

Conservation of Biodiversity of Manipur: Sustainable Management Strategies

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Abstract-- All the living beings---animals, plants and microbes---living in soil, water, on trees, in and around other animals; useful and/or harmful; cultivated, domesticated, or wild; their genes and the ecosystems in which they live, make up the Biodiversity of the Earth. The State of Manipur forms part of the Global Biodiversity Hotspots. Of the two Hotspots areas in the North Eastern region of India---Eastern Himalayan Biodiversity and Indo-Burma Biodiversity Hotspots, the State of Manipur belongs to Indo-Burma Biodiversity Hotspot and she is richly endowed with diverse floral and faunal species in diverse ecosystems that includes species rich, broad leaf ambrophilous tropical forests, sub-alpine and temperate forests within the small geographical areas of 22,327 Sq. Km. The oval shaped central valley of Manipur dotted with lakes and crisscrossed with rivers forms one of the most unique wetland ecosystems of this planet. As per the India State of Forest Report 2015, the total forest and tree cover of the State is 17,233Sq.Km. which is 77.20 % of the total geographical area of the State and 2.17 % of the country's forest and tree cover. In fact, the State of Manipur is the storehouse of biological diversity which includes 4000 angiospermic plants species, 430 medicinal plants species, 34 edible fungi species, 500 orchid species and 55 species of bamboo, 40 endemic rice cultivars, 160 fish species and 21 species of migratory aquatic birds. An environment rich in biological diversity offers the broadest array of options for sustainable economic activity. However, the State of Manipur is now facing the problems of biodiversity degeneration due to varied reasons. The loss of biodiversity often reduces the productivity of ecosystems, thereby shrinking nature's baskets of goods and services, from which we constantly draw. Hence, it is the need of the hour to take up measures for conservation of biodiversity and sustainable management of biodiversity which is fundamental to sustainable development. And as such, the present study aims at (i) to identify the floral and faunal species that are threatened or endangered because of biotic and abiotic pressures; (ii) to make an assessment of the various causes of biodiversity loss in the State of Manipur; (iii) to formulate appropriate biodiversity conservation strategies; and (iv) to make plan for a conducive sustainable management of environment.

Key Words-- Biodiversity, Ecological balance, Hotspots, Sustainable Management, Wetlands.

I. INTRODUCTION

The State of Manipur is a tiny hilly State with a geographical area of 22,327 Sq. Km. located in a lush green corner of the North Eastern Region of India between 23.83^o& 25.68^o North Latitudes and 93.03^o & 94.78^o East Longitudes. The State has five valley districts and four hilly districts where 90 % of the total forests occur and the State is endowed with a vast forest areas covering 17,233 Sq. Km. which is 77.20 % of the total geographical area of the State and 2.17 % of the country's forest and tree cover. ^[1] The oval shaped central valley of Manipur is surrounded by nine ranges of bluish-green hills intertwined with more than 13 small and large lakes and crisscrossed with various river basins forms one of the most

unique wetland ecosystems of this planet. The Shiroi Lily (Lilium Mcklineae), the only terrestrial lily which is not found anywhere in the world is grown on the tops of Shiroi hill, holds the distinction of being the State Flower. The Dzuko valley is also the only habitat of the endemic and the "rarest" species Dzuko Lily (lilium chitrangade). The State of Manipur is also the only Hotspot on Earth in which "Sangai", the Brow Antlered Deer (Cervus eldi eldi, McClelland, 1842) presently known as Rucervus eldii and locally called "Sangai" is found. In fact, the State of Manipur is the storehouse of biodiversity.

