National Biodiversity Action Plan

Government of India
Ministry of Environment and Forests

2008

NATIONAL BIODIVERSITY ACTION PLAN

APPROVED BY THE UNION CABINET ON 6TH NOVEMBER, 2008

जहाँ है हरियाली।
वहाँ है खुशहाली।।

GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT AND FORESTS

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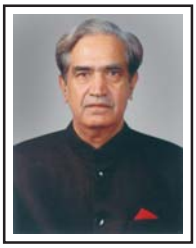
Namo Narain Meena



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FOREWORD

Biodiversity, the natural biotic capital of the earth, is fundamental to the fulfillment of human needs and vital for the survival of this planet. Biodiversity thus is life insurance for life itself. However, biodiversity is being increasingly threatened globally on account of various factors. Human activities are also placing severe pressure on biological resources, and increasingly leading to fragmentation and degradation of habitats, and resultant loss of biodiversity. These losses are irreversible and are a threat to our own well-being.

India has a long history of conservation and sustainable use of natural resources. Formal laws, policies and programmes for conservation and sustainable utilization bio-resources date back to several decades. Over the years, India has developed a stable organizational structure and a strong legal and policy framework for protection of environment in the country.

India is also a Party to the Convention on Biological Diversity (CBD), which calls upon all Parties to prepare national biodiversity strategy and action plans for conservation and sustainable use of biological diversity. Accordingly, India had developed a 'National Policy and Macrolevel Action Strategy on Biodiversity' in 1999. The present document on National Biodiversity Action Plan has been prepared through a consultative process by revising and updating the earlier policy, so that it is in consonance with the National Environment Policy, 2006.

This document provides the framework for taking action by the multitude of stakeholders in biodiversity, including the people themselves, for achieving the three objectives of the CBD, namely conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of benefits arising out of their use.

I congratulate all those who were involved in this challenging assignment. I especially wish to put on record the overall guidance and support provided by Shri Bir Singh Parsheera, Special Secretary, and the diligent and whole-hearted efforts put in by Dr. Sujata Arora, Additional Director in this endeavour.

(Namo Narain Meena)
15/12/08

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PREFACE

India is an identified megadiverse country, rich in biodiversity and associated traditional knowledge. The country also has a tradition of conservation and sustainable use of its biodiversity, which has now come under pressure on account of various factors including development imperatives, habitat fragmentation, and introduction of invasive alien species. A global scientific analysis of current trends and plausible future scenarios project that biodiversity loss is likely to continue in the foreseeable time largely because the direct drivers of biodiversity loss are projected to either remain constant or to increase in the near future. This global concern about loss of biodiversity is sought to be addressed in the international Convention on Biological Diversity (CBD), to which India is a Party.

In pursuance to Article 6 of the CBD, India within five years of ratifying the Convention, had developed a National Policy and Macrolevel Action Strategy on Biodiversity in 1999. Thereafter, an externally-aided project on National Biodiversity Strategy and Action Plan (NBSAP) was also implemented in the country during 2000-2004, adopting a highly participatory process involving various stakeholders. Meanwhile, India also enacted the Biological Diversity Act in 2002, Section 36 of which empowers the Central Govt. to develop national biodiversity action plan.

After approval of the National Environment Policy (NEP) in 2006, preparation of National Biodiversity Action Plan (NBAP) was taken up by revising and updating the document prepared in 1999, and by using the final technical report of NBSAP project. The NBAP draws upon the main principal in the NEP that human beings are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature.

The NBAP which has been developed in consultation with various stakeholders, attempts to identify threats and constraints in biodiversity conservation. Taking cognizance of the existing legislations, implementation mechanisms, strategies, plans and programmes, action points have been designed, so as to integrate biodiversity concerns into various others sectors. The attempt has been to make the NBAP consistent with the ecological, social, cultural and economic mosaic of the country, and provide a focus and impetus to the current efforts towards biodiversity conservation.

Since the consequences of biodiversity loss are often the harshest for the subsistence of the rural poor who depend most directly and immediately upon services provided by biodiversity for their livelihoods, and who are often the least able to access or afford substitutes when these services become degraded, there is an urgent need to recognize and factor-in the contribution made by biodiversity services to poverty alleviation efforts specifically, and to national economic growth more generally. The NBAP is an important tool for translating these concerns, as well as the policies and programmes provided by the CBD, into actions. Development and implementation of the NBAP is thus central to achieving the objectives of the CBD at the national level. The intrinsic nature of biodiversity and the multiple nature of its stakeholders underline the need for securing substantial inter-sectoral coordination and for providing flexibility in timelines for implementation of the action points.

I express my appreciation for the sincere and dedicated efforts put in by Dr. Sujata Arora, Additional Director in preparation of the NBAP. I also wish to thank Dr. J.R. Bhatt, Director for his assistance and Shri A.K. Goyal, Joint Secretary for his supervision of this assignment.

Dated : 15th Dec 2008
Place : New Delhi

(Bir Singh Parsheera)

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CHAPTER 1

PREAMBLE

India is known for its rich heritage of biological diversity, having already documented over 91,000 species of animals and 45,500 species of plants in its ten bio-geographic regions. Nearly 6,500 native plants are still used prominently in indigenous healthcare systems. Thousands of locally-adapted crop varieties, grown traditionally since ancient times, and nearly 140 native breeds of farm livestock, continue to thrive in its diversified farming systems. The country is recognized as one of the eight Vavilovian Centres of Origin and Diversity of Crop Plants, having more than 300 wild ancestors and close relatives of cultivated plants still growing and evolving under natural conditions.

