducing greenhouse gas emissions in the process.

- ***Geo Engineering***

Climate change represents humanity's first planet wide experiment. But, if all else fails, it may not be the last. So-called geo engineering, radical interventions to either block sunlight or reduce greenhouse gases, is a potential last resort for addressing the challenge of climate change. Among the ideas: releasing sulphate particles in the air to mimic the cooling effects of a massive volcanic eruption; placing millions of small mirrors or lenses in space to deflect sunlight; covering portions of the planet with reflective films to bounce sunlight back into space; fertilizing the oceans with iron or other nutrients to enable plankton to absorb more carbon; and increasing cloud cover or the reflectivity of clouds that already form. All may have unintended consequences, making the solution worse than the original problem. But it is clear that at least some form of geo-engineering will likely be required: capturing carbon dioxide before it is released and storing it in some fashion, either deep beneath the earth, at the bottom of the ocean or in carbonate minerals. Such carbon capture and storage is critical to any serious effort to combat climate change.

Conclusion

Human-induced climate change has contributed to changing patterns of extreme weather across the globe, from longer and hotter heat waves to heavier rains. From a broad perspective, all weather events are now connected to climate change. While natural variability continues to play a key role

in extreme weather, climate change has shifted the odds and changed the natural limits, making certain types of extreme weather more frequent and more intense. While our understanding of how climate change affects extreme weather is still developing, evidence suggests that extreme weather may be affected even more than anticipated. Extreme weather is on the rise, and the indications are that it will continue to increase, in both predictable and unpredictable ways.

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INFLUENCE OF CLIMATIC CHANGES ON THE GROWTH OF NEMATODES

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Introduction

Everywhere on earth, climate is changing. A change in the pattern of weather, in oceans, land surfaces and ice sheets, occurring over time scales of decades or longer is known as Climate change, a prime factor in global warming which arises due to the combined effect of air and sea surface temperatures over the world (Kelly, 2013).Changes in natural ecosystems threaten biodiversity worldwide and have implications for global food production. It was driven by human emissions of greenhouse gases, resulting large-scale shifts in weather patterns. There are many "natural" and "anthropogenic" (human-induced) factors that contribute to climate change, it is the rapid rate and the magnitude of climate change occurring now that is of great concern worldwide. Human activity has increased greenhouse gases(carbon dioxide, nitrous oxide, methane, ozone, and water vapor) in the atmosphere mainly due to the burning of fossil fuels since the Industrial Revolution, leading to more heat retention and an increase in surface temperatures. Natural processes can also contribute to

climate change, including internal variability (e.g., cyclical ocean patterns) and external forcing (e.g., volcanic activity, changes in the Sun's energy output and variations in Earth's orbit).

The nematodes or roundworms are soil enduring, poikilothermic, all-pervading and most bountiful organisms from the phylum Nematoda of kingdom Animalia (Hoogen, *et al*. 2019), a diverse animal phylum inhabiting a broad range of environments. They are the marvel of evolution on the Earth, possess incredible ability to survive extreme weather events and hostile environments with its simple body organization. Nematodes have successfully adapted to nearly every ecosystem: from marine (salt) to fresh water, soils, from the polar regions to the tropics, as well as the highest to the lowest of elevations (including mountains). They are most abundant in freshwater, marine, and terrestrial environments, where they often outnumber other animals in both individual and species counts.

Nematodes are primary producers and play an important role in the breakdown of organic matter in their ecosystem and are free-living consumers. Some nematodes act as decomposers, responsible for recycling decaying, rotting, organic matter, which is present in almost all ecosystems. Most nematodes are harmless, but a handful of troublesome species attack the outside surfaces of plants, burrowing into the plant tissue and causing root, stem and even flower damage. Others live inside the plants for part of their lives, causing damage from the inside out.

Impacts of Climatic Change on Nematodes

Climate change due to the elevated level of $CO_2$and temperature, influence the biology of nematodes parenthetically. Climate changes may influence the frequency, intensity and geographical distribution of parasites. An increased level of carbon dioxide (CO_2) and temperature in the atmosphere leads to global warming may influence plant pathogenic nematodes directly by interfering with their developmental rate and survival strategies and indirectly by altering host plant physiology. Nematode development rate is directly propelled by temperature gradient with slower development at cooler and a faster rate at warmer soil temperatures (Tyler, 1933).

Plant pathogenic nematodes are one of the important biotic constraints in crop production. Increased emission of green house gases pose a serious challenge to sustainability of crop production by interfering with biotic and abiotic components and their interactions with each other. The geographical distribution range of plant pathogenic nematodes may expand with global warming spreading nematode problems to newer areas.

Climate change may influence the interactions between herbivorous nematodes and plants. They may also influence the plant nematode interactions by interfering with host defense mechanisms. An increased water stress due to climate change diminishes plant vigor and alters C:N ratios, lowering

plant resistance to nematodes. (Neilson and Boag,1996).Under CO_2 enriched situation, the plant accelerates its metabolic and physiological activities and encourages for plentiful and profuse root production. These roots are low in nitrogen content and soluble sugars. Nematodes consume more on these roots and incur maximum damage to crops under elevated CO_2 levels (Somasekhar and Prasad, 2010).

Apart from plant parasites, soil nematodes, a widespread and species- rich group belong to tropic groups such as microbial feeders, predators and insect parasites have influence on the plant productivity indirectly by regulating the processes such as decomposition, nutrient mineralization, biological pest suppression and energy transfer in food webs. They perform a significant functions in soil ecosystems, making them valuable biological indicators of soil quality and soil health (Bongers and Ferris,1999; Yeats, 2003).Climate change may influence free-living (microbial feeding) nematodes by changing the quality and availability of food under enriched CO_2 conditions. Annual rainfall and temperature play a crucial role in the development and maintenance of soil nematode diversity at a global scale(Chen *et al.*,2015; Nielsen *et al.*,2014; Song *et al.*,2017). In biologically diverse nematodes climate warming contributes to the increase in the range of distribution, colonization of new hosts and modification of their development cycles.

Increased temperature and precipitation due to climate changes will provide favorable living conditions to free-living

soil nematodes, resulting in a rapid growth in their development and reproduction rates. This will cause a positive effect on nutrient cycling rates and encourage plant growth. Plant feeding nematodes may have a beneficial role in nutrient recycling in the soil by excretion of ammonia and organic nitrogen by defecation (Verschoor 2002). Higher soil temperature may induce a greater reproduction rate and result in a higher population density. The metabolic rate, activity level and behavior of nematodes depend on the temperature and hence it is one of the most important factors in nematode biology (Dao, 1970).

Nematode life cycle may be accelerated due to climate change leading to increase in nematode population.Nematodes do not have a capacity for active dispersal to the long distances, but due to prolonged effect of climate change a change in the nematode population could be forecasted in geographical distribution (Wilschut *et al.* 2019). Nematodes being a vital part of the ecosystem, interacting with multiple other species throughout their life cycles and playing crucial roles in nutrient cycling and primary production, a change in their number may be expected to imbalance the rest of the ecosystem. This phylum with its remarkable biodiversity play varied roles within the global ecosystem as being composed of approximately 80,000 species.

The population density of the soil-dwelling root-feeders, especially members belonging to the *Longidoridae* family do not benefit much from the enhanced root biomass that occurs with enriched CO_2level. It would be due to the

activation of plant defense systems against the root-feeding nematodes or the least availability of soil nitrogen under enhanced CO_2conditions (Cesarz *et al.* 2015).

All organisms which nematodes feed on need water for respiration, metabolism and for reproduction. Water is the major important factor that determines the activity rate and food provisions and it influences nematodes as they are soft-bodied, water dwelling creatures which live in the soil water films in the spaces between soil particles, quickly entering a dormant state when soil water becomes scarce. Hence, they largely rely on plant-derived resources for its survival. Any consequent changes in its availability may directly impact soil nematode development and community composition (Yeates, 1999).

Research on impacts of climate change on soil nematodes has been limited, with most work concentrating on the effects of a single atmospheric constituent under controlled conditions. More long term studies in varied ecosystems under different cropping systems of particularly tropical regions are needed to critically assess the impact of climate change on soil nematodes. This knowledge is vital for developing appropriate mitigation and adaptation strategies to minimize the impact of climate change on agriculture. Recently, national (Network Project on Climate Change of the Indian Council of Agricultural Research to understand the variability among major soil borne pathogens) and international network are also actively anticipating and responding to biological complexity

in the effects of climate change on agriculture and crop diseases. (Karen *et al.,* 2009).

Influence of Climate Change in Controlling Nematodes

Climate change will cause alterations in the spatial and temporal distributions of nematodes and consequently, the control methods will have to be altered to suit these new situations. Assessment of the impacts of climate change on nematode infestations and in crops provide a basis for revising management practices to minimize crop losses as climatic conditions change (Ghini *et al.,* 2008). Nematicides are primarily used for the management of nematodes. Changes in temperature and precipitation can alter persistence and availability of chemical nematicides in soil which may influence their efficacy. Information on impact of climate change on the fate of nematicides in soil is almost negligible.

Recent observations suggest that nematode pressure on plants may increase with climate change. There may be a substantial rise in the use of nematicides in both temperature and tropical regions to control them. Organophosphorus and carbamates require moderate temperature (25-30°C) and moisture for the effective control of plant parasitic nematodes, but, higher temperature and moisture comparatively reduce the toxicity of the chemicals. Nonchemical nematode management methods, such as green manuring, crop rotation, mulching, application of organic manures, etc., have a great significance in the present scenario. One of the direct consequences of climate change for the nematode management is the host plant resistance to nematodes. Climate change mediated changes in physiology can alter the expression of resistance genes.

However, the most serious threat to genetic resistance to nematodes may be posed by the increased selection pressure resulting from acceleration of nematode developmental rate and increase in number of generations per season due to global warming.

Changes in temperature and precipitation can alter persistence and availability of chemical nematicides in soil which may influence their efficacy. Information on impact of climate change on fate of nematicides in soil is almost negligible.

Conclusion

Effect of global warming on plant pathogenic nematodes though limited, it reveals that nematodes show a neutral or positive response to CO_2enrichment effects, showing the potential to build up rapidly and interfere with plant's response to global warming. Nematodes are currently being extensively investigated in most researches, analyzing response of terrestrial ecosystems to climate change. They underline the importance of understanding the impact of climate change on soil nematodes and its implications to crop production and developing mitigation and adaptation strategies to address the impact of climate change on agriculture. In future, soil nematode communities serve as an excellent model system for studying impacts of climate change on the belowground productivity. The overall impact of climate change on agriculture is the reduced water availability, increased frequency of drought and flood conditions over a period, inequality of rainfall and imbalances in temperature

which in turn worsen the nematode problems in crop production.

Nematological Society of India (NSI) has organized a national symposium at Thiruvananthapuram, Kerala (2011) under title of 'Nematodes: a Challenge under Changing Climate and Agricultural Practices' and discussed nematode problems of crops especially grown under poly-house or protected conditions. The increased nematode infestation and crop damage commonly observed in the poly houses has forecasted the situation that may arise in open fields in the near future due to climate change. So while nematodes are generally small and often unnoticeable, they have an enormous impact on us and our world

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CLIMATE CHANGE DRIVEN BY COVID 19 AND HUMAN BEHAVIOUR

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Introduction

One third of the earth is covered by the ocean. Ocean is the mother house of the earth. Climate change is a larger environmental problem. Global warming and climate change are caused by green house gases like CH_4,N_2O,CO_2 andO_3. Over half of Antarctica badass Adelie penguins could get wiped out by climate change. Climate is the average of weather over time and space. The consequences on marine environment are ocean warming, ocean acidification, due to salinity fluctuation, extreme events and deoxygenation. Since the industrial revolution, human activities have rapidly increased the amount of carbon dioxide in the atmosphere.

GHGs and air pollution due to the COVID-19 global restrictions during the period February–June 2020 and project these into the future. These emission changes are then used to make a prediction of the resultant global temperature response. We examine the temperature response of a direct recovery to

pre-COVID-19 national policies and emission levels, and also explore responses where the economic recovery to COVID-19 is driven by either a green stimulus package or an increase in fossil fuel use.