Currently, there are 34 Biodiversity Hotspots as per classification of the United Nations International Conservation, of which three are located in India, viz. (i) Western Ghat Hotspot; (ii) Indo-Burma Biodiversity Hotspot and (iii) Eastern Himalayan Biodiversity Hotspot. Two of these Biodiversity Hotspots namely, Indo-Burma Biodiversity Hotspot and Eastern Himalayan Biodiversity Hotspot spread across the North Eastern Region of India and South Eastern Region of Asia. The State of Manipur belongs to the Indo-Burma Biodiversity Hotspot and she is endowed with rich diverse floral and faunal species in diverse ecosystems that includes species rich, broad leaf ambrophilous Tropical forests, Sub-alpine and Temperate Forests within the small geographical area of 22,327 Sq. Km. The Indo-Burma Biodiversity Hotspot is home to 13,500 plant species (2.3% of World total), 2185 vertebrates species (1.9% of World total), of which 7000 and 528 species are endemic to this hotspot, respectively. This hotspot is also home to 1,170 avian and 329 mammals and a large number of reptiles. Although comparatively a small geographical area, the State of Manipur has the distinction of representing a wide range of climate from Temperate alpine to Tropical and consequently has a wide range of forests and biodiversity. In the State of Manipur, the known biodiversity includes 4000 angiospermic plants species, 430 medicinal plants species, 34 edible fungi species, 500 orchid species and 55 species of bamboos, 40 endemic rice cultivars, 160 fish species and 21 species of migratory aquatic birds. ^[2] Communities in and around forests are directly dependent on these bio-resources for their livelihood. However, the threat of imminent climate change due to global warming caused by increasing levels of Green House Gases in the atmosphere, deforestation, construction of buildings, unsustainable consumption patterns, etc. have been looming large on the biodiversity of the State of Manipur. The unique biodiversity of the State is feared to suffer irreparable damage, with ominous implications for human well-beings. The devastating impact of climate change will be compounded by other drivers of biodiversity loss viz., habitat alteration, over-exploitation, pollution, etc. Introduction of exotic species also threaten the biological resources. The loss of biodiversity often reduces the productivity of ecosystems thereby shrinking nature's baskets of goods and services from which we constantly draw; lowered resistance to environmental perturbations such as drought and increased variability in certain ecosystem processes such as plant productivity, water use, and pest and disease cycles. Hence, it is the need of the hour to take up measures for conservation of

biodiversity and sustainable management of biodiversity which is fundamental to sustainable development.

II. OBJECTIVES

In the light of the above facts, the present study aims at to achieve the following objectives:

1. To identify the floral and faunal species that are threatened or endangered because of biotic and a biotic pressures;
2. To make an assessment of the various causes of biodiversity loss in the State of Manipur;
3. To formulate appropriate biodiversity conservation strategies; and
4. To make plan for conducive sustainable management of environment.

III. MATERIALS AND METHODOLOGY

The data used in the present study is based on the secondary sources of data generated by the Directorate of Environment (the erstwhile Ecology and Environment Wing); Institute of Bio-resources and Sustainable Development (IBSD); and Forest Department, Government of Manipur; India State of Forest Report 2015 published by the Forest Survey of India, Government of India; and from other sources viz., Economic Survey Manipur 2013-14 & Statistical Year Book of Manipur 2013 published by the Directorate of Economics & Statistics, Government of Manipur. References from various books and journals relating to the present study have also been used. Though secondary the data have been carefully scrutinized, analysed and draws conclusions through their scientific interpretation.

IV. CONCEPT OF BIODIVERSITY

Biodiversity refers to the incredible variety of life found in our planet. All the living beings---animals, plants and microbes---living in soil, water, on trees, in and around other animals; useful and/or harmful; cultivated, domesticated, or wild; their genes and the ecosystems in which they live, make up the Biodiversity of the Earth. The word "Biodiversity" is the contraction of the phrase "Biological Diversity". The term biodiversity, which represents the very foundation of human existence, was coined by Walter G. Rosen in 1985 for the first planary meeting of the "National Forum on Biodiversity" held in Washington D.C. in September 1986, the proceedings of which brought the notion of biodiversity to the attention of a wide field of scientists and others. However, the credit for popularising this word goes to E.O. Wilson who is often called the "Father of Biodiversity". Biodiversity is defined as the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.^[3] According to the Report of the Ad-hoc Work Group of Experts on Biological Diversity, United Nations Environment Programme "Biological diversity encompasses all species of plant, animals and microorganisms and the ecosystems of which they are parts".^[4] Thus, biodiversity can be defined as the flora and fauna i.e., variety of all plants, animals and microbes of a region. It is an umbrella term for the degree of

nature's variety including both the number and frequency of ecosystems, species or genes in a given assemblage.

It is usually considered at two different levels, viz.,

1. Genetic Diversity: This is the amount of genetic variability among individuals of a single species and between species; and
2. Ecological Diversity (species richness): This is the number of species in a community of organisms.

