

Impact of Climate Change on Biodiversity in India: Review

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ABSTRACT

The dynamic nature of biodiversity is subject to the influence of a fluctuating climate. Biological interactions are subject to reorganisation due to varying speeds of changing conditions across different regions of the world. Climate change and the resulting loss of biodiversity pose a significant threat to the survival of humanity. The biodiversity in India, which is distinct and unparalleled, has been facing a significant threat from climate change. This phenomenon has been exacerbated by various anthropogenic activities that have resulted in multiple sources of pollution. Climate change poses a significant threat to biodiversity as it exerts pressure on genetic resources, species, and populations.

The role of biodiversity in climate regulation is significant. Human activities have had a significant impact on the Earth's climate in recent decades. The preservation and rehabilitation of a robust ecosystem is crucial in both adapting to and reducing the impact of climate change. This can be achieved through the conservation of biodiversity, sustainable land management practises, and the promotion of sustainable resource utilisation. Such efforts can yield a variety of positive outcomes, including environmental, economic, and social benefits.

The present article examines the significance of biodiversity and the repercussions that climate change poses to the flora, fauna, humans, and ecosystem. Additionally, the article explores potential measures or strategies that could be implemented to safeguard biodiversity, thereby mitigating the adverse effects of climate change on the planet.

Keywords: Biodiversity, Climate change, Conservation, Ecosystem, Anthropogenic, Species.

I. INTRODUCTION

Climate change is the term used to describe the enduring alterations in temperature and weather patterns. These oscillations could be triggered by substantial volcanic eruptions or fluctuations in solar activity. Since the 19th century, anthropogenic activities, predominantly the combustion of non-renewable energy sources such as coal, oil, and gas, have been the principal driver of global climate change. The process of burning fossil fuels results in the release of greenhouse gases, which act as a thermal insulator around the Earth, leading to the retention of solar heat and consequent rise in temperatures.

The overexploitation of natural resources is contributing to this issue and altering weather patterns. The escalation in the concentration of greenhouse gases and deforestation has resulted in the phenomenon of global warming, which causes disturbances in weather patterns, wind movements, and the upper circulation of the atmosphere (Pandey, 2007).

Thomas (2007) has identified several significant examples of climate change in India, including the reduction of glacier size, diminished water flow in perennial rivers, inadequate rainfall during the monsoon season, sporadic heavy rainfall in coastal regions, and a lengthening of the summer season accompanied by a decrease in winter duration.

Climate change is primarily caused by the greenhouse gases carbon dioxide and methane. These emissions are generated, for example, through the combustion of coal or petrol for the purpose of building heating. The process of clearing land and woods may result in the emission of carbon dioxide. The primary contributors to methane emissions are the industries of oil and gas production as well as agriculture.

The mean global temperature has experienced an increase of approximately 1 degree Celsius since the pre-industrial era. The observed magnitude and rate of warming cannot be solely attributed to natural variations and require consideration of anthropogenic influences. The atmospheric composition has been significantly altered during the industrial period due to the release of greenhouse gases (GHGs), aerosols, and changes in land use and land cover (LULC). since the 1950s has resulted in a noteworthy escalation of weather and climate extremes on a global scale.

BIODIVERSITY

Biodiversity encompasses the complete range of life forms present on Earth, encompassing variations within species, between species, and across ecosystems. The concept of biodiversity is commonly employed in reference to the preservation of the natural environment. As per the definition provided by UNCED (United Nations Conference on the Environmental and Development). This encompasses the diversity within species, between species, and of ecosystems. Biodiversity can be defined as the aggregate of species richness, encompassing the quantity of plant, animal, and microorganism species present within a designated region, country, continent, or the entirety of the planet. Biodiversity encompasses various forms of diversity, namely genetic diversity which pertains to the diversity of genes within a particular species, species diversity which pertains to the diversity among different species, ecosystem diversity which pertains to the diversity at the level of community or ecosystem, and habitat diversity. According to Verma (2017a), genetic diversity serves as a protective mechanism for maintaining biodiversity.

The preservation of biodiversity is fundamental to the sustenance of human life and the advancement of economic progress. It assists in the preservation of the ecological equilibrium. The maintenance of ecological equilibrium is imperative for the promotion of extensive biodiversity, as stated by Verma A.K. in 2017b. Biodiversity encompasses nonmaterial benefits. It is imperative that individuals comprehend the various levels and values of biodiversity (Verma A.K. (2018a)) for the greater good of the global community. According to Sharma et al. (2011), it serves as a wellspring of creative motivation for artists across various disciplines such as music, painting, and writing.

