

**BIOSPHERE RESERVES IN INDIA :
STATUS AND PROSPECTS FOR
INTEGRATED CONSERVATION**

*Dissertation submitted to Jawaharlal Nehru University
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MASTER OF PHILOSOPHY

MUKESH KUMAR

*CENTRE FOR INTERNATIONAL POLITICS,
ORGANISATION and DISARMAMENT STUDIES
SCHOOL OF INTERNATIONAL STUDIES
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI-110067*

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जवाहरलाल नेहरू विश्वविद्यालय
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI - 110067

CENTRE FOR INTERNATIONAL POLITICS,
ORGANIZATION AND DISARMAMENT
SCHOOL OF INTERNATIONAL STUDIES

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CERTIFICATE

Certified that the Dissertation entitled **Biosphere Reserves in India : Status and Prospects for Integrated Conservation** submitted by **Mukesh Kumar** in partial fulfilment of the requirements for the award of the Degree of **Master of Philosophy** has not been previously submitted for the any other degree of this or of any other University. To the best of our knowledge this is a bonafide work.

We recommend that this dissertation be placed before the examiners for evaluation.

(Dr.) Kanti Prasad Bajpai
Chairperson

(Prof.) R.C. Sharma
Supervisor

***DEDICATED TO
MY GRANDFATHER***

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Mukesh Kumar

MUKESH KUMAR

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CHAPTER I
SYSTEM OF BIOSPHERE RESERVES

1.1. **INTRODUCTION:**

Biosphere refers to the zones of contact between the atmosphere, hydrosphere and the lithosphere. There is exchange of matter and energy between these three elements of the physical environment and the organisms in the biosphere. While the animals are able to migrate from place to place according to seasonal changes, plants are rooted to the soil and they make physiological adjustments to seasonal changes. Plants and animals are interdependent on one another. The very idea of a biosphere was first suggested by the Austrian geologist Edward Suess nearly a century ago.¹ The average thickness of biosphere or life supporting layer consisting of air, water, soil and rock is about 30 km.² The upper limit of the biosphere is determined by the availability of oxygen, moisture, temperature and air pressure with increased height in the atmosphere limits the upper boundary of the biosphere. Though the NASA has discovered the presence of bacteria upto a height of 15 km. in the atmosphere, but the lower layer of the atmosphere upto a few hundred metres accounts for most of the living organisms because favourable environmental conditions are available for the growth and development of living organisms in the lower part of atmosphere. The biosphere extends upto greater depth in the oceans. The existence of life has been

detected upto a depth of 9,000 meters in the deep ocean trenches and deep sea plains.

The biosphere is an example of a system as it is composed of basically three components, viz. (i) organic component (plants, animals including man and micro-organisms), (ii) inorganic or abiotic component (physical environments - land, air, water) and (iii) energy component (solar and geothermal energy). These three components are mutually inter-dependent and are inter-related through a series of large scale cycle mechanisms which make the input-output mechanism effective in the biosphere. The biosphere is considered an open system because there is continuous flow of energy and output of matter. As long as the balance is maintained between the input of energy and material and output of matter, the biospheric system remains in equilibrium condition. But when this critical balance is disturbed, the equilibrium state of biospheric system is also disturbed and several environmental and ecological problems crop up. The equilibrium state of biospheric system which is, in natural state, self-sustaining and ecologically efficient, depends on the intimate relationships between various components of the biosphere and a series of large scale cyclic mechanism, viz. (i) energy cycle, (ii) hydrological cycle, (iii) sediment cycle, (iv) nutrient cycle, etc. collectively known as biogeochemical cycle. These cycles influence the biotic, abiotic and energy components of the biosphere whereas in

turn these components also influence the cyclic mechanisms involving the movement and transfer of energy, water, sediments and nutrients throughout the biospheric system. If any of the attributes of the biospheric system crosses the critical limit, the system equilibrium is disturbed.

The biosphere, or the ecosystem, as it is generally called, is an evolutionary systems. Since ecosystem is a fundamental functional unit occupying spatial dimension on the earth and is characterized by total assemblage of biotic community and abiotic community together with energy component. Thus the biosphere becomes the largest ecosystem. The biosphere consists of two major systems,³ viz., (i) terrestrial biomes systems and (ii) aquatic biomes system. The terrestrial biomes systems are further comprised of three sub-systems viz., (a) plant system, (b) animal system and (c) soil system. These sub-systems are intimately inter-related among themselves. On the other hand, the aquatic biomes systems are also composed of two sub-systems - (i) animal system and (ii) nutrients.

Aquatic ecosystem is divided into fresh water, estuaries and marine ecosystem. Fresh water ecosystems are represented by fresh water lakes and rivers. The estuaries ecosystems are the most productive among the aquatic ecosystems. Marine ecosystem is the largest in terms of surface of the earth. Three distinctive habitat zones have been identified as the inter-tidal, the neritic and oceanic zones. Inter-tidal zone refers to the area between high

tide and low tide. The neritic zone extends from the shoreline upto the limit of the continental shelf. This zone with estuaries accounts for 50 per cent of productivity of sea. The oceanic zone refers to wide open ocean beyond the edge of the continental shelf, though sunlight may be present on surface waters, nutrients required for photosynthesis are not adequate. As productivity is quite low, open oceans are biological desert.

Terrestrial ecosystems are of greater concern to us as human beings live on land. The surface of land has a cover of vegetation of great variety depending on climatic conditions. Plants occur in distinct group of communities in areas having similar climatic conditions. These are called biomes. Terrestrial ecosystems have been further divided on basis of vegetation and climatic conditions. it is divided as forests, grassland, desert vegetation.

Forest Types:

Forests are classified into evergreen and deciduous forests. In evergreen forests, there is no mass shedding of leaves during any season of the year. Tropical evergreen forests occur in Equatorial regions and tropical coastal regions with heavy rainfall. Mid-latitude evergreen forests occur in the eastern margins of Continents in the sub-tropical belt. Mediterranean forests occur in the western margins of Continents in middle latitude. Coniferous forests extend as a continuous belt around the North Polar region and high mountains in Europe, Asia and

North America. Deciduous forests are classified into two further sub-types. Tropical deciduous forests are found in sub-tropical regions with a distinct dry season, such as monsoon regions of Asia, parts of Central America, Brazil and Northern Australia. Mid-latitude forests occur in the coastal regions of cool climates. Main regions are Western Europe, North-eastern China, Japan, North-eastern United States, Southern Chile and New Zealand.

Grasslands

Grasslands are divided into tropical grasslands and mid-latitude grasslands. Tropical grasslands occur in the interior of Continents in the tropical zone. Mid-latitude grasslands occur in the interior of Continents in middle latitudes receiving moderate rainfall.

Deserts

Due to low rainfall, deserts don't have continuous cover of plants. Short scrubs occur in patches. Tundra type of vegetation occurs around the North Pole in Eurasia and North America.

Today, different environmental and ecological problems have surfaced in different biospheric systems. Therefore, action is required to preserve the biological diversity of different ecosystems. In order to conserve the biological diversity and sustainable development, UNESCO started the programme of biosphere reserves. And biosphere reserves are being set up in different biogeographical regions of the world.

1.2. CONCEPTUAL FRAMEWORK

Biosphere reserves are areas of terrestrial and coastal/marine ecosystems or a combination thereof, which are internationally recognised within the framework of UNESCO's programme on Man and Biosphere (MAB).⁴ The first biosphere reserves were designated in 1979. Since then the international network which they constitute has reached 324 biosphere reserves located in 82 countries. The concept of biosphere reserve has emerged from UNESCO's Man and the Biosphere programme (MAB) of which it constitute an essential part. MAB itself originated from the 1968 Conference on Rational Use and Conservation of the Resources of the Biosphere, as an international and inter-disciplinary research programme whose major objective is to provide the scientific knowledge and trained personnel needed for sound and sustainable management of land resources. It was proposed to make specific efforts to preserve representative samples of significant ecosystems, original habitats of domesticated plants and animals, and remnant population of rare and endangered species. Another recommendation dealt with the 'preservation of natural areas and endangered species', inspired in particular by the inventory work undertaken on terrestrial conservation under the International Biological Programme.

General criteria for an area to be qualified for designation 'a biosphere reserve'⁵: first, it should encompass a mosaic of ecological systems representative of

major biogeographic regions, including gradation of human intervention; second, it should be of significance for biological diversity conservation; third, it should provide an opportunity to explore and demonstrate approaches to sustainable development on regional scale; fourth, it should have an appropriate size to serve three functions of biosphere reserves; fifth, it should include these functions through appropriate zonation recognizing -

- (a) a legally constituted core areas or areas devoted to long term protection, according to the conservation objectives of the biosphere reserves, and of sufficient size to meet these objectives;
- (b) a buffer zone or zones clearly identified and surrounding or contiguous to the core area or areas, where only activities compatible with the conservation objectives can take place;
- (c) an outer transition area where sustainable resource management practices are promoted and developed.

Sixth, organizational arrangements should provide for the involvement and participation of a suitable range of *inter alia* public authorities, local communities and private interests in the design and carrying out the functions of a biosphere reserve; seventh, in addition, provision should be made for (a) mechanisms to manage human use and activities in the buffer zone or zones, (b) a management policy or plan for the area as a biosphere reserve, (c) a designated authority or mechanism to implement this policy or plan, (d)

programmes for research, monitoring, education and training.

Functions of Biosphere Reserves:⁶

On the basis of the UNESCO (MAB) programme guidelines, the major functions of a biosphere reserve are following -

1. Conservation - It should contribute to conservation of landscapes, ecosystems, species and genetic variation.

2. Development - It should foster economic and human development which is socio-culturally and ecologically sustainable.

3. Logistic Support - It should support demonstration projects, environmental education and training, research and monitoring related to local, regional, national and global issues of conservation and sustainable development.

Functional Characteristics of Biosphere Reserves

First, each biosphere includes one or several core areas that are strictly protected according to well defined conservation objectives and consist of typical samples of natural or minimally disturbed ecosystem. Collectively these core areas should be large enough to be effective as in situ conservation units and, whenever possible, have value as benchmarks for measurements of long term changes in the biosphere and the ecosystems they represent. Normally core area, or some of the core areas, are representative of the surrounding ecosystems where sustainable development is to be promoted.

Second, the size and shape of the core areas depend on the type of landscape in which they are located and on the

conservation objectives they are intended to meet. They can obviously be much larger in low population density regions than in regions with heavier human pressure and less available land.

Third, core areas correspond to strict nature reserves to wilderness areas of national parks, or to other types of strictly protected areas. Strict protection of core areas doesn't necessarily mean 'non-intervention', they can be submitted to different types of protective management, depending on their specific conservation objectives and on the character and history of the landscape. Core areas naturally exclude the presence of significant human settlements. Besides non-destructive research, one activity of growing importance that typically can take place in the core areas of biosphere reserves is environmental observation and monitoring.

Fourth, core areas are generally surrounded by a buffer zone which is strictly delineated and very often corresponds, together with the core areas, to a single and autonomous administrative unit. Thus, a number of national parks that have been designated as biosphere reserves are constituted in fact by core areas namely, the strictly protected areas or the 'wilderness areas' of national park surrounded by a delineated buffer zone corresponding to the boundaries of the park. In some national parks where very limited human activity takes place, the core area may in fact be very large relative to the buffer zone.

Fifth, this buffer zone must have a clearly established legal or administrative status even when several administrators are involved in its management. Only activities compatible with the protection of core areas may take place. This includes in particular, research, environmental education and training as well as tourism and recreation or other uses carried out in accordance with the management requirements and regulations. Besides its other functions, the buffer zone may well serve to protect areas of land that could be used for experimental research.

Sixth, the core areas and the buffer zone are surrounded by a transition area that may also constitute a protective buffer corresponding to the 'outer buffer zone'. It serves several characteristic functions of biosphere reserve, particularly its developmental role. Usually, the transition area as a whole is not strictly delineated and corresponds more to biogeographic than administrative limits. It generally extends into large and open areas where efforts are made to develop co-operative activities between researchers, managers and local population. It is done with a view to ensure appropriate physical planning and sustainable resources development in the region while maintaining the greatest possible harmony with the purposes of the biosphere reserve. This broad and open area multiple-use area constitutes an 'area of cooperation' of the biosphere reserve where one of the main goals, the

association of environmental and development, is actively pursued.

Seventh, partly within the buffer zone or entirely outside, a biosphere reserve may include any one or some combination of following types of associated areas, used to develop knowledge and skills for ecosystem use and management: (a) Areas suitable for experimental manipulation to develop, assess and demonstrate methods for sustainable development; (b) Examples of harmonious landscape resulting from traditional patterns of land use designated as traditional use areas; and (c) Examples of modified or degraded ecosystems that are suitable for restoration to more natural conditions, designated as rehabilitation areas.

Eighth, experimental research areas where manipulative research on managed ecosystems is performed, are normally delineated by the research organisation concerned and may be entirely located outside the buffer zone. The latter situation corresponds to a type of 'cluster biosphere reserve'. This cluster concept refers more generally to a combination of a number of non-contiguous areas - and possibly of research and education centres or laboratories - serving the same or different functions of biosphere reserves. These areas and centres are not usually administered by the authority and hence the management of cluster biosphere reserve calls for coordinating mechanism through which the various administrative authority concerned - as well as the local population - will cooperate.