Maintaining both types of diversity is fundamental to the functioning of ecosystems and hence to human welfare. Thus biological diversity is the variety of life and its processes; and it includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

There are two main categories of conservation of biodiversity: In-situ Conservation and Ex-situ Conservation. (i) In-situ conservation: Biodiversity hotspots regions with very high levels of species richness and high degree of endemism (species confined in that region & not found anywhere else). Conservation of floral and faunal species in the sacred groves in our country is an example of in-situ conservation. (ii) Ex-situ conservation: Threatened animals and plants are taken out from their natural habitat and placed in special care. For example, conservation of 'Sangai' (*Cervus eldi eldi*) presently known as *rucervus eldii* at the Manipur Zoological Garden, Iroisemba as 2nd Home of 'Sangai' from its natural habitat of Keibul Lamjao National Park.

V. FLORAL BIODIVERSITY OF MANIPUR

As stated above the State of Manipur is endowed with a diverse flora and fauna and has varied richness in her diversity and ecosystems with luxuriant growth of vegetation ranging from Moist Tropical Forest Types in the valley to Sub-Tropical Forest Types in the hills in association with a large number of orchid species, many epiphytic plants species, wetland species, shade loving herbs, climbers, etc. Besides these, the State is the only zone of teak growing area in the North Eastern Region of India. The biodiversity of forest resources of the State constitute the entire variability among various floral and faunal species available in the ecosystems of the State. No systematic and comprehensive documentation of the floral and faunal species of the State has been carried out other than identified by Dr D.B. Deb in 1961. Dr D.B. Deb has identified 2190 species of flora. However, a wide range of plants and trees have been found in the State due to its geographical and climatic diversity.^[5]

The State of Manipur is also endowed with a vast rare and endemic species of flora and fauna especially inside the sacred groves which have great ecological and ethno-medicinal significance. The sacred groves are the repository of a diverse species of trees, shrubs, herbs, climbers, etc. which have symbiotic relationship with the people of Manipur. These sacred plants are used in a diverse way relating to various cultural and religious activities during worshipping forest deities dwelled in the sacred groves in Manipur and performing religious rituals. It has cultural as well as ecological significance. Some of the rare, endangered and pressures are given in Table 1-4 as depicted below:

Table 1: Rare, Endangered and Threatened Orchids of Manipur

SL No.	Botanical Name	Local Name	Occurrence	Present status
1.	<i>Renantheraimachootina</i>	KwakleiAngangba	All the Dist. of Manipur	Endangered
2.	<i>Paphipedilum</i>	Lady sliper	Imphal West Dist.	-do-
3.	<i>Dendrobiumthysiflorum</i>	Meleileisana	-do-	-do-
4.	<i>Cymbidium tigrinum</i>		UkhrulDist.	Threatened
5.	<i>Bulbophyllumpectrinatum</i>		-do-	-do-
6.	<i>Dendrobiumarachites</i>		Imphal West/Churchandpur Dist.	-do-
7.	<i>Kalimpongianrajitii</i>		Imphal West Dist.	Endangered
8.	<i>Schoenborchismanipurensis</i>		Senapati/Imphal West Dist.	-do-
9.	<i>Ascocentrumpullaceum</i>		Senapati/Ukhrul Dist.	
10.	<i>Dendrobium</i>		Jiribam	
11.	<i>D. hercoglossum</i>		Jiribam	
12.	<i>Cymbidium eburnium</i>			

Table 2: Rare and Threatened Trees of Manipur

SL No.	Botanical Name	Local Name	Occurrence	Present status
1.	<i>Podocarpus</i>	Nou-U Nakuppe	Jiri/Tousem sub-Division	Threatened
2.	<i>Podocarpuslatifolia</i>	Nou-U Nakuppe	-do-	-do-
3.	<i>Cephalotaxusgriffithii</i>			
4.	<i>Magnolia liliflora</i>	U-Thambal	Ukhrul Dist.	-do-
5.	<i>Mangoliadolsofa</i>	U-Thambal	Ukhrul/Imphal West Dist	-do-
6.	<i>Dalbergialatifolia</i>		Indo-Myanmar Border	-do-
7.	<i>Diospyrosspp</i>	Kap		Threatened
8.	<i>Hydnocarpuskurzii</i>	Chalmugra		-do-
9.	<i>Strychnosnux-vomica</i>			
10.	<i>Micheliamontana</i>	Ching-leihao	Ukhrul Dist.	Rare
11.	<i>Neolisacazeyleanica</i>		ChandelDist	-do-
12.	<i>Aquilariaagalocha</i>	Agar	Churchandpur/Senapati/ Ukhrul/West Chandel	-do-
13.	<i>Dipterocarpus</i>	Khamgra	Indo-Myanmar border	-do-

