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Climate Change and Bio-Diversity Loss -Interrelated Phenomena

Samir Kumar Mukherjee
Pincipal,
Bankura Sammilani College,
Bankura, West Bengal, India

Somnath Mukherjee
Ph.d Student
Information System and Decision Science
Lousiana State University
Baton Rouge,USA

Abstract

The diversity within species, between species and ecosystems, act as an important life-supporting safety-net for us. But our safety net is at the brink of falling apart. In a recent global assessment report produced by the Intergovernmental Science Policy Platform on Bioderversity over 145 Scientists from various parts of the globe painted a gloomy picture on the contemporary world. The report says “The health of ecosystem on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economics, livelihood, food security, health and quality of life worldwide.”

Biodiversity is threatened by human induced climate change. It is already forcing biodiversity to adopt either through shifting habitat or changing life cycles.

The environment as well as the human societies that exist within it depend on fresh water and its associated resources (Srivastava, 2006). Human health and well-being are directly dependent on bio-diversity. Global biodiversity is changing at an unprecedented rate, the most important divers of the change being land conservation, climate change, pollution, unsustainable harvesting of natural resources and introduction of exotic species.

Genetic resources are provided by it for food and agriculture and therefore constitutes the biological basis for world food security along with support for human livelihoods (Dahiya, 2006).

Keywords: Ecosystem, Bio=Diversity, Greenhouse gases, Global Warming, Tropical, Deforestation, Fossil Fuel, Phenology.

Introduction

Global climate change represents one of the most severe threats to biodiversity of our planet. More specifically, climate change is now a global challenge for humankind and also for life on earth as whole. Plants and animals are equally endangered due to global warming resulting from increasing concentration of carbon dioxide (CO_2) released into atmosphere through different human activities. Climate plays a critical role in fluctuations of biodiversity levels. climate change is predicted to be the greatest long term threat to biodiversity in many regions and is listed as a key threatening process under the Threatened Species Conservation Act 1995 and the Environment Protection and Bio-diversity Conservation Act, 1999 (Commonwealth).

Plants and animals of extremely diverse and varied morphological characteristics and structural organisation are encountered on earth (Bhattacharya, 2005). Religion, art and literature from ancient history (Sen, 2008) have identified the basic, social, ethical, cultural and economic significance of living and non-living natural resources.

Climate change affects agriculture throughout the world (Agriculture, Agro-biodiversity and climate change, 2008). Climate change is an important factor in determining the past and future distributions of biodiversity (Chenng et al, 2009). 22nd May is observed and the International day for Biological Diversity. The theme of this day in 2007 was ‘Biodiversity and climate change.’ Global climate change is the most severe environmental threat in the 21st century. ‘Civilization itself is threatened by global warming’ as being observed today.

Objective of the study

The Objective of the study is to create all-round awareness among the people about the negative impacts of Climate Change on Biodiversity .Proper precautionary measures are now needed to be taken to eliminate the root causes for change of climate. It is having significant effects and is a major threat not only for mankind but also for life on earth

as a whole. It represents one of the most important threats to plants biodiversity.

What is Biodiversity?

It is web of life as many plants, animals, fungi and microorganism interact together. Variety of life forms and habitats occur in a defined area. Biodiversity are vast array of species of plants, animals and microorganism created by nature are the 'foundation of human life' on earth (Sharma et al, 2004). It is defined in accordance with Article-2 of the convention of Biological Diversity to mean the variability among having organisms from all sources including inter alia, terrestrial marine and other aquatic ecosystems and the ecological complexes of which they are part.it includes variability of genes, varieties, species population in different ecosystem and their relative abundance. According to IUCN, 1980 our earth supports 5 to 10 million (approx.) species of plants and animals, the result of three billion years of evolution including mutation, recombination and natural selection.

Fig.1:- Indicates Biodiversity web

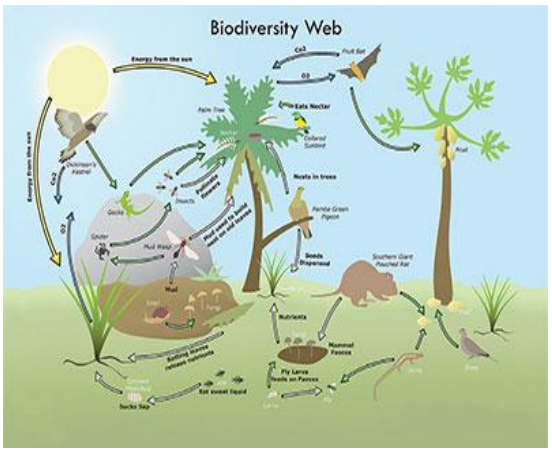


Fig.2:- Biodiversity Loss and Climate Change

O3 levels of Biodiversity

Species diversity

It corresponds to different species of plants, animals and microorganisms, Species richness or number of species per unit area denotes the measure of species diversity.

Genetic diversity

It corresponds to variety of genes within a species and between species variability with a species measured by variation in genes. It is the sumtotal of genetic information contained in the genes of individuals of plants, animals and microorganism that inhabit the earth.

