

RESEARCH ARTICLE

CLIMATE CHANGE AND ITS IMPACT ON BIO-DIVERSITY

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ABSTRACT

The climate change is unprecedented scale and speaks of an emerging crisis throughout the world. It is an alarming issue beyond human control. The change is caused by so called development. This article is pen down the climate change and its impacts on various levels of biodiversity.

Keywords: Alarming, biodiversity, climate change, impacts and unprecedented.

1. INTRODUCTION

The climate change is resulted in greenhouse gases. Among the gases CO₂ plays a vital role to change it. This is emitted more from the combustion of fossil fuel. The concentration of CO₂ in the atmosphere increased from 280 ppm in 1760 to 379 ppm in 2000. If the trend continues, the end of the century it will increase to 560 ppm. The CH₄ and N₂O increased from 700 ppb to 1774 ppb and 270 ppb to 319 ppb respectively during the same period. The other green house gases are such as methane, black carbon and nitrous oxide which currently contribute about 25 percent of the total warming. Effects of the concentration of CO₂. Concentration of CO₂ makes the earth hotter that is global warming. This global warming leads to negative impact on physical structure of the earth. The effects are

2. ICE MELTING

As a result of global warming mountain glaciers are melting rapidly. Artic ocean ice sheet has thinned by 42 percent in 2001. Within 50 years, the Antarctic continent will shrink and Europes Alps and Himalaya, the glacial volume shrinks more than half since 1850.

3. SEA-LEVEL RISING

Sea level is rising due to global warming. The main causes include thermal expansion of oceans and melting of the glaciers and ice caps. From 1961 to 2003, the average rate of global mean sea level rise is estimated to be 1.8 ± 0.5 mm/year. The contribution from thermal expansion is estimated to be 0.42 ± 0.12 mm/year. The contribution from glaciers, ice caps and ice sheets is estimated to be 0.7 ± 0.5 mm/year. During 20th century the sea level rose by 10 – 20 cm (4.8 inches). For each millimeter rise in sea level, the seashore will retreat an average of 1.5 meters. The Inter Governmental Panel on Climate Change 2001 assessed that the sea level could rise by as much as

one meter during 21st century when the present global warming continues. Thus one meter rise in sea level will retreat 1500 meters or nearly one mile. As a result two thirds of the Marshall Island and Kiribati 3600 square kilometers of the USA would be under sea water.

4. GLOBAL TEMPERATURE

There were not many changes from 1850 to 1915, besides the fluctuations associated with the natural variability. An increase in the warming occurred from 1919 to 1940s followed by a slight cooling due to aerosol reflectance and decline in the sun pot cycle period, followed by a rapid warming up to the end of 2006. Notable increases were reported from 1950 onwards. The global average surface temperature has increased and the 100 year end (1906-2005) indicates an increase of $0.74^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$. Eleven of the last 12 years (1995 to 2006), with the exception of 1996, rank amongst the 12 warmest years on record. The high level concentration of CO₂ increases the global temperature. If the concentration of CO₂ reaches 560 ppm, the temperature is projected to increase 1.4 to 5.8 degree Celsius.

5. CHANGES IN THE HYDROLOGIC CYCLE

The increase in the global mean temperature result in increase in the evaporation rates resulting in an increase in humidity levels which have been observed to increase since 1976 over both the land and oceans. The upper troposphere water vapour has been increased in the last two decades. This troposphere water vapour absorbs radiation and amplifies the warming rates.

An interrelationship between the El Nino event and cloud cover exists. The radiation changes from 1980s to 1990s during the E1 Nino phenomenon appear to be associated with the reduction in the tropical upper level cloud cover. These changes bring changes in the energy balance. The number of hurricanes in the North Atlantic

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region has increased when compared with their occurrences over the last 25 years.

