Climate Change

Impact on Environment

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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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Introduction

Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. The observed changes in the Earth's climate since the early 20th century are mainly due to human activities, in particular the burning of fossil fuels, which increases the levels of heat-trapping greenhouse gases in the Earth's atmosphere, thus increasing the average temperature of the earth. These man-made increases in temperature are commonly known as global warming.

Natural processes can also contribute to climate change, including internal variability (e.g., cyclical ocean patterns like El Niño, La Niña and the Pacific Decadal Oscillation) and external forcing (e.g., volcanic activity, changes in the Sun's energy output, variations in Earth's orbit).

Scientists use observations from the ground, air and space, along with theoretical models, to monitor and study past, present and future climate change. Climate data records provide evidence of climate change key indicators.

Evidence

Earth's climate has changed throughout history. Just in the last 650,000 years there have been seven cycles of glacial advance and retreat, with the abrupt end of the last ice age about 11,700 years ago marking the beginning of the modern climate era and of human civilization.

The current warming trend is of particular significance because most of it is extremely to be the result of human activity of about greater than 95% probability since the mid of 20^{th} century and proceeding at a rate that is unprecedented over decades to millennia [1]. Earth-orbiting satellites and other technological advances reveal the signals of a changing climate.

The evidence for rapid climate change is due to

- ***Global Temperature Rise:*** The planet's average surface temperature has risen about 2.12^0F(1.18^0C) since the late 19^{th}century, a change driven largely by increased CO_2emissions into the atmosphere and other human activities. The years 2016 and 2020 are tied for the warmest year on record.
- ***Warming Ocean:*** The ocean has absorbed much of this increased heat, with the top 100 meters (about 328 feet) of ocean showing warming of more than 0.6^0 F (0.33^0 C) since 1969 [2]. Earth stores 90% of the extra energy in the ocean.
- ***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 279 billion tons of ice per year between 1993 and

2019, while Antarctica lost about 148 billion tons of ice per year.

- ***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 the snow is melting earlier[3].
- ***Sea Level Rise:*** Global sea level rose about 8 inches (20 centimeters) in the last century. The rate in the last two decades, however, is nearly double that of the last century and 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.
- ***Ocean Acidification:*** 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 between 20% and 30% of total anthropogenic carbon dioxide emissions**.**

Causes

Scientists attribute the global warming trend observed since the mid-20th century to the human expansion of the "greenhouse effect".Gases that contribute to the greenhouse effect include:

- ***Water Vapor:*** The most abundant greenhouse gas, increases as the Earth's atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect.
- ***Carbon dioxide (CO_2):*** A minor but very important component of the atmosphere, carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels. Humans have increased atmospheric CO_2 concentration by 47% since the Industrial Revolution began. This is the most important long-lived "forcing" of climate change.
- ***Methane:*** A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. It is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.
- ***Nitrous oxide:*** A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production and biomass burning.
- ***Chlorofluorocarbons (CFCs):*** On Earth, human activities are changing the natural greenhouse. Over the last century the burning of fossil fuels like coal and oil has increased the concentration of atmospheric carbon dioxide (CO_2). This happens because the coal or oil burning process combines carbon with oxygen in the air to make CO_2. To a lesser extent,

the clearing of land for agriculture, industry and other human activities has increased concentrations of greenhouse gases.

Climate extremes, such as droughts, floods and extreme temperatures, can lead to crop losses and threaten the livelihoods of agricultural producers and the food security of communities worldwide. Depending on the crop and ecosystem, weeds, pests, and fungi can also thrive under warmer temperatures, wetter climates and increasedCO_2 levels and climate change will likely increase weeds and pests.

The Role of Human Activity

In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change, a group of 1,300 independent scientific experts from countries all over the world under the auspices of the United Nations, concluded there's a more than 95 percent probability that human activities over the past 50 years have warmed our planet.

The industrial activities that our modern civilization depends upon have raised atmospheric carbon dioxide levels from 280 parts per million to 414 parts per million in the last 150 years. The panel also concluded there's a better than 95 percent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years [4].

Solar Irradiance

The amount of solar energy that Earth receives has followed the Sun’s natural 11-year cycle of small ups and downs with no net increase since the 1950s. Over the same

period, global temperature has risen markedly. It is therefore extremely unlikely that the Sun has caused the observed global temperature warming trend over the past half-century. Credit: NASA/JPL-Caltech

Solar radiation is highly variable spatially and temporally and this high variability has hampered integration of worldwide trends. This is in sharp contrast with greenhouse gases which mix well in the atmosphere and whose rate of increase can be discerned within a few years. Trends for individual sites are highly variable, and for some places and some parts of the world no change or increases in solar radiation have been found[5].

Indeed, studies show that solar variability has played a role in past climate changes. For example, a decrease in solar activity coupled with an increase in volcanic activity is thought to have helped trigger the Little Ice Age between approximately 1650 and 1850, when Greenland cooled from 1410 to the 1720s and glaciers advanced in the Alps.

Effects

Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gases produced by human activities. The Intergovernmental Panel on Climate Change (IPCC), which includes more than 1,300 scientists from the United States and other countries, forecasts a temperature rise of 2.5 to 10^0F over the next century.

The IPCC predicts that increases in global mean temperature of less than 1.8 to 5.4^0F (1 to 3^0C).Two degrees may sound like a small amount, but it's an unusual event in our

planet's recent history. Earth's climate record, preserved in tree rings, ice cores, and coral reefs, shows that the global average temperature is stable over long periods of time. Furthermore, small changes in temperature correspond to enormous changes in the environment. For example, at the end of the last ice age, when the Northeast United States was covered by more than 3,000 feet of ice, average temperatures were only 5^0 to 9^0cooler than today [6].

Future Effects

According to the Third and Fourth National Climate Assessment Reports, Global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally.

- ***Temperatures Will Continue to Rise:*** Earth's global average surface temperature in 2020 tied with 2016 as the warmest year on record, according to an analysis by NASA. Continuing the planet's long-term warming trend, the year's globally averaged temperature was 1.84^0F (1.02^0C) warmer than the baseline 1951-1980 mean, according to scientists at NASA's Goddard Institute for Space Studies (GISS) in New York.
- ***Frost-free Season (and Growing Season) will Lengthen:*** The length of the frost-free season has been increasing since the 1980s, affecting ecosystems and agriculture. In a future in which heat-trapping gas emissions continue to grow, increases of a month or more in the lengths of the frost-free and growing seasons. The increases will be considerably smaller if heat-trapping gas emissions are reduced.

➢ ***Changes in Precipitation Patterns:*** Changes in precipitation frequency and intensity have greatest impact on soil respiration in xeric ecosystems or dry seasons of mesic ecosystems. It has been observed that soil respiration in arid or semiarid areas shows dynamic changes within a raining cycle. The rate of respiration in dry soil usually bursts to a very high level after rainfall and then declines as the soil dries.

➢ ***More Droughts and Heat Waves:*** Droughts and heat waves everywhere are projected to become more intense and cold waves less intense everywhere. Summer temperatures are projected to continue rising and a reduction of soil moisture, which exacerbates heat waves, is projected for much in summer. By the end of this century, what have been once-in-20-year extreme heat days (one-day events) are projected to occur every two or three years over most of the nation.

➢ ***Hurricanes Will Become Stronger and More Intense:*** The intensity, frequency and duration of hurricanes, as well as the frequency of the strongest hurricanes, have all increased since the early 1980s. Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm.

➢ ***Sea Level Will Rise 1-8 feet by 2100:*** Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected 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. In the next several decades,

storm surges and high tides could combine with sea level rise and land subsidence to further increase flooding in many regions.

➢ ***Arctic Likely to Become Ice-Free:*** The Arctic Ocean is expected to become essentially ice free in summer before mid-century.

Summary

Multiple studies published in peer-reviewed scientific journals show that 97 percent or more of actively publishing climate scientists agree: Climate-warming trends over the past century are extremely likely due to human activities."Observations throughout the world make it clear that climate change is occurring and rigorous scientific research demonstrates that the greenhouse gases emitted by human activities are the primary driver". There will always be uncertainty in understanding a system as complex as the world's climate. However, there is now strong evidence that significant global warming is occurring. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001).

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A WORLDLY GROWING THREAT ON CLIMATE CHANGE – 2020

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Introduction

Climate change is a long-term significant change in the "average weather" of a region or of the earth as a whole. Average weather may include average temperature, precipitation and wind patterns. It involves changes in the variability or average state of the atmosphere over durations occurring over decades or longer time scales. Until now, changes in the global climate have occurred naturally, across centuries or millennia, because of continental drift, various astronomical cycles, variations in solar energy output, and volcanic activity. Over the past few decades, it has become increasingly apparent that human actions are changing atmospheric composition, thereby causing global climate change. Climate change weaves through our daily lives -- from global politics and business to sea levels and weather to the clothes we wear and the food we eat. Overwhelming evidence shows that climate change brings growing threats to each and every living organism across the globe.

Worldly Climate Change in the Past Years

Each part of the world is greatly affected by the climate change for the past few years. This climate change has become the very greatest threat to our planet and everyone on it, besides all-out war with modern weapons of mass-destruction. Some of them include,

- A flooded street in Miami Beach in September 2015. The flood was caused by a combination of seasonal high tides and a rise in sea levels due to climate change. Miami Beach has already built miles of seawalls and has embarked on a five-year, $400 million storm water pump program to keep the ocean waters from inundating the city.
- Sea water collects in front of a home in Tangier, Virginia, in May 2017. Tangier Island in Chesapeake Bay has lost two-thirds of its landmass since 1850. Now, the 1.2 square mile island is suffering from floods and erosion and is slowly sinking. Scientific Reports states that "the citizens of Tangier may become among the first climate change refugees in the continental USA."
- A NASA research aircraft flies over retreating glaciers on the Upper Baffin Bay coast of Greenland. Scientists say the Arctic is one of the regions hit hardest by climate change.
- In the Mississippi Delta, trees are withering away because of rising saltwater, creating "Ghost Forests."

- Powerful storms have swept a street in Sun Valley, Southern California in February 2017 after years of severe drought, in a "drought-to-deluge" cycle that some believe it is consistent with the consequences of global warming.
- A wooden pole that had been driven into the ice the year before now stands exposed as the Aletsch glacier melts and sinks at a rate of about 10-13 meters per year near Bettmeralp, Switzerland.
- South Africa ranks as the 30th driest country in the world and is considered a water-scarce region. A highly variable climate causes uneven distribution of rainfall, making droughts even more extreme.
- Low tide reveals the extent of accelerated erosion shown by the amount of exposed beach rocks on Maafushi beach in the Maldives. This is the world's lowest-lying country, with no part lying more than six feet above sea level. The island nation's future is under threat from anticipated global sea level rise, with many of its islands already suffering from coastal erosion.
- Strawberries are lost due to a fungus that experts report It is caused by climate change in La Tigra, Honduras, in September 2016. According to German watch's Global Climate Risk Index, Honduras ranks among the countries most affected by climate change.

Some climate crises are big, noisy and obvious like hurricanes, typhoons, floods and wildfires. This worldly 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.

Inter-governmental Panel on Climate Change

Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gases produced by human activities. The Intergovernmental Panel on Climate Change (IPCC), which includes more than 1,300 scientists from the United States and other countries, forecasts a temperature rise of 2.5 to 10 degrees Fahrenheit over the next century.

According to the IPCC, the extent of climate change effects on individual regions will vary over time and with the ability of different societal and environmental systems to mitigate or adapt to change. The IPCC predicts that increases in global mean temperature of less than 1.8 to 5.4 degrees Fahrenheit (1 to 3 degrees Celsius) above 1990 levels will produce beneficial impacts in some regions and harmful ones in others. "Taken as a whole," the IPCC states, "the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time."

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. The India Meteorological

Department (IMD) says that the events are increasing in both frequency and intensity

This summer in Chennai, locals were praying for some rain; in Mumbai, people were reeling under a deluge. Long ago, these extreme disparities may have been solely blamed on nature's vagaries, but now science has established that human-induced climate change is playing a major role. Climate change, caused by emissions from industries and other human activity, is making the world warmer, disrupting rainfall patterns and increasing the frequency of extreme weather events. More than other country immune to these forces, India is particularly vulnerable. In parts of Rajasthan, Gujarat, Tamil Nadu, Kerala and the North-East, average temperature over the last decade has risen by nearly 1° C compared to the historical average in the 1950-80 period.

According to the World Bank, central districts in India are the most vulnerable to climate change because they lack the infrastructure and are largely agrarian. The districts in Maharashtra's Vidarbha region are particularly susceptible to climate change damage. These districts are already under severe rural distress, having experienced the greatest number of farmer suicides in recent years. In these districts, the World Bank suggests that GDP per capita could shrink by nearly 10% by 2050 because of climate change. According to the Global Climate Risk Index, India is the 14th most climate change-affected country in the world.

Climate change is also manifesting itself in the rise in extreme hot days (temperatures exceeding 35° C) across Indian cities. In cities, which are epicenters of economic activity, rising temperatures can increase the spread of diseases and hurt productivity.

Threat of Extreme Heat

India is already experiencing a warming climate. Unusual and unprecedented spells of hot weather are expected to occur far more frequently and cover much larger areas. Under 4°C warming, the west coast and southern India are projected to shift to new, high-temperature climatic regimes with significant impacts on agriculture.

Threat of Changing Rainfall Patterns

A decline in monsoon rainfall since the 1950s has already been observed. The frequency of heavy rainfall events has also increased. A 2°C rise in the world's average temperatures will make India's summer monsoon highly unpredictable. At 4°C warming, an extremely wet monsoon that currently has a chance of occurring only once in 100 years is projected to occur every 10 years by the end of the century. An abrupt change in the monsoon could precipitate a major crisis, triggering more frequent droughts as well as greater flooding in large parts of India. Dry years are expected to be drier and wet years wetter.

Threat of Droughts

Evidence indicates that parts of South Asia have become drier since the 1970s with an increase in the number of droughts. Droughts have major consequences. In 1987 and 2002-2003, droughts affected more than half of India's crop area and led to a huge fall in crop production. Droughts are expected to be more frequent in some areas, especially in north-western India, Jharkhand, Orissa and Chhattisgarh in the upcoming years. Crop yields are expected to fall significantly because of extreme heat by 2040.

Threat of Groundwater

More than 60% of India's agriculture is rain-fed, making the country highly dependent on groundwater. Even without climate change, 15% of India's groundwater resources are overexploited. Although it is difficult to predict future ground water levels, falling water tables can be expected to reduce further on account of increasing demand for water from a growing population, more affluent life styles, as well as from the services sector and industry. The efficient use of ground water resources should be incentivized.

Threat of Glacier Melt

Glaciers in the northwestern Himalayas and in the Karakoram range - where westerly winter winds are the major source of moisture - have remained stable or even advanced. At 2.5°C warming, melting glaciers and the loss of snow cover over the Himalayas are expected to threaten the stability and

reliability of northern India's primarily glacier-fed rivers, particularly the Indus and the Brahmaputra. The Indus and Brahmaputra are expected to see increased flows in spring when the snows melt, with flows reducing subsequently in late spring and summer.

Threat of Sea Level Rise

Mumbai has the world's largest population exposed to coastal flooding, with large parts of the city built on reclaimed land, below the high-tide mark. Rapid and unplanned urbanization further increases the risks of sea water intrusion. With India close to the equator, the sub-continent would see much higher rise in sea levels than higher latitudes. Sea-level rise and storm surges would lead to saltwater intrusion in the coastal areas, impacting agriculture, degrading groundwater quality, contaminating drinking water, and possibly causing a rise in diarrhea cases and cholera outbreaks.

Threat to Agriculture and Food Security

Even without climate change, world food prices are expected to increase due to growing populations and rising incomes, as well as a greater demand for bio-fuels. While overall rice yields have increased, rising temperatures with lower rainfall at the end of the growing season have caused a significant loss in India's rice production. Recent studies show that wheat yields peaked in India and Bangladesh around 2001 and have not increased since despite increasing fertilizer applications. Seasonal water scarcity, rising temperatures, and intrusion of sea water would threaten crop yields, jeopardizing

the country's food security. 2°C warming by the 2050s, the country may need to import more than twice the amount of food-grain that would be required without climate change.

Threat to Energy Security

Climate-related impacts on two dominant forms of power generation in India - hydropower and thermal power generation - both of which depend on adequate water supplies to function effectively. To function at full efficiency, thermal power plants need a constant supply of fresh cool water to maintain their cooling systems. The increasing variability and long-term decreases in river flows can pose a major challenge to hydropower plants and increase the risk of physical damage from landslides, flash floods, glacial lake outbursts, and other climate-related natural disasters. Decreases in the availability of water and increases in temperature will pose major risk factors to thermal power generation.

Threat to Water Security

Many parts of India are already experiencing water stress. Satisfying future demand for water will be a major challenge. Urbanization, population growth, economic development, and increasing demand for water from agriculture and industry are likely to aggravate the situation further. An increase in variability of monsoon rainfall is expected to increase water shortages in some areas. Studies have found that the threat to water security is very high over central India, along the mountain ranges of the Western Ghats, and in India's northeastern states.

Threat to Health

Climate change is expected to have major health impacts in India- increasing malnutrition and related health disorders - with the poor likely to be affected most severely. Child stunting is projected to increase by 35% by 2050 compared to a scenario without climate change. Malaria and other vector-borne diseases, along with diarrheal infections which are a major cause of child mortality, are likely to spread into areas where colder temperatures had previously limited transmission. Heat waves are likely to result in a very substantial rise in mortality and death, and injuries from extreme weather events are likely to increase in the future years.

Threat of Migration and Conflict

South Asia is a hotspot for the migration of people from disaster-affected or degraded areas to other national and international regions. The Indus and the Ganges-Brahmaputra-Meghna Basins are major trans boundary rivers, and increasing demand for water is already leading to tensions among countries over water sharing. Climate change impacts on agriculture and livelihoods can increase the number of climate refugees.

Threat of Global Warming

The Earth's climate is changing due to global warming/climate change caused primarily by the human use of oil, coal, and natural gas. The burning of these fossil fuels

releases carbon dioxide into the atmosphere, which traps more heat from the sun. The recent rapid global average temperature increase is indeed the result of human activity. While the climate is always changing, attribution studies using sophisticated supercomputer global climate models show that natural causes do not account for the recent rapid temperature increase and that human activity does.

Threat of Greenhouse Gases

The Greenhouse gases that cause climate change have a delayed effect, like a disease with a long incubation period. This means that we do not know how much irreversible damage we have done already - but we know that if we don't act now the effects will be many times more devastating still. The damage has been done mainly by the rich nations but the poorest will suffer worst and most immediately ...though everyone is threatened in the long run. Altogether the rise in greenhouse gas concentrations is just beginning to feed through into actual climatic impacts. The 2000s were the warmest decade on record.

Threat on Species and Ecosystem

A changing climate threatens species and ecosystems. The distribution of species is largely determined by climate, as is the distribution of ecosystems and plant vegetation zones. Climate change may shift these distributions but, for a number of reasons, plants and animals may not be able to adjust. The presence of roads, cities, and other barriers associated with human presence may provide no opportunity for distributional

shifts. For these reasons, some species and ecosystems are likely to be eliminated by climate change. As a consequence of these multiple forces, many scientists fear that by end of next century, perhaps 25 percent of existing species will be lost.

2020, COVID-19 and Climate Change

It is safe to say that 2020 has been the most disruptive and challenging year in many decades. The emergence of COVID-19 and its gradual spread around the globe brought in tremendous social and economic upheaval. In less than 12 months, nearly 70 million people have been infected and, regrettably, more than 1.6 million have died because of the corona virus pandemic. This most difficult and even overwhelming year has served to remind us of our ultimate dependence on the physical environment. It has confirmed the value of science as our most reliable instrument to understand and to overcome natural threats. It has proved that cooperation is the only way to address the challenges. The year 2020 also serve as a wake-up call for individuals, communities and nations in the face of another equally grave and urgent threat to humanity: climate change.2020 has been a year of falling short of the global goal of preventing a rise in average global temperature above 1.5°C. It also moved us away from the unsustainable exploitation of Earth's resources towards a more sustainable, equitable and climate-friendly future.

Conclusion

Earth is our home. We are part of this world and its destiny is our own. Life on this planet will be gravely affected

unless we embrace new practices, ethics, and values to guide our lives on a warming planet. By this Statement of Conscience, we declare that we should not acquiesce to the ongoing degradation and destruction of life that human actions are leaving to our children and grand children. Change, is not 'just another' environmental problem. We have only been significantly aware of it for the last twenty or so years...in that time it has revolutionized the environmental debate, and magnified beyond measure the scale of the environmental threat. So, "Saving the Planet" is not just a one-time talk. It is the responsibility of each human individual to remedy and mitigate climate change through innovation, cooperation, and self-discipline. We should undertake this work for the preservation of life on Earth.

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EFFECTS OF CLIMATE CHANGE CAUSED BY HUMAN BEINGS

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Introduction

Climate change is a periodic modification of earth's climate brought about as a result of changes in the atmosphere as well as interactions between the atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth's system. Climate change**,** includes both the global warming driven by human emissions of greenhouse gases, and the resulting large-scale shifts in weather patterns. Though there has been previous periods of climate change, since the mid-20th century, humans have had unprecedented impact on earth's climate system and caused change on a global scale.

Humans are increasingly influencing the climate and the earth's temperature by burning fossil fuels, cutting down rainforests and farming livestock. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming.

Many human activities involved in climate changes some of those are mentioned below.

1. Deforestation

Deforestation refers to cutting down trees or removal of trees from earth's surface by nature or manmade activities which affects ecosystems and biodiversity. Human beings or nature causes deforestation which leads to the change in climate and altered weather pattern. It can be characterized by the extreme heat or too much rainfall. Forest store large amount of carbon. Trees and other plants absorb carbon dioxide from the atmosphere as they grow. This is converted into carbon and stored in the plant's branches, leaves, trunks and soil. When forest are cleaned or burnt, stored carbon is released into the atmosphere, mainly as carbon dioxide. Averaged over 2015-2017, global loss of tropical forests contributed about 4.8billion tons of carbon dioxide per year. Industrial development and hydroelectric power plant projects also causes deforestation [1].

Deforestation increases the temperature of the earth which also leads to disturbance of the ice caps. Eventually, there is increased melting of ice in the Polar Regions which further leads to the rise in the ocean or sea level. Climate change is also a consequence of this activity. The soil gets washed away with rain water on sloppy area in the absence of trees leading to soil erosion. Due to action of strong wind mass of land gradually gets covered to sand deserts. Decrease in rainfall in the absence of forest rainfall decreases considerably

because forests bring rains and maintains high humidity in atmosphere.

Deforestation includes regional and global climate change. Climate has become warmer due to the lack of humidity in deforestation regions and also patterns of rainfall has changed. One of the major reasons for deforestation is forest fire. The most common hazard in forests is forests fire. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark. Forest Fire is caused by humans when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material [2].

Forest fire releases large amounts of carbon dioxide, black carbon, brown carbon, and ozone precursors into the atmosphere. These emissions affect clouds, and climate on regional and even global scale.

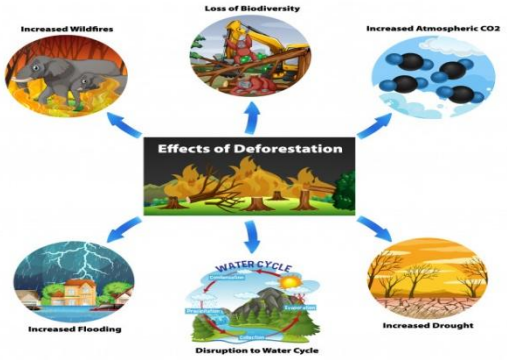

Figure 1 – Deforestation affects Climate Change

2. Industrialization

Industrialization is the period of social and economic change that transforms a human group from an agrarian society into an industrial society. Even though industries are important for the economic growth and development of a society, can also be harmful to the environment. Amongst other things industrial processes cause climate change, pollution to air, water and soil, health issues, extinction of species, and more.

The causes of global warming are found in the multiple consequences of industrialization. Industrial emissions, pollution, overpopulation and deforestation are double-duty issues being the negative effects of industrialization, they are also the main causes of global warming. Most scientists agree that "the blame for air and land pollution, global warming and ozone depletion have all been laid at the door of industrialization. These issues of pollution have been intensified in the large urban areas which developed as a result of industrialization". Industrialization is an ongoing process in modern society and its effects are long lasting, which is why the problem of global warming persists today.

Just as global warming is an issue that is evident on a global scale, its intersection with the interior design industry can also be seen around the world. As accurately stated by the American Society of Interior Design (ASID), "building interiors are fitted with materials, products and systems from a network of raw materials that stretches around the globe". Also, the processes involved with the manufacturing and

transportation of these materials and products can sometimes produce negative consequences that contribute to global warming. Since all areas of the world are connected in this interior design "network" it is logical that they are all connected, also, to its contributions to global warming[3].

3. Urbanization

Urbanization refers to general increase in population and the amount of industrialization of a settlement. It includes increase in the number and extent of cities. It symbolizes the movement of people from rural to urban areas. Due to uncontrolled urbanization environmental degradation has been occurring very rapidly and causing many problems like land insecurity, worsening water quality, excessive air pollution, noise and the problems of waste disposal.

Climate change affects urbanization that urban population meet the consequences by floods in the settlement areas like Chennai floods 2015. Urban people change their environment through their consumption of food, energy, water, and land. The three major effects of urbanization are

i) Loss of Biodiversity

ii)Insufficient ground water and

iii) Air pollution

As cities grow in number, spatial extent and density, their environmental and ecological footprints increase. Urban lifestyles, which tend to be consumptive, requiring great

natural resources and generating increasing amount of waste also lead to increased levels of air, water and soil pollution. 97% of the earth's water is stored in the oceans, and only a fraction of the remaining portion is usable freshwater.

This is a consequence of urban industry, emissions from cars, and the electricity demand. Around the world, companies use fossil fuels such as coal and petrol to generate electricity. Burning these compounds leads to an increase in air pollution and greenhouse gas emissions. Greenhouse gas emissions are largely responsible for global warming and climate change[4].

Figure 3: Impact of Urbanization on Climate Change

4. Air Pollution

The Earth's atmosphere is polluted in many different ways. Mostly air pollution is created by people. Though many living things emit carbon dioxide when they breathe, the gas is widely considered to be a pollutant when associated with cars, planes, power plants, and other human activities that involve the burning of fossil fuels such as gasoline and natural gas.

These manmade sources of pollution are called anthropogenic sources. Climate change and air pollution are closely interlinked. Air pollutants include more than just greenhouse gases principally carbon dioxide but also methane, nitrous oxide [5]. That's because carbon dioxide is the most common of the greenhouse gases, which trap heat in the atmosphere and contribute to climate change. Another pollutant associated with climate change is sulfur dioxide, a component of smog. Sulfur dioxide and closely related chemicals are known primarily as a cause of acid [6].

Air pollutants cause less-direct health effects when they contribute to climate change. Heat waves, extreme weather, food supply disruptions, and other effects related to increased greenhouse gases can have negative impacts on human health.

5. Livestock Forming

Livestock is commonly defined as domesticated animals raised in an agricultural setting to produce labor and commodities such as meat, eggs milk, fur, leather, and wool. Raising livestock generates 14.5 per cent of global greenhouse gas emissions that are very bad for the environment. Forests help lower the risks of sudden climate change and also tone down the impacts from natural disasters [7]. Livestock production is the largest methane source emitter in the world. In fact, animal agriculture is responsible for more greenhouse gases than all the world's transportation systems combined. About 92 per cent of the

fresh water is used for farming purposes, and 1/3rd of it is used for rearing livestock and manufacturing animal products. Livestock farming creates a huge carbon footprint and has a very high global warming potential.

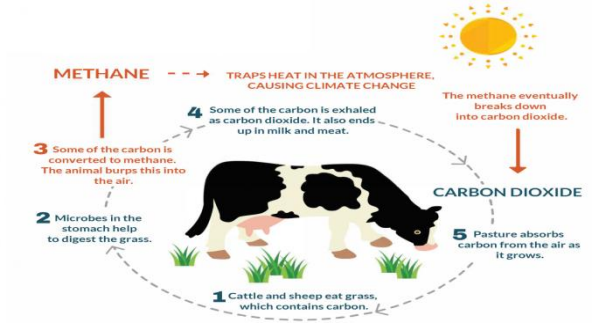

Figure 5 –Flow Diagram of Livestock Forming Affects the Climate Change

Conclusion

To reduce deforestation, we should encourage planting trees raise awareness in your circle and community so that greenhouse effect can reduce. Industrial pollution can be controlled by measuring the waste products from the industry. Changes in the construction industry which is turning to more efficiently produced products like cross-laminated timber can help to reduce carbon pollution. The solution to urbanization is building sustainable and environmentally friendly cities. Government should pass laws that plan and provide environmentally sound cities and smart growth technique, considering that people should not resist in unsafe pollutant areas. people everyday make simple changes

in their life taking public transportation instead of driving car or bike instead of travelling in carbon dioxide emitting vehicles are a couple of way to reduce global warming. And avoid burning leaves trash and other material avoid using gas powered lawn. so that reduces air pollution. We should follow this measure to reduce climate change.

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IMPACT OF SOIL MICRO – ORGANISMS AND SOIL HEALTH INDICATOR OF CLIMATE CHANGE

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Introduction

The Indian system of soil classification scheme included a very specific soil group "Microbisols" possessing beneficial and effective soil microorganisms. The ways in which microorganisms have been used over the last few decades to advance the medical technology, human and animal health, food processing, food safety and quality, genetic engineering, environmental protection, agricultural biotechnology and effective treatment of agricultural and municipal wastes provide conceptual and logical inputs for their application in soil based research across the globe.