Community and Ecosystem diversity

These correspond to different habitats and places like a) tropical and temperate forests b) Hot and cold deserts c) Wetlands d) Rivers, Mountains, Coral reefs. These also correspond to series of complex relationship between biotic an abiotic components. All the species in a particular ecosystem live independently. Any loss of a particular species will break the food chain or food web in the ecosystem.

Taxonomic diversity

It corresponds to variety of organism within a region at a taxonomic level.

Categories of Biodiversity

Alpha diversity (within community diversity)

It refers to the diversity of organisms showing the same community or habitat.

Beta diversity (Between community diversity)

There are differences in species composition of communities along environment gradients eg. Attitudinal, Moisture gradients.

Gamma Diversity

It refers to the diversity of habitat over the total landscape or geographical area etc.

The spatial relationship between the habitat types are analysed by a way as provided by Geographic Information System (GIS), Global Positioning System (GPS) and Remote Sensing.

A global picture of Biodiversity

According to Wilson, 1988 following are the approximate number of different species of plants, animals and microorganism existing on the earth.

Categories of plants/ animals/ microorganisms	***Number of described species (No of existing ones)***
Higher plants (flowering plants)	2.7 lakh (2.5 lakh)
Gymnosperms	750
Algae	40,000 (26,900)
Fungi	72000 (46983)
Bacteria and Cyanobacteria	4000
Viruses	1550 (4760)
Bryophytes	17000
Pteridophytes and other	12000
Mammals	4650 (4170)
Birds	9700 (9198)
Reptiles	7150 (6300)
Fish	26959 (19056)
Amphibians	4780 (4184)
Insects	10.25 Lakh (7.51 lakh)
Crustaceans	43000 (38000)
Mollusces	(70000) (50000)
Nematodes and Earthworms	25000 (24000)
Protozoa	40000 (30800)
Starfish	6100

Other arthropods and minor invertebrates	132461
Corals and jelly fish	9000
Sponges	5000

According to Erwin (1982) as many as 30 million species in total mostly are undescribed living species in tropical forests.

Importance of Biodiversity

1. It supports human life and society.
2. It provides food, medicine, and many vital Chemicals, macro and micro nutrient essential for human growth and thriving. Materials for our shelter and clothing from the living things surrounding us are also provided by the Bio-dicersity.
3. Plants produce food through the process of photosynthesis and energy thus stored helps to sustain human life. Energy is transferred from one trophic level to other but at a diminishing rate.
4. Most of the medicines used for treating human ailments come from different plants, fungi and bacteria. The importance of biotic medicine is increasingly felt in modern medical science.
5. Biological diversity present us with a pool of valuable genetic resources. The genetic organisation of traditional wild varieties of plants and animals are time tested evaluation of species for millions of years. Reduction of biological diversity results in adverse effect upon the future breeding and improvement of species.
6. It appears to an instrument for preservation of ecosystem. All species in a particular ecosystem live independently as well as inter-dependently. Any loss of a particular species will break the food chain of food web in the ecosystem and the life supporting system of other dependent species will be jeopardized.
7. Biodiversity loss may decrease human's ability to produce medicine, as extinction claims more and more key plant species. Biodiversity also protects against natural disasters, such as grass that have evolvedspecifically at resist the spread of wild fire.

Global change of Environment

It is being observed that with the advancement of civilization through the process of urbanisation, industrialization there is rapid change of environment day by day. The greenhouse gases like carbon-di-oxide (CO2), Methane (CH4), Nitrous oxide (N2O), sulphur-di-oxide (SO2), and Chlorofluorocarbons (CFC) as emitted by way of domestic activities industrial process, burning of fuels, emission of smoke while running vehicles, burning debris, incineration plastic products etc., are the major causes of this change. The conversion of a forest to a grazing land or a cropland through depletion causes loss of carbon stored in soil and affects global carbon cycle.

Fig.3- Biodiversity crisis as a big threat as climate change

Greenhouse Effect

The greenhouse mantle around the globe allows a considerable portion of solar radiation to enter right up to the surface of the earth which absorb it and radiates back infra-red waves.

At the normal CO2 concentration (0.03%) in the atmosphere the surface temperature of the earth remains constant due to energy balance of the sun rays. These rays strike on the earth's surface and heat the atmosphere and then radiates back into the space. This is called energy budget. But when there is increase in CO2 concentration in the atmosphere the thick layer of CO2 prevents the heat from being radiated out into the outer space. This layer of CO2 thus functions as if aglass pane of greenhouse which allows the sunlight to pass through it but prevents heat from being radiated back into the outer space.

