

Projected Status of Climate Change and Its Impact on Biodiversity in India

Satish Kumar^{1*}, Vijayanti Jakhar², Janak Raj³

¹Department of Botany, Government College, Hisar-125001 (Haryana, India)

²Department of Zoology, Government College for Women, Bhodia Khera, Fatehabad-125050 (Haryana, India)

³Department of Botany, Government National College, Sirsa (Haryana, India)

*Corresponding Author E-mail: drsatishverma1008@gmail.com

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ABSTRACT

Climate change is a natural process which is triggered by anthropogenic activities. A small change in the climate severely impacts the diversity of organisms and disturbs the ecological balance. Frequent incidences of higher and lower rainfall are taking place, but the global temperature is increasing regularly and is projected to increase around 2°C by 2030. More destructive hurricanes, droughts, heat waves, and severe rainfall will occur in coming years due to global warming, adversely affecting the income of about 10% population of India. The biodiversity of a region includes the diversity among genes of the individual, members of a species, species of an ecosystem and habitats of the biosphere. Biodiversity is the key element for ecological balance and ensures the human race's survival. India is one of the 12 mega biodiversity countries of the world, having 2 hotspots and 10 biogeographical regions. About 46000 plant species and 81000 animal species have been reported in India. Biodiversity must be conserved for sustainable development, ecological balance and survival of human beings. Planners should plan the conservation strategies of natural biodiversity with high priority, and the government should take measures to implement conservation techniques of biodiversity, minimizing climate change, sensitizing the mass and promoting research on the importance of climate change and biodiversity.

Keywords: Anthropogenic, Biodiversity, Climate change, Ecological Balance, Conservation.

INTRODUCTION

The climate is the variation in weather conditions of a particular area over a period of time and comprises temperature, precipitation and sunlight. Changes in the environmental conditions cause changes in the climate. The United Nations Framework Convention on Climate Change (UNFCCC), under its article 3

on definitions, states, "Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

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The Intergovernmental Panel on Climate Change (IPCC) defend climate change as any change in climate which can be observed through statistical methods and persists for a longer period. Climate change has emerged as the most discussed current environmental issue that has an adverse impact on a country's economy and the ecosystems' biodiversity. Scientists have extensively studied the causes of climate change, and there is a consensus that greenhouse gases released through human activities are the main cause of climate change. Continental drift also affects the climate because the separation of landmasses affects the flow of ocean currents and winds, which affect the environment. Variations in solar output, volcanic eruptions, ocean currents, El-Nino effects and extensive use of natural resources have adversely affected the region's climate.

Biodiversity is the diversity among the individuals and members of a species within the ecosystem and among ecosystems of a biosphere. According to United Nations Framework Convention on Climate Change (UNFCCC), "Biodiversity means the variability among the living organisms from all sources including inter-alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of the ecosystem". In other words, biodiversity is an area's species richness, including genetics, species, ecosystem and habitat diversity (Verma, 2017). Biodiversity is necessary for ecological balance and human survival. Knowledge of the levels and values of biodiversity is the source of spiritual and aesthetic inspiration for painters, writers, musicians and other art-loving persons (Sharma & Mishra, 2011).

India is ranked among the 12 mega biodiversity countries of the world and has 10 biogeographical regions. Biogeographically, India is situated at the meeting point of three realms named Agro-tropical, Indo-Malayan and Paleo-Arctic realms and thus has a rich biodiversity of forests, wetlands and marine ecosystems. It is estimated that 46000 plant

species and 81000 animal species are reported in India. Among the plant species, 50000 insects, 4000 molluscs, 2546 fishes, 197 amphibians, 408 reptiles, 1224 birds, 6500 other invertebrates and 350 species of mammals have been reported (Myers et al., 2000). Human activities like construction, industrialization, mining and other development projects have caused significant threats to the biodiversity of a region. Habitat destruction, exotic species invasion, uncontrolled increase in pollution and over-exploitation of natural resources have adversely affected biodiversity. Deforestation and rampant poaching are other important factors of biodiversity loss. There is a great need to conserve biodiversity through in-situ and ex-situ measures (Kumar & Verma, 2017). Proper documentation and scientific quantification of a country's biodiversity should be maintained in the current regime of globalization and Intellectual Property Rights (IPR).