6. CHANGES IN THE CRYOSPHERE

The main components of the cryosphere are snow, river and lake ice, sea, ice glaciers, ice caps and frozen ground. Nearly 90 percent of the solar radiation gets reflected by the cryosphere, whereas only 10 percent gets reflected from oceans and forest lands. Increase in temperature causes an increase in the melting of snow and ice cover, reducing their rate of reflectivity, thereby enhancing the absorption of radiation in the melted areas.

The mountain snowpack in western North America and the Swiss Alps have been declined. One hundred and fifty records on freezing and melting of river and lake ice delayed in the freezing dates and an early melting date. Ice sheets shelves lose mass by calving ice bergs and melting and melting at the base into the ocean. A warming of about 1°C in the oceans can increase the melting of the base of an ice shelf at a rate of 10m/year. The ice sheets have shrunk in response to warming and increased in volume in response to cooling. The volumes of the Greenland and Antarctic ice sheets are equivalent to approximately 7m and 57 m of the sea level rise, respectively. Thinning or loss of ice shelves in Greenland, the Antarctic Peninsula and West Antarctica has been associated with an accelerated flow of water in the form of ice streams.

7. HEAT WAVES

Climate change is indicated by the heat waves. As a result of global warming, the number of days per year is increasing continuously. Heat waves create spatial death and affect the health of the people. The recent heat waves killed about 70,000 people in Europe in 2003. IPCC report indicated that Romania will have 28.9 days in 2050. Majority of the countries in the world will have more than 10 days of heat waves in near future. The high level of temperature will lead to more mortality.

8. NATURAL DISASTER

Frequent natural disasters have been realized by the world. Flood, earthquake, cyclone, hurricane have been faced by many countries in recent years. The natural disasters affect the life of the people and a very huge economic loss. The mortality due to drought was 1728 since 1971-2008.

9. CLIMATE CHANGE AND BIO-DIVERSITY

Earth supports a web of a 5 million to 10million species of plants and animals. Single species human destroys or disturbs the every functioning of that web. A few dozen species provide basic nutrition, 20 percent of human calorie intake

comes from rice, 20 percent comes from wheat, a few species of cattle, and poultry supply 70 percent of animal protein. Only among the 20 percent of animal protein from fish and shell fish is a diversity of dietary species found.

Climate change has been accelerated many changes in the biosphere. Biosphere is the place where living organism is interacting with them. Biodiversity is the variety of all forms of life, including genes, populations, species and ecosystem. The number of species is often used as an indicator of the diversity of an area. Most of them are micro organisms and only about 1.75 million have been formally described. Two-thirds of the diversity is the tropics.

Global warming has significantly impact on the timing of the species life cycle. In future, the impacts are expected to be much more extreme. In many plant species, the timing of spring growth phases such as budding, flowering and fruiting is a response to accumulated temperature. In animals, the timing of migrations, breeding emergence and metamorphosis has changed significantly. These phenological events have been and will continue more than earlier periods. Delay in autumn events such as leaf colour, leaf fall and migration of animals and birds.

The characteristics of all individual animals and plants are determined by the interaction between their genes and environment. The physical environment experienced by each individual includes temperature, rainfall, day length and geological substrate, while the biotic environment includes the presence of food, competitors and natural enemies.

When the environmental changes, phenotypes of organism may change in direct responses. Most of the insects grow faster and have shorter generation time at higher environmental temperature. Under warmer conditions in the Northern hemisphere, plants have flowered earlier, insects have emerged earlier in the season, amphibians have returned to their breeding ponds earlier, migrant birds have returned earlier in spring and non-migrant birds have nested earlier in spring. There can be longer breeding periods for both plants and animals. The largest phenological changes will be more at higher latitudes and altitudes because the warming of the globe is more intense in these areas.