Biosphere Reserves : The First Twenty Years

The concept of biosphere reserves as originated by a Task Force of UNESCO's Man and the Biosphere (MAB) programme in early 1970s. It was launched in 1979 and as of March 1995, had grown to include 324 reserves in eighty-two countries.⁷ The network is key component in MAB's objective of achieving a sustainable balance between the sometimes - conflicting goals of conserving biological diversity, promoting economic development, and maintaining associated cultural values. Biosphere reserves are sites where this objective is tested, refined, demonstrated and implemented.

In 1983, UNESCO and UNEP jointly convened the First International Biosphere Reserve Congress in Minsk (Belarus) in cooperation with FAO and IUCN. The Congress's activity gave rise in 1984 to an 'Action Plan' for Biosphere reserves which was formally endorsed by the Governing Council of UNEP. While much of this Action Plan remains valid today the context in which biosphere reserves operate has changed considerably. The 'Convention on Biological Diversity' was signed at the Earth Summit in Rio de Janeiro in June 1992, entered into force in December 1993 and has now been ratified by more than hundred countries. The major objectives of convention are: (i) conservation of biological diversity; (ii) sustainable use of its component; (iii) and fair and equitable sharing of benefits arising from the utilization of genetic resources. Biosphere reserves

promote these integrated approach and are thus well placed to contribute to the implementation of the convention.

In the decade since the Minsk Congress, thinking about protected areas a whole and about the biosphere reserves has been developing along parallel lines. Most importantly link between conservation of biodiversity and the developmental needs of local communities - a central component of the biosphere reserve approach - is now recognized as a key feature of successful management of most national parks, nature reserves and other protected areas. The Fourth World Congress on National Parks and Protected Areas, was held in Caracas, Venezuela, in February 1992. The world's protected-area planners and managers adopted many of the ideas that are essential aspects of biosphere reserves, such as community involvement, the links between conservation and development, the importance of international networking system, etc. The Congress also approved a resolution in support of biosphere reserves.

There have also been important innovations in the management of biosphere reserves since then. New methodologies for involving stakeholders in decision-making process and resolving conflicts have been developed. There has been increased attention to need to use regional approaches. New kinds of biosphere reserves, such as cluster and trans-boundary reserves have been devised and many biosphere reserves have evolved considerably, from a primary focus on conservation to a greater integration of

conservation and development through increasing cooperation among stakeholders. And new international networks, fuelled by technological advances, including more powerful computers and Internet, have greatly facilitated communication and cooperation between biosphere reserves in different countries.

In this context, the Executive Board of UNESCO decided in 1991 to establish an Advisory Committee for Biosphere Reserves. This Advisory Committee considered that it was time to evaluate the effectiveness of 1984 Action Plan, to analyse its implementation and to develop a strategy for biosphere reserves in 21st Century. So UNESCO organised the International Conference on Biosphere Reserves at the invitation of Spanish authorities in Seville (Spain) from 20 to 25 March 1995. This Conference was attended by some four hundred experts from 102 countries and 15 international and regional organisations. The Conference was organized to enable an evaluation of experience in implementing the 1984 Action Plan. A reflection on the role of biosphere reserves in the context of 21st Century was also made. The Conference drew up the Seville Strategy.

Current trends in population growth and distribution, increasing demands for energy and natural resources, the erosion of cultural distinctiveness, uneven spread of technological innovations - all these paint a sobering picture of environment and developmental prospects in near future. The UNCED process laid out the alternative of

working towards sustainable development, including respect for rural communities and their accumulated wisdom. Agenda 21 and other multilateral agreements show the way forward at international level. But the global communities also needs working examples that encapsulate the ideas of UNCED for promoting both conservation and sustainable development. These examples can only work if they express all the social, cultural, spiritual and economic needs of society. Biosphere reserves offer such examples. Rather than forming islands in a world increasingly affected by severe human impacts, they can become theatres for reconciling people and nature, they can bring knowledge of the past to the needs of the future. In short biosphere reserves are much more than just protected areas. Thus it is poised to take on a new role. Not only will they be a means for the people, who live and work within and around them to attain a balanced relationship with natural world, they will also contribute to the needs of society as a whole by showing a way to a more sustainable future. This is at heart of vision for biosphere reserves in the 21st Century.

The International Conference on Biosphere Reserves, organized by UNESCO in Seville adopted a two-pronged approach. First, to examine past experience in implementing the innovative concept of biosphere reserve and second, to look at the future to identify what emphases should now be given to their three functions of conservation, development and logistical support.

The Seville Conference concluded that in spite of the problems and limitations encountered with the establishment of biosphere reserves, the programme as a whole had been innovative and had much success. In particular, the three basic functions would be as valid as ever in the coming years. In the implementation of these functions and in the light of analysis undertaken, the following key directions were identified by the Conference and are the foundations of the new Seville Strategy:⁸

First, Development of biosphere reserves that include a wide variety of environmental, biological, economic and cultural situations, going from largely undisturbed regions and spreading towards cities. There is a particular potential and need to apply the biosphere reserve concept in the coastal and marine environment. Second, strengthen the emerging regional inter-regional and thematic networks of biosphere reserves as components within the World Network of Biosphere Reserves. Third, ensure that all zones of biosphere reserves contribute appropriately to conservation, sustainable development and scientific understanding. Fourth, extend the transition area to embrace large areas suitable for approaches such as ecosystem management and use biosphere reserves to explore and demonstrate approaches to sustainable development. Fifth, reflect more fully the human dimensions of biosphere reserves. Sixth, promote the management of each biosphere reserve essentially as a 'pact' between local community and society as a whole. Seventh,

bring together all interest groups and sectors in a partnership approach to biosphere reserves both at site and network levels. Eighth, invest in the future.

In sum, biosphere reserves should preserve and generate natural and cultural values through management that is scientifically correct, culturally creative and operationally sustainable. The World Network of Biosphere Reserves, as implemented through the Seville Strategy, is thus an integrating tool which can help in creating greater solidarity among people and nations of the world.

1.3. LITERATURE SURVEY

The purpose of the literature review is to analyse how they differed from each other in method and focus and what is their perspective on the subject.

A survey of literature on the proposed topic give important facts. On the general study of biosphere reserves , UNESCO's published materials are quite relevant. UNESCO has produced many reports on status and futuristic role of biosphere reserves. They deal with the concept, objective, institutional arrangement for the study of biosphere reserve. Particularly UNESCO's "MAB Information System: Biosphere Reserves" is very much relevant. This was published in 1981. It contains basic information about various biosphere reserves of the world. UNESCO has prepared another report titled "Biosphere Reserves : The Seville Strategy and the Statutory Framework of the World Network", which was published in 1996. It contains the

recommendations of the International Conference on Biosphere Reserves, organized by UNESCO in Seville (Spain) from 20-25 March 1995. In this report conceptual framework for biosphere reserve is given. And various resolutions have been passed in respect to the implementation of biosphere reserves. It has examined the various implementational task of biosphere reserve. And it has adopted two-pronged approach. First to examine the past experience in implementing the innovative concept of the biosphere reserve. And second, to look into the future to identify what emphases should now be given to their three functions of conservation, development and logistic support. UNESCO's books are also available on Biosphere Reserves. The title of the book is "Ecology in Practice" which consists of two volumes. Both of them are edited books, which are collection of papers presented at a conference "Ecology in Practice - Establishing a Scientific Basis of Land Management held between September 22-29, 1981, organized by UNESCO and ICSU. UNESCO has also published another report titled "The Social Sciences in the Man and the Biosphere Programme". This is compilation of papers presented in the seminar represented by seven Asian countries including India. The role of social scientist in organizing and implementing the biosphere reserve has been highlighted. More importantly, various areas of research for social scientists have been proposed. It has suggested three methodologies for studying biosphere reserves.⁹ First,

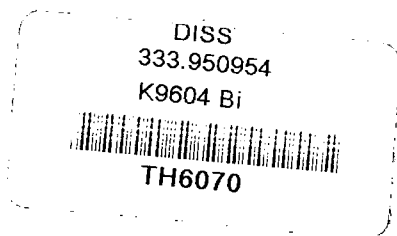
historical approach to establish nature and origins of a particular pattern of cultural adaptation and thereby to suggest how resilient it may be in the face of changing external forces. Second, participant observation in particular communities, to establish at the relevant scale. Third, sample surveys to get basic data of social and economic characteristics of a random sample of a population or of a group.

Ministry of Environment and Forests, New Delhi has also published a number of reports on biosphere reserves in India. The one book titled "Biosphere Reserve" was published in 1987 which is compilation of papers presented in First National Symposium on Biosphere Reserves held at Udhagamandalam (September 24-26, 1986). It is divided into four sections, viz. Management and Manpower Development, Environmental Education, Research Priorities, Economic Regeneration and Sympathetic Resource Utilization. These articles cover conceptual framework, management, research, monitoring and implementation aspects of biosphere reserves in India. S.S. Negi has written a book titled "Biodiversity and its Conservation in India". The book deals with biological diversity of India. It discusses in brief the diversity of plants and animals. The book contains fifteen chapters. According to Negi, biodiversity refers to the diversity of biological organisms, both animals and plants in region, country, continent or entire globe. He has described two types of conservation method.¹⁰ First ex-situ

conservation in which biological diversity is conserved outside the areas, viz., botanical, horticultural, recreational, zoological gardens. Second, in-situ conservation in which conservation is done at the natural habitat, viz., National Parks, Reserved and Protected Areas, Biosphere Reserves, etc. In the Chapter titled, "Biosphere Reserves", the author has discussed about different biosphere reserves in India.

P.R.Rao's book titled *Biodiversity in India: Floristic Aspects* deals with the diverse floral resources, distribution of vegetation types and enormous floristic diversity. Broadly, the floristic diversity and vegetation types of twelve different biographic zones of the country have been discussed in addition to the aquatic and wetland flora. The scope of this book is however limited to the community and species diversity and provides a full and overall view of vegetational diversity in the country. Though this book lacks sufficient field work and study of certain phytogeographically significant groups.

B.P. Pal has written a book titled, *Environmental Conservation and Development*. This book is collection of memorial lectures and articles written by the author in different journals. In the chapter titled, "The Environmental Imperatives of Development", the author has classified environmental problems in two types. First, those arising from conditions of poverty and under development, secondly those arising as negative



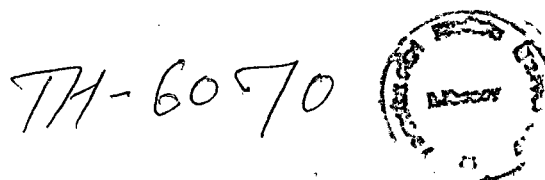
effects of the very process of development. The author is of opinion that a sound national policy on environment is needed. For its success, it will have to be backed by a massive programme of environmental education and environmental awareness.

Another book titled, *Understanding Environment*" has been written by M.S. Sethi and Inderjeet Kaur Sethi. The book comprises five sections. They are, the nature of environment, components of environment, environmental deterioration, population control; and society and environment. According to the authors, all living organisms together with the physical and chemical components of total environment make up the biosphere. It involves all the interactions between the living and non-living components that produce and affect life.

1.4. OBJECTIVES

The basic objectives of the proposed study are:

1. to examine the pattern of man-nature interaction the biosphere reserves. How the pattern of man-nature interaction has changed over time?
2. the role of biosphere reserves in maintaining biological diversity. How the biosphere reserves are more suitable for conservation of biological diversity in India.
3. to examine the role of biosphere reserves in integrated conservation in India.



4. the participation of local population in maintaining biosphere reserves .

1.5. HYPOTHESIS

The hypothesis is: system of Biosphere Reserves is most effective tool of conserving biological diversity.

1.6. SOURCES OF INFORMATION AND METHODOLOGY

The research work is primarily based on secondary sources of information. The major sources of information have been books, journals, UNESCO's reports and some government documents.

The methods employed include descriptive and analytical. Attempts have been made to analyse the man-nature interaction in given biosphere reserves. Extensive literature survey has been taken up in order to ascertain the basic facts about biosphere reserve. And finally the role of biosphere reserves in conserving the biological diversity has been looked upon. The prospects of biosphere reserves in 21st century have also been described. The study is descriptive and analytical.

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CHAPTER II

CONSERVING BIOLOGICAL DIVERSITY IN INDIA: A RETROSPECT

2.1. PHYSICAL FEATURES:

The Indian subcontinent comprises four regions, namely, the great Himalayan zones, plains of the Ganga and Indus, the desert region and southern peninsula.

The Himalayas comprise three almost parallel ranges interspersed with large plateaus and valleys, some of which like Kashmir and Kullu valleys, are fertile, extensive and of great scenic beauty. Some of the highest peaks in the world are found in these ranges. The high attitudes limit travel only to a few passes notably the Jelep La and Nathua La on the main Indo-Tibet trade route through the Chumbi valley, north-east of Darjeeling and Shipki La in Satluj Valley, north-east of Kinnaur. The mountain ranges extend over a distance of about 2,400 km. with varying width of 240 to 320 km. In the east, between India and Myanmar and India and Bangladesh, hill ranges are much lower, Garo, Khasi, Jaintia and Naga Hills, running almost east-west join the chain to Mizo and Rakhine Hills running north-south.