PRESENT AND PROJECTED STATUS OF CLIMATE CHANGE IN INDIA

Rainfall status in India is analyzed through Rain Gauge, and it is observed that Western Ghats and North East India have maximum rainfall in the active monsoon season (MOEF, 2010). According to rainfall data for the period of 1951 to 2000 for central India, a significant rise in the frequency of extreme rainfalls events (>100 mm/day of rain) and a decline in moderate rainfall events (>5mm and <100 mm/day of rain) have been observed (Goswami et al., 2006). Hence, no predetermined trend of rain in India due to unstable environmental conditions. Mean annual temperature shows a significant rise of 0.51°C per 100 years during the period 1901 to 2007, and most states in India warmed from 2001 to 2010 at about 0.1°C (MOEFCC, 2015).

Projections of all models on climate change in India state that the extreme rainfall events in central India and other regions are likely to increase in the summer monsoon. There is a possible flood in the Mahanadi River Basin areas in the month of September

but a threat of water scarcity in April. An alarming situation of groundwater depletion in states like Punjab, Haryana and Rajasthan can occur due to unplanned and uncontrollable use of groundwater for paddy cultivation. The severe decline in the wheat, sorghum and other cereals yields is projected from 2050 to 2080. Coastal regions may submerge in water due to global increases in temperature, and more catastrophic events may occur. It is estimated that agricultural loss may reach upto US \$7 billion in 2030 due to the projected 2°C increase in temperature and it will adversely affect the income of 10% of the Indian population. The projected rise in global temperature will cause more destructive hurricanes, droughts, heat waves and severe rainy events (McNeely et al., 1995).

IMPACT OF CLIMATE CHANGE ON BIODIVERSITY IN INDIA

Plants and animals are directly affected by changes in the climate, and it is assumed that organic evolution is associated with rapid changes in the climate. Climate change mainly occurs due to natural and anthropogenic activities. Changes in solar radiations, ocean currents, plate tectonics, earthquakes and volcanic eruptions are major natural causes of climate change (Kunzing, 2008). Emission of greenhouse gases like carbon dioxide, methane and nitrous oxide by different activities like energy sources (25.9%), industries (19.4%), deforestation (17.4%), agricultural activities (13.5%), transportation (13.1%), urbanization (7.9%) and waste production (2.8%) are the anthropogenic activities contributing in climate change and affecting the biodiversity of a region (Rathore & Jasrai, 2013). A small change in climate severely impacts an area's biodiversity by altering the habitat of species, which may lead to the extinction of many species.

It has been observed that plant species like *Taraxacum officinale*, *Berberia sciatica*, *Jasminum officinale* etc., have shifted to higher altitudes in Nanital (India) due to an increase in mean annual temperature. An increase in temperature up to 3°C may cause the movement of forests at a 2.50 km/year rate,

which is around 10 times higher than normal (Gates, 1990). Continuous temperature increases may replace the sal trees in forests by teaks and coniferous by deciduous tree species. Fluctuations in temperature and precipitations will cause drought and floods. Thus, pests and diseases will frequently attack indigenous plant species (Tibbetts, 2007). Exotic species like *Lantana*, *Parthenium*, *Ageratum* etc., are reported to be harder to climate fluctuations replacing the indigenous plant species (Anonymous, 2009).

Climate change has adversely affected animal species, also. Like Golden Toad and Monteverde Harlequin Frog have become extinct, North Atlantic Whales are facing the danger of extinction, and the population of polar bears has been reduced to an alarming level (McCarthy et al., 2001). Fluctuations in the temperature of oceans may cause the loss of up to 95% of the coral populations of Australia's Great Barrier Reef (Anonymous, 2007). Global warming may lead to more production of female turtles, and it will disturb their sex ratio, hence the population also. The distribution and composition of species in the Rann of Kutch (Gujarat) and Sunderban Coastal Regions are vulnerable to climate change (Rathore & Jasrai, 2013). It is estimated that 96% of the tiger habitat will be destroyed in the Sunderban ecosystem in the next 50 years (Loucks et al., 2010). Islands have rich biodiversity of plants and animal species, but according to a report, around 23% of island species have become endangered due to climate change.