The level of CO2 has increased considerable 280ppm (Pre-industrial level, 1750AD) about 368 ppm in 2000 AD. The chronological gradual concentration of greenhouse gases in the atmosphere can be interpreted in the following bar diagram (Fig.5):-

Fig.4 :- Indicates year wise increase of Co2 Concentrationin the atmosphere

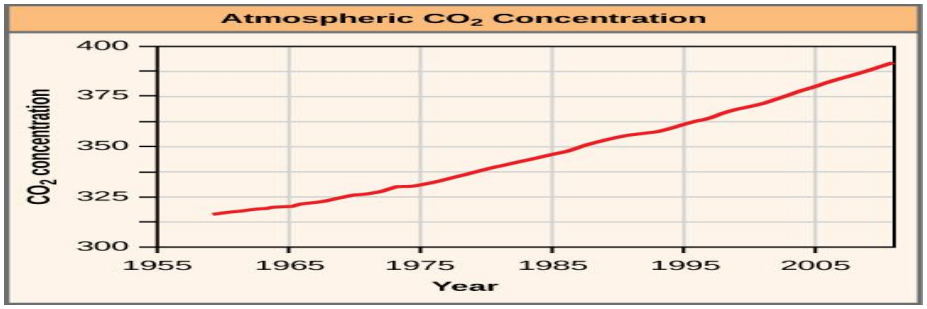
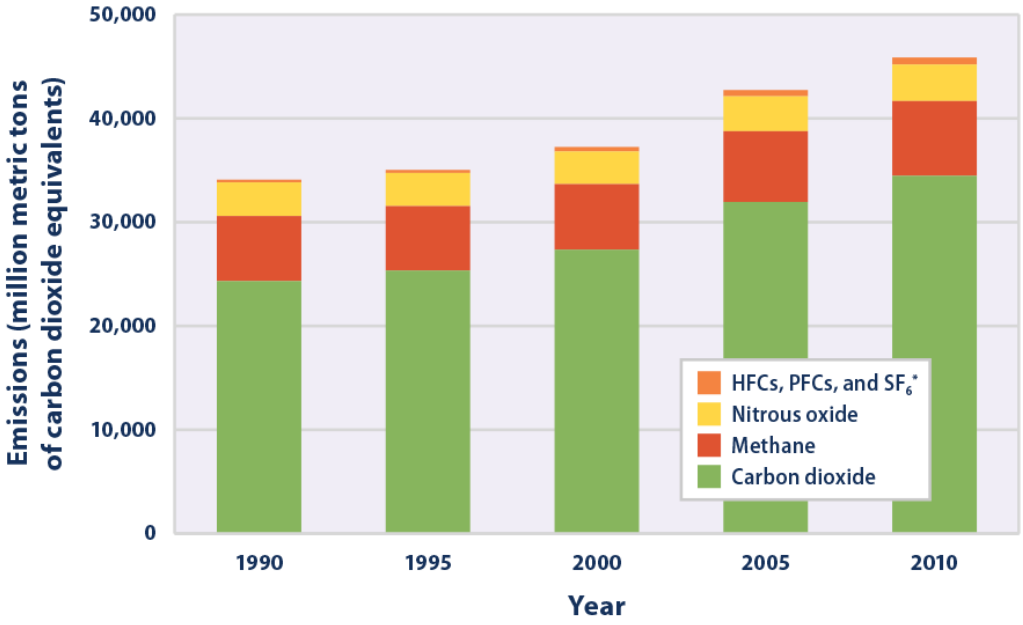


Fig.5 - Indicates year wise increase of Green House Gases



The increase in concentration is mainly due to burning of fossil fuels, deforestation and change in land used etc. Regarding other greenhouse gases Methane (CH4) is produced as a result of incomplete decomposition by a group of bacteria called Methanogens under anaerobic conditions. Its concentration in the atmosphere was about 750 ppb (parts per billion) at the pre-industrial level (1750 AD). Whereas in 2000 AD its level has become 1750 ppb. (source- Freshwater wetlands, Enteric fermentation in cattle, flooded rice fields etc.)

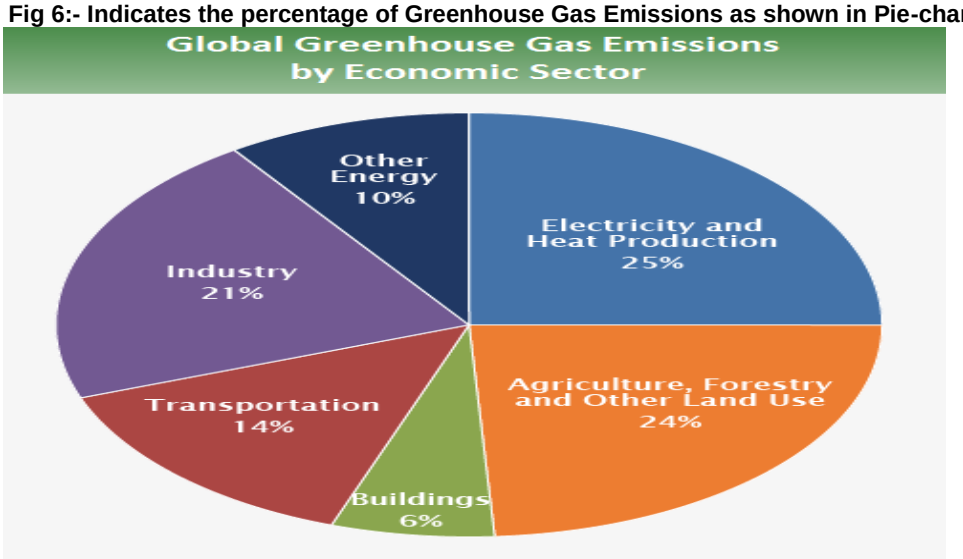
Nitrous oxide (N2O) concentration in the atmosphere as increased from 270 ppb (1750 AD) to 316 ppb (2000 AD). Sources are- Agriculture, Biomass burning, breakdown of Nitrogen rich fertilizer, industrial process during nylon production.