The great plains of Ganga and the Indus are formed by basins of three distinct river systems namely the Indus, the Ganga and the Brahmaputra. They are about 2,400 km long and 240 to 320 km. wide. Between the Yamuna at Delhi and the

Bay of Bengal, nearly 1,600 km. away, there is a drop of only 200 metres in elevation.

The desert region can be divided into two parts - the great desert and little desert. The great desert extends from the edge of the Rann of Kachchh beyond the Luni northward. The whole of Rajasthan-Sind Frontier runs through this. The little desert extends from Luni between Jaisalmer and Jodhpur upto northern wastes. Between these two deserts, there lies a zone of absolutely sterile country consisting of rocky land cut-up by limestone ridges.

The Peninsular Plateau is marked off from the plains of the Ganga and the Indus by a mass of mountain and hill ranges varying from 460 to 1,220 metres in height. Prominent among these are the Aravalli, Vindhya, Satpura, Maikala and Ajanta. The Peninsula is flanked on one side by the Eastern Ghats where average elevation is about 610 metres and on the other by the Western Ghats where it is generally from 915 to 1220 metres, rising in places to over 2400 metres. Between the Western Ghats and the Arabian Sea lies a narrow coastal strip, while between the Eastern Ghats and the Bay of Bengal there is a broader coastal area. The southern point of plateau is formed by the Nilgiri Hills where the Eastern and Western Ghats meet. The Cardamom Hills lying beyond may be regarded as a continuation of the Western Ghats.

2.2. BIOLOGICAL DIVERSITY:

Biological diversity is the sum total of species richness, i.e. number of species of plants, animals and micro-organisms occurring as individuals, population, community or an ecosystem.¹ Biodiversity is a part of the biosphere supported by biological processes and organic evolution.

The Indian sub-continent has wide range of climatic conditions from the torrid to the arctic. This has given rise to a great variety of forests and taxa. It accounts for two per cent of the earth's area. While it has more than 21,000 species of living higher plants, which is more than ten per cent of the species in the world. Though the Malayan floristic element is dominant, African, Tibetan-Siberian, Sino-Japanese, Mediterranean and other flora are represented. The forest cover is presently estimated at 14.1 - 19.6% of the total area. Similarly, India has a great variety of fauna numbering a little over 8,100 species, which represent 6.5 per cent of world's fauna. Of these, insects constitute about 57,000 molluscs, a little over 5,000, mammals 372, birds 1,228, reptiles 428, amphibians 204 and fishes 2,546²

Faunal Resource: India has a great variety of fauna which is widely distributed among different ecological regions of the country. The country accounts for more than six per cent of world's fauna. The mammals include the majestic elephant,

the gaur or Indian bison, the great Indian rhinoceros, the gigantic wild sheep of the Himalayas, the swamp deer, nilgai, four-horned antelope, etc. Among the cats, the tiger and lion are the most magnificent of all; other splendid creatures such as the clouded leopard, the snow leopard, the marbled cat are also found. Many other species of mammals are remarkable for their beauty, colouring, grace and uniqueness.

Rivers and lakes harbour crocodiles and gharials, the latter being the only representative of crocodylian order in the world. The salt water crocodile is found along the eastern coast and in the Andaman and Nicobar Islands. A project for breeding crocodiles, started in 1974, has been instrumental in saving the crocodile from extinction.

The great Himalayan range has a very wide range of fauna that includes wild sheep and goats, markhor, ibex, shren and tapir. The lesser panda and the snow leopard are also found in the upper reaches of the mountains. Of these animals, 81 species of mammals, 47 of birds, 15 of reptiles, three of amphibians and a large number of butter flies are listed as endangered. The Zoological Survey of India, with its headquarters in Calcutta and 16 regional stations located in different parts of the country, is responsible for surveying the faunal resources of our country. Thus the country has a wide range of faunal resource which should be protected by different methods of conservation.

Floral Resource: India has a wide range of climatic conditions from the torrid to the arctic which has given rise to rich and varied vegetation. India can be divided into nine floristic regions, namely, Western Himalaya, Eastern Himalaya, North-east hills, Indo-Ganga plains, western desert region, Central India, Deccan Plateau, Malabar region/Western Coast and Bay of Islands.³

First, Western Himalaya: This comprises Jammu and Kashmir, Himachal Pradesh and the Uttar Pradesh hills. It is one of the most interesting regions of the world with climate and vegetation varying from tropical to temperate, arctic, and even arid type. The following are some sub-divisions of this region. (i) Sub-Montane or outer region: It consists of the tract between 300 and 1,500 mts. The forest is dominated by Shorea robusta, in riverine successions Shisham and Khair occur. On elevations over 1,000 mts. Chir pine begins to appear. (ii) Temperate or Montane Region: This region ranges from about 1,500 to 3,500 mts. In the lower parts of this zone, Chir pine is the main species, which is gradually replaced at higher altitudes by blue pine, fir and spruce. Deodar forests are abundant between 1,600 and 1,900 mts. (iii) Alpine Region: This region represents the uppermost limit of tree growth at over 3,300 mts. Stunted growth and grassy meadows are common. This zone gradually merges into the zone of permanent snow which is above 3,500 mts.

Second, Eastern Himalayas: This region comprises the Darjeeling hills, Sikkim and Arunachal Pradesh. Sub-Montane zone extends from the plains to about 1,800 mts. altitude. Sal, Shisham, Khair are common trees in this zone. Temperate region extends from about 1,800 to 3,500 mts. The region comprises of several species like Junipers, Picea, Abies, etc. Alpine region is uppermost zone and comprises all vegetation-bearing areas over 3,500 mts. altitude. In this zone, there is a dominance of shrubs and stunted dwarf trees.

Third, North-Eastern Hills: This region comprises a series of hill ranges occurring in the extreme north of the country covering parts of Mizoram, Manipur, Tripura, Meghalaya, Nagaland, etc. The Garo, Khasi, Jaintia, Mikir and Mishmi hills are main ranges. Very dense forests occur in this region. Some of the main species are *Mesua ferra*, *Pinus khasia*, *Pinus insularis*, *Dillenia Indica*, etc.

Fourth, Indo-Ganga Plains: This region comprises the flat alluvial, fertile plain of the river Ganga and tributaries of the river Indus. The Western region has dry conditions which have given rise to a Khair-Sissoo dominant vegetation. The Upper Ganga plain has common species, namely, *Acacia caatechu*, *Tamarix*, *Sachharum*, etc. The middle Ganga plain comprises the species of *Madhuca Indica*, *Ziziphus*, *Acacia Catechu*, etc. The Bengal region has swamp/delfaic vegetation.

Fifth, Western Desert Region: It comprises parts of Rajasthan, Delhi, Haryana and Gujarat. Important species are Acacia Senegal, Boswellia serrata, S. persica, Boswellia serrata, etc.

Sixth, Central India: This region comprises parts of Madhya Pradesh, Orissa and Gujarat. Depending upon the intensity and distribution of rain, soil conditions and topographic factors, the following are the main forest types:⁴ (i) open, thorny forests, mainly scrub and arid vegetation, (ii) Mixed deciduous forests, and (iii) Sal forests. The southern limit of Sal occurs in this zone. Rich Sal forests have developed in the northern portion of this zone, whereas teak forests occur in the Southern part.

Seventh, Deccan Plateau: This region comprises the plateau occurring to the south of the central Indian zone. The climate is relatively dry with the rainfall received annually about 1,000 mm. Extensive teak forests have developed in this zone.⁵

Eighth, West Coast/Malabar Region: This region comprises the West Coast of the country climatically; this region experiences a typical coastal climate, very heavy rainfall is received from the moisture-bearing winds from the Arabian Sea. The vegetation is very rich. It includes the virgin tropical monsoon forest of Silent Valley. The following are the four main types of forests, which occur in this region: (i) Tropical moist evergreen forests, (ii)

Sub-tropical evergreen forests, (iii) Mixed deciduous forests, and (iv) Mangrove forests.

Ninth, Bay Islands: The Andaman and Nicobar chain of islands in the Bay of Bengal forms a distinct ecological unit. Forests are mangroves, evergreen forests and beech forests. Dry type vegetation also occurs. Trees may attain very great heights.

2.3. **FOREST ECOSYSTEM**: India's forests occupy an area of about 6,39,182 sq.kms. which is 19.44 per cent of the total geographical area of the country. These forests are found in different parts of the country, from Kashmir to Kanyakumari and from Rajasthan to Tripura. The widely accepted classification of forest types/ecosystems in India has been given by Champion and Seth (1968). On the basis of this classification the forest ecosystems may be grouped into four type groups, each of which is made up of a number of groups. The groups in turn include forest types. They are following:⁶

<u>Type Groups</u>	<u>Percent of forest area</u>	<u>Main Distribution</u>
I. Tropical Group		
1. Tropical Wet Evergreen Forest	8.0	North-east and South India; Bay Islands
2. Tropical Semi-Evergreen Forest	4.1	Southern and Eastern India
3. Tropical Moist Deciduous Forest	37.0	Central and Eastern India
4. Tropical Littoral and Swamp Forest	0.6	Along the Coast

5. Tropical Dry Deciduous	28.6	Western and Central India
6. Tropical Thorn Forest	2.6	Western and Central India
7. Tropical dry evergreen	0.02	Central and Southern India
II. Sub-tropical Group		
8. Sub-tropical broad leaved hill forest	0.4	Southern India
9. Sub-tropical pine forest	6.6	Sub-Himalayan Tract
10. Sub-tropical dry evergreen forest	2.5	North-east and Southern India
III. Temperate Group		
11. Montane Wet Temperature Forests	3.6	Himalaya and Nilgiri Hills
12. Himalayan Moist Temperate Forests	3.4	Temperate Areas of the Himalaya
13. Himalayan Dry Temperate Forests	Neg.	Dry Temperate Areas of the Himalaya
IV. Sub-Alpine and Alpine Group (2.9% for group)		
14. Sub-Alpine Forest		Sub-Alpine Areas of the Himalaya.
15. Moist Alpine Scrub		Moist Alpine Areas of the Himalaya
16. Dry Alpine Scrub		Dry Alpine Areas of the Himalaya

Though the forest cover is presently estimated at about 19 per cent of the total area, the rate of loss is 1.3 million hectare per year. While 33 per cent of total geographical area should be covered with forest in order to maintain ecological balance. There is an urgent need for

afforestation programme. Likewise faunal resources are also depleting due to loss of their natural habitat. Several faunal species are on the verge of extinction. In this regard, Indian government has started several programmes of conservation. And measures adopted by the Government of India are being discussed now.

2.4. CONSERVATION OF BIOLOGICAL DIVERSITY:

The conservation of biodiversity is a holistic concept and encompasses a wide spectrum of biota and of activities. Conservation of biological diversity is essential for the survival of the human race. The World Commission on Environment and Development (WCED) constituted by the General Assembly of the United Nations in 1986 provided a major boost and endorsement to the need for conserving the world's rich biodiversity particularly that of the tropical areas. In 1992, the 'Earth Summit' held under the auspices of UNCED at Rio de Janeiro adopted a convention on biological diversity. It laid stress on the integration, as far as possible of conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

India's first protected area for the conservation of biological diversity was established about two hundred years back in Tamil Nadu. It was known as Vedanthangal Bird Sanctuary and this area has served as a nucleus for conservation of rich aquatic avifauna of South India.

However, India did not have a national park till the thirties of this century when the Corbett (then Hailey) national park was established. Since then over eighty national parks and 441 sanctuaries have been constituted which cover over 4.5 per cent of the total geographical area of the country.

Ex-situ and In-situ Conservation:

Biological diversity (both animal and plant species) may be conserved outside the areas where they naturally occur and also in their natural habitat. The former ex-situ conservation while the latter is known as in-situ conservation.⁷

In ex-situ conservation, animals and plants are reared/cultivated in areas outside their natural habitat. Animals may be conserved in this way in zoological parks or zoos, where species found in far away places may be reared. There are a number of animal species which have become extinct in the wild. They are being conserved in zoos, e.g., cheetah.

Re-introduction of an animal or plant in the habitat where it has become extinct is another form of ex-situ conservation. The great Indian rhinoceros has been re-introduced in the Dudhwa National Park, an area from where it had become extinct. In the same way re-introduction of threatened plant species is done in the areas from where they have become extinct. Botanical,

horticultural and recreational gardens are important centres for the ex-situ conservation of plant species.

In-situ conservation pertains to conserving animals and plants in their natural habitats. The following areas may be set aside for in-situ conservation: (i) National parks and sanctuaries, (ii) Biosphere reserves, (iii) Nature reserves, (iv) Reserved and Protected forests, (v) Reserved trees, and (vi) Preservation plots and Sample plots.

Important in-situ and ex-situ conservation programmes are being discussed.

National Parks and Sanctuaries

These are legally constituted protected areas for conserving both the flora and fauna of a region. In India, the Wildlife Protection Act of 1972 empowers the State governments to declare an area as a sanctuary or national park after following the procedure that has been laid down.

