



Biodiversity Conservation in India: A Review

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ABSTRACT

India is one of the 34 Mega biodiversity hotspots of the world. It is home for threatened and endemic species that have immense ecological and commercial value. Due to increased human population and over-exploitation of natural resources biodiversity is under threat worldwide. Threats to species are principally due to decline and fragmentation of their habitat. Biodiversity, as measured by the number of plant and vertebrate species, is greatest in the Western Ghats and North East in India.

Biodiversity has several values such as economical, ecological, ethical, medicinal, aesthetical, social and many more. The present need of the hour is the sustainable use of biodiversity. Inventory only will identify the key issues of management of biodiversity which include a continuing process of searching and re-examining the early findings. Conservation of biodiversity is being done in the form of various legislations, the establishment of the protected area, Zoos and botanical gardens, gene Bank, seed bank etc.

In this paper, the overview of Biodiversity and Its types, values, the status of biodiversity in India, causes of threats and various steps to be taken for the conservation of biodiversity have been discussed.

1) INTRODUCTION

In our biosphere immense diversity (or heterogeneity) exists not only at the species level but at all levels of biological organisation ranging from macromolecules within cells to biomes. Biodiversity is the term popularised by the sociobiologist Edward Wilson to describe the combined diversity at all the levels of biological organisation.

Biodiversity itself is a combination of two words, *Bio* (life) and *diversity* (variety). In simple terms, biodiversity is the number and variety of organisms found within a specified geographic region. It refers to the varieties of plants, animals and micro-organisms, the genes they contain and the ecosystems they form [1]. It relates to the variability among living organisms on the earth, including the variability within and between the species and that within and between the ecosystems.

Biodiversity is our living wealth. It is a result of hundreds of millions of years of evolutionary history. Biodiversity can be discussed at three levels: (i) Genetic diversity; (ii) Species diversity; (iii) Ecosystem diversity.

Genetic Diversity

Genes are the basic building blocks of various life forms. Genetic biodiversity refers to the variation of genes within species. Groups of individual organisms having certain similarities in their physical characteristics are called *species*. This genetic diversity is essential for a healthy breeding of population of species.

Species Diversity

This refers to the variety of species. It relates to the number of species in a defined area. The diversity of species can be measured through its richness, abundance and types. Some areas are richer in species than others. Areas rich in species diversity are called *hotspots* of diversity.

Ecosystem Diversity

The broad differences between ecosystem types and the diversity of habitats and ecological processes occurring within each ecosystem type constitute the ecosystem diversity. At equator terrestrial biodiversity is higher than poles [2]. At the ecosystem level, India, for instance, with its deserts, rain forests, mangroves, coral reefs, wetlands, estuaries, and alpine meadows has greater ecosystem diversity. There is latitudinal gradient in species diversity [3].

Importance of Biodiversity

Biodiversity has contributed in many ways to the development of human culture and, in turn, human communities have played a major role in shaping the diversity of nature at the genetic, species and ecological levels. Biodiversity plays the following important roles:

Ecological Role of Biodiversity

Living organisms provide many ecological services free of cost that are responsible for maintaining ecosystem health [4]. It helps in many ways-

- **Protection of water resources:** Natural vegetation cover helps in maintaining hydrological cycles, regulating and stabilizing water run-off and acting as a buffer against extreme events such as floods and droughts.
- **Soil protection:** Biological diversity helps in the conservation of soil and retention of moisture and nutrients.
- **Nutrient storage and cycling:** Ecosystem perform the vital function of recycling nutrients found in the atmosphere as well as in the soil. Plants are able to take up nutrients, and these nutrients are used by a wide range of life forms. Nutrients in the soil, in turn, are replenished by dead or

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waste matter which is transformed by micro-organisms.

- **Pollution reduction:** Ecosystems and ecological processes play an important role in maintenance of gaseous composition of the atmosphere, plants absorb atmospheric carbon dioxide and release oxygen. Some ecosystems, especially wetlands have the ability to breaking down and absorb pollutants.
- **Climate stability:** Vegetation influences climate at macro as well as micro levels. Cooling effect of vegetation is a common experience which makes living comfortably.
- **Maintenance of ecological processes:** Different species of birds and predators help to control insect pests, thus reduce the need and cost of artificial control measures.

Without ecological services provided by biodiversity it would not be possible to get food, pure air to breathe and would be submerged in the waste produced.