A large area of the Earth is covered by forests which are an important source of food, timber, and drugs and maintain ecological balance. Due to climate change, the composition of forest species has been disturbed, and many tree species have migrated to higher altitudes. According to FAO (2000), about 9% of plant species are at the level of extinction in forests due to global warming. Changing patterns of rainfall and increased infestation of pests and diseases have adversely affected agricultural crops, disturbing the ecosystem's biodiversity

component (Verma, 2018). Many physical factors like temperature, precipitation, hydrological disturbances, forest fires, acidification of oceans, upwelling of coastal

areas, increased sea level etc., are responsible for climate change and affect direct or indirect affect the potential of biodiversity (Table 1).

Table1. Physical factors and their impact on biodiversity

Physical Factor	Impact on Biodiversity
1. Increase in Temperature	Species richness and composition are adversely affected. Loss of biotic interaction also.
2. Change in Precipitation	Community interactions and its composition is altered
3. Change in Hydrological cycle	Due to low levels of water in streams, aquatic species' composition is disturbed.
4. Floods and Droughts	Cause mortality and decrease in population of many species.
5. Forest Fires	Loss of many species and disturbance in ecological balance.
6. Ocean acidification	Due to the increase in acid level, the calcification of many molluscs is adversely affected.
7. Increase sea water level	Loss of habitat of many species and the population of many species will be decreased.
8. Changes in coastal upwelling	Species number of marine organisms are likely to be reduced

Anthropogenic activities like industrialization, urbanization, overpopulation and over-exploitation of resources are largely responsible for biodiversity loss. It is estimated in a report that about 27000 species become extinct every year, and if the extinction rate continues at the same pace, then 30% of the total number of the world's species may be lost by the year 2050. Deforestation and habitat loss have caused the loss of many valuable species (Drakare et al., 2006). Population explosion and rapid consumption of natural resources are one of the major causes of biodiversity loss (Sharma & Mishra, 2011).

Climate change is a very serious global problem, and there is an intense need to minimize the effects of climate change on biodiversity and human beings for sustainable development and survival of the human species. Efforts are being made at national and international levels through proposals in national and international conventions on climate change. There is a need for proper implementation of policies to conserve biodiversity and minimize the impact of changing climate on biodiversity.

CONCLUSION

Climate change is the main concern to researchers because it affects the environment, biodiversity and human life. Global warming due to anthropogenic activities is a threat to biodiversity and ecological balance. A small change in the climate may be responsible for

the extinction of many valuable species as it results in a change in the distribution pattern of species, migration of species, invasion of exotic species and change in the behaviour of the individuals.

To conserve biodiversity and maintain the ecosystem's ecological balance, there is a need to understand the interaction among members of a species, the interaction between plants, animals and different species. Biodiversity should be conserved in the hotspots and biosphere reserves through regular afforestation, reforestation and other mitigation strategies. Without conserving biodiversity and minimizing harmful anthropogenic activities, achieving inclusive and sustainable development is almost impossible. Policymakers should keep the priority of biodiversity conservation strategies in their policies for the welfare of human beings and future generations.

Significant emphasis should be placed on reducing the quantity and quality of fuel consumption, implementing improved and advanced technologies, and sensitizing people on the importance of biodiversity and climate change. Activities like watershed management, sustainable agriculture, reduction in carbon emission, eco-friendly industrialization, green urbanization, forestry management etc. should be part of the school syllabus, and climate managers should be appointed at the village level for sustainable growth of the nation. The government should promote research on areas

of biodiversity and climate change for the country's sustainable development.

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Conflict of Interest:

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Author Contribution

All authors have participated in critically revising the entire manuscript and approving the final manuscript.

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