Chapter IV from Section 18 to 38 of the Wildlife (Protection) Act, 1972 deals with sanctuaries, national parks, game reserves and closed areas. Section 18 to 34 deal with sanctuaries, section 35 with national parks and section 36 and 37 with game reserves and closed areas respectively. All kinds of destruction, exploitation and removal of wildlife and any damage to the habitat of any animal is strictly prohibited inside a national park. In sanctuaries, no person is allowed to move freely except with the permission of sanctuaries authorities. The permanent

residents of the area are bound to perform certain duties such as helping in controlling fire damage; to report about dead animals and to render all kinds of help in arresting the offenders. Inside a sanctuary, the carrying of weapons without permission, setting fire to sanctuary, use of explosives and chemicals are strictly prohibited. The network of protected areas consists of 80 National Parks and 441 Sanctuaries in the country.

Game Reserves

Under Section 36, the State Government, by notification, may declare any area to be a game reserve and no hunting of wild animals is permitted in such a reserve except with the prior permission of the concerned authorities. Under Section 37 of Wildlife (Protection) Act, 1972, the State government by notification may declare any area closed to hunting for such period as may be specifically mentioned in the notification.

Botanical Gardens

A botanical garden may be described as a living repository of plants that are arranged and maintained on scientific lines and where collections are systematically labelled and marked for identification. The aims, objectives and functions of Botanical Gardens are as follows: First, study and conservation of the diversity of plant life of region. This is also known as ex-situ conservation under which rare and threatened plants may be

raised in a botanic garden so as to conserve them for posterity. Second, to serve as a living repository of plants of the country. Third, to house the germ plasm collection of selected plants of economic, agricultural, ornamental and medicinal importance and their wild progenitors. Fourth, to create an awareness in the general public, particularly students towards plants and the environment.

In India, botanical gardens are managed by the Botanical Survey of India.

Zoological Parks

Zoological Parks are important centres for the ex-situ conservation of wild animals, particularly those which are rare and threatened with extinction. In India, the first zoo was probably started in 1854 by Raja Mullick Bahadur in then private mansion in the centre of Calcutta. In 1885, a zoo was set up by the Municipality of Madras in a eight hectare area near the railway station. Now several zoological parks have been established in different parts of the country. They have become centres for conservation of biological diversity, captive breeding and for creating an awareness towards nature amongst the common man. India's zoos are facing some constraints in their development and management. They have paucity of funds, dearth of adequate and qualified staff, shortage of space for expansion, etc. Apart from the above mentioned conservation programmes, the

Government of India has also started two other projects, namely, Project Tiger and Project Elephant.

Project Tiger

It is a centrally sponsored scheme which was launched on 1 April 1973, to achieve the following objectives:⁸ First, to ensure maintenance of a viable population of tigers in India for scientific, economic, aesthetic, cultural and ecological values. Second, to preserve for all times, areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people.

Presently, there are twenty-three Tiger Reserves in fourteen States of the country, covering an area of 33,000 sq.kms.

Project Elephant

Project Elephant was launched in 1991-92 to assist the States having free ranging populations of wild elephants to ensure long term survival of identified viable populations of elephants in their natural habitats. The States are being given financial as well as technical and scientific assistance in achieving the objectives of the project. The main activities of Project Elephant are as follows:⁹ First, ecological restoration of existing natural habitats and migratory routes of elephants. Second, development of scientific and planned management for conservation of elephant habits and viable population of wild Asiatic

elephants in India. Third strengthening of measures for protection of wild elephants from poachers and unnatural causes of death. Fourth, research on Project Elephant management related issues.

The purpose of establishing national parks and sanctuaries has not been fully served. Protected areas have improved the floral and faunal resources of the country to a lesser extent. Since the exclusion of humankind from management of protected areas has been something of a blow to rural India's masses who have lived in and off the forest for centuries. So a comprehensive in-situ conservation programme known as biosphere reserve has been started in the country. This programme has added advantage over the other protected areas in the sense that participation of local people in management of the area is encouraged. So status of Biosphere Reserves is being looked into in the next chapter.

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CHAPTER III

STATUS OF BOISPHERE RESERVES IN INDIA

3.1. BACKGROUND

In order to initiate action of the man and biosphere programme, Indian National MAB Committee was constituted in 1972.¹ It functions as an advisory body to catalyze action on research and other issues related to the biosphere reserves programme.

The Indian region with a total area of about 329 million hectares is rich in its biological diversity and origin of several cultivated plants in the world as identified by the famous Russian Botanist, N.I. Vavilov. It is estimated that about 45,000 species of plants occur in India, of which the flowering plants alone account for 15,000 species.² Among these, 30 per cent of flowering plants are endemic to India. Similarly, this region is also rich in fauna, containing about 65,000 species. So in India, about 7 per cent of world's flora and 6.5 per cent fauna are available. Many of the plant and animal species have become rare and endangered and need immediate protection.³ Their protection through in-situ conservation method constitutes an important activity of biosphere reserves programme. To achieve this objective, in 1979, the Government of India constituted a Core Advisory Group of

Experts, which identified and prepared a preliminary inventory of potential areas for recognition as biosphere reserves. The Group also recommended the priorities for taking up areas. Accordingly, experts were located within the country and requested to prepare comprehensive project documents, taking into account, the diverse parameters involved and make specific recommendations on the boundaries, structure, management, etc. of the proposed biosphere reserves as single viable unit.

3.2 BIOGEOGRAPHIC REGIONS OF INDIA

India lies at the junction of three biogeographical provinces of Africa, temperate Eurasia and orient.⁴ As a result, it has a rich biological heritage that qualifies it as one of the 12 megadiversity nations of the world.⁵ India is a tropical country with a tremendous heterogeneity of environments ranging from tropical rainforests of Andaman and Arunachal Pradesh to deserts of Rajasthan and Ladakh. For the first time, Indian sub-Continent was divided into eight biogeographic regions by Blandford in 1901. They are as follows:⁶

- i) Punjab and adjoining semi-arid and desert regions
- ii) The alluvial plains of Ganges and lower Brahmaputra
- iii) The Western Peninsula tract excluding the Western Ghats
- iv) The Eastern Peninsular tract
- v) The Western Ghats or Sahyadris and West Coast
- vi) Ladakh and adjacent regions

vii) The forested hill slopes and Himalayas

viii) Assam and adjacent hill tracts.

Bladdford's classification has been modified by Udvardy in 1975. He considered the factors of biogeography and biome types, and divided Indian sub-Continent into twelve biogeographical provinces.⁷ They are following:

- 1) Himalayan highlands
- 2) Thar Desert
- 3) Malabar rainforest
- 4) Indus-Ganges monsoon forest
- 5) Deccan Thorn Forest
- 6) Coromandel
- 7) Mahanadian belt
- 8) Bengalian rainforest
- 9) Burma monsoon forest
- 10) Laccadives Islands
- 11) Maldives and Chagos Islands
- 12) Andaman and Nicobar Islands.

Indian biosphere reserves are based on above mentioned biogeographic provinces. And biosphere reserves are being established in representating biogeographic region of the country.

3.3 BIOSPHERE RESERVES IN INDIA

An expert committee constituted in the Department of Science and Technology called the core advisory committee

which identified fourteen areas which could be demarcated as biosphere reserves in the country.⁸ They are following:

<u>Biosphere Reserves Sites</u>	-	<u>States</u>
1. Great Nicobar	-	Andaman & Nicobar Islands
2. North Andaman	-	Andaman & Nicobar Islands
3. Namdhapa	-	Arunachal Pradesh
4. Manas	-	Assam
5. Kaziranga	-	Assam
6. Rann of Kutch	-	Gujarat
7. Kanha	-	Madhya Pradesh
8. Nokrek	-	Meghalaya
9. Thar Desert	-	Rajasthan
10. Gulf of Mannar	-	Tamil Nadu
11. Nilgiri	-	Karnataka, Kerala and Tamil Nadu
12. Nanda Devi	-	Uttar Pradesh
13. Uttarakhand (Valley of Flowers)	-	Uttar Pradesh
14. Sunderbans	-	West Bengal

These sites have been selected on the basis of comprehensive floral and faunal analysis of these areas as well as the nature of these areas which represents a characteristic bio-mass.

Under this scheme, the first biosphere reserve was set up in the Nilgiri in 1986. So far, following eight biosphere reserves have been set up in the country.⁹ They are (1) Nilgiri, (2) Nanda Devi, (3) Gulf of Mannar, (4) Great Nicobar, (5) Simlipal, (6) Nokrek, (7) Manas, and (8) Sunderbans. Major objectives of biosphere reserves in India are following:- First to promote research on ecological conservation and other environmental aspects. Second, to conserve the diversity and intensity of plants, animals and

micro-organism. Third, to promote facilities for education, awareness and training.

The details of each biosphere reserve is being discussed below.

I. Great Nicobar Biosphere Reserve

The Great Nicobar island is the Southernmost island of the Andaman and Nicobar group of islands. It is also Southernmost landmass of the country. This island is located at about 482 kms to the South of Port Blair and 145 km to the North of the Northern tip of Sumatra. The Great Nicobar island is about 55 km long stretching from Murray point in the North to the Pygmalion point in the South. In the North, this island is about 30 km wide but narrow down to about 3 km in the South. It encompasses an area of about 145 sq.km.

The island supports a unique combination of floral and faunal assemblage that has given rise to the need for preserving it for posterity.

Forest types and flora:

The following forest types are found in the Great Nicobar island -

- (a) *Adanthera payonia*, *Albizzia lebbek*, *Calophyllum soulattri*, *Magniferra sylvatica*;
- (b) Hill top tropical evergreen forest: *Canarium Manil*, *Cratoxylon Formosum*, *Dipterocarpus costatus*, *Euphoria* sp.;
- (c) Wet bamboo bracks: *Bambosa* sp., *Dendrocalamus* sp., *Oxytenanthera* sp.;

(d) Semi-evergreen forest: Albizzia Chinesis, Albizzia lebbek, Artocarpus chaplasha;

(e) Moist deciduous forest: Albizzia Chinesis, Pterocymbium sp., Terminalia bilata, Terminalia procera;

(f) Littoral forest: Calophyllum Chophyllum, Casuarina Equisteifolia, Terminalia Catappa;

(g) Mangrove Forest: Arcca triandra, Avicennia officinalis, Bruguiera conjugata, Bruguiera Parviflora, Carellia branchiata, Ceriops tagal;

(h) Heritiera Forest: Barringtonia asiatica, Barringtonia, Racemosa, Heritiera littoralis, Acanthus sp., Brownlowia.

Fauna - (a) Mammals: Squirrel, Fruit bat, Black Monkey, Wild Pig, Rat, Blue Whale, Pugong; (b) Birds - Megapodes, Green Imperial Pigeon, Nicobar Pigeon, Myna, Jungle Fowl, Parrot, koel; (c) Reptiles - Python, Crocodile, Water lizard.

II. North Andaman Biosphere Reserve

The Andaman and Nicobar group of islands lying in the Bay of Bengal cover a total area of 8235 km. The highest point in these islands is the Saddle Peak (732 mtrs) situated in the North Andaman island. The next highest point is Mount Harriet in the South Andaman. The two group of islands are separated by ten degree channel. The North Andaman island lies in the Northern part of the Andaman group of islands. It encompasses an area of about 1376 sq.km. of which 1248 sq.km. are covered by forests. Other areas falling within this biosphere reserve are Interview

Island, Buchanah, Boudaville, Bennet, numerous small islands in the Austen Strait, sound, Stewart. The North-western coast includes the lagoon near Temple sound, Bluff point, many islands in the Elizabeth Bay.

The following core areas have been identified in this biosphere reserve -

(a) Saddle Peak : It is the highest tract in the Andaman and Nicobar group of islands. It has already been declared as a national park for the conservation of rare stunted evergreen forests covering the hill slopes and fauna living in them.

(b) Dense creeks on the Northern part of the North Andaman island: The dense creeks on the Northern part of Andaman island have been delineated as a core area. These bear dense mangrove forests.

(c) Creeks near Austen Strait: The creeks near Austen Strait in the South have also been identified as another core area. This tract too bears dense mangrove forests.

The most important sustaining factor for the maintenance and growth of the land towards the sea is the mangrove ecosystem. The mangroves progress towards the sea and bring about a growth in the land. They also afford protection of existing land area.

Forest types and Flora: Bulk of the total land area of this biosphere reserve is under a forest cover. The following forest types are found in this tract:

(a) Giant Evergreen Forest: *Artocarpus chaplasha*, *Artocarpus gomeziana*, *Calophyllum soulattri*, *Dipterocarpus grandiflorus*.

(b) Tropical Evergreen Forest - *Artocarpus chaplasha*, *Hopea odorata*, *Caryoto* sp..

(c) Semi-evergreen Forest - *Albizia chinensis*, *Albizia lebbek*, *Artocarpus chaplasha*, *Artocarpus lakoocha*, *Calophyllum soulattri*.

(d) Moist Deciduous Forest - *Albizia libbek*, *Chukrasia tabularis*, *Layerstroemia hypoluca*, *Pterocarpus dalbergioides*, etc.

(e) Hill-top Evergreen Forest - *Canarium manii*, *Cratoxylon formosum*, *Dipterocarpus costatus*, *Euphorbia epiphyllodes*, *Euphorbia trigona*.

(f) Secondary Moist Deciduous Forest - *Canarium euphyllum*, *Pariswa insignis*, *Salmalia insignis*, *Sederxylon longipetiolatum*.

(g) Littoral Forest - *Manilkara littoralis*, *Barringtonia asiatica*, *Calophyllum inophyllum*, *Cordia subcordata*, etc.

