

Assessing The Efficacy of Modern Biodiversity Conservation Approaches: Advancements and Challenges

S. Sadhana^{1,*}

Abstract

This study aims to offer valuable insights by investigating the advancements and challenges inherent in these strategies. Its objective is to assess whether these contemporary approaches have truly contributed to enhancing biodiversity conservation and fostering the sustainable utilization of resources, as compared to conventional historical practices. This study focuses on the different approaches of conservation and advancements, challenges and comparative analysis of biodiversity conservation. The goal of the biodiversity project is to thoroughly investigate and record the diverse range of life that exists in a particular ecosystem or geographic area. It includes an interdisciplinary approach in which local people, scientists, researchers, and conservationists work together to evaluate and classify the diversity of species, habitats, and ecosystems. The project aims to identify and catalog a variety of flora, animal, and microbial life forms, including those that are endangered or vital to the health of an ecosystem, through field surveys, data gathering, and analysis. The research may also look into ecological connections, processes, and environmental elements that affect the dynamics of biodiversity. The ultimate objective is to produce insightful knowledge about the complex web of life, guide conservation initiatives, and advance sustainable management techniques to protect biodiversity for coming generations.

Keywords: Biodiversity, Ecosystem, Extinction, Reserved, Conservation.

INTRODUCTION

Due to the human activities conservation of biodiversity is a global concern. The ecosystem is facing a lot of threats due to the same. Various approaches have been developed to address the conservation of biodiversity. The modern approaches are more effective than the traditional methods that were followed. This study aims to offer valuable insights by investigating the advancements and challenges inherent in these strategies. Its objective is to assess whether these contemporary approaches have truly contributed to enhancing biodiversity conservation and fostering the sustainable utilization of resources,

as compared to conventional historical practices. In recent decades, the acceleration of habitat loss, species extinction, and environmental degradation has underscored the need for innovative and adaptive strategies in biodiversity conservation. This focuses on the advancements in conservation of biodiversity along with the challenges faced and a comparative analysis on how conservation of biodiversity helped in saving the flora and fauna from extinction.

Role of Biodiversity in Ecosystem

(i) *Stabilizes the ecosystem:* Biodiversity make the ecosystem more stable and make it resilient in

*Author for Correspondence

S. Sadhana
E-mail: 252210045.sclas@gmail.com

¹UG Student, II BCA Department of Computer Applications, Saveetha College of Liberal Arts and Sciences, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Thandalam Chennai, Tamil Nadu, India

Received Date: February 23, 2024

Accepted Date: March 26, 2024

Published Date: May 9, 2024

Citation: S.Sadhana. Assessing The Efficacy of Modern Biodiversity Conservation Approaches: Advancements and Challenges. Research & Reviews: Journal of Ecology. 2024; 13(1): 1–6p.

facing disturbances like climate change, disease outbreaks or human activities. They generally enhance by strengthening the ecosystem. Biodiversity is described as critical for the vital processes that sustain all life [1].

- (ii) *Nutrient cycling*: Some organisms break down dead organisms and organic matter, which returns nutrients back to the soil by enriching it. For example, earthworms consume the decaying plants and digest them. They excrete the waste (castings) which is rich in nutrients. This also enhances the soil fertility. This process is known as decomposition which helps in maintaining the health of soil ecosystems.
- (iii) *Pollination*: For example, various pollinators like bees, butterflies and birds help in fertilizing plants by ensuring the reproduction of many flowering plants, which in turn provide food and habitats for other species.
- (iv) *Pest Regulation*: They play important role in maintaining the populations of the pests. For example, predators like birds feed on the pests that eat crops which helps in preventing from damaging the crops.
- (v) *Food web complexity*: Biodiversity contribute more in the interactions within an ecosystem's food chain. They help in maintaining the energy flow of ecosystem efficiently.
- (vi) *Cultural value*: Landscapes with biodiversity are beautiful and are culturally significant. They serve as wellspring of inspiration for art, literature and spiritual traditions. They also enhance the richness of human experiences.
- (vii) *Soil erosion – controls*: They play important role in preventing the soil erosion and stabilizing the soil.

These are the few major roles of biodiversity in the ecosystem. There are still few other roles also which can be studied in depth.