Table 3: Rare, Endangered and Threatened Plants of Manipur

SL No.	Botanical Name	Local Name	Occurrence	Present status
1.	<i>Rhododendron johnstonianum</i>	Chinglei	UkhrulDist .	Endangered
2.	<i>Rhododendron falconeri</i>		Ukhrul Dist.	-do-
3.	<i>Cycassiamensis</i>	Yendung	Indo-Myanmar border	Threatened
4.	<i>Cycaspectinata</i>	Yendung	All the Dist. of Manipur	Rare
5.	<i>Cytheaspp</i>	Tree fern	Barak valley	Endangered
6.	<i>Vanilla pilifera</i>			Threatened
7.	<i>Iris watii</i>		Shiroi	Rare
8.	<i>Iris bakeri</i>	Kombirei	Swamps in the Imphal valley	Threatened
9.	<i>Liliumlongifolium</i>		Ukhrul/Tengnoupal Dist.	Threatened
10.	<i>Liliumdevidii</i>		Shiroi	-do-
11.	<i>Oryzarufipogon</i>	Wynuchara	Loktak/Pumlen	-do-

Table 4: Rare Orchid Trees of Manipur

SL No.	Botanical Name	Local Name	English Name
1.	<i>Artocarpuslakoocharoxb.</i>	Harikhagok	Monkey jack fruit
2.	<i>Averrhoacarambolalinn.</i>	Heinoujom	
3.	<i>Bauhinia variegatelin.</i>	ChingthraoArangbi	Orchid tree
4.	<i>Bauhinia purpurea D.C.</i>	Chingthrao	Orchid tree
5.	<i>Bauhinia alba</i>	HeinaKundo	Orchid tree
6.	<i>Cestrum nocturmmlinn.</i>	Thabi-lei	Queen of the night
7.	<i>Crataevareligiosaforst</i>	Mitnabi	
8.	<i>Erythrinastrictaroxb.</i>	kurao	
9.	<i>Prunusarmeniocalinn.</i>	Malhei	Apricot

10.	Pyruscommunislinn.	Naspati	Pear
11.	Rosa multiflorusthumb	Natonchabi	
12.	Thevetianerifoliajuss.	Utong-lei	
13.	Oroxylumindicum vent.	Samba	

Wetlands of Manipur are storehouse of diverse floral and faunal species. In fact, wetland resources are often rare and even unique ecosystems. In many cases, this is because of the rarity of the species that they host such an endemic species and species threatened with extinction. Valuation of wetlands is an anthropocentric activity, i.e., it means different people

depending on their need and greed, and cultural, economic and educational backgrounds. The value of each wetland is intimately tied up with the culture and needs of the people who exploit it and its location. Some of the important plants found in the wetlands of Manipur is depicted in Table-5:

Table 5: Rare and Threatened Plants in Wetlands of Manipur

SL No.	Botanical Name	Local Name	English Name
1.	Cyprus esculentuslinn.	Kaothum	
2.	Eweyabfroxsalisb.	Thanging	
3.	Iris pseudacorus	Kombi-rei	
4.	Liliumhenryi	Kingdom ward	
5.	Nymphaeaeastellata wild	Thariktha	
6.	Nymphaea alba linn.	Tharo-Angouba	
7.	Nymphaea lotus linn.	Tharo-angangba	
8.	Nelumbiumspeciosum wild	Thambal	
9.	Zizania latifoliaturez	IshingKangbong	
10.	Lamanessustralis	Nungsham	

These plants have been diminishing due to ever increasing human activities and ecological changes for sustaining the livelihoods of the people.