(h) Mangrove Forest - *Areca triandra*, *Aricennia officinalis*, *Bruguiera conjugata*, etc.

Fauna: The North Andaman biosphere reserve is extremely rich in fauna ranging from microfauna to insects, amphibians, reptiles, birds and mammals.

III. Namdhapa Biosphere Reserve

The Namdhapa biosphere reserve constitutes one of the ecologically richest biotic communities in India.¹⁰ It is located in Lohit and Tirap districts in the South-eastern part of Arunachal Pradesh. The Namdhapa biosphere reserve has been divided into following zones -

1. Core Zone: The core area of the biosphere reserve covers an area of over 2,500 sq km falling within both Tirap and Lohit districts. It is divided into two equal parts by Daphla Bum ridge. In the upper reaches there occur glaciers and alpine meadows particularly at the headwaters of the river La Ti. This tract is remote and inaccessible. Within the core area, a stable climax ecosystem is found in an area about 1200 sq.km., viz. the Diyun valley on the Northern slopes of Patkai mountains. Dense forests are found in the main Nao Dihing or Diyun valley.

2. Buffer Zone A: The buffer zone comprises following tracts

(i) Kulung river valley bearing extensive coniferous forests,

(ii) Kamlang river valley, (iii) the Kumon Bum ridge that closes at the upper reaches of the Diyun river, (iv) the evergreen forests along the Western slopes of Miao Bum-Nanon Bum-Teng Bum ridge.

3. Buffer Zone B: This buffer zone includes the following tracts:-

(i) the Manabum and Diyun reserved forests along the rivers Diyun and Deban, and (ii) the forests of the Honkap ridge North-east along the Nangthawa stream to Miao and also South of Honkop to the Pangsau ridge.

The vegetation in several parts of this buffer zone has been disturbed particularly in the Manabum ridge. Thus, there is need to nurse this area back to health.

4. Command Zone: The command zone or area has been constituted to serve as the feed area of the biosphere reserve. It functions as recipient of inputs of various kinds.

Forest types and Flora: The following types occur in this biosphere reserve:

- (a) Tropical Evergreen and Semi-evergreen - *Ailanthus granids*, *Bauhinia purpusea*, etc.
- (b) Secondary Wet Mixed Forest: *Actino daphane obovata*. *Ailanthus grandis*, *Elaco carpus* Sp. etc.
- (c) Moist Mixed Deciduous Forest: *Aphanamias polystachya*, *Cedrela founa*, *Dillenia pentagyna*.
- (d) Hollock Forest: *Ailanthus granids*, *Amoora wallichii*, *Dunbanga grandiflora*, *Biscobia javanica*.
- (e) Sub-tropical Wet Hill Forest: *Calophyllum polyanthum*, *Phoebe attenuata*.

- (f) Wet and Moist Temperate Forest: Lauraceous forest, Buk Oak forest, High level Oak forest, Mixed coniferous forest.
- (g) Sub-alpine Forest and Pasture.
- (h) Moist alpine scrub.

Fauna (a) Mammals - Tiger, Leopard, Golden Cat, Common Langur, Jackal, etc.

(b) Birds - Black Eagle, Shahin, Hobby
Jungle Crow, Jungle Fowl,
Spotted Dove, etc.

IV. Manas Biosphere Reserve

This biosphere reserve is situated at the foot of the Bhutan hills in Assam on the northern bank of the river Brahmaputra. The Manas sanctuary lies in this biosphere reserve.¹¹ The terrain has a gradual slope towards south. The area is drained by river Manas and its tributaries including the Hakua. The rivers have formed pebble banks and channel islands as they leave the Bhutan hills.

Forest Types and Flora

1. Tropical Wet Evergreen Forest: *Altingia excelsa*, *Amoora Wallichii*, *Artocarpus*, *Chaplasha*, *Dipterocarpus macrocarpus*.
2. Cane and Bamboo Brakes: *Bambusa balcooa*, *Bambusa pallida*, *Calamus* sp.
3. Moist mixed deciduous forest: *Adina Cordifolia*, *Dillenia pentagyna*, *Gmelina arborea*, etc.

4. Creeper Swamp Forest: *Antingia* sp., *Litsea* sp., *Magxolia griffithi*, etc.

5. Eastern Seasonal Swamp Forest.

6. Low Swamp Forest.

Fauna: Some of important faunal species found in this biosphere reserve are:

(a) Mammals: elephant, Indian rhinoceros, Gaur, Wild buffalo, Swamp deer, Leopard, etc.

(b) Birds: Little Grebbe, Grey heron, Painted Storck, Spotbill duck, etc.

(c) Reptiles: Common sand boa, King Cobra, etc.

(d) Fishes: Katli, Chanja, Labeo.

5. Kaziranga Biosphere Reserve:

The Kaziranga biosphere reserve encompasses the Kaziranga national park and its adjoining tract in Assam. This region is important for its population of the Indian one-horned rhinoceros, elephant wild buffalo and many other species. The terrain lies along the river Brahmaputra. The main geomorphic features include river islands, old channels and swamps. The general slope of land is towards the Brahmaputra. A number of tributaries of the main river flow through this tract. These too have formed extensive swamps and marshes.

Forest Types:

1. Assam Valley evergreen forest. These are dense, mixed evergreen forests. The forest soil is rich in humus.

The main species are: *Ailanthus grandis*, *Amoora wallichii*, *Canarium sp.*, etc.

2. Cane and Bamboo Brakes: This forest type comprises an impenetrable thorny thicket formed primarily by bamboos and canes. The main species are: *Bambusa balcosa*, *Bambusa pallida*, etc.

3. Syrgium parkland: This is an open stand consisting of low crowned trees that may attain a height of about three metres. It is well developed on heavy alluvial soils. The main species are: *Antiderma diandrum*, *Bridelia sp.*, *Emblica officinalis*.

4. Creeper Swamp land: This consists of a almost impenetrable swamp forest in which trees support a dense growth of creepers.

5. Seasonal Swamp Forest: This is a dense forest occurring in the swamps and marshes of this biosphere reserve.

Fauna: The Kaziranga biosphere reserve is the home of rhinoceros, elephant, wild buffalo, tiger, leopard, wild boar, etc. Many interesting species of both terrestrial and aquatic birds and reptiles are also found in this biosphere reserve.

VI. Rann of Kutch Biosphere Reserve:

The Rann of Kutch is a vast saline wasteland situated in the western tip of Gujarat. A part of this tract is inundated by sea water from time to time. It is one of the

most interesting areas so far as the floral and faunal assemblage and physiography is concerned.

This is a vast wilderness that is subjected to frequent flooding. There occur many marshes and swamps. Areas of higher ground which are not usually submerged are known as bets.

Flora: The principal vegetation types found in this biosphere reserve are:

1. Mangrove Scrub: This is a dense forest with low average height. Well developed near the sea coast. The main species are: *Acanthus ilicifolius*, *Aejialitics* sp. etc.

2. Rann Saline Thorn Scrub: This forest type is extensively developed in the Rann of Kutch. The tract is inundated by the sea from time to time. The main species are: *Acacia* sp., *Calotropis procera*, etc.

3. *Salvadora* Scrub: This is a characteristic association of arid saline/alkaline soils found in the Rann of Kutch. The main species are: *Calotropis procera*, *Salvadora oleoides*, etc.

Fauna: This biosphere reserve is the only home of the Asiatic wild ass. Large herds roam in this tract. They migrate from one place to the other and move to higher ground when the saline waste land is inundated. Other animals include the desert cat, wolf, hyaena, black buck and many species of aquatic and terrestrial birds including Great Indian bustard.

VII. **Kanha Biosphere Reserve**: It is situated in Madhya Pradesh and is one of the richest forest areas of India. The Kanha National Park forms a part of this biosphere reserve. The terrain comprises low rolling hills which are part of the hills on the northern part of peninsular India. A number of rivers and streams drain this area and contribute their waters to the Bay of Bengal.

Forest Types and Flora:

1. Moist Teak Forest: *Adina cordifolia*, *Anogeissus latifolia*, *Dalbergia sissoo*, etc.
2. Moist mixed Deciduous Forest: *Ficus scholaris*, *Delbergia latibolia*, *Euminalia crenulata*, etc.
3. Dry Teak Forest: *Adina cordifolia*, *Diosphyros tomentosa*, *Lagerstroenia*, etc.
4. Dry Mixed Deciduous Forest.
5. Dry Bamboo Brakes.
6. Secondary Dry Deciduous Forest.
7. Tropical and Ravine Thorn Forest.
8. Grassland.

Fauna: (a) Mammals - Hanuman monkey, Tiger, Leopard, Leopard cat, Jungle cat, Jackal, Indian fox, Wild boar, Sambhar, (b) Birds: Great crested grebe, Little grebe, sparrow hawk, common crane, etc., and (c) Reptiles: Common worm snake, Trinket snake, common krent, banded krent, etc.

VIII. **Nokrek Biosphere Reserve**: This biosphere reserve is situated in Meghalaya in North-east India. It includes the

area to the east of Tuza in the West Garo Hills. The biosphere reserve forms a part of the Garo Hills, located to the south of the Brahmaputra plains. These hills rise to elevations of over 1200 mts. The slopes are steep and erosion by water has given rise to the present configuration. To the south of this tract lies Bangladesh. A number of small rivers and streams drain this tract. They contribute their water to the Brahmaputra river system.

Forest Types and Flora: (1) Tropical Wet Evergreen Forest: *Altingia excelsa*, *Amoora wallichii*, *Artocarpus chaplasha*, *Mesua ferra*, *Michelia* sp. etc. (2) Cane Bamboo Brakes: *Bambusa balcosa*, *Bambusa pallida*, *Calamus* sp., *Zalacea* Sp., etc. (3) Semi-evergreen Forest: *Amoora wallichii*, *Artocarpus chaplasha*, *Canarhum* Sp., *Dillenia indica*. (4) Secondary Semi-evergreen Forest. (5) Moist Deciduous Forest. (6) Moist Sal Savannah. (7) Hollock Forest. (8) Khasi Pine Forest.

Fauna: a) Mammals: Assamese macaque, Pig-tailed macaque, Capped langur, Slow loris, etc. (b) Birds: Little grebe, Upland burrard, Spotted grebe, Hill pigeon, Forest eagle. (c) Reptiles: Indian rock python, Banded kurki, Rat snake, Flying snake, King cobra.

IX. Thar Desert Biosphere Reserve

This biosphere reserve includes parts of Thar Desert or great Indian desert situated in the western parts of the country. Bulk of this vast desert lies in Rajasthan State

of India and rest is in Pakistan. In the east, the desert grades into semi-arid tract which in turn is succeeded by the Aravallis. In the west too, there is semi-arid tract that extends right upto the river Indus and merges with the semi-arid tract that lie beyond.

The desert comprises low rolling shifting sand dunes, small stable hills covered by sand and vast stretches of sandy waste. Huge quantities of sand are constantly being shifted by the winds. Many experts are of opinion that the desert is expanding towards east and north-east through the gaps in the Aravalli hills.¹²

Forest types and Flora:

1. Desert thorn forest - *Acacia arabica*, *Acacia senegal*, *Butea monosperma*, *Balanites Sp.*, etc.
2. Zizyphus scrub - *Acacia leucophloea*, *Acacia senegal*, *Prosopis spicigera*, *Capparis decidua* etc.
3. *Acacia senegal* forest - *Gymnosporia senegal*, *Prosopis spicigera*, etc.
4. *Salvadora* scrub - *Salvadora oleoides*, *Salvadora persica*, *Tamarix aphylla*.
5. Desert dune scrub - *Acacia arabica*, *Calotropis procera*, *Caparis decidua*, *Captadenia Sp.*, *Prosopis spicigera*, etc.

Fauna: a) Mammals - Hanuman moneky, Desert cat, Wolf, Indian fox, Common yellow bat, Indian mole rat, Desert hare, etc.

(b) Birds - Crested hawk eagle, Great Indian bustard, King

crow, Vulture, etc. (c) Reptiles - Snake lizard, Rat snake, Russell's viper, etc.

X. Gulf of Mannar Biosphere Reserve

The Gulf of Mannar is situated along the southern coast of Tamil Nadu. This biosphere reserve includes the Gulf, the adjoining coasts and also the small islands dotting the Gulf.

The coastline extends in an arcuate shape from north to south. A small land area abuts into the sea in the north. Further towards east there occur a series of islands, the largest one being near the coast. A number of islands occur almost parallel to the shore till the coastline begins to straighten out into a north-south alignment. Many water courses draining the southern part of Tamil Nadu enter the Gulf of Mannar after flowing through this biosphere reserve.

Forest types and Flora: (1) Dry Mixed Deciduous Forest - *Albizzia odoratissima*, *Cassia fistula*, *Dalbergia latifolia*, *Hordvickia binata*, etc. (2) Dry Deciduous Scrub - *Albizzia amara*, *Pterocarpus santalinus*, *phoenix humilis*, *Cymbopogon coloratus*. (3) Dry Savannah Forest - *Bridelia retusa*, *Pterocarpus santalinus*, etc. (4) Dry Tropical Riverine Forest - *Anogeissus acuminata*, *Mitraguna parvifolia*, etc. (5) Secondary Dry Deciduous Forest - *Buchanania lanzan*, *Grewia tiliaefolia*, etc. (6) Littoral Forest - *Calophyllum*

Sp., *Casuarina equisetifolia*, *Terminalia* Sp., etc. (7)
Mangrove Forest and Scrub.