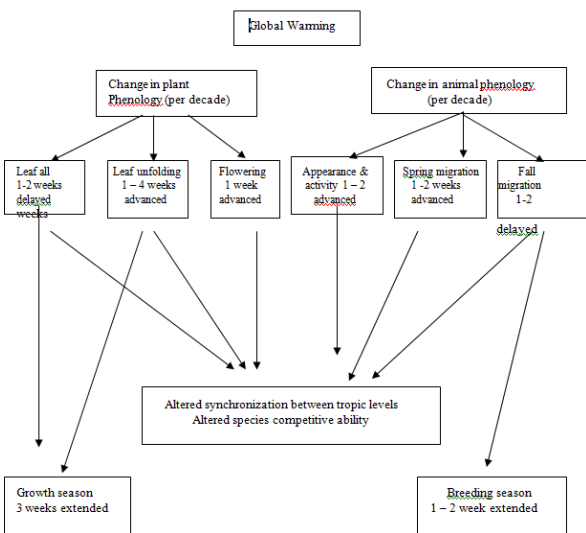
10. IMPACTS ON FRESHWATER ECO-SYSTEM

Fresh water ecosystem will naturally be sensitive to change in the hydrologic cycle. A warmer climate will result in evaporation from water surfaces a greater transpiration by plants, which will

result in a more vigorous water cycle. Future climate change will directly affect lake ecosystems through warmer temperatures and changes to the hydrologic cycle.

A strong case can be made that future climate warming will alter the extent of habitats available cold, cool and warm water organism depending upon region and result in range expansions and contractions. Rapid climate change has many negative implications for the biodiversity of rivers and streams. Streams are coolest in the headwaters and a warming will tend to push species upstream to find thermally optimal habitats. Climate change may cause extinction at several taxonomic levels.

Ecological consequences of climate warming for plants and animals phenology



Source: Lovejoy and Hammak (Ed.) 2006.

11. CLIMATE CHANGE AND MARINE ECOSYSTEM

At about 70 percent of the earth's surface is covered by sea water. Climate change is already changing the distribution of ecosystems. Marine plants and animals live within fairly narrow set of physical and chemical conditions. Rapid change of environmental conditions results in changes in the abundance of organisms.

The increase in greenhouse gases within the earth's atmosphere is set to change three fundamental variables associated with oceanic environments: the calcium carbonate saturation state, sea level, and temperature of the earth's oceans. These bring negative impact on marine biodiversity. Total carbonate alkalinity of seawater will decrease as carbon dioxide increases within the earth's atmosphere. The doubling carbon dioxide concentrations in the atmosphere will decrease the aragonite saturation state in the tropics by 30 percent in 2050.

The level of the ocean has fluctuated by more than 100 over the past 100000 years as ice stored on land has changed in volume. During the last ice age, sea level was 120 m below where it is today. During the transition out of this period of glaciation, sea level changed at an average rate of 10 mm/per year. During the interglacial periods rates of sea level rise have been lower that is 0.1 – 0.2 mm/per year over the past 3000 years. Changes in sea level have had major impacts on the abundance and particularly the distribution of both marine and terrestrial diversity. Ocean temperature has increased 2.3×10^{23} J between the mid 1950s and mid 1990s. The mean warming is 0.60° C. The changes in global temperature bring the changes in direction of ocean water movement. Coastal ecosystems are generally dominated by food webs that depend on attached plants such as algae or water borne microalgae. They are important for the flow of resources within the ocean and are the basis for more than 60 percent of the productivity of the ocean.

Tropical intertidal and sub tidal regions are dominated by ecosystem that are characterized by a framework of scleractinian corals, The biodiversity of coral reef is extra ordinary with an estimated million species of plants, animals and protists living in an estimated 400,000 km. of coral reef. These ecosystems form rich and complex food chains that support large populations of fish, birds, turtles and marine mammals. Coral reefs have already experienced major impacts from climate change. Tropical oceans are $0.5 - 1.0^{\circ}$ C warmer than 100 years ago. Major disturbances of mass coral bleaching have increased dramatically over the last 30 years. Changes in reef building coral communities create a huge impact on marine diversity. Fishes depend on corals for food, shelter or settlement cues may experience dramatic changes in abundance or go extinct. Thousands of other organisms are also vulnerable changes in sea temperature are affecting plankton processes in polar and temperature regions. The mid 1970s fledgling survival has declined and penguin as well. The population size decreased by 70 percent since 1987. The emperor penguin numbers have declined by 50 percent. In the Indian Ocean some regions lost all their reef building coral communities and the over all average loss for the Indian Ocean was 46 percent. Between 1992 and 2000, the share of severely damaged reefs world wide expanded from 10 percent to 27 percent.