But, while microbial technologies have been applied to various agricultural and environmental constraints with considerable success, they have hardly been accepted widely because of limitations in reliability of impacts. Microorganisms are effective optimum conditions for metabolizing their substrates including moisture, temperature, pH as well as oxygen (whether microorganisms

are obligate aerobes or facultative anaerobes). Since microorganisms are useful in eliminating the limitations associated with the use of chemical fertilizers, amendments and pesticides, they may be applied widely particularly in organic farming. Imbalanced environment caused by excessive soil erosion and the associated transport of sediment, chemical fertilizers and pesticides to surface and groundwater besides faulty exploitation of human and animal wastes has caused serious environmental and climatic problems. However, it is well documented that such problems cannot be solved without using microbial methods in agricultural production system.

Impact of Soil Micro-organism

Beneficial microorganisms are those that can fix atmospheric nitrogen, decompose organic wastes and residues, detoxify pesticides, suppress plant diseases and soil-borne pathogens, enhance nutrient cycling and produce bioactive compounds such as vitamins, hormones and enzymes that stimulate plant growth. Soil microorganisms are the major component of biochemical nutrient cycles and global fluxes of CH_4, CO_2 and N. Reports claim that the climate change is already changing the pattern of infectious diseases caused by soil pathogens. The harmful microorganisms are those that can induce plant diseases, stimulate soil-borne pathogens, immobilize nutrients and produce toxic and putrescent substances that adversely affect the plant growth.

Selected soil microorganisms mediate the N-cycles,

while methanotrophic bacteria help to oxidize methane into CO_2 in presence of oxygen. The high CO_2 concentration in soil accelerates the average growth of a plant and thus allows sequestering more CO_2. Bacteria and fungi in soil respiration help in organic matter decomposition forming CO_2. Global soils are estimated to contain twice as much C as the earth's atmosphere. It is thus logically emphasized that like many soil groups in the classification schemes, efforts should be made to characterize a soil specific dominantly to beneficial microorganisms effective in farming system and may be designated as Microbisols in respective classification scheme.

Soil Health Indicators of Climate Change

Soil health indicators are a composite set of measurable physical, chemical and biological attributes which relate to functional soil processes and can be used to evaluate soil health status, as affected by management and climate change attributes. 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 Soil health in relation to climate change may take into account the impacts of localized status of global warming index including existing levels of atmospheric green house gases, increased temperature, changing trend of frequency, intensity and distribution of rainfall, flood and drought events and atmospheric nitrogen deposition on soil chemical, physical, biological and fertility behaviours. But, the complexity associated with interactive effects causing the

climate change is not fully understood and needs a comprehensive interpretation to arrive at a sound but logical prediction. It is further to note that the soil health is often used synonymously as soil quality in soil science text books, but soil health provides better opportunities to emphasize both soil biodiversity as well as agro-ecology together in order to enable the soil as a dynamic living entity of nature.

Indigenous knowledge based on accumulated experience of the farming communities across the globe has been a powerful source to forecast the climatic happenings. In India, the folk poems of Great Ghagh are on everyone's lips to tell about the changing events in weather and climate. But, those poems are not coinciding to the actual climatic happenings of today. This is a strong indicator of deviation in climatic calendar in India. However, such indigenous tools need to be reviewed and tested globally. Until a few years before, incidence of flood in India was centered to only northern states like Bihar and Assam, but the situation now is completely changed and flood occurrence is becoming common to most of the states as of now. This year (2016), almost half of the Indian Territory has suffered from incidence of flood. Water tables beneath the soil are moving down after rain or flood at higher rate followed by manifestation of drought even in flood prone areas. There is severe infestation of pests and diseases not only in crops, but the soils also suffer from pathogens and harmful microorganisms.

Photopedogenesis that refers to interaction of light

with rock, soil, moisture and phototrophic microorganisms including soil organic matter may be tested in line with soil-climate chain. The lakes and rivers are drying, ground water levels are moving down and the glaciers are melting. Similarly, soil quality is getting deteriorated, soil water is getting contaminated and air for breathing is not safe. Such changes do have linkage with soil- water-forest chain in a particular eco-system and so with the climate even at micro levels.

Soil health indicators are a composite set of measurable physical, chemical and biological attributes which relate to functional soil processes and can be used to evaluate the soil health status as affected by climate change at least on location basis. 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. Soil health in relation to climate change may take into account the impacts of localized status of global warming index including existing levels of atmospheric green house gases, increased temperature, changed frequency, intensity and distribution of rainfall besides changing flood and drought events as well as atmospheric nitrogen deposition on soil chemical, physical, biological and fertility behaviours. But, the complexity associated with interactive effects of climate change is not fully understood and needs a comprehensive interpretation to arrive at a sound but logical prediction. It is further to note that the soil health is often used synonymously with soil quality, but soil health provides better opportunities to emphasize both soil biodiversity as

well as agro-ecology together in order to designate a soil as a dynamic living entity of nature.

How Much Carbon Can a Soil Sequester?

Current interest in carbon sequestration in soil rests on facts of how much organic carbon can virtually be stored in soil. The total organic carbon refers to the amount of carbon in the soil that also relates to the living organisms. By increasing the amount of OC stored in soil, one may improve the soil quality, since the OC contributes to favorable physical, chemical and biological processes in the soil environment.

In fact, the amount of organic carbon stored in soil is the sum of inputs to soil through plant and animal residues and losses from soil through decomposition, transformation, erosion and removal through flood or rain water. Increasing the total organic carbon in soil with subsequent reduction of CO_2 emission promotes soil quality for sustainable agriculture.

Obviously, the management practices that can maximize plant growth as well as vigor and minimize the losses of organic carbon from soil forms the basis of highest organic carbon storage in soil, wherein soil type forms the basis to decide the maximum capacity to store organic carbon. Without continual inputs of OC, the amount stored in soil will decrease over time because OC is always being decomposed by microorganisms. The process in which losses and gains of organic matter proceed simultaneously is described as turnover and may be defined as the flux of

organic matter through a given volume of soil. The turnover time is the amount of carbon in a soil system when equilibrium is reached divided by the annual input of carbon into that system. The off take of OC in crop or plant as well as animal produce is also a loss of OC from soil. Harvested materials such as grain, hay, feed and animal grazing all represent loss of OC including nutrients from the soil.

Organic carbon storage in soil is basically a function of associated components like soil type with defined organic matter turnover, existing climate and management inputs as depicted in Figure

Plant growth generally increases shoot, roots and root exudates with optimal nutrition under sound water use efficiency, but protection against pest and disease. By keeping soil covered with vegetation as well as crop residues or at least growing plants for longer duration by allowing shorter fallow followed by transfer from cropping to pasture or even agro forestry may promote OC stock in soil. Reducing the OM decomposition and erosion, improving soil aggregation and reducing soil compaction are all the precautionary measures to promote OC capture in soils.

The dynamic nature of soil carbon storage and interventions to foster is by and large conditional. Firstly, adoption of SOC- sequestration measures may take time and reasonably such schemes could only be implemented gradually at large-scale. Secondly, if soils are managed as carbon sinks, then SOC will increase only over a limited time, up to the point when a new SOC equilibrium is

reached. Thus, SOC sequestration is not a C wedge that could contribute increasingly to mitigate the climate change beyond the defined limitations associated with a soil type.

Fraction	Size	Turn over time	Composition
Dissolved organic matter	<45 (µm) (in solution)	Minutes to days	Soluble root exudates, sugars & by-products of decomposition, less than 5% of total SOM.
Particulate organic matter	53µm–2mm	2-50 years	Fresh decomposable plant and animal substances, 2-25% of total SOM.
Humus	<53µm	50-90 years	Decayed organic compounds, resistant to decomposition, more than 50% of total SOM.
Resistant organic matter	<53µm <2mm	100-200 years	Inert material, chemically resistant or organic remnants like charcoal, upto 10% of SOM.

Table : Fractions of soil organic matter (SOM) on generalized basis.

However, restoring or increasing the SOM through efficient management inputs could sustain the soil health, agro-ecosystem and inherent productivity besides potential additional sequestration of SOC. It is commonly assumed that the introduction of soil carbon sequestration measures on agricultural land, such as conservation agriculture, will continue to fix carbon at a constant rate for some decades into the future, but not beyond its capacity. There is no single technology in isolation to stop climate change without integration.

Immobisols: A proposed Soil Group in Ethiopia

In Ethiopia, the soils derived from basalt and even limestones under sub-temperate climate often show high C: N ratio . Apparently, the soil organic matter is strongly under immobilization processes. High biological activity is indicated by common, fine, open or filled channels or holes called krotovinas. However, termite mounds are seldom noticed in the vicinity of these soils. Ingestion of soils by insects may influence the association and chemical character of inorganic/ organic constituents in these soils. Generally, these soils are low in total nitrogen, but indicate appreciable amounts of available phosphorus.

They are further characterized with high clay contents (> 60%), prominent slickensides, clay skins, absence of gilgai [30,31] and with smectite, corrensite, attapulgite and iron-rich clay minerals. They are moderately well drained. It is probable that this suite of minerals form complexes with organic matter during biological activity and/or during

organic matter decomposition.

Morphologically, they have strong features of mollic, nitic and even vertic features along the soil depth. The surface horizons normally have granular to crumb structure, whereas sub-surface zones show blocky or prismatic structure of different grades. The vertic features of the surface soils remain suppressed due to the granular and/or crumb structure. Such a situation complicates the grouping of these soils into any of the recognized reference soil groups of the world. Philosophically, one may look for the proper soil grouping based on dominant criteria for management. In this respect, the dominant attribute of importance relates to organic matter immobilization. For this reason, we propose a new reference soil group called Immobisols, reflecting organic matter immobilization. The form together with state of organic matter in such soils plays a dominant role leading to immobilization. Even if the soil has adequate total nitrogen, its availability to plants appears to be restricted due to protected soil organic materials by clay minerals or even amorphous materials. This might explain significant crop response to applied nitrogen fertilizer, even though the total soil nitrogen is 0.4%.

First vs Second Green Revolution

The first green revolution was solely credited to crop breeders to evolve high yielding dwarf varieties of certain cereal crops. This was a very crucial situation of food crisis across the globe. The release of such high yielding cereal varieties was accepted like a gift of God everywhere to

combat against hunger. With great enthusiasm, government of the countries started supporting the farmers with inputs necessary for the recommended packages of crops such as tillage, irrigation, fertilizers and crop protection measures including insecticides, pesticides etc which all have been applied mostly through soils.

The partial factor productivity of a soil then started going down besides high rate of nutrient mining, emergence of pollution and toxicity of heavy metals like arsenic, fluoride, chromium, lead and many others. With the increasing population, the land area is virtually decreasing and as such, the problem of food security is at critical stage, if not disastrous. More importantly, there is global need of food safety with balanced nutrition.

However, with the advancement of technology generated in different facets as well as management techniques identified, we are now in a position to look for a better congenial environment coherent to the proposed soil based second green revolution in India

Conclusion

India developed a strong database on methodologies for assessment and application of climate change impacts and mitigation. Similar accumulated data across the globe may be reviewed on some international yardstick in order to establish the success stories to be utilized for generating useful technologies of relevance.

A new soil group proposed as Immobisols in Ethiopia is a good example to understand the soil based hidden facts of carbon sequestration. However, by restoring the soil health through conservation agriculture (as innovated by imposing "Soil Carbon Trade") following a strict policy to minimize the extent of land shrinkage (both rural and urban), a strong strategic base could be developed on way to maximize carbon sequestration as well as capturing the increasing trend of atmospheric temperature to its desired limit.

Besides, global necessity to insure clean energies generation by minimizing coal and fuel burning, petroleum consumption and irreversible uses through non-farming activities of lands is inevitable. By and large, the world has to be seriously aware of technological generation for utilizable transformation of solar energy in different fields of interest.

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IMPACT OF CLIMATE CHANGE ON PARASITES AND INFECTIOUS DISEASES OF AQUATIC ANIMALS

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Introduction

An ecosystem includes all living things (plants, animals and organisms) in a given area interacting with each other also with their environment (weather, earth, sun, soil, climate, atmosphere) The influence of climate change over all aquatic ecosystem has an impact on the plant and animal species in different aspect of their growth, feeding behaviour, migration and distribution.

Climate change is found to have the impact on the spread of parasites and disease in aquatic ecosystems. Effect of climate change on its host indirectly affects the parasites that depend on these hosts. These effects on host will cascade up leading to impact on communities and ecosystems which results in socioeconomic consequences. However, diseases may not increase with climate change but the distributions of parasites and pathogens will be fluctuated. Enhanced temperature has made its impact on changes in water levels, increased penetration of UV-Rays into atmosphere,

eutrophication, run-off and weather extremes. All these factors resulted in consequences for entire ecosystem and their food webs.

Effect of Temperature on Parasites

Global warming, a serious cause for the increased temperature on all aquatic ecosystem has its impact in altering the behavioural and morphological changes on the plant and animal species including the parasites that depend on these aquatic ecosystems. Increased temperature has resulted in faster embryonic development and hatching of parasites. It has also altered the lifecycle of parasites on these water bodies in its growth and maturation process.

Studies show that there was an eight fold increase of trematode species with a 10degree Celsius rise in temperature which is higher than the standard metabolic principles. There may be serious consequences for human population at risk of trematode diseases such as schistosomiasis, if temperature increases. Longer growing seasons and higher temperatures should lead to more generation of parasites and more frequent outbreak of disease from the increased transmission rate. It is also to be known that pathogens virulence of diseases increase at higher temperatures. For eg; virulence genes expresses in the bacterium *Flavo bacterium. columnare*, the causative agent of columnaris disease in fish, adhere more strongly to gill tissue at high temperatures. An increase or change in the endemic range of parasitic diseases as a result of climate change will have very serious repercussions. Climate change directly causes increases in temperature and affects weather

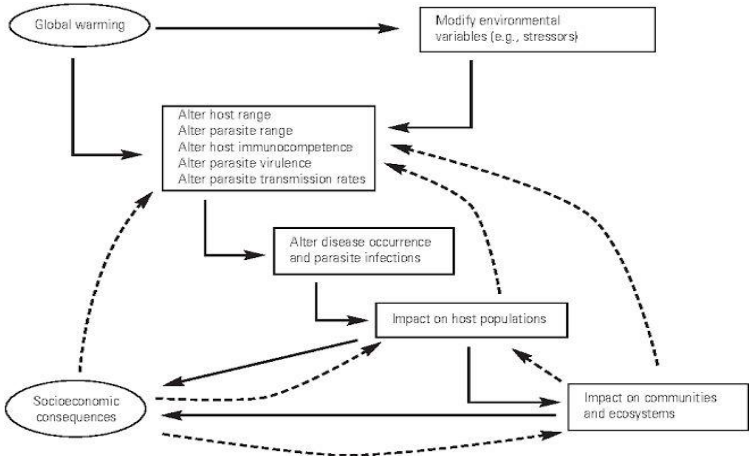
patterns, which indirectly can change spatial patterns of disease vectors and human populations.

Warm climate also increases the range of reservoir hosts, vector abundance, biting rates and overall survival, and parasitic transmission rates of vectors such as mosquitoes, ticks, and tsetse flies. Parasitic diseases are often the burden of tropical and subtropical communities because those climates promote species richness and therefore can support a multitude of potential hosts to sustain parasitic diseases. Complex host interactions are key to survivability and thrivability of parasites, and these complex interactions can be altered by a changing climate to promote infectious diseases. Increases in temperature affect the life cycles of parasites, which can directly affect how prevalent the organism is within the area, considering many parasitic organisms have a temperature-dependent developmental baseline, either within their host or in the environment.

Global climate change is predicted to alter the distribution and dynamics of soil-transmitted helminth infections, and yet host immunity can also influence the impact of warming on host-parasite interactions and mitigate the long-term effects. It is evident that climate warming increases the availability of infective stages of both helminth species and the proportional increase in the intensity of infection for the helminth not regulated by immunity.

Diseases in Marine Invertebrates

Global warming is negatively impacting the natural ecosystems by enforcing the glacial melting, sea level rise, enhanced lake evaporation, green house effects, increase ocean acidity, and biological invasions. Global warming-induced climatic changes affect directly and indirectly on land and water sources mainly by disturbing the balances between habitats of aquatic and terrestrial species. Climatic changes are happening across the globe and impacts on the nature and dynamics of flora and fauna. The most prominent examples include the earlier onset of spring and longer crop growing season, which are generally observed in several regions of the world. These climatic alterations are resulting in algal blooms and acidification of marine waters. Such algal blooms have been reported from different parts of world such as Australia, Japan, USA and Europe. Coastal marine ecosystems and their biodiversity are reportedly affected by global warming. Additionally, sea pollution particularly resulting from breaking



and recycle industry pollutants, overproduction and incorrect disposal of pharmaceuticals and overfishing have seriously affected the marine diversity.

The effect of climate change has resulted in increased mortalities of sea grasses, oysters, star fish, corals and sea urchins. Accelerated pathogen growth with reduced host resistance at higher temperatures is likely to result in a higher frequency of disease outbreaks. Another example is the transmission of black band disease (BBD) on Staghorn Coral also increases at higher temperature. Massive die-offs of the green Sea urchins, *Strongylocentrotus droebachiensis in coastal* North-eastern North America are associated with warmer sea surface temperatures. Higher water temperatures have resulted in coral bleaching with mortality reaching 70% in some regions.

Natural and Anthropogenic Factors Affecting the Marine Biodiversity

Changes in environmental factors due to pollution, construction of dams, increasing deposition of woody debris from human activities and climate changes effects aquatic ecosystems, especially their nutrient and carbon cycles. Considering pharmaceuticals as pollutants, they are originated from either overproduction or incorrect disposal may play an important part in the water pollution. There are additional sources of water pollution including ship-breaking and recycle industries (SBRIs), overfishing, organic matter (OM) pollution and global warming (GW). These cause deteriorations of habitats and marine biodiversity with algal blooms and acidification.

The 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. Human health and well-being is sustained by the critical ecosystem-services provided by biodiversity, which has been effected negatively by global warming in last decades. It was reported that Nitrogen, as a pollutant, caused losses in terrestrial and aquatic biodiversity under climate warming conditions.

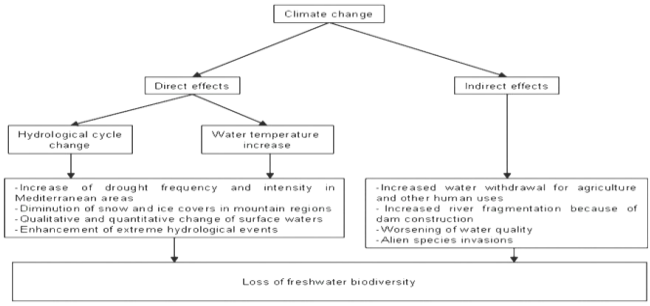
Effect on Freshwater Systems

Fresh water parasites (or) Pathogens on account of Global warming have resulted in increased rates of parasitism and disease. Effects on these parasites differ among species and are context-dependent. Even the similar parasites that affect different organisms may display different seasonal transmission patterns under the same thermally enhanced conditions. It is experimentally demonstrated that infection levels and parasite-induced mortality also increases under warmer conditions. This causes fluctuation in the species population. Parasites can regulate host populations, in freshwater systems influencing the composition, structure and function of biological communities. Climate change also leads to significant changes in groundwater recharge. Smaller change in temperature has been observed on those freshwater ecosystems that receive input from groundwater than those dependent on precipitation. In tropical and arid regions, water flows depend primarily on precipitation. In tropical rivers,

seasonal heavy rainfall events already surpass the natural infiltration rates of soil, leading to high sediment input. In tropical lakes, large scale decrease in the primary productivity have been observed and are likely to have a considerable impact on the rest of the food chain due to climate change. Climate warming cause changes in the physical and thermal stratification in temperate lakes and therefore effects the biotic communities. Changes in water level have a strong effect on river fishes than by changes in temperature. Rare species may get lost if the ephemeral wetlands (especially in arid regions) dry up.

Climate change is a naturally occurring event, but human activities have contributed significantly to changes in atmospheric conditions, resulting in an accelerated change in this process, and the current precarious state. Climate change is increasingly threatening as we continue to realize its potential impacts on global health and security

It can cause a serious impact when it conjoint with other stress factors such as pollution, hypoxia and desiccation. Eutrophication is predicted to increase in aquatic ecosystems and this is expected to affect parasite distribution and its abundance. Rising temperatures can directly affect the



Direct and indirect effects of climate change on freshwater biota.

metabolism, lifecycle and behaviour of aquatic species. It can also have an impact in their successful breeding. Changing climate could therefore retard sex ratios and also threatens population survival. Carbon dioxide released by human activities has resulted in the acidic condition of water bodies. This condition could affect the aquatic animals as they may find it harder to breathe as the dissolved oxygen becomes difficult to extract since the water turns more acidic. Even the transportation of nutrients between the deep and shallow waters has been affected due to variation in climate. It has even reduced oxygen levels at depth.

Conclusion

Outbreaks of numerous water borne diseases in both humans and aquatic organisms are linked to climatic events. There is much evidence to suggest that parasite and disease transmission and possibly virulence, will increase with global warming. Moreover, parasitism and disease may act along with other stress factors to further increase the effects of climate change on animals and human populations thus leading to socioeconomic consequences. Global climate experts agree that anthropogenic activities have significantly contributed to the increasing concentration of atmospheric greenhouse gases and destruction of ecosystems

Effect of thermally enhanced conditions have made a huge impact in the distribution and spreading of parasites. It has also created the biological consequences to the species that depend on the water bodies.

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GLOBAL WARMING: CLIMATE CHANGE

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Introduction

In today's era, the temperature of the planet earth is increasing day by day with a great extent which is very dangerous and highly disturbing. Global warming and climate change can be used transportable, but the term climate change includes all the reality of global warming and its effects like change in precipitation, adverse impacts that differ by regions.

Global Warming

Global warming refers to the gradual rise in the overall temperature of the atmosphere of the Earth. There are various activities taking place which have been increasing the temperature gradually. Global warming is melting our ice glaciers rapidly. This is extremely harmful to the earth as well as humans. It is quite challenging to control global warming; however, it is not unmanageable.

Definition

"Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by

increased levels of carbon dioxide, CFCs and other pollutants".

Global Warming and Climate Change

Global warming and climate change are two of the most pressing issues of the world today. Global warming refers to the heating up of the planet due to holes created on the ozone layer. The ozone layer protects our planet from harmful UV rays that the sun emits. This phenomenon causes our planet to heat up, and this concept is called global warming which leads to climate change. There are many human-made ways in which the holes in the ozone layer are created, which are harmful to us and our entire planet.

The Ozone layer is a layer that covers the Earth and acts as a protective cover from the harmful Ultra Violet rays or UV rays of the sun. This layer also helps to maintain the temperature on the planet to let life sustain on the planet. Recently, the world has changed the balance of the Ozone layer and the planet. Here, we are talking about global warming and climate change.

Over the last few decades, planet Earth has heated up a lot. This is called the phenomena of global warming, which means the warming up of the globe, i.e., Earth. Since we now live in the age of development and capitalism, there are factories all over the world that emit harmful fumes. These fumes are an example of the kind of substances that create the holes in the Ozone layer. These holes allow in harmful UV rays and heat the planet.

There are several reasons for global warming and climate change. The primary reason for global warming and climate

change is the greenhouse effect. The greenhouse effect refers to the entrapment of heat by greenhouse gases, such as carbon dioxide, nitrous oxide, etc. between the Ozone layer and the surface of the Earth, creating more and more heat as it remain trapped. This causes the temperature on the Earth to rise increasingly.

Causes of Global Warming

Global warming heats the surface of the Earth. Global warming generally refers to the anthropogenic component of climate change alone and only the surface warming associated with it. Earth is surrounded by various gases primarily Nitrogen and Oxygen and is 149,600,000 Km from the Sun. It consists of Carbon dioxide (CO_2), Methane ($CHCl_3$), Nitrous Oxide(N_2O). The term which defines this process is called as greenhouse effects. It is now feared that the warming effect is being undesirably increased, causing climatic changes and melting Polar Icecaps.

Following are the major causes of global warming:

Greenhouse Gases

Greenhouse gases play a vital role in the earth's climate cycles. As the planet gets hit with the sun's rays, some of the energy is absorbed, and the rest of that energy and heat gets reflected into space. Greenhouse gases in the atmosphere trap the reflected energy, redirecting it back down to the earth and eventually contributing to global warming. Various gases play this role, including:

- Water vapor
- Carbon dioxide (CO_2)
- Methane

- Nitrous oxide
- Chlorofluorocarbons (CFCs)

When fossil fuels are burned, they release large amounts of carbon dioxide, a greenhouse gas, into the air. Greenhouse gases trap heat in our atmosphere, causing global warming.

While some of these greenhouse gases, such as water vapor, are naturally occurring, others, such as CFCs, are synthetic. CO_2 is released into the atmosphere from both natural and human-made causes and is one of the leading contributors to climate change. CO_2 has been increasing at an alarming rate and has the potential to stay in the earth's atmosphere for thousands of years unless it gets absorbed by the ocean, land, trees, and other sources. However, as CO_2 production has steadily risen, the earth's natural resources to absorb it has also been diminished. This is already occurring in many ways as earth's resources are disappearing from things like deforestation. Some studies even predict that plants and soil will be able to absorb less CO_2 as the earth continues to warm - possibly accelerating climate change even further.

Solar Activity

Solar activity, as mentioned above, does play a role in the earth's climate. While the sun does go through natural cycles, increasing and decreasing the amount of energy that it emits to the earth, it is unlikely that solar activity is a major contributor to global warming or climate change. Since scientists began to measure the sun's energy hitting our atmosphere, there has not been a measurable upward trend.

Agriculture

There are many significant ways in which agriculture impacts climate change. From deforestation in places like the Amazon to the transportation and livestock that it takes to support agricultural efforts around the world, agriculture is responsible for a significant portion of the world's greenhouse gas emissions. However, agriculture is also an area that is making tremendous strides to become more sustainable. As productivity increases, less carbon is being emitted to produce more food. Agriculture also has the potential to act as a carbon sink, and could eventually absorb nearly the same amount of CO_2 it emits.

Deforestation

Deforestation and climate change often go hand in hand. Not only does climate change increase deforestation by way of wildfires and other extreme weather, but deforestation is also a major contributor to global warming. According to the Earth Day Network, deforestation is the second leading contributor to global greenhouse gasses. Many people and organizations fighting against climate change point to reducing deforestation as one of, if not the most, important issues that must be addressed to slow or prevent climate change.

Human Activity

According to the Environmental Protection Agency, the most significant contributor to climate change in the United States is the burning of fossil fuels for electricity, heat, and transportation. Of these factors, transportation in the form of cars, trucks, ships, trains, and planes emits the largest

percentage of CO_2–speeding up global warming and remaining a significant cause of climate change.

Livestock

While interconnected to many of the agricultural and deforestation issues we have already touched on, livestock in the form of cattle, sheep, pigs, and poultry play a significant role in climate change. According to one study, "Livestock and Climate Change," livestock around the world is responsible for 51% of annual global greenhouse gas emissions.

Global Warming: The Effects

Predicting the consequences of global warming is one of the most difficult tasks faced by the climate researchers. This is due to the fact that natural processes that cause rain, snowfall, hailstorms, rise in sea levels is reliant on many diverse factors. Moreover, it is very hard to predict the size of emissions of greenhouse gases in the future years as this is determined majorly through technological advancements and political decisions. Global warming produces many negative effects some of which are described here.

Following are the major effects of global warming:

Effects on the Physical Environment

Global warming changes the physical appearance of our environment. For example, glaciers will melt due to global warming and will eventually disappear.

Moreover, sea levels will rise and small islands will be covered by the sea. In addition, natural disasters and weather extremes due to global warming like droughts are likely to increase in number. Thus, affected areas will often change from fertile

land to deserted areas which will no longer be suitable for farming purposes.

Rise of Sea Levels

The global sea levels are rising due to global warming which destroys the habitat for several plants, animals and humans. The meltdown of glaciers and ice shields in the Antarctic could account for up to 90% of the rise in sea levels and thus is the biggest source of sea-level increase.

Antarctic glaciers are melting due to an increase in ocean temperature. Due to the rise in sea levels, many people will lose their homes. People who live in countries or islands which are located just a few feet above the sea level right now will lose their livelihood since the land that they currently inhabit will just be underwater in the near future.

Increase in heat waves

Since the year 1950, heatwaves and droughts have appeared more frequently. Moreover, extremely dry or wet periods during the monsoon season have increased. These increases in extreme weather conditions are likely to continue in the future.

Making things worse, scientists estimate that heat waves will become even more likely in the future due to the global warming issue. These heat waves will result in many other problems, including a shortage of drinking water in many poor countries.

Increase in Average Temperature

Moreover, apart from weather extremes, there will also be a significant increase in average temperature over time. There are many different estimates on the scale of global

warming, depending on the models underlying for the estimation. Most scientists agree that until the year 2100, the average air temperature will increase by 0.3-1.7 degrees.

However, there are some scientists that believe that the extent of global warming may be much more severe. Even estimates of 4.8 degrees exist in scientific discussions.

How big the increase will eventually be will be determined by human behavior. If we are able and willing to take suitable measures against global warming, we may be able to confine it to a certain extent.

Increase in Rainfalls and Wind Speed

Additionally, wind speed and maximum rainfalls from typhoons and hurricanes are increasing. Hurricanes usually get their power from warm ocean water.

Since trough global warming, not only air temperature, but also water temperature will increase, hurricanes and other tropical storms are likely to get stronger in the near future.

This may have severe impacts on the coastal cities, which may be hit by enormous winds. These winds may be powerful enough to destroy significant infrastructure and may also cause many deaths.

Effects on the Biosphere

Global warming has led to an expansion of drier climatic zones, e.g. the expansion of deserts in the subtropics. These changes in the structure and composition of ecosystems will move forward in the future if global warming cannot be mitigated. This effect is likely to lead to a reduction in diversity of the ecosystem and to an extinction of many species.

This also includes species living in the ocean. Although the ocean heated more slowly than land, even small changes in ocean temperature can cause large adverse effects on sea animals, plants and corals.

Social Tensions

There will be severe adverse effects of global warming on humans in the future. Since some regions of the world will be hit much harder than others, there will be large social tensions. Global inequality will even rise in the future because of the effects of global warming.

Effects on Agriculture

Also, agricultural production will be affected differently in different parts of the globe. While global warming is likely to have negative effects on crop yields in low-latitude countries, it may have positive effects on crop harvests in the northern latitudes.