Fauna: a) Mammals - Common langur, Jungle cat, Blue whale, Spotted deer, Finner whale, Common dolphin, etc. b) Birds - Grey billed pelican, Grey heron, Black ibis, Indian river terch. c) Reptiles - Common Indian crocodile, Starred tortoise.

XI. Nilgiri Biosphere Reserve

The Nilgiri hills are an extension of the Western ghats and lie almost entirely within Tamil Nadu though it also covers some areas of Karnataka and Kerala. This area has been constituted into a biosphere reserve and it includes some protected areas.

The Nilgiris hills extend in a more or less north-south direction along the Kerala-Tamil Nadu border. A number of off-shoot ranges branch off from the main range. These hills rise to an elevation of over 2500 mtrs. They have resulted in a rain shadow area to the west. A number of rivers rise from Nilgiris. The west-facing slopes drain into the Arabian sea, While the rivers rising in the eastern slopes of the Nilgiris drain through Tamil Nadu to enter the Bay of Bengal.

Forest types and Flora: (1) Hill top tropical evergreen forest: *Calophyllum elatum*, *Culenia excelsa*, *Hopea parviflora*, *Tetrameles nudiflora*, etc. (2) Hill Valley Swamp: *Eugenia* sp., *Mollotus albus*. (3) Nilgiri Sub-tropical

Hill Forest (Shola Forest). (4). Sub-tropical hill Savannah Forst. (5) Montana Wet Temperate Forest. (6) Montana Wet Scrub and (7) Montana Wet Grassland.

Fauna: (a) Mammals: Nilgiri langur, Leopard, Indian fox, Sloth bear, etc. (b) Birds: Cormorant, Sparrow hawk, Common Red Shank, Speckled wood pigeon.

XII. Nanda Devi Biosphere Reserve: The Nanda Devi Biosphere Reserve is situated in the higher Himalaya of Uttar Pradesh at the border of Garhwal and Kumaun. the Nanda Devi National Park falls within this biosphere reserve. The Nanda Devi group of peaks which include the Nanda Devi, Nanda Devi East and Nanda Kot form a towering mountain wall in the north. At the base of this massif lies the pindari glacier from which rises the pindar river that joins the river Alaknanda.

The river Pindar flows through this biosphere reserve. It is joined by several small tributaries all of which are snowfed. Together these streams and rivers have carved deep, v-shaped valleys, steep gorges, incised meanders, terraces, and inter-locking spurs.

Forest types and Flora: 1) Mixed temperate coniferous forest, 2) Mixed temperate deciduous forest, 3) Temperate pasture, 4) Alder forest, 5) Sub-alpine birch / fir forest, 6) Sub-alpine pasture, 7) Birch phododendron scrub, 8) Deciduous alpine scrub, 9) Dwarf Rhododendron scrub, 10) Moist alpine pasture.

Fauna: a) Mammals - Leopard, Jungle cat, Brown bear, Ibex, Ghoral. b) Birds - Wood cock, Hill pigeon, Myna, Indian cuckoo, etc. c) Reptiles - Asian house gecko, Trinket snake, King cobra, etc.

XIII. Uttarakhand Biosphere Reserve

The eight hill districts constitute the region known as Uttarakhand. It is the easternmost end of the Western Himalayas bound in the east by Nepal, in the north lies Tibet, in the west H.P. and plains of U.P. are to its south.

The Uttarakhand biosphere reserve covers an area of 3942 sq.km. falling within parts of Tehri, Uttarakashi, Chamoli and Almora districts.. The main characteristics of this biosphere reserve are

- i) this tract is a transition zone between the relatively drier tracts of the Himalayas in the west and the moisture parts in the east,
- ii) the vast tract of natural forests with a relatively low biotic pressure conforms to the international criterion for biosphere reserves,
- iii) a wide variety of forest types ranging from temperate forests at lower elevations to moist alpine pastures near the snow line are found in this biosphere reserve.
- iv) both the floral and faunal elements found in this tract represent the transition between the elements of the western and eastern Himalayas,

- v) this is the home of almost 3 per cent of the avifauna of the world bearing affinity to both the Sino-Himalayan and trans-Himalayan regions,
- vi) the rock strata of this tract ranges from pre-cambrian to recent age.

Forest types and Flora: 1) Moru oak forest, 2) Moist deodar forest, 3) Temperate mixed coniferous forest, 4) Temperate moist mixed deciduous forest, 5) Kharsu oak forest, 6) Blue pine forest, 7) Sub-alpine high level fir forest, 8) Sub-alpine birch-fir forest, 9) Deciduous alpine scrub, etc.

Fauna: a) Mammals - Yakm Leopard, Tibetan sheep, Brown bear, Black bear, etc. b) Birds - Western tragopan, Crimson tragopan, Cheer pheasant, Slaty-headed parakeet, etc. c) Reptiles - King cobra, Cobra, Himalayan pit viper, Common house gecko. d) Fishes - Kali machhi, Hill trout, etc.

XIV. Sunderbans Biosphere Reserve

The Sunderbans consists of the deltaic tract of the Ganga and Brahmaputra river systems before they debauch into the Bay of Bengal. It is considered to be the largest prograding delta in the world. Of this, nearly ten thousand square kilometres of the inter-tidal zone lies in India while the rest falls within Bangladesh. Bulk of this tract is covered by a unique mangrove forest ecosystem. The Sunderbans is the only area in the world where tiger occupies the apex of both the aquatic and terrestrial food triangle.

The Sunderbans biosphere reserve has been divided into following zones -

1. Core area : This zone comprises 1700 sq.km. of rich mangrove forests of the existing Sunderbans tiger reserve which includes 1300 sq.km. of the Sunderbans national park.
2. Manipulation zone : This zone consists of remaining forest area of the Mangrove forest tract. It is meant for forestry practices.
3. Restoration zone : This zone includes
 - a) the remaining degraded forest areas,
 - b) saline blanks spread over the entire forest area,
 - c) degraded mud flats within the non-forest areas.
4. Manipulation zone : The remaining areas have been constituted into the manipulation zone for agriculture, animal husbandry, etc.

Forest types:-

- i) Littoral forest,
- ii) Mangrove forest,
- iii) Mangrove scrub,
- iv) Salt water mixed forest,
- v) Brackish water mixed forest,
- vi) Barringtonia swamp forest,
- vii) Low swamp forest, and
- viii) Wet alluvial grasslands.

Fauna: a) Animals - Tiger, Indian fox, Jackal, Pangolin, etc. b) Birds - Cotton teal, Pintal, Little fern,

Black-billed fern etc. c) Reptiles - Hurriah, Sea snake, Pond turtle, Tokay, Mouse gecko.

Thus, the role of biosphere reserves in conserving the rich flora and fauna of the country is very important. They are being established in the representative biogeographical regions. This would help in conserving the biological diversity of each and every biogeographical region. The concept of local people's participation in management of biosphere reserves has added new advantages to this programme.

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CHAPTER IV

PROSPECTS OF BIOSPHERE RESERVES IN INDIA

Preservation of our biological heritage, development of areas with genetic diversities and maintenance of such areas under the supervision of some management council or some other organizational structure is one of the main objectives of the Man and Biosphere Programme. In order to preserve endangered species of plants and animals for research and educational purposes, for the conservation of important gene pools and areas with such living resources, demarcation of these areas into biosphere reserves has been accorded highest priority.

4.1 Establishment of Central Cell for Programme Implementation

The biosphere reserve programme is based on principles of conservation and is essentially an ideal management concept for all protected areas. In India, the management of all protected areas, viz., National Parks and Sanctuaries is directly the responsibility of the concerned States or Union Territories. This arises from the present constitutional framework and the federal polity nurtured thereunder. The States are also the proprietors and custodians of 'Land' and 'Forest', the two resources vital to the biosphere reserve programme. The implementation of this programme will thus have to be in keeping with present pattern and modalities for this purpose have to be worked

out accordingly. If, however, some State Government or UT Administration agrees to transfer its responsibility in this respect to the Centre, there should be no difficulty in taking such responsibility and handling it directly by the Central Government. But, as a general rule, this would depend on the concerned State Government or UT Administration. However, it is contemplated that the Central Government will, through a special cell created for the purpose, assume direct responsibility in three main respects:¹

- i) full financial assistance for the approved items of the programme,
- ii) technical expertise and know how, including trained personnel; and
- iii) detailed guidelines covering all aspects of management for implementation by the State machinery, followed by close and effective monitoring and supervision.

The Central Government would play a key role in the setting up and management of these conservation areas, particularly since the effort involves substantial investments which would not be forthcoming easily from the State Governments. The Central Government will also make it possible to keep a greater check over local pressures and for maintaining consistency of management practices and scientific research over the country as a whole. Under the education programme, Paryavaran Kendras (Environmental

Centres) will also be established in each biosphere reserve. This would enable researchers, teachers, students and even interested amateurs, to undertake field work for purposes of research, education and training and also familiarization with the problems in a particular biosphere reserve.

The management of these areas will call for a combined effort by personnel from diverse backgrounds. A key role will have to be played by technical experts in the areas of ecology and other environmental sciences. The management would also involve personnel from technical departments such as forestry, agriculture, animal husbandry, fisheries, soil and water conservation, tribal/rural welfare etc. it is important that such personnel should make a long term commitments to conservation effort and involve themselves for substantial periods. They should be encouraged to do so by including an element of 'flexible complementation' in the scientific and technical cadres from the very beginning. They should be given attractive emoluments to provide compensation for working in difficult and remote areas without normal amenities. To fulfill the diverse and specialised tasks involved in the management of biosphere reserves, specialised cadres will be required. Such central cadres of scientific personnel will be created, along with the supporting and managerial cadres.

4.2 Legal Protection

It is obvious that when a biosphere reserve is established in an area which has not so far been protected, adequate legal or regulatory measures will be required. However, it is felt that it would be better to formulate a new legislation specifically for biosphere reserves. Otherwise, the establishment of such reserves would be delayed. It is obvious that biosphere reserves are complementary to the existing network of National Parks and Sanctuaries for which a comprehensive law - the Wild Life (Protection) Act, 1972, already exists in India. It affords considerable flexibility and latitude to establish such reserves expeditiously. It has, therefore, been decided that the proposed biosphere reserves be created with the help of aforesaid Act, thereby affording immediate protection to some of the biologically richest areas of the country against external pressures as well as providing the framework for initiating a dynamic programme.² There are isolated State legislative rules which control over exploitation of trees and similar resources. Section 18 of the Wild Life (Protection) Act, 1972 deals with declaration of sanctuaries. It states that the State Government may declare any area to be a sanctuary if it considers that such an area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance for the purpose of protecting, propagating or developing wild life

or its environment. Similarly, sections 35, 36 and 37 empower the Government to declare national parks/game reserves and closed areas.

Though in due course, particularly with respect to the respective roles of the Central and State Governments, enactment of new legislation is required.

Legislative - The existing legislative provisions are inadequate, new provisions are necessary.

Administrative - Any effective administrative arrangement has to recognize the following factors

- i) The State Government with the various competing demands on their resources, can't be expected to make adequate financial and other provisions for effective management of the biosphere reserves;
- ii) Traditional claims of rural population to the minor forest resources should be kept in mind. In view of this, close public participation in management is also indispensable;
- iii) Proper provisions for training and researches is another factor meriting our attention.

4.3 Local People's Participation in Biosphere Reserves

The approach of the entire MAB programme is to associate the local population so far as possible with the formulation and implementation of research projects. This approach becomes all the more important when establishing and managing the protected areas, which invariably involve

restrictions and changes in the traditional land use patterns.

It is only when a biosphere reserve is integrated into its region and constitutes a positive element in the local socio-economic milieu that its future can be really ensured. As the population increases and resources become scarce, there is bound to be pressure on the natural reserves. Unless the local population develops a permanent stake in the reserve, its long term future cannot be guaranteed. It is, therefore, necessary that the people are made to understand the merits of the programme so that they become the guardians and custodians of the reserves. Environmental education and training is aimed at achieving these goals. Hence, it is proposed to open Paryavaran Kendras (Environmental Centres) in each biosphere reserve to create general awareness as well as to impart and disseminate the knowledge and skills on the relevant subject areas.

4.4 Research and Monitoring

The conservation efforts must be backed with a strong component of research for fully utilising the benefits emanating out of the creation of biosphere reserves. The Indian National MAB programme envisages research on the following major aspects:³

- I) Baseline data collection for preparation of an inventory of abiotic and biotic components of the biosphere reserve areas, collection of information on

meteorology, land use practices, distribution and status of key species as well as endemic, rare and threatened species, socio-economic survey regarding the local population, their occupations, needs, etc.

- II) Monitoring research to concentrate on climatological measurements, soil, water and air pollution studies, productivity, phenology, population dynamics of selected animal and plant species, energy and material flow, demography of human population, patterns of human utilization of wild plants and animals for food, fodder, drugs, construction of shelter, etc.
- III) Manipulation research to investigate the effects of various kinds and degrees of human uses and interferences.
- IV) Restoration research designed to study ways of rehabilitating degraded ecosystems or restoring climax where this has disappeared.

