



PERSPECTIVE OF CLIMATE CHANGE AND BIODIVERSITY

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INTRODUCTION:

Climate is defined as the average weather conditions, characterized by long-term statistics for the meteorological elements in a given area. While climate change (CC) is described as the change in the climate of an area as a result of anthropogenic and natural disorders such as the depletion of the ozone layer, and greenhouse effects (Kotir, 2011). It may result from factors such as changes in solar emission, long-term changes in the earth's orbital elements (eccentricity, obliquity of the ecliptic, the procession of the equinoxes), natural processes, and human forcing on a planet. Though CC is due to alteration in external forcing (natural factors or human activities), future projections consider the influence of only anthropogenic increases in greenhouse gases and other human related factors. Therefore, the twentieth century experienced the strongest warming trend of the last millennium with average temperatures rising by about 0.6 °C. However, future temperature rises are likely to exceed this with a predicted rise of between 0.1 and 2 °C per decade (Dawson *et al.*, 2016). It has been emphasized that climate change poses major risks to biodiversity and will probably work against it. Temperature and precipitation variations are two crucial facets of climatic variability that are probably going to directly and significantly impact India's biodiversity. As CO₂ levels and temperatures continue to rise, as well as in extreme conditions like heat and storms, the impact of climate change on biodiversity is predicted to increase in magnitude and prevalence, according to a study by the Intergovernmental Panel on Climatic Change (IPCC), a United Nations Scientific Consortium. Entire ecosystems such as forests and peat lands sequester carbon in their vegetation and soil thus supporting climate-regulating functions worldwide. Frequent occurring of extreme weather conditions such as hurricanes and climate change will have impact on coastal development, water supply, energy, agriculture, and health, among other sectors. Bellard *et al.* (2012) reported that the climate change causes widespread impacts across multiple scales of biodiversity including genes, species, communities, and ecosystems. Climate change is affecting biodiversity in numerous ways and impacts are expected to increase in the century ahead; thus, evaluation of the risks and

exposures of biodiversity is needed to inform decision-making and where and how to most effectively allocate scarce resources. It may result from factors such as changes in solar emission, long-term changes in the earth's orbital elements (eccentricity, obliquity of the ecliptic, the procession of the equinoxes), natural processes, and human forcing on a planet. Though CC is due to alteration in external forcing (natural factors or human activities), future projections consider the influence of only anthropogenic increases in greenhouse gases and other human related factors (Penuelas *et al.*, 2020).

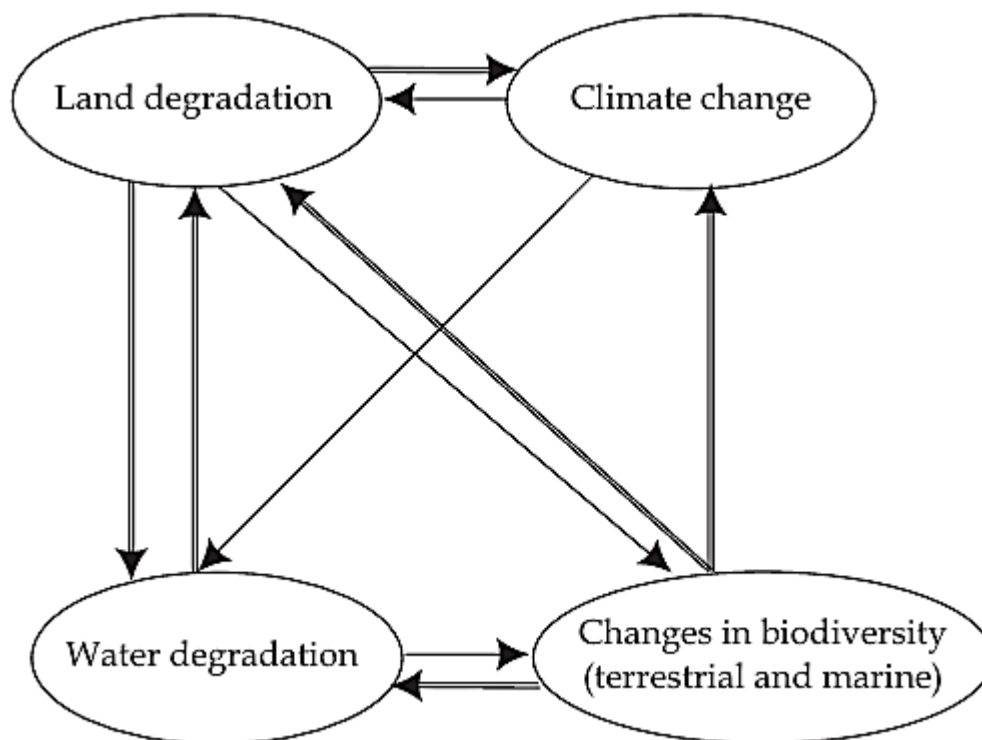
Table 1: physical changes associated with climate change and examples of the potential ecological consequences associated with these changes.