Causes of Climate Change

Natural and man-made (anthropogenic) radioactive forcings (RF) are depicted. RF or climate forcing, expressed in W/m^2 , is a change in energy flux, viz., the difference of incoming energy (sunlight) absorbed by Earth and outgoing energy (that radiated back into space). A positive forcing warms up the system, while negative forcing cools it down. (Anthropogenic) CO_2 emissions, which have been accumulating in the atmosphere at an increasing rate since the Industrial Revolution, were identified as the main driver. The position of the IPCC has been adopted by several renowned scientific societies, and a consensus has emerged on the causes and partially on the consequences of climate change. The history of climate change science is reviewed in (Miller *et al.*, 2009). There are researchers who oppose the scientific mainstream's assessment of global warming (Linden, 1993). However, the public seems to be unaware of the high degree of consensus that has been achieved in the scientific community, as elaborated in a 2009 World Bank report (Worldbank, 2009). In (Antilla, 2005), there is a treatment of the mass media's coverage of the climate change discussion with a focus on rhetoric that emphasizes uncertainty, controversy, and climate scepticism. Climate change skeptic films were found to have a strong influence on the general public's environmental concern (Greitemeyer 2013).

Outbreak of COVID 19 Period and Climate Change

COVID-19 has changed the world. The pandemic has caused devastation, pain and loss, with no corner of the globe untouched. But for some scientists the unprecedented disruption has also brought about a previously unimaginable opportunity. The dramatic fall in air pollution that accompanied countries going into lockdown has provided a unique natural experiment, enabling scientists to probe some of the long-standing mysteries surrounding cloud formation. In doing so, they have gained a better understanding of the complicated interactions between air pollution, weather and climate.

Stringent lockdown measures were first introduced in Wuhan, China – where COVID-19 was initially identified – on 23 January 2020, and quickly rippled out across the rest of the country to combat the spread of the SARS-CoV-2 virus. With public transport shut down, schools, universities and workplaces closed, and people confined to their homes, the streets became silent and air pollution plummeted. Satellite data revealed, for example, that nitrogen dioxide had fallen by as much as 70% across eastern China, with some locations – including Wuhan – seeing drops of up to 93%. And as the virus swept around the world and other countries imposed their own versions of lockdown, the atmosphere responded, with smog being replaced by blue skies in New Delhi, the Himalayan mountain chain becoming visible from parts of northern India for the first time in 30 years, and city skylines being brought into sharp relief in Jakarta, Los Angeles, Paris and beyond.

However, cleaner air doesn't necessarily result in wall-to-wall blue skies. Just as a small amount of sugar or salt can make a cake taste very different, so small changes in the composition of the atmosphere can trigger a chain reaction of interesting atmospheric effects: concocting new chemicals, making or breaking up clouds, and potentially changing the weather at the surface. But teasing out those changes, against the background of natural climate variability, is difficult.

The Post-pandemic Climate

The long-term effects of the pandemic on our climate will be determined more by what happens to long – lived greenhouse gases, such as CO_2 and methane. These remain in the atmosphere for centuries and decades respectively, compared to a few days to weeks for NO_x, SO_2 and black carbon. CO_2 emissions dropped during lockdown, but not enough to stop levels in the atmosphere growing. Global heating won't stop until emissions reach zero.

It may seem daunting that the near shutdown of society didn't cause a big enough reduction in emissions to stop climate change. But this just shows the limits of doing less of the stuff we normally do, instead of changing how our economies and infrastructure are powered. While lockdown measures have brought temporary reductions in emissions, there are better ways of doing this that cause less harm to society and people.

Only a decisive shift from fossil fuels will stabilise global temperatures. That's why the decisions governments take to revive economic growth after COVID-19 will be pivotal. The 2008 financial crisis caused a similar slowdown,

but emissions soon rebounded as a direct result of economic rescue packages which invested heavily in fossil fuels. We cannot afford to make the same

Control Measures of Climate Change

- Reduce the production of carbon dioxide, methane and other gases. This can be done by minimising the burning of the woods or resources that produce such gases.
- Grow maximum number of trees.
- Minimise the use of paper so that lesser number of trees are cut down.
- Agricultural production should not be dependent on weather conditions. Technology should be improved to tackle such type of situations.
- Replacing petrol and diesel with electric vehicles.

Conclusion

There has been a heated discussion on climate change in recent years, with a particular focus on global warming. Over the last several million years, there have been warmer and colder periods on Earth, and the climate fluctuates for a variety of natural reasons as data from tree rings, pollen, and ice core samples have shown. For instance, in the Pleistocene, the geological epoch which lasted from about 2,588,000 to 11,700 years ago, the world saw repeated glaciations ("ice age"). More recently, "Little Ice Age" and the "Medieval Warm Period" (IPCC) occurred. Several causes have been suggested such as cyclical lows in solar radiation, heightened

volcanic activity, changes in the ocean circulation, and an inherent variability in global climate. Also on Mars, climate change was inferred from orbiting spacecraft images of fluvial landforms on its ancient surfaces and layered terrains in its polar regions (Haberle*et al.*, 2012). Spin axis/ orbital variations, which are more pronounced on Mars compared to Earth, are seen as main reasons. As to recent climate change on Earth, there is evidence that it is brought about by human activity and that its magnitude and effects are of strong concern.

Instrumental recording of temperatures has been available for less than 200 years. Over the last 100 years, a temperature increase of 0.5 C could be measured (Le Houérou, 1996) with rather different regional patterns and trends (Folland*et al.*, 1992). In (Ehrlich 2000), Bruce D. Smith is quoted as saying, "The changes brought over the past 10,000 years as agricultural landscapes replaced wild plant and animal communities, while not so abrupt as those caused by the impact of an asteroid as the CretaceousTertiary boundary some 65 Ma ago or so massive as those caused by advancing glacial ice in the Pleistocene, are nonetheless comparable to these other forces of global change." At the Earth Summit in Rio de Janeiro in 1992, over 159 countries signed the United Nations Framework Convention on Climate Change (FCCC, also called "Climate Convention") in order to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (United Nations (UN) 1992). In 2001, the Intergovernmental Panel on Climate Change (IPCC)

(Intergovernmental Panel on Climate Change (IPCC 2007) wrote, "An increasing body of observations gives a collective picture of a warming world and other changes in the climate system... There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." In its fourth assessment report of 2007, the IPCC stated that human actions are "very likely" the cause of global warming. More specifically, there is a 90 % probability that the burning of fossil fuels and other anthropogenic factors such as deforestation and the use of certain chemicals have already led to an increase of 0.75 in average global temperatures over the last 100 years and that the increase in hurricane and tropical cyclone strength since 1970 also results from man-made climate change. In its fifth assessment report of 2013, the IPCC confirms their findings as "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased" (IPCC 2013).

An overall higher temperature on Earth, depending on the magnitude of the effect and the rate at which it manifests itself, will change the sea level, local climatic conditions, and the proliferation of animal and plant species, to name but a few of the most obvious examples. The debate on the actual consequences of global warming is the most heated part of the climate change discussion. Apart from changes in the environment, there will be various impacts on human activity.

One example is the threats to tourism revenue in winter ski resorts (Hoffmann *et al.*, 2009) and low-elevation tropical islands (Becken, 2005). Insurance companies will need to devise completely new business models, to cite just one example of businesses being forced to react to climate change.

Climate change is not only controlled by our nation. Each and every person should take the action for climate change in the world wide. Because mostly climate change and temperature increased by human activities. During pandemic condition emission of green house gases are reduced. So first we are reduce the use of fossil fuels and plastics.

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THE CHALLENGES OF SOCIAL MEDIA FOR CLIMATE CHANGE EXPERTS

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Introduction

For the past three decades the world has become increasingly digitalized. Digital media have become ubiquitous to the point of being invisible, a phenomenon achieved through converging technologies and social communications. While Web 1.0 enabled large-scale global communications and networks already in the 1990s, Web 2.0 offered a two-way or many-to-many interactive communication model; it made digital media social. Web 3.0 allows online applications and websites to receive information that's on the Web and give new information/data to the users. Web 4.0 connects all devices in the real and virtual world in real-time. Web 5.0 will be about the (emotional) interaction between humans and computers. Climate change has been one of the most debated topics in the past few decades, but a number of challenges have hindered the development of robust policies and strategies by nations. At the same time, social media platforms–such as Instagram, Twitter and Facebook have given the opportunity for the general public to share opinions and engage with the issue of climate change like never before. For climate change experts ranging from humanitarian organisations, scholars, activists, policymakers, to the scientific community, this trend has had contentious effects. Social media

have shown to be a double-edged sword, offering both vast opportunities and also extensive challenges. Controversies around social media feature in the private and public sector, and they are ever present in digital research. The field is underlined with uncertainty, a theme that has strongly featured in my previous research. When we asked humanitarian actors about how social media affected their work, there was little agreement. Social media are and remain a complex, contentious and uncertain field.

Climate Change

Climate change has been one of the most debated topics in the past few decades. Even though the majority of nations now agree on the basic ideas related to climate change and participate together in international initiatives, such as the Kyoto Protocol and the Paris Agreement, comprehensive and effective steps are yet to be taken. The political process has been stagnant and plagued by claims of national interest. Feeling a sense of urgency, a number of bottom-up initiatives around the world have taken the
initiative in their own hands. The recent few decades have seen a rise in public figures and pop culture products focused on raising awareness on climate change through effective campaigns, using the advances of technology. At the same time, social media platforms – such as Instagram, Twitter, and Facebook have provided an opportunity for the general public to discuss and share opinions instantly with vast cross-border networks. This phenomenon is considered to be a new form of soft power which can provide input into the discussion on

climate change and possibly affect the current international political mechanisms.

Influence of Social Media on Climate Change

Climate change has been singled out as one of the most urgent global challenges. The world today is estimated to be about 1°C warmer, on average, than it was in the 1950s, and the effects are being felt. From the evidence of science and the scenarios projected by the world climate experts and the community of scientists. Increasing temperature, irregularities in rain, flood, drought, decreasing underground water levels, shorter or longer range of seasons, changing precipitation patterns, reducing snow cover, changing soil moisture, melting sea ice and glaciers, rising sea-water level, earlier flowering and ripening of flowers and fruits, and migration of plants and animals towards the poles, are the visual signs of global warming.

One of the best ways of making people aware of climate change issues is the advanced features of social networking and communication technologies. Mass media representational practices have broadly affected translations between science and policy and have shaped perceptions of various issues of environment, technology and risk. Zhao *et al*. (2011) found that attention to the science-based news has a positive effect on individual concern and knowledge about climate change. Reynolds *et al*. (2010) show that in recent years, there has been a significant increase in information available to the public about the topic. Social media connect people all across the globe - via networks of interest - who share messages with each other, joint comment, discuss, rate

and create unique social content. They facilitate large-scale conversation and distributed problem solving; creating waves and endless possibilities for collective social action. Social media networks allow sharing of information and news at an incredible speed. Social networking applications such as Facebook, twitter, hi5, and MySpace are emerging technologies that could be used to build many virtual societies. Social networking brings students and teachers of a school, or school district, together in order to share their perspectives about global warming, environmental pollution, and climate change.

Benefits of Social Media

One of the many controversies around social media is whether its benefits outweigh its challenges. Social media have been praised for offering new ways of communicating, advertising, campaigning, participating, and mobilising. Aside from offering new routes, social media have also been seen as particularly valuable due to being fast – even immediate, integrative, cheap (compared to alternatives), global, mobile, multimedia, and for providing more direct and equal access to and for large audiences. As such, social media should be beneficial for social and political actors, and therefore for climate change experts.

Challenges of Social Media – a territory of vast data

However, despite its many affordances, social media have also created new challenges in the socio-political sphere, in particular with regards to the vast amount of data now available. There are challenges around the organisation, management and standardisation of information, in particular

information overload – which may lead to what has been called 'information fatigue' and even 'compassion fatigue'. Aside the amount of data now available, its quality has also been contentious. Scholars have raised concerns around data currency, accuracy and credibility, easy manipulation, adaptation or misuse of content, literacy barriers and English language dominance, data verification, and general reliability. For climate change experts this means that despite the new opportunities it offers, the web remains an uncertain, dispersed, and complex field. Social media have therefore added to the complexity of an already complex subject.