Overall, there is a severe risk of global food scarcity, desertification and an increase in global inequality if the global warming process continues.

Shortage of Drinking Water

Moreover, also the supply with drinking water will become an even bigger problem in low-latitude countries. By 2050, up to 600 million people are likely to experience increased water stress due to climate change in Africa.

Human Health Effects

There are also severe impacts of global warming on human health. This includes effects from extreme weather leading to losses of lives and injuries and also adverse effects from under nutrition due to crop failures. Moreover, there has been found

evidence that increases in temperature could cause an increasing number of suicides.

Climate change also increases the probability of conflicts driven by economic shocks and poverty. It also contributes to a rise in crime rates and serious conflicts. It can also lead to a spread of diseases and even to new human forms of diseases.

Migration

As sea levels continue to rise, many islands will be flooded and human settlements and infrastructure will be destroyed. Since many people are likely to lose their livelihood and their homes, people will be forced to leave their home countries in order to find a better future.

This will likely lead to increased migration from low-latitude to high-latitude countries since the living conditions of high-latitude countries will be much better after the adverse effects of global warming manifested.

Change in Land Use

Many areas of land which are currently not suitable for agriculture, since it is too cold right now will become suitable for farming purposes due to global warming in the future. Thus, global warming will have an upside for countries with large areas of land in cold climate zones. Due to global warming, they will be able to farm these areas of land and to harvest significant amounts of crop yields.

Solutions

Climate change is motivated mainly by the use of fossil fuels and secondly by greenhouse gas emissions through deforestation, agriculture and other causes that are less prominent.

The main way of solving global warming is to eliminate wherever possible the position of fossil fuels in contemporary culture. This implies transitioning to renewable and carbon-free power sources such as solar, wind, and hydro, resulting in less than 3% of fossil fuel power greenhouse gas emissions.

Secondly, with sustainable forestry and land-use methods, deforestation should be avoided and substituted. Because crops breathe in and store carbon dioxide, they effectively remove atmospheric carbon dioxide. There are therefore two methods to fix climate change in the easy sense.

Firstly, reduce and prevent greenhouse gas emissions including carbon dioxide, methane and nitrous oxide. Secondly, remove carbon dioxide from the environment by enabling trees, oceans and other natural structures to behave as sinks of carbon–which is what they do naturally. By ending deforestation, ocean habitat destruction and encouraging sustainable forestry, we can encourage this removal of greenhouse gasses from the atmosphere.

Other Solutions

As elaborated earlier, toxic emissions are a major cause of global warming, A solution to reduce harmful emissions is to cut the usage of vehicles which produce them. This has not been met with much success as many people refuse to cut down their practice of using cars. No doubt, some people have started to use bicycles and public transport, whereas some other prefer to walk but these numbers are relatively small. It should be noted that fuel economy and emission rates are chief factors to consider regarding the car choice. Hybrid cars have

higher efficiency and lower emission rates. Keeping the tires inflated will help improve mileage and air filters should be frequently replaced to cut down harmful emissions. People should share the ride with friends or co-workers to reduce the total number of vehicles on the road. Print and social media can play an effective role in curbing the problem. It should use the philosophy of automobile advertisements to encourage drivers to conserve energy and reduce pollution. Awareness campaigns can be started using placards, posters and logos. They are a very useful way to demonstrate that global warming is not good for the planet. Recycling is also a good way to reduce global warming. People should use rechargeable batteries instead of disposable ones. Quality products should be bought that have a long life. Shopping should be done from local markets which reduce transportation. Even small individual efforts like lowering the thermostats in winter and using compact fluorescent lamps instead of incandescent lamps can aid to address the issue of global warming. Reforestation schemes must be started to grow a large number of trees. Forest degradation and deforestation must be discouraged at government level.

Conclusion

Global warming has become a well-conversed topic among scientists and peoples in the world today. Some extremists do everything possible to stop contributing to the warming, but the average person does little to alleviate the issue and, in many cases, refuses to acknowledge that there is a problem at all. This chapter provides all the information about global warming its causes, effects and how we can overcome

this problem in the present era. In this century the environmental problems are increasing day by day this chapter provides some easy solutions for it.

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IMPACT OF CLIMATE CHANGE ON ENVIRONMENT

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Introduction

The existence of life on earth is because of the appropriate climatic condition in the environment. The unwanted abrupt change in the climate may hinder the physical and chemical environment for life. The quality of life is affected directly or indirectly by both the influence of Human-induced change in the climate and the global environmental issues. The loss of biological diversity and the ozone depletion disturbs the basic human needs. Air, water, food and energy cannot be replaced by any means; hence the basic needs must be available in pure and safer way. Therefore the changing climate must be controlled to protect the life of human beings, animals, plants and our planet from extinction.

Each year 15million babies are born premature, the leading cause of death among children under five is women exposure to high temperatures and heat waves during pregnancy . This likely increase with global warming especially during more frequent and intense heat waves.

Global warming has seen Earth's average temperature rise by 1degree Celsius over the last century, with greater increases over large land masses. According to the UN's climate science advisory panel the number of exceptionally hot days are expected to increase most in the tropics. The new study also found that still births are also associated with the prevailing climate change.

The current trend of catastrophic climate events results from a mere 0.6 degree Celsius temperature rise in the last 100 years. India is already the fifth most vulnerable country globally in terms of extreme climate events and it is all set to become the world's flood capital. In the last 50 years, the frequency of flood events increased almost eight times. Further, events associated with floods such as landslides, heavy rainfall, hailstorms, thunderstorms, and cloudbursts increased by over 20times. The frequency of floods surged significantly in the last two decades. Between 1970 and 2004, three extreme flood events occurred over year on average. However after 2005, the yearly average rose to 11. Also, the yearly average for districts affected until 2005 was 19, but after 2005, it jumped to 55. In 2019, India witnessed 16 extreme flood events, which affected 151 districts.

Over 75 percent of Indian districts, which are home to more than 638million people are hotspots extreme climate events such as cyclones, floods, droughts,and cold waves. The study by the Council on Energy Environment and Water (CEEW) said that the frequency, intensity and unpredictability

of these extreme events have also risen in recent decades. While the country witnessed 250 extreme climate events between 1970 and 2005. It recorded 310 extreme weather events post 2005 alone. The study also found a shift in the pattern of extreme climate events such as flood prone areas becoming drought prone and vice-versa in over 40% of Indian Districts. Over 97 million people were currently being exposed to extreme floods in India. After 2000, there has been a rise in urban floods due to flawed urban planning, encroachments on wetlands and deforestation.

The Copernicus Climate Change service (C3S) analysis of surface and air temperature found that November 2020 was 0.8degree warmer than the 30 year average of 1981-2010 more than 0.1 degree C hotter than the previous record. For boreal autumn (September-November) temperatures in Europe were 1.9 degree Celsius above the standard reference period. 0.4 degree higher than the average temperature in 2006, which was the previous warmest. C3S directors says "These records are consistent with the long term warming trend of the global climate". All policy makers who prioritize mitigating climate risks should see these records as alarm bells and consider more seriously than ever how to best comply with the international commitments set out in the 2015 "Paris Agreement".

The United Nations World Meteorological Organization said 2020 was on course to be among the three hottest years recorded. With just over 1 degree of warming so far, Earth is already dealing with the devastation caused by

more frequent and stronger extreme weather events such as wildfires and tropical storms. Satellite images analysed by C3S also showed that Artic sea ice extent was the second lowest for the November in the database which began in 1979. The largest negative sea ice concentration anomalies were in the Kara Sea, while there was below average cover in the eastern Canadian archipelago and Baffin Bay. This trend is concerning and highlights the importance of comprehensive monitoring of the Artic , as it is warming faster than the rest of the world. Temperatures were sustainably higher than normal across the Artic and much of Siberia last month and higher than average across the United States, South America, South Africa, Eastern Antarctica and most of Australia.

The Global Carbon Project an authoritative group of dozens of International scientists who track emissions calculated that the world will have put 37 billion US tons of carbon di- oxide in the air in 2020. That's down from 40.1 billion US tons in 2019. Scientists found that this drop is chiefly because people are staying home, travelling less by car and plane because of the pandemic Covid-19. The calculations based on reports detailing energy use, industrial production and daily mobility counts-were praised as accurate by outside scientists. Even with the drop in 2020, the world on average put 1,185 tons (1,075 metric tons) of carbon dioxide into the air every second.

The climatic change has made the massive Green land ice sheet in London facing a point of no return, beyond which

it may no longer fully re-grow, permanently changing sea levels around the world. The effects of Greenland ice sheets melting under a range of possible temperature rises, ranging from minimal warming to worst-case scenarios. At current rates of melting the ice sheets contributes almost one millimeter to sea level per year, accounting for around a quarter of the total increase. Once the ice sheet retreats from the Northern part of the island the area would remain ice-free.

Rising temperature worldwide is expected to adversely affect the global water cycle in major river basins including the Ganga and Brahmaputra. Researchers from India's IISc and Australia's University of New South Wales used satellite-derived estimates of total annual recharge to investigate the effect of rise in temperature for areas drained by 31 major rivers around the world. These includes the Amazon, Ganga, Brahmaputra, Indus, Nile, Tigris-Euphrates, Mekong and Mississippi, alongside which most of the global population resides.

The area drained by 23 out of these 31 rivers showed reduced recharge with increase in temperature, vegetation growth in these areas also reduced, owing to decline in the annual water recharge. This is the result of just 0.9 degree C rise in global temperature; the impact of the 3.5 degree C by the end of this century that is expected is a major concern.

The study based on Gravity Recovery and Climate Experiment (GRACE) satellite observations are the first of their kind and in line with future projections from

mathematical models. In a future warmer climate, even an unchanged precipitation expected to exacerbate it further. Subsequently availability of water is expected to be reduced in many parts of the world just due to rising global temperatures. These changes could threaten the water and food security of human beings as well as the flora and fauna around us, jeopardizing human life and ecosystems alike.

Climate change continued it's relentless in March 2020, with the year on course to be one of the three warmest ever recorded. The past 6 years, 2015 to 2020 are set to make up all six of the hottest years according to the World Meteorological Organization (WMO). More than 80% of global ocean experienced a marine heat wave at some time in 2020, with widespread repercussions for marine ecosystems that are already threatened by acidic waters due to carbon di-oxide absorption, the WMO said in its provisional 2020state of the Global Climate Report.

The report which is based on contributions of dozens of international organizations and experts, shows how high impact events including extreme heat, wildfires and floods, as well as the record breaking Atlantic hurricane season, affected millions of people, compounding threats to human health and security and economic stability posed by the Covid -19 pandemic.

Despite the Covid-19 lockdown, atmosphere concentrations of greenhouse gases continued to rise, pushing

the planet to further warming for many generations to come because of the long lifetime of CO2 in the atmosphere.

The average global temperature in 2020 is set to be about 1.2 degree C above the pre-industrial (1850-1900) level. There is at least a one in five chance of it temporarily exceeding 1.5degree C by 2024. Records warns years have usually coincided with a strong EI Nino event, as was the case in 2016. 2020 saw new extreme temperatures on land ,sea and especially in the Arctic. Wildfires consumed vast areas in Australia, Siberia, the US West Coast and South America. Flooding in parts of Africa and South East led to massive population displacement and undermined food security for millions.

Populations aged 65years and older are particularly vulnerable to the health effects of climate change and extreme heat. In 2019, about 77.5 crore people were impacted by heat exposure in India with 31,000 deaths. New evidence from the countdown reports shows that the last two decades have seen a 54 per cent increase in heat related deaths among the elderly, with a record 2.9billion additional days of heat wave exposure affecting those over 65s in 2019. The period saw growing levels of heat-related mortality among vulnerable people in all parts of the world, with 2,96,000 deaths in 2018.

In 2019, India saw a record number of above base-line days of heat wave exposure affecting its elderly population, at almost 775 million. Eight of the 10 highest ranking years of heat wave exposure in India have occurred since 2010.

Meanwhile, heat related deaths in the over 65years have more than doubled since the early 2000s to more than 31,000 in 2018.

Heat and drought are also driving sharp increases in exposure to wildfires, resulting in burns, heat and lung damage from smoke and the displacement of communities. India per capita spend on health adaptation is just $0.80 rising from $0.60 in 2015-16. Livelihoods are also at risks as heat is increasingly affecting people's ability to work out-doors in developing regions.

Most people know that land-dwelling dinosaurs were wiped out some 66million years ago when an asteroid roughly twice the diameter of Paris crashed into Earth. But more than 100million years ago, another climate change cataclysm devasted a different set of dinosaur species with many going extinct. It was global warming rather than global cooling that did them in with the planet heating up more quickly than the dinos capacity to adopt. Scientists have found evidence of this traumatic event some 179 million years ago in plant fossils in argentine Patagonia. They also discovered a previously unknown dinosaur. The species, called Bagualia Alba, is in the family of massive, long-necked sauropods, the largest animals to walk the Earth.

Before the global warming event, sauropods were only one branch of the Sauropodomorpha lineage. Other dinosaurs in the same group were smaller and lightly built , with some no bigger than a goat. Smaller Sauropodomorpha dinosaurs were

unable to cope with the change, but larger sauropods like the Bagualia Alba thrived.

Change in climate can increase infectious disease risk in animals, with the possibility that these disease could spread to humans. This is based on the phenomenon known as 'thermal mismatch hypothesis' which is the idea that the greatest risk for infectious disease in cold climate-adapted animals such as polar bears occurs as temperature rises. The hypothesis proposes that smaller organisms like pathogens function across a wider range of temperatures than larger organisms such as hosts or animals.

Understanding how the spread, severity and distribution of animals infectious diseases could change in the future has reached a new level of importance as a result of the global pandemic caused by SARS-CoV-2 a pathogen which appears to have originated from wildlife. The majority of emerging infectious disease events has a wildlife origin, this is yet another reason to implement mitigation strategies to reduce climate change.

The research team collected data from more than 7000 surveys of different animal host-parasite systems across all seven continents to provide a diverse representation of animals and their pathogens in both aquatic and terrestrial environments. Pathogens found at warm locations outperform their animal hosts during cool weather as warm-adapted animals perform poorly. Similarly pathogens found at cool

locations thrive at warm temperatures while cold-adapted animals are less tolerant to heat.

Climate change affects the environment at its fullest; it leads to decline in salinization and organic matter. It aggravates erosion and leads to landslides, flooding and desertification. Fast melting of snow or ice and river discharges influences soil degradation. Extreme precipitation, increased droughts are climate-related events. Salt water intrusion from seaside made the saline soils to get collected in the coastal areas because of the rising sea-levels.

Climate change has leading impacts on both species and ecosystems directly or indirectly. Biodiversity is continuously responding to the climate change. Direct impacts on habitat structure phenology, habitat structure, species abundance and ecosystem processes. Indirect impact is more damaging than the direct impacts because of its speed and scope. Pollution of water, soil and air, over-exploitation and spread of invasive species are the major areas of indirect impacts which has to be looked in cautiously and must be rectified through proper methods, otherwise climate regulation, clean air, food, water and capacity to control floods or erosion will reduce the resilience of ecosystem to climate change. The over health of aquatic ecosystems is determine by the water temperature. The climate change have increased the temperature of rivers and lakes, and decreased the ice cover this will inversely affect the water quality and fresh water ecosystems.

Conclusion

Climate change may bring major changes in the environment. It will increase the chance of water scarcity and flood in many of the continent. It is of higher risk which has to be rectified at the present situation. It may affect many marine regions, natural environments and species. Changes in the temperature and ocean circulation have the potential to change the geographical distribution. Hence it is the need of the hour to pay more attention towards the climate change to save the future generation from extinction.

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GREEN HOUSE EFFECT AND CLIMATIC CHANGE

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Introduction

Climate change due to 'enhanced greenhouse effect', arising as a result of human activities is considered a major global environmental threat to mankind. The Earth provides a unique life-supporting environment. Solar radiation has been responsible for maintaining the Earth's climatic system, the biosphere and fuelling the present technological age. Earth's temperature is a result of the equilibrium between the solar energy absorbed by the Earth and the long wave (infra-red) radiation from the Earth escaping into space. The natural greenhouse effect arises due to some of the trace gases, called the greenhouse gases, which are nearly transparent to solar radiation but strongly absorb the infra-red radiation emitted by the Earth. This results in a warming of the Earth by about 30°Cand makes it habitable. Since industrialization, human activities have resulted in steadily increasing concentrations of the greenhouse gases - carbon dioxide, methane, nitrous oxide and chlorofluorocarbons--in the atmosphere, leading to fears of the 'enhanced greenhouse effect'. Carbon dioxide alone contributes roughly two-thirds to the “enhanced greenhouse effect”.

Past records suggest that the Earth has warmed by 0.5°C and the global sea level has increased by 15 cm since the beginning of this century. Climate models predict a further

warming of 0.3°C per decade if no efforts are made to decrease emissions of greenhouse gases. This warming rate is higher than that at any time during the past 10000 years and is likely to cause global changes in agricultural patterns, precipitation, water resources, rise in sea levels and inundation of coastal areas, occurrence of more frequent and intense extreme events such as droughts and hurricanes. African nations will be particularly vulnerable to some of these changes. Uncertainties do remain in the predictions of climate change at regional level and the scale and timing of such changes. Limitation and adaptation strategies need to be developed and implemented. Decreasing use of fossil fuels and increasing use of alternative sources of energy-solar, wind, hydro, biomass coupled with energy conservation strategies are needed to reduce emissions of greenhouse gases.

Reducing deforestation and embarking on reforestation programs is needed to increase the sinks of carbon dioxide. More research is needed to enable better understanding of climate processes and decrease uncertainties in climate predictions. Climate data, analyses and information need to be utilized in planning processes. Climate change due to the man-made greenhouse effect has emerged as a major environmental challenge facing mankind today.

International agencies which are playing important roles to meet this challenge include United Nations Environment Program (UNEP), the Global Environment Facility (GEF), World Bank, United Nations Development Program (UNDP) and the International Geosphere Biosphere Program (IGBP). The United Nations Framework. Convention

on Climate Change (FCCC) was recently signed by 155 countries in Rio de Janeiro in June 1992. While the existence of the natural greenhouse effect due to the presence of some of the trace gases has played an important role in keeping the climate of the Earth habitable, it is the increase in this effect--'enhanced greenhouse effect' resulting from the release of the greenhouse gases in the atmosphere due to increased human activities that is causing the present concern. The 'enhanced greenhouse effect' has the potential to cause unprecedented global warming and climate change on the Earth leading to widespread destruction, catastrophe and changes on our planet.

Role of solar radiation in global climatic change

The Earth receives 5.45 × 1024 J of solar energy annually through radioactive transfer. This energy is a tiny fraction-a mere 4.55 x 10^{-8}%of the total energy emitted by the sun. Yet this is roughly 10^4 times the global annual energy consumption. This energy and some of the geological processes have been responsible for creating a unique environment for life to be preserved on the Earth over the past 3-4 billion years. Solar energy has played a crucial role in creating the Earth's unique climatic system, the biosphere and fuelling the present technological age.

So far life has been found to exist on our planet only. An important factor in this is the fortuitous maintenance of unique climatic conditions, particularly the temperature, which is necessary to support living organisms and which has remained between 0°C and 40°C over the past billions of years. The Earth's average temperature is a result of the equilibrium between the solar energy absorbed by the Earth

and the infra-red radiation lost by it to space. The sun has slowly evolved to its present level of luminosity which is thought to be 20-40% higher than that 5 billion years ago. Low incoming solar radiation suggests that the surface temperatures should have been low, well below the freezing point of water. But geological evidence do not suggest this, leading to the weak sun-enhanced early temperature paradox. The explanation for this paradox is that a strong greenhouse effect arising due to large concentration of carbon dioxide in the primeval atmosphere created higher temperature on the Earth. A number of geological processes, viz. extensive volcanism, degasification and mantle convection were responsible for this. These processes gradually attenuated and the atmospheric CO_2 was fixed in the biosphere through photosynthesis activity in plants. The fortuitous and amazing coincidence of the rate and direction with which two completely independent processes - the changes in the atmospheric CO_2 and the solar output proceeded, led to the maintaining of the Earth's temperature within a favorable range.

Global ecosystems including human beings are maintained by solar energy fixed by green plants on the Earth. Solar energy fixed by the terrestrial vegetation is only about 0.4% of that impinging on the land surface. But the time integration of this energy over the past 3-4 billion years has resulted in the formation of the Earth's ecosystem. Throughout the evolution of the global environment, green plants influenced the atmospheric constituents considerably, constantly absorbing carbon dioxide from the atmosphere and releasing oxygen into it. A small part of the organic matter in

the form of green plants and animals has been continuously stored in the sedimentary shells. It is the remains of these early living organisms which over millions of years turned into fossil fuels-oil, coal and gas. These fossil fuels have provided the cheap energy source for establishing and developing the industrial and modern technological civilization on the Earth.

Impacts of Climate Change

The impacts of climate change are expected to be vast and varied though it is difficult to quantify them accurately. They are likely to affect virtually every walk of human life by affecting such vital systems as agriculture and food security, ecology, water resources, land use pattern, energy use, etc. According to the statement of the Second World Climate Conference (SWCC) held in Geneva in 1990, Climate issues reach far beyond atmospheric and oceanic sciences, affecting every aspect of life on this planet. The issues are increasingly pivotal in determining future environmental and economic well-being. Variations of climate have profound effects on natural and managed systems, the economies of nations and the well-being of people everywhere. A clear scientific consensus has emerged on estimates of the range of global warming which can be expected during the 21st century. If the increase of greenhouse gas concentration is not limited, the predicted climate change would place stress on natural and social systems unprecedented in the past 10000 years.

Agriculture

One of the most important impacts of climate change, particularly in Africa, would be on agriculture and global food

security though there remain uncertainties regarding the prediction of the magnitude and nature of potential impact of climate change and higher levels of carbon dioxide on global agricultural pattern. Plants, in general, are found to grow faster in a carbon dioxide rich environment as they absorb more CO_2through photosynthesis. The rate varies with variety of plants. At the same time varieties of weeds will also grow faster offering competition to plants for growth. C4 food crops-maize, sorghum, sugarcane and millet would have to with stand increased competition from C3 weeds causing an unhappy outlook for much of sub-Saharan Africa where maize, millet and sorghum are the staple foods. These crops would not benefit as much from the fertilizing effect of carbon dioxide as would rice and the stable crops of the temperate regions. Another problem arising would be the need to fertilize the soils more because with bigger and more crops there could be extreme soil nutritional depletion. Hence the use of synthetic fertilizers would become quite expensive. Also a warmer and wetter environment is favorable to diseases, pests and water logging. Consequently agriculture and other activities would suffer a big blow. Climate change can also lead to significant changes in total rainfall and the distribution of rainfall. The 1991-92 drought in Southern and Eastern Africa is a recent reminder to this.

Sea-level Rise

Increased flooding of coastal areas due to increase in the sea level will be an important consequence of the global warming. About one third of the world population lives within 60 km of a coastline. A number of low lying coastal cities and

countries such as Bangladesh, Florida, Malaysia, Maldives and The Netherlands are in potential danger due to sea-level rise. For example, even a 50 cm sea level rise would inundate large areas of Bangladesh. A 2.5 m rise would nearly reach the capital city.

Eco-system

Climate change influences the nature and distribution of natural ecosystem. For example, at the end of the last ice age, as temperature rose, the conifer tree line moved upwards and northwards, to be replaced by deciduous woodland. Changing climate affects not only trees but also the composition of plants, altering their geographical distribution and even threatening their survival if the change is too rapid or too severe. Species that are most responsive to increased carbon dioxide levels or to warmer temperatures and higher rainfall, would predominate over the other. This, in turn, would influence the animal population that feed on those plants. The life cycles of most plants would probably accelerate resulting in poorer soils due to faster uptake of nutrients from it. In semi-arid areas where growth is naturally controlled by outbreak of fire, faster fuel accumulation may lead to more frequent fires. Climatic change could lead to the disappearance of many rare species which are often kept in protected parks in semi-arid areas. If climatic change made the area unsuitable for the species, it is possible that alternative habitats are not found easily.

Water Resources

One of the most important impacts of climate change will be on the hydrological cycle and water management

systems. Increase in the occurrence of extreme events such as droughts would cause increased frequency and severity of disasters. Increased temperatures would lead to more evaporation of water from lakes, rivers and dams requiring changes in their management. The design of many costly structures to store and convey water, from large dams to small drainage facilities, is based on analyses of past records of climatic and hydrological parameters. Some of these structures are designed to last 50 or 100 years or even longer. Records of past climate and hydrological conditions may no longer be reliable guide to the future. The design and management of water resource systems should allow for the possible effects of climate change.

Health

Climate change can modify the occurrence of diseases and pests due to shift in the average range of climatic conditions. The impact on people and their health could be severe. Climate change could result in increasing number of environmental refugees with associated increases of ill health.

Conclusion

Continued research should form an integral component of any policy measures on climate change. Alternative energy technologies need to be developed more. There is need for lot more of research on climate so as to enable more understanding of complex climate processes and decrease the existing uncertainties in climate prediction. The Second World Climate Conference (SWCC) recommended research addressing the following priority areas to reduce underlying uncertainties:

- Clouds and hydrological cycle
- Greenhouse gases and the global carbon biogeochemical cycle
- Oceans; physical, chemical and biological aspects, and exchange with the atmosphere
- Palaeo-climate studies
- Polar ice sheets and sea ice
- Terrestrial ecosystem

There should be increased use of climate information in assisting sustainable social and economic development. Climate data, analyses and eventually predictions can contribute substantially to enhancing the efficiency and security of economic and developmental activities in environmentally sustainable ways.

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IMPACT OF CLIMATE CHANGE ON CROP PRODUCTION

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Introduction

Food is one of the basic necessities of humans, and it stands first among all basic needs - food, shelter, and clothing. It is important as it nourishes the human body- sustaining the very existences of humans. Our food supply depends on climate and weather conditions. Although agricultural practices may be adaptable, changes like increased temperatures, water stress, diseases, and weather extremes create challenges for the farmers and ranchers who put food on our tables. Impacts from climate change are happening now. These impacts extend well beyond an increase in temperature, affecting ecosystems and communities in and around the world. Things that we depend upon and value - water, energy, transportation, wildlife, agriculture, ecosystems and human health - are experiencing the effects of a changing climate. So let us discuss the impact of climate change on crop production.

Climate Change: Meaning

Climate change, periodic modificationof Earth's climate brought about as a result of changes in the atmosphere as well as interactions between the

atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth system.Climate is often defined loosely as the average weather at a particular place, incorporating such features as temperature, precipitation, humidityand windiness. Weather varies from day to day, so too does climate vary, from daily day-and-night cycles up to periods of geologic time hundreds of millions of years long. In a very real sense, *climate variation is* a redundant expression - climate is always varying. No two years are exactly alike, nor are any two decades, any two centuries, or any two millennia.

Crop Production: Meaning

Crop production is concerned with growing crops for use as fibre and food. Crop production is a common agricultural practice followed by worldwide farmers to grow and produce crops to use as food and fibre. This practice includes all the feed sources that are required to maintain and produce crops. Listed below are few practices used during crop production.

- Preparation of Soil.
- Sowing of Seeds.
- Irrigation.
- Application of manure, pesticides, and fertilizers to the crops.
- Protecting and Harvesting Crops.
- Storage and Preserving the produced Crops.

The ultimate stages of crop production are harvesting and storage. Harvesting requires art and practice because a large proportion of crops can be lost due to improper methods

of harvesting. Another concern besides harvesting is storage. Storage of grains is to be given utmost priority as improper storage can result in the destruction of crops being by pests or unfavourable environmental conditions

Effect of Climate Change

1. *Warming Water*

Whether it's a liquid, solid or gas, water is vital to our planet. We depend on it for drinking and for sustaining our crops and animals and countless species rely on freshwater ecosystems to live. The oceans help modulate CO_2 levels and maintain global temperatures while transporting nutrients and supporting marine ecosystems.

2. Ocean

Covering 71 percent of our blue-marbled planet, the seas now absorb so much human-generated CO_2 and energy from the sun that seawater chemistry and temperatures are endangering many organisms. Changes in the marine environment affect what thrives in the water and what we can harvest from it. Sea-level shifts are altering coastlines and undermining buildings, posing risks to human life.

3. Land

The dynamic interactions between climate change and freshwater resources on land are critically tied to the availability of good-quality water for human use. Today at

least half the world's population relies on groundwater for safe drinking water. With projected urban growth expected to increase demand by 55 percent by 2050, we'll have to manage future water use carefully.

4. Ice

The freshwater that was once frozen in the Arctic, Greenland, Antarctica and global alpine regions is melting and spilling into the world's oceans, streams, and soil. As more ice melts, rivers and watersheds will fill at first. But as the ice dwindles, so will the runoff and the available freshwater.

Crop Changes

Climate change may actually benefit some plants by lengthening growing seasons and increasing carbon dioxide. Yet other effects of a warmer world, such as more pests, droughts, and flooding, will be less benign. How will the world adapt? Using an aggressive climate model known as HadGEM2, researchers at the International Food Policy Research Institute project by 2050, suitable croplands for four top commodities - corn, potatoes, rice, and wheat - will shift, in some cases pushing farmers to plant new crops. Some farmlands may benefit from warming, but others won't, says IFPRI's Ricky Robertson. Climate alone doesn't dictate yields; political shifts, global demand, and agricultural practices will influence how farms fare in the future. The winnerswill be farmers who modernize their methods and diversify their fields.

The impact of climate change in our agricultural systems is undoubtable. For example, drought followed by

intense rain can increase the flooding potential, thereby creating conditions that favor fungal infestations of leaves, roots and tuber crops. In addition, reduction of bees' density due to global climate change has led to local extinction of several plant species. The production of enough food to match population growth while preserving the environment is akey challenge, especially in the face of climate change.