BIODIVERSITY OF INDIA

India possesses unique characteristics in terms of physiography, landscape, climatic conditions, and biodiversity. The country exhibits diverse climatic conditions owing to notable variations in temperature and precipitation across different regions and seasons. The Great Indian Desert experiences temperatures that can attain a maximum of 55°C, whereas the Leh region of Jammu and Kashmir can observe a minimum of -45°C during the winter season. Mausinram, Meghalaya, India boasts the highest average annual rainfall globally, measuring at 11,873 mm. In contrast, Jassalmer, Rajasthan, experiences a mere 10 to 25 mm of precipitation. The nation's heterogeneous climatic conditions facilitate an extensive range of biological resources to thrive in their indigenous surroundings. The subcontinent harbours a diverse range of flora and fauna owing to its favourable climatic conditions.

India is classified as one of the twelve mega biodiversity countries globally and is partitioned into ten distinct biogeographic regions. As a result, it exhibits distinctive features from each of these realms. The amalgamation of three discrete domains renders the nation affluent and unparalleled in terms of its biological variety. The region exhibits a significant abundance of biological diversity within its forested, wetland, and marine ecosystems.

India's biodiversity is currently facing significant threats. The primary factors contributing to the endangerment of biodiversity include habitat destruction, the introduction of invasive species, pollution, population growth, and the overexploitation of natural resources. Another significant factor contributing to the decline of biodiversity is the widespread practise of poaching. Despite the implementation of rigorous legislation by the government with respect to poaching, and the enactment of the Wildlife Protection Act (1972) which guarantees the safeguarding of wildlife, there remains a need for continued efforts to preserve and protect these valuable resources. Despite the government's significant investment in animal conservation, poaching remains a persistent concern for biodiversity. Although there have been numerous arrests made in recent years in response to poaching-related issues, the effective implementation of laws to combat poaching remains a challenge. The depletion of regional biodiversity is also a consequence of excessive forest harvesting.

IMPACT OF CLIMATE CHANGE ON BIODIVERSITY

This study examines the various potential impacts of climate change across multiple levels of ecological organisation, including individual, population, species, community, ecosystem, and biome scales. Notably, it is observed that species may adapt to the challenges posed by climate change by adjusting their climatic niche along three distinct but interrelated axes: temporal (e.g. phenology), spatial (e.g. range), and physiological (e.g. self). The phenomenon of climate change has resulted in phonological alterations in the flowering plants and insect pollinators. This has resulted in incongruities between the populations of the plants and pollinators, leading to the extension of both entities.

The available literature provides evidence indicating that climate change is currently occurring and has a significant impact on biodiversity. This impact compels species to adapt through various means such as migration, alteration of phenological cycles, or development of new physiological traits (Lohmann et al., 2012). According to the findings of the Millennium Ecosystem Assessment (MEA 2005), it is probable that climate change will emerge as one of the foremost factors contributing to the depletion of biodiversity by the conclusion of the current century. The phenomenon of climate change is causing significant harm to various flora and fauna

in India, as evidenced by studies conducted by Telwala et al. (2013) and Ray et al. (2014). The preservation and rehabilitation of robust ecosystems are crucial in the efforts to adapt to and alleviate the effects of climate change. This is achieved through the conservation of biodiversity, sustainable land management practises, and sustainable resource utilisation. These measures result in numerous advantages for the environment, economy, and society. The augmentation of biodiversity loss, which is already in progress due to various human stressors, is being further jeopardised by the human-induced accelerated climate change, in addition to the natural variability. Consequently, there exists a pressing necessity to amass and distribute information in order to aid in the formulation of a comprehensive strategy for both mitigating and adapting to climate change.

In accordance with the principles of jurisprudence, modifications are inevitable within the legal framework in the event that any constituent element of the system undergoes alteration through any mechanism. The alteration of climatic conditions and the consequent reduction in biodiversity pose a significant threat to the survival of the human species. The global phenomenon of biodiversity loss presents a significant risk to the anthropological system. An analysis of present trends and future projections indicates that this decline is expected to persist in the foreseeable future. India boasts a vast array of biodiversity, which has been subject to significant threats in recent decades. These threats have been exacerbated by climate change, which has been accelerated by anthropogenic activities stemming from various sources of pollution. The issue of climate change has emerged as the foremost environmental concern of the current decade.

The organisms within the plant and animal kingdoms exhibit sensitivity to variations in temperature and climatic conditions. The presence of organic evolution is suggestive of a correlation between swift climate fluctuations and a widespread extinction event of flora and fauna. The occurrence of swift alterations in climate may result in heightened prevalence of illnesses, landslides, and forest fires, ultimately leading to the destruction of flora and fauna. All living beings have evolved to suit specific climatic conditions.

