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Biodiversity conservation and management: A Review

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Abstract:

First, biodiversity-related issues are set in the global context, while India's own biological profile is highlighted. Then, the importance of forest management and policies are expressed, as well as the necessity of a new strategy and action plans for sustainable conservation and management of biodiversity through an integrative approach by taking into account ecological, social, economic and institutional aspects. In the wide field of biodiversity, the French Institute's research programmes have been focusing for about four decades on species diversity and ecosystem diversity at the local (i.e. stand and community), landscape and regional levels. The Institute has been concentrating on plant ecology with a strong emphasis on trees and forests, from open woodland to dense moist evergreen forests, considering their present status as well as their long-term history. Geographically speaking, most of the studies are being carried out in the Western Ghats and some projects in the Eastern Ghats and mangroves. The biodiversity-related activities of the French Institute come under 'assessment of biodiversity' and 'monitoring the dynamics of biodiversity'.

Key words: Biodiversity conservation, geographical information system.

Introduction

Biodiversity refers to the variety and variability among living organisms, the ecological complexes in which they occur, and the ways in which they interact with each other and their environment. At present, biodiversity is a result of a series of turnovers in the rate of evolution and extinction since the geological past. Extinction is a natural process. The geological record indicates that hundreds of plant and animal species have disappeared over the aeons as they failed to adapt to changing conditions due to geological events like continental drift, massive volcanic eruptions or asteroid impacts. Currently, humans are the most powerful agents of environmental change driving the latest wave of extinction. Human activities have already caused the destruction of over one third of the world's forest. The rapidly escalating human demand for natural resources is causing genes, species and habitat to disappear at an unprecedented rate. Conservative estimates indicate that human activity has increased the extinction rates of plants and vertebrates to between

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10 and 100 times the normal "background" rate. The IUCN Red List of Threatened Species indicates that species extinction is on an increasing spiral. Since the earliest date of recorded history, the fundamental social, ethical, cultural and economic values of humans have directly or indirectly revolved around biological resources. Diversity in genes, species and ecosystems has contributed immensely to the productivity of agriculture, forestry, fisheries and industry. Especially the tropical forests, which are rich in biological diversity, contribute substantially to the local communities in terms of security in income, employment and livelihood and farming systems.

India's biological profile and status

India has a rich and varied heritage of biodiversity, encompassing a wide spectrum of habitats, from tropical rainforests to alpine vegetation and from semi-arid vegetation to coastal wetlands. India figured with two hotspots - the Western Ghats and the eastern Himalayas - out of 25 biodiversity hotspots identified by Myers (1988). In addition, India has 26 recognized endemic centres that are home to nearly one third of all the flowering plants identified and described to date. Of the 1.7 million of the world's described biota, India contributes 7.3% of the global fauna. Among flowering plants, India accounts for 7% of the 250,000 flowering plants so far described in the world. India is one of the 12 centres of origin of cultivated plants. There are 167 cultivated species and 273 wild relatives of crop plants. The endemism of Indian biodiversity is high. About 33% of the country's recorded flora (49,219 plant species) are endemic to the country and are concentrated mainly in north-east India, the Western Ghats, north-west Himalayas and the Andaman and Nicobar islands. In animals, the endemism among mammals and birds is relatively low (6 to 9%). However, the amphibians and reptiles are, respectively, nearly 62 and 50% endemic to India, and the majority of them are found in the Western Ghats.

Forest management and policies

The concept of the management of forests was introduced in India 150 years ago. Colonial legacy and princely states carved out Reserved Forests and State Forests under different forest laws for the "scientific" management of forests. While doing so, nearly an equal percent of forests were kept outside the purview of the Reserved Forest for community use, that is, for obtaining their bonafide requirements of small timber, fuel, fodder, green manure and a host of other non-timber products. At that time, the population was less and consequently the pressure on the forest was minimal. Most of

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the requirements of the local population were obtained from the Revenue Forests. Currently, the State Forest Departments, which are the custodians of forests, control large areas of forest as state property. However, substantial areas of natural vegetation still remain either in private control or under the Revenue Department's authority. The management of the Reserved Forests (RF) under the State Forest Departments has traditionally revolved around protection, silviculture and plantation. On the other hand, Revenue Forests are under the control of the Revenue Departments without any kind of management. Locals have had free access to revenue forests, and due to heavy pressures, vast areas of such lands are being converted into private croplands by granting title deeds to local communities under different schemes and programmes. With the disappearance of Revenue Forests, pressure is being brought on the Reserved Forests to provide the bonafide requirements of the local people. This has resulted in the degradation of Reserved Forests, too.

Developing an information system to prioritize biodiversity conservation areas and management zones

Developing a good strategy requires a highly reliable and meaningful information system at different levels. In the wide field of biodiversity, the French Institute of Pondicherry (FIP) research programmes have been focusing for about four decades on species and ecosystem diversity at the local (i.e. stand and community), landscape and regional levels. The Institute has been concentrating on plant ecology with a strong emphasis on trees and forests, from open woodland to dense moist evergreen forests, considering their present status as well as their long-term history. Geographically speaking, most of the studies are being carried out in the western gnats and some projects in the Eastern Ghats and mangroves.