Environmental Factors Affecting Crop Yields

The environmental factors affecting crop yields can be classified into abiotic and biotic constraints. Abiotic stresses adversely affect growth, Productivity and trigger a series of morphological, physiological, biochemical and molecular changes in plants. The abiotic constraints include soil properties, soil components, pH, physiochemical and biological properties and climatic stresses such as drought, cold, flood, heat stress and so on. On the other hand, biotic factors include beneficial organisms, pollinators, decomposers and natural enemies, pests and anthropogenic evolution.

Effects of Climatic Conditions on Crops

Variations in annual rainfall, average temperature, global increase of atmospheric CO_2 and fluctuations in sea levels are some of the major manifestations of climate change, which negatively impact crop yields. Temperature and rainfall changes are expected to significantly have negative impact on wide range of agricultural activities for the next few decades. Most often, crop plants are sensitive to stresses since they were mostly selected for high yield. Climate change is the result of global warming. It has devastating effects on plant growth and

crop yield which can affects directly, indirectly and socio-economically reduce crop yields by upto 70%.

1.Drought:

Drought refers to a situation in which the amount of available water through rainfall or irrigation is insufficient to meet the evapotranspiration needs of the crops. Moisture or drought stress accounts for 30-70% loss of productivity of field crops during crop growth period. It also results in abnormal metabolism that may reduce plant growth, and/or cause death of entire plant.

2. Heat Stress:

Heat stress is the rise in temperature beyond a threshold level for a period sufficient to cause permanent damage to plant growth and development. High temperature due to climate changeaffects the percentage of seed germination, photosynthetic efficiency, flowering timesand pollinator populations.

3. Cold Stress:

Cold or chilling stress experiences by plants leads to major crop losses. Many of the crops in tropical or subtropical origin are injured or killed by non-freezing low temperatures and exhibit different symptoms such as poor germination, chlorosis or growth retardation and reduced leaf expansion.

Strategies to Overcome Crop Yield Reduction

Climate smart agriculture is now widely accepted as the best approach for addressing the effects of climate change in agriculture. It is defined as agriculture that sustainability increases productivity, resilience, reduces or removes

greenhouse gases and enhances the achievement of national food security.

Management of the Environment

Climate influences all components of crop production including crop area and crop intensity. Weather forecasting and crop yield prediction orsimulations are relevant tools that provide a warning to farmers in preparation of the upcoming season.In a general view, the reduction of chemical usage such as fertilizers and pesticides, associated with the improvement of crop input use efficiency will minimize greenhouse gases emissions while protecting the environment. The knowledge of appropriate planting methods is important because climate events influence the selection ofplanting method and thus yield even though the total planted areas remains unchanged. There is a possibility of producing more yields in sustainable agriculture while generating less environmental pressure.

Conclusion

Climate smart agriculture sustainably increased crop yields while facilitating achievement of adaptation and mitigation in crop production. The development of new climate resilient crop tolerant and adapted to biotic and biotic stresses will require the propagation of novel cultural methods and the implementation of various cropping schemes.

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CLIMATE CHANGE EDUCATION

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Introduction

"The world will not be destroyed by those who do evil, but by those who watch them without doing anything."

-- *Albert Einstein*

The entire species of the world is now facing an urgent threat that needs to be addressed immediately by all of us collectively, and the threat is related to drastic climate change. As per the quote given by Einstein, it is the responsibility of every human being to protect our mother earth for our survival. Climate change is a comprehensive phenomenon of climate transformation and is characterised by the changes in the usual climate of the planet. Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity and is widely recognized as the most serious environmental threat facing our planet(Ozor,2009). According to the United Nations Framework Convention on Climate Change (UNFCCC), Climate change is referred to as the change of climate which is attributed directly or indirectly

to human activity that alters the composition of the global atmosphere and which occurs in addition to natural climate variability observed over comparable periods.

Climate change not only affects the animal world but also human all over the world. Climate change affects natural, social, and economic systems which in turn end up in the physical and emotional wellbeing of humans. Every citizen has to care about incredible species. If we fail to care about climate change, it will be harder for them to find food, and it leads to a decrease in their habitats. Similarly, it is irreplaceable to preserve the rainforests, as it is considered as 'The world's lungs' and the most precious habitats on the planet for getting ample amount of oxygen. It is clear that climate change, directly and indirectly, affects rainfall patterns, mainly both drought and flooding. To tackle this, it is fundamentally necessary to create a world where people and nature thrive and create awareness among humans.

There are different causes for climate change, caused by many natural factors like changes in the sun, emissions from volcanoes, variations in Earth's orbit, and levels of carbon dioxide. Of the different causes, human activity is the main cause of climate change. Burning fossil fuels and emitting a lot of carbon dioxide, and converting lands from forests to agricultureand from agriculture to building construction and industries affect the climate a lot. As a result of climate change, more frequent drought, storms, heat waves, rising sea levels, melting glaciers and warming oceans happen

which can directly harm animals, destroy the places they live, and wreak havoc on people's livelihoods and communities.

Education-A Tool for Creating Awareness on Climate Change

Education is an essential tool that can create awareness among people and increase the "climate literacy" among the young generation. Climate change education is part of UNESCO's Education for Sustainable Development (ESD) programme. In 2014, UNESCO launched the Global Action Programme (GAP) on ESD, the official follow-up to the UN Decade of ESD, with climate change as a critical thematic focus. UNESCO aims to make climate change education a more central and visible part of the international response to climate change. Climate change education makes the learners aware of the causes and consequences of the drastic change that is happening in climate around the globe. It helps the students to live with the changes and empower them to do appropriate acts for better living and adopt a different lifestyle to cope with the changes. Education, as a process can inspire, engage and empower people as well as inform people of the climate emergency, including its causes and impacts, and this role of education is even acknowledged in international climate agreements.

Integrating Climate Change into Formal Education

Awareness of climate change is to be created even from a young age and hence climate change education needs to be incorporated into school curricula, teaching and learning

materials, and also pre-service teacher education. Through the different action plans and policies, a culture of caring for the climate among children should be inculcated.

Different training programmes can be organized to enable young people to understand the physical changes in their environment better and provide them with the tools with which to combat climate change. This may also help to produce qualified specialists for the green jobs, which contribute to preserve or restore the environment may be in the traditional sectors such as manufacturing and construction, in new emerging green sectors such as renewable energy and energy efficiency. For this education in Science, Technology, Engineering and Mathematics (STEM) need to be strengthened.

It can be seen that Environmental education is made mandatory in many institutions both at the school level and in higher education, which is a positive step, taken by many Governments all over the world to create awareness and make the students feel the importance of protecting our nature. Environmental education which is a compulsory course in many programmes helps students to understand the basic concepts of climate change and the importance of natural resources for daily life. It also helps to learn the concepts of climate change adaptation and mitigation and will make the students know how to identify risks, local threats and vulnerabilities and their relationships.

How the Children can be Made Aware of Climate Change?

The concept of climate change can be integrated into the formal curriculum by different child- friendly activities. Some activities are mentioned.

- Activities related to global warming can be explained in the laboratory through simple experiments and show children how global warming causes problems. For example,in science class, simulations on greenhouse effects can be done which will show how plastics wrap to trap the sun's heat and with the help of charcoal we could see how black carbon from air pollution can speed the melting of ice.
- Videos related to global warming and its disastrous effects could be shown to the students.
- Simple projects related to factors causing climate change and ways to prevent it could be assigned and this could be explained by the children to their peers which has more effect than teacher-student interaction.
- Periodically speeches and debates can be conducted in the institution which will make children to think about the threats of climate change.
- Students can be made to contribute their ideas in the form of novels, poetry, and fiction in relation to global warming.
- Students can create their blog and log to disseminate ideas related to climate change awareness and the teacher can also actively participate and contribute a lot for creating awareness of the threats of climate change.

- Nature clubs in schools can organize many programmes concerning global warming and climate change.
- Scientists and environmentalists working with dedication to preserve nature and conserve renewable energy can be invited to give talks to motivate children.
- Healthy habits like eating more meat-free meals, buying organic and local products, not wasting food, growing our food, greening our community, taking public transport, car share need to be inculcated among the students which will develop in them the habit of Consuming less, wasting less and enjoying life.
- Investing in renewable energy source like the usage of Solar Panels and Wind Turbines, Batteries for Electric Vehicles to reduce the emission of gases like carbon monoxide, CFC which is harmful to the environment can be explained to the students. These ideas can be integrated into education to impart into children's minds to bring a clean and safe environment.
- Developing civic sense among the children will result in keeping the environment clean and do socially relevant and appropriate activities which can end up with the protection of our environment.
- Arranging for teachers and students face-to-face time with climate scientists will help both of them. Especially teachers will be able to convey the information received from the scientists to the students in an effective way.

Technological Tools for Climate Change Education

In this era of technology, children can be made aware of the threats of global warming, through technological tools in addition to the traditional teaching in class. Many technological free tools help to incorporate certain practices like preparing models to understand the fundamental processes of climate change, causes for global warming, and hands-on data to interpret and learn to predict and arrive at conclusions. Some of the tools available are:

- *NASA Global Climate Change* is a reference site with well designed content related to climate.
- *Climate Kids* is a site that improves learning about climate change through cartoons and games. In addition to digital content, Climate Kids has resources to get kids to build and for designing. The Climate Change Time Machine interactive allows students to travel through time and see mapped evidence of sea-ice and carbon-emission changes.
- *The Global Oneness Project* has resources that explore life experiences around the world.It mainly is concerned with building empathy towards the people who live in small island nations which is often facing the ecological challenges. Through a series of films, photo essays, and articles, students can be witnesses to ecological challenges.
- *Earth-Now* is an app, with current climate data obtained from earth satellites and students can work with real data and can manipulate color scales on a

3-D model of Earth and see up-to-date reports for air temperature, carbon dioxide, sea level, and other climate factors.

- *Our Climate Our Future* is a site that motivates and empowers students through videos, animations, and activities that help students to learn about and take action against climate change. The site inspires the students and makes students think that all students can take action against further climate change.
- *Magic box* is a learning tool for students. With e-books and purposeful teacher tools fostering a highly engaging learning environment.

Conclusion

The concept of preserving our nature can start from home and school. By creating a garden with rainwater capture and compost systems to regenerate the soil in the school the students can be taught the importance of the conservation of nature. Only when we take care of our mother earth we will be taken care of by nature.

"If the bee disappeared off the surface of the globe then man would only have four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man" *-Albert Einstein*

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EFFECTS OF CLIMATE CHANGE ON MARINE ORGANISMS

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Introduction

Climate is one of the most important factors controlling the distributions and abundance of marine organisms. The climate in a region ultimately controls most of the physical parameters of ecosystems which to a great extent determine the basic habitat suitability for marine species. Impacts from climate change are happening now. These impacts extend well beyond an increase in temperature, affecting marine ecosystems and communities.

Sea Level Rise

Rising sea levels due to thermal expansion and melting land ice sheets and glaciers put coastal areas at great risk of erosion and storm urge. Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected to rise another 1 to 8 feet by 2100. This is the result of added water from melting land ice and the expansion of sea water as it warms. In the next several decades, storm surges and high tides could combine with sea level rise and land subsidence to further increase flooding in many regions. Sea level rise will continue past 2100 because the oceans take a

very long time to respond to warmer conditions at the Earth's surface. Ocean waters will therefore continue to warm and sea level will continue to rise for many centuries at sales equal to or higher than most of the current century.

Based on tide guage data, the rate of global mean sea level rise during the 20thcentury **is** the range 1.0 to 2.0 mm/yr. On the time-scaled of decades to centuries, some of the largest influences on the average levels of the sea are linked to climate and climate change processes.

As ocean water warms, it expands. On the basis of observation of ocean temperatures and model results, thermal expansion is believed to be one of the major contributors to historical sea level changes. Further, thermal expansion is expected to contribute the largest component to sea level rise over the next hundred years.

More than half of the Arctic region is comprised of ocean. Many arctic life forms rely on productivity from the sea, which is highly climate-dependent. Climate variations have profound influences on marine animals. Polar bears are dependent on sea ice, where they hunt ice-living seals and use ice corridors to move from one area to another. Changes in ice extent and stability are thus of critical importance, and observed and projected declines in sea ice are very likely to have devastating consequences for the polar bear. The loss of polar bears is likely to have significant and rapid consequences for the ecosystems that they currently occupy.

Some seabirds such as ivory gulls and little auks are very likely to be negatively impacted by the decline of sea ice and subsequent changes to the communities in which they

live. For walrus in many areas, the ice edge provides the ideal location for resting and feeding because walrus are bottom feeders that eat clams and other shellfish on the continental shelves. As the ice edge retreats away from the shelves to deeper areas, there will be no clams nearby and hence their population decreases. Arctic marine fisheries are largely controlled by local weather conditions.

Ocean Acidification

Marine ecosystem is under tremendous stress from climate change. Ocean acidification paired up with other climate impacts like warming waters, deoxygenation, melting ice and coastal erosion pose real threats to the survival of many marine species.

The ocean absorbs about 30% of the CO_2 that is released into the atmosphere from the burning of fossil fuels. First, it forms carbonic acid. Then this carbonic acid dissociates and produces bicarbonate ions and hydrogen ions. Ocean acidification results from an increased concentration of hydrogen ions and a reduction in carbonate ions due to the absorptions of increased amounts of CO_2. Ocean acidification is known to reduce calcification of many calcifying organisms (Eg. Coralline algae) and the content of bio genic silica in diatoms. Acidification reduces the settling of particulate organic carbon by lowering diatom silicification and empty.

A new study says that the seas are acidifying ten times faster today than 55 million years ago, when a mass extinction of marine species occurred. Current changes in ocean chemistry are due to the burning of fossil fuels may portend a new wave of die-off. In other words, the vast clouds of shelled

creatures in the deep oceans had virtually disappeared. Many scientists now agree that this change was caused by a drastic drop of the ocean's pH level. The sea water became corrosive that is eaten away at the shells, along with other species with calcium carbonate in their bodies. It took hundreds to thousands of years for the oceans to recover from their crisis and for the sea floor to turn from red back to white.

Ocean acidification is particularly detrimental to species that build their skeletons and shells from calcium carbonate (like clams, mussels, crabs, phytoplankton, and corals), and that constitute the bottom of the food chain. Acidification reduces the availability of carbonate ions in ocean water, which provide the building blocks these organisms need to make their shells and skeletons, significantly reducing the chances for their offspring to survive.

Marine Ecosystem

Healthy marine ecosystems are important for society since they provide services including food security, feed for livestocks, raw materials for medicines, building materials from coral rock and sand and natural defenses against hazards such as coastal erosion and inundation. Marine ecosystem has been exposed to long term human impacts. In recent decades, the impacts of climate change have become additional sources of stress on the ocean. These impacts are projected to become more severe during 21st century. Marine fishes, sea birds and marine mammals all face very high risks from increasing

temperatures, including high levels of mortalities, loss of breeding grounds and mass movements as species search for favorable environmental conditions. Long-standing human caused stressors on marine ecosystem have been widely demonstrated to cause numerous undesirable changes in living systems (IUCN-WCPA 2008) including

- loss of biodiversity
- decrease abundance of key species
- structural damage to living and non living habitats and
- loss of ecological functions, resulting in reduced resilience to additional stresses.

Fisheries

Fisheries and aquaculture are also a source of income for millions of people worldwide. One of the most dramatic effects of climate on ecology and the environment is the phenomenon called El Nino that occurs off the west coast of Peru, a highly biologically productive area. This effect of El Nino has reduced the fish harvest from this area by 50 % or more. El Nino reduced the upwelling in the sea, thus affecting phytoplankton growth and then eventually the squid and fish as which the birds feed.

Coral Bleaching

Coral bleaching is another ecosystem phenomenon for which climate plays an important role. Coral reefs support more species per unit area than other environment. However, shallow water reefs are very sensitive to elevated sea surface temperature as reef building corals are thought to live near their thermal maxima. When their temperature tolerance is

exceeded, the corals "bleach" dissociating from the endosymbiotic algae which normally provide corals photosynthetic energy and their color. Widespread bleaching events are primarily caused by extended periods of heightened temperatures.

Corals maintain a mutualistic relationship with photosynthetic algae living in their tissue: corals provide shelter for the algae and each provide the other with nutrients necessary for their survival. But when water temperatures get too high, corals expel these algae, leaving them more vulnerable to disease and less able to maintain and build their skeletal structure.

Ocean acidification hinders the ability of corals to recover from these bleaching events because it reduces the amount of calcium carbonate available that corals need to grow back to health. A report by the Intergovernmental Panel on Climate Change finds that 99 percent of the world's warm-water coral reefs could disappear if global average temperatures rise 2°C or more above.

Oxygen Depletion (Deoxygenation)

One additional effect of ocean warming is that it decreases the solubility of oxygen in seawater. In oceanic and coastal waters, the dissolved oxygen content has declined over the past 50 years. In coastal regions deoxygenation is driven mainly by eutrophication, leading to excess oxygen consumption and the development of hypoxia and "dead

zones". Most marine organisms need O_2 for their metabolic process. When the dissolved O_2 concentration is below a certain value, these organisms suffer from stressed respiration and hypoxic events may lead to the death of many organisms.

Deoxygenation promotes denitrification reducing the concentration of nitrate and affecting the ocean nitrogen cycle, primary productivity and the efficiency of the marine biological carbon pump. The oceans are losing oxygen due to climate change with their consequences for marine life and vulnerable communities and fisheries. Scientific report predicts that the ocean will lose 3-4% of its oxygen inventory globally by the run of the next century. Most of the losses are anticipated to be in the upper 1000 meters (3300 feet) of the water column which is the richest in marine biodiversity

The loss of oxygen form the world's oceans is increasingly threatening fish species and disrupting ecosystem. Ocean oxygen loss driven by climate change and nutrient pollution is a growing menace to fisheries and species such as tuna, marlin and sharks. Deoxygenation is starting to alter the balance of marine life favouring low oxygen tolerant species (Eg. Microbes, jelly fish and some squid) at the expense of low oxygen sensitive ones (many marine species, including most fish) Some of the ocean most productive biomes are formed by ocean currents carrying nutrient-rich but oxygen poor water to coasts. The nutrient pollution causes oxygen loss in coastal waters as fertilizer, sewage, animal and aquaculture waste cause excessive growth of algae, which in turn deplete oxygen as they decompose.

Shifting Distribution of Marine Species

Changes in maximum ocean temperatures are leading to shifts in the distribution of many species. If climate change alters the environment where a species lives, it may change it's location to find more suitable conditions elsewhere. Certain species may change their location to follow food sources or to remain for their survival. These re-locations can impact local species as the new arrivals compete for food and can also bring diseases or parasites.

Conclusion

The ocean absorbs most of the excess heat from green house gas emissions, leading to rising ocean temperature. Increasing ocean temperature affects marine species and ecosystems. Rising temperature causes coral bleaching and the loss of breeding grounds for marine fishes and mammals. Establishing marine protected areas and putting in place adaptive measures to protect ocean ecosystem and shield humans from the effects of ocean warming. The climate variations and changes will continue to have large impacts on marine ecosystems. We must make substantial and immediate investments in marine climate change research to enable informed decisions by resource managers and society to ensure the future utility and enjoyment of coastal and marine ecosystems under changing climate conditions.

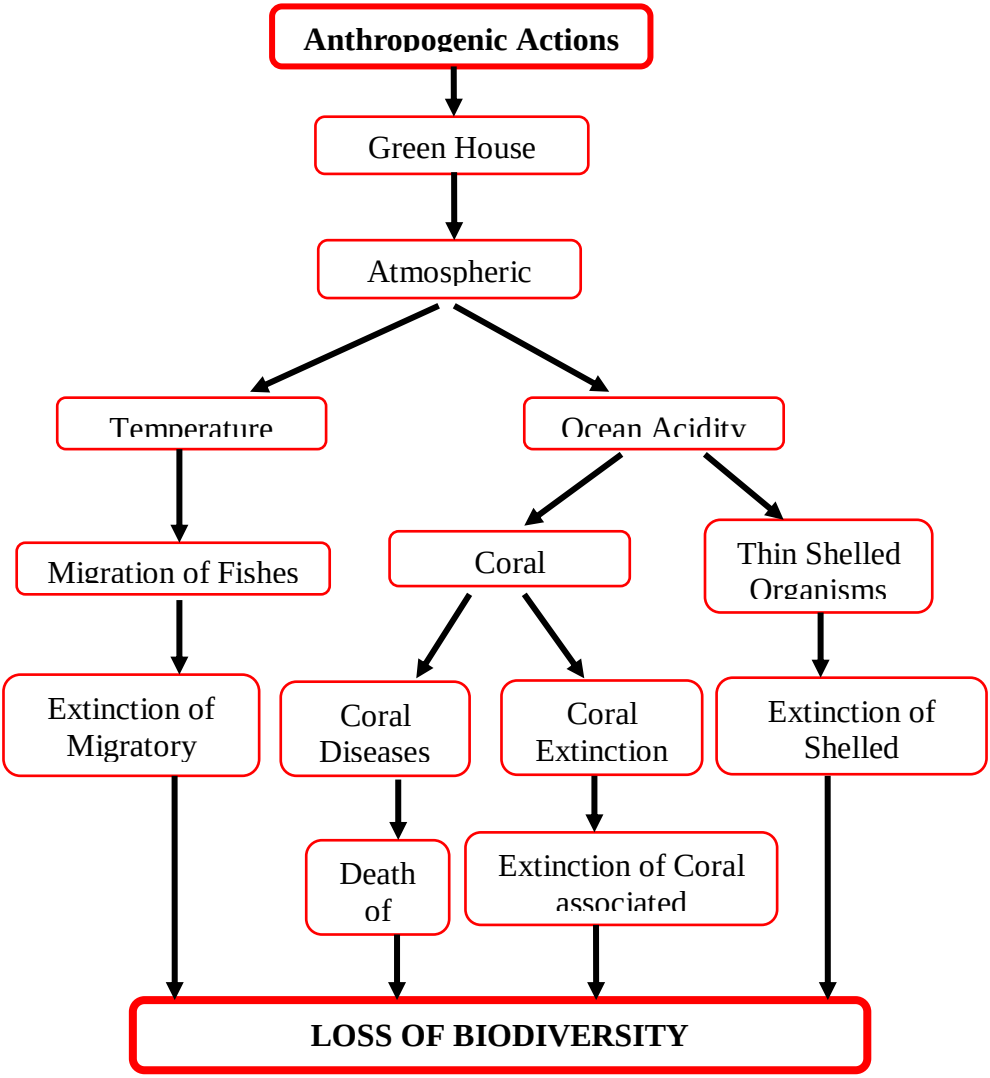

Figure: 1 Effects of climate change on marine organisms

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IMPACT OF CLIMATE CHANGE ON PESTICIDE USAGE

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Introduction

The Environmental Protection Agency (US EPA) defines pesticide as "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest". A pesticide may be a chemical substance or biological agent (such as a virus or bacteria) used against pests. Farmers in the hot spots are overburdened with increasing costs of cultivation, a deleterious credit system, and declining productivity, increased incidences of pests and diseases, and spurious pesticides. The sole reliance on chemical pesticides for plan protection has created serious problems. In addition, problems of pest outbreaks, resistance and resurgence of pests demand more pesticides.

Pesticides have been the center of controversy for a long time and are associated with risks to human health and/or to the environment. On the other hand, society accepts these risks within certain limits as there are also benefits linked to the use of pesticides, in particular in agricultural production. Overuse of pesticides has brought about a decline in the bio-

diversity of non-target organisms in the hot spots. The respondents in the hot spots revealed that a significant decline in population of birds, earthworms, natural predators like green lacewing, *Chrysoperiacarnea*, lady bird beetles, spiders, *A panteles spp.*, *Trichogrammanspp.*, *Cheloanus, black burni*, etc., was noticed in their field. Long-term changes of climate have already been detected and there is wide agreement that the climate will continue to warm over the 21st century (IPCC, 2001a; 2001b) [1,2].

Insects and other arthropods are potentially useful taxa for examining the direct and indirect effects of changes in climate over time. Unlike many other taxa, insects exist over a wide range of temporal and spatial scales. Insect populations can respond rapidly, allowing researchers to identify study foci from ongoing monitoring. In plain words, insects live short lives, are everywhere, and respond quickly to subtle changes in habitat. This quick response makes insects particularly suitable as candidate species for monitoring changing environments. In addition, monitoring insect populations is generally inexpensive, and often requires a minimal investment in equipment and training. Insects are poikilotherms, consequently their life history parameters are directly linked to temperature (Beresford, and Sutcliffe, 2009; Beresford, 2011) [3,4]. Insects have optimal temperatures for maximal survival and population growth, a variety of different life history responses to sub-optimal temperatures, and temperature minima and maxima beyond which insects either enter developmental stasis or die. Because of this, insect populations, physiological growth, and other life history

parameters are measured in accumulated degree days above (and below) developmental temperature thresholds, symbolized as ADD lower threshold, and commonly standardized against 0, 5 or 10^{o}C thresholds. This direct linkage between growth and temperature makes insects and other arthropods powerful tools for assessing climatic effects on a region's habitat and diversity [5,6].

Impact on Agriculture

Changes in the incidence and severity of agricultural pests, diseases, soil erosion, troposphere ozone levels, as well as changes in extreme events such as drought, floods, are largely unmeasured or uncertain and have not been incorporated in estimates of impacts. These omitted effects could results the true impacts of climate change on agriculture. It seems obvious that any significant change in climate on a global scale should impact local agriculture, and therefore affect the world's food supply. Agriculture of any kind is strongly influenced by the availability of water. Climate change will modify rainfall, evaporation, runoff, and soil moisture storage.

a. ***Agriculture can be Part of the Solution***

Countries around the world are now recognizing the unique role that agriculture can play in sequestering carbon. Nearly the entire European Union joined a host of nations in signing onto the international initiative 4 per 1000 under the Lima-Paris Action Agenda, officially recognized by the Paris Climate Accord. The initiative recognizes that a 4% annual growth rate of soil carbon stock would make it possible to stop

the present increase in atmospheric CO_2. Countries are called on to do this by scaling up regenerative farming, grazing and land-use practices with a focus on soil health.

Implications of Climate Change for Pests and Diseases

More than 10,000 insects, 600 weeds and 1,500 fungi, commonly named pests, adversely affect daily human life. They reduce the quality and quantity of food produced, by lowering production and destroying stored produce, compete with humans for food and cause a variety of diseases to humans, animals and crops. Humans began to control pests at the same time as they started farming. Over the years several pest management systems have been applied: manual removal of weeds and animal pests, cultivation breaks for vulnerable crops, mechanical soil treatment, biological pest control, genetic engineering and use of chemical pesticides. Across all available pest management systems, pesticides have become the most frequently selected alternative for pest control. Once disseminated to the environment, pesticides may cause changes in the natural biological balances may reduce biodiversity. Since pesticides are designed to be toxic to living

species, they may also adversely affect human health. Worldwide, the application of 3 million metric tons of pesticide, results in more than 26 million cases of human pesticide poisonings. Of all the pesticide poisonings, about 3 million cases are hospitalized and there are approximately 220,000 fatalities and about 750,000 chronic illnesses every year. There is some evidence that poisoning from exposure to pesticides may cause neurological, respiratory and reproductive disorders, sensory disturbances, cognitive problems and cancer (Teitelbaum*et al.*, 2007; Cockburn 2007; Alavanja*et al.*, 2006) [7].

a. Insect pests

• Climate change is likely to alter the balance between insect pests, their natural enemies and their hosts.

• One of the most important effects of climate change will be to alter the synchrony between host and insect pest development, particularly in spring, but also in autumn; the predicted rise in temperature will also generally favor insect development and winter survival, although there will be some exceptions.

b. Fungal diseases

• The impact on pathogens whose reproduction or dispersal is clearly affected by temperature is relatively predictable.

• Warmer summers may in particular favor certain thermophilic rust fungi • Warmer winters may increase the activity of some weak pathogens

• An increased incidence of summer drought would probably favor diseases caused by fungi whose activity is dependent on host stress, particularly root pathogens.

Areas of Impact

Weeds, insects, and pathogen-mediated plant diseases are affected by climate and atmospheric constituents. Resultant changes in the geographic distribution of these crop pests and their vigor in current ranges will likely affect crops.

a. Weeds

Weeds may benefit from the "CO_2 fertilization effect" and from improvements in water use efficiency associated with increasing CO_2 concentrations, but the impact on crop production will depend on how enhanced growth weeds compete with enhanced-growth crops. Regarding temperature, most weeds of warm season crops originate in tropical or warm temperate areas and are responsive to small increases in temperature. For example, the growth of three leguminous weeds increased significantly as day/night temperature increased (Flint *et al.*, 1984). Biomass of C4 smooth pigweed (*Amaranthushybridus*) increased by 240% for an approximate 3°C temperature increase; C4 grasses also showed large increases (Patterson 1993)[5]. Accelerated range expansion of weeds into higher latitudes is likely (Rahman and Wardle 1990; Patterson 1993) as demonstrated for itch grass (*Rottboelliacochinchinensis, Lour.*), cogongrass (*Imperatacylindrica*), Texas panicum (*Panicumtexanum*), and Witchweed (*Strigaasiatica*) (Patterson *et., al.,*, 1999). However, not all exotic weeds will be favored by climatic warming. Patterson et al. (1986) found loss of competitiveness

under warmer conditions for the southward spread of wild proso millet (Panicummiliaceum) in the southwestern United States. Increasing CO_2 and climate change probably will also affect mechanical, chemical, and natural/biological efforts to control weeds (Patterson, 1993), which currently cause worldwide crop production losses of about 12% (25% for traditional production systems).

b. Insects

Climate and weather can substantially influence the development and distribution of insects. Current estimates of changes in climate indicate an increase in global mean annual temperatures of 1°C by 2025 and 3°C by the end of the next century. Such increases in temperature have a number of implications for temperature-dependent insects, especially in the region of Middle-Europe. Changes in climate may result changes in geographical distribution, increased overwintering, changes in population growth rates, increases in the number of generations, extension of the development season, changes in crop-pest synchrony of phenology, changes in inter specific interactions and increased risk of invasion by migrant pests (Memmott*et al*., 2007; Parmesan 2007; Porter *et al*., 1991) [6].

c. Climate Variability

Increased variability in rainfall and changes in temperature will likely disrupt key ecosystem processes such as phonology and will influence insect pests and diseases in mostly unknown ways. Direct effects on pests will involve disruption of insect life cycles or creation of more suitable conditions for new pests (or for old pests to expand their territory). Agricultural systems are vulnerable to climate

extremes, with effects varying from place to place because of differences in soils, production systems, and other factors. Changes in precipitation type (rain, snow, or hail), timing, frequency, and intensity, along with changes in wind (windstorms, hurricanes, and tornadoes), are likely to have significant consequences. Heavy precipitation events cause erosion, water logging, and leaching of animal wastes, pesticides, fertilizers, and other chemicals into surface and groundwater.

d. Pesticides and Climate Change

Along with flood, drought and fire, add pests to the list of anticipated impacts of climate change. With a longer growing season and a warmer climate, weeds and insect pests will proliferate, most likely leading to more pesticide use – which is itself responsible for harmful emissions that further exacerbate climate change. The principles of regenerative agriculture in order to reduce pesticide use, improve soil health, and increase the capacity of soil to retain water and sequester carbon.

e. A Warmer Climate Brings More Pests

As a report by the Union of Concerned Scientists put it, "global warming is like Miracle-Gro for weeds."Warmer weather is very good news for insect pests too. Monocropping provides an uninterrupted food supply, and warmer weather is expected to extend the duration of the feast. Milder winters will reduce insect mortality, and we can expect to see expanded pest ranges too as northern regions warm. All of this adds up to either a whole lot more chemical pesticide use – or

an opportunity for a radical transformation of agricultural practices that's focused on soil health and emissions reduction.

f. Pesticide Use is Itself a Major Contributor to Climate Change

A report from the Intergovernmental Panel on Climate Change finds that about 30% of global emissions leading to climate change are attributable to agricultural activities, including pesticide use. More than 200 million pounds of agricultural pesticide active ingredients are applied to California fields each year, of which more than 40 million pounds are fumigants – among the most hazardous and greenhouse gas-producing pesticides.