Chlorofluorocarbon (CFC)- The CFC and HFC (Hydrofluorocarbon) though introduced in 1950 AD attained concentration in the air about 282 ppt (Parts per trillion) in 2000 AD.CFC have the major role in depletion of the Ozone layer facilitating the entry of UV rays in the earth atmosphere which have harmful effects.

Sources are- Leaking of air conditioners, refrigeration units and evaporation of industrial solvents, production of plastic foams, propellants in aerosol spray cans.

Percentage of greenhouse gases contributing to global warming is interpreted in the following Pie-chart (Fig.6):-

Fig 6:- Indicates the percentage of Greenhouse Gas Emissions as shown in Pie-chart



Effect of Greenhouse Gases

CO2 Fertilization effect on plants

According to the data produced in the USA the atmospheric CO2 concentration has been rapidly rising since the year 1959. It is estimated that by the end of 21st century the atmospheric CO2 concentration shall increase to a level somewhere between 540 to 970 ppm.

When CO2 concentration of the atmosphere is more of less doubled, the growth of many plants i.e. C3 plants, in particular, under favourable conditions of water, nutrients, light and temperature could increase by about 30% in few years or so.

The response of plants to elevated concentration of CO2 is called CO2 fertilization effect. In the increased rate of CO2 concentration the photosynthesis also increases and the stomatal conductance decrease due to partial closer of stomata. Hence the transpiration rate reduces and water use efficiency increases.

The ozone holes are created by depletion of this ozone layer (i.e. the ozonosphere). Ozone hole was first discovered in 1985 over Antarctic region and in 1990 over the Arctic region. During 1956-70 the spring season ozone layer thickness above the Antarctica region varied from 280-325 Dobson units (DU) [1DU=01PPb (parts per billion)]. This thickness is sharply reduces to 225 DU in 1979 and to 136 DU in 1985. Later on the ozone layer thickness continued to decline to about 94 DU in 1994.

Effects of ultra violet radiation increase the chance of cataract, skin cancer and diminish the functioning of immune system. Increase level of UV-B radiations affectphotosynthesis and damage nucleic acid of large number of organisms.

Such effect allows many species to grow successfully in the regions of water scarcity. Moreover, greater root production under greater proportion of photosynthesis increases the development of mycorrhiza and functions of nitrogen in the root nodule. This makes possible the plants to grow in soil which are poor in nutrition. However, effects of increased CO2 are not applicable.

Effect on Global warming

Weather and Climate Effect

The global mean temperature has increased by about 0.6 degree centigrade. It is thought that mean global temperature may increase by 1.4-5.4 degree centigrade by 2100 AD. Temperature change are expected to wreck havoc in the regions of middle and higher altitude. Polar Regions of the world shouldundergo larger increase in temperature, about 10-12 times as much as tropics. Warming of atmosphere will considerably increase its moisture carrying capacity. While the troposphere warms up the stratosphere will cool down. It is expected that precipitation will increase at higher altitude in both summer and winter and in south and EastAsia in summer. Wheat and Maize crops may suffer from moisture stress. More fertilizers shall have to be used to sustain productivity. The climate change will increase threats to human health also, particularly in tropical and sub-tropical regions of the world. This is due to change in ranges of disease vectors, water borne pathogens.

Change in Sea-level

About 12000 years back in the Ice age the sea level was merely 100 meters lower than the present day level. It is expected that global rise in temperature shall further enhance the rate of already rising sea level in two ways:-

1. Large deposits of ice present on the earth's polar caps will melt which in turn will add more water to the oceans.
2. Rise in temperature shall also cause thermal expansion of the upper layers of water. It is expected that by the end of 2100 AD the global mean sea level can increase up to 0.88 metre over 1990 level.

A rise of even ½ meter in sea level would largely affect human population one third of which lives within 60 KM of coastline.

Human settlement such as tourism, fresh water supply, fisheries, wetland etc. will be negatively affected as predicted by the scientists.

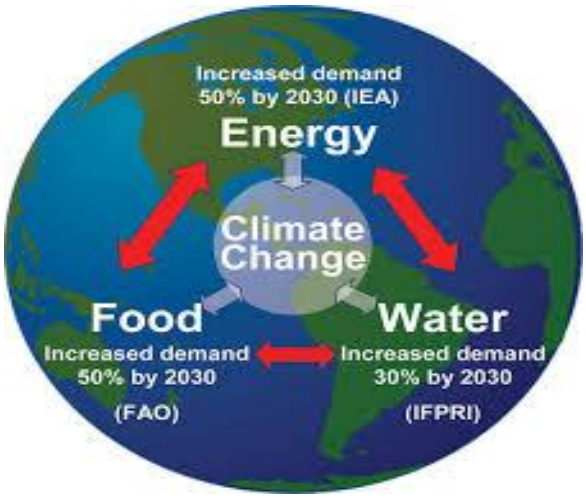
Effect on phenology of species and their distribution

With a global rise in temperature by 2 to 5 degree centigrade during the 21st century the high temperature vegetation may shift 250 to 600 km towards pole as the climate belts shift away from equator towards poles. Vegetation will also shift in the same direction to stay in favourable climate conditions. Pests and insets may increase as warmer condition could be more favourable to their growth. Pathogens may also multiply coupled with higher humidity.