2) BIOLOGICAL RESOURCES OF ECONOMIC IMPORTANCE

Food, fibre, medicines, fuel, wood and ornamental plants:

Five thousand plant species are known to have been used as food by humans. A large number of plants and animals materials are used for the treatment of various ailments. It is estimated that at least 70 % of the country's population rely on herbal medicines and over 7000 species of plants are used for medicinal purposes.

Wood is a basic commodity used worldwide for making furniture and for building purposes. Fire wood is the primary source of fuel. Wood and bamboo are used for making paper. Plants are the traditional source of fibre such as coir, hemp, flax, cotton, jute.

Breeding material for crop improvement: Genetic material or genes of wild crop plants are used to develop new varieties of cultivated crop plants for restructuring of the existing ones for improving yield or resistance of crops plants. For example: rice grown in Asia is protected from four main diseases by genes contributed by a single wild rice variety.

Future resources: There is a clear relationship between the conservation of biological diversity and the discovery of new biological resources. Many presently under-utilised food crops have the potential to become important crops in the future.

3) SOCIAL BENEFITS

Recreation: Forests, wildlife, national parks and sanctuaries, garden and aquaria have high entertainment and recreation value. Ecotourism, photography, painting, film making and literary activities are closely related.

Cultural values: Plants and animals are important part of the cultural life of humans. Human cultures have co-evolved with their environment and biological diversity can be impart a distinct cultural identity to different communities.

4) LOSS OF BIODIVERSITY

Since the last few decades, growth in human population has increased the rate of consumption of natural resources. It has accelerated the loss of species and habitation in different parts of the world. The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years. Some examples of recent extinctions include the dodo (Mauritius), quagga (Africa), thylacine (Australia), Steller's Sea Cow (Russia) and three subspecies (Bali, Javan, Caspian) of tiger. The last twenty years alone have witnessed the disappearance

of 27 species. Presently, 12 per cent of all bird species, 23 per cent of all mammal species, 32 per cent of all amphibian species and 31 per cent of all gymnosperm species in the world face the threat of extinction. The vulture has suffered a 99% population decrease in India [5].

In general, loss of biodiversity in a region may lead to (a) decline in plant production, (b) lowered resistance to environmental perturbations such as drought and (c) increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles.

Causes of biodiversity losses: The threat to survival or loss may be caused in the following three ways:

- Direct ways: Deforestation, hunting, poaching, commercial exploitation.
- Indirect ways: Loss or modification of the natural habitats, introduction of exotic species, pollution, etc.
- Natural causes – Recent climate change, such as warmer temperature in certain areas had significantly impacts on biodiversity and ecosystem [6].

Among these causes, habitat destruction and over-exploitation are the main

- Habitat loss and fragmentation:** This may result from clearing and burning forests, draining and filling of wetlands, converting natural areas for agricultural or industrial uses, human settlements, mines, building of roads [7, 8] clearing of forest habitat for construction of hydroelectric project on the river [9].
- Over-exploitation:** Humans have always depended on nature for food and shelter, but when 'need' turns to 'greed', it leads to over-exploitation of natural resources.
- Exotic species invasions:** When exotic species are introduced unintentionally or deliberately for whatever purpose, some of them turn invasive, and cause decline or extinction of indigenous species.
- Co-extinctions:** When a species becomes extinct, the plant and animal species associated with it in an obligatory way also become extinct. When a host fish species becomes extinct, its unique assemblage of parasites also meets the same fate. Another example is the case of a coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other.

5) INDIA AS A MEGA BIODIVERSITY NATION

India has a rich heritage of biodiversity, encompassing a wide spectrum of habitats from tropical rainforests to alpine vegetation, and from temperate forests to coastal wetlands. Almost all the biogeographical regions of the world are represented here in India. India is one of the 12 mega-diversity nations of the world. With a mere 2.4% of the total land area of the world, the known biodiversity of India contributes 8.22% of the known global biodiversity. India is one of the twelve mega-diversity nations of the world accounting for 7.31% of the global faunal and 10.88% of the global floral total species. Generally, biodiversity tends to cluster in hotspots [10].

Some of the salient features of India's biodiversity are as under:

- India has two major realms called the Palaearctic and the Indo Malayan; and three biomes, namely the tropical humid forests, the tropical dry deciduous forests and the warm desert/ semi-deserts.
- India has ten biogeographic regions, namely the Trans-Himalayan, the Himalayan, the Indian desert, the semi-arid

zone, the Western Ghats, the Deccan Peninsula, the Genetic plain, North-East India, the Islands, and the coasts.