The biodiversity-related programmes of the FIP could be listed under two main headings: ‘assessment of biodiversity’ and ‘monitoring the dynamics of biodiversity’. These programmes are being carried out in collaboration with Forest Departments in Karnataka, Kerala, Tamil Nadu and Andhra Pradesh, the School of Environmental Sciences (JNU), the Kerala Forest Research Institute, the Centre for Ecological Sciences (IISc), the Salim Ali School of Ecology (Pondicherry University) and the National Remote Sensing Agency (Department of Space)

Assessment of biodiversity

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The habitat/ecosystem oriented approach

This approach is derived from biogeography and phytoecology and was the cornerstone of the ecological mapping programme initiated in the late 50s by the FIP. It consists in studying and classifying vegetation in relation to ecological conditions (climate and soil), in characterizing the species composition, structure and physiognomy of the vegetation units, in analyzing their dynamics and succession under 'natural' and 'disturbed' regimes.

The species oriented approach

This approach is in direct lineage of taxonomic and botanical studies. It is best illustrated by the "Atlas of Endemic Plants of the Western Ghats" published by the FIP. The species oriented approach consists in collecting information on the location of the species from various sources: herbaria, literature and field surveys. This information may be extended to include the ecological conditions (bioclimatic, soil, altitude, topography) and the type of ecosystems in which the plant is encountered, the role it plays in these ecosystems, as well as its biological traits (morphology, architecture, growth and reproductive strategy). The ultimate goal is to have a sort of 'identity card' for each species. This information is most crucial for rare and endangered species in the perspective of their in situ conservation.

Monitoring the dynamics of biodiversity

Land use and land cover changes

The first step in monitoring changes in biodiversity consists in comparing successive observations. At the local level, this can be done by observing the appearance and disappearance of species: it requires that the same sites be sampled on several occasions. In order to observe this, two permanent plots have been set up in the Biligirirangan hills (3.5 ha) and the Kadamakal RF (28 ha), both in Karnataka. In addition to these, initial data have also been collected from one hundred 1- ha permanent plots, established by the Karnataka Forest Department in the Karnataka, part of the Western Ghats.

Ecosystem uses and forest products

Understanding changes in biodiversity requires the analysis of the processes that are at play. A first major set of processes is constituted by those related to human activities, especially the direct exploitation of the ecosystems and species. This is where the social

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sciences play a key role: the land tenure system, the representation of ecosystem and species and the sacred and economic values of the resources are important factors to explain the changes.

Forest dynamics

Biological processes and ecological factors temporally govern plant demography and constitute a major set of processes, which have a strong influence on changes in biodiversity. It is thus important to analyze, in 'natural' and 'disturbed' conditions, how the plants regenerate, grow and die when they interact with each other. Such studies are best carried out at the local level in large permanent plots where the environmental conditions can be described.

Perspectives

These long-term efforts have already been able to put together a sum of knowledge that can help to better define conservation strategies. Further, using these data, it may be possible to construct models that simulate disturbance regimes and their impacts on the forest physiognomy and species composition. Modelling the effect of various types of activity, particularly on sensitive areas, would allow an informed assessment of the potential environmental impact and a comparison of costs and benefits, which also takes into account the losses of biological diversity. There is a need to carry out or incorporate data from studies on a finer scale of forest and landscape change linked to social and economic studies of forest use and management. These would shed light on some of the proximate and underlying causes of deforestation and loss of biodiversity. New approaches those are holistic, integrative and involve multiple agents would require a degree of coordination and cooperation between institutions. It would be useful for the State Forest Department to assume a leading role in this and to invite participating institutions to share their findings and to propose resource management alternatives based on empirical studies. There also needs to be better coordination among government agencies and research institutions, for example, between the State Forest Departments and the Revenue Department, which between them administer vast tracts of land in India.

Conclusion

Biodiversity conservation is critical for economic development and poverty alleviation. Around 70% of the global poor live in rural areas where as much as 50% to 90% of livelihoods are sourced from non-marketed goods and ecosystem services. The

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agriculture sector is highly dependent on the services generated by biodiversity and neighboring natural ecosystems that provide key services such as pollination, pest control, genetic diversity, soil retention, structure and fertility, water supply, etc. Although there is certainly an increased adoption of good agricultural practices, there are still abundant unsustainable practices in agriculture that cause substantial environmental degradation, biodiversity loss and a progressive loss of agricultural productivity at the same time. SAN's approach focuses on the five principal causes of pressure on biodiversity: climate change, habitat loss and degradation, excessive nutrient loading and other forms of pollution, overexploitation and unsustainable use, and invasive alien species.

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