Conclusion

Several elements that can influence pesticide use have been presented. In the first instance, pesticide producing companies will strive to supply optimal products. (New) pesticide active ingredients will have to be formulated in rain-fast products for agricultural use. For farmers, the season and timing of the pesticide application, seasonal precipitation and temperature in relation to environmental factors, will strongly influence management decisions represented by the initial deposit, pesticide fate and (eco-) toxicity, also has a major impact on pesticide use. In general, pesticide losses of mobile active substances are mainly influenced by the time gap between extreme weather events and pesticide application in soil, transport of pesticides is thus mainly driven by rainfall seasonality, intensity and temperature increases but also land-use changes which indicates an indirect impact on the long term impact.

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VANQUISHING THE IMPACT OF CLIMATE CHANGE ON MENTAL HEALTH

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Introduction

Our climate is changing at an accelerated rate and continues to have profound impacts on human health. This change jeopardizes not only physical health but also mental health. Our communities' health, infrastructure, and economy are directly connected to our climate (Krygsman, Speiser, Wood & Barry, 2016). As temperatures increase, we experience higher levels of pollution, allergens, and diseases (Krygsman, Speiser, Merse, Marx&Tabola, 2016). Severe weather events threaten our businesses and vulnerable communities. Pollution and drought undermine our food and water supplies, and the latter increases the prevalence of wildfires that can destroy homes and communities (Ziska et al., 2016). Climate change is a wicked problem that threatens the continuity of life. The importance of climate is clear for humans as we need food, fresh water, fibre, timber and protection from hazards to survive and thrive. Climate

influences crop productivity, disease, water scarcity or availability, and vulnerability to hazards (Sachs 2015).

Temperatures are rising globally, ice at the poles is melting at an alarming rate, sea levels are rising, and intense storms and flooding are beginning to become the norm rather than the exception. The impacts of the climate crisis have been far reaching with significant implications for people and the planet. These impacts will only become more acute and stress as the crisis continues. After a catastrophic event like a natural disaster, response efforts generally focus on physical health and safety. What often goes unnoticed is the mental and emotional toll the climate crisis is taking on individuals and communities. An increase in the frequency and intensity of natural disasters leads to trauma, post-traumatic stress, and other acute mental health consequences, while more incremental changes to our environment such as increasing temperatures and rising sea levels threaten food security and economic livelihoods, cause migration, mass displacement, and disrupt lives, communities, and cultures, all of which have significant consequences for mental health and wellbeing. Beyond tangible impacts, the climate crisis also causes overarching psychological and psychosocial distress. In this chapter, the impact of climate change on mental health is dealt in detail.

Climate Change and Health

Health is more than the absence of disease. Health includes mental health, as well as physical well-being, and

communities that fail to provide basic services and social support challenge both. As we think about the impacts of climate change on our communities, we need to recognize not only the direct effects but also the indirect consequences for human health based on damage to the physical and social community infrastructure. Regardless of how these impacts surface, whether they occur within a matter of hours or over several decades, the outcomes of climate change are interconnected to all facets of our health.

Mental Health

The World Health Organization (2014) defines mental health as:

…a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community. Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The ability to process information and make decisions without being disabled by extreme emotional responses is threatened by climate change. Some emotional response is normal, and even negative emotions are a necessary part of a fulfilling life. In the extreme case, however, they can interfere with our ability to think rationally, plan our behavior, and consider alternative actions. An extreme weather event can be a source of trauma, and the experience can cause disabling emotions. Subtler and indirect effects of climate change can

add stress to people's lives in varying degrees. Whether experienced indirectly or directly, stressors to our climate translate into impaired mental health that can result in depression and anxiety (USGCRP, 2016).

The 1986 Ottawa Charter for Health Promotion builds on this definition in the following way:

To reach a state of complete physical, mental and social wellbeing, an individual or group must be able to identify and to realize aspiration, to satisfy needs, and to change or cope with the environment. Health is, therefore, seen as a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities. Therefore, health promotion is not just the responsibility of the health sector, but goes beyond healthy lifestyles to wellbeing.

Impact of Climate Change on Mental Health

Humans are beginning to grow familiar with climate change and its health impacts. It is time to expand information and action on climate and health, including mental health. The health, economic, political and environmental implications of climate change affect all of us. The tolls on our mental health are far reaching. They induce stress, depression and anxiety; strain social and community relationships; and have been linked to increases in aggression, violence and crime. To compound the issue, the psychological responses to climate change, such as conflict avoidance, fatalism, fear, helplessness and resignation are growing. These responses are keeping us,

and our nation, from properly addressing the core causes of and solutions for our changing climate, and from building and supporting psychological resiliency.

The impacts of climate change on people's physical, mental, and community health arise directly and indirectly. Some human health effects stem directly from natural disasters exacerbated by climate change, like floods, storms, wildfires, and heat waves. Other effects surface more gradually from changing temperatures and rising sea levels that cause forced migration. Weakened infrastructure and less secure food systems are examples of indirect climate impacts on society's physical and mental health. Some communities and populations are more vulnerable to the health-related impacts of climate change. Factors that may increase sensitivity to the mental health impacts include geographic location, presence of pre-existing disabilities or chronic illnesses, and socioeconomic and demographic inequalities, such as education level, income, and age. Major chronic mental health impacts include higher rates of aggression and violence, more mental health emergencies, an increased sense of helplessness, hopelessness, or fatalism, and intense feelings of loss. These feelings of loss may be due to profound changes in a personally important place and/ or a sense that one has lost control over events in one's life due to disturbances from climate change.

The connection between changes in the climate and impacts on a person can be difficult to grasp. Although people's understanding and knowledge of climate change can

increase by experiencing the effects directly, perception, politics, and uncertainty can complicate this link. Psychological factors, a political divide, uncertainty, helplessness, and denial influence the way people comprehend information and form their beliefs on climate change. Research on the impacts of climate change on human well-being is particularly important given the relationship among understanding, experiencing, and comprehending climate change. People's willingness to support and engage in climate solutions is likely to increase if they can relate them to local experiences or if they see the relevance to their own health and well-being (Sawitri, Hadiyanto & Hadi, 2015).

There are three key mental health impacts due to climate change. Firstly, direct impacts of climate change, such as extreme weather events, are likely to have immediate impacts on the prevalence and severity of mental health issues in affected communities as well as significant implications for mental health systems. Secondly, vulnerable communities are beginning to experience disruptions to the social, economic and environmental determinants that promote mental health. Finally, there is an emerging understanding of the ways in which climate change as a global environmental threat may create emotional distress and anxiety about the future (https://ijmhs.biomed.....).

Addressing Climate Change and Mental Health

While understanding the relationship between climate change and mental health is complex, action on the issue is

paramount. Addressing climate change and mental health may be thought of as both adaptations to the climate crisis, in that it helps build healthy, resilient individuals and communities in the midst of the crisis, and mitigation in that the process of addressing these issues in and of itself encourages engagement and action. Acknowledging mental health issues in the climate crisis can raise awareness and reduce stigma. As people begin to acknowledge how mental health is influenced by a changing environment, they may be more inclined to undertake positive and productive action to support their own resiliency and adapt to the reality of our times (Hayes and Poland, 2018).

Addressing mental health and well-being leads to, and supports engagement in advocacy and action (Hayes and Poland, 2018). If individuals are able to manage the feelings and thoughts that arise and come to terms with the crisis and the threats it poses, effectively avoiding "eco-paralysis," they may move from disempowering feelings to empowering ones which lead to action. However, as previously discussed, this action must come from a depth of understanding that ensures it is effective. Further, paying close attention to self-care and seeking mental health supports may also help support and sustain action already underway by preventing individual burnout. Taking part in work toward climate solutions and advocacy for these solutions may also lead to other positive individual mental health benefits that promote wellbeing such as a sense of agency, empowerment, growth, compassion, altruism, belonging and a sense of identity. On the community level, action further promotes social cohesion, connection, and collaboration. Thus, in turn, action towards mitigation builds

individual and community resiliency necessary for adaptation (Hayes and Poland, 2018).

Acting on the health consequences of climate change requires actions rooted in both mitigation and adaptation at all levels - from global to local - and from all sectors and individuals. Climate change mitigation refers to overarching efforts to reduce greenhouse gas emissions and enhance carbon sinks to slow the speed, scale, and magnitude of climate change. Key climate change mitigation priorities include reducing energy demand (through reduced consumption and increased energy efficiency); a swift and equitable transition from fossil fuels to renewable energy; reducing emissions from agriculture and forestry; and strengthening land-based emissions sequestration. Climate change adaptation refers to interventions that respond to the effects of climate change by adjusting, moderating, and coping with the risks and impacts of climate change.

Coordinated, collaborative efforts to address the mental health implications of climate change not only require policy frameworks but also concrete actions on behalf of mental health practitioners. Such concrete actions may include: communicating about climate change and mental health in a way that helps people to see that it is relevant and salient to them; advocacy for greenhouse gas reductions in health care facilities and engagement in efforts to reduce the environmental footprint of the health care sector; and, engaging in adaptation measures like preparing for and responding to extreme events (https://www.ncbi.....).

Building resilience is essential to address the physical and mental health impacts of climate change. Many local governments and other countries have created plans to protect and enhance infrastructure, but these plans tend to overlook the support needed to ensure thriving psychological well-being. There is an opportunity to include the resilience capacity of individuals and communities in the development of preparedness plans. Mental health and well-being which include the degree to which an individual is able to achieve optimal mental health in a given context (CACUSS, 2013).

Climate Change Education and Development of Mental Health

Climate change education applies systems thinking in order to understand how the world works. According to a rational systems view, it is clear that humans are part of natural systems first, living things second, human beings third, members of society and culture fourth, and particular individuals fifth. Nature and culture should be considered as one, interrelated system. The eco-social perspective helps to understand this interconnectedness and could be applied as the basic principle for all learning and educational practices.

The understanding and response to climate change is socially constructed; each person with a unique view. In order to understand what to do about it, we need to become aware of cultural dichotomies and strive for interconnected thinking and better understanding about how we are connected to each other and nature, how we can reconnect to emotions and our bodies.

Active agency can be learned only through practice. Embodied experiences, awareness and emotions are valuable intuitive resources for improving rational thinking, learning and knowing.

It is essential that climate education be based on a scientific understanding of socio-ecological systems and the ethical dimensions of human behavior. Connections between local and global, between individual behavior and communitarian practices and climate change need to be identified and illuminated through social experiences. Climate change education should be developed and enriched with contextual, subjective knowing in practice. The resulting dialogical learning situation offers open encounters where adults and young people can learn from each other and together construct pathways for a sustainable future. The basic elements of climate change education as:

- Our understanding and response to climate change is socially constructed; each person with their own perspective.
- Nature and culture are one entity. The eco-social perspective should serve as a foundation for all learning and educative practices. Active agency can only be learned in practice.
- The global perspective: existing connections between everyday individuals and communitarian practices and climate change need to be identified and illuminated through social experiences.

- Climate change education should be developed and enriched in practice with contextual, subjective knowing.
- Reflection on embodied experiences and emotions, intuitive knowing are useful resources for rational thinking and learning. Reflecting with intuition can connect us to deeper questions of human needs, desires and wishes, values and identities.
- Art-based learning unleashes creative potential and naturally combines different ways of knowing: pre-conscious, intuitive and rational. Arts can enrich and be used aside natural and social sciences to deepen the insight of questions traditionally approached only through scientific knowledge.
- Dialogical learning situations offer open encounters where adults and young people learn from each other and together construct pathways for a sustainable future. Hope, courage and trust are strengthened through embodied, shared experiences.

Conclusion

Psychologists are well positioned to provide guidance on what constitutes healthy coping with the psychological impacts of global climate change and to intervene in situations of mental health injury or disordered adjustment. Optimal coping with the threat and unfolding impacts of climate change is likely to entail a number of factors, including accurate recognition of risks, effective management of emotions and problem solving, a focus on pro-social outcomes, and

engagement in actions that have a reasonable chance of mitigation and adaptation (see American Psychological Association Task Force on the Interface Between Psychology and Global Climate Change, 2009; Gifford, 2011, this issue; Reser & Swim, 2011; Weber & Stern, 2011).

A main principle of climate change education is that taking care of the wellbeing of future generations does not constitute a sacrifice. This is because an individual's interests and the common good can be aligned. While it is egoistic to maximize the relevance of one's own life, it can become a civilized selfishness, because knowledge, social prosperity, arts, intellectual capital and increased humanity do not consume the planet's limited resources.

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CLIMATIC IMPACT ON WATER RESOURCES: EFFECT AND PREVENTION

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Introduction

Climate is the condition of a place with regard to temperature, wind, humidity in the air etc. The climate of a region certainly affects the water resources like wells, ponds, small tanks etc. High temperature, polluted air and low percentage of humidity in the air all these have strong effects on water resources like drying of domestic wells, decrease in ground water level and poor rainfall. These in turn lead to drought and poverty. According to NASA's research, the last five years have been considered the hottest in the history of observations[1]. Among the inevitable consequences of climate change, the most important is its impact on water resources — the basis of environmental well-being, economic growth, and global security[2].

Climatic Changes

Water resources are important to both society and ecosystems. We need a reliable and regular supply of drinking water to sustain our health. For, human body contains 70% water in its various secretions, blood etc. We also need water

for agriculture, energy production, navigation, recreation and manufacturing.

In many areas, climatic changes are likely to increase the water demand while its supply is shrinking. This shifting balance would challenge water managers to meet the various needs of the growing communities. In some areas, the increase in runoff, flooding or a sea level rise reduce the quality of water and can damage the infrastructure that we use to transport and deliver water.

Water cycle and water demand create a delicate balance of precipitation, evaporation and all the steps in between. Increased evaporation may dry out some areas and fall as excess precipitation on some other areas. Changes in the amount of rainfall also change the water cycle. Warming winter temperatures cause more precipitation to fall as rain than as snow. This causes snow to begin melting earlier in the year and that in turn, alters the timing of stream flow in rivers that have their resources in mountainous areas.

As temperature rise, people and animal need more water to maintain their health. Important economic activities like growing food crops, raising livestock and producing energy at power plants also require water. Warming of earth reduces the amount of water available for these essential activities. Climatic changes thus affect water resources through its impact on the quantity, variability, timing, form and intensity of participation.

Additional effects of climatic change that have impact on water resources include increased evaporation rates, earlier and shorter run off seasons, and decreased water quality in both

inland and coastal areas. Increased evaporation reduces water supplies in many regions. The greatest deficits are expected to occur in summer leading to decreased soil moisture levels and more frequent and severe agricultural drought.

Causes of Climate Change

The main cause for climatic change may be due to the interaction among the natural resources such as Earth, marine, terrestrial and all above the atmosphere. So the fluctuations in these systems may be responsible for climatic change. This may be natural or most probably due to human activities.

Climate Change and Water

Water is vital for life, but its accessibility at a viable quality and quantity is threatened by many elements, of which climate plays a major role. Climate change intensifies the danger of both heavy rains and life threatening droughts. It hints every nook and corner of all the ecosystems, and badly affects the water cycle .The hydrologic cycle vastly dependent on temperature; fluctuations in one have consequences on the other. In recent years, the overall temperatures have gradually increased at their wildest rates in millions of years; it directly affects the water cycle.

Climate change has started to initiate our earth in more means than we predicted. Temperatures continue to increase throughout the sphere and we are undergoing deviations in rainfall patterns. The main basis of these disastrous effects on our globe is pollution.

Climate Change and Extreme Precipitation

Warmer temperatures have directed to increase dehydrating of the land surface in areas, thereby causing

severity of drought and it should be noted that many uncertainties remain in the prediction of future climate with increased risks of drought and floods. Warmer temperatures increase the rate of evaporation of water into the atmosphere, in effect increasing the atmosphere's capacity to "hold" water.[4] Heavy downpours can increase the amount of runoff into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into water supplies, making them unusable, unsafe, or in need of water treatment.[3]

Water Cycle and Water Demand

Due to climate change resources like ponds and lakes beside the coastlines face threats from rising of sea level. When the sea raises, sea water interchange with fresh water, in estuaries, water becomes more saline as the freshwater supply reduced. Over exploitation of freshwater usage may cause drought. Water infrastructure in coastal cities, including sewer systems and wastewater treatment facilities, faces risks from rising sea levels and the damaging impacts of storm surges.[3]

As heat rises, living creatures need more and more water to maintain their well being. Some other commercial activities and agriculture also have need of water. The amount of water available for these activities may be reduced as Earth warms up and if competition for water resources increase.[4]

In some places, climate change is expected to increase water scarcity while dwindling water. This impact is a challenge to ecosystem, communities, livestock and wild life. In some other areas, climate change is likely to increase run off causing flooding which in turn causes rising of sea level.

Thus, climate change affects changes in water resources, building new and water safety problems in and around the globe. In the absence of effective water management, water scarcity caused by climate change can cost some regions up to 6 percent of their GDP.[5]Decreasing of water resources can be a chief trial even for rich countries because of their necessity of water dependant goods. Thereby, the water supply of other regions significantly affects the supply of agricultural products to the European Union: Up to 38 percent of water used to grow imported agricultural products comes to the EU from exporting countries.[6]

The negative effects of climate change and the associated decline in GDP growth can be neutralized by properly allocating water resources, providing incentives to improve their efficiency, and attracting investment in the construction of water supply infrastructure.

Risk Prevention:

By changing our life style we can tackle climate change so that protect our environment. The following are the ways we can do to preserve our Earth. Climate change alteration comprises both threat prevention processes and dealings to increase the climate flexibility of regions. Risk prevention measures are directed at stopping the adverse effects of climate change on the water zone. The measures include, developing and executing water-saving machineries in agronomy and commerce, restoring and protecting ecosystems and establishing forests. Trials to raise sustainability are aimed at reducing the undesirable effects of climate change by increasing the flexibility of certain areas: replacement of crops

with less moisture-loving and salt-resistant ones, construction of dams and reservoirs, and transforming floodplains for agriculture.[7]

Additional investments needed to adapt the infrastructure to climate change are estimated at 5 to 20 percent of its cost[8]and two to three times higher than the current level of funding. According to the World Bank, the cost of adapting water infrastructure to climate change in the period from 2010 to 2050 is estimated at $75 billion to $100 billion per year[9]. In developing countries with inadequate water infrastructure and high climate risks, this amount could rise to $280 billion to $500 billion.[10]

Conclusion

The foremost outcome of climate change on the water resources of the whole earth is the disorder of the water cycle. Thus, the upswing in temperature leads to arise of the water evaporation, melting of glaciers causing extreme effects. The accessibility of clean water is greatly disappearing by various human activities and of concern is pollution which in turn affects the ecosystem and causes various climatic changes. Although numerous wastewater management methods are being explored by industries and several treatment plants, unprocessed wastewater is still being discharged into the water bodies by some industries. The influences of climate change on water assets, in turn, disturb all major segments of the economy. Thus, actual eco-friendly protection policies agreement effort will be of huge advantage to the environment and by addition to human.

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STARCH BASED BIOPLASTICS: AREMEDY FOR PLASTIC POLLUTIONAND HAZARDOUS CLIMATIC CHANGES

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Introduction

"Plastic pollution is not just an oceans issue. It's a climate issue and it's a human health issue,"

Claire Arkin.

Bio-degradable plastics get additional prominence nowadays. Bioplastics can be prepared from natural and renewable resource and they are able to break down naturally. This chapter discusses the climate change due to plastic pollution and centers to formulate bio-degradable plastics from starch by simple method. The prepared bioplastics were used to create antique ornaments and value added merchandises like kid's toys.All living creatures including the child in the womb is being affected through exposure to deadly chemicals in plastics that hamper their functioning and direct assimilation of non-degradable plastic waste by animals. Non-degradable plastic products are used to a great extent and dumbed directly

into soil and waterbodies. The process of recycling and incineration of them produces greenhouse gas emissions, global warming and thereby furnishings. The quality and permanency of amalgamated bioplastics were scrutinized by spectral and soil degradation analysis respectively. The bioplastics were almostcompletely degraded in soil within seven days which was confirmed by soil degradation analysis. These innovative bioplastics were easy to prepare, economically cheap and eco-friendly.

Climate Change due to Plastics

The direct disposal of million tons of plastic wastes to landfills is substantially threatening our fertility of soil, purity of groundwater and quality of air. The waste management process including incineration, inflicting the emission of excessive heat-trapping gases every minute such as water vapor, carbon dioxide, methane, nitrous oxide and ozone gas. These emissions from plastic could cross 56 gigatons in 2050,reported by Center for International Environmental Law. So, plastic lifecycle is believed to be athreat to maintain the global temperature rise below 1.5°C and this is one of the reasons for hazardous climate changes. In addition to that plastic wastes causeAsthma, pulmonary cancer, liver damage, Nerve and brain damage, Kidney disease.

Bio-Plastics as Panacea

Plastics that are made from renewable resources (plants like corn, tapioca, potatoes and algae) and which are fully or partially bio-based, and/or biodegradable or compostable are

called bioplastics [1]. Bioplastics are a revolution in the toxic plastic world. The property of biodegradability is what makes them unique and separates them from the rest of the plastics. They certainly would not cause any pollution as their composition is completely from biomasses and do not contain any toxins [2].

Experimental Preparation of starch based bioplastics

Accurate amount of dried potato starch was weighed and then diluted with 150ml double distilled water in a beaker. Then stoichiometric ratios of 1% glycerol and white vinegar were added. The beaker was heated with magnetic stirring for 10 minutes. After attaining thick consistency, the beaker was removed from it.

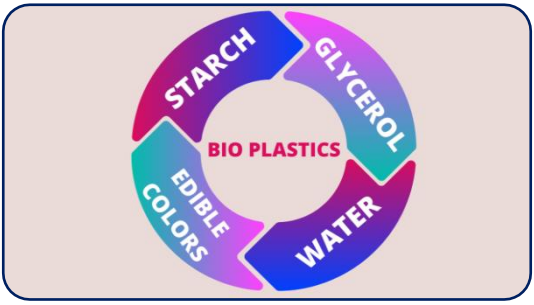


Fig. 1. Preparation of starch based bioplastics

Fabrication of antique ornaments and value added products using bioplastics

The synthesized bioplastics at warm condition was spread into a thin layer and then desired ornaments were prepared from it. Using silicon mould, raw bioplastic was improvised into value added products like kid's toys, buttons, keychain and wall decors.

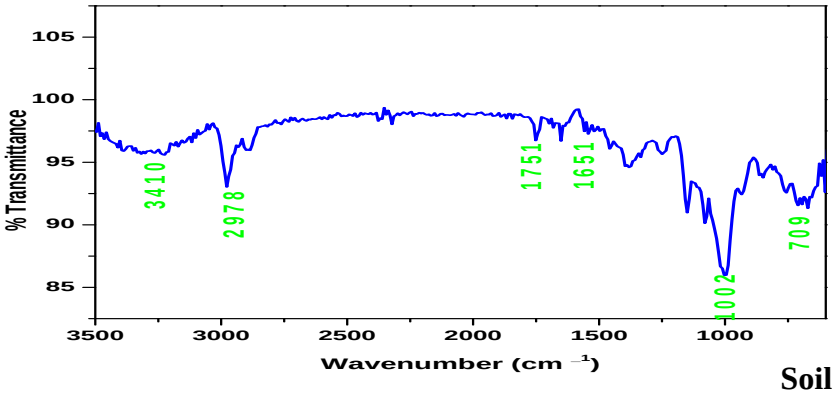
Fig. 2.Fabrication of antique ornaments and value added products using bioplastics

Characterization of starch based bioplastics

FT-IR Analysis

The synthesized starch based bioplastics were characterized by FT-IR spectroscopy. The broadband at 3410 cm^{-1} is due to OH stretching. A sharp peak at 2978 cm^{-1} is due to the C-H stretching. The peak at 1751 cm^{-1} is due to the carbonyl group of plastic. The peak at 1651 $cm^{-1}$is due to the C=O stretching. The bands from 709 to 1002 cm^{-1} due to the C–O bond stretching. All spectral peaks confirm the formation starch based bioplastics.[3]

Fig. 4. FT-IR spectrum of starch based bioplastics



Soil

Degradability Analysis of Starch Based Bioplastics

The permanencies of prepared starch based bioplastics were tested by soil biodegradability test. One gram of bioplastic was buried inside the soil at a depth of 5 cm in a

flower pot (roots of plants which are rich in nitrogenous bacteria) The flower pot with soil was placed in sunlight for seven days and the moisture of the soil was maintained by sprinkling water at regular intervals. The degradation rate of the soil burial test was calculated from weight loss of the sample over time. The biodegradation weight loss can be determined by using the following equation-

$$\text{Weight loss \%} = (Mi-Mf)/Mi \text{ X } 100 \text{ \%}$$

(Mi is the initial mass and Mf is the final mass of the sample after drying) [3].

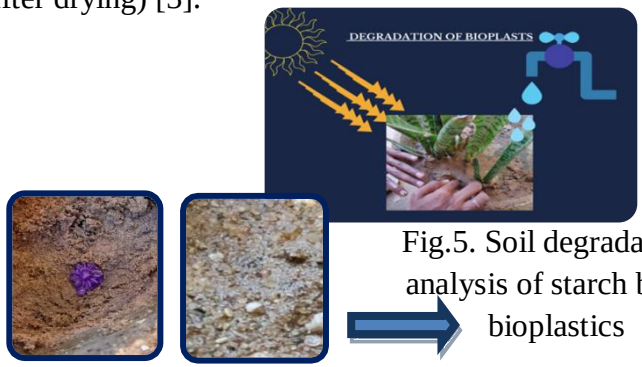


Fig.5. Soil degradability analysis of starch based bioplastics

Conclusion

The modern and digital world needs toxic free plastics known as bioplastics from renewable resources. This work was successfully fabricated antique ornaments and value added products like kid's toys and wall decor using biodegradable plastics which was initially prepared from starch by simple thermal method. The property, quality and stability of synthesized bioplastics were analyzed by various techniques. Bioplastics were almost completely degraded (90%) in soil

within seven days which was confirmed by soil burial analysis. This neoteric antique ornaments and value added products from starch based bioplastics were cheap, simple, atom economy and eco-friendly. Bioplastics do not rectify the hazardous climatic changes at once, but definitely can be a panacea for the non-degradable plastics. It is the responsibility of each individual to save our Mother Natureand our descendants as soon as possible, bioplastics can be a tool for that.

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OCEAN ACIDIFICATION

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Introduction

Industrial revolution, too much combustion of fossil fuels but also to large-scale tropical deforestation which depletes the climate system's capacity for photosynthesis. Energy moves between the atmosphere and oceans in natural fluctuations (El Niño events) this means that we cannot expect an immediate direct relationship between any influencing factor and surface temperature. Oceans warm they are less able to hold CO_2 so release it, again with the result the initial warming is enhanced. In current years CO_2 passed 400ppm, more than 40% higher than its pre-industrial value of 280 ppm and a level that has not existed on Earth for several million years. The climate system responds in various ways which both enhance and ameliorate the effects of these gases. In the decade 2009-2018, the ocean absorbed around 22% of the annual emissions of CO_2, which helps to attenuate climate change. However, increasing atmospheric carbon dioxide concentrations affect the chemistry of the ocean.Due to COVID-19 lockdownscarbon emissions in India show third-highest drop after US and Europe in 2020.

Earth's CO_2

About five billion years ago, Carbon dioxide (CO_2) has been present in the earth atmosphere since its condensed formation from the explosion of a huge star. About 2.5 billion years ago, Microbes were start their first life, plants developed the ability to photosynthesis, generate glucose and oxygen from CO_2 and water in the presence of light from the Sun. CO_2 was consumed, around 20 million years ago its concentration was down to below 300 molecules in every one million molecules of air.CO_2 plays an important role in climate because it is one of the atmospheric "greenhouse" gases (GHGs) which keep the Earth's surface warmer.

CO_2 trap the sun's radiant heat and enhance the warmness on earth. In the present climate the most effective GHGs are water vapour, which is responsible for about half of the total warming and CO_2 which accounts for about one by four.The greenhouse effect means that as the atmospheric loading of GHGs increases the earth's surface temperature. The overall increase in global temperature of about 1^0C over the past 150 years is almost entirely due to the human activities that have increasing amounts of atmospheric GHGs. It's concentration increases about 0.17% per year.