- India is one of the 12 centres of origin of cultivated plants.
- There are two hotspots that extend into India. There are the Western Ghats/ Sri Lanka and the Indo-Burma region (covering the Eastern Himalayas). Further these hotspots are included amongst the top eight most important or hottest hotspots.
- India has 26 recognised endemic centres that are home to nearly a third of all the flowering plants (angiosperms) identified and described to date.
- India has six Ramsar Wetlands. They are –
- Chilika Lake, Harike Lake, Loktak Lake, Keoladeo National Park, Wular Lake and Sambhar Lake.
- India has 5 world heritage sites namely, Kaziranga National Park, Keolades Ghana National Park, Manas Wildlife Sanctuary, Nanda Devi National Park and Sundarban National Park.
- India has twelve biosphere reserves, namely Nilgiri, Nanda Devi, Nokrerik, Manas, Sunderbans, Gulf or Mannar, Great Nicobar, Similpal, Dibru-Saikhowa, Dehang Debang, Pachmarchi and Kanchanjanga.
- Further, amongst the protected areas, there are 88 national parks and 490 sanctuaries in India covering an area of 1.53 lakh sq.km.

It is estimated that only 1.7 million have been identified among 5-50 million species of living forms exist on the earth. These include 4,27,205 species of green plants, fungi, bacteria and viruses; 61,917 species of vertebrates and protochordata; and 12,32,490 species of invertebrates including protista [11]. Today, India has 59,353 insect species, 2,546 fish species, 240 amphibian species, 460 reptile species, 1,232 bird species and 397 mammal species, of which 18.4 per cent are endemic and 10.8 per cent are threatened. India is the home to at least 18,664 species of vascular plants, of which 26.8 per cent are endemic [12]. India also has rich marine biodiversity, along the coastline of 7516.5 km, supporting the most productive ecosystems such as mangrooves, estuaries, lagoons and coral reefs. The benthic fauna largely consists of polychaeta (62%), crustacean (20%) and molluscs (18%) with the biomass of about 12 gm per sq. metre. Over 16,000 species of zooplankton, 30 species of marine algae and 14 species of seagrass have been reported. There are over 45 species of mangrove plants. Over 342 species of corals belonging to 76 genera have been reported and about 50% of the world's reef building corals are found in India.

6) BIODIVERSITY CONSERVATION

When we conserve and protect the whole ecosystem, its biodiversity at all levels is protected - we save the entire forest to save the tiger. This approach is called *in situ* (on site) conservation. However, when there are situations where an animal or plant is endangered or threatened and needs urgent measures to save it from extinction, *ex situ* (off site) conservation is the desirable approach.

In situ conservation

- (i) **Protection of habitat:** In India, ecologically unique and biodiversity-rich regions are legally protected as biosphere reserves, national parks and sanctuaries. India now has 13 biosphere reserves, 96 national parks and 500 wildlife sanctuaries, twenty-seven Tiger Reserves and eleven

Elephant Reserves covering an area of 15.67 million hectares or 4.7 % of the geographical area of the country. India has also a history of religious and cultural traditions that emphasised protection of nature. In many cultures, tracts of forest were set aside, and all the trees and wildlife within were venerated and given total protection. Such **sacred groves** are found in Khasi and Jaintia Hills in Meghalaya, Aravalli Hills of Rajasthan, Western Ghat regions of Karnataka and Maharashtra and the Sarguja, Chanda and Bastar areas of Madhya Pradesh. Twenty-one wetlands, thirty mangrove areas and four coral reef areas have been identified for intensive conservation and management purposes by the Ministry of Environment and Forests, Govt. of India.