Challenges of Social Media – the lack of filters and control

Other issues arise in the lack of filters and control in digital space, which leaves individuals open to harm. In the last two decades, the web has come under continuous critique for not protecting individuals from commercial exploitation, government surveillance, privacy breaches, and harm through other individuals such as trolling and cyber-stalking. As a politically and scientifically controversial phenomenon and a highly contentious item on the global public policy agenda, climate change has historically attracted a lot of tension and has therefore been particularly prone to trolling. More recently, with Donald Trump's US presidency, the issue has received strong public reactions via social as well as traditional media (e.g. Kastrenakes, 2017). Thus, while social media have offered new opportunities to respond to the public Climate Change debate, the resulting dialogue has not always been constructive or positive, but has also shown to be ideological and vitriolic and may include trolling.

Challenges of Social Media – widening participation

In part, the fiery debates are a result of the widening participation in public debates through digital media. With social media being open to the general public, the new terrain for climate change debates integrates organisations, institutions, policymakers, as well as individuals. Its, essentially, open to everyone. Popularity of a given space is, however, based on Google's search engine listings and therefore on advertising or search term popularity, and partly on popularity among individuals' personal digital networks. Therefore, more formal outlets such as institutional websites or posts are in direct competition to individuals' content production and circulation – user-generated content. While traditional power dynamics still exist in digital space, the web also offers opportunities for counter-movements and niche communities. As a result, climate change communications have become more mainstream, but as a complex scientific and political issue climate change communications faces challenges.

Making Climate Social

Overall, the challenges of social media for climate change communications are tied to a variety of factors, for example information overload, lack of formal control or filters, and widening participation on the social web. While social media have created more diversity through integrating new actors, media channels, platforms, and contents, more diversity has also created more complexity and fragmentation. Those effects are palpable across sectors. Following and participating in climate change debates online is therefore increasingly difficult for experts in the field, despite the many affordances of

digital technology. Social media are essentially busy due to the large amount of users, vast data, and the lack of controls and filters to manage the new spaces. Thus, social media remain contentious for climate change communications. Aside cyber-optimism and pessimism, social media have without doubt created a range of new challenges for climate change experts.

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CHALLENGES, OPPORTUNITIES AND REVOLUTION OF SOIL CHEMISTRY AND AGRICULATURAL PHYSICS IN CLIMATE CHANGE

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Introduction

The Paris climate conference has set a critical goal to limit the global warming to 1.5 degrees Celsius as against the threshold of 2 degrees as speculated before. The disastrous consequences within the limit between 1.5 and 2.0 degree would signify the extent of danger that everyone on the earth is going to encounter. Even the target of 1.5 degree Celsius fixed during the conference needs to be authenticated for being realistic on global basis. Today's human population stands at a critical zone of climate change. The climate may be the average of weather condition, but in true sense, it is the product of multi-component interactions associated with interplanetary and extra-terrestrial environments, which form a wide range or sequence covering the spectrum for common goal of climate change.

Altogether six spectra viz. planetary in physical state, EM-nuclear, chemical, biological, pedogenic and anthropogenic spectra are considered viable.

Solar radiation coming to the land area is of the order of 28,000 x 1012 watts per year. Starr et al stated that hydropower produces a maximum of 3 x 1012 watts per year. Sys et al. concluded that 95 per cent of the energy input of the world comes from solar radiation. It is further argued by Sys et al. that nearly half of such incoming solar radiation is directly transformed to heat, remaining about 23 per cent consumed in energizing the evaporation and precipitation and hardly 0.02 per cent (5.6 x 1012 watt per year) is used in photosynthesis.

If climate is changing, land is automatically liable to change, since climate is the integral part of the land. Under such critical situation, soil being the second integral part of climate could only be the hope to mitigate the extent of climate change as much as possible. Obviously, soil must be considered as a reservoir to store green house gases. Truly, as Janseens et al. stated, the soil is one of the important sources as well as sinks of greenhouse gases (GHGs) causing global warming and climate change.

Global Warming Potential (GWP)

The balance between incoming and outgoing energy on the earth surface is responsible for temperature variation on the earth. If incoming solar radiation is absorbed on the earth, it gets warm. However, if the same radiation is reflected back to space, the warming situation is negligible.

But, if the absorbed radiation is released back to space, there is chance to cool the earth. This simply follows the classical laws of physics, but it remains surrounded by a number of complex factors both natural and man-made. The greenhouse gas ultimately warms up the earth's atmosphere by absorbing the energy as well as declining the rate at which the energy does escape to the atmosphere. The type specific greenhouse gases may vary in warming the earth's atmosphere. So, these gases differ from each other in respect of their ability to absorb the energy and the lifetime of their co- existence in the atmosphere. A study of the long-term trend in surface air temperatures in India by Hingane et al. indicated an increase in mean annual temperature of 0.4°C over the past century.

The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Virtually, it is a measure of how much energy the emissions of one ton of a gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide. The larger the GWP, the more that a given gas warms the earth compared to carbon dioxide over that time period. The GWP thus refers to an index that compares the strength of different green house gases (GHGs) in raising the temperature of the atmosphere, wherein CO_2 is used as a reference gas to compare the ability of a GHG to trap the atmospheric heat relative to CO_2 [8]. The GHG emissions are thus computed as CO_2 equivalent. A 100-year GWP is standard that is accepted globally on time scale. The GWP of

CH_4 and N_2O are significantly higher than of CO_2, since the GWP of CH_4 is 25-times and of N_2O is 298-times higher than CO_2 over a 100 year's time horizon [7]. The GWP of a soil may be calculated using equation as below [7].

$$\text{GWP of a soil (kg } CO_2 \text{ equivalent ha}^{-1}) =$$

$$CO_2 + CH_4 \text{ X } 25 + N_2O \text{ X } 298$$

Principles of Strategic Planning to Combat with Challenges of Climate Change using Integrated Management Inputs

The record of our climate dates back hundreds of thousands of years and even more based on interpretation of a number of indirect measures like tree ring, ice core, glacier's height and lengths and ocean sediments besides details of changes in earth's orbit around the sun. This record shows that the climate system varies naturally over a wide range of time scales. In general, climate changes prior to the Industrial Revolution in the 1700s can be explained by natural causes, such as changes in solar energy, volcanic eruptions, and natural changes in greenhouse gas (GHG) concentrations. However, present trend of climate changes can hardly be considered by natural causes alone. The atmosphere is simply the envelope surrounding the earth's lithosphere, wherein six spectra are playing major role in maintaining the equilibrium responsible for a climate. These are physical form and stability of the earth i.e. planetary physical spectrum, electromagnetic-nuclear spectrum besides chemical, biological, pedologic and anthropogenic spectra. The earth's primitive atmosphere was presumed to contain CH_4, H_2, NH_3, N_2, CO, CO_2 and H_2S.

A group of physicists may approve and quantify the mode of equilibrium among earth's magnetic field, gravitational matrix and incoming solar radiation that could be congenial to the existence of life on the earth, since life by no means can be the inherent constituent of the earth's system, but simply a by-product as a result of interactions during climate change by itself. This will surely be a breakthrough in modern science. Similarly, fauna and flora including their diversity contribute significantly to balancing the atmospheric load. Besides, human interferences as well as pedogenic disturbances lead to challenge the equilibrium and stability of the earth's atmosphere in a big way. In totality, global climate change is virtually a spontaneous natural process as controlled by planetary and other natural phenomenon. The composition of primitive atmosphere of the earth was entirely different from present day's composition.

Land Shrinkage towards Disastrous Consequences

Imbalanced human population increase and rapid urbanization followed by non-farming uses of land are some examples of land shrinkage for agricultural use. Such shrinkage (sealing) is irreversible causing complete stoppage of greenery and grain production besides ecological imbalance, which calls for immediate legal ban against such practice. For rehabilitation, alternative planning may be executed either in the form of construction of multistory buildings in lands with rock outcrops and so or similar arrangement on coastal or river bank, since soil cannot be the waste so long as it is a resource. But, the situation with land shrinkage is very alarming and disastrous even in bringing climate changes in particular. Even

the young orchards are being destroyed on way to sale the productive lands for construction purposes extensively. He first author (B.B. Mishra) in a book entitled " 25 Years' Perspective Plan of Land Use Planning of Bihar, 2000-2025" [19] made a first-hand working plan to restore overall sustainability of soils in Bihar that may also help to maintain a congenial climate.

It is projected that out of total geographical land mass of 328 million hectares in India, only about 182 million hectares (60%) is cultivable. However, in 1988-89, there was 185.14 million hectares of cultivable land, out of which only 45 percent of land was under irrigation. It is further projected that the land area is decreasing faster than population employed on it. Based on a statement appeared in The Times of India on 13th August, 2013, as many as 20 states in India suffer from decline in cultivable land to the tune of 0.79 million hectare during 2007 and 2011 (four years). Such decline is attributed to irreversible shifting of cultivable land for non-farming activities including construction of roads, buildings, industries and many other infrastructural facilities, since these activities and diversions are inevitable for any development programme. However, the government in its National Rehabilitation and Resettlement Policy (NRRP) 2007 suggested measures against ever-declining cultivable land. Earlier, The Economic Times In similar statement on 27th February 2011 indicated the shrinkage of 2.76 million hectares of agricultural land in the last two decades.

Historically, India has moved from being a food deficient land in 1960s to almost a food surplus nation with success in Green Revolution around 1970. However, the continued

shrinking trend of productive agricultural land during the last decades is becoming alarming. In terms of employability, almost 57 percent of total work force was employed in agriculture sector in 2001, whereas in 2011, only 54.61 percent is employed causing unemployment stress of 2.39 percent. The central government has formulated the National Policy for Farmers and the National Rehabilitation and Resettlement Policy in 2007 which also envisage prevention or minimization in utilization of agricultural land in non-agriculture activities. But, such land in India has shrunk by around two percent almost within the last two decades. This signifies that India can hardly be respected for being the predominate agrarian country in days to come. Even if we justify that India had produced 169.92 million tonnes of food grain in 1988-89 followed by 234.47 million tonnes food grain in 2008-09 (38% yield increase), the issue of land shrinking is location specific, which is disastrous.

Conservative Agriculture

The easiest way to minimize the challenges of climate change through C-sequestration is to follow the conservation agriculture (CA) by keeping the land covered with vegetation and/or crop residues round the year with least or zero tillage. The CA follows the principles of restoring the biodiversity and pedo-ecosystem.

Selection of site-specific crop rotation based on parametric land evaluation followed by land use suitability identification may be the prerequisite for a given field plot. In this particular agriculture, one suitable cover crop is identified between two main crops based on nature and height of main

crops already identified and such exercise needs exhaustive experience with indigenous knowledge and this may enable a soil scientist to work together with farmers in an interactive environment. Then, fix the balanced nutrition to the crops in rotation (including cover crops) based on soil fertility evaluation.

Soil covered with vegetation round the year may buffer the diurnal temperature change and minimize the organic matter decay considerably, thus, creating a congenial environment for C-sequestration. As farmers seek to change from chemical- based conventional farming systems to more sustainable kinds of agriculture i.e. organic farming, which may be adopted in conservation agriculture (CA) successfully, wherein one has to be sincere to use accessible organic sources like (i) crop residues comprising of both shoot and root residues (ii) plant debris in suitable sizes (< 2 mm but larger than 0.053 mm) (iii) humus (decomposed materials less than 0.053 mm that are dominated by molecules stuck to soil minerals) and (iv) compost, FYM, vermicompost and others, which are prepared locally [20]. In CA, farmers should essentially learn, ahead of managing the organic resources, how to sustain soil moisture by managing organic source itself. The amount of plant available water can be determined by two parameters: (i) the lower limit i.e. the amount of water in the soil that plants cannot extract or utilize and (ii) the upper drained limit i.e. the amount of water that can be held against drainage.

Conclusion

The past may entail the issues, while present will scrutinize the challenges and based on critically documented issues and challenges, our efforts should aim at recognizing the priorities for framing the action plan on integrated basis to look for a healthy future environment congenial to our survival and livelihood on sustainable foundation of the earth. In such endeavor, the pedologic interventions do deserve special attention in integrating all the components including GHGs. There is need to develop and formulate a "pedo-ecologic zone" as a representative to a particular climate of a region in terms of its characterization, management and possible mitigation options.

