



Conservation Of Biodiversity And Sustainable Development Are Crucial For Addressing Desertification And Climate Change

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Abstract

Sustainable development and biodiversity conservation are two intertwined fields that prioritize ecosystem preservation, social advancement, economic expansion, and environmental preservation. The most pressing environmental, socio-economic, and political problem of our time is climate change, which is also one of the main drivers of desertification. Desertification is mostly caused by changes in the climate and human activity like overuse, improper farming methods, deforestation, rapid population increase, and unauthorized access to land and rights. One of the global environmental problems, desertification is the ongoing deterioration of arid landscapes, leading to a decrease in biological productivity. This, in turn, causes a decline in plant biomass, a reduction in land productivity for livestock, crop yields, and societal welfare. However, the effects of desertification brought on by human activity and global warming present difficult problems for the ecosystem today. Because of the extreme variations in temperature and precipitation, ecosystem services in arid regions are particularly susceptible to the effects of global warming. Climate change adaptation and mitigation are two potential strategies identified to address the effects of global warming or desertification. It involves breeding crops, using irrigation techniques to cool the environment, trading plants for carbon, and utilizing carbon capture and storage technology. Therefore, biodiversity conservation and global climate change reduction are linked to ecosystem management strategies aimed at halting desertification. Therefore, the population of the drylands may benefit from greater co-operation and efficacy that arises from the combined implementation of significant environmental accords.

Key words: Climate change (CC), Desertification, Ecosystem, Biodiversity.

Introduction

Sustainable development and biodiversity conservation are two interconnected fields that prioritize ecosystem preservation, social advancement, economic expansion, and environmental preservation. The greatest environmental, socio-economic and political threat of our day is climate change, which is also one of the main factors contributing to desertification. The loss of biodiversity in our ecosystem is a result of climate change brought on by the release of greenhouse gases into the atmosphere. One of the biggest threats to conservation in the ensuing decades is climate change. There will be new challenges faced by many species when temperatures rise and ecosystems change, including habitat loss, altered food sources, and increased competition. The development of climate-resilient habitats and assisted migration are two examples of the creative tactics that conservationists will need to employ to help species adjust to these changes. For conservationists, the challenge of climate change also offers a chance to address the underlying causes of environmental change by tackling more general societal issues like energy policy and land use planning.

Climate change (CC), or a change in weather patterns, is mostly caused by greenhouse gas emissions (GGE) from industry and natural systems. Global warming is mostly caused by GGE, which causes the earth's temperature to rise. Human activity is currently causing global warming that is about 1.0°C warmer than pre-industrial levels; if current emissions continue, this is predicted to increase to 1.5°C between 2030 and 2051 (Fawzy S et al.,2020). Since the Earth's atmosphere has warmed by 0.740°C, global warming is now the most serious issue facing humanity. The atmospheric CO₂ concentration increased to 385 parts per million, which is much more than it has ever been, causing global warming (Solomon S et al. 2009).

One of the main causes of the swiftly deteriorating natural environment is climate change (IPBES 2019b). Climate change impacts species in a number of ways, including direct physiological stress, the loss of suitable habitat, and altered migration and reproductive patterns. According to WWF (2020), up to a fifth of wild species could become extinct this century alone as a result of climate change, and the ranges of over half of land-based animals and nearly a quarter of vulnerable bird species may already have been seriously altered (IPBES 2019b).

Climate change is anticipated to contribute more to biodiversity loss in the next decades, compounding the impact of other influences on ecosystems and human well-being. A 1.5°C to 2°C global warming is predicted to significantly reduce the ranges of the majority of terrestrial species. Coral reefs are extremely vulnerable to climate change; it is predicted that they will lose just 10% to 30% of their previous cover at 1.5°C warming and less than 1% at 2°C warming (IPBES 2019a). Thus, for conserving biodiversity against climatic change effects, essential to implement effective climate-smart agriculture including early warning systems, and sustainable water management techniques restoring riparian forests

and planting new trees along water basins that are at risk can enhance groundwater supplies, preserve biodiversity, and improve water quality (IPCC 2022). Other studies reported that the generation of hay and fodder stockpiles as well as pasture rotation systems have helped Mongolia recover more than 3,220 hectares of degraded land. Creating plans that take into consideration the risks and effects of climate change can aid in community adaptation and resilience building strategies.