- **National parks and sanctuaries:** India's national parks and wildlife sanctuaries (including bird sanctuaries) are situated Ladakh in Himalayas to Southern tip of Tamil Nadu with its rich bio-diversity and heritage. Wildlife sanctuaries in India attract people from all over the world as the rarest of rare species are found here. With 96 national parks and over 500 wildlife sanctuaries, the range and diversity of India's wildlife heritage is unique.
- **Biosphere Reserves:** These are representative parts of natural and cultural landscapes extending over large areas of terrestrial or coastal/marine ecosystems which are internationally recognized within UNESCO's Man and the Biosphere Programme Thirteen biodiversity-rich representative ecosystems, largely within the forest land (total area – 53,000 sq. km.) have been designated as Biosphere Reserves in India.
- **Sacred forests and sacred lakes:** A traditional strategy for the protection of biodiversity has been practiced in India in the form of sacred forests. These are small forest patches protected by tribal communities due to religious sanctity. These have been free from all disturbances. Sacred forests are located in several parts of India i.e. Karnataka, Maharashtra, Kerala, Meghalaya, Similarly, several water bodies for example, Khecheopalri lake in Sikkim, have been declared sacred by the people, leading to protection of aquatic flora and fauna.
- ii) **Species-oriented projects:** Certain species have been identified as needing a concerted and specifically directed protection effort. Project Tiger, Project Elephant and Project crocodile are examples of focusing on single species through conserving their habitats.

Ex-situ Conservation

- **Botanical gardens, zoos, etc.** Ex-situ conservation is being undertaken through setting up botanical gardens, zoos, medicinal plant parks, etc by various agencies. The Indian Botanical Garden in Howrah (West Bengal) is over 200 years old. Other important botanical gardens are in Ooty, Bangalore and Lucknow. The most recent one is The Botanical Garden of Indian Republic established at NOIDA, near Delhi in April, 2002.
- A number of zoos have been developed in the country. These zoological parks have been looked upon essentially as centres of education about animal species and recreation. They have also played an important role in the conservation of endangered animal species such as the Manipur Thamin Deer (*Cerus eldi eldi*) and the White winged Wood Duck (*Cairina scutulata*). Notable successful examples of captive

breeding are those of Gangetic gharial (*Gavialis gangeticus*), turtles and the white tiger.

- **Gene Banks:** Ex-situ collection and preservation of genetic resources is done through gene banks and seed banks. The National Bureau of Plant Genetic Resources (NBPGR), New Delhi preserves seeds of wild relatives of crop plants as well as cultivated varieties; the National Bureau of Animal Genetic Resources at Karnal, Haryana maintains the genetic material for domesticated animals, and the National Bureau of Fish Genetic Resources, Lucknow for fishes.
- **Cryopreservation:** (“freeze preservation”) is particularly useful for conserving vegetative propagated crops [13]. Cryopreservation is the storage of material at ultra low temperature of liquid nitrogen (-196°C) and essentially involves suspension of all metabolic processes and activities. Cryopreservation has been successfully applied to meristems, zygotic and somatic embryos, pollen, protoplasts cells and suspension cultures of a number of plant species.
- **Conservation at molecular level (DNA level):** In addition to above, germplasm conservation at molecular level is now feasible and attracting attention. Cloned DNA and material having DNA in its native state can all be used for genetic conservation. Furthermore, non-viable material representing valuable genotypes stored in gene banks can all be used as sources of DNA libraries from where a relevant gene or a combination of genes can be recovered.

Legal measures: Market demand for some body parts like bones of tiger, rhino horns, furs, ivory, skins, musk, peacock feathers, etc results in killing the wild animals. The Wildlife Protection Act (1972) contain provisions for penalties or punishment to prevent poaching and illegal trade. India is also a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The Convention entered into force on 1st July, 1975. In addition to this, India is also a signatory to Convention on Biological Diversity (CBD), which it signed on 29th December, 1993 at Rio de Janeiro during the Earth Summit [14]. Government of India have also passed the Biological Diversity Act, 2002, the details of this acts is given in lesson 23.

- World Wide Fund for Nature (WWF) and World Conservation Union supports projects to promote conservation and appropriate development of Biosphere Reserves.

7) CONCLUSION

It is believed that an area with higher species abundance has more stable environment compared to an area with lower species abundance. We can further claim the necessity of biodiversity by considering our degree of dependency on Environment.

Conservation of biodiversity refers to protection, upliftment and management of biodiversity in order to derive sustainable benefits for present and future generation.

The knowledge and values of local communities are now being acknowledged as valuable for biodiversity conservation. Environmental laws should be followed strictly, deforestation and poaching should be strictly prohibited.

public awareness should be created regarding biodiversity conservation and its importance. Every individual can make a small but significant effort to save our planet and conserve biodiversity if current human growth and resource management pattern do not change. It is likely that we will lose many important species and can never recover it.

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