VI. FAUNAL BIODIVERSITY OF MANIPUR

The State of Manipur is one of the richest faunal biodiversity as it is the junction of Mainland Indian Types, Himalayan and Trans-Himalayan Types and Indo-Malayan Types. According to the data provided by the Chief Wildlife Warden, Government of Manipur, [6] there are 19 mammals enlisted in the Schedule-I (part-I); 5 in Schedule-II (part-II); 8 in Schedule-II (part-II); 5 in Schedule-III and 1 in Schedule-IV respectively. There are 6 reptiles enlisted in Schedule-I (part-II); 3 in Schedule-II (part-II); 14 in Schedule-IV respectively. There are 15 forest and wetland birds including migratory birds enlisted in schedule-I (part-III); 143 in Schedule-IV; and 40 orchids in Schedule-VI respectively. Though no formal survey of faunal species have been done, records are available about availability of many rare species. The only tribe of apes in India, the Hoolocks Gibbons are found in the tropical forests of Manipur. Serow, a rarity in wilderness is reported from various parts of the State. The occurrence of the Slow-Loris, the Golden Cat, the Clouded Leopard, the Leopard cat, the Malayan Sun Bear, the Spotted Linshang and such rare and threatened animals speaks volumes about the faunal heritage of Manipur. The Sangai (*Cervus eldi eldi*) is endemic to Manipur. The occurrence of as many as six different species of pheasants; the Mrs. Humes Barbacked Pheasant, the Blythes Tragopan, the Peacock Pheasant, the Burmese Pea Fowl, the Jungle Fowl and the Kalej Pheasant give a testimony to rich avifauna of the State. As many as four different species of Hornbills are recorded from the hills of Manipur. It is also worth mentioning that thousands of migratory birds visit the State every year. [7]

A. Causes of Biodiversity Loss in Manipur

Though the State of Manipur has extra-ordinary rich biodiversity, the State is facing the problem of biodiversity degeneration. The biodiversity of Manipur has been declining rapidly and the accusing finger is clearly pointing to human

activities. The following are important causes for biodiversity loss in the State of Manipur:

1. Loss of Forest Vegetation due to severe practices of Shifting Cultivation: This is the most important cause driving animals and plants to extinction in the State. Though no survey to ascertain the exact population involved in shifting cultivation and areas subjected to jhuming has been carried out, it is estimated that about 70,000 families are traditional jhumias constituting about 80% of the tribal population who earn their livelihood by practicing jhuming. Forest cover affected due to shifting cultivation is 855 Sq. Km. or 85,500 hectares [8]
2. Forest Fires: Frequent forest fires both in the valley and the hills are responsible for the biodiversity loss in the State. In the village, the villagers set fire to forests to get flush of new grass for their cattle and for collection of fire wood. Regeneration (natural as well as artificial) is completely wiped out and wildlife including rare plants is severely damaged. In the hills, the forest dwellers get burnt the forest every year due to wild fire spreading from the burning of jhuming cultivation. Most of the fires occur in un-classed forests wherein the State Forest Department of Manipur have little or no control and maintain the records. The extent of area affected by forest fire in the State is estimated to about 2000 Sq. Km. annually. [9]
3. Habitat loss and fragmentation due to encroachment: This is another major factor responsible for biodiversity impoverishment causing driving animals and plants to extinction. There has been a steady encroachment inside forest land before and after 1980 as there are thickly populated areas adjoining every Reserved and Protected forests. Villagers encroached upon forest lands not only out of necessity but in anticipation of getting better land inside Reserve and Protected forests, expecting to get them regularized in their favour later on. The extent of encroachment in forests is 1844.63 hectares. [10]
4. Over-exploitation of forest resources: Reckless exploitation of forest resources for short-term pecuniary gains of a few is another major responsible factor to the

biodiversity loss. Humans have always depended on nature for food and shelter, but when 'need' turns to 'greed' it leads to over-exploitation of natural resources without compromising the future need. For instance, a large scale removal of medicinal plants causes soil erosion, land slide, loss of soil humus and posed a threat of extinction of many valuable species.

5. Lack of alternative sources of livelihood: The main sources of livelihood of the hill people are the shifting cultivation practices, on the one hand and collection of non-timber forest products to support their lifeline, on the other. Due to their share ignorance still today, the tribal people use to practice shifting cultivation which causes incalculable damage to the forests and it makes deterioration in the ecological balance. The tribal people have little idea of replacement of shifting cultivation by settled or permanent terraced cultivation, except few of them practice cultivation of perennial and indigenous plantation crops, there is no intensification of forest-based industries as an alternative to shifting cultivation.
6. Vague legal status of the forest and lack of adequate legal and institutional structure for managing the forest: Another problem that stands in the way of biodiversity conservation in Manipur is the uncertainty about the ownership of the forest lands. The forest lands in the hills which occupied more than 90 % of the total forest areas were never allotted by the State to the tribal people. As such the Forest Department is entitled to manage the forests in the hill areas of Manipur as State Forests. The State forest Department prepares forest development plans accordingly. On the other hand, the tribal people who lived in and around the forest areas have been enjoying the forest wealth from time immemorial, therefore they may feel that all the forest wealth including the land belongs to them. Therefore, they opposed tooth and nail when any plan for development of forest resources undertaken by the State Forest Department. This hampered on the way of biodiversity conservation.