India has fortunately considerable scientific base. The assistance of existing organizations like Survey of India, National Remote Sensing Agency, Botanical Survey of India, Zoological Survey of India, I.M.D., various universities and research organizations will be fully utilized. However, in the long term, a strong cadre of trained scientists to undertake environmental research in the biosphere reserve areas will have to be developed for which the international organizations like IUCN and UNESCO

will have to play a key role in terms of arranging training programmes.

4.5 Education and Training

It has been pointed that the key for success of biosphere reserve programme lies in educating local population, planners, managers and custodians of these reserves. For this reason, the reserve should become a permanent place for environmental education. The major focus should be to explain the value and benefits of protected areas to the local people and develop a favourable perception and new attitudes towards conservation. The education and training programmes will be needed for both public and for those persons who are involved in the management and operation. Each biosphere reserve will have environmental education centre. The centre will provide informational material describing the working of the biosphere reserves, history and natural features of the area, social, cultural, religious and economic aspects of the life of local people and aesthetic benefits, etc. Information could be disseminated through local newspapers, radio, television, exhibitions, film documentaries, public meetings or even setting up small museums. For demonstrating the improved land use practices, visits to field demonstrations in the manipulation/restoration zone shall form an important element of the programme. School children will form the major target group.

Training of both professionals and managers will be extremely important in the management of biosphere reserves. Some of the training can be undertaken in the individual reserve while some may be handled by specialised training centres. These training programmes should be primarily inter-disciplinary, skill-oriented and field conducted wherever possible. It will be important to stress the need for the employees to understand the various functions of the reserves and the benefits accruing to the nation. They will have to be trained both in education and communication so that they can spread the conservation message to the people they interact with. It should be stressed that all employees particularly local people employed in the reserves should be given an orientation to understand how the biosphere reserve works.

Once the biosphere reserve has been established or even before; if possible, projects should be developed to demonstrate the application of information resulting from existing scientific knowledge about particular problem. Consideration should also be given to organise eco-development camps, involving local residents as has already been done in several areas of India. India has already achieved remarkable success through community movement such as Chipko movement organized by Dasholi Gram Swarajya Mandal in U.P. hills. The help and existence of voluntary groups may be encouraged to organise these community forestry or

eco-development camps for which necessary support may be provided by the government agencies.

4.6. Role of International Organisation

Research and monitoring is implicit in the biosphere reserve programme. This requires a cadre of trained manpower and establishment of a strong research base which is resource intensive. The developing countries have insufficient trained manpower particularly in the area of nature-conservation and ecology which are relatively new subjects. At the same time, adequate financial support is unlikely to come from the governments for developing research facilities. It is here that the international organisation can play a key role by extending assistance to countries in training scientists and managers involved in the programme and also by fiscal support for research and monitoring stations. The role of IUCN and UNESCO is very important at international level. UNESCO is assisting respective countries in following ways. First, it facilitate provision of adequate resources for implementation of the Statutory Framework of the World Network of Biosphere Reserves. Second, it facilitates the periodic review by each country of its biosphere reserves, as required in the Statutory Framework of the World Network of Biosphere Reserves and assist countries in taking measures to make their biosphere reserves functional. Third, it supports the functioning of the Advisory Committee for Biosphere Reserves

and fully considers and utilizes its recommendation and guidance. Fourth, it lead the development of communication among biosphere reserves, taking into account their communication and technical capabilities, and strengthen existing and planned regional or thematic networks. Fifth, it promotes and facilitates twining between biosphere reserve sites and foster trans-boundary reserves. Sixth, it develops standards and methodologies for collecting and exchanging various types of data and assist their application across the Network of Biosphere Reserves.

4.7. Eco-Tourism and Biosphere Reserves

The biosphere reserves are potential sites for eco-tourism. The biosphere reserve has four zones, viz., the core or natural zone with no human interference, the buffer zone with mild human interference, the restoration or reclamation zone where human interference is common, and the cultural or tourism zone where humans live with nature. So the cultural or tourism zone can be important zone of tourism. The eco-tourism has following objectives.⁴ The first objective of eco-tourism is to ensure that local population acquires a stake on tourism and they see that eco-tourism benefits them. In this way, natural resources can be preserved with eco-tourism. The second objective is that eco-tourism should not harm the local poor people indirectly. It is quite important that tourism should be so designed that it improves the condition of local population

in biosphere reserve. Therefore, eco-tourism in biosphere reserve can be better sustained with local people's participation, so that it can utilize the potential of biosphere reserve for eco-tourism fully and responsibly.

4.8. Problems Related with Biosphere Reserves

Conflict in Biosphere Reserve: Though local people's participation in management of biosphere reserve takes place, but the conflict between management and local people has taken place. Villagers living within Nanda Devi Biosphere Reserve have threatened to launch a popular movement in support of their demands for opening its core zone to them.⁵ According to them this zone had sustained their life and formed a part of their culture and customs since time immemorial. The 2,232 sq.m. Nanda Devi Biosphere Reserve, much of which lies in the Chamoli district of Garhwal, was closed to local people in 1982. Consequently, all treks and expeditions to the majestic mountains of Nanda Devi, Nanda Kot, Chang Bank, Dungargiri, Kalanka, Trishul, etc., were stopped.⁶ According to local people, since the Reserve was closed, they were unable to protect it and poachers from outside were decimating its rich wild-life. As a result, trappers and hunters, mostly from across the Kali River in Nepal, were entering its core zone through the Milan glacier in Pithorgarh district. The closure in effect for the past fifteen years had only impoverished them.⁷ Their sheep flocks had dwindled to one-fourth of what they

were earlier. As the Biosphere, which contained their pastures, was closed, they had been forced to sell their flock to the butcher.

Though the experts of this reserve were unable to pacify the local people.

Problem of Flourishing Wild Life Trade: It is also one of the problem of Biosphere reserves or other protected areas. A study, conducted by Vatvaran, an non-governmental organization, revealed that the very animals which are supposed to be under total protection inside the Nilgiri biosphere reserve are being traded at its fringes. Live specimens and their body parts are all available at over thirty sports, both within and outside the boundaries of the reserve.⁸ Twenty-eight species of birds included in Schedule IV of the Wild Life Protection Act - 7 species of birds in Schedule 1 - are being traded illegally. About thirty per cent of the birds trapped at the reserve end up as pets but some species are sold for their meat, oil or even for use in black magic. The price of an animal appreciates as its name goes up in the Wild Life Protection Act Schedules. The rate of a Schedule IV animal is much lower than one included in the Schedule I.⁹

As far as back as 1973, eighty countries had signed the Convention on International Trade in Endangered species of Wild Flora and Fauna (CITES). The treaty, which was meant to monitor and regulate trade in endangered species, has

today 130 signatories. In addition to CITES, a stringent national legislation for India came with the 1991 Amendment of Indian Wild Life (Protection) Act, 1972, that bans hunting of any wild fauna and includes specified endangered flora in its protected list.¹⁰ The Import-Export Control Act of India bans the export of any wild life and related products. Despite this, the trade is still going on in a covert fashion. Loopholes in the law, environmental corruption, dwindling respect for other forms and enforcement agencies are all in one way or the other responsible for this.

The implementation of biosphere reserve programme can take place in true sense by bringing new legislation. This should be stringent. And publicity programme for biosphere reserve should be launched through different media to make the local population aware about the benefits of Biosphere Programmes.

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- (10) *ibid.*

CHAPTER V

CONCLUSION

The biosphere reserve is most effective tool for conserving biological diversity. It is different from other protected areas because the role of local people in management of biosphere reserve has been recognised. This is one of the reasons for the popularity of biosphere reserve programme in many countries of the world. The conflict between local population and managing authority use to take place in other protected areas because their right over the local resources has been snatched. But in case of biosphere reserve programme, this conflict has been reduced to minimal stage.

The effort of IUCN and UNESCO is quite appreciating. Both these organizations have popularised the biosphere programme all over the world and they created the world network of biosphere reserves.

India has an incredibly rich flora and fauna, found in a diverse array of ecosystems from the Himalayas to the deserts of Rajasthan, from the misty jungles of the North-east to the majestic Teak and Sal forests of the Deccan, from one rich coast in the West to another in the East. India has five per cent of the world's biological wealth and diversity. But the reality is that India has little left of her rich biological wealth. The plunders of the twentieth

century impoverished the natural wealth. It is argued that the country might lose as much as half of the living organisms by the turn of century. It is rather disconcerting that many of these species still remain a mystery to man and therefore, their loss would be absolute. Many potential plants will slip into thick fog of extinction, unsung.

To revive the age old practices of the indigenous conservation of nature would be to attempt to create a harmony between human beings and environment. There is an urgent need of human co-operation in all acts of wildlife protection and preservation. Perhaps this is also what was expected' when the Indian Wildlife Protection Act was formalised and passed in 1972. Almost 25 years thereafter, India has 80 national parks and 441 wildlife sanctuaries, 23 tiger reserves and 8 biosphere reserves which are included in these two categories. The basic concept of a sanctuary is not sound. The emphasis is on saving one or a few important species of animals. The protection of the habitat of the animal is more incidental than planned, which is ironic because the habitat is certainly a prerequisite for the wellbeing of any animal. This situation stands marginally improved in a national park, but to the exclusion of humankind and has been something of a blow to rural population who have lived on and off the forest for centuries. It is hardly surprising that these systems are faulty since the ecological principles on which they are

built are not natural. Legal loopholes exist. About one-third of all the Indian national parks have been declared so and the remaining have an uncertain legal status. Technically they are called 'intention to declare National Park'. The Wildlife Protection Act demands certain mandatory legal procedures and about ten per cent of the sanctuaries in India fulfill the requirements.

National parks have preserved the fast depleting natural wealth, but at the cost of antagonizing the locals of that area. It is disturbing to find that people who have lived with nature, guarding wilderness areas with zeal, are today hostile to the national park or sanctuary. The answers to these questions could go a long way in an attempt to find a solution to the global environmental crisis. It is important to search for a symbiotic solution where not just the tiger or elephant, the rain forest or the alpine meadows will be happy, but also the human being who has been neglected so far. For this reason, the biosphere reserve programme came into existence. This concept envisaged the protection of a whole area in its existing form as a complete bio-community - large or small.

The biosphere reserve concept implies the management of a large portion of a typical biogeographical zone as a single conservation unit. It also embodies the framework of a multiple land use system, which is practical and sensible, going by the scarcity of totally verdant wilderness areas in

India or the world over for that matter. The selection of these biosphere reserve areas has been carried out in a systematic manner, recognizing that the area should be a natural and undisturbed zone where all the flora and fauna of that region should be represented. Areas that house rare or endangered species would be treated high on the priority list as also the areas with great biological diversity. More importantly, besides being regions of great biological significance these reserves also emphasize the traditions of the area and the cultural, religious and social practices of the communities who live within them. Besides being a complete conservation unit which believes in multiple land use, it is broken into zonal structuring. The popularity of biosphere reserves as a concept in conservation is questionable. Reluctance on the part of managers of protected areas in accepting this concept could be attributed to the usual reaction to all things new. With its ecosystem approach to conservation, including the human as an essential and vital element of the larger network of life on earth, this method may take time to break in. The most positive attributes of biosphere reserves is that it strives to bridge the ungainly gap between 'environmentalist' and 'development'. This is because the biosphere reserve recognizes the interface between the quality of human life and need for better and more effective conservation practices to conserve the environment. It is

the allowances to humans that make the biosphere reserve concept meaningful as a supplement to the conservation effort in terms of sanctuaries, national parks and tiger reserves, which is what the Core Advisory Committee had originally meant it to be back in 1979. The idea of allowing scientific research, the scope for community interaction, the in-built concept of buffer zone management so as to minimize pressure on the core zone are all strengths of the Biosphere Reserve Programme. In biosphere reserves the protection of tradition of old cultivation patterns and honouring of religious beliefs has won the confidence of the people. It is a very important facet of this programme because the guaranteed long-term conservation of natural resources would be impossible without active involvement and support of those who live in area. Scientists, park managers, policy-makers and scientists have to come together to ensure the success of biosphere reserve programme. The zone-based structure may sound systematic and organized but it requires strong and sound management. Therefore, the biosphere reserve concept is a comprehensive, healthy and balanced strategy for development as well as for the conservation of biological diversity.