The consequence of Biodiversity loss

Numerous studies reported that the loss of biodiversity is an urgent worldwide concern that is mostly caused by human activities like habitat destruction, resource overuse, pollution, climate change, ecosystem degradation, loss of ecosystem services, and social inequality of land (G. Roberts 2022; Dinerstein et al. 2024). Without specialized tools, it is practically impossible to grow important crops in a degraded environment brought on by desertification. However, these are reasonably priced. Pollution, climate change, and biodiversity loss are the three primary reasons behind the current extraordinary environmental catastrophe in the world (UNEP 2021a). The IUCN World Congress made a forceful call to halt the degradation of nature, and the fifteenth meeting of the Conference of the Parties (COP-15) of the Convention on Biological Diversity (CBD) will explore new global biodiversity targets. Currently, biodiversity is declining more quickly than it has ever done in human history, and we are using ecosystem services at a rate that is more than 1.6 times faster than what nature can provide sustainably (UNEP 2021b).

According to WWF (2020), there have been twice as many verified plant extinctions as there have been mammals, birds, and amphibians combined, and more than 25% of the species listed on the IUCN Red List are in danger of going extinct. Our present level of biodiversity is the consequence of both the gradual impact of human activity and thousands of years of natural processes (Pievani, T. et al. 2014). Nonetheless, Pimm S Let al. (2018) reported that biodiversity is vanishing and diminishing in some regions of the world at a surprising rate. According to (Singh RL et al. 2017) global warming, invasive species, pollution, unsustainable resource management and exploitation, and changes in land use all of which are generally associated with an increasing population are the primary causes of biodiversity loss.

Desertification is a challenge for conservation of Biodiversity

According to recent studies reports the conservation of biodiversity is seriously threatened by desertification, which has an impact on ecosystems, animals, and human livelihoods everywhere. In response to desertification, there are a number of major challenges, such as habitat degradation brought on by soil erosion, decreased vegetation cover, and biodiversity loss; climate change, which raises temperatures and modifies precipitation patterns; and, lastly, human activities like overgrazing, deforestation, and unsustainable land-use practices (Smith, J. E., & Pettorelli, N. 2020). Similarly, the genetic deterioration of the flora, fauna, and microbes that comprise the living elements of arid regions is referred to as desertification.

Additionally, desertification has probably led to the extinction of the majority of plants, animals, and soil microorganisms that have evolved to favourable conditions. Several research studies reported that a slight effect on biodiversity and desertification creates dry, unproductive land that is unsuitable for crops or other agricultural outputs. In certain parts of Africa and the entire world, sustainable development is seriously threatened and challenged. It is evident that there is a serious decline in forests, wildlife ecosystems, and overall biodiversity.

One of the global environmental problems, desertification is the ongoing deterioration of arid landscapes, leading to a decrease in biological productivity. This, in turn, causes a decline in plant biomass, a reduction in land productivity for livestock, crop yields, and societal welfare. Social, political, and climatic variables contribute to an unsustainable consumption of natural resources. Desertification brought on by global warming frequently poses a serious threat to the vegetation found in ecosystems. Desertification is the term for the degradation of land in arid conditions, which leads to a reduction in vegetation cover or the replacement of one type of plant with another, less productive species, and deterioration of ecosystems. The effects of desertification brought on by human activity and global warming, however, present difficult problems for the environment today.

Dorj O.et al. (2013) reported that desertification is caused by artificial and natural factors. The areas are particularly vulnerable to human activity due to the drying, arid conditions brought on by drought, rain patterns, rising temperatures, and global warming. Ten to twenty percent of dry lands are already badly degraded, and according to some statistics, human activity is to blame for 70 percent of land degradation. This is mainly because of population growth, agricultural advances, and unreliable management. By affecting arid regions and producing response effects that lead to biodiversity loss and other negative consequences for humanity, a variety of human activities and natural systems contribute to desertification.