B. Biodiversity Conservation Strategies

The World Conservation Strategy suggests that the initial efforts toward biodiversity conservation should aim at establishment and maintenance of a net work of protected areas through making policy changes to involve local people in protected area management and also to mobilise financial resources for their conservation and protection. The strategy also laid down that considering the stress on environment, countries should aim at earmarking 10% of their land area for Protected Area Network.^[11]

Conservation of biodiversity is the planning and management of biological resources in a way so as to secure their wide use and continuous supply, maintaining their quality, value and diversity. UNESCO's Convention (1970) on Conservation and Protection of Biodiversity viz., Man and Biosphere Convention, Rio De Janeiro Convention and Biodiversity by UNCED (1992) are considered important landmark towards effective management of biodiversity in future. The Global Biodiversity Conservation Strategy 1992, WRI, IUCN and UNEP, U.S.A. address the following Biodiversity Conservation Strategy which encompasses the following three basic elements,^[12] viz.,

1. Saving biodiversity i.e., taking steps to protect genes, species, habitats and ecosystems either in their natural environment (in-situ conservation) or in artificial

environment created for their preservation (ex-situ conservation);

2. Studying biodiversity i.e., understanding and documenting the roles and functions of genes, species, and ecosystems and also building awareness of biodiversity value amongst the general public; and
3. Using biodiversity sustainably and equitably i.e., making sure that biodiversity is used to improve quality of human life of present and future generation.

As the ICUN General Assembly, Costa Rica held in 1988, Government of India had already taken up Agenda of Action of National Conservation Strategy and Policy Statement on Environment and Development of our Biodiversity. The primary purposes of the National Conservation Strategy adopted by the Government of India in June 1992 came out on the eve of the Earth Summit held in Rio De Janeiro, Brazil is to build up a conservation society living in harmony with nature and mankind fragile and efficient use of resources guided by the best available scientific knowledge. The various action points enlisted to the Policy Statement as regards conservation of biological diversity addressed the following:

1. To ensure sustainable and equitable use of resources for meeting the basic needs of the present and future generation without causing damage to the environment;
2. To conserve and nurture the biological diversity, gene pool and other resources through environmentally sustainable development and management of ecosystems with special emphasis on our montane, marine and coastal, desert, wetlands, riverine and island ecosystems; and
3. To protect the scenic landscape, areas of geomorphological significance, unique and representative bio-mass and ecosystems and wild habitats, heritage sites/structures and areas of cultural heritage importance.

C. Structure of Biodiversity Conservation in Manipur

Biodiversity conservation strategy and Action Plan of Manipur have been prepared under the National Biodiversity Strategy and Action Plan (NBSAP) Project for development of Eco-tourism, conservation and sustainable use of biodiversity address the following strategies which are appropriate for biodiversity conservation in Manipur:^[13]

1. Establishment of Biodiversity Park in each District to serve as ex-situ conservation, education and recreation centers with promotion and management of biodiversity friendly eco-tourism through active participation and involvement of local people;
2. Development of eco-tourism related infrastructure and other basic amenities at Dzuko Valley, Loktak Lake, Koubru, Thangjing-Hill, Nongmaiching-Hill, Ango-Hill, Khayang Waterfall, Tamenglong Waterfall, Tharon Cave, Kangkhui Cave, Chandel Cave, Shiroy National Park, Zeilad Lake, Bunning, Lokchao, Kailam, etc. and other possible sites giving due importance to biodiversity;
3. Non-destructive use of the other Protected Areas (PAs) of the State for promotion of eco-tourism with extension of awareness; and
4. Creation of amenity forests and green belts on the fringes of urban areas for aesthetic and recreational purposes

The structure of Biodiversity Conservation in Manipur is depicted in the following chart-I: [14]