Effect on food production

Eruption of plant disease and plant parts are affected with the increase of temperature. Besides, there will be explosive growth of weeds and increased basal rate of respiration of plants. It is expected that rice yield alone in South-East Asia will go down 5% for each I degree centigrade tem.

Fig.7:- Indicates impact of climate change on Food, Water and Energy.



However, despite beneficial CO2 fertilization effect, the overall world crop productivity will decline due to projected global warming. Consequently, the food supply of the whole of the world shall be affected. It is required to develop pest resist4ant varieties more suitable in warmer conditions and also alter the cropping pattern.

Strategies to reduce global warming

1. To reduce the greenhouse gas emission we must limit the use of fossil fuels by developing alternative renewable source of energy. eg-solar energy, wind energy.
2. To increase vegetation cover particularly the forests for photosynthetic utilization of carbon di-oxide.
3. To use Nitrogen fertilizer at minimum level in agriculture, so that, emission of nitrous oxide (N2O) may be reduced.
4. To develop substitute of Chloro Fluoro Carbon (CFC).

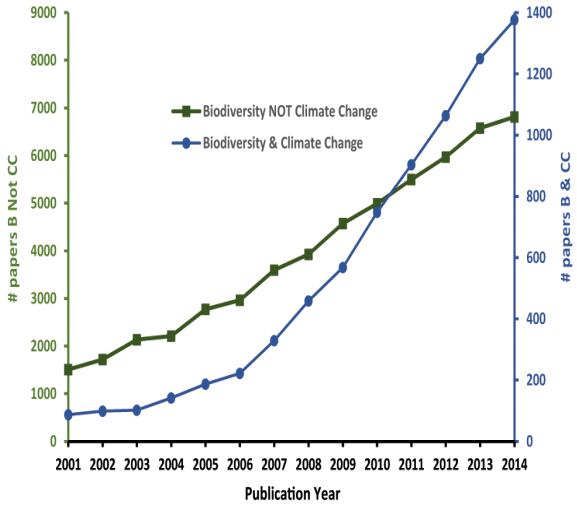
Fig.8: - Climate change and Biodiversity should be given top priority in the news

Climate change Affects Biodiversity

Throughout our planet's history, the climate has changed over time, with ecosystem and species coming and going. The link between climate change and biodiversity has long been established. Rapid climate change affects ecosystems and species ability to adopt and it is detrimental to biodiversity.

The rapid climate change and accelerating biodiversity loss risks human security. For example, change in food chain upon which we depend, water sources may change, recede or disappear, medicines and other resources we rely on may be harder to obtain as the plants and other they are derived from may reduce or disappear.

Fig.9: Biodiversity Status with or without Climate change (Graphic comparison).



According to United Nation's Biodiversity outlook 3, in May 2010 "Climate change is already having an impact on biodiversity and is projected to become progressively more significant threat in the coming decades. Loss of Arctic sea ice threatens biodiversity across and entire biome and beyond. ……Ecosystems are already showing negative impacts under current levels of climate change. ……..Warming temperatures, more frequent extreme weather events and changing patterns of rain fall and draught can be expected to have significant impacts on biodiversity."

Impact of climate change on biodiversity in the Arctic

There are highest rates of warming in the Arctic, Antarctic and high latitudes. In the Arctic, it is not just a reduction in the extent of sea ice, but its thickness and age. Less ice means less reflective surface meaning more rapid melting. Whole species assemblages are adapted to life on top of or under ice. These include algae that grown on the underside of multiyear ice forming up to 25% of Arctic ocean's primary production and invertebrates, birds, fish and marine mammals further up the food chain. The iconic polar bear is at the top of that food chain.

Loss of sea ice has implications on biodiversity beyond the Arctic. According to the Global Biodiversity outlook report- i) Bright white ice reflects sunlight. ii) When it is replaced by darker water the ocean and the air heat much faster, a feedback that accelerates ice melt and heating of surface air inland with resultant loss of tundra. iii) Less sea ice leads to changes in sea water temperature and salinity leading to changes in primary productivity and species composition on plankton and fish, as well as large scale changes in ocean circulation affecting biodiversity well beyond the Arctic. (Secretariat of the convention on Biological Diversity, 2010).

Change in Ocean

A lot of changes of ecosystem occur in the oceans as most of the warming goes into it. According

to John Cook, 2011, "Just as it takes for a cup of coffee to release heat into the air, so to it takes for the ocean to release its heat into the atmosphere."

According to OheHoegh-Guildberg, one of John Bruno's colleagues, the impact of climate change will have on ocean ecosystems. Rapidly rising greenhouse gas concentration are driving ocean systems towards conditions not seen for millions of years with an associated risk of fundamental and irreversible ecological transformation.