However, efforts are equally vital towards natural components contributing to climate change by disturbing the earth's equilibrium by specialist persons. As more and more evidence come to light, we can have more and more confidence that may help in getting nearer the truth. It is true, for example, that sun is the centre of the solar system that earth is not flat and that atom is not solid. Science does not know the answer of every question for simple reason that every question is hardly covered by the objectives of an experiment. Science, as a rule, evolves raising new questions and new techniques to develop so that new types of measurements can be made. The important point is that the more mature the science, the more confident we can be towards mitigation of overall global climate change. In such exercise;

(i) the carbon sequestration in type specific soils deserves immediate attention in a planned manner through conservation agriculture. This must follow

(ii) a legal ban against land shrinkage. Moreover, efforts must be initiated

(iii) to maximize the use of solar energy as well as bio-fuel as the substitute for coal and petroleum. If climate is changing, land would automatically be changed besides manifestation of other changes.

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NATURE BASED SOLUTIONS FOR CLIMATE CHANGE

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Introduction

Mankind has for centuries exploited nature, building cities and industries at the cost of environment. For years, governments and private companies have invested in heavily engineered solutions to counter climatic challenges which have not only failed in the long term in many cases but have also destroyed livelihoods of local communities. Nature-based solutions are being taken up as solutions to climatic changes.

Climate change is fuelling more intense weather and compounding the impact of hazards that communities are dealing with already, such as flooding and heat waves. Projects that restore and emulate natural systems in order to increase human, ecosystem, and infrastructure resilience to climate impacts are often referred to as nature-based solutions. They provide multiple environmental, economic, and social benefits, including carbon sequestration, which is a key tool for reducing greenhouse gas emissions.

In recent years, awareness has risen rapidly on the importance of integrating nature in our approaches. The theme for World Environment Day (June 5) this year is 'Time for Nature', highlighting the crucial role of nature in our lives.

The theme for Fifth Session of the UN Environment Assembly in 2021 is "Strengthening Actions for Nature to Achieve the Sustainable Development Goals". This is a momentous step that will propel nature-based solutions (NBS) into the spotlight globally and attract major investment.

What is Climate Change?

Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time. For example, 20,000 years ago, much of the United States was covered in glaciers. In the United States today, we have a warmer climate and fewer glaciers. Global climate change refers to the average long-term changes over the entire Earth. These include warming temperatures and changes in precipitation, as well as the effects of Earth's warming, such as:

- Rising sea levels
- Shrinking mountain glaciers
- Ice melting at a faster rate than usual in Greenland, Antarctica and the Arctic
- Changes in flower and plant blooming times.

Earth's climate has constantly been changing — even long before humans came into the picture. However, scientists have observed unusual changes recently. For example, Earth's average temperature has been increasing much more quickly than they would expect over the past 150 years

What are Nature-Based Solutions for Climate Change?

The International Union for Conservation of Nature (IUCN) defines NBS as "actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."

Nature-based solutions for climate change harness the power of nature to reduce greenhouse gas emissions and also help us adapt to the impacts of climate change. They are win-win solutions that involve protecting, restoring and sustainably managing ecosystems to address climatic change and promote human well-being. Forests are probably the most well-known nature-based solution for climate change.

Why do we Need NBS?

Our planet is facing a dual climate and biodiversity crisis. Around a million animal and plant species are now threatened with extinction - more than ever before in human history. At the same time, the climate emergency threatens to expose millions of people to extreme heat waves and could leave a billion people affected by sea-level rise within decades, among several other impacts.

Today, we are facing an environmental crisis which has far-reaching consequences for our society, economy, biodiversity, health and our future generations. Loss of ecosystems, land, air and water pollution, increased risk of disasters all adversely affect our ability to adapt to climate change. NBS is a holistic, umbrella concept that breaks down

silos to address a wide range of global issues. These include climate change, disaster risk, food insecurity, gender inequality, human health, water insecurity, desertification and land degradation, biodiversity crisis, energy, poverty, and economic and social development.

Solutions for climate change through nature provide an opportunity to deliver multiple benefits simultaneously. They have the capacity to address all 17 of the United Nations Sustainable Development Goals (SDGs). Nature-based solutions are finding their place in flood control, food production, carbon capture and storage, pollination, medicine, disease prevention, nutrient cycling, soil formation, air filtration, water regulation and purification, waste minimisation and climate regulation. According to a 2019 report from the Food and Land Use Coalition (FALU), by 2030 NBS could account for as much as one-third of the solutions to climate change. NBS provides a platform to rethink and reframe our social, developmental and environmental priorities to integrate nature into our way of thinking and evolving remedies for climate change.

Different Types of NBS

NBS can be categorised into five broad categories: i) ecosystem restoration approaches, ii) issue-specific ecosystem-related, iii) infrastructure-related, iv) ecosystem-based management; v) and ecosystem protection approaches.

These approaches include sustainable agriculture, green infrastructure, sustainable finance, governance and law,

ecological restoration, and sustainable land-use management among others. Optimally, these approaches should be used in an integrated manner so as to diversify the value obtained. For example, utilising green infrastructure (such as green roofs, street trees, or green drainage basins) in urban settings can improve air quality, lower temperatures leading to reduced cooling requirements, support wastewater treatment, reduce water runoff, improve wellbeing and increase biodiversity.

NBS for Climate Change

- *Bringing Nature into Cities*

  Creating green roofs and walls and planting trees in cities can moderate the impacts of heat waves, capture storm water and abate pollution. Such measures also have positive outcomes for mental and physical health.

- *Coastal Habitat Restoration*

  Protecting or restoring coastal ecosystems (mangroves, reefs and salt marshes) protects communities and infrastructure from storm surges and erosion. Coastal habitats, especially mangroves, are particularly good at sequestering carbon, so restoration also contributes to climate change mitigation.

- *Restoring and Protecting Forests and Wetlands in Catchments*

  Protecting or restoring forests and wetlands in catchments can secure and regulate water supplies, support

production of forest products, and protect communities and infrastructure from floods, soil erosion and landslides.

- *Practice and Innovation*

  Building risk adjusted scalable projects that increases resilience to the risks of climate changes.

- *Science and Research*

  Accelerate research and use the data to better understand, analyse, predict and manage the risks of climatic changes.

- *Policies and Programmes*

  Policies and programmes that synergistically promote development that is climate-resilient and sustainable could be the game-changer. These could span the transition from fossil fuel-intensive energy to renewables; climate-proofing of future infrastructure investments; promotion of green infrastructure and nature-based solutions such as mangroves that could serve as green barriers to floods; conservation and preservation of nature reserves for carbon sinks and planning green spaces in urban systems.

- *Finance*

  Mobilizing public and private sources of finance to drive decarbonization of all priority sectors and advance resilience.

- *Energy Transition*

  Accelerating the shift away from fossil fuels and towards renewable energy, as well as making significant gains in energy efficiency.

- *Industry Transition*

  Transforming industries such as oil and gas, steel, cement, chemicals and information technology.

- *Resilience and Adaptation*

  Advancing global efforts to address and manage the impacts and risks of climate change, particularly in those communities and nations most vulnerable.

Success of NBS for Climate Change in India

Globally, there have been several success stories of NBS. One of the success stories from India that was recognised in the UN World Water Development Report 2018 highlights the efforts of the NGO Tarun Bharat Sangh in Rajasthan when it was facing one of the worst droughts in its history in 1985-86. The NGO supported local communities led by women to undertake landscape-scale restoration of local water cycles and water resources. The outcomes have been significant. For instance, groundwater levels rose by an estimated six metres; water was restored to 1,000 villages across the state; five rivers that used to run dry after the annual monsoon season are now flowing again and fisheries has revived; productive cropland increased from 20 per cent to 80

per cent of the catchment; forest cover grew by 33 per cent, and the biodiversity improved. Hence, it is evident that natural processes have immense potential to achieve our objective of sustainability in all spheres of life.

Conclusion

Communities across the country can access assistance for projects that use nature-based solutions to reduce pollution and increase resilience to severe weather and other climate change impacts. Many of these solutions provide social, economic, and environmental co-benefits that can further strengthen communities.

In our fast-paced world, we are constantly seeking quick fixes to our problems. However, it is important for us to remember that the challenges we face today were not created overnight, and therefore it is irrational to expect to solve them overnight. We have spent centuries destroying the environment that led to climate change, and if we are to look towards nature to provide us solutions then we must give it a real chance. While our technology may provide us with easy and costly fixes in the short term, it has been proven multiple times that in the longer run, nature is our best bet. Nature-based solutions provide an opportunity for consolidation of global efforts maximising impact by bringing in convergence across all sectors that leads to climatic changes. Nature-based solutions are the means for us to incorporate nature into how we think, how we live and into our everyday choices. Therefore, it is imperative for governments and NGOs to

recognize the centrality of NBS and make them a vital part of strategies for tackling climate change.

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AN OVERVIEW: INCREASING OCEAN ACIDITY

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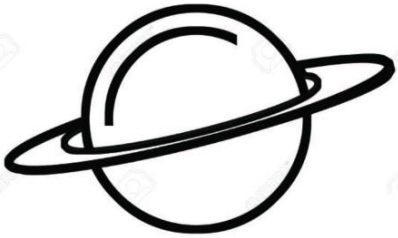
Introduction

Earth is the third planet, in the solar family. Around 29% of Earth's surface is land consisting of continents and islands. The remaining 71% is covered with water, mostly by oceans but also by lakes, rivers, and other fresh water systems. In the Earth's Polar Regions waters are covered by ice.



World is changing day by day,if we look the window long, we might see the weather change. Weather can change from one year to the next. For example, Minneapolis might have a hot one year and a much colder winter the next. Changes is general but when average pattern over many years changes;

Climate Change

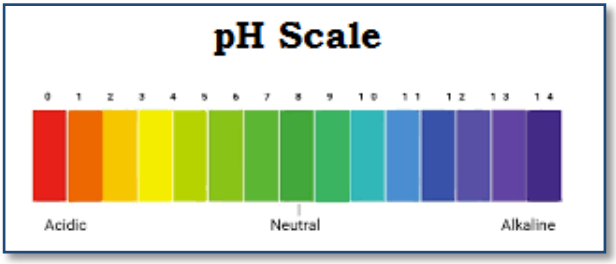
Many years ago, individuals living in the earth started burning huge quantities of coal, oil, and natural gas to power their homes, factories, and vehicles. Nowadays, most of the world relies on these fossil fuels for their energy needs. Burning fossil fuels releases carbon dioxide, carbon monoxide, unburned hydrocarbon, a heat-trapping gas, into the atmosphere, which is the main reason for climate change. Heat-trapping gases are also called greenhouse gases. They exist naturally in the atmosphere, where they help keep the Earth warm enough for plants and animals to live. But people are adding extra greenhouse gases to the atmosphere. These extra gases are causing the Earth to get warmer, setting off all sorts of other changes around the world—on land, in the oceans, and in the atmosphere. And these changes were affected the people, plants, and animals in many ways.

Causes and Effects

Causes	**Effects**
Industrialization	Global warming
Deforestation	Rising sea levels
Resource extraction	Increasing sea water pH
Consumer behaviour	Land degradation
Transportation	Loss of wildlife and biodiversity

What is pH and pH scale?

To begin with the pH concept was introduced by Danish and Soren in the year 1909 at the Carlsberg Laboratory. The pH scale is agrade of solutions in terms of how acidic or how basic they are. It point out the concentration of hydrogen ions (H^+) and hydroxide ions (OH^-) in a solution. These ion concentrations are equal in pure water, which has a pH of 7.



On the Basis of Lewis acid-base definition, the pH scale was developed by the absolute chemical potential of the proton. The pH scale measurement is applicable for liquids, gases and solid phenomena. A new "Unified absolute pH scale" proposed on 2010, which would allow various pH ranges across different solutions to use a common proton reference standard.

The Ocean

The Ocean is a huge salt water body that covers about 70 % of the Earth's Surface. The Planet has only one global ocean, though Ocean experts and the nations of the world has

divided into distinct geographic regions viz. The Indian ocean, The Pacific Ocean , The Atlantic Ocean, The Arctic Ocean and The Antarctic Ocean. Ocean acidity is presently affecting the entire ocean, including coastal estuaries and water bodies. In our food chain fish and shellfishes are unavoidable and many jobs and economies are related with Ocean.