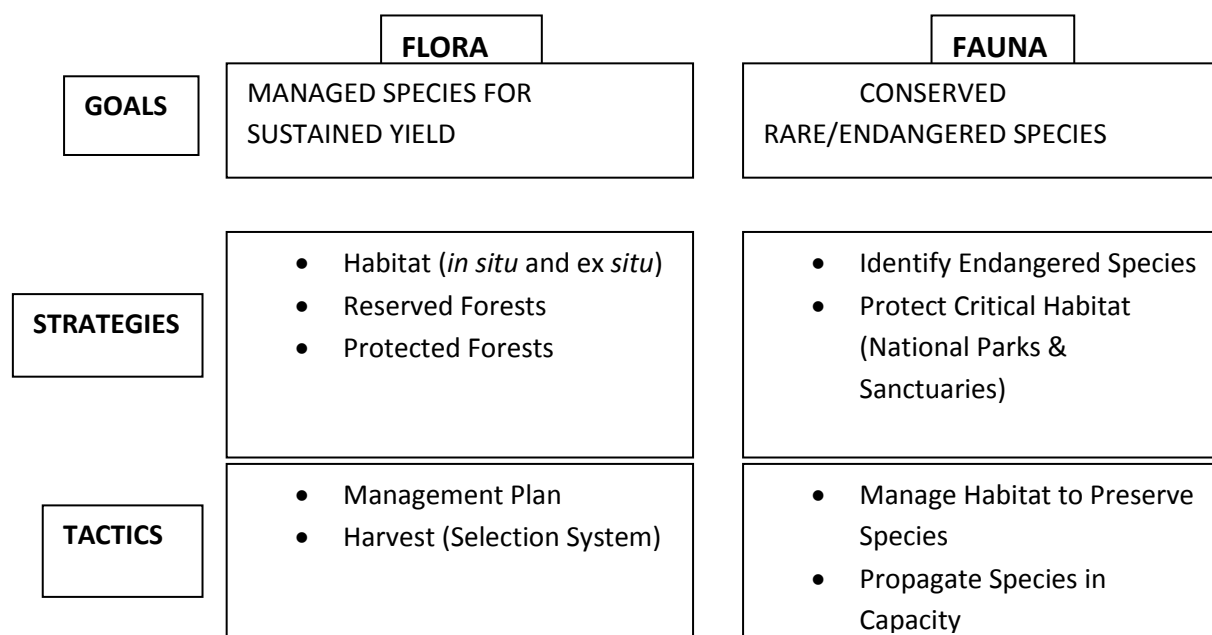


Chart-1: Structure of Biodiversity Conservation in Manipur

The following are the biodiversity conservation practices adopted by the State Forest Department of Manipur in order to achieve the goals for sustainable yield and conserving the rare, endangered and threatened species of flora and fauna of the State:

1. Habitat and Species Protection: In order to recoup the rapid loss of bio-resources of Manipur due to various biotic and abiotic factors, the State Forest Department of Manipur had taken up Protected Area Network (PAN). The Department had already identified 7 in-situ and 3 ex-situ conservation sites under the Protected Area Network for conservation of biodiversity of Manipur as depicted in Table-6:

Table 6: Protected Area Network of Manipur

SL No.	Name of the Protected Area	Location	Area in Sq. Km.
I-In situ Conservation Sites			
1.	KeibulLamjao National Park	Bishnupur Dist.	40.00
2.	YangoupokpiLokchao Wildlife Sanctuary	Chandel	184.80
3.	Bunning Wildlife Sanctuary*	Tamenglong Dist.	115.80
4.	Zeilad Wildlife Sanctury*	Tamenglong Dist.	21.00
5.	Kailam Wildlife Sanctuary*	Churchandpur Dist.	187.50
6.	Jiri-Makru Wildlife Sanctuary*	Tamenglong Dist.	198.00
7.	Shiroi National Park*	Ukhrul Dist.	41,00
Sub Total:			797.00
II-Ex situ Conservation Sites			
8.	Manipur Zoological Garden	Iriosemba, Imphal West Dist.	0.08
9.	2 nd Home of Sangai	Iriosemba, Imphal West Dist.	0.06
10.	Orchid Preservation Centre	Khonghampat, Imphal East Dist.	0.50
Sub Total:			1.18
Grand Total: (I + II)			798.80

N.B. * SL No. 3 to 7 declared under Section 18 Wild Life Protection Act 1972, process for final constitution in under progress.

Sources: GOM: Statistical Booklet of Manipur Forest 2008-09, Forest Department of Manipur, p.14.