The carbon dioxide – carbonate system is the most important chemical equilibrium in ocean. It influences nearly every aspects of marine science, including the ecology, and ultimately, the biodiversity of the ocean. It is largely controlling the PH

of sea water and thus affects directly much other chemical equilibrium as well. By the middle of the century atmospheric carbon dioxide is expected to reach double pre industrial level. CO₂ will give rise via passive diffusion to a two fold increase in surface ocean CO₂ concentrations and cause a drop in surface PH of about 0.4 units because of the CO₂ carbonate buffer system. The breeding centre for the fishes is disturbed that the fish population will decrease drastically. Finally, the poor people's food will be affected to them.

12. ECONOMIC LOSS

The components of biological diversity are important from ecological point of view. Elements of bio-diversity provide food, medicine and raw materials for industries and maintaining the

ecological balance of nature. It protects and stabilizes soil, local climate, soil hydrology and efficiency of the nutrient cycle between soil and vegetation. The survival and well beings of society depend on a large number of antibiotics and anti cancer drugs developed from plants, animals and micro organisms. World attention was focused on natural drugs only in the late 20th century. Plants derived drugs represented a market value of \$ 40 million all over the world. It has been estimated that 3 billion people depend on traditional medium. In the USA a quarter of all prescription dispensed by pharmacies are substance isolated from plants. More than 5000 species of plants are used in Chinese traditional medicines. If the climate change continues, the plants diversity will affect and consequently irrecoverable huge loss to the society.

Table 1. Climate change and agricultural production

	Change in temperature 0°C	Change in heat wave duration No. of days	Precipitation % change	Agricultural output %change	Agric. Yield
	2000-50	2000-50	2000-50	2000-50	2000-50
Australia	1.5	10.9	-1.4	- 26.6	- 16.4
Bangladesh	1.4	8.7	1.4	- 21.7	8.9
China	1.7	16.1	4.5	- 7.2	8.4
Finland	2.1	29.6	5.6	-	15.7
Russian Federation	2.2	29.5	8.8	- 7.7	11.0
Pakistan	1.8	19.8	- 3.0	- 30.4	- 32.9
United States	1.8	24.4	2.7	- 5.9	- 1.7
India	1.6	10.8	1.9	- 38.1	- 12.2

Source: World Development Report, World Bank, 2010.

Table 2. Climate change and natural disasters

	Mortality		People affected		Economic loss	
	No. of people		No. of people thousand		\$ thousands	
	Drought	Flood & storms	Drought	Flood & storms	Drought	Flood & storms
	1971-2008	1971-2008	1971-2008	1971-2008	1971-2008	1971-2008
Bangladesh	0	5673	658	8751	0	44576
Australia	0	10	186	108	262447	390461
China	93	1304	9642	53460	522350	4791624
Ethiopia	10536	51	1361	59	2411	424
India	8	2409	25294	22314	61608	1055375
Iran	0	102	974	101	86842	202133
Italy	0	8	0	2	21053	597289
Philippines	0	743	172	2743	1696	164362
United States	0	272	0	672	187763	12104146
Vietnam	0	393	161	1749	17082	157603
Mozambique	2633	65	455	328	1316	22846

Source: World Development Report, World Bank, 2010.

13. BIO-DIVERSITY IN AGRICULTURE

Biological diversity is an important resource essential to sustainable development in agriculture.