Approaches For Conservation of Biodiversity

Over the course of the past century, a diverse array of conservation approaches with a focus on preserving biodiversity have been implemented. These methods span various scales, ranging from local to global initiatives. They encompass actions such as establishing protected areas, conducting ex-situ conservation (outside of natural habitats), developing plans for species and ecosystem recovery, managing specific threats like diseases and fires, and employing strategies like biodiversity offsets. At a global level, international policies like the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) have been instrumental in shaping conservation efforts [2].

These strategies are rooted in recognizing the manifold values of biodiversity, encompassing not only those tied to human interests but also intrinsic values. In this context, two prominent approaches are in-situ conservation, which involves safeguarding species and ecosystems within their natural habitats, and ex-situ conservation, which entails preserving species outside of their native environments. The 1992 CBD serves as a pivotal framework within which these in-situ and ex-situ strategies for conserving biological diversity are discussed and shaped [3].

The rise in urbanization has posed a challenge to the conservation of biodiversity. Many nations find it unrealistic and economically not feasible to conserve all the biological wealth. There are many species that are waiting to be saved from the extinction. There are two approaches to conserve biodiversity: In-situ and Ex-situ. The above two approaches mains focus on conserving the species from its extinction. These approaches can be categorized into different types based on their focus, scale, and methods. Biodiversity conservation approaches are necessary due to the critical role that biodiversity plays in maintaining the health of ecosystems, human well-being, and the overall functioning of the planet. We'll be looking into it in the further topics in brief.

In-situ

In-situ conservation is a biodiversity conservation approach that focuses on protecting and preserving species and ecosystems within their natural habitats. This method aims to maintain the integrity and

functioning of ecosystems while safeguarding the genetic diversity of species in their evolutionary contexts. In-situ conservation is essential for maintaining the ecological processes, interactions, and adaptations that have evolved over time. Globally, prominent conservationists have tackled this issue by pinpointing specific areas known as "biodiversity hotspots." These regions exhibit exceptionally high species diversity and a significant prevalence of endemism, meaning that they host species exclusive to that particular area and not found elsewhere. The identification of these hotspots serves the purpose of maximizing conservation efforts and protection on a large scale.

The methods of in-situ conservation include Biosphere reserves (18), National parks (105), Wild-life sanctuaries (553) and biodiversity hotspots (4) (in India).

- (i) *Biosphere Reserve*: They cover area more than 5000 km². Protection of species for a long time is supported by biosphere reserve (Table 1). There are 18 Biospheres in India [4].

Table 1. Some Biosphere reserve

Name	State
Nanda Devi	Uttarakhand
Nokrek	Meghalaya
Manas	Assam
Sudarban	West Bengal

- (ii) *National parks*: A national park is a region which is designated for preserving wildlife and the natural surroundings (Table 2). This region is regarded as sanctuary for safeguarding landscapes as well as historical and natural elements. Typically spanning around 100 to 500 square kilometres, a national park often constitutes to a compact conservation area. As of now, India hosts a total of 103 national parks.

Table 2. Some National parks

Name	State	Important wildlife
Kaziranga National Park	Assam	One-horned rhino
Gir National Park	Gujarat	Asiatic Lions
Bandipur	Karnataka	Tiger, Elephant
Dhachigam	J&K	Hangul
Kanha	M.P	Tiger
Periyar	Kerala	Tiger, elephant
Ranthambore National Park	Rajasthan	Tiger

- (iii) *Wildlife sanctuaries*: An area that is reserved for the conservation of animals only. Currently there are 551 wildlife sanctuaries in India (Table3)

Table 3. Some Wildlife sanctuaries

Name	State	Major wildlife
Hazaribadh sanctuary	Jharkhand	Tiger, Leopard
Ghana Bird Sanctuary	Rajasthan	300 species of birds
Sultanpur Bird Sanctuary	Haryana	Migratory birds
Abohar Wildlife Sanctuary	Punjab	Black buck
Nal Sarovar Bird Sanctuary	Gujarat	Water birds
Mudumalai Wildlife Sanctuary	Tamil Nadu	Tiger, Elephant, Leopard
Vedanthangal Birds Sanctuary	Tamil Nadu	Water birds

- (iv) *Biodiversity hotspots*: Conservation International has established stringent criteria for identifying a region as a hotspot:
 The region must house a minimum of 1,500 endemic species of vascular plants (Δ accounting for 0.5% of the global total).
 It should have experienced a reduction of at least 70% in its original habitat.
- (v) *Sacred Groves*: Sacred groves are portions of ancient forests safeguarded by rural communities as sacred spaces inhabited by deities (Table 4).