2. Legislation: As the Indian Government has enacted and implemented the Wildlife (Protection) Act, 1972, the State Government of Manipur has followed the Wildlife (Protection) Act, 1972 and the Manipur Wildlife (Protection) Rules, 1974 has been acclaimed as ushering in a new environmental era. To this the Forest Conservation Act, 1980

and the Air (Prevention and Control and Management of Pollution) Act, 1981. In accordance with the above mentioned Acts and Rules, the power, control and management of wildlife has been vested with the State Government. The Act also prohibits trade in animal and wildlife.

3. Identification of Protected Areas: The Forest Department of Manipur over the years has carried out study, exploration and research in various parts of the State with regard to forests and wildlife and has earmarked the following potential areas for conservation:

- i. Dzuko Valley---Proposed as biosphere;

- ii. Kailam Range---Clouded Leopard and Serow were found and recommended for National Park;
 - iii. Jiri-Makru Range---Host Hoolock Gibbon, the Caped Langur, Stump Tailed Macaque, potential area for a Sanctuary;
 - iv. Zeilad Lake---Amidst impregnable tropical forest in western part extremely rich in gene pool.
8. Action plans to stress on individual responsibility and actions to conservation of biodiversity and to achieve a sustainable future should be made.
 9. Appropriate land ownership policy in forest areas should be properly framed for mainstreaming biodiversity, sustaining the forest dwellers and their livelihoods.

CONCLUSION

4. Public Awareness and Voluntary Agencies: The Community Organizations, Research Centers, Environmental Advocates and other Non-Governmental Organizations can often play active role as a catalytic agent between the Government and conservation of diverse flora and fauna in the State. They can play the role of extension agency in educating masses for conservation of biodiversity. Ecological and Environment Wing, Government of Manipur took initiative for Environmental Awareness Programmes through active participation of Clubs, NGOs and other environmental activists for conservation of biodiversity of Manipur.

SUGGESTIONS FOR SUSTAINABLE MANAGEMENT OF BIODIVERSITY

In order to tackle the problems of biodiversity conservation, the State Government of Manipur needs to take up the following short term and long term plan for a conducive sustainable management of our environment:

1. The State government should frame long term policy for regulation and control of shifting cultivation through providing alternative sources of livelihood. Provision for permanent terrace cultivation and introducing agro-forestry as well as farm forestry including horticulture, animal husbandry, etc. should be given to the jhumia families.
2. The State Government should also formulate long term policy for habitat and species protection (in-situ and ex-situ). The biodiversity conservation planning has to take into account the entire local ecosystems.
3. In order to achieve the goals of Sustainable Forest Management, Criteria and Indicator Approach can be used to conceptualise, evaluate and implement Sustainable Forest Management in the State in order to avoid over-exploitation of forest resources.
4. For conservation of biodiversity of Manipur and sustainable management of environment, the existing forest resources including gene pool of bio-resources should be managed on scientific line.
5. Environmental Awareness Programmes through active participation in planning and decision making concerning forest resource management in the State should be organized periodically and also proposes Environmental Education Programmes and campaigns to build support for conservation of biodiversity.
6. Action plans for the wise use and sustainable management of the existing wetland resources of Manipur should be framed for conservation of biodiversity of Manipur. Wetlands should also be included in Protected Area Network as in-situ conservation measures.
7. In order to protect the atmosphere which is now under pressure of greenhouse gases that threaten to change the climate and from chemicals that reduces the ozone layer, the State Government need to modernize existing power systems to gain energy efficiency and develop new and renewable energy sources, such as developing wind and solar energy sources, etc.

The State of Manipur is endowed with a vast forest cover and she is storehouse of biological diversity which includes 4000 angiospermic plants species, 430 medicinal plants species, 34 edible fungi species, 500 orchid species and 55 species of bamboo, 40 endemic rice cultivars, 160 fish species and 21 species of migratory aquatic birds. An environment rich in biological diversity offers the broadest array of options for sustainable economic activity. However, the State of Manipur is now facing the problems of biodiversity impoverishment due to unsustainable forest management, fragmentation, unethical developmental activities and climate change and many other varied reasons. In order to recoup the loss of biodiversity of Manipur, the conservation approach of in-situ (on site) and ex-situ (off site) is the desirable approach. And as such the implementation of the above enlisted suggestions for sustainable management of biodiversity in letter and spirit is the need of the hour.

“Let’s think and act for a better future through sustainable management of biodiversity!”

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