Loss of species and genetic diversity presents a serious threat to sustainable agriculture. Species and genetic diversity provide raw materials for plant breeding. Climate change is highly influenced the

agricultural production. The production is affected by rainfall, temperature and precipitation. There are crops respondent to carbon fertilization and it increases the production. The negative impact is increase the requirement of water and shrinking of crop land result in decrease production. The wetland will be changed into dry land as a result agricultural bio diversity will be declined.

The rising trend of sea water results in retreat nearby areas of coastal line. It creates alkalinity of agricultural lands and the ultimate result is that, the soil is not suitable for cultivation crops. The cropped area will be reduces and the agricultural production will be fallen. The desertification falling of water availability and intrusion of sea water affect the entire agriculture production of the world. Some parts of the world will not have enough water to always grow all of their food. Many countries already import a large share of their food from other countries.

Table 1 depicts that the change in temperature ranges from 1.4^oC to 2.2^oC in different regions. As a result of hotter temperature, the heat waves will be higher in all regions. All the developing countries will face the problem less yield and production. People will in secured food. This kind of problem will lead to huge economic problem to society as well as the nation. There were 70 countries projected the heat waves, agricultural output and agricultural yield. Almost all the countries change in temperature is more than 1^oC. There are countries will face problem of reduction in output from agriculture. The developing countries will have more threat because of decline in agricultural output and agricultural yield. This kind of problem reduces the food security to the people of developing countries.

14. NATURAL DISASTERS AND ECONOMIC LOSS

Climate change is one the reasons for natural disasters. Climate change influences the hydrological cycle and as a result flood and drought experienced by the world. There were 70 countries estimated the human loss and economic loss. Both the developed and developing countries faced the problem of human loss and economic loss. The loss of China was 2.9 percent, the USA 1 percent, India 2.5 percent, Australia 3.2 percent, Belize 2002.2 percent, Grenadu 20.5 percent Samoa 248.4 percent of GDP. Table 2 indicates that many countries faced the problem of drought, flood and storms.

15. BIO-DIVERSITY IN AQUATIC ECOSYSTEM

Increasing sea and river water temperature is likely to affect fish breeding and migration and harvest. A rise in temperature 1^oC could have rapid

effects on the mortality of fish and geographical distribution. The marine ecosystem provides a very huge amount food to all section of the people especially protein nutrient provider to the entire mass of the world. Fish and selfish currently supply about 8 percent of the world animal protein consumed with the world population growing by about 78 million people every year, fish and shellfish production must grow by about 2.2 million metric tones every year to maintain current consumption. The climate change already affected marine ecosystem and there is a threat to the future. If the trend continues, the stock of fish and animals will fall. There are countries earning sizeable amount of income through fishing industry. This industry face loss and finally the major section of the population loss their nutrient food. The most vulnerable section of people is the poor section of the population. They are not missed the food but also millions of people lost their livelihood.

16. FOREST ECOSYSTEM

Forest eco-system is not only expanding species and micro organism but also the plants and trees are oxygen producers. The climate change makes the forest drier. The most threat to the forest is forest fire. The high level of temperature creates fire in the forest. If this situation continues, the forest ecosystem will highly impair. As a result forest based industries lost their inputs and loss of the oxygen. An average a tree inhales 12 kg of CO₂ and exhales enough O₂ to keep a family of four breathing per year. On an average one tree produces nearly 260 pounds of oxygen every year. More than 20 percent of the entire world's oxygen is produced in the Amazon region. These rain forests generate about 40 percent of the world's oxygen. The level of carbon dioxide concentration will increase in the atmosphere.

17. CONCLUSION

These kind of problems have been arising all over the world. A beautiful planet is facing threat by so called development. A man is not satisfied by a single wants. The man wants have been expanded and therefore exploit the natural resources for his comfort and luxury life. People enjoy the comfort and luxury life that they called development. This development brings more income. This development affects the people's life and brings economic loss to the entire world. Will the people limit their wants? Not at all. They will bring modification and try to adopt the existing nature. How long? No answer for it. Educate the people in the line of limiting wants then only this planet will be saved and limit the economic loss in near future.

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