How Ocean gets acidified?

As carbon dioxide (CO_2) dissolves in sea water, it forms carbonic acid, decreasing the ocean's pH, a process collectively known as ocean acidification. Present ocean acidification occurs approximately ten times faster than anything experienced during the last 300 million years, jeopardising the ability of ocean systems to adapt to changes in ocean chemistry due to CO_2.Ocean acidification has the potential to change marine ecosystems and impact many ocean-related benefits to society such as coastal protection or provision of food and income. Increasing the ocean temperatures and oxygen loss act concurrently with ocean acidification and constitute the 'deadly trio' of climate change pressures on the marine environment. To combat the worst effects of the deadly trio, CO_2 emissions need to be cut significantly and immediately at the source. Sustainable management, conservation, restoration and strong, permanent protection of at least 30% of the ocean are urgently needed.

Increasing acidity will make it harder for corals to build skeletons and for shellfish to build the shells they need for

protection. Corals are particularly important because they provide homes for many other sea creatures.

Though the oceans cover more than 70 percent of Earth, only 20 percent is visible to us. So are usually only able to see the water at the surface, not most of it, the other 80 percent.

Plants, Animals and Ecosystems

Most plants and animals live in areas with very specific climate conditions, such as temperature and rainfall patterns, that enable them to thrive. Any change in the climate of an area can affect the plants and animals living there, as well as the makeup of the entire ecosystem. Some species are already responding to a warmer climate by moving to cooler locations. For example, some North American animals and plants are moving farther north or to higher elevations to find suitable places to live. Climate change also alters the life cycles of plants and animals. For example, as temperatures get warmer, many plants are starting to grow and bloom earlier in the spring and survive longer into the fall. Some animals are waking from hibernation sooner or migrating at different times, too.

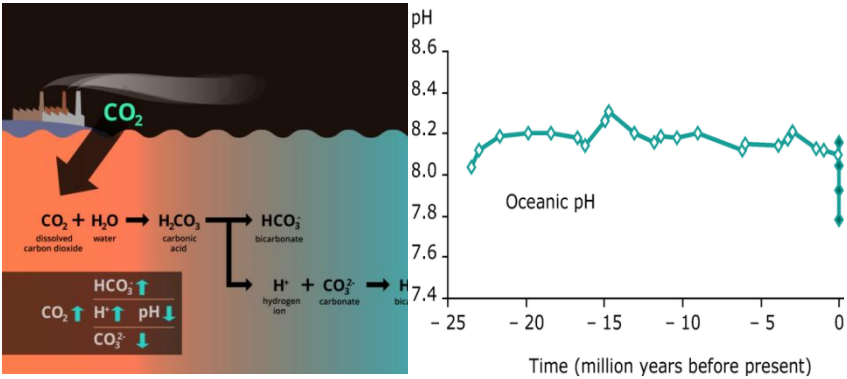
Disappearing Habitats

As the Earth gets warmer, plants and animals that need to live in cold places, like on mountaintops or in the Arctic, might not have a suitable place to live. If the Earth keeps getting warmer, up to one–fourth of all the plants and animals

on Earth could become extinct within 100 years. Every plant and animal plays a role in the ecosystem (for example, as a source of food, a predator, a pollinator, a source of shelter), so losing one species can affect many others.

Coral Reefs

Coral reefs are created in shallow tropical waters by millions of tiny animals called corals. Each coral makes a skeleton for itself, and over time, these skeletons build up to create coral reefs, which provide habitat for lots of fish and other ocean creatures. Warmer water has already caused coral bleaching (a type of damage to corals) in many parts of the world. By 2050, live corals could become rare in tropical and sub-tropical reefs due to the combined effects of warmer water and increased ocean acidity caused by more carbon dioxide in the atmosphere. The loss of coral reefs will reduce habitats for many other sea creatures, and it will disrupt the food web that connects all the living things in the ocean.



Solutions to minimize the impacts on Earth/Ocean

a. Greener approaches

Steps forwarded to more resource efficient and design molecules, materials, products and processes safely.

b. Greener Vehicles

Vehicles manufactures against combustion engine, worked with diesel, gasoline and work in environmental friendly.

c. Energy efficient materials

Eliminating energy waste for every work and less energy usage for the same.

d. Wind energy

Producing electricity by wind power/energy, is the another form of solar energy.

e. Bio Energy

Renewable energy producing from organic matter, living organic materials either matter.

f. Water Energy

Energy produced by the power of water or hydroelectricity derived from flow of water from dams.

g. Geothermal Energy

Geo energy is clean energy. Electricity harnessed from heat on earth crust.

h. Solar Energy

Evergreen energy comes from sun it satisfy our all purposes.

Conclusion

Ocean Acidification/acidity is one aspect of universal Climate Change. Anything we do to modify/mitigate climate change now will advantage the future of the ocean as well. In the worldwide Scientists, Researchers efforts are in the beginning level to monitor ocean acidity and it's difficult to predict impacts will falls throughout the marine food chain and entire structure of marine ecosystem. It is our responsibility to move forward to minimize the ocean acidity by sound decision making and action.

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CLIMATE CHANGE AND ITS IMPACT

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Introduction

Climate change destabilizes the Earth's temperature equilibrium and has far-reaching effects on human beings and the environment. During the course of global warming, the energy balance and thus the temperature of the earth change, due to the increased concentration of greenhouse gases, which has a significant impact on humans and the environment. It is not scientifically possible to assign individual weather events to the current climate change, however, it can be statistically proven that global warming will increase the probability of extreme weather events.

Climate Change

Starting from the origin of life, the planet earth have evidenced a number o climatic changes. Those climatic changes were the result of natural processes on the earth. Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region such conditions which average over a long period at least 30 years is called climate. Climate change is any long term, significant change in the 'average

weather' of a region or of the earth as a whole. Climate includes temperature, wind, rainfall, humidity, light, etc. and these are called as climate factors. Any fluctuations in the climatic factors are known as climate changes.

Effects of Carbon Dioxide on Climate Change

- Plate tectonics
- Solar variations
- Orbital variations volcanism
- Fossil fuels
- Aerosols
- Cement manufactures
- Lad use
- Live stock
- Interplay factors
- Evidence for climate change

Impact of Climate Change

Direct Consequences of Climate Change

The direct consequences of man-made climate change include:

- Rising maximum temperatures
- Rising minimum temperatures
- Rising sea levels
- Higher ocean temperatures
- An increase in heavy precipitation (heavy rain and hail)

- Shrinking glaciers
- Thawing permafrost

Indirect Consequences of Climate Change

The indirect consequences of climate change, which directly affect us humans and our environment, include:

- An increase in hunger and water crises, especially in developing countries
- Health risks through rising air temperatures and heat waves
- Economic implications of dealing with secondary damage related to climate change
- Increasing spread of pests and pathogens
- Loss of biodiversity due to limited adaptability and adaptability speed of flora and fauna
- Ocean acidification due to increased HCO_3 concentrations in the water as a consequence of increased CO_2 concentrations
- The need for adaptation in all areas (e.g. agriculture, forestry, energy, infrastructure, tourism, etc.)

. As the global climate is a highly interconnected system that is influenced by many different factors, the consequences usually result in positive or negative feedback effects. This refers to developments that are self-enhancing due to the occurrence of certain conditions.

Climate Change vs Human Activities

The global warming of the last 50 years is, with over

95% probability, due to humans. The Intergovernmental Panel on Climate Change (IPCC) is responsible for evaluating the risks of human-caused climate change and gathering prevention and adjustment strategies. It was established by the United Nations Environmental Organization (UNEO) and the World Meteorological Organization (WMO).

The latest IPCC report from 2018 is based on broad scientific analyses. The exponential population and economic growth, but also the modern lifestyle of our globalised consumer society over recent decades has all continuously increased the emissions of CO and other greenhouse gases. The concentration of these greenhouse gases in the earth's atmosphere is currently higher than at any time in the last 800,000 years, and it is continuing to rise faster than ever before (current measurement methods can only go back as far as the last 800,000 years).

Impact of Green House Gases

In addition to CO, methane and nitrous oxide are two of the most important greenhouse gases, the annual emissions of which are greatly increased by human activities. Methane emissions are particularly dominant in the area of livestock farming. With regard to natural emission sources, methane is produced in wetland areas as the gas can only arise under anaerobic conditions, i.e. when there is no oxygen. Thawing permafrost, as a direct consequence of the rising global temperatures, thus represents a significant source of greenhouse gases in the form of methane emissions. The main source of emissions

of nitrous oxide can also be found in the area of agriculture related to the use of nitrogen fertilizers. In ecological farming the use of such fertilizers is forbidden.

Issues Related to Climate Change in India

In 2018-19, as many as 2,400 Indians lost their lives to extreme weather events such as floods and cyclones, according to the environment ministry. In 2020, many people would suffer by lot of health issues and climatic condition issues. The report by the Union Ministry of Earth Sciences observed that the impact of climate change on the availability of freshwater is a critical area of concern for India and the growing propensity for droughts and floods because of changing rainfall patterns caused by climate change. The India Meteorological Department (IMD) says these events are increasing in both frequency and intensity Extreme events may be the most tangible and immediate impact of climate change, but another more long-term and equally dangerous effect is rising temperatures.

Approaches Taken by India

Participants noted that in India climate change is viewed as an issue of serious urgency. They noted that traditionally climate change was viewed as a problem caused by the West. In the recent past however, there has been a realization of India's vulnerability to climate change. This has led to an increased effort on India's part in tackling climate change. Some participants felt that this shift has been due to an understanding of how vulnerable India is to climate change due to studies on issues such as rising sea levels and their

detrimental impact on India's coastal cities. Participants agreed that besides the tangible cost of climate change, India also developed an increased sense of responsibility towards climate change due to rising pressures from the international community. They noted the Indian state's efforts in exploring alternative sources of energy.

Evidence for Rapid Climate Change in India

- ***Global Temperature Rise:*** The planet's average surface temperature has risen about 1.62 degrees Fahrenheit (0.9 degrees Celsius) since the late 19th century, a change driven largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the warming occurred in the past 35 years, with the five warmest years on record taking place since 2010.
- ***Warming Oceans:*** The oceans have absorbed much of this increased heat, with the top 700 meters (about 2,300 feet) of ocean showing warming of more than 0.4 degrees Fahrenheit since 1969.
- ***Shrinking Ice Sheets:*** The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 286 billion tons of ice per year between 1993 and 2016, while Antarctica lost about 127 billion tons of ice per year during the same time period.
- ***Glacial Retreat:*** Glaciers are retreating almost everywhere around the world — including in the

Alps, Himalayas, Andes, Rockies, Alaska, and Africa.

- ***Decreased Snow Cover:*** Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier.
- ***Sea Level Rise:*** Global sea level rose about 8 inches in the last century. The rate in the last two decades, however, is nearly double that of the last century and is accelerating slightly every year.
- ***Declining Arctic Sea Ice:*** Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades.
- ***Extreme Events:*** The number of record high-temperature events in the United States has been increasing, while the number of record low-temperature events has been decreasing, since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events.
- ***Ocean Acidification:*** Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30 percent. The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.

Conclusion

Climate change could push more than 100 million people into extreme poverty by 2030 by disrupting

agriculture and fueling the spread of malaria and other diseases, the World Bank said in a report. The effect of climate change has recently been seen in some cities of India like Delhi, Hyderabad, and especially Chennai where the city was facing a water crisis and was relying on alternative water sources such as distant, unreliable public water pumps, and costly private water tankers. This article discussed about rapid climate change in India, its potential effect on the country, and how to cope with the climate change effects.

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HOW GLOBAL WARMING IS AWAKENING DEADLY DISEASES

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Introduction

People are aware of global warming which is caused due to emission of greenhouse gases from industries, vehicles, populated areas etc. which results in climate change, melting of glaciers, sea level rise, ozone layer depletion etc. But recently studies have discovered a new serious issue of climate change that is caused by global warming, that is, the awakening of deadly virus dating back to the paleolithic age. Now that the bombshell is dropped let us see its origin its effects and its possible outcomes in the future.