Table 4. Sacred Groves

Sacred Groves	States
Khasi and Jaintia Hills	Meghalaya
Aravalli Hills	Rajasthan
Western Ghat regions	Karnataka and Maharashtra
Sarguja, Chanda, Bastar	Madhya Pradesh

Ex-situ Conservation: In this approach, endangered animals and plants are removed from their natural habitats and placed in specialized environments where they receive protection and special care. Zoological parks, botanical gardens, and wildlife safari parks fulfill this role. Some species that have vanished from their natural habitats persist in zoological parks. In recent times, ex-situ conservation has progressed beyond confining threatened species in enclosures [5]. Now, reproductive cells of endangered species can be effectively preserved using cryopreservation techniques, eggs can be fertilized outside the organism, and plants can be propagated through tissue culture methods. Seeds from diverse genetic strains of economically valuable plants can be stored for extended periods in seed banks [6].

Biodiversity transcends political borders, making its preservation a collective responsibility for all nations. The landmark Convention on Biological Diversity, established during the Earth Summit held in Rio de Janeiro in 1992, urged all nations to take appropriate actions for biodiversity conservation and the sustainable use of its benefits. Building on this, the World Summit on Sustainable Development in Johannesburg, South Africa, in 2002, saw 190 countries pledge their dedication to achieving a significant reduction in the ongoing global, regional, and local rates of biodiversity loss by 2010.

Challenges faced in the above approaches: In-situ conservation, while crucial for preserving biodiversity within natural habitats, faces several challenges that can hinder its effectiveness. Some of the major challenges include:

- (i) *Habitat Destruction and Fragmentation*: Human activities such as deforestation, urbanization, and agriculture can lead to the loss and fragmentation of natural habitats. This reduces the available space for species to thrive and can disrupt ecological processes.
- (ii) *Climate Change*: Rapid changes in climate patterns can impact ecosystems and species distributions. In-situ conservation efforts may need to adapt quickly to shifting conditions and help species migrate to suitable habitats.
- (iii) *Invasive Species*: Non-native species introduced to an ecosystem can outcompete native species, leading to their decline or extinction. Managing invasive species within in-situ conservation areas is complex and resource-intensive.
- (iv) *Poaching and Illegal Wildlife Trade*: Protected areas are not always immune to illegal activities such as poaching and wildlife trafficking. These activities can lead to the depletion of species targeted for their valuable parts.
- (v) *Human-Wildlife Conflict*: As human populations expand and encroach on natural habitats, conflicts between wildlife and people can arise, especially when species cause damage to crops or pose threats to human safety.
- (vi) *Lack of Funding and Resources*: Adequate funding and resources are essential for the effective management of in-situ conservation areas. Insufficient funding can result in inadequate protection, monitoring, and enforcement efforts.

- (vii) *Lack of Awareness and Engagement*: In-situ conservation requires the support and cooperation of local communities, governments, and the public. Lack of awareness or understanding can hinder collaborative efforts.
- (viii) *Genetic Isolation*: Fragmented habitats can lead to genetic isolation among populations, reducing genetic diversity and increasing the risk of inbreeding.
- (ix) *Disease Outbreaks*: Disease outbreaks, such as those affecting wildlife or their habitats, can have devastating impacts on species populations and ecosystem health.

There are still more challenges that are faced in conservation of biodiversity which are to be taken of greater concern.

Advancements In Conservation Approaches for Biodiversity: Advancements in conservation approaches for biodiversity have emerged as our understanding of ecosystems, species dynamics, and technology has evolved [7]. These advancements aim to enhance the effectiveness of conservation efforts and address the challenges posed by habitat loss, climate change, and human impacts. Some notable advancements include:

Technology And Data Integration:

- (i) *Remote Sensing*: Satellite imagery and remote sensing technology help monitor and assess changes in habitats, land use, and vegetation cover.

Genetic And Reproductive Technique:

- (i) *Assisted Reproduction*: Techniques like artificial insemination and in vitro fertilization aid in breeding programs for endangered species [8].
- (ii) *Cryopreservation*: Cryogenic storage of genetic material, such as seeds, embryos, and tissues, helps preserve genetic diversity and assists in species recovery efforts.