Observed physical change	Examples of potential impacts on biodiversity
Increased ambient temperature	Species and population range shifts and/or changes in phenology leading to alteration or loss of biotic interactions
Changes to hydrologic regimes	Reduced stream flow affecting population persistence and community composition
Changes to fire regimes	Changes in community composition
Ocean acidification	Change in water chemistry affecting calcification rates of marine organisms
Sea level rise	Habitat loss and fragmentation affecting population persistence
Increases in ocean stratification	Reduced productivity of pelagic ecosystems
Changes in coastal upwelling	Changes in productivity of coastal ecosystems and fisheries

INTER-LINKAGES BETWEEN HUMAN INDUCED ENVIRONMENTAL DEGRADATION, CLIMATE CHANGE AND BIODIVERSITY:

The responses for CC arises not only among populations throughout a species range but also between co-occur ring individuals within a population. For instance, there is a significant micro-geographical genetic differentiation of populations of *Triticum dicoccoides* (wild emmer wheat) in response to climate (solar radiation, temperature, and aridity stress) over distances of several meters within a habitat mosaic. A similar pattern has been reported in *Hordeum spontaneum* (wild barley). Biodiversity is determined by the interaction of many factors that differ spatially and temporally for example, by the mean climate and climate variability, by the

availability of resources and overall productivity of a site, the disturbance regime and occurrence of perturbations of cosmic (e.g. meteorites), tectonic, climatic, biological or anthropogenic origin; the original stock of biodiversity and dispersal opportunities or barriers (Huang *et al.*, 2002); spatial heterogeneity of habitats; the intensity and interdependency of biotic interactions such as competition, predation, mutualism and symbiosis; and the intensity and kind of sexual reproduction and genetic recombination. Biodiversity at all levels is not static, as the dynamics of natural evolutionary and ecological processes induces a background rate of change. In short, biodiversity is the result of an interplay of current climate, and hence climate change, their impact on resources needed for biodiversity to survive such as land and water.



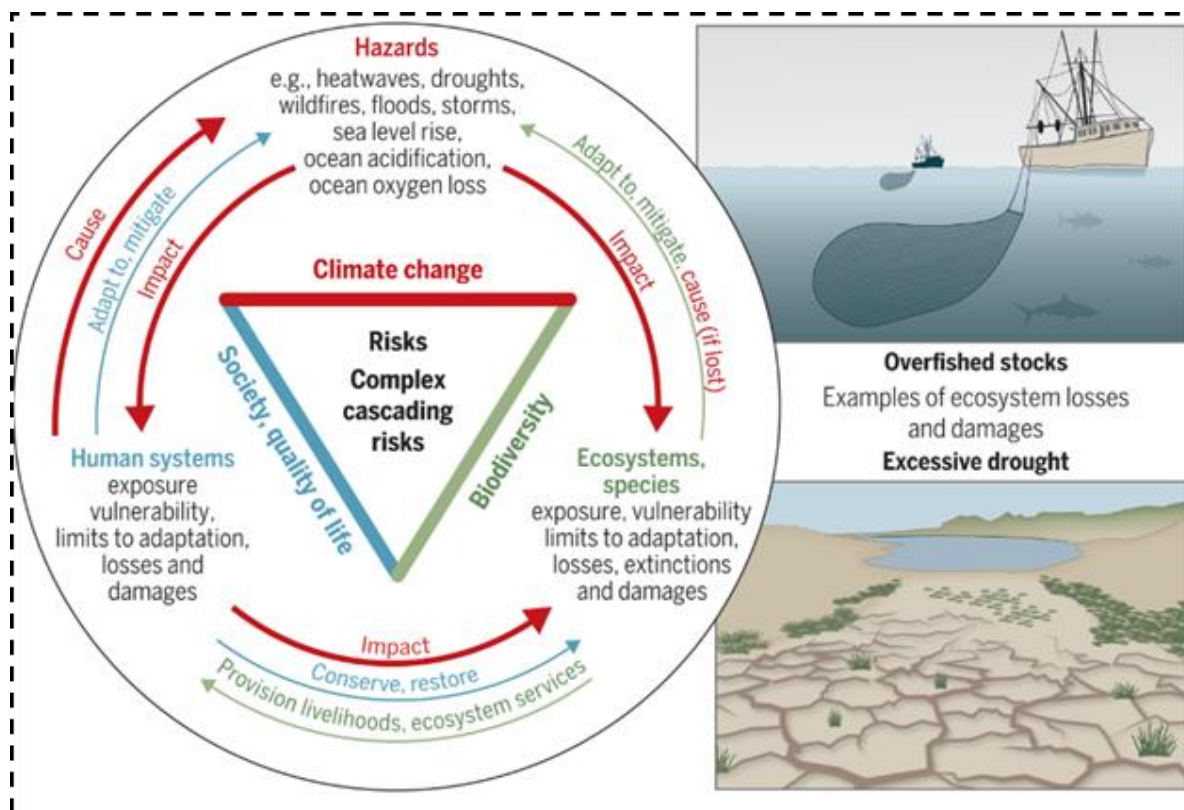
PROJECTED CHANGES IN BIODIVERSITY:

Studies since the IPCC third assessment (IPCC, 2001) have enabled more systematic understanding of the timing and magnitude of impacts related to differing amounts and rates of climate change. Some systems, sectors and regions are likely to be especially affected by climate change. Terrestrial Ecosystems such as tundra, boreal forest and mountain regions will be affected adversely because of sensitivity to warming. Mediterranean-type ecosystems will be affected because of reduction in rainfall. Tropical rainforests will decline because of decline in precipitation. Regions such as the Arctic will be affected due to the high rates of projected warming on natural systems and human communities. Africa, because of low adaptive capacity and projected climate change impacts. Small islands, where

there is high exposure of population and infrastructure to projected sea level rise and warming of the oceans. Asian and African mega deltas, due to large populations and high exposure to sea level rise, storm surges and river flooding.

LAND DEGRADATION, CLIMATE CHANGE AND BIODIVERSITY:

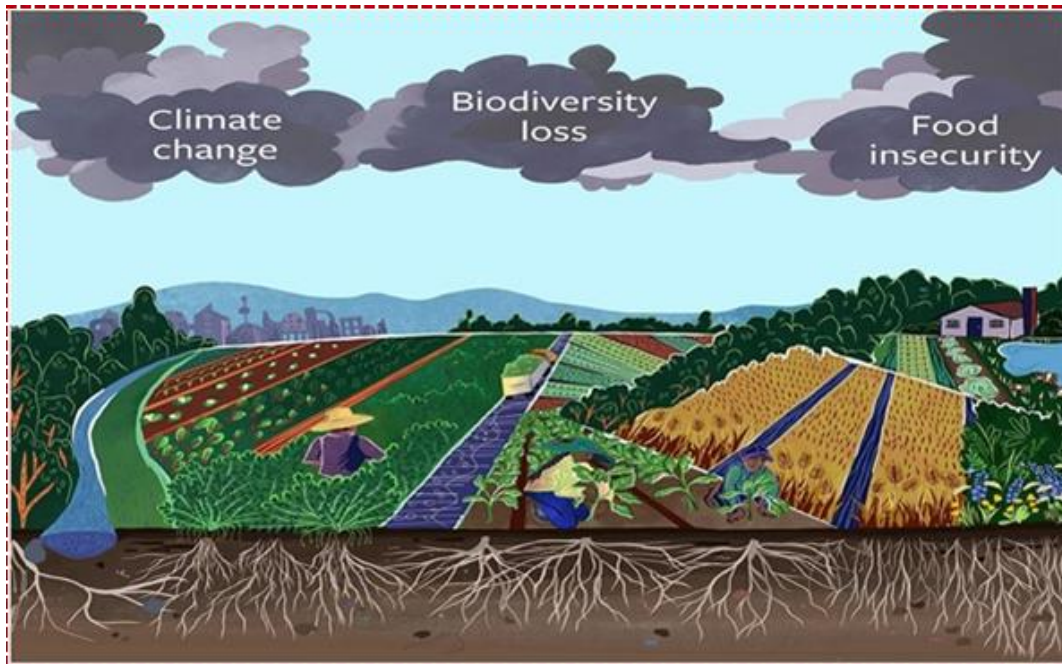
Both directly and indirectly, biodiversity is impacted by land degradation. Earthworms, rhizobia, and mycorrhizae are among the soil biota that can be destroyed by physical and chemical processes of land degradation in terrestrial land systems. Additionally, vegetation cover may be altered or reduced. Land degradation may have an indirect impact on the biodiversity of aquatic and coastal systems, particularly on coral reefs, mangroves, and sea grasses, by altering the flow of sediment. Pollutants like POPs that may be absorbed by soil particles might sometimes make this effect worse.