Climate Change

Climate change is totally normal. The official word for it is 'Season'. The seasons we know are summer, winter, autumn, spring, rainy etc. These occur naturally. Man induced climate change is what we call as global warming. It is caused by the emission of greenhouse gases like methane, carbon dioxide, fluorocarbons etc. which trap the sun's energy and increase the temperature in the atmosphere.

As a result the earth as we know is slowly increasing in warmth and heat and causes bizarre climate change in places that have not been subjected to such changes. A simple definition of climate change states that "Climate change is the global phenomenon of climate transformation characterized by the changes in the usual climate of the planet (regarding temperature, precipitation and wind that are especially caused by human activities". There are so many effects of climate change. It is listed as follows;

- Melting of glaciers
- Sea-level rise
- Earthquakes
- Floods
- Draught
- Cyclones
- Forest fires
- Damaged crops
- Loss in Biodiversity
- Awakening of deadly virus

Most of the effects have already been known to many of us but none would have heard of the new imminent threat which will surely induce fear among the readers. Thousands of lives have been lost by the so called virus. What if diseases like corona gradually increase? Then human life as we know would become extinct. Before we jump into any conclusions let us see the origin and reasons for the scientists' anxiety.

As melting ice allows pathways to open up in the

Arctic, people and animals can use these routes to access previously inaccessible areas. Corporations and governments are making plans to use a more open Arctic for shipping routes and development, which could end up releasing more contaminants into the ecosystem. Animals, meanwhile, may already be traversing these open passageways to travel to new locations and spread disease.

Discovery and Research

As climate change continues to take its toll on the planet, experts are warning that ancient viruses which have been preserved in ice could be thawed out. A team of researchers from the US and China travelled to Tibet to gather samples of Earth's oldest glacial ice. By drilling 50 metres below the surface, researchers were able to collect samples of ice which offer a glimpse into Earth's viral history. The team uncovered 28 ancient viruses in the 15,000-year-old ice which were previously unknown to scientists.

"However, in a worst-case scenario, this ice melt could release pathogens into the environment".Climatechangeismeltingpermafrostsoilsthathavebeensolidforthousandsof years, and as the soils melt they have the potential to release ancient viruses and bacteria that may be capable of springing back to life.

The most recent discovery of an ancient virus came when French and Russian scientists investigated a 30,000 year-old piece of Siberian permafrost .

The temperature in the Arctic Circle is rising quickly, about three times faster than in the rest of the world. As the

ice and permafrost melt, other infectious agents may be released."Permafrost is a very good preserver of microbes and viruses, because it is cold, there is no oxygen, and it is dark," says evolutionary biologist Jean-Michel Claverieat Aix-Marseille University in France. "Pathogenic viruses that can infect humans or animals might be preserved in old permafrost layers, including some that have caused global epidemics in the past."

While global warming has yet to expose any ancient viruses harmful to humans, it has begun re-exposing more familiar diseases that modern society thought it had eradicated. In August 2016, a 12 year-old boy in northern Russia was killed after being infected by Anthrax. The Anthrax outbreak, which saw up to 20 people hospitalized, was blamed on unusually warm weather in the Arctic circle.

It is believed that a reindeer carcass infected with Anthrax was buried deep in the ice, but with temperatures reaching 35C in the Siberian tundra last summer, the carcass thawed and Anthrax spores were released. Up to 2,300 reindeer were killed as a result of the outbreak, and the entire reindeer herdsman community – of which the fatally infected boy was a member – had to be evacuated.

Average temperatures in Russia have increased by 0.43C in the past 10 years, but the rise has been more pronounced in areas of the far north, according Alexei Kokorin, head of WWF Russia's climate and energy programme. Speaking to The Guardian, Kokorin said the warmer climate has begun thawing the permafrost soil that covers much of Russia, including cemeteries and animal

burial rounds. Thawing permafrost has also led to greater erosion of river banks where nomads often buried their dead, Kokorin said.

Anthrax may not be the only infectious disease lurking in the ice. In 2004, US researchers successfully revived the 1918 Spanish flu – which killed millions of people – from a fragment of a corpse's lung frozen in the Alaska permafrost.

In a 2011 study, Boris Revich and Marina Podolnaya wrote: "As a consequence of permafrost melting, the vectors of deadly infections of the 18th and 19th Centuries may come back, especially near the cemeteries where the victims of these infections were buried."

In a 2005 study, NASA scientists successfully revived bacteria that had been encased in a frozen pond in Alaska for 32,000 years. The microbes, called *Carnobacteriumpleistocene*, had been frozen since the Pleistocene period, when woolly mammoths still roamed the Earth. Once the ice melted, they began swimming around, seemingly unaffected.

Two years later, scientists managed to revive an 8-million-year-old bacterium that had been lying dormant in ice, beneath the surface of a glacier in the Beacon and Mullins valleys of Antarctica. In the same study, bacteria were also revived from ice that was over 100,000 years old. However, not all bacteria can come back to life after being frozen in permafrost. Anthrax bacteria can do so because they form spores, which are extremely hardy and can survive frozen for longer than acentury.

Bigger Threats

While the risk of infectious diseases being released by thawing permafrost is real, scientists are at pains to point out that the chances of any future pandemic are incredibly low. Speaking in Nature magazine on the discovery of *Pithovirus, Curtis Suttle*, a virologist at the University of British Columbia in Vancouver, Canada, points out that people already inhale thousands of viruses every day, and swallow billions whenever they swim in the sea.

The idea that melting ice would release harmful viruses, and that those viruses would circulate extensively enough to affect human health, "stretches scientific rationality to the breaking point", he said."I would be much more concerned about the hundreds of millions of people who will be displaced by rising sea levels."

In central America incidences of chronic kidney disease are on the rise, and are being blamed on increased dehydration as hotter days become more frequent. The alternative perspective is that we should not ignore risks just because we cannot quantify them.

"Following our work and that of others, there is now a non-zero probability that pathogenic microbes could be revived, and infect us," says Claverie. "How likely that is not known, but it's a possibility. It could be bacteria that are curable with antibiotics, or resistant bacteria, or a virus. If the pathogen hasn't been in contact with humans for a long time, then our immune system would not be prepared. So yes, that could be dangerous."

Conclusion

There are many discussions about whether the released viruses would cause a pandemic or whether humans will be capable of adapting to it. Some argue that the released virus will more or less become dormant due to the present conditions. But none expected that the so-called corona virus would cause such a pandemic so it is best advisable that humans be prepared for any crisis in the years to come.

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EFFECTS OF CLIMATE CHANGE

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Introduction

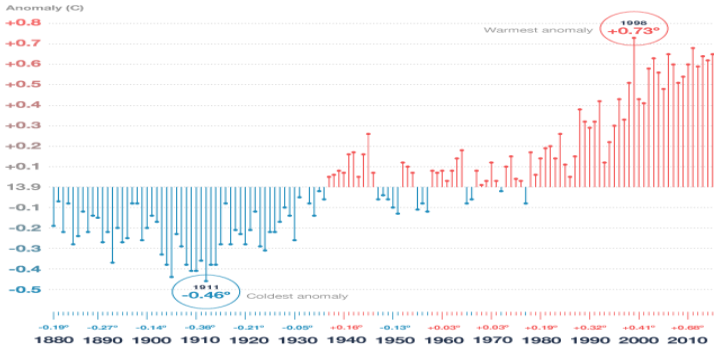
The effects of climate change span the physical environment, ecosystems and human societies. It also includes the economic and social changes which stem from living in a warmer world. Human-caused climate change is one of the threats to sustainability. Climate change destabilizes of the Earth's temperature equilibrium and has far-reaching effects on human beings and the environment. During the course of global warming, the energy balance and thus the temperature of the earth change, due to the increased concentration of greenhouse gases, which has a significant impact on humans and also the environment. It is not scientifically possible to assign individual weather events to the current climate change, however, it can be statistically proven that global warming will increase the probability of extreme weather events.

The direct consequences of man-made climate change include:

1. Rising Maximum Temperatures

In recent years, scientists have noted a rapid increase in average temperatures throughout the country. According to

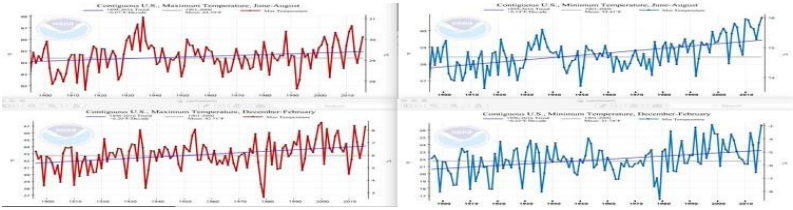
a report from the National Resources Defense Council (NRDC) titled 'Killer Summer Heat,' the average temperature of the United States could rise by as many as 11 degrees Fahrenheit by the end of the 21st century. Rising maximum temperature is the main reason to affect the climate change. Global temperatures have risen by 1 °C and are expected to rise further in the future. Over most land areas since the 1950s, it is very likely that at all times of year both days and nights have become warmer due to human activities. Night-time temperatures have increased a faster rate than daytime temperatures. In the U.S. since 1999, two warm weather records have been set or broken for every cold one.



2. Rising Minimum Temperatures

The maximum temperature decreased by 0.25 to 1.0 o C from normal and minimum temperature increased simultaneously from 1 to 3 o C from normal keeping the other climate variables constant, the phenology of rice, wheat and gram were advanced by as much as 1 to 15 days.When the

minimum temperature increased by 1.0 to 3.0 o C and maximum temperature decreased by 0.25 to 1.0 o C from normal, the heading in rice was advanced by 1 to 4 days, while the physiological maturity was advanced by 2 to 8 days from normal; in groundnut physiological maturity was advanced by 1 to 3 days from normal; in wheat both the anthesis and maturity were advanced by up to eight days from normal; and in gram flowering was advanced by 2 to 11 days while podding and physiological maturity were 2nd Proof advanced by 2 to 15 days from normal.



3. Rising Sea Levels

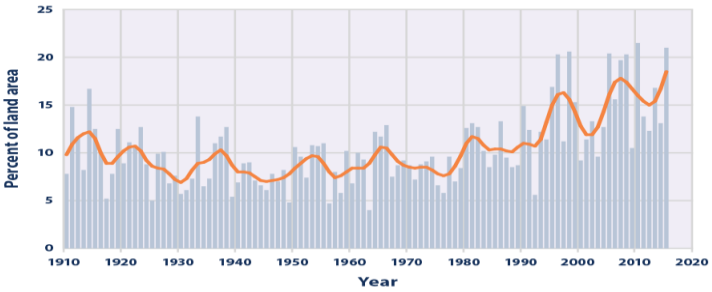
Global sea level rise began around the start of the 20th century. Between 1900 and 2016, the globally averaged sea level rose by 16–21 cm (6.3–8.3 in).More precise data gathered from satellite radar measurements reveal an accelerating rise of 7.5 cm (3.0 in) from 1993 to 2017,which is a trend of roughly 30 cm (12 in) per century. This acceleration is due mostly to human-caused global warming, which is driving thermal expansion of seawater and the melting of land-based ice sheets and glaciers.Between 1993 and 2018, thermal expansion of the oceans contributed 42% to sea level rise; the melting of temperate glaciers, 21%; Greenland, 15%; and Antarctica, 8% Climate scientists expect the rate to further

accelerate during the 21st century.As the impact of global warming has accelerated, melting from glaciers and ice sheets has become the main contributor.

4. An Increase in Ocean Temperatures

Ocean absorbs most of the excess heat from greenhouse gas emissions, leading to rising ocean temperatures.Increasing ocean temperatures affect marine species and ecosystems. Rising temperatures cause coral bleaching and the loss of breeding grounds for marine fishes and mammals.Rising ocean temperatures also affect the benefits humans derive from the ocean – threatening food security, increasing the prevalence of diseases and causing more extreme weather events and the loss of coastal protection.Achieving the mitigation targets set by the Paris Agreement on climate change and limiting the global average temperature increase to well below 2°C above pre-industrial levels is crucial to prevent the massive, irreversible impacts of ocean warming on marine ecosystems and their services.Establishing marine protected areas and putting in place adaptive measures, such as precautionary catch limits to prevent overfishing, can protect ocean ecosystems and shield humans from the effects of ocean warming. Marine heatwaves have seen an increased frequency and have widespread impacts on life in the oceans, such as mass dying events. Harmful algal blooms have increased in response to warming waters, ocean deoxygenation and eutrophication.