Ocean Acidification

Researchers said marine chemistry can be studied using four parameters: partial pressure of carbon dioxide in the water dissolved inorganic carbon, alkalinity and pH. Any two of

these parameters, along with measurements of salinity and temperature, allow us to understand the complete carbon chemistry of the ocean. Excess CO_2 increase the acidity of sea water is called Ocean acidification. Carbon dioxide, which is naturally in the atmosphere, dissolves into seawater. Water and carbon dioxide combine to form carbonic acid (H_2CO_3), a weak acid that dissociate water into hydronium ion (H_3O^+) and bicarbonate ions (HCO_3^-) as follows,

$$CO_2 + H_2O \rightleftharpoons H_2CO_3$$

$$H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$$

$$HCO_3^- + H_3O^+ \rightleftharpoons CO_3^{2-} + H_3O^+$$

When more CO_2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions. It increases the acidic nature of water. Because of human-driven increased levels of CO_2 in the atmosphere, there is more CO_2 dissolving into the ocean. The ocean's average pH is now around 8.1, which is basic, but as the ocean continues to absorb more CO_2, the pH decreases and the ocean becomes more acidic.

The pH scale runs from 0 to 14, with 7 being a neutral pH. Anything higher than 7 is basic (or alkaline) and anything lower than 7 is acidic. The pH scale is an inverse of hydrogen ion concentration, so more hydrogen ions translates to higher

acidity and a lower pH. The ocean absorbs about 30% of the carbon dioxide (CO_2) that is released in the atmosphere. As levels of atmospheric CO_2 increase from human activity such as burning fossil fuels (e.g., car emissions) and changing land use, the amount of carbon dioxide absorbed by the ocean also increases.

This process has far reaching implications for the ocean and the creatures that live there. A reduction in pH will have impacts on the entire oceanic system, with high latitude cold water oceans affected earlier and more severely than warm water oceans. Concentrations of atmospheric CO_2 and other radioactively active trace gases have risen since the Industrial Revolution. Such atmospheric modifications can alter the global climate and hydrologic cycle, in turn affecting water resources. Fossil fuel combustion now adds 5.5 - 2 0.5 billion metric tons of CO_2 to the atmosphere annually, mostly in economically developed regions of the temperature zone.

Effects on Marine Organisms

Ocean acidification has been found to affect several key processes in open ocean planktonic ecosystems, including calcification, photosynthesis, and nitrogen-fixation. These changes affect the community composition of phytoplankton and zooplankton they are calcifiers. The Arabian Sea, hold a diversity of marine habitats together with coral reefs, is witnessing acidification of its surface waters, a consequence of excessive carbon dioxide in the atmosphere, say Indian scientists. Using remote sensing, researchers collected and

analyzed data spanning ten years with the focus on five parameters that directly correlate with carbon condition of the ocean surface. The idea was to monitor the status of two important regions of the Indian Ocean, the Arabian Sea and the Bay of Bengal.

Calcification rates in tropical calcifying macroalgae may decrease even more strongly due to increasing CO_2. Reduced rates of calcification, along with the shoaling of the saturation horizons for calcium carbonate minerals to shallower depths will also affect the marine calcium carbonate cycle and especially the ones that build their skeletons and shells from calcium. Ocean acidification has the potential to alter the marine nitrogen cycle which controls much of primary production in the sea.

Laboratory experiments with the nitrogen-fixing cyanobacterium Trichodesmium revealed an increase in both carbon and nitrogen fixation with increasing CO_2. Another important consideration is the possible interactive effects of climate change and acidification such as the warming of surface waters and reduced nutrient availability. Similarly, ocean microbes produce and destroy a number of trace gases that are important for atmospheric chemistry and climate besides CO_2 and O_2. For example, nitrous oxide(N_2O), a powerful greenhouse gas, is a by-product of both nitrification and denitrification and its marine production might thus be affected by acidification.

Coastal ecosystems exhibit naturally high variability in pH and seawater chemistry due to biological activity, freshwater input, upwelling atmospheric deposition, and other factors. In response to climate change, highly migratory species, such as oceanic tunas, are expected to follow preferred species-and size-specific habitat conditions (mainly determined by temperature and oxygen). Ocean acidification may also affect tunas, although the effects at ecosystem level are difficult to forecast. Negative effects on tuna larvae survival have been observed in laboratory studies.

As a result, tuna may alter the spatial distributions in latitude and longitude, and modify the vertical distribution. In the south eastern Indian Ocean, the thermal habitat of several tuna species (skipjack, yellowfin, bigeye and albacore) is projected to move southwards in the course of this century, with consequences on spatial distribution. Tuna fisheries are a source of income for several coastal countries and islands in the Indian Ocean. Landings from artisanal and commercial tuna fisheries are sold on local and international markets, generating revenues for fishermen.

The pteropod or "sea butterfly," is a tiny sea snail about the size of a small pea. Pteropods are an important part of many food webs and eaten by organisms ranging in size from tiny krill to whales. When pteropod shells were placed in sea water with pH and carbonate levels projected for the year 2100, the shells slowly dissolved after 45 days. Researchers have already discovered severe levels of pteropod shell

dissolution in the Southern Ocean, which encircles Antarctica. Estimates of future carbon dioxide levels, based on business-as-usual emission scenarios, indicate that by the end of this century the surface waters of the ocean could have a pH around 7.8. The last time the ocean pH was this low was during the middle Miocene, 14-17 million years ago. The Earth was several degrees warmer and a major extinction event was occurring.

Ocean acidification is currently affecting the entire ocean, including coastal estuaries and waterways. Billions of people worldwide rely on food from the ocean as their primary source of protein. Ocean acidification is one aspect of global climate change. Anything we do to mitigate climate change today will benefit the future of the ocean as well. Over the last decade, there has been much focus in the ocean science community on studying the potential impacts of ocean acidification.

Effects on Humans

Humans are connected to the health of the ocean. We have always depended on the ocean's resources for food, recreation, transportation and medicines. Of the global population of over 7.8 billion people, more than 4.5 billion obtain at least 15% of their animal protein intake from fish. One of the most obvious connections people have with the ocean is seafood. Most of the shellfish we eat are going to be negatively impacted by ocean acidification due to the fact that they will be unable to build sturdy shells. Some oyster

hatcheries in the Pacific Northwest have already been impacted, and have seen declines in larval settlement and survival rates.

Pteropods may seem insignificant to many people, but since they are a major food source for fish, their survival is very important to us.In some countries, the share of protein from fish can be greater than 50%, including in West Africa; Asian coastal countries; and many small island states Ocean acidification and its chemical changes can have direct effects on the physiology of consumed marine species at key life history stages (e.g., eggs, larvae, juveniles, and adults), such that their survival and, therefore, availability, is altered.

For commercially important stocks of fish, particularly wild-capture fisheries, concern centers on population-level processes that are disrupted by ocean acidification, such as recruitment (i.e., the number of fish surviving to enter the fishery). Consequently, early life history stages have been a strong research focus. In the context of fish, studies have found negative effects of increased CO_2 on the survival of eggs (as indicated by hatching success) and early larval stages for some species (e.g., summer flounder, *Paralichthysdentatus* and Atlantic cod, *Gadusmorhua* L.).From an interpretive standpoint, the important thing is to help people realize how they are personally connected to the ocean, and then to be able to explain to them how that connection is being jeopardized by ocean acidification.

Conclusion

In conclusion, the most effective way to limit ocean acidification is to act on climate change, implementing solutions to dramatically reduce the use of fossil fuels. If we dramatically cut our global warming emissions, and we limit future warming, we can significantly reduce the harm to marine ecosystems.Ocean acidification is anticipated to drive complex changes in the occurrence of individual species and ecological infrastructure from which human health and well-being benefit. To understand the scale and risks of such challenges, researchers may improve the value of their research by anticipating and monitoring for such changes.

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INFLUENCE OF CLIMATE CHANGE IN DAY TO DAY LIFE

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Introduction

In the fast moving world, things that we depend upon value that is water, energy, transportation, resources, wildlife, agriculture, ecosystems, and human health is experiencing the effects of a changing climate.

Causes for Rising Emissions

There are many reasons behind the climate change;

- **Burning Gases**

Burning of coal, oil, gas and other harmful products produces carbon dioxide and nitrous oxide.

- **Cutting Down Forests (Deforestation).**

Trees help to regulate the climate by absorbing CO_2 from the atmosphere. So when they are cut down, that beneficial effect is lost and the carbon stored in the trees is released into the atmosphere, adding to the greenhouse effect.

- **Increasing Livestock Farming.**

Cows and sheep produce large amounts of methane when they digest their food.

- **Fertilisers Containing Nitrogen**

Fertilizers produce nitrous oxide which not only spoils the soil in addition it contaminates the environment.

- **Fluorinated Gases**

Fluorinated gases produce a very strong warming effect, up to 23 000 times greater than CO_2. Factories and industries gives out this gas. Thankfully these are released in smaller quantities and are being phased down by EU regulation.

Global Warming

Global warming the leading threat to human kind, it not only affects the climate change but also spoils the human health. The current global average temperature is 0.85ºC higher than it was in the late 19th century. Each of the past three decades has been warmer than any preceding decade since records began in 1850.

The Effects of Climate Change:

Global climate change has already had observable effects on the environment. Amount of Rainfall has changed, Glaciers have shrunk, ice on rivers and lakes is breaking up

earlier, plant and animal ranges have shifted and trees are flowering sooner. The average sea level is not in balance. It has affected the life of sea creatures

Climate change destabilises the Earth's temperature equilibrium and has far-reaching effects on human beings and the environment. During the course of global warming, the flaura and fauna has affected, 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, animals and the environment.

Climate change encompasses not only rising average temperatures ,level of water, but also extreme weather events, shifting wildlife populations and habitats, rising seas, and a range of other impacts which will prove to be threat to human life. 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. All of these changes are emerging as humans continue to add heat-trapping greenhouse gases to the atmosphere.

Effects of Global Warming due to Climate Change

- Rising maximum temperatures level.
- Rising minimum temperatures level.
- Rising sea levels from the normal level.
- Higher level of ocean temperatures

- An increase in heavy precipitation leading to heavy rain and hailstones.
- Shrinking glaciers and affecting animals life.
- Thawing permafrost.
- An increase in hunger and water crises, unavailability of resources especially in developing countries.
- Health risks through rising air temperatures, climate and heat waves.
- Economic implications of dealing with secondary damage and health risk related to climate change.
- Increasing spread of unwanted pests and pathogens.
- Loss of biodiversity due to limited adaptability.
- Adaptability speed of flora and fauna.
- Ocean acidification due to increased HCO_3 concentrations in the water as a result of increased CO concentrations.
- The need for adaptation in all areas of agriculture, forestry, energy, infrastructure, tourism, etc.

Impacts on Health

. As the global climate is a highly interconnected system that is influenced by many different factors, the consequences of climate change usually result in positive or negative feedback effects. This refers to developments that are self-enhancing due to the occurrence of certain conditions which is against the nature. Other Health Impacts is the linkages exist between climate change and human health. For example,

changes in temperature and precipitation, droughts and floods, will affect agricultural yields and production.

In some regions of the world, these impacts may compromise food security and threaten human health through malnutrition. This gives way to the spread of infectious diseases, and food poisoning. The worst of these effects are projected to occur in developing countries, among vulnerable populations. Declines in human health in different countries can affect the United States through trade, migration, and immigration and has implications for national security.

Although the impacts of climate change have the potential to affect human health in many countries and around the world, there is a lot we can do to prepare for and adapt to these changes - such as establishing early warning systems for heat waves, awareness programmes on impacts of climate change and other extreme events, taking steps to reduce vulnerabilities among populations of concern.

Raising awareness among healthcare professionals and ensuring that infrastructure is built to accommodate anticipated future changes in climate and ways to overcome it. Understanding the threats that climate change poses to human health is the first step in working together to lower risks and be prepared.

The impacts of climate change include warming temperatures, changes in precipitation and increases in the frequency or intensity of some extreme weather events, and rising sea levels. These impacts threaten our health by

affecting the food we eat, the water we drink, the air we breathe, and the weather we experience.

The severity of these health risks will depend on the ability of public health and safety systems to address or prepare for these changing threats, as well as factors such as an individual's behaviour, age, gender, and economic status. Impacts will vary based on a where a person lives, how sensitive they are to health threats, how much they are exposed to climate change impacts, and how well they and their community are able to adapt to change.

People in developing countries may be the most vulnerable to health risks globally, but climate change poses significant threats to health even in wealthy nations such as the United States. Certain populations, such as children, pregnant women, older adults, and people with low incomes, face increased risks; see the section below on Populations of Concern.

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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CLIMATE CHANGE VS FLORA AND FAUNA

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Introduction

"Climate change is a terrible problem, and it absolutely needs to be solved. It deserves to be a huge priority"

-Bill Gates

Global climate is the connected system of sun, earth, oceans, wind, rain, snow, forests, deserts, savannas and human activities. The Earth's average temperature is about 15 degree Celsius but there has been deviation in it from the past 20 years. Though there may be natural causes such as changes in the sun's radiation, volcanoes or internal variability in the climate system or due to human influences such as changes in the composition of the atmosphere or land use. The observable long-term effects of Climate change are numerous such as warming temperatures, changes in precipitation as well as the effects of Earth's warming include, rising sea levels, shrinking mountain glaciers, Ice melting at faster rate than usual in Green land, Antarctica and the Arctic, Changes in flower and plant blooming times. As a result of it habitat destruction and extinction of flora and fauna is also at increasing rate throughout the world including India. The conservation of biodiversity is of paramount importance to our survival. We have about 20 species of plants and 410 species of animals,

birds and fishes on the verge of extinction. Although they are on the verge of extinction, there are chances to revive them. So let us find the issues along with their causes and finally with plans for preservation.

Importance of Flora and Fauna

"A world without flora and fauna is the world without us"

The ecosystem is a complex, interconnected network comprising of biotic and abiotic elements. Among all biotic elements, Flora and Fauna are the most fascinating ones. The term flora in Latin means "Goddess of the flower". Flora is a collective term for a group of plant life found in a particular region. The whole plant kingdom is represented by this name. As per Roman mythology, Fauna or "Faunus" is the name of the goddess of fertility. Another source is "Fauns" which means "Forest spirits". Fauna represents the animal life indigenous to a region.

India is a land of varied flora and fauna. It is the one of the 12 mega biodiversity hotspots of the world. The Eastern Himalayas and the Western Ghats are among the world's 18 biodiversity hotspots. But, in the last few decades, we have seen a steady increase in the extinction rate of flora and fauna all over the world including India. Many factors are responsible for the depletion of flora and fauna such as population explosion, hunting, forest fires, expansion of agriculture, extensive use of fossil fuels, destruction of natural habitats, climate changes, pollution, natural disaster, deforestation etc.

The flora and fauna are important for the following reasons:

- ***It maintains Ecological Balance:*** We are connected through a food chain which starts from the primary producers the plants and ends with the highest consumer- man. Flora and fauna are important for human existence. The flora liberates oxygen that is consumed by the fauna for respiratory activities. Flora, in turn, liberates carbon dioxide consumed by the flora for photosynthesis. Human beings get benefitted through the medicinal and food offerings by flora and fauna. Animal maintain the equilibrium by predating on different plants and animals to balance their population on earth. Animal droppings are a source of fertilizer. The dead animals decay and act as supplement minerals for other animals.
- **Aesthetic Value:** The flora and fauna spread across the earth contribute to the aesthetic value of the earth. People visit several biosphere reserves, national parks and zoos, forests botanical gardens etc. to enjoy the beauty of landmarks.
- **Expansion of Local Economies:** Flora and fauna contribute to the local economies through tourism.
- **Promote Biodiversity:** Biodiversity refers to the variety of life in a given area. Biodiversity exists in rural and urban areas. If humans are more concerned about flora and fauna, in return it improves their quality of living like providing cleaner air, and water to satisfy their basic needs.
- **Provide Companionship and Boost Productivity:** The world is a big hub of social interactions and

human beings are at the centre of it. While flora and fauna are fit for food and even labour, they do afford humanity the pleasure of their company. They have lasted this long providing comfort and happiness enabling productivity. Example- Pet animals like cats, dogs and rabbits are great companions for home as well as for the owner. Saplings in our garden &flowers refresh our mind from stress and anxiety, offer pleasure to our mind and boost productivity when we see them every day.

Extinction of Flora due to Climate Change

Climate change can affect life of plants and affect the blooming patterns and pollination in flowers. Climate change can affect a number of variables that helps us to determine how plants grow. Extreme temperatures, a decrease in water availability and changes to soil conditions will make it more difficult for plants to thrive. Hence climate change is expected to stunt plant growth. The impacts can be classified into direct impacts and indirect impacts. Direct impacts include:

- **Changes in Distributions:** If climatic factors such as temperature and precipitation change in a region beyond the tolerance of a species phenotypic plasticity, then the distribution changes of the species may be inevitable. The plant species are shifting their ranges in altitude and latitude as a response to changing regional climate.
- **Changes in Life-cycles (phenology):** The timing of phenological events such as flowering are often related to environmental variables. Changing

environments are therefore expected to lead changes in life cycle events. For example: Flowering time changes, flowering occurs earlier than usual. Plant responses to warming, which include altered flower, nectar and pollen production, which could modify floral resources availability and reproductive output of pollinating insects, similarly pollinator responses such as altered foraging activity, body size, and life span could affect patterns of pollen.

- **Genetic Diversity:** Species richness and species evenness play a key role in how quickly and productively an ecosystem can adapt to change. Absence of genetic mutations and decrease in species richness greatly enhances the possibility of extinction. The indirect impacts of climate change are also equally important in determining the response of plants to climate change.
- This may include introducing a new competitive relationship or altering the process of carbon sequestration
- The rise in temperature and lack of precipitation reduces the populations of people sensitive to flood risk
- The range of symbiotic fungi associated with plant roots may directly change as a result of altered climate, resulting in a change in the plant's distribution.
- A new grass may spread into a region, altering the fire regime and greatly changing the species composition

- Pathogens or parasites may change its interactions with plants. As pathogenic fungus becoming more common in an area where rain fall increases
- Increased temperatures may allow herbivores to expand further into alpine regions, significantly impacting the composition of alpine herb fields
- As a result of climate change, the colours of flower changes. The UV pigments in flowers which are invisible to human eye, but they attract pollinators and serve as a kind of sunscreen for plants. The more UV absorbing pigment that petal contains, the less harmful radiation reaches sensitive cells. Absence or lesser UV pigments in petal can also damages flower's pollen.

  Endangered plant species can be found all over the world. The effects of climate change, deforestation and land development have also played a role in the demise many species. The Endangered Species Act (ESA) was enacted by congress and is one of the dozens of United States environmental laws passed in 1973.Here are the lists of endangered plant species due to climate change

  - Baobab Tree
  - Monkey Puzzle Tree
  - Dragon Tree
  - Bois Dentelle
  - Cork
  - Underground Australian Orchid
  - Venus Fly Trap

- Baseball plant
- Green Pitcher Plant
- Welwitschia Mirabilis
- Snowdonia Hawkweed
- Rafflesia
- Titan Arum
- Black Bat-Flower
- DendroserisNeriifolia
- The Giant Mountain Lobelia
- Encephalartoswoodii

Fauna Vs Climate Change

Humans and wild animals face new challenges for survival because of climate change.Here are some animals that are now extinct.

S.No.	*Name of the Species*	*Year of Extinction*
1	*West African Black Rhinoceros*	*2011*
2	*Baiji White Dolphin*	*2002*
3	*Pyrenean Ibex*	*2000*
4	*Passenger Pigeon*	*20^{th} century*
5	*Tasmanian Tiger*	*1936*
6	*Stellers Sea Cow*	*1768*
7	*Great Auk*	*Long ago*
8	*Dodo*	*1662*
9	*Woolly Mammoth*	*1700 B.C*
10	*Sabre-toothed Cat*	*55 million to 11,700 B.C*

Here are the lists of animals that are becoming extinct because of climate change

- *Columbia Spotted Frog- In the mountains and deserts of Utah, Columbia spotted frogs are sentinels of climate change. Mormon pioneers saw the frogs as messengers of clean water. Now, their survival is jeopardized by habitat loss, drought and soaring heat.*
- *Stag Horn Coral- Particularly susceptible to bleaching, Stag horn coral populations have declined more than 80 percent over the past 30 years due to higher incidence of disease and the impacts of global warming, climate change especially higher ocean temperatures and ocean acidification.*
- *American Pika- American Pikas are suffering because of climate change. Climate change has brought higher temperatures to their western mountain homes. Pikas have already disappeared from more than one-third of their previously known habitat in Oregon and Nevada.*
- *Adelie Penguin- Climate change affects Adelie penguins. Because the rapid warming of sea ice along the Western Antarctic Peninsula is shrinking in size and the sea-ice season is shorter. The loss of sea ice is harming Emperor Penguin chicks and adults. Emperor penguins rear their chicks on land-locked sea ice.*
- *Leather Back Sea Turtle- Because of climate change, the increased storm activity may wash away the turtle's nest along with its eggs and decrease turtle nestling habitat.*

- *Koala- Koalas (native to Australia) have very limited capability to adapt to rapid, human-induced climate change, making them very vulnerable to its negative impacts.*
- *Atlantic Cod- Due to increasing acidification, the cod embryos become more sensitive. Thus the species shrinks as the planet warms.*
- *Polar Bear- Polar bears will be wiped out by the end of the century unless preventive measures taken to tackle climate changes. They have already reached their survival limits as the Arctic sea shrinks*

And the list expands with creatures such as Monarch Butterfly, Ringed seal, White Lemuroid ringtail possum, Sierra Nevada blue, Bramble Cay melomys, Baird's sand piper, Hawaiian Honey Creepers etc.

Control Measures – Preservation of Flora and Fauna &Role of Climate Heroes

To control the extinction of Flora and Fauna, let us join hands in preserving them. Here are some strategies to save Flora and Fauna.

- Adopt animals and volunteer to donate money and your time to preserve them.
- Restore wetlands or involve in cleaning polluted water bodies as an act of service.
- Speak up the issues in public and create awareness among all.
- Plant saplings, which will in return plant the seeds of peace and hope.

- Here comes the Climate Heroes, which help us to overcome climate change
- **Plants:** Plants keep our climate stable over time by offsetting temperature and moisture fluctuations through transpiration. Plants use carbon dioxide during photosynthesis, which slightly offsets the amount of green house gas being released in the atmosphere through the burning of fossil fuels. Afforestation should take place as vegetation is necessary for normal climate.
- **Tropical Forests:** They act as filters, observing 25% of the world's carbon
- **Wetlands:** Wetlands are essential to life on earth, supporting more than 125,500 freshwater-dependent species.
- Emission of heat from meet can be controlled by reducing the consumption of pork and beef.
- Follow 3R strategy: Reduce, Reuse and Recycle.
- Choose Eco-friendly fuels and products.

Conclusion

The Earth is what we all have in common, though we have rights to use the resources in them, we do not deserve rights to destroy them. The Natural resources in our universe are borrowed from our ancestors, to safely hand it over to our forth coming generations.

"Only after the last tree has been cut down.Only after the last river has been poisoned. Only after the last fish has been caught, only then will you find that money cannot be eaten".

Hence let us preserve Flora and Fauna by following the above mentioned strategies. We have to protect the climate heroes so that they would protect our universe and us in return. Let us all be responsible and sow the seeds of responsibilities to the boundless extent.

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CLIMATE CHANGE: RISKS AND RESCUE OF MARINE ORGANISMS

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Introduction

The fifth largest planet of the solar system – Earth, is the only planet known to have an atmosphere containing free oxygen and oceans of water on its surface and to maintain life. Naturally earth has green house effect. The green house effect is the trapping of energy from the sun by certain gases in the atmosphere leading to rise in earth's temperature. Carbon dioxide, nitrous oxide, methane, water vapour and chlorofluorocarbon absorb and reflect infra red waves radiated by earth and hence conserve heat as in a green house. All the living organisms need this green house effect for its survival. If not, the earth will be cooled and ice will cover the earth from pole to pole.

The most abundant green house gas is CO_2 which comes to the atmosphere due to anthropogenic and natural activities. CO_2 is removed by plants through photosynthesis and absorbed by ocean water. But human activities such as burning of fossil fuel, solid wastes, wood products etc increase CO_2 in the atmosphere. This release of CO_2 is at faster rate than

at which earth's natural processes can recycle this gas. When the CO_2 increases in the atmosphere, it greatly affects the physical and chemical properties of the ocean.

Ocean is a beautiful, largest ecosystem and important in various ways such as providing oxygen, regulating earth's climate and creating jobs so on. It is also a good source of food and contains incredible biodiversity. While the ocean has been a buffer to humans on land from the full consequences of our emissions, the excess heat and carbon absorbed by the ocean are changing marine ecosystems to the detriment of the animals and plants in these systems and the people who rely on them.

Atmospheric concentrations of the green house gases are increasing day by day which are responsible for the rise in the temperature of our planet. The process of heating and cooling of the oceanic water is slower than land. Oceans contain dissolved gases that are very important to living organisms, particularly oxygen, carbon dioxide, and nitrogen. In the ocean, photosynthesis consumes CO_2 and produces O_2, while respiration and decomposition consume O_2 and produce CO_2. Solubility of gases decreases when temperature rises. pH of the ocean is regulated by Carbon dioxide, which acts as a buffer and its increased concentration lowers the pH of sea water.The most abundant atmospheric gas nitrogen dissolves into the surface layers of the ocean.

Risks

Climate change is happening everywhere. The main driving force which affects the life on earth is climate change. Human activities make our planet to warm at an alarming rate. Increasing ocean temperature, melting ice in the poles, rising

sea level, acidification of the ocean due to elevated CO_2 in the atmosphere are the major signs of climate change occurs in the marine environment.

Increasing Ocean Temperature

Direct effects of changes in ocean temperature and chemistry may alter the physiological functioning, behaviour and demographic traits (e.g., productivity) of organisms, leading to shifts in the size structure, spatial range, and seasonal abundance of populations. Warmer ocean surface waters result in increased ocean stratification, which means there is less ocean mixing, which would normally help deliver oxygen from surface waters to the deep. This intensified physical barrier in surface and deep waters has contributed to reduced oxygen levels in the ocean, suffocating many marine species in deeper waters or causing them to relocate. Species affected include ones that we eat or depend on for livelihood.

Marine species affected by persistently rising temperatures, having a cavalcade of effects on marine life which include plankton, forms the basis of marine food chains. In many marine species the migratory patterns are changed due to ocean currents they follow are altered. Species that depend on ocean currents for reproduction and nutrients will be affected much, if there is alteration in ocean current. Many reef-building coral and reef fish species depend on ocean currents for the dispersal of their larvae.

Species responses to climate change is variable across ocean regions and are consistent with expectations from climate change, including shifts in distribution to higher latitudes and to deeper locations, declines in calcification and

increases in the abundance of warm-water species. The ocean plays a central role in regulating the Earth's climate and any changes poses a threatening life to life in the oceans, including coral reefs and fisheries, with impacts on marine ecosystems, economies and societies. Rising temperatures can directly affect the metabolism, life cycle and behaviour of marine species. For many species, temperature serves as a cue for reproduction. The changes in sea temperature could affect their successful breeding. The number of male and female offspring is determined by temperature for marine turtles, as well as some fish and copepods.

Changing climate could tilt sex ratios and threaten population survival. Increase in temperature causes mass migration of marine species. Mobile species, such as fish, may respond to climate change by moving to more favorable regions, with populations shifting pole ward or to deeper water, to find their preferred range of water temperatures or oxygen levels. Development and growth of fishes are much affected by the change in temperature. One of the most visually dramatic effects of climate change is coral bleaching, a stress response caused by high water temperatures that can lead to coral death. Coral bleaching due to warm water affects coral reef eco system which is the home to most of the marine diversity.

Polar Ice Melting

Warming of the atmosphere leads to the melting of inland glaciers and ice, causing rising sea levels with significant impacts on shorelines such as coastal erosion,

saltwater intrusion, habitat destruction. The production of algae, foundation of Arctic food web depends on the presence of sea ice. Diminished sea ice results in the loss of vital habitat for seals, walruses, penguins, whales and other megafauna. Sea ice is a critical habitat for Antarctic krill, the food source for many seabirds and mammals in the Southern Ocean. In recent years, as sea ice has diminished, Antarctic krill populations have declined, resulting in declines in the species dependent on the krill. Due to closely linked changes in seawater chemistry, less oxygen remains available leads toocean deoxygenation. Seawater contains more dissolved carbon dioxide, causing ocean acidification. Non-climatic effects of human activities are also ubiquitous, including over-fishing and pollution.

Warm water coral reefs host a wide variety of marine life and are very important for tropical fisheries and other marine and human systems. They are particularly vulnerable, since they can suffer high mortalities when water temperatures persist above a threshold of between 1°C to 2°C above the normal range. Sea ice influences global weather patterns, with the white surface of the ice reflecting sunlight and its heat back into the atmosphere. But with higher oceanic and atmospheric temperatures, sea ice has been melting. In the absence of sea ice, the darker ocean absorbs the sun's heat, leading to positive feedback in which warmer water and warmer air melt more sea ice, exposing more ocean. Loss of sea ice also directly impacts the people and animals that live in and adjacent to it. Inuit people who have lived in the Arctic for 20,000 years are seeing an unprecedented and swift change to their homes and livelihoods.

Rising Sea Levels

Rising sea levels increase the amount and severity of floods and shoreline erosion. It may also destroy wildlife habitats on the shoreline, interfere with coastal farming, and contaminate potable water sources.

Oceans become more Acidic

The acidity of seawater is increasing as a direct result of increasing carbon dioxide levels in the air from human activities. Concentrations of carbon dioxide are higher than in the last 800,000 years. Carbon dioxide dissolves in water, changing seawater chemistry and decreasing pH. The ocean's increased acidity results in thinner shells and more shellfish die as they become easier for predators to eat.