Community Engagement and Indigenous Knowledge:

- (i) *Participatory Conservation*: Involving local communities and indigenous peoples in conservation planning and decision-making enhances sustainable practices and builds support for conservation efforts [9].
- (ii) *Traditional Ecological Knowledge (TEK)*: Integrating indigenous knowledge into conservation strategies improves understanding of local ecosystems and informs effective management practices.

Ecosystem-Based Approaches:

- (i) *Landscape-Level Conservation*: Focusing on entire landscapes rather than isolated areas helps preserve ecological processes and migration corridors, supporting the resilience of ecosystems.
- (ii) *Ecological Restoration*: Active restoration of degraded habitats helps recover ecosystem functions, biodiversity, and ecosystem services.

Conservation Through Sustainable Use:

- (i) *Sustainable Harvesting*: Incorporating sustainable harvesting practices for resources like timber, fisheries, and non-timber forest products can support both biodiversity and local livelihoods [10].

CONCLUSION

Overall, this study provides the important insights on importance of biodiversity in ecosystem, the approaches followed to conserve the biodiversity, and each of them in detail and challenges faced by the approaches in conserving the biodiversity and finally the advancements in conservation of biodiversity. This study is mainly done in order to give a proper insight on the importance of biodiversity conservation in the urbanizing world. This study also gives the detailed view on in-situ and ex-situ conservation with some examples of the places in India.

Acknowledgement

We would like to thank Saveetha Institute of Medical and Technical Sciences for supporting this research. We would also like to thank our guide Dr. A. Hency Juliet, Associate Professor, Department of Computer Applications, who made this work possible. Her guidance and advice carried me through all the stages of my research.

REFERENCES

1. Hoffmann, Samuel. "Challenges and opportunities of area-based conservation in reaching biodiversity and sustainability goals." *Biodiversity and Conservation* 31.2 (2022): 325-352.
2. Rands, M.R., Adams, W.M., Bennun, L., Butchart, S.H., Clements, A., Coomes, D., Entwistle, A., Hodge, I., Kapos, V., Scharlemann, J.P. and Sutherland, W.J., 2010. Biodiversity conservation: challenges beyond 2010. *science*, 329(5997), pp.1298-1303.
3. Dawson, T.P., Jackson, S.T., House, J.I., Prentice, I.C. and Mace, G.M., 2011. Beyond predictions: biodiversity conservation in a changing climate. *science*, 332(6025), pp.53-58.
4. Ukpoju, Emmanuel Adikwu, Ayodeji Abatan, Bartholomew Obeyioye Obaedo, Obe Destiny Balogun, And Abimbola Oluwatoyin Adegbite. "Assessing The Effectiveness of Biodiversity Conservation Strategies In Nigeria: A Comprehensive REVIEW." *International Journal of Applied Research in Social Sciences* 5, no. 10 (2023): 577-598.
5. Akter S. Harnessing Technology for Environmental Sustainability: Utilizing AI to Tackle Global Ecological Challenges. *Journal of Artificial Intelligence General science (JAIGS)* ISSN: 3006-4023. 2024 Feb 16;2(1):49-57.
6. Naruka Kp, Reddy Pb. Assessing The Efficacy of In-Situ Vs. Ex-Situ Biodiversity Conservation Measures. *Recent Advances in Biodiversity Research*. 2023:67.
7. Tomar, Ruchi, and Suresh Sikarwar. "The Science of Ash Values in Pharmacognosy: Evaluating the Efficacy of Medicinal Plants."
8. Odah, Mohammad. "Advancements in DNA Barcoding: Revolutionizing Taxonomy and Biodiversity Studies." (2024).
9. Cashmore M, Richardson T, Hilding-Ryedvik T, Emmelin L. Evaluating the effectiveness of impact assessment instruments: Theorising the nature and implications of their political constitution. *Environmental impact assessment review*. 2010 Nov 1;30(6):371-9.
10. Greenwell PJ, Riley LM, Lemos de Figueiredo R, Brereton JE, Mooney A, Rose PE. The societal value of the modern zoo: a commentary on how zoos can positively impact on human populations locally and globally. *Journal of Zoological and Botanical Gardens*. 2023 Jan 13;4(1):53-69.