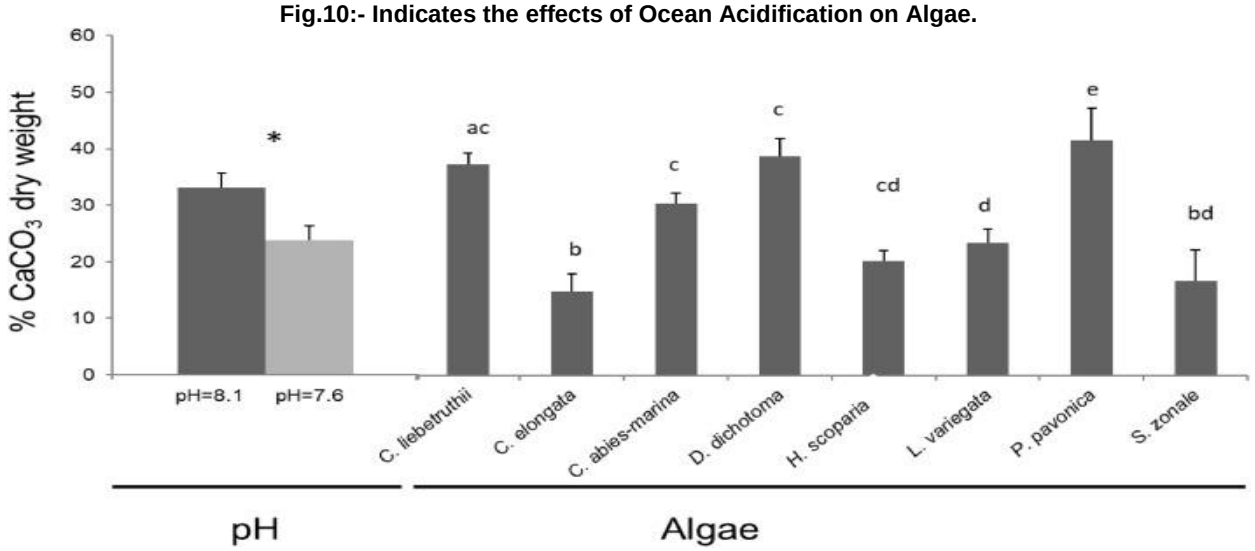
Ocean Acidification

According to the NOAA (National Ocean and Atmospheric Administration), a US agency, there are O3 main concepts regarding chemistry of ocean acidification:-

1. More CO2 in the atmosphere means more CO2 in the ocean.
2. Atmospheric CO2 is dissolved in the ocean which becomes more acidic.
3. The resulting changes in the chemistry of the ocean disrupts the ability of flora and fauna in the sea to make shells and skeletons of calcium carbonate while dissolving shells already formed. According to the scientists as oceans absorb some of the ecess CO2 released by human explain, the water is some 30% more acidic than pre-industrial times due to reaction of CO2 with water to form a weak acid called carbonic acid. One recent finding is that a tiny sand grain sized plays a major role in keeping the atmospheric CO2 concentration at much lower level.

According to the Inter Press Service, there are oceanic dead zones (areas where there is too little oxygen in the sea to support life) and decline of important plants and forests such as mangrove forests that play and important role in carbon absorption.

Fig.10:- Indicates the effects of Ocean Acidification on Algae.



Ocean Stratification

As the climate change warms the oceans (an increase of about 0.2 degree centigrade per decade on average), the warmer water (which is lighter) tends to stay on the top; this affects tinny drifting marine organism known as phytoplankton. According to Boris worm of Canada's Dalhouse University these phytoplankton produce half of the oxygen we breathe and draw down surface CO2 and ultimately support all of our fisheries.

Inter Press Service (IPS) report says that phytoplankton can only live in top of 100 or 200 meters of water, but if it is getting warmer they eventually run out of nutrients to feed on unless the cold deep water mix with those near the surface creating ocean stratification. Researchers have found a direct correlation between rising sea surface temperature and decline in phytoplankton growth around the world.

Oceanic dead Zones

According to the NASA Earth observatory, fertilizer and sewage run-off cause huge growth of plankton. However these quickly die and are consumed by bacteria that deplete oxygen of water. E.g. half of Mexico has a 22000 square kilometre dead zone every spring due to run off from Mississippi river.

It will take a thousand years for the oceans to cool down, so it is imperative to pull the emergency brake on global warming emissions (Stephen Leahy, Inter Press Service, 2010).

Climate change threatens coral reefs

According to Charlie Veron, an Australian Marine Biologist coral reefs have been dying largely around the world due to climate change. There is no hope of reefs surviving to even mid-century in any form that it is now recognised. Coral reefs provide many ecosystem service to humans

Effect of Climate Change on land Biodiversity

Rising temperature already has affected the polar region of the world. Diminishing ice peaks reduce the habitats of polar bears, penguins, puffins and other Arctic creatures. As the ice melts, it increases the sea level, which will affect and perhaps destroy ecosystems on coastlines. Change in temperature will also cause shifts in mating cycle, especially for migratory animals that rely on changing seasons to indicate their migration and reproductive timing. Climate change is predicted to be the greatest long-term threat to biodiversity in many regions and is

listed as a key threatening process under the threatened species conservation Act, 1995 and Environment Protection an Biodiversity conservation Act, 1999 (Commonwealth). The most valuable ecosystems include coastal ecosystems, alpine areas, rainforests, fragmented terrestrial ecosystems and areas vulnerable to fire or low freshwater availability.