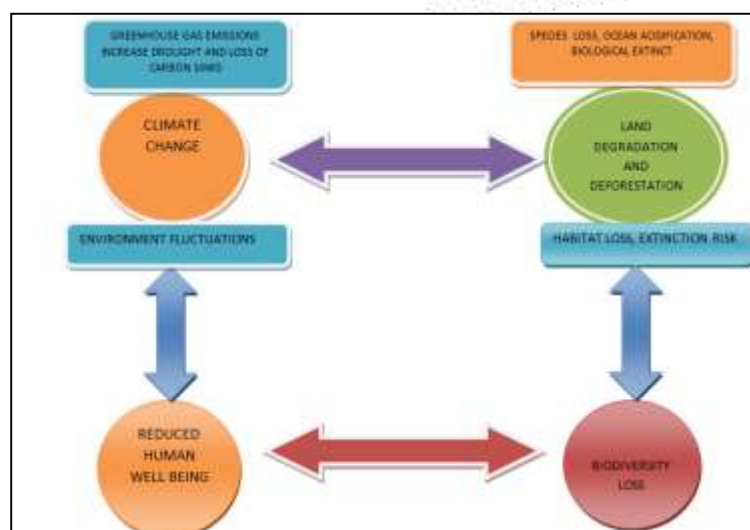


Fig: Interactions between biodiversity, climate change and land use source and Biodiversity loss

Impacts of desertification on ecosystems

The main reason for anthropogenic activities are held responsible for desertification is that they are invariably closely associated with increased amounts of CO₂, methane, laughing gas, and other greenhouse gas emissions. These resulted in the highest layers of the Earth's atmosphere holding onto the radiation-induced warmth. These dangers have the potential to exacerbate several wildlife-related risks that already exist, including diseases, invasive species, and habitat loss and fragmentation. They are often linked with one another. The impacts of global warming can affect ecosystem services in arid locations. Sea levels are rising, extreme weather events are becoming more intense, and global warming is mostly caused by anthropogenic greenhouse gas emissions. Climate change directly leads to biodiversity loss through phenological changes, habitat disruption, and species being driven to migrate, adapt, or face extinction (IPCC, 2022). Conversely, healthy ecosystems particularly forests, wetlands, and oceans are essential carbon sinks and offer powerful natural solutions for climate change adaptation and mitigation (Seddon et al., 2020).

According to UNCCD (1994), this is the continuous degradation of land in arid, semi-arid, and dry sub-humid regions, primarily due to human activities (like deforestation and unsustainable farming practices) and climate changes (like prolonged droughts). Desertification reduces land production, which raises vulnerability, leads to water scarcity and food insecurity, and often leads to population displacement. Furthermore, it releases carbon held in vegetation and soils, contributing to climate change (Nachtergaele et al., 2011).

Desertification directly contributes to habitat fragmentation and degradation, which leads to a significant reduction in the number and diversity of plant and animal species. When fertile land becomes barren, species that have evolved to exist in those specific ecosystems struggle to survive, leading to population declines and potentially extinctions (IPBES, 2019a). This includes the loss of beneficial soil bacteria and pollinators, which are essential for ecosystem health and agricultural output (Drishti IAS, 2025). Desertification releases stored carbon from soils and vegetation, contributing to climate change, when plants and trees that would normally absorb carbon disappear. A positive feedback loop that reduces the Earth's capacity to absorb carbon dioxide from the atmosphere exacerbates global warming (DGB Group, 2023).

Several findings reported that the dramatic decline in agricultural productivity is desertification's most obvious impact on human well-being. The loss of arable land, reduced water availability, and increased soil erosion make it difficult or impossible for farmers to raise livestock and grow crops, which leads to crop failures and lower yields. Global food security is directly threatened, and severe famine and starvation may ensue, particularly in regions that are already at risk. Rising temperatures, altered precipitation patterns (resulting in more frequent and severe droughts or unpredictable rainfall), and increased evapotranspiration are the main ways that climate change accelerates the processes of land

degradation and desertification in arid regions (IPCC, 2019; Le Houérou, et al.,1996). Existing drylands become dryer as temperatures rise, while semi-arid areas become more arid and lose their vegetation cover.

Studies reported that degraded land has less capacity to absorb and store carbon. As vegetation is destroyed and soil organic matter declines, stored carbon is released into the atmosphere as carbon dioxide, contributing to further global warming (IPCC, 2019; DGB Group, 2023). Moreover, desertification may increase the albedo, or reflection, of the land surface, which may have complex effects on regional climate patterns (IPCC, 2019). There is a chance that the increased dust storms from degraded land will decrease rainfall and produce a positive feedback loop that further lowers precipitation and promotes desertification, according to Rosenfeld et al., (2001). Due to the substantial habitat loss and fragmentation brought on by the combined effects of desertification and climate change, many species are in danger of going extinct.

One of the most pressing issues in ecology is estimating how species will react to climate change. Traditional models of species distribution may not accurately capture the complexity of ecological connections and often rely on a limited number of environmental parameters. Using ecological niche modeling (ENMs), this method forecasts the possible distribution of species under both present and future climate conditions (Tiamiyu et al. 2021). The findings demonstrated that many species are expected to experience significant range shifts, with some species estimated to lose up to 90% of their current habitat. These results suggest that conservation actions are necessary to protect species that are threatened by climate change.