The alteration in climatic conditions poses a threat to the survival of numerous species of flora and fauna, potentially leading to their extinction. While not all species are directly impacted by alterations in environmental conditions, they can still be indirectly affected through their interactions with other species. The assessment of plants' response to climate change necessitates equal consideration of indirect impacts. Climate change can cause a shift in the distribution of a particular species, leading to its potential invasion into the range of another species. This may result in the establishment of a novel competitive relationship between the two species. It is probable that climate change will have an impact on both the minimum and maximum temperatures, leading to an increase in the occurrence of severe rainfall events and storms. Projections indicate that the Indian sub-continent will experience reduced levels of precipitation during winter and heightened levels during the summer monsoon. Specifically, it has been estimated that winter precipitation will decrease by 10-20% and summer precipitation will decrease by 30% by the year 2050.

According to Kumar Ajay et al. (2017), the ecological impact of biodiversity loss is significant and primarily attributed to environmental changes. The function and distribution of organisms are significantly influenced by environmental conditions, in conjunction with other factors. The effects of environmental changes on biodiversity patterns have been significant in the past and are expected to continue as a major driving force in shaping biodiversity patterns in the future. The study of environmental changes encompasses alterations in climate, as well as those resulting from overpopulation, overexploitation of natural resources, and deforestation.

Considerable emphasis is appropriately placed on mitigating carbon emissions and greenhouse gases originating from the industrial, energy, and transportation sectors. This is achieved through the curtailment of fuel consumption and the utilisation of renewable and sustainable energy sources. The safeguarding of natural habitats is a crucial element of climate change strategies, as nations seek to implement measures for both mitigation and adaptation. Enhanced backing for safeguarded regions and increased implementation of sustainable resource management techniques can serve as viable approaches towards safeguarding biological resources and ecosystems.

The phenomenon of climate change is emerging as a significant peril to biodiversity, amplifying the stress on genetic resources, species, and populations.

Currently, the Earth's surface has experienced an increase in temperature of approximately 1.1°C compared to the late 1800s, a period preceding the industrial revolution. This warming trend surpasses any temperature recorded in the past 100,000 years. The decade spanning from 2011 to 2020 has been documented as the warmest on record. Furthermore, each of the four preceding decades has exhibited higher temperatures than any decade prior to 1850.

The prevailing belief among a significant portion of the population is that climate change is primarily characterised by an increase in temperature. However, the increase in temperature represents merely the initial phase of the narrative. Due to the interconnectedness of the Earth's system, alterations in one domain can have an impact on modifications in all other domains.

The ramifications of climate change encompass a range of issues, including but not limited to, heightened occurrences of prolonged droughts, limited access to water resources, heightened risk of wildfires, escalating sea levels, inundation, thawing of polar ice caps, severe storms, and a reduction in biodiversity.

In order to preserve and safeguard the equilibrium of an ecosystem, it is imperative to comprehend the interplay among the flora, fauna, and biodiversity. This can be achieved by identifying the hotspots and designating them as biosphere reserves, as well as implementing afforestation, reforestation, and agro forestry practises. The implementation of strategies that are based on biodiversity for adaptation and mitigation purposes has the potential to bolster the resilience of ecosystems and avert harm to both human and natural ecosystem.

II. CONCLUSION

Climate change has emerged as the foremost environmental concern of the current decade. To mitigate carbon and greenhouse gas emissions from energy, industrial, and transportation sources, it is recommended to decrease fuel consumption and improve the efficiency of technologies. Additionally, increasing public awareness of the environment and promoting the importance of biodiversity and climate change can also aid in reducing emissions. By means of executing environmentally sustainable policies and incorporating biodiversity and climate change into national plans and programmes, there is a drive to encourage suitable and effective coordination among activities in India that are associated with biodiversity and climate change. The formulation of regulations and policies pertaining to biodiversity and climate change is imperative to mitigate the vulnerability of local communities to its impacts and enhance their capacity to adapt to such changes.

Enhancing our comprehension of the impacts of climate change on biodiversity, devising strategies to alleviate these impacts, and curtailing human activities are imperative in order to restrict the extent of harm caused. Achieving inclusive and sustainable development is a formidable challenge without the preservation of biodiversity and the reduction of anthropogenic activities. There is an increasing awareness among policymakers that biodiversity is not a discretionary add-on in human affairs, but rather the fundamental basis of our existence. In addition, it is imperative to implement biodiversity conservation strategies that are adaptable to the dynamic nature of climate conditions. This approach is crucial not only in facilitating the adjustment of species and habitats to changing environments but also in potentially reducing the impact of climate change. In the realm of agriculture, there exists a necessity for farming systems that are resilient to climate variability and change. It is imperative to disseminate climate literacy and establish a group of Community Climate Risk Managers within rural communities. The adverse effects of climate change can be transformed into a prospect for the advancement and dissemination of farming techniques and systems that are resilient to climate variability.

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