Fig.11 - Climate Change to pose bigger threat to biodiversity than land use by 2070

Climate Change Threatens Lizards

The 'global scale study' as published in the journal Science, as described by the BBC indicates that climate change could out 20% of the world's lizard species by 2080.

Global protection models used by the scientists suggest that "Lizards have already crossed a threshold for extinctions caused by climate change" according to BBC lizards are far more susceptible to climate warming extinction than previously thought them previously thought. Many spcies live right at the edge of their thermal limits. Rising temperatures leave lizards unable to spend sufficient time foraging for food as they have to rest and regulate their body temperature.

Loss of Biodiversity is the catastrophe of the combined effects of climate change and land-use change

Climate change is expected to become the largest driver of Bio-diversity loss by the second half of the century surpassing the effects of deforestation and agriculture, as the research finds. Rising temperature and changing rainfall patterns are expected to make existing habitats inhospitable for many animal species. Biodiversity is also under threat from land-use change caused by agriculture, deforestation.

The research finds that in a future with relatively high amount of global warming and land use change, the number of animal species in the average ecosystem could fall by 38% when compared to conditions from 1961-90.

According to Dr. Tim Newbold, centre for Biodiversity and Environment Research "Climate change is to become, perhaps, the greatest pressure on biodiversity and overtake land use in terms of impacts on biodiversity. If you combine these things together, the predictions are at least under business as usual-for very large losses of biodiversity."

Biodiversity losses are expected to be particular high in the tropical grasslands and savannahs of Southern Africa and southern America. This is because these regions are the most likely to be converted to agricultural sites, possibly for the production of palm oil.

Many amphibians have complex reproductive life cycles that rely on availability of both land and freshwater. This reliance on multiple environments is likely to increase the group's vulnerability to climate change.

Fig.12- Ecosystem services analysis in response to Biodiversity Loss caused by Built Environment

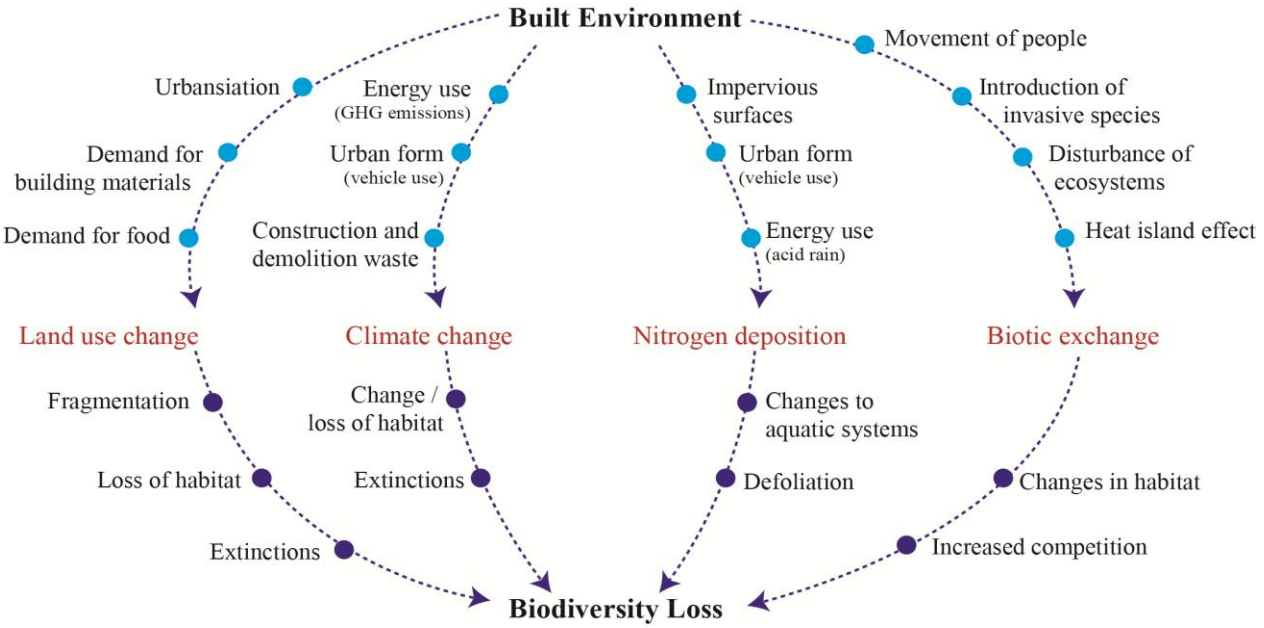
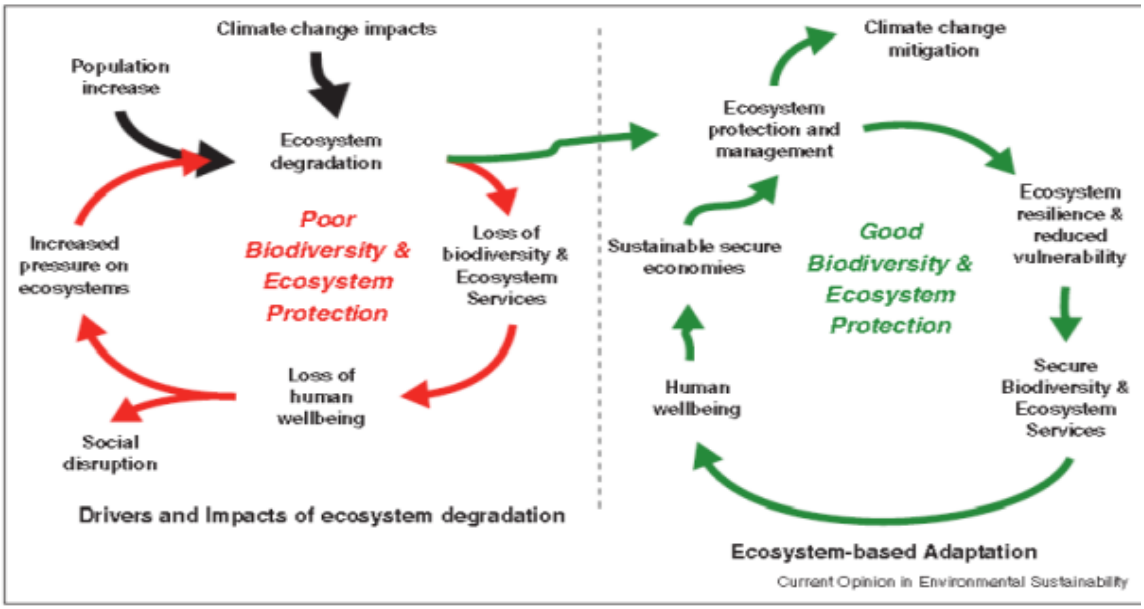