5. An Increase in Heavy Precipitation



Heavy precipitation refers to instances during which the amount of rain or snow experienced in a location substantially exceeds what is normal. What constitutes a period of heavy precipitation varies according to location and season. Climate change can affect the intensity and frequency of precipitation. Warmer oceans increase the amount of water that evaporates into the air. When more moisture-laden air moves over land or converges into a storm system, it can produce more intense precipitation for example, heavier rain and snow storms. The potential impacts of heavy precipitation include crop damage, soil erosion, and an increase in flood risk due to heavy rains (see the River Flooding indicator)—which in turn can lead to injuries, drowning and other flooding-related effects on health. Heavy precipitation does not necessarily mean the total amount of precipitation at a location has increased - just that precipitation is occurring in more intense events. However, changes in the intensity of precipitation, when combined with changes in the interval between precipitation events, can also lead to changes in overall precipitation totals.

6. Shrinking Glaciers

Earth's glaciers are melting much faster than scientists thought. A new study shows they are losing 369 billion tons of snow and ice each year, more than half of that in North America. The most comprehensive measurement of glaciers worldwide found that thousands of inland masses of snow compressed into ice are shrinking 18 percent faster than an international panel of scientists calculated in 2013. Glaciers grow in winter and shrink in summer, but as the Earth has warmed, they are growing less and shrinking more. Zemp said warmer summer temperatures are the main reason glaciers are shrinking faster.

7. Thawing Permafrost

Permafrost is any ground that remains completely frozen - 32°F (0°C) or colder - for at least two years straight. These permanently frozen grounds are most common in regions with high mountains and in Earth's higher latitudes - near the North and South Poles. As Earth's climate warms, the permafrost is thawing. That means the ice inside the permafrost melts, leaving behind water and soil. As permafrost thaws, microbes begin decomposing this material. This process releases greenhouse gases like carbon dioxide and methane to the atmosphere. These newly-unfrozen microbes could make humans and animals very sick. Scientists have discovered microbes more than 400,000 years old in thawed permafrost. Because of these dangers, scientists are closely monitoring Earth's permafrost. Scientists use satellite observations from

space to look at large regions of permafrost that would be difficult to study from the ground. NASA's Soil Moisture Active Passive, or SMAP, mission orbits Earth collecting information about moisture in the soil. It measures the amount of water in the top 2 inches (5 centimeters) of soil everywhere on Earth's surface. It can also tell if the water within the soil is frozen or thawed. SMAP's measurements will help scientists understand where and how quickly the permafrost is thawing.

Humans are exposed to climate change through changing weather patterns (temperature, precipitation, sea-level rise and more frequent extreme events) and indirectly through changes in water, air and food quality and changes in ecosystems, agriculture, industry and settlements and the economy. Air pollution, wildfires, and heat waves caused by global warming have significantly affected human health, and in 2007, the World Health Organization estimated 150,000 people were being killed by climate change-related issues every year.

Conclusion

The conclusion is that natural systems around the world are being affected by regional climate changes, particularly temperature increases, and that these temperature increases are very likely to be the result of anthropogenic emissions of greenhouse gases. A warming planet leads to many other changes in our climate. As the planet warms, heatwaves become more likely. A changing climate impacts crop growth

and human health, while many people may need to leave their homes.

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IMPACT OF CLIMATE CHANGE ON MARINE SPECIES

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Introduction

Ocean is an integral part of the climate system. Climate change is driving changes in the physical and chemical properties of the ocean that have consequences for Marine ecosystems and climate change is already making a huge impact on the lives of marine mammals and also other marine species. As oceans warm due to climate change, marine animals – from backboned fish to spineless jellyfish will react. Marine species are affected by climate change include plankton (which is the basis of marine food chain) – corals, fish ,polar bears , walruses, seals, sea lions, penguins and seabirds. The population of many marine species is decreasing at an unsustainable rate and the number of Species listed as endangered from marine life families; like whales, dolphins, salmon, sea turtles, sharks etc., Not all marine species are responding to the changing temperature and nutrient availability at the same time which can disrupt the food web. The ocean is the earth's largest ecosystems. It covers up to 70 percent of the earth's surface and 90 percent of the world's water. It is the home to the hundreds of aquatic creatures and also the reason for every human's living. It

means the ocean generates half of the oxygen which we inhale and absorbs the carbon dioxide we exhale.

Issues

Climate change is harming marine animals, plants, and birds in many ways. Here we can see some the reasons why the marine species are at risk. First and foremost one is, Oceans are getting hotter. Secondly, due to the oceans are getting hotter the sea water level also rising and thirdly, Oceans are becoming more acidic.

Oceans are Getting Hotter

The temperature of the water at the ocean surface is an important physical attribute of the world's oceans. The surface temperature of the oceans varies with latitude, the warmest waters generally near the equator and the coldest waters in the Arctic and Antarctic regions. Changes in sea surface temperature can alter marine ecosystems in several ways. Ocean temperature can affect the plants, animals and microbes which are present in the ocean. Sea surface temperature increased during the 20^{th} century and continues to rise.

As there are constant exchanges between air and water, the warming of the atmosphere also influences the ocean. The increase in the Ocean's temperature causes, in turn, a rise in sea levels. Due to sea surface temperature, the ice regions- Arctic and Antarctic ices are melting. This adds to the amount of water in the Ocean, increasing its volume and therefore raising sea levels.

Oceans are Getting more Acidic

Another less well-known, but the important problem in the marine environment is "Ocean acidification". The increase in the amount of carbon dioxide absorbed by the ocean, due to the emissions of human origin , causes a change in its chemical, composition and in particular, a decrease in pH . The oceans play an important role in regulating the amount of carbon dioxide in the atmosphere. As atmospheric concentrations of carbon dioxide rise, the ocean absorbs more Carbon dioxide. Because of the slow mixing time between surface waters and deep waters, it can take hundreds to thousands of years to establish this balance. Over the past 250 years, oceans have absorbed about 28 percent of the carbon dioxide produced by human activities that burn to fossil fuels. Although the ocean's ability to take up carbon dioxide prevents atmospheric levels from climbing even higher, rising levels of CO_2 dissolved in the ocean can have a negative effect on some marine life. Carbon dioxide reacts with sea water to produce carbonic acid.

Challenges

Global warming is affecting many species around the world such as polar bears, whales, sharks etc., although climate change will affect the marine mammals, species directly. Some of them are affected by this like walruses, seals, polar bears and others, are in danger, endangered and threatened. Threatened species means one that may become extinct if measures aren't taken to protect it. An endangered

species is one that has a very small population and at greater risk of becoming threat. Here we can see some of the most endangered species polar bears, seals, whales, krill.

Polar Bears

The Arctic is warming as fast as the global average, causing the ice that melt away, in which the polar bears depend on. Polar bears are the biggest carnivorous in their ecosystems. And also they spend most of their lives around water and ice. In Latin, it is called 'sea bear'. So they are in risk because they are depending on ice which is melting gradually. Polar bears generally live and hunt alone though they can be quite social too. They mainly eat seals as their favorite food. Why polar bears are so important? Because they play a vital role in balance of their ecosystem. Due to the melting ice, more polar bears will starve soon; they are currently listed as vulnerable and becoming endangered. It depends on seals for their primary food source; loss of sea ice threatens the bear's main prey that is seals. Without sea ice, the polar bears will starve and become extinct.

Seals

There are six different types of seals are available in the Arctic region. Although sea ice affects all these species harp seals, ringed seals, bearded seals. These seals are closely linked to sea ice and depend on ice for mating, resting and giving birth. It consumes plankton, algae and krill, which then in turn supply the seal populations with energy needed to stay warm in cold water and stay active in their throughout their lives. Since there is growing lack of

ice, there is less space for the plankton, algae and krill to make a living, causing a decrease in success. Now many of the seal species throughout the world are becoming endangered.

Whales

Whales love krill. One adult whale can eat up to 3 tones of krill in a day. How climate change could affect whale population? Whales may have to compete for food because of changes in the ocean environment and the amount of krill available for whales to eat.

Krill

If the population of krill start to fall that could threaten many ocean creatures including blue whales. Blue Whales can eat up to tons of krill a day. If krill become extinct, the blue whales could lose a major part of their diet. Krill are tiny, shrimp like creature that are extremely prevalent and provide food for the hundreds of different animals. But the temperature of ocean rise , krill's primary food source phytoplankton has begun disappearing

Coral reefs are some of the most iconic and important ecosystems, housing a quarter of all the ocean's marine life. But their survival is under threat. Climate change is making oceans warmer and more acidic and these changes are having a big impact on coral reefs. It is a house of many fish stocks, so lots of fish spend some time on a coral reef at some stage of their life. Coral reefs are complex ecosystems, made

up of calcareous rich in biodiversity; since they are home to many marine species.

However, they are also a fragile environment threatened by ocean acidification. In fact as the water becomes more acidic, the organisms that make up the reef can no longer build their calcareous skeleton, which decreases the size of the reef. It is also threatened by an increase of ocean temperature. As the water becomes too warm, the corals lose their color and eventually die. Worldwide 19 percent of reefs have already been destroyed and 15 percent are seriously damaged. Corals cannot survive the frequency of current bleaching events from global temperature rise. If temperatures continue to rise, bleaching events will increase in intensity and frequency. Why is it important? Coral reefs harbor the highest biodiversity of any ecosystem globally. Reefs provide a wide variety of ecosystem services such as subsistence food, protection from flooding and sustaining the fishing and tourism industries

How to Control or Recover these Animals from Climate Change? What is the Solution?

Because of climate change, the earth and sea face many consequences as shown in above. But all of these humans are the base. Humans are the main reason for the climate change. This is one of the important issue that the human beings are facing through global level. Climate change is already impacting a variety of ecosystems and environment around the world; putting vulnerable animals in danger of extinction or putting already endangered species at

even higher risk. Hope these animals won't be wiped out completely by the impact of climate change.

Climate change is the greatest environmental challenge the world has ever faced. We people are the responsible to stop devastating climate change. We can all contribute to reducing climate change therefore help the endangered species. A significant cause of climate change is the emission of polluting gases from fossil fuels like coal and oil.

Green house gas emissions: Burning fossil fuels such as natural gas, coal, oil and gasoline raises the level of carbon dioxide in the atmosphere and carbon dioxide is a major contributor to the greenhouse effect and global warming. We can help to reduce the demand for fossil fuels which in turn reduces global warming by using more wisely.

The following steps we can take to reduce greenhouse gas emissions.

***Reduce, Reuse and Recycle* :** Buying products with minimal packaging will help to reduce waste. By recycling half of your household waste , you can save 2,400 pounds of carbon dioxide per year.

Buy Green Electricity : There is the need to adopt renewable sources of energy such as wind, solar and wave power. There is a possibility that coal, natural gas and oil will be depleted from the Earth's surface and adopting safe and renewable sources of energy is imperative. If one is to reduce the emissions of greenhouse gases, then they have to replace their entire energy systems by the electricity from green

energy sources.

Transportation **:** Because electricity increasingly comes from natural gas and renewable energy, transportation became the major source of carbon dioxide emissions. A average car produces about five tons of carbon dioxide each year.

Drive Less, Drive Smart : It helps to reduce carbon dioxide emissions which means fewer carbon dioxide emissions because people will save on gasoline.

Hybrid Technology: It works in such a way that allows the cars to reduce their green house gas emissions significantly. Hybrid cars use more electricity than gasoline, thus help to reduce carbon dioxide emissions. Undoubtedly, cars related emissions are the major cause of global warming like manufacturing these cars, production of fuel together with making the roads is a major source of the gases which are harmful to the environment.

Plant a Tree : If you plant a tree means definitely it will reduce the global warming. Because it absorbs carbon dioxide and gives more oxygen. One tree can absorb around one ton of carbon dioxide in the whole of its lifetime.