According to World Economic Forum - Global Risks Report 2024, climate change is one of the most significant environmental problems of our time because of the significant consequences it has on ecosystems and species. As temperatures rise, precipitation patterns shift, and extreme weather events increase, species must adjust to new climate conditions. These changes are creating rapid evolutionary reactions because organisms with traits better adapted to the new environment have a higher chance of surviving and reproducing. In reaction to climate change, many species are rapidly altering their morphology, physiology, behaviour, and phenology. These changes are often the result of natural selection, as people with traits that provide them with a survival advantage in the changing climate are more likely to pass those traits on to their progeny.

Emerging Strategies in Biodiversity Conservation

Several recent findings reported that new approaches to biodiversity protection concentrate on tackling the intricate problems brought about by habitat loss, climate change, and human activity. Researchers aim to preserve at least 30% of the world's lands, oceans, and inland waters by 2030, highlighting the significance of preserving regions that are home to priceless species Eric Dinerstein et al. (2024).

Conservation planning and management can be informed by the use of automated habitat monitoring systems and remote sensing technology, resulting in more effective and efficient conservation initiatives. Conservation planning and management can be informed by the use of automated habitat monitoring systems and remote sensing technology, resulting in more effective and efficient conservation initiatives Jennifer L. Bufford et al. (2024). Conservation tactics are evolving in response to the growing challenges to biodiversity in the twenty-first century. Emerging biodiversity conservation strategies include ecosystem-based management, community-based conservation, and the use of protected areas. While trying to protect biodiversity, these tactics also consider the needs and welfare of everyone in the area.

The conservation of biodiversity and ecosystem management are evolving to address the complex issues resulting from human activity and environmental change. Rewilding, ecological restoration, community-based conservation, and protected areas are promising strategies for maintaining ecosystem services and biodiversity. However, addressing the underlying factors that contribute to biodiversity loss, such as habitat loss and climate change, and ensuring that conservation efforts are equitable and long-lasting, are critical to the success of these strategies. For conservation biology, Evo-Devo has important implications for managing genetic diversity and safeguarding endangered species. Conservation strategies, including as habitat restoration and captive breeding programs, can be guided by an understanding of the genetic and developmental processes that underpin a species traits.

According to (Climate Change 2023 Synthesis Report) climate change adaptation and mitigation are two potential strategies identified to address the effects of desertification or global climate change. It involves growing crops, using irrigation techniques to cool the atmosphere, and trading plants for carbon. It also involves the use of carbon capture and storage technology. Therefore, climate change mitigation, biodiversity protection, and ecosystem management strategies aimed at halting desertification are all connected. Thus, enhanced cooperation and efficacy that benefits the dryland population might arise from the coordinated implementation of key environmental agreements.

Certain interventions can be utilized to revive dryland ecosystems and build conservation strata (Durant SM, et al., 2015; Morales-Márquez J et al., 2022). Reactive methods are an intervention used to restore desertified areas. It is made up of the following: i) To prevent monocultures, diversify the production of crops and animals ii) Incorporate organic matter into the soil iii) Establishing new trees iv) Reintroduce specific species and manage invasive ones v) Preserve the plantation areas by erecting terraces, barriers or fences composed of native plant species, cultivating hedges, planting vegetation whose roots maintain and protect the soil, and preventing livestock from grazing vi) Utilizing plant and animal species that have adapted to the changing climate vii) plantation activity.

Conclusion

Desertification and climate change are undoubtedly external shocks brought on by human activity and natural systems. It is a significant issue that our planet is facing, since the industrial revolution. Due to human activity, Greenhouse gas emission production has accelerated the march of desertification or global warming and made in non-ecofriendly manner. The world's populations are at risk from the continuous desertification of dryland ecosystems, which affects their livelihoods. One of the global environmental issues affecting many people is desertification, which is the ongoing deterioration of arid landscapes. Additionally, there is still a significant knowledge and monitoring gap regarding desertification processes, which hinders the implementation of cost-effective measures in impacted areas. Therefore, biodiversity conservation and global climate change reduction are associated to ecosystem management strategies aimed at reducing desertification. Therefore, the population of the drylands may benefit from greater cooperation and efficacy that arises from the combined implementation of significant environmental accords.

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