Corals are also very sensitive to rising acidity, as it is difficult for them to create and maintain the skeletal structures needed for their support and protection. Corals provide vital fish spawning habitat and support for thousands of marine species.CO_2emissions are also making the ocean more acidic, making many marine species and ecosystems increasingly vulnerable. Increased acidification can also limit the ability of certain fish to detect predators, disrupting the food chain. The disruption and destruction of coral reefs and shellfish will have profound effects on humanity, chiefly in the form of less food for people who rely on the ocean for it.

As the ocean absorbs more carbon dioxide, the pH of the water decreases, making it more acidic and hindering the ability of marine organisms to make the shell and skeleton structures on which they rely for survival. This affects plankton, coral reefs, oysters, sea urchins, clams and more.

Ocean acidification thereby undermines the base of the food web, critical fish habitats, commercial fisheries and the coastal ecosystems that protect our shorelines.

Storms and Precipitation can Pollute Coastal Water

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. Heavy rain in coastal areas can lead to increase in runoff and flooding, impairing water quality as pollutants on land wash into water bodies. Some coastal areas, are already experiencing "dead zones" (lack of life)where water is depletion of oxygen because of pollution from agricultural fertilizers, delivered by runoff. It also exacerbates existing physiological stresses and reduces growth and survival rates during the early life stages of some species. Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability [IPCC 5th Report]

Rescue

The sustainable management, conservation and restoration of coastal and marine ecosystems are vital to support the continued provision of carbon sequestration and other ecosystem services on which people depend. Marine Protected Areas can protect ecologically and biologically significant marine habitats, including regulation of human activities to prevent environmental degradation.

Globally ambitious efforts are also needed to reduce the use of fossil fuels, increase the use of renewable energy

systems and enhance energy efficiency. ReducingCO_2 and other green house gases is the key to reduce the impacts of climate change on the ocean.

Illegal deforestation is a gateway activity for climate change. Easiest way of removing carbon dioxide is by afforestation and reforestation. It is the urgent responsibility of every human being to protect our earth from climate change by repairing some of the damage done by humans and maintain the environment for future generations, maintaining species diversity for our benefit and that of wildlife and providing opportunities for education and the enjoyment of the environment. It is the role of an individual and also the community in which he lives.

Role of an Individual

- Make sure to turn off lights and unplug devices that you are not using anymore.
- Replace your light bulbs with energy-efficient light bulbs to save electricity.
- Transportation is now the largest source of carbon emissions. Instead of travel by car or airplane which contributes heavily to our shared carbon footprint, take public transit, biking, or walking when possible.
- Food waste is an enormous contributor to climate change. Reduce our carbon footprint through food choices. Eat more non-meat proteins, less dairy and more vegetables
- Show your support for programs and organizations including community and citywide actions that are fighting climate change.

- **Voting for legislation and politicians that aid against the detrimental effects of climate change**.
- Recyclingis a **cost-effective and eco-friendly process that eliminates waste** and doesn't emit greenhouse gasses into the environment.
- Educating others about the **dangers of climate change and how to act against it**.
- Use less paper and read e-books.
- Buy products that do not cause damage to the environment

Role of Community:

- Deforestation should be prevented and steps to be taken for afforestation.
- Industries must use catalytic converter.
- Lead free petrol should be sold.
- **Awareness should be created about** how **renewable energy is better than utilizing fossil fuels**.
- Since the coastal ecosystems like mangroves, salt marshes and seagrasses play a vital role in carbon storage and sequestration, conserve them.

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AGRICULTURAL GREEN HOUSE GAS EMISSION

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Introduction

Agriculture is highly at risk from climate change, requiring urgent adaptation response in coming years to meet global food supply. At the same time, agriculture emits significant amount of greenhouse gases (GHG) into the atmosphere, so that mitigation in agriculture features prominently in many country climate change response plans. The largest contributors from agriculture are non-CO_2 emissions from crop and livestock activities within the farm gate and carbon losses from land use - mainly due to deforestation and peat land degradation.

Sources of Agricultural Greenhouse Gases

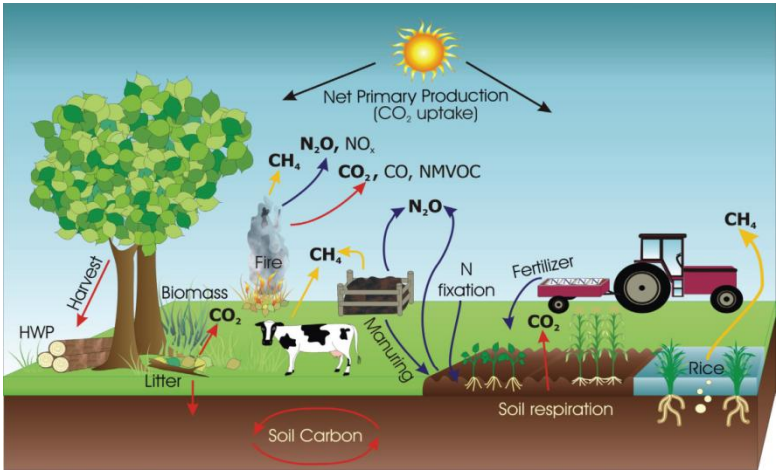
- The conversation about climate change largely revolves around greenhouse gases. Agriculture is both a source and sink for greenhouse gases (GHG). A source is a net contribution to the atmosphere, while a *sink* is a net withdrawal of greenhouse gases.
- Most agricultural emissions originate from soil management, enteric fermentation (microbial action in the digestive system), energy use and manure management The primary greenhouse gases related to agriculture are (in

descending order of magnitude) methane, nitrous oxide and carbon dioxide.

Animal Agriculture's Contribution to Greenhouse Gas Emission

Within animal production, the largest emissions are from beef followed by dairy and by methane produced in during cattle digestion. Excess nitrogen in agriculture systems can be converted to nitrous oxide through the nitrification-denitrification process. Nitrous oxide is a very potent greenhouse gas, with 310 time greater global warming potential than carbon dioxide. Nitrous oxide can be produced in soils following fertilizer application.

As crops grow, photosynthesis removes carbon dioxide from the atmosphere and stores it in the plants and soil life. Soil and plant respiration adds carbon dioxide back to the atmosphere when microbes or plants breakdown molecules to produce energy.



Farming emissions

Some carbon dioxide is stored in soils for long periods of time. The processes that result in carbon accumulation are called carbon sinks or carbon sequestration. Crop production and grazing management practices influence the soil's ability to be a net source or sink for greenhouse gases. Managing soils in ways that increase organic matter levels can increase the accumulation (sink) of soil carbon for many years.

Agricultural Soil Management

These are nitrous oxide emissions and account for about 60 percent of the total emissions from the agricultural sector. Nitrous oxide is produced naturally in soils through the microbial processes of nitrification and de-nitrification. During nitrification, ammonium (NH_4) produces nitrates (NO_3,). During de-nitrification, nitrates (NO_3,) are reduced to nitrogen gas (N_2). An intermediate step in both of these processes is the creation of nitrous oxide (N_2O).

The large increase in the use of nitrogen fertilizer for the production of high nitrogen consuming crops like corn has increased the emissions of nitrous oxide. Although nitrogen fertilizer is essential for profitable crop production, the development of practices for more efficiently using nitrogen fertilizer has the potential to significantly reduce nitrous oxide emissions while also reducing production costs and mitigating the nitrogen contamination of surface and ground waters.

Enteric Fermentation

Methane is produced as part of the normal digestive processes in animals. During digestion, microbes in the animal's digestive system ferment feed. This process, called enteric fermentation, produces methane as a by-product which can be emitted by the exhaling and belching of the animal.Because of their unique digestive system, ruminant animals (e.g. cattle) are the major emitters of methane. Beef cattle account for about 70 percent and dairy cattle for about 25 percent of these methane emissions. If beef and dairy cattle numbers increase, methane emissions will also increase.

Feed qualify and feed intake influence the level of methane emissions. In general, lower feed quality and higher feed intake lead to higher methane emissions.

Manure Management

Methane is produced by the anaerobic (without oxygen) decomposition of manure. When manure is handled as a solid or deposited naturally on grassland, it decomposes aerobically (with oxygen) and creates little methane emissions. However, manure stored as a liquid or slurry in lagoons, ponds, tanks or pits, decomposes anaerobically and creates methane emissions. Dairy cattle and swine produce about 85 percent of the methane emissions. Methane emissions will increase as the number of large scale livestock confinement systems increases.

Methane emissions can be reduced through the application of technologies designed to capture the methane and use it as an energy source. In addition to reducing methane emissions, methane capture will improve the profitability of the livestock operation by offsetting the need for fossil fuel energy from outside sources.

Carbon Dioxide from Fossil Fuel Consumption

The use of fossil fuels in agricultural production accounts for eight percent of the emissions from agriculture. These emissions are primarily from combustion of gasoline and diesel fuel. Using renewable fuels can reduce the carbon dioxide emissions from agriculture production.

Agricultural Greenhouse Gas Sinks

A sink is a reduction in atmospheric greenhouse gases by storing (sequestering) carbon in another form. A traditional carbon sink is underground coal and oil deposits where millions of year ago living plants (and other organisms) used atmospheric carbon to build the plant. When the plants died, instead of decomposing and releasing carbon back into the atmosphere, they were stored under high pressure and became oil and coal. When oil and coal are recovered and consumed, the sequestered carbon is emitted into the atmosphere as carbon dioxide.

Forest Management Practices

Growing trees sequester large amounts of carbon dioxide from the atmosphere through photosynthesis. The carbon is used to build the plant and the oxygen is released

back into the atmosphere. An increase in biomass from the growth of forests (both above ground and below ground) provides a carbon sink. As long as the wood does not decompose or is not burned or otherwise destroyed, the carbon is maintained in the wood and the wood continues to be a carbon sink. Trees harvested for building materials maintain the carbon in the new structure (houses, etc.) for decades. Wood disposed of in a solid waste disposal site provides an almost permanent carbon sink. The growth of new trees planted on harvested areas sequesters additional carbon.

The carbon sink created by forests and forest products (9.6 %) more than offsets the greenhouse gas emissions from agriculture (8.2 %). Although most forested areas are not located in the Midwest, sinks do occur in Midwest agriculture. Agroforestry practices such as managed shelterbelts and forested riparian zones enhance carbon emission offsets and provide other wildlife and aesthetic benefits.

CO_2 flux from agricultural soils

The soil is a great storehouse (sink) of carbon in the form of organic matter. Currently agriculture soils provide a small (.4%) positive flux (soil sequestration slightly exceeds soil emissions) of carbon dioxide.

Midwest topsoil was created by the decomposition of prairie grasses that grew on these soils. Over the centuries, carbon was stored (sequestered) in the soil. When the prairie was plowed, soil carbon oxidized and became atmospheric carbon dioxide. Tillage of the soil over the decades released

more carbon than was added by crop residue and thereby reduced soil organic matter. However, equilibrium has been reached in most soils where the amount of carbon sequestration approximately equals the amount of carbon released.

No-till farming practices provide a great potential for the future sequestration of atmospheric carbon and building soil organic matter while also minimizing soil erosion and reducing production costs.

Conclusion

Agriculture, and the land use associated with agricultural production systems, contributes significantly to global greenhouse gas emissions. Most emissions are associated with N_2O emissions from N fertilizers and manures and from CH_4 emissions from ruminant livestock and rice cultivation. A smaller amount of emission is also associated with CO_2 loss from soils converted into croplands from forests and pastures. There is an urgent need to improve the efficiency of farming systems in order to ensure that productivity is maintained or increased at the same time as their environmental impact (particularly greenhouse gas emissions) are reduced.

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CLIMATIC CHANGE AND MARINE ALGAE

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Introduction

Algae are an ecologically important and often conspicuous feature of marine wetland. They are highly diverse, evolutionary group of photoautotrophic organisms with unicellular reproductive structures and relatively simple life cycle that enable them in rapid establishment, growth and propagation. They are fundamental players in the physical, chemical, and biological processes that characterize wetland ecosystem. Most obvious is their role as primary producers and their place in the aquatic food web as the base of the trophic structure.

Algae provide food source for invertebrates and small fish in wetland and contribute to nutrient cycle as the sources of dissolved organic matter and nitrogen. Algal photosynthesis and respiration can account for a significant fraction of wetland metabolism in some habitats and therefore, can strongly influence water –column oxygen dynamics. Algae are important in energy and nutrient cycling, stabilizing substrata, and serving as habitat for other organisms in wetland. Because of their role in ecosystem energetics and biogeochemical cycling, algae provide an integrated picture of wetland condition.

Climate Change on Marine Algae

‘*Ocean afforestation’* is proposal for farming seaweed for carbon removal. After harvesting the seaweed decomposes into biogas in an anaerobic digester. The methane can be used as a biofuel, while the carbon dioxide can be stored to keep it from the atmosphere. Seaweed grows quickly and takes no space on land. Afforesting 9% of the ocean could sequester 53 billion tons of carbon dioxide annually. The approach requires efficient techniques for growing and harvesting, efficient gas separation, and carbon capture and storage.

Physical and Chemical Characteristics Features of Marine Environment

Water is an essential to the maintenance of all life. It constitutes 80 percent or more by weight of active protoplasm .it is the most efficient of all solvents and carries in solution the necessary gases, oxygen, and carbon dioxide, as well as the mineral substance necessary to the growth of plants and animals, and it is itself one of the essential raw materials, in the manufacture of foods by plants. Organism lives in the terrestrial environment have devised means, such as impervious integuments, to conserve water, and the land plants have roots and special vascular system for transport of water to all growing parts. In the marine environment there is freedom from desiccation, except at high –tide level, and therefore no highly specialized means are provided for conservation of water or for its transport in plants.

Also asbiological importance are the high heat capacity of water and its high latent heat of evaporation, both of which obviate the danger that might result from rapid change of temperature in the environmental medium. Owing to the high degree of transparency of water it is possible for the sea to sustain plant life throughout a relatively deep layer, and in animals the development of organ of vision and of orientation has progressed to a marked degree. Sea water is a buffered solution; that is, changes from acid to alkaline condition, or vice versa are resisted. This property is of vital importance to the marine organism, mainly for two reasons:

1] An abundant supply of carbon can be available in the form of carbon dioxide for the use of plants in the synthesis of carbohydrates without disturbance to the animal life that may be sensitive to small changes in pH.

2] In the slightly alkaline habitat the many organisms that construct shells of calcium carbonate can carry on this function much more efficiently than in a neutral solution.

The support offered to the bodies of marine organisms by the specific gravity of the surrounding medium obviates the need of special supporting skeletal structure in many forms. Striking examples of these are the jelly fishes, molluscs, unarmoured dinoflagellates, and even the large marine mammals with their heavy skeletons, which could not survive in their present bulky state except in an aquatic habitat. The hard shells of crabs, clams, snails, and so on, doubtless serve as support, especially in some burrowing and intertidal forms,

but these hard parts may be looked upon also as protective and as a framework for attachment of muscles used in digging, creeping or swimming.

pH_Daily and Seasonal Shifts in Photosynthesis and Respiration

Increasing amounts of carbon dioxide (CO_2) in the earth's atmosphere are the driving force behind global climate change .Ocean acidification, a decrease in pH brought about by increased atmospheric CO_2, has garnered attention due to the overwhelmingly negative effects predicted for calcifying organisms. Changes in ocean chemistry associated with ocean acidification, such as lowered saturation states, are causing reductions in growth, increased shell dissolution, and declines in fitness and performance of many marine calcifying species.

Conversely, less attention has been paid to non-calcifying autotrophic organisms. These species may benefit from ocean acidification and the subsequent change in ocean chemistry, as increased concentrations of both aqueous $CO_2$and bicarbonate (HCO_3^-) may enhance photosynthesis and growth in primary producers. Enhanced growth rates under acidification conditions have been observed in fleshy macro-algae and sea grasses.

pH is highly variable due to daily and seasonal shifts in photosynthesis and respiration, and coastal acidification may be driven more by eutrophication than increases in atmospheric CO_2. The signal of ocean acidification is easy to determine in the open ocean; unlike in the open ocean, coastal pH is highly variable due to daily and seasonal shifts in photosynthesis and respiration, and coastal acidification may

be driven more by eutrophication than increases in atmospheric CO_2.

Climate Change and Marine Environment

Change has been occurring over the last century due to changes in atmospheric composition from increased emissions of greenhouse gases such as carbon dioxide. Anthropogenic increases in greenhouse gas emissions have led to global increases in temperatures. As greenhouse gas emissions have increased, global warming in the last century has occurred at an increased rate.

Temperature

Over the past 100 years, global climate temperature has increased by 0.6°C, and the rate at which it has been increasing has now doubled and is now greater than it has been in the past 1,000 years Research on climate change has revealed that over the years, this increase in climate temperature has affected organisms that are known to live in a broad range of geographical locations and has affected species diversity

The effects that anthropogenic changes have had on organisms are not limited to a certain part of the globe; the effects have been traced to every ocean, continent and to the majority of taxonomic groups. The ocean can absorb approximately 80% of the heat and 50% of carbon emitted into our atmosphere resulting in an "air conditioner," which may lead to terrestrial temperatures not increasing as rapidly as expected with current greenhouse gas emissions. Heat storage relies on the rate at which the ocean can absorb heat and distribute it to be released slowly back into the atmosphere.

However, while the ocean is acting to absorb $CO_2$and heat and mitigate terrestrial climate change, large changes in temperature and acidification are occurring in the oceans as a result of the absorption of heat and CO_2.

This pattern is referred to as "multi-decadal variation," and it consists of two 65 year cycles of accelerated warming, followed by a period in which temperature increases at a slower pace. The global temperature increases, whether they are going through a recent slowdown period as more heat is transferred into the oceans than into terrestrial systems, are due to anthropogenic production of greenhouse gases due to human activities. This climate change will have significant impacts across ecosystems, particularly in marine systems. Future research should focus on understanding the extent of warming in deep oceans and its effects on marine ecosystems. Importance of Macro-algae Green macro-algae are known to live in some of the most extreme environments on earth including deserts, permafrost, and hyper saline environments.

Climate Change Effects on Macro-algaephotosynthesis

Climate Change Effects on Macro-algaephotosynthesis is the process that allows plants, including algae, to convert CO2into sugars, using solar energy, and this process is vital for plant growth. As temperature increases, the rate of photosynthesis generally increases.However, this does not always hold true. There is an optimum temperature at which a plant's photosynthetic rate is greatest, and, once the temperature gets past this optimum, the rate of photosynthesis begins to decline rapidly. For macro-algae, rather than a fixed temperature, this optimum temperature can vary by several

degrees. The effects that temperature will have on photosynthetic rate vary based on whether algae are in their species-specific optimum temperature range or not .The rate at which photosynthesis occurs is limited by the photosynthetic electron transport chain, and the carbon fixation rate of RUBISCO.

Reactive oxygen species (ROS) are chemicals that are released by organisms during metabolic processes such as photosynthesis, and are produced by chloroplasts and mitochondria in the electron transport flow.ROS are able to rapidly react with cellular components and water, but also contain a short life time.

UV Radiation

A disruption of cellular homeostasis, including UV radiation. This is due to the fact that UV light affects the biomolecules that block enzymatic reactions that ultimately induce the formation of ROS. Due to the stress, ROS can cause damage to membrane lipids, proteins and nucleic acids which can lead to cell death .To counteract the effects of ROS, plants have developed non-enzymatic, as well as enzymatic systems in which superoxide ($O_2^{-)}$ is converted to hydrogen peroxide (H2O2) via enzymes (Lu, 2006). Some of these enzymes include ascorbate peroxidase (APX), superoxidedismutase (SOD), and catalase (CAT), and for the non-enzymatic system phenolic compounds are present (Dummermuth, 2003; Lu, 2006). Although plants have this defence system, an increase in CO2concentration and ocean acidification due to an increase in temperature can change the chemistry and alter the UV protection that algae have, leaving them at higher risk of UV

damage (Hader, 2015). At the end, the side effects that occur to algae as temperatures increase, only add more stress to the plant caused by the direct effects of increasing temperatures (Rautenberger, 2015). Temperature has additional lasting effects on marine plants. An increase in ocean temperature means that habitat will change as well as species composition, especially for sensitive organisms. The ecological effects would then alter the evolutionary adaptation for many of these organisms (Reusch, 2014). Algae are known to be geographically widespread which could mean that local adaptation is possible. According to Reusch (2014), ocean warming can result in immediate effects which will help macro-algae survive. Macro-algae tend to grow in warmer temperatures due to an increased CO_2availability.

Climate Change Effects on High Temperature

Very high temperature tolerance of 30°C for its reproductive cells. High photosynthetic capacities at high temperatures than those compared to brown macro-algae. For those with greater phenotypic plasticity, it allows acclimatization to the changing environment. Even though increased temperature does provide some benefits, it adds stress to algae which can result in detrimental effects.

Conclusion

Green macro-algae have been shown to be an important part of ecosystems. They not only provide food and structure to other organisms, but they also help regulate and absorb CO2from their environment. Understanding how factors such as temperature affects green macro-algae could help prevent damage and death of these organisms. This would help

maintain more suitable conditions for algae so that ecosystems could stay balanced and thrive. One of them isthat we can conserve and help maintain an adequate environment in which it can thrive along with the other species that depend on it. A number of macro-algae species would take a long time which is propose that a few model species would be used to represent different temperature tolerance levels. Green macro-algae could perhaps also hold new applications. Once we have a better idea of how macro-algae functions, and how temperature affects macro-algae.

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INFLUENCE OF CLIMATE CHANGE IN FERMENTATION RATE OF FRUIT JUICES

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Introduction

The term "fermentation" comes from the Latin word "Fermentum". The science of fermentation is called "zymology". The first zymologist, Louis Pasteur who was able to identify and he was applied the yeast in fermentation process. In the 16^{th} century, the beginning of industrialization initiated technological interventions in food and beverage production. However the last two centuries, significant changes in the world's food system have established. In olden days, fermentation of food was meant for food preservation and flavour improvement. Nowadays, in food and beverages fermentation, various technologies and operations are used. The conversion of perishable and indigestible raw materials into pleasant foods and drinkable beverages are added value and high stability. The assurance of the quality and safety of the final product is the main goal of the technologies applied.

Among the most important factors affecting the quality of fermented fruit juices are the clarification and composition of fruit juice, the sulfur dioxide level added, the interaction with other indigenous microorganisms, the supplementation with nutrients, strain and amount of inoculated yeasts and the fermentation temperature. The most important parameter of fermentation temperature for the production of fermented fruit

juice since it can affect the biochemical reactions and metabolism of the yeasts. White wines are often fermented in the range of 10 - 20°C. Some European wineries still prefer fermentation temperatures between 20 - 25°C. Recently, low temperature (10 - 15°C) fermentations are becoming more frequent due to the winemaker's tendency to enhance the production of some volatile compounds and improve the wine aromatic profile.

Food Formed by Fermentation

Most people are aware of food and beverages that are fermentation products but may not realize many important industrial products. Fermented food products such as Beer, Wine, Yoghurt, Cheese, Foods containing lactic acid, including Sauerkraut, Kimchi and Pepperoni, Bread leavening by yeast, Sewage treatment, Some industrial alcohol production such as for bio-fuels and Hydrogen gas.

Types of Fermentation - Ethanol Fermentation

Yeast and certin bacteria perform ethanol fermentation where pyruvate (glucose metabolism) is broken into ethanol and carbon dioxide. The net chemical equation for the production of ethanol from glucose is:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2\ CO_2$$

Ethanol fermentation has used in the production of beer, wine and bread. It's worth noting that fermentation in the presence of high levels of pectin results in the production of small amounts of methanol which is toxic when consumed.

Lactic Acid Fermentation

The pyruvate molecules from glucose metabolism (glycolysis) may be fermented into lactic acid. Lactic acid

fermentation is used to convert lactose into lactic acid in yoghurt production. It also occurs in animal muscles when the tissue requires energy at a faster rate than oxygen can be supplied. The next equation for lactic acid production from glucose is:

$$C_6H_{12}O_6 \rightarrow 2\ CH_3CHOHCOOH \text{ (lactic acid)}$$

The production of lactic acid from lactose and water may be summarized as: [10]

$$C_{12}H_{22}O_{11} \text{ (lactose)} + H_2O \rightarrow 4CH_3CHOHCOOH$$

Yeast

Yeast is unicellular eukaryotic microorganisms classified in the kingdom Fungi. Its size can vary greatly depending on the species, measuring 3-4 μm in diameter. Most yeast reproduce asexually by mitosis and many do so by an asymmetric division process called budding. Yeasts do not form single taxonomic or phylogenetic grouping. The term "yeast" is often taken as a synonym for *Saccharomyces cerevisiae*.

Medicinal Applications of Fermentation

The prevention of diseases by altering lifestyle and dietary conducts may present more benefits than medical care. Uptill now, adjusting individual dietary habits is a challenge. Most often, consumers must choose between nutrition, taste, price, convenience and cost. Nowadays, the nutritional value appears to be the health benefit that has the most impact on a consumer's purchase.

Fruit juices contain water and 20 % carbohydrates, 1% organic acids and trace amounts of vitamins, minerals and nitrogenous compounds. The sugars, organic acids and

phenolics give the juice its flavour, while the vitamins, minerals and nitrogenous compounds are, in many cases, essential to yeast growth and fermentation. Fermented fruit juice has much lower levels of sugar, 8-13% alcohol and a greater range of minor components.

Nutritive Applications of Fermentation

Fermentation is widely used as a food preservation method. However, lactic acid bacteria (LAB) are used to improve the nutraceutical profile of food. LAB have the ability to degrade plant and cyano bacterial cell walls, hydrolysis, the conversion of complex organic compounds such as polysaccharides, lipids and proteins, within the cell, into smaller molecules with enhanced antioxidant, anti-inflammatory and immune-modulatory activity [15-39]. Among LAB, *L. plantarum* has been studied as a suitable strain for the fermentation of food due to its endogenous enzymes. It has a capable of producing antioxidants such as hydroxytyrosol and pyrogallol or approved flavouring agents like 4-vinyl phenol.

Collection of Fruit Materials

Six different types of fruit juices from dissimilar producers were analyzed in this study. The selected fruit juices were collected from different markets and superstores in Thoothukudi. Collected samples were fresh, sealed and free from any kind of deterioration.

Preparation of Fruit Sample Extracts

The six different fruit samples were homogenized and accurate amount was weighed as required for different analysis. The collected fruit samples were washed thoroughly

and crushed into liquid sample. Six samples of fruit juices were selected for fermentation process. These experimental extracts were used for the investigations.

Fermentation Process

Requirements

Conical flask (250 mL), Test tubes, Water bath, Juice samples and Fehling's solution

Procedure

5.0 mL of the juice sample was taken in a clean 250 mL conical flask and it was diluted with 50 mL of distilled water. 2.0 gram of baker's yeast and 5.0 mL of solution of pasteur's salt were added to the above conical flask. The contents of the flask were shaken well and the temperature of the reaction mixture was maintained between 35 - 40 ^{o}C. After 10 minutes, 5 drops of the reaction mixture were taken from the flask and it was added to a test tube containing 2 mL of Fehling reagent. The test tube was placed in the boiling water bath for about 2 minutes and the colour of the solution or precipitate was noted. The step 4 after every 10 minute was repeated when the reaction mixture gives red colour or precipitate. The time taken for completion of fermentation was observed.

Pasteur's Salt Solution

Pasteur's salt solution was prepared by dissolving ammonium sulphate, potassium sulphate, calcium sulphate and magnesium sulphate in 860 mL of water.

- Ammonium sulphate -10 g
- Potassium phosphate-2.0 g
- Calcium phosphate-0.2 g

- Magnesium sulphate-0.2 g

Fermentation Process

Table 1: Fermentation Process of Fruit Extracts with Different Contact Time.

S.NO	FRUIT EXTRACTS	TIME TAKEN FOR FERMENTATION (minutes)
1.	*Punica granatum*	110
2	*Citrus x sinensis*	90
3.	*Citrus limon*	120
4.	*Vitis vinifera*	60
5.	*Carica papaya*	90
6.	*Ananas comosus*	40

In a beaker 1 g of yeast powder was mixed with water and saturated solution of ammonium sulphate. 2 mL of the above solution was mixed with 20 mL of distilled water in a round bottom flask. Now both the contents were mixed, shaken and heated to about 35-45^{o}C. Now 10 drops of the above mixture was taken, 1 mL of Fehling's solution was added and heated. The above procedure was repeated after interval of ten minutes. When the fruit juice gets fermented, it gives red precipitate with the Fehling's solution and the time taken was noted for every juice. The following results were shown in Table 5.1. From the observation, it was found that lemon takes more time to get ferment (90 minutes) whereas pineapple gets fermented (40 minutes) easily.

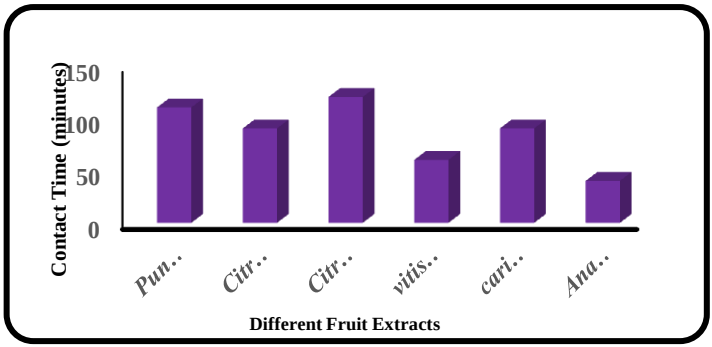

Figure 1: Fermentation of Fruit juices with Various Contact time.