These are the major steps to reduce the greenhouse gases emission. And some of the other steps are,

- Use less heat and Air conditioning
- Buy energy sufficient products
- Use less hot water
- Eating a plant based diet

- Avoid air travel as much as possible

Every year up to 13 million tons of plastic enter the ocean which is equivalent of one garbage truck of every minute according to the study. The plastic creates big problem for wildlife and for humans also. Birds, turtles and also other ocean creatures become ensnared in carrier bags, stuck in abandoned fishing gear and die because of plastic. The plastic problem is enormous, but it can be solved. Government should implement fee on polluting plastics.

Climate change and pollution, the results of human activities have significantly affected oceanographic conditions: warming of marine waters, desalination, and acidification of the sea, lack of oxygen, melting of sea ice, more and more toxic algae, reducing the abundance of other species such as phytoplankton and krill which are essential for feeding whales that are struggling to survive the vertiginous speed of climate change.

We should aware the people those who don't know about this. It's our duty to do that because, the people who are in nearby coastal areas may unaware of these. So, the marine life and the marine environment may blissful and safe. In all the countries we have the act and laws to protect these marine species (plants and animals). Just as,

- MMPA - Marine Mammal Protection Act
- MLPA - Marine Life Protection Act

- ODA - Ocean Dumping Act
- ESA - The Endangered Species Act

Conclusion

All these actions will help to reduce the amount of pollution we create and we can create a healthy ocean and also keep the animals from a threat or extinct. Without a healthy Ocean, there would be no life. By creating marine protected areas we can take care of the ocean. From mangroves to coral reefs, from polar regions to the ocean, these special places gives us hope for the future. The protection or conservation of marine areas and animals start from individual. Each and Everyone is the starting point, it is start from within us. Surely we could protect our nature.

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MIYAWAKI FOREST: A RARELY EXPLORED SOLUTION FOR CLIMATE CHANGE

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Introduction

Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. Effects that scientists had predicted in the past would result from global climate change are now occurring such as loss of sea ice, accelerated sea level rise and longer, more intense heat waves. Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gases produced by human activities. Net annual costs will increase over time as global temperatures increase. Climate changes have been caused by many natural factors, including changes in the sun, emissions from volcanoes, variations in Earth's orbit and levels of carbon dioxide. Global climate change has typically occurred very slowly over thousands or millions of years. Some notable effects of global climate change are rising maximum temperatures, rising minimum temperatures, rising sea levels, higher ocean temperatures, an increase in heavy precipitation (heavy rain and hail), shrinking glaciers, thawing permafrost.

Miyawaki Forestation

The Miyawaki forestation method is a unique way to create an urban forest pioneered by Japanese botanist Akira Miyawaki. In the Miyawaki technique, various native species of plants are planted close to each other so that the greens receive sunlight only from the top and grow upwards than sideways. As a result, the plantation becomes approximately 30 times denser, grows 10 times faster and becomes maintenance-free after a span of 3 years. Here are the basic steps to create an urban forest with the Miyawaki method. Ideally the selected site should have minimum dimensions of 4 by 3 metres and receive sunlight for at least 8 hours a day.

Step 1: Determining the Soil Texture and Quantifying Biomass

Soil texture helps determine water holding capacity, water infiltration, root perforation capacity, nutrient retention and erodibility. The soil would be suitable if the texture is sandy, loamy or clayey.

What to add to the Soil

- ***Perforator*** materials help to improve perforation and allow roots to grow quickly. For this, biomass can be used that is spongy and dry in nature. Husk is a by-product and easily available at grain mills and animal feed stores. Other options include rice husk, wheat husk, corn husk (chipped) or groundnut shells (chipped).
- ***Water retainer*** helps soil retain more moisture and water, as compared to its natural water retention

capacity. Natural materials such as coco-peat or dry sugarcane stalk can be used. A good test is to dip the material into water for some time, and take it out and squeeze. If water oozes out during squeezing, then the material can be used as water retainer.

- ***Organic fertilisers*** are required for nourishment. Different materials can be used depending on region and availability, such as cow manure, goat manure or vermicompost. Compared to vermicompost, manure is a slow nutrient-releasing plant fertiliser. Manure provides small amounts of nutrients over an extended period, whereas vermicompost gives high doses of nutrition initially but very little later on.

Step 2: Selecting Tree Species for Plantation

- Making a database of all native species of the area of plantation, identifying its type (Evergreen, Deciduous or Perennial), advantages, maximum height and assign layer.
- Checking the native species saplings availability in the nursery, their age and sapling height. Ideal height for miyawaki plantation is 60 to 80 centimeters.
- Choosing five different species to be the major forest species common in the area of plantation, which may constitute 40-50 percent of number of trees in the forest.

Step 3: Designing the Forest

- Master Plan: Identifying the exact area for afforestation so as to procure materials and execute the project. The minimum width of the project area

should be 3 metres, but 4 metres is recommended.

- Watering Plan: The water pipeline layout may need to be designed by an architect, based on the daily water requirement for the area, backed by borewells and overhead tanks. The forest should be watered regularly for the first 2-3 years.
- Planning Project Execution: Identify spaces such as the material/sapling/equipment storage areas, site office and resting area for labourers. There should also be approach roads to the afforestation area for earthmover access, and to the materials/saplings storage areas for truck access, if the project area is large.

Step 4: Preparing the Area

- Site inspection: Visiting the site to determine the feasibility and scope of the project. After taking pictures of the site, the availability of fencing, maintenance staff, running water and sunlight could be confirmed. The site should get sunlight for a minimum of 8-9 hours a day. No pipes/drains/wires or debris should be present in the area.
- Removing debris and weeds: Weeds take away nutrition of the soil, and also restrict movement of materials and people. Either they should be cleaned manually, or using a JCB if the area is huge. Ensure that the pulled out weeds are disposed away from the site; else they may re-grow.
- Watering facility installation: There should be a main line with watering outlets for hoses, which can reach

the entire area of the forest. Watering should be done everyday manually using a hosepipe with a shower or by drip irrigation, sprinklers etc. The requirement is around 5 litres/sq metre per day.

Step 5: Planting the Trees

- Mixing materials: Perforator, water retainer and fertiliser, all without clumps, should be mixed together. They should be mixed in the exact ratio as was decided initially, for each mound.
- Selecting trees for plantation: Placing plants to create a multi-layered, natural forest and trying to group plants that grow into different layers – shrub, sub tree, tree and canopy – in each sq. m. will be effective. No two trees of the same kind should be placed next to each other with a distance of 60 cm between saplings. The goal is to have random, dense plantation of native tree species.
- Plantation: To plant the tree gently in the pit it needs digging a small pit on the mound with a trowel and removing the root bag in which the plant was growing. Levelling the soil outside gently around the stem of the plant not pressing or compacting the soil is recommended and there should not be more than 8-10 people on a mound at a time, since the idea is to plant on loose, aerated soil.
- Mulching: Mulch should be evenly laid out on the soil, in a 5-7 inch layer. To ensure that the mulch stays on the ground and does not fly around, it should be tied down with jute ropes. For this,

bamboo pegs should be nailed at the periphery of the forest. There should be 30 pegs, each around 2 ft long, around every 100 sqm mound.

- First watering: The first time, the forest should be watered for an hour. Minimum water requirement is 5 litres per sqm, or 500 litres per 100 sqm mound.

Step 6: Looking after the Forest for Three Years

- *Monitoring:* The forest should be monitored once in 1-2 months, to check if the targets have been achieved and if any changes should be made to improve results. This should be done the first 8-12 months. Growth of selected species should also be monitored by counting the saplings that have survived, and recording the data.
- *Maintenance:*
    - Watering the forest with hose pipe once a day.
    - Keeping the forest weed-free for the first 2-3 years. Once the forest starts growing, weed growth will stop.
    - Ensuring that the plants stay straight, are not buried under the mulch, and are only loosely tied to the support stick.
    - Keeping the forest clean, and free of plastic, paper etc.
    - Maintaining proper drainage system so that water does not get accumulated anywhere in the forest.
    - Mortality rate of plants is usually 2-5 percent.

Mortality is to be checked only after 3-4 months of planting.

- Avoiding the use of any chemicals like pesticides or inorganic fertilizer in the forest will slowly build its own mechanism to keep itself healthy.

Role of Miyawaki Forests in Mitigating Urban Heat Island Effects

Loss in green cover and increased concretisation in urban areas has led to cities becoming 'urban heat islands', which pose significant threats to not just human populations but also contribute to global climate change. In countries like India that are highly vulnerable to climate breakdown, forests are an integral element towards mitigation. In this pledge to the UNFCC, the Indian government promised to cover 33% of its geographical area with forest cover by 2022, which currently stands at 24%. One possible method to achieve the target would be the Miyawaki method of afforestation. Also called the potted seedling method, this afforestation technique uses native species to create dense, multilayered forests. In the face of a climate breakdown, Miyawaki forests are a welcome addition to the environment.

Miyawaki in India

In India, this method is slowly gaining momentum. Many social enterprises has worked with various companies and individuals to create these forests. Recently, similar attempt was done with the Department of Biotechnology (DBT), Government of India (GOI) to convert a sewage-ridden patch of land near the Barapullah drain. This was part

of a bigger project named Local Treatment of Urban Sewage Streams for Healthy Reuse (LOTUS HR) to clean the drain. LOTUS is a joint initiative of DBT, Ministry of Science and Technology, and the GOI that set up a demonstration plant to clean up the Barapullah drain. Creating a tiny forest of 300 ft & 100 square metre, this method guarantees a high survival and growth rate compared to conventional forests and experts look at this method as a terrific option in urban cities where land and space are a constraint. Allowing maximum optimization of land, the results are very rewarding with a visible increase in growth.

Miyawaki in Thoothukudi

Thuvakkam trust, an NGO with the support of Thoothukudi Corporation has adopted Miyawaki method of creating urban forest and implemented at Pasumpon Nagar, Thoothukudi. Around 1500+ trees of 90 different species are planted in 15,000 sq.ft by 250+ Volunteers, Mr Sandeep Nanduri I.A.S, the then district collector of Thoothukudi jointly with Dr Alby John Varghese I.A.S, the then corporation commissioner and other officials initiated this green cover project at Thoothukudi as a debut project. In first Phase a deep pit which measures about 15,000 sq.ft were 3 feet was dug at right piece of land allowed to dry for a week. In second phase pit is filled with one layer of vegetable waste compost followed by Perforator like Rice husk / wheat husk, Water Retainer like Coco Beat /Saw dust and Fertilizer like Cow Manure, Goat Manure were added. This is done in order to make sure soil has rich nutrients to support all trees. Third phase was conducted in which

1500+ saplings of 90+ different species of native trees were planted by keeping it at an approximate gap of 3 feet between each sapling. More than 250+ Volunteers which includes students from Annammal college, Kamaraj college and volunteers from local NGOs including All can trust, We can trust, RISE trust, Udhavum karangal, nallavan team, and nearby residents and children enthusiastically participated for this green initiative.

Miyawaki @ Annammal

After got inspired by participating in the Miyawaki plantation project held in Thoothukudi on 17.02.2019, the author of this article started planning for a similar green initiative project in small scale in the college she is working. As a result, many voluntary organizations came forward to sponsor for this event and successfully the Miyawaki Forest Plantation was inaugurated in Annammal College of Education for Women campus by Mrs. Kanimozhi Karunanidhi, Member of Parliament, Thoothukudi Constituency on 24.11.2019. Mrs. P. Geetha Jeevan, M.L.A; Thoothukudi served as the Guest of Honour. The sponsors for the plantation were Rotary Club of Seaside,Thoothukudi, Rajesh Tilak Multi specialty Hospital, Thoothukudi, Giants Group of Tuticorin, Giants Group of Tuticorin Saheli and We can Trust Thoothukudi.

Conclusion

Today Miyawaki forests are thriving in countries around the world, including Belgium, the Netherlands, the U.K., Pakistan, Curaçao and France. These projects are bringing together volunteers to transform small patches of

wasteland. The popularity of Miyawaki forests is also growing with initiatives in India. Urban forests not only bring many benefits to communities beyond their impact on biodiversity but also the green spaces can help to improve people's mental health, reduce the harmful effects of air pollution, and even counter the phenomenon of heat islands in cities, where expanses of concrete and asphalt raise temperatures unnaturally high.

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