Fig.13:- Resilience of Ecosystem to climate change



Reptiles also are uniquely vulnerable to climate change. One reason for this is because reptiles rely on their external environment to regulate their body temperature, meaning they can over heat if temperatures are unusually high.

Impacts of climate change are already occurring from shifting species distribution to altered environmental conditions and are resulting form changing temperature, more frequent extreme events and exacerbation of existing threats (Tompkins and Adger et al, 2004). Integrating climate change into conservation strategies is vital if biodiversity is to be protected in the long run (Hannah etal, 2002).

It is found through scientific project studies (Karen, et al, 2010) that most common impacts of climate change are to habitat quality or quantity and to hydrologic regimes. Most of the expected impacts are temperature mediated. The conservation strategies are needed to be modified to adopt to climate change.

Conclusion

The Climate and altitudinal variation coupled with varied ecological habitats have contributed in the development of immensely rich vegetational wealth and flora and fauna forming a unique biodiversity. Many birds and insects are showing changes such as earlier onset of migration, egg laying and breeding. These changes are being observed at species level that can be attributed to climate change involving those surrounding phenology (The timing of events). In the last couple of centuries the Earth's Biological diversity has been threatened by various human activities leading to extinction of plants and animal species. It is estimated that nearly 1/10thof the world's floristic diversity is seriously threatened and at verge of extinction.

Most of the observed changes are modest, which is possibly due to limited changes in the climate that has occurred. Over the past 30 years, freshwater species have declined faster compared to terrestrial or marine species. On one hand freshwater ecosystems will probably further suffer from invasive species and land use changes. On the other hand freshwater biota is likely to be impacted by the predicted reduction in water availability driven by increased water consumption for human uses and indirectly related to global climate change (Freshwater Biodiversity Threatened by climate change, 2006).

According to Watson et al, 1998, global change is often perceived as human induced modification in climate. Indeed human activities have undeniably altered the atmosphere and probably the climate as well. Global warming is expected to increase evapotranspiration, causing soil moisture declines that may offset modest increase in continental precipitation and lead to greater acidity in water limited systems around the world (Zavaleta, 2003).

Some other features for threats of extinction and vulnerability may be mentioned in this context like 1)Population crash 2)Loss of specific pollinators,3)Loss genetic variability 4) Low seed germination capability 5)Over exploitation e.g .Removal of timber, fuel, fodder and other commercially important species 6) Habitat degradation for human settlement and other commercial projects 7) Competition like ecologically better suited species replacing the weaker ones.8) Pathological causes like outbreak of diseases, epidemics.etc.

It is now widely recognised that climate change and biodiversity are interconnected. Biodiversity is affected by climate change with negative consequences for human wellbeing. But biodiversity, through ecosystem services it supports, also make an important contribution to both climate change mitigation and adaptation. Consequently, conserving and sustainably managing biodiversity are critical to addressing climate change. We should develop sourcing policies focussed on sourcing from responsibly managed forests along with

understanding ecosystem service values of forests in the supply chain related to water, climate change and biodiversity. We should also explore how different marketplace tools can help measures and explain our sourcing impacts.

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