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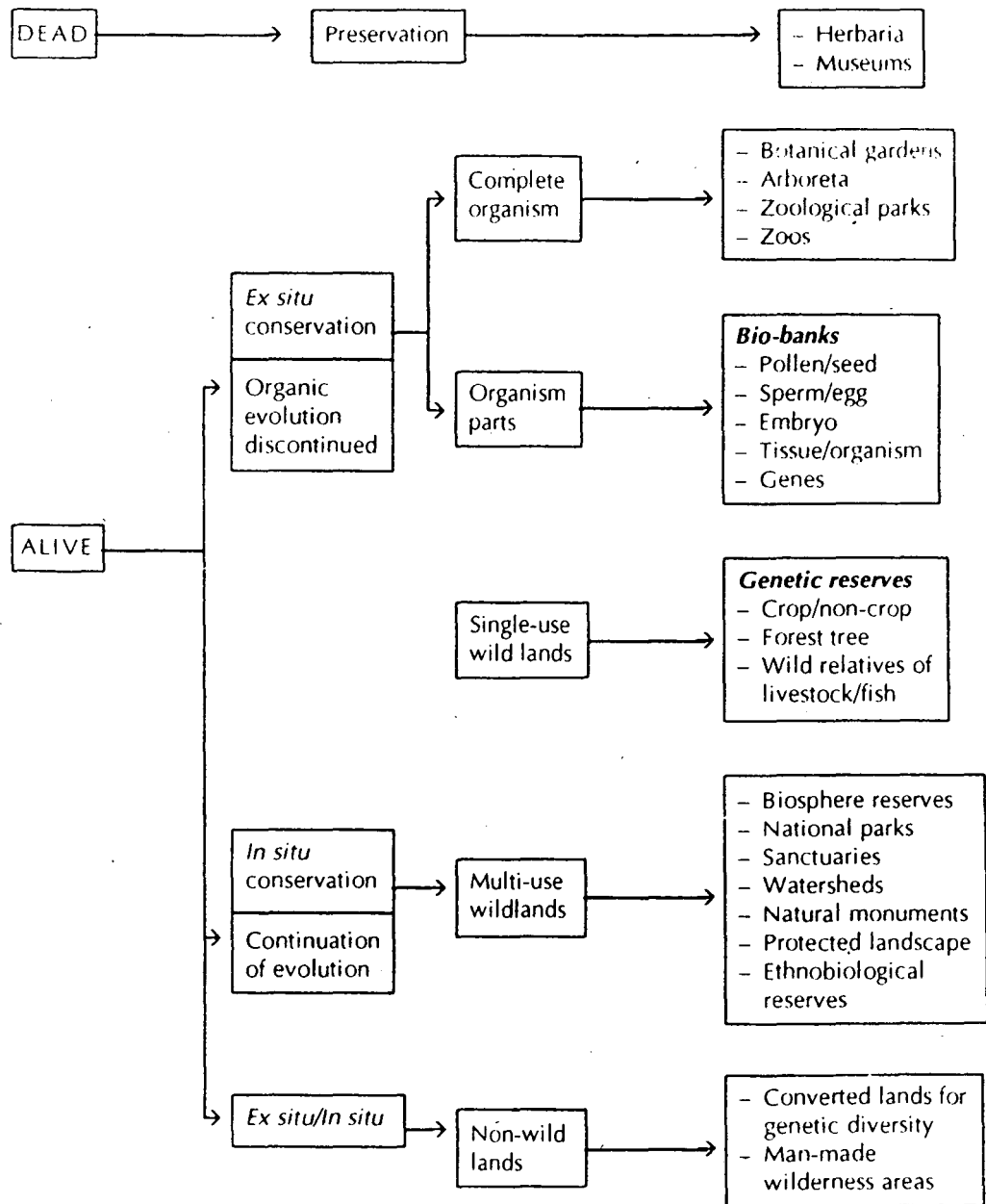
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DIAGRAM

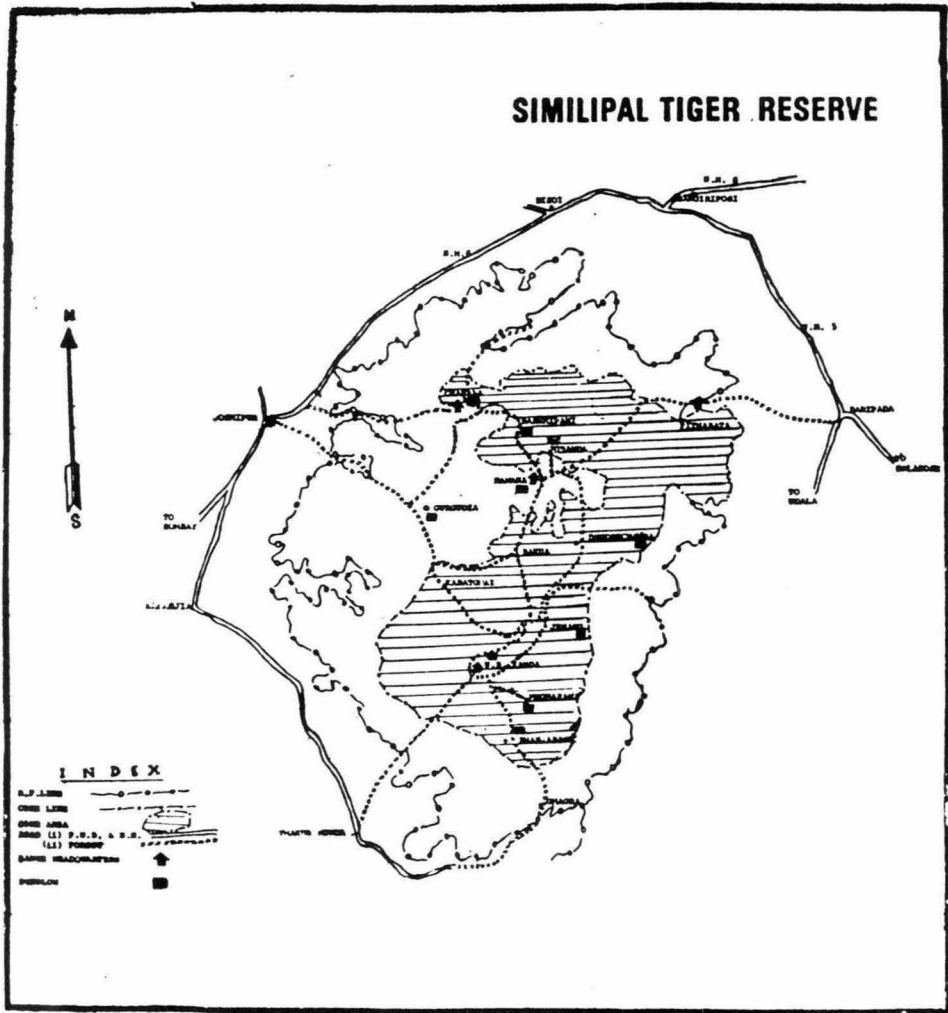


Options for biological diversity conservation

MAP I

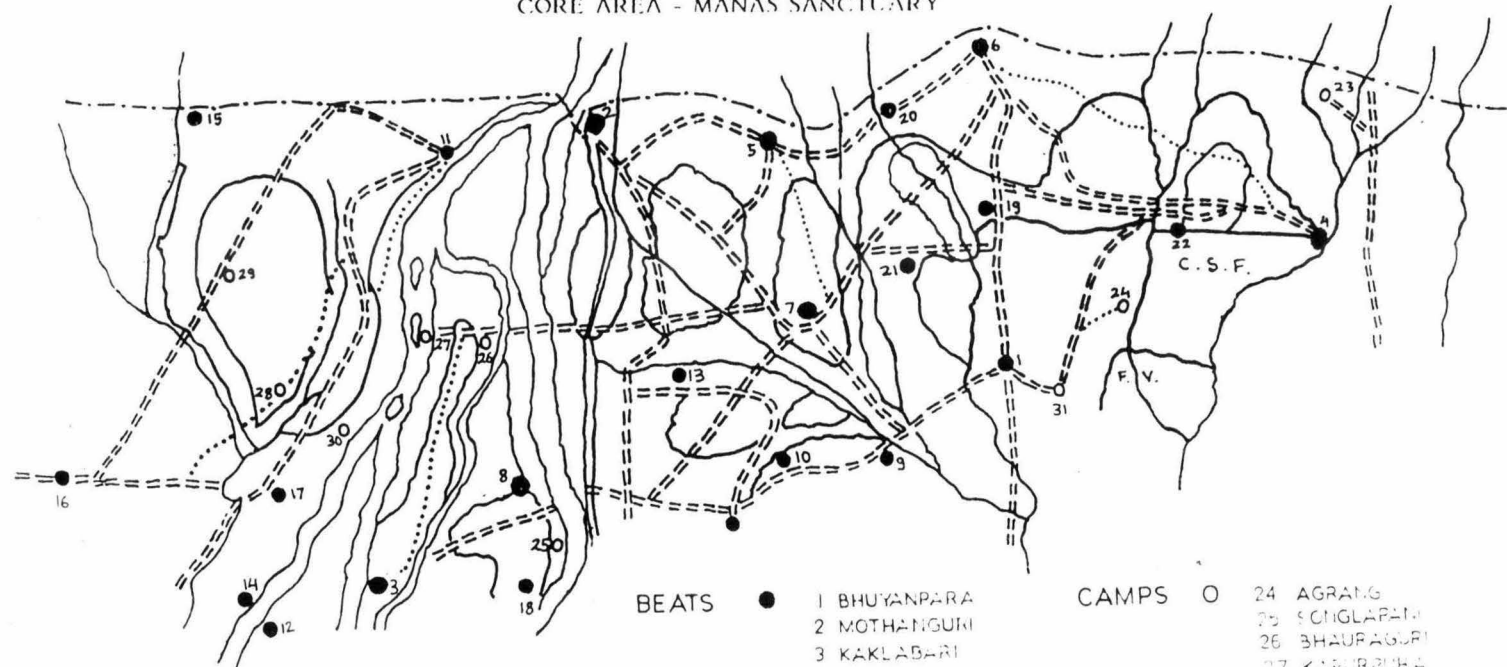


MAP II



CORE AREA - MANAS SANCTUARY

MAP III



RESERVE BOUNDARY

INDO BHUTAN BOUNDARY

ROAD & PATH

RIVERINE FOREST

TREE FOREST

GRASSLAND

SWAMP AREA

CENTRAL SEED FARM

FOREST VILLAGE

BEATS ●

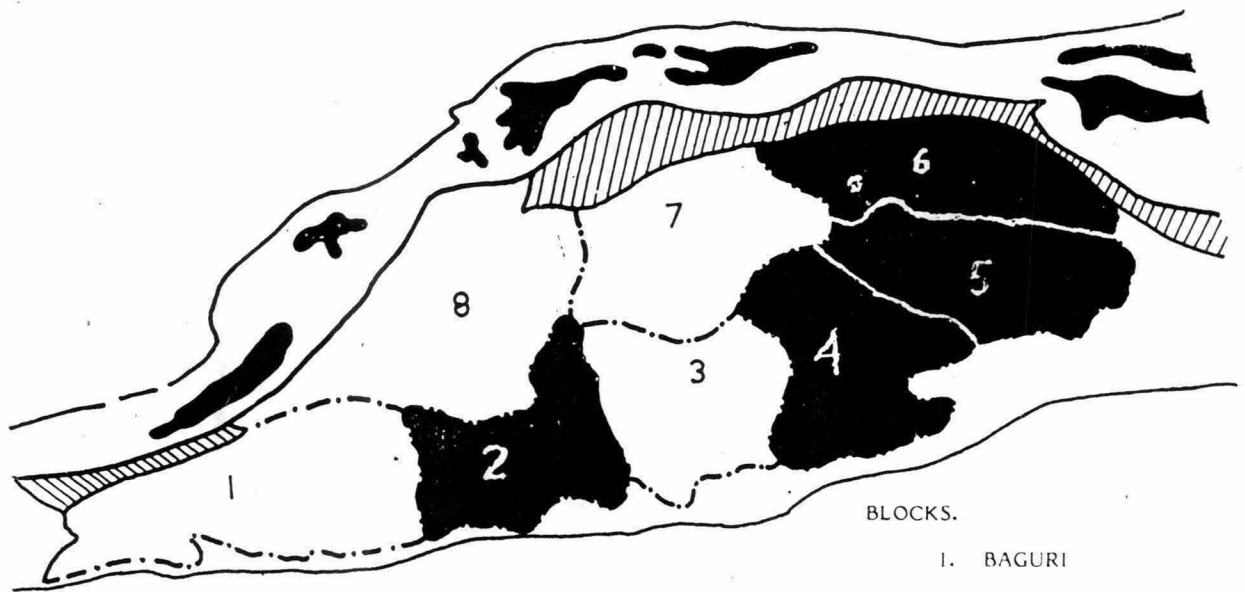
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- 2 MOTHANGURI
- 3 KAKLABARI
- 4 KAHITAMA
- 5 GARUCHARA
- 6 DOIIMARI
- 7 UCHILA
- 8 NARAYANGURI
- 9 KATAJHAR
- 10 BHATGALI
- 11 GABARU KHUNDA
- 12 KAHITAMA
- 13 GIATI
- 14 GHOGE HAGA
- 15 SUKANJANI
- 16 LAKHIJHAR
- 17 SIKLAIJHAR
- 18 BHALAGURI
- 19 MAKHI BABA
- 20 RABANG
- 21 RUPAHI
- 22 CHYAMJHORA
- 23 ALABARI





CAMPS ○

- 24 AGRANG
- 25 SONGLAPATI
- 26 BHAUPAGURI
- 27 KAPURPUHA
- 28 UFA BARI
- 29 BADI BARI
- 30 BABALA
- 31 DIGORI

MAP IV

EXISTING KAZIRANGA NATIONAL PARK



NATIONAL PARK BOUNDARY - - - - -
BHEELS 
BRAHMAPUTRA RIVER 
CHAPORIS 
NATIONAL HIGHWAY NO. 37. 

BLOCKS.

1. BAGURI
2. HALDHIBARI
3. KAZIRANGA
4. PANBARI
5. TAMULIPATAR
6. BORALIMORA
7. CHARIGHORIA
8. BHAWANI