WATER DEGRADATION, CLIMATE CHANGE, AND BIODIVERSITY:

Water resource management techniques, such as rerouting inflows and withdrawing water, have an impact on watershed production and biodiversity, particularly in agricultural areas. By altering the biological conditions—such as flow regimes and turbidity under which species have evolved, water degradation (pollution, siltation, canalization, and water abstraction) has a negative impact on biodiversity. In marine and coastal waterways, for example, water degradation frequently creates an environment that is more favorable for invading aquatic

species that are aggressive or tolerant, which then compete with or prey on native species. Fisheries and biodiversity are negatively impacted by the eutrophication of water bodies, including freshwater and coastal rivers, lakes, reservoirs, and coastal and inland seas. Climate change can intensify the global hydrological cycle and can have major impacts on regional water resources, affecting both the surface and groundwater supply for domestic and industrial uses, irrigation, hydropower generation, navigation, in-stream ecosystems and water-based recreation.



CHALLENGES AND OPTIONS OF FEEDING THE FUTURE IN A CHANGING CLIMATE AND BIODIVERSITY LOSS:

Could global food security goals of the future be met in the face of CC and biodiversity loss is a big concern of twenty-first century ? Consequently, achieving food security and conserving biodiversity is among the most critical challenges of our time. Currently > 1 billion people are hungry and > 2 billion are malnourished globally. Furthermore, the world's population is expected to grow to nine billion by the year 2050 (Perrings *et al.*, 2006). Thus there is a need for 70–100% more food. Furthermore, developing countries will account for 93% and 85% of cereal and meat demand growth to 2050. Likewise, more than 30 million people in African currently lack access to safe water and adequate food. Therefore, global food security will remain a worldwide concern for the coming years. Furthermore, flooding and desertification lead to loss of agricultural lands and biodiversity, poisoning of water supplies, and destruction of economic infrastructures thereby preventing buying and selling foods on the markets. This will, in turn, resulted a decline in irrigation, rural infra structure, and increasing water scarcity (Meybeck *et al.*, 2018). Moreover, the conventional model to achieve food security has been to convert wildlands to

intensive commercial agri cultural use leading to the increased homogenization of natural landscapes. An immediate result of this model has been a drastic loss of wildlands, biodiversity, and ecosystem services. In the face of biotic challenges and global environmental change, crop growth and yield have also slowed. As a result, impoverished people are more reliant on climate-sensitive resources like food and water supplies and have fewer adaptive capacities. Exploiting new fish supplies and expanding agricultural area have historically been the main ways to address food shortages. However, when biodiversity and natural ecosystems are prioritized, this is becoming an increasingly implausible and expensive solution due to land scarcity and competition for land from other human activities.

ADAPTATION TO CLIMATE CHANGE: THE PATH AHEAD:

Ecosystems have historically adjusted to shifting environments, but the rates of change that are happening now are unprecedented. The impact on ecosystems and humans will increase with the rate of climate change. These pressures can be reduced by lowering greenhouse gas emissions, which will provide these systems more time to adjust. Plans for climate change adaptation are necessary, nevertheless, because in addition to the effects of climate change, land- and water-degradation-causing activities (such deforestation and overgrazing) can make them worse. The conventional adaptation strategies to counteract the effects of environmental deterioration on biodiversity have included conservation, preservation, and the establishment of buffer zones. To counteract the effects of climate change, such as shifting plant distribution, rising extinction rates, altered reproductive schedules, and shortened growing seasons, more measures would be necessary. Considering the connections between biodiversity and climate change, it is necessary to:

- Maintaining and restoring native ecosystems.
- Protecting and enhancing ecosystem services.
- Identify and conserve biodiversity components that are especially sensitive to climate change.
- Preserve intact habitats so as to facilitate the long-term adaptation of biodiversity.
- Fully integrate biodiversity considerations into climate change mitigation and adaptation plans.
- Establishing networks of terrestrial, freshwater and marine protected areas that take into account projected changes in climate.
- Creating refuges and buffer zones.

CONCLUSION:

The most important environmental problem facing the entire world today is climate change. It poses a challenge as well as a threat. The main economic sectors and sustainable development are probably going to suffer from the anticipated climate changes. There is a noticeable human influence on the climate system, according to a number of scientific evaluations and special studies released by the Intergovernmental Panel on Climate Change (IPCC). It is anticipated that emerging nations would be more severely affected by climate change in all areas. One such area that is probably going to be negatively affected is biodiversity. Water resources, agriculture, natural ecosystems including forestry, health, and the industrial sectors are just a few of the important sectors that could be impacted by changes to India's current climate system.

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