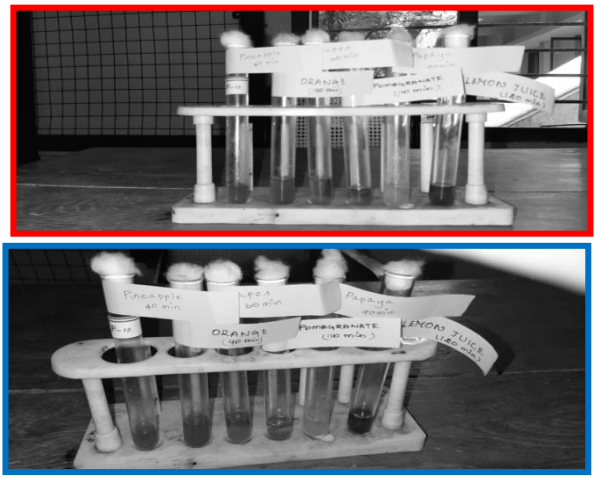

Figure 2: Observation of Colour Changes during Fermentation Process of various fruit Juices

Conclusion

Fruit and vegetable juices are suitable for fermentation or as vectors for probiotic bacteria. The combination of fermentation with fruit and vegetable properties present

numerous nutritional advantages. The applications include specific taste, decrease in the sugar content and production of bioactive compounds. Fermented juice consumption can improve intestinal tract health, enhance the immune system, synthesize and bioavailability of nutrients and reduce the risk of certain cancers and cardiovascular diseases. Fermented fruit and vegetable beverages may provide an asset for metabolic disease management.

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FABRICATION, CHARACTERIZATION OF CELLULOSE INTERCALATED CuO NANOCOMPOSITE FOR ENVIRONMENTAL REMEDIATION

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1. Introduction

Metal nanoparticles comprising noble metal [1] nanoparticles like Cu, Ni, Zn, Pt, Pb and their oxides [2] are recently received extensive fascination in various fields such as photocatalyst, biosensor, batteries, wastewater treatment, antimicrobial activity, biomedical application. In spite of several studies has been investigated about environmental and technologies, the human being is facing a lot of trouble regarding environmental problems.

The prominent issue in the world is to the dumping of inorganic and organic contaminants or pollutants that exist in water from agriculture, textile industries, domestic, electroplating industries [3]. These sorts of industries are

dumping pollutants/effluents onto the soil and water resources, initially, the effluent is mixed with soil and water. Then, it destructs the nature of soil and self-purification of the water. Therefore, the soil and water are turned into a polluted system. Generally, the soil contain preliminary nutrients such as C, H, O, primary nutrients like N, P and K then secondary nutrients viz. Ca, Mg, Cu, Zn, Co, Mn etc. these preliminary, primary and secondary nutrients support the foster of plants.

When we dump this sort of effluents from various industries onto the soil, initially soil followed by plants will be affected. The pollutants are first constrained the internal characteristics, rate of growth of the plants then protein contains, yield of fruits and ultimately productivity standpoints.

Moreover, the plants are the major responsible for rainfall [4] when the nature of the soil is contaminated by both inorganic and organic pollutants the plants and trees are damaged automatically the rate of rainfall is suffered. Thus, the organic effluents or pollutants are one of the factors to change the climate. In order to save the environment and humans, researchers are developing technologies with more efficient photocatalysts for the degradation of organic pollutants.

Malwal*et al* [5] reported CuO-ZnO composite nanofibers for water remediation. There are numerous nanomaterials that have been utilized for environmental remediation. Recently, cellulose based nanocomposite received fascination in several fields like self-healing, biosensors, photocatalyst, membranes and thin films etc. Further, cellulose

based composite has used in the treatment of polluted water due to their biocompatibility and high efficiency, high surface area. However, cellulose based CuOnanocomposite is rarely reported for environmental remediation. In this chapter, cellulose based CuO composite was fabricated and utilized for environmental remediation.

2. Concept

2.1. Characterization:

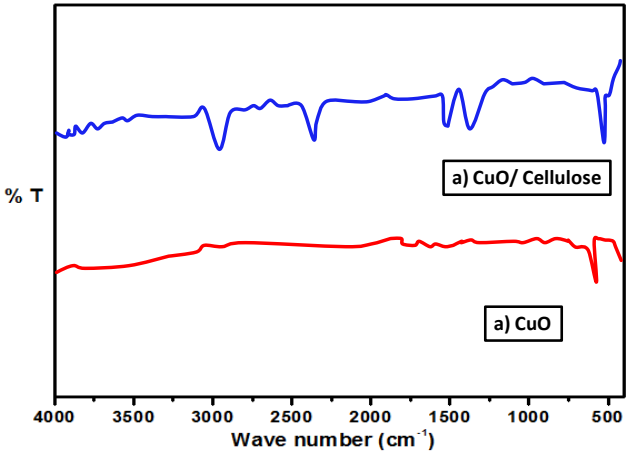
The prepared nanomaterials were synthesized by simple chemical precipitation method and characterized through Fourier transform infrared spectrometer, powder X-ray diffraction analysis, Scanning electron microscope and X-ray photoelectron spectrometer. Further, the prepared nanomaterial was utilized as a photocatalyst for the degradation of Rhodamine-B (Rh-B) is a modern dye.

2.2. Results and Discussion

2.2.1. FT-IR

FT-IR spectrometer is widely used in organic synthesis, nanotechnology, polymer science, pharmaceutical industries, petrochemical engineering and food analysis. The main intention by exploit the FT-IR spectrometer is to identify metal oxide bonds, functional group analysis, mechanism of chemical reactions and detection of unstable substances can be investigated with this instrument based on the molecular vibrations.

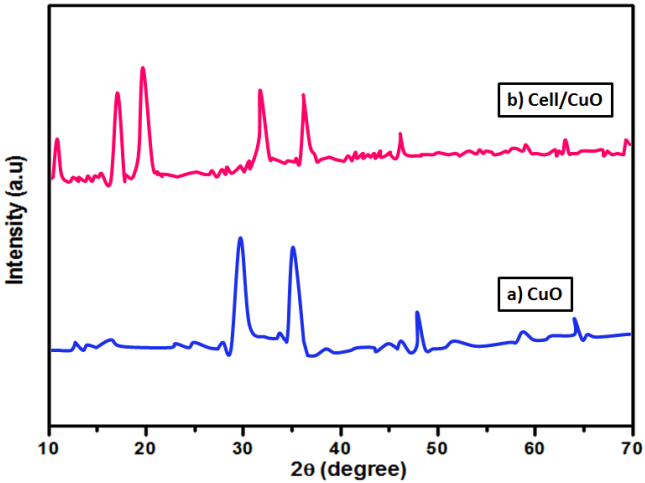
The FT-IR spectrum of CuO and Cellulose modified CuO (Cell/CuO) is shown in Fig. 1. The sharp peak appeared at 611.24 and 601.48 cm^{-1} corresponding to the Cu-O bending vibration [6] of CuO and Cell/CuO respectively. Further, no impurity peaks were ascribed in the spectrum of CuOnanomaterials. Moreover, in the spectrum of Cell/CuO nanomaterial, the peaks noticed at 1410.95 and 1450.44 cm^{-1} can be assigned to be C-H_2 bending vibration of cellulose and the stretching bands observed at 2345.11 and 2919.63 cm^{-1} relevant to the vibration of C-H group of cellulose. Thus, the formation of Cellulose modified CuOnanocomposite is confirmed.



2.2.2. XRD

The phase structure of synthesized CuO and Cell/CuOnanocomposite were investigated by XRD analysis and shows in Fig. 2. The diffraction peaks of CuO (Fig. 2a) acquired at 35.2°, 38.3°, 48.6°, 58.5°, 61.5°, 66.2° and 68.7° can be assigned to the (-111), (111), (-202), (-113), (-311) and

(220) planes of CuO [7] (JCPDS No: 89-5899, phase: monoclinic, lattice: end-centered, a = 4.68, b = 3.42 and c = 5.13). No impurity peaks are monitored in the patterns which indicate the purity of the fabricated CuO samples and also the sharp diffraction peaks show the brilliant crystal structure of prepared CuO. Further, the XRD pattern of Cell/CuO shows peaks at 12.11^{o}. 19.12^{o} and 21.95^{o} correspond to (-110), (020) and (040) planes of cellulose.

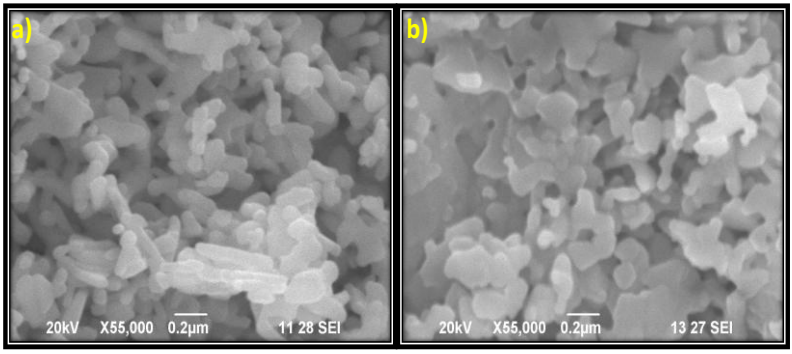


Moreover, the XRD pattern of CuO compared with Cell/CuOnanocomposite (Fig. 2b), the cellulose molecule can keep the typical CuO crystal structure after incorporated with CuO. This affirmed the formation of Cellulose-CuOnanocomposite.

2.2.3. SEM analysis

The surface morphology of prepared nanomaterialsCuO and Cell/CuO are characterized by SEM and exhibited in Fig. 3 (a-b). The CuO (Fig. 3(a)) shows

nanoflakes like structure and the surface is rough. However, after loading of cellulose the Cell/CuOnanocomposites (Fig. 3(b)) became hollow nanoflakes structure. Moreover, the Cell/CuOnanocomposite have bigger in diameter derived from CuO nanomaterial. This illustrates that, the polymerization of cellulose takes place on the surface of the CuO. Thus, the formation of Cell/CuOnanocomposite is confirmed. The CuO nanoparticles are good dispersion within the polymer matrix of cellulose.



2.2.4. Photocatalytic activity of prepared nanomaterial

The photocatalytic activities of fabricated nanomaterialsCuO and Cell/CuO were examined towards the degradation of Rhodamine B (RB) dye under sunlight. In this study, 0.5 g of the prepared nanomaterials were dispersed in 300 mL of 20 µM RB solution. The resultant mixture was stirred for 15 min in a slutty type batch reactor under a dark condition to accomplish an adsorption-desorption equilibrium and then irradiated under solar light. The degradation of RB dye was noticed at a standard interval by taking 5 mL of an aliquot from the reaction mixture and centrifuged. The

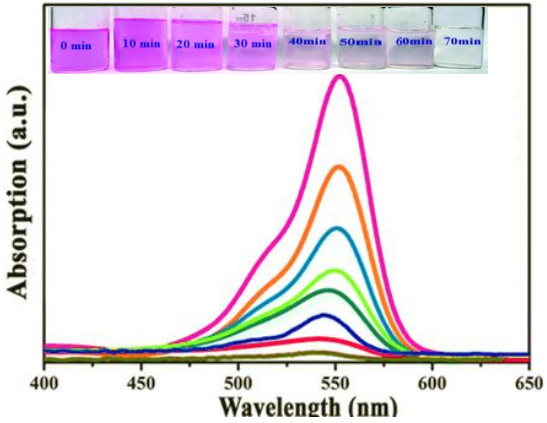
supernatant solution was inspected by UV-Vis spectrometer. The consistent degradation of RB was studied by illumination time, catalyst dosage and initial concentration of RB dye.

The degradation of the dye from the solution was estimated using the following relation.

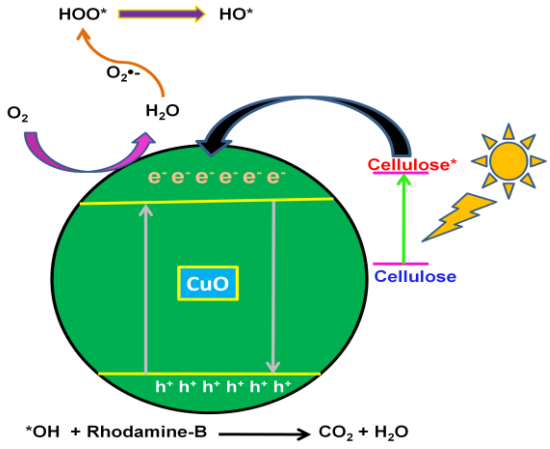
$$\text{Photodegradation \% of dye} = \frac{Co - C}{Co} \times 100 \quad (1)$$

Where, C_o is the concentration of dye before irradiation and C represents the concentration of dye after a certain time illumination.

The absorption spectrum of Cell/CuO nanocomposite was given in Fig.4. The absorption spectrum of CuO is not displayed. From the Figure, the order of photocatalytic activity for the degradation of methylene blue is Cell/CuO > CuO. Similarly, the percentage of activity of the above catalyst fall in the order 93.24% and 74.78% severally due to the better catalytic efficiency of Cell/CuO expanded with modification of cellulose [1]. The blank experiments were also determined to test the effect of photolysis on RB is (7%) insignificant.



The following mechanism has proposed for the enhanced photocatalytic movement of MCP nanocomposite. The schematic diagram of solar light driven photodegradation of RB under Cell/CuOnanocomposite is demonstrated in Fig. 5. The improved photocatalytic activity of Cell/CuO was evaluated by degradation of RB under solar light irradiation. Since the solar light was found to be more effective than other irradiation techniques for dyes degradation as reported by previous studies [8]. When the photocatalyst is irradiated, cellulose modified on the surface of CuO can be simply excited and make transportable electrons, which are then injected into the conduction band of CuO. In Cell/CuOnanocomposite act as an electron trap and then accelerating the injected electrons into surface adsorbed O_2 diminishing O_2 to $O^{2\bullet-}$. This results in the formation of more reactive oxygen species ($O_2^{\bullet-}$ and $^{\bullet}OH$), which promotes the degradation of RB.



3. Conclusion

Solar light driven Cell/CuOnanocomposite was synthesized successfully by chemical precipitation method. The XRD patterns and SEM results show the crystal structure does not affect by the surface modifier Cellulose. The Cell/CuOnanocomposite shows unique photocatalytic properties under solar light irradiation. The efficiency of photocatalytic degradation of RB can be determined to be 93.24%. The possible mechanism for the photocatalytic degradation of RB under solar light has been proposed. The reaction conditions are optimized and maximum photocatalytic degradation is obtained. From the degradation of organic dye by cellulose modified CuOnanocomposite, the soil would be saved. Thus, the rainfall becomes standard.

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ROLE OF SOCIAL MEDIA IN CREATING AWARENESS ON CLIMATE CHANGE

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Introduction

Climate change has been one of the most prime topics to be discussed. Even though the majority of nations now agree on the basic ideas related to climate change and participate together in international initiatives but effective steps are yet to be taken. 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. Information sharing through social media can raise awareness and encourage more environmentally-friendly behavior in people.

Climate Change

The long-term change in the average weather patterns of Earth's local, regional and global climates is known as climate change. Climate change increases the appearance of violent weather phenomena, drought, fires, **the death of animal and plant species. Climate change results in flooding from rivers and lakes,** destruction of the food chain and economic resources.It refersto the significant, long-term changes in the global climate.The global climate is the connected system of sun, earth and oceans, wind, rain and snow, forests, deserts and savannas, and everything people do, too. The climate of a place can be described as its rainfall, changing temperatures during the year and so on.But the global climate is more than the "average" of the climates of specific places.

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, loss of sea ice, accelerated sea level rise and longer, more intense heat waves.

Taken as a whole," the IPCC states, "the range of published evidence indicates that the net damage costs of

climate change are likely to be significant and to increase over time."

Global Warming and Climate Change

Heat is energy and when this energy added to any system changes occur. All systems in the climate system are connected, adding heat energy causes the global climate as a whole to change.Much of the world is covered with ocean, when it gets heats up more water evaporates into clouds. Which results up in storms like hurricanes and typhoons, this results in more energy-intensive storms. A warmer atmosphere makes glaciers, mountain snow packs, the Polar ice cap, and the great ice shield of Antarctica melt raising sea levels.

Climate Change due to Temperature Change

Changes in temperature change the great patterns of wind that bring the monsoons in Asia and rain and snow around the world, making drought and unpredictable weather more common.

This is why scientists have stopped focusing just on global warming and now focus on the larger topic of climate change.Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time.

Climate Change due to Weather Change

Extreme weather events are more regular and their patterns are changing – they're more intensive, aggressive, and with more energy. This means more storms, floods, cyclones, and droughts will take place over the next years.

At the same time, the regulating capacity of oceans is also being affected by an increase in temperatures. If global temperatures increase dramatically, ocean levels will not only increase – they will also be facing the ecological challenges of oceanic acidification and deoxygenation.

Climate Change due to Global Warming

Climate change refers to the increasing changes in the measures of climate over a long period of time – including precipitation, temperature, and wind patterns. Global warming refers only to the Earth's rising surface temperature, while climate change includes warming and the "side effects" of warming—like melting glaciers, heavier rainstorms, or more frequent drought. Ultimately, this means that global warming is one side of the much larger problem of human-caused climate change.

Role of Social Media in framing Climate Change

Social media encourages greater knowledge of climate change, mobilization of climate change activists, space for discussing the issue with others, and online discussions that frame climate change as a negative for society. Social media,

however, does provide space for framing climate change sceptically and activating those with a sceptical perspective of climate change. Further examination of the relationship between social media use and climate change perceptions is warranted.

Relationship between social media use and its relationship to climate change suggests several positive impacts. Social media encourages greater knowledge of climate change, space for discussing the issue with others, and online discussions. Social media helps to frame climate change as a negative for society.

Climate Change Behaviour and Social Media have examined the relationship between Internet use or social media use and climate change activism or engagement, Social media discussions by both professional environmental organizations and by regular Internet users encourage different forms of online action on the issue of climate change.

Social media have wide range of possible roles social media can play in encouraging different attitudes and behaviors around climate change. Social media use may simply encourage more reinforcement of existing perceptions of climate change rather than reaching new individuals or changing opinions.

NGOs contribution to overcome Climate Change

Non-profit organizations (NGOs) have been in the forefront of the battle against climate change since the late 1980s and early 1990s. They work to mobilize different countries to cooperate for tackling climate change.They have acted as mediators between scientific expertise and the public. They have used different PR tactics to gain news coverage and get public attention to the issue according to their particular perspectives. NGOs have increasingly adopted various types of digital platforms to communicate directly to different audience groups. NGOs have played an important role in bridging the gap in climate change communication between scientists and other actors including the news media, policymakers, and the public. In countries around the world, NGOs have assisted in the promotion of climate change awareness, augmenting lapses of media coverage on the topic and bolstering action in the face of governmental inaction. NGOs have also organized citizen science groups and projects to foster public engagement with climate change.

Internet Technology

Communication through social media, news and opinion articles, not only spread extremely quickly, but also extremely cheaply. The fast and vast spread of the Internet technology a powerful tool of soft power has risen to prominence.The usage of Google data is increasingly becoming common practice in quantitative studies of digital

media, especially to gain insight into human behavior and societal trends

The features of Google Trends also provide the opportunity to examine broader data capture, since it considers multiple language searches correlated with the searched term for climate change, e.g., 'cambiamenticlimatici' , 'cambioclimático' 'klimawandel', 'changementclimatique',.

Public Figures

— *Leonardo DiCaprio Speech at the Academy Awards Ceremony*

On 28 February 2016, Leonardo DiCaprio while receiving his Best Actor award for the film *The Revenant,*, gave a memorable speech on the strong correlation between climate change and human activity.

"Climate change is real; it is happening right now. It is the most urgent threat facing our entire species, and we need to work collectively together and stop procrastinating. We need to support leaders around the world who do not speak for the big polluters, but who speak for all of humanity, for the indigenous people of the world, for the billions and billions of underprivileged people out there who would be most affected by this. For our children's children, and for those people out there whose voices have been drowned out by the politics of greed … Let us not take this planet for granted. I do not take tonight for granted."

Films—Before the Flood

Before the Flood is a documentary film about climate change produced by Leonardo DiCaprio in cooperation with the National Geographic channel. It premiered in the Toronto International Film Festival in September 2016, was released in theatres on 21 October, and aired on the NatGeo channel on 30 October. The film showed a strong commitment to bring the issue of climate change to the forefront of the global conversation and aimed to inspire viewers to take action. For a documentary film, *Before the Flood* made an impressive record of 60 million views worldwide on the multi-platform of NatGeo network

News Engagement—Role of Media in the Climate Change Dialogue

As more traditional information outlets, newspapers and television channels, are nowadays using social media to share content with their audiences, News, both from televisionor newspapers, as well as incoming through the current forms of social media, has also played a prominent role in increasing people's awareness of the climate change discussions.The researchers analyzed climate change coverage in *the news media,* 3,979 Facebook posts from 289 climate-focused nonprofits in 18 English-speaking countries around the world.

More than one-third were devoted to setting out the problem of climate change, while fewer – about one-quarter in each case – were about what needs to be done to solve climate

change or called people to collective action. It's unfortunate that even after 30 years of public climate discourse, so much attention still needs to be devoted to the basics of climate change. Everyone should be aware that climate change is a global challenge.No one person or group can face the challenge alone.

Conclusion

The severe effect of climate change is the need of hour to study the reasons, causes and impacts of climate change it is very urgent to create awareness about causes and impacts 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 these impacts of climate change on human lives. Media can play a vital role in creating awareness about climate change. Much research has not been conducted into the representation of climate change in the social media. 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. Media knows the significance of covering environmental issues. All media like T V, Radio, Newspaper and new media spread the news and information at the speed of light. Language press, regional papers, small papers they all give at least minimum importance to climate changecoverage

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MARINE PROTECTION AGAINST CORROSION HULLS BY NANOTECHNOLOGY

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Introduction

Marine pollution and anthropogenic climate transition have been affected and causing changes in global ocean scales.Transportation, industrialization, increase in population are the major causes for change in nature the effects of chemicals associated in atmosphere makes increase in global temperature.Generally atmosphere consists of many gases the air in Earth's atmosphere is made up of approximately 78 percent nitrogen and 21 percent oxygen. Air contains lots of other gases, too, such as carbon dioxide, neon, and hydrogen. The increase in global temperature is due the increase of CO_2 gases leads to change in climate [1].Another one important factor polluting sea water is due to the influence of environmental factor on corrosion of shiphulls, oil tankers, pipeline in marine atmosphere.This dissemination of corrosion behaviour on ships hulls occurs due to relative humidity, temperature and chlorides in salt water.The lower part of the ship hulls are completely immersed in seawater.

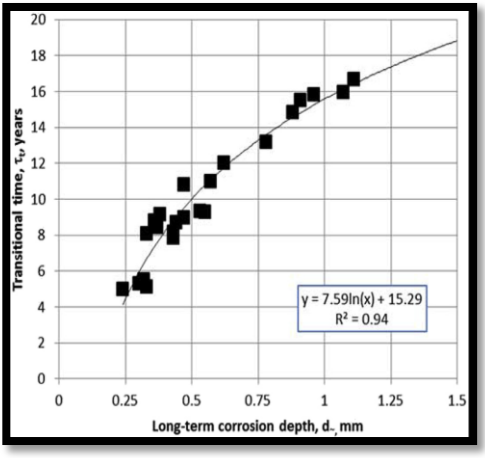
Water properties such as salinity,temperature,oxygen content and PH level and chemical composition vary according to location and water depth these properties generally affects corrosion degradation[2].Generally, temperature of the ocean water varies by location both in terms of latitude and depth due to variation in solar radiation and physical properties of water.The major change in seawater occurs due to temperature. As temperature increases water expansion when it warms up heat energy makes molecules to move around the space temperature and salinity both affects the density of seawater.

The corrosion behaviour of ship hulls causes pollution in sea water this influence the major disturbance into the organism lives in seawater.The corrosion behaviour can be reduced by high dielectric strength insulating layer coupled with cathodic protection system to prevent corrosion. Alumina is an insulator that helps in preventing corrosion failure analysis corrosion occurs due to absence of oxygen so it will be coated with a best oxidizing agent[3,4,5]. Due to ion exchange process in the paints can immobilise aggressive ions such as chlorine that penetrate the coating from the exterior and affect the under film metallic corrosion process, while other species or the water bodies released in the ion-exchange process can migrate to the paint interface and inhibit the corrosion process form a protective layer on the metallic surface. So it is eco-friendly and cost effective[6].

Intend of doing Research

Fouling describe the growth of marine plants,it is also one of the reason for corrosion of ships.The important factor that increases the growth of fouling and corrosion in ship hulls

temperature,salinity,PH,oxygen,nutrition,pollution,light,intensity,current resistance, high relative humidity, lack of moisture dew condensation.Poor corrosion protection is due to low film thickness may lead to solvent result in slow drying. This reduces the rate of corrosion which helps in protect the organism from pollutants[7].Corrosion data represents thickness reduction measurements taken during periodical surveys at different ship lives. This reduction represents the corrosion degradation from both sides of the structural members.



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Relationships between the transition time and the long-term corrosion depth for tankers

Long-term corrosion depth *d* is the maximum steady corrosion. As the corrosion process progresses, corrosion products (rust) are accumulated on the surface of the metal. If this layer of rust did not flake out and depending on the thickness of the paints which is enough to isolate the substrate from the corrosion and then the corrosion process stops.

Factors Affecting Ocean Corrosion

- ***Temperature and Salinity***

Sea water varies with temperature as the temperature increases causes expansion in seawater correspondingly volume gets increased initializing change in density of sea water. Another important factor affecting water density will be salinity which is the amount of salt in sea water, more salt water makes water heavier and denser therefore temperature and salinity are the two main driving forces behind earth ocean conveyor belt which is the huge water circulation system.

- ***Chlorine Content in Sea Water***

The active thin layer of electrolyte (seawater) contains chlorine accelerate the rate of corrosion. The process takes place in oxygen rich atmosphere so the effect of temperature and different environmental factor on atmosphere leads to corrosion. Salinity influences the conductivity of water and chloride ions also affect and penetrate through the passive films coated across the ship this will initiate the pitting and corrosion of localised site in ship hulls with breakdown of passitivity.

- ***Dissolved Oxygen***

The more dissolved oxygen content in sea water increases the electrode potential, leads of faster rate of corrosion since the class of metal get corroded when it is get oxidized, while it get coated with the oxide film for no longer corrosion in order to maintain a passive rate. But for aluminum and stainless steel, when it is oxidized, the surface to form a thin layer of oxide film, to maintain a passive state.

Electrochemical Reaction due to Climate Change

Statistics for ship hull damages show that around 90% of ship failures are attributed to corrosion. Corrosion degradation of ship plates is predicted at different ship locations based on limited information on local environmental conditions. The primary difference between these systems is the mechanism used to protect the metal. Continuous immersion systems use high dielectric strength insulating layers coupled with cathodic protection systems to prevent corrosion[5].

Generally, physical properties and chemical properties of the ship hulls are not same, the potential is different on different parts of metal surface of the ships, there are four main characteristic for ship hull corrosion law,

1) When dissimilar metals contact, anode metal may cause significant galvanic corrosion damage, where seawater has high conductivity and small corrosion resistance.

2) Seawater has large amount chlorine, passive metals prone to suffer the localized corrosion in seawater, such as pitting corrosion, crevice corrosion and stress corrosion, and prone to suffer erosion corrosion in the high velocity seawater.

3) Increase in current density could aggravate metal corrosion due to the corrosion of carbon steel in seawater is oxygen absorb corrosion, which controlled by oxygen distribution and the anodic polarization energy is found to be very small.

4) Contact between metal and seawater, it will be classified into five zones: atmospheric zone, splash zone, tidal zone, and immersion zone and sea area. The metal corrosion in these

areas is simply different and the significant corrosion appears in splash zone [6].

Steer Clear of Marine Pollution

Surface treatment and coating technologies are focus on the interface of metal materials and corrosive medium hence, the corrosion protection occured by the treatment of metal plating and coating. Corrosion in iron is the rejoining of oxygen with the iron to form oxides that were present with the iron when it was in ore form. Numerous methods have been developed for fabricating the protective coatings, and the most extensively used protecting technique against marine corrosion is the use of organic coatings. On mixing alumina (aluminium oxide) nanoparticles in paints which was helps on protective coating with excellent anti corrosive, non-toxic to the marine organism lives in sea water. General properties of alumina are, it has high density, high wear resistance and often having tremendous potential in the field of anti-friction/wear application. There are different metals on the ship hull .when exposed to salt water which is a conductor of electricity, the potential difference between adjacent metals causes electron to flow i.e. electricity from one metal to another causing galvanic corrosion.

Alumina is an insulator this helps in preventing corrosion. Corrosion on the ship hulls is due to accumulation of sea water because they are rich in chlorine content as well as oxygen and other corrosion minerals [2, 6] .The ship hulls are often appeared to have humidity while during motion the salt water get sprayed over the ship this was happened due to

blown of wind. Finally it accelerates the rate of corrosion. The prevention in corrosion depends on the thickness of the paint that coated on the hulls of the ship. The paint mixture consisting of alumina as a core material prevents the hulls coming in contact with oxygen and moisture [7].

Technological Data Currently

Nowadays, Europe, Japan, South Korea and Singapore yards are building large oil barges, oil rigs and drill-ships designed for work at the deepest water, such in the GOM. These are a new generation of fuel-efficient, cheap to run 'eco-ships'. These platforms, and the metallic underwater pipelines used to transfer oil and gas from the borehole to the surface, are fitted with sacrificial anodes for corrosion control by cathodic protection. They are towed out to sea and installed at various depths around the world.

Summary

This report examines a number of environmental, climate change and sustainable development of corrosion in ship hulls which causes danger to the marine organism in sea water. Now a day a deep universal concern about the influence of climate change (CC), global warming and green house gas emissions on the corrosive and deterioration effects of the marine environment on maritime activities. Higher temperatures promote melting of polar and glacial ice and snow; sea-level rise affects the coast structures and changes atmospheric moisture and rain precipitation patterns. This chapter deals with marine pollution These are occurs due to changes occurs in atmosphere if the atmospheric temperature changes causes change in tidal speed of sea water the increase

in speed of seawater increases the conductivity this leads to electrochemical reaction this cause to happen corrosion of ship hulls. When the water in a port is contaminated and the sea soil beneath the floating dock contains corrosive sediments, accelerated corrosion results in a large number of cavities and perforations in the floating dock floor and the seawater chambers. .The prevention in corrosion depends on the thickness of the paint that coated on the hulls of the ship. The paint mixture consisting of alumina as a core material prevents the hulls coming in contact with oxygen and moisture, that corrodes as long as the paint remains in good condition without any cracks.

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