Biodiversity (comprising all the diversity observed among species, their populations and also the vast ecosystems) that we see around us today, is the outcome of over 3.5 billion years of evolutionary development, shaped by natural processes and increasingly by human influence. It sustains the web of life and we fully depend upon it to meet our food, healthcare and other needs. Conserving biodiversity is basic to our survival and well-being and using it sustainably forms part of the Indian culture and lifestyle. Biodiversity and ecosystem services provided by it contribute to poverty eradication and national development.

Biodiversity is not distributed evenly across the globe. Certain countries, lying mostly in the tropics, are characterized by high species richness and more number of endemic species. Called megadiverse countries, 17 of them formed the group of Like Minded Megadiverse Countries (LMMCs) and India was invited in 2004 to chair this group for two years. During this period, India coordinated the development of common position of LMMCs, especially for negotiations of an international regime on access and benefit sharing.

India has participated actively in all the major international events related to environment protection and biodiversity conservation over the past decades and has ratified all the major biodiversity and environment related global conventions **(Table 1)**. It played an important role in developing the agreed text for the Convention on Biological Diversity (CBD) and became a Party to it in February 1994. The three objectives of the CBD are conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of benefits arising out of the use of these resources. Article 6 of the Convention calls upon the Parties to develop national biodiversity strategies and action plans. Recognising the sovereign rights of States over their natural resources, the Convention provides that access to genetic resources rests with the national governments and it is subject to national legislation (Article 15).

The Union Ministry of Environment and Forests (MoEF), the nodal agency for implementing provisions of CBD in India, developed a strategy for biodiversity conservation at macro-level in 1999 and enacted the Biological Diversity Act in 2002 followed by the Rules thereunder in 2004. There is a need now to develop and implement a suitable national action

plan for promoting biodiversity conservation, sustainable use of its components and equitable sharing of benefits arising from such use. The National Environment Policy, 2006, seeks to achieve balance and harmony between conservation of natural resources and development processes and also forms the basic framework for the National Biodiversity Action Plan.

Table 1: Major multilateral environment agreements (MEAs) ratified by India

MEAs	Year	Entry into force	Date of ratification by India	Issues covered
Convention on Wetlands of International Importance	1971	21.12.1975	11.02.1982	Conservation and wise use of wetlands, primarily as habitat for the water-birds
Convention for the Protection of World Cultural and Natural Heritage	1972	17.12.1975	04.11.1977	Protection and conservation of cultural and natural heritage
Convention on International Trade in Endangered Species	1973	01.07.1975	20.07.1976	International trade in endangered species of wild fauna and flora
Bonn Convention on Migratory Species of Wild Animals	1979	01.11.1983	01.11.1983	Conservation, management and wise use of migratory species of wild animals and their habitats
Vienna Convention for Protection of the Ozone Layer	1985	22.09.1988	18.03.1991	Protection of atmospheric ozone layer above the planetary boundary layer
Montreal Protocol on Substances that Deplete the Ozone Layer	1987	01.01.1989	19.06.1992	Protection of atmospheric ozone layer above the planetary boundary layer
Basel Convention on Transboundary Movements of Hazardous Wastes and their Disposal	1989	05.05.1992	24.06.1992	Regulation of transboundary movements of hazardous wastes and their disposal
United Nations Framework Convention on Climate Change (UNFCCC)	1992	21.03.1994	01.11.1993	Changes in the earth's climate system due to anthropogenic interference
Kyoto Protocol to the UNFCCC	1997	16.02.2005	26.08.2002	Quantified emission limitation and reduction commitments for Annex I Parties
Convention on Biological Diversity (CBD)	1992	29.12.1993	18.02.1994	Biological diversity and biological resources
Cartagena Protocol on Biosafety to the CBD	2000	11.09.2003	11.09.2003	Regulation of transboundary movement, transit, handling and use of living modified organisms (LMOs)
United Nations Convention to Combat Desertification	1994	26.12.1996	17.12.1996	Combating desertification and mitigate the effects of drought, particularly in Africa
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	1998	24.02.2004	24.05.2005	Promote shared responsibility and cooperative efforts among the Parties in the international trade of certain hazardous chemicals, in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use
Stockholm Convention on Persistent Organic Pollutants	2001	17.05.2004	13.01.2006	Protect human health and the environment from persistent organic pollutants

CHAPTER 2

INTRODUCTION

Biological diversity, or biodiversity, encompasses the variety of all life on earth. Biodiversity manifests itself at three levels: species diversity which refers to the numbers and kinds of living organisms; genetic diversity which refers to genetic variation within species; and ecosystem diversity which denotes the variety of habitats, biological communities and ecological processes.

Notwithstanding the fact that current knowledge of the number of species inhabiting the earth is still incomplete, estimates vary from 8 to 14 million species. To date, about 1.7 million species have been described while many more await discovery. India, a megadiversity country with only 2.4% of the land area, accounts for 7-8% of the recorded species of the world spread over 45,500 species of plants and 91,000 species of animals that have been documented so far **(Tables 2 & 3)**.

At the global level, 2,78,900 species of microorganisms have been described so far out of the estimated 3.75 million extant species. In India, 5,650 microbial species have been described.

A wide variety in physical features and climatic situations has resulted in a diversity of habitats and ecosystems such as forests, grasslands, mountains, wetlands, coastal and marine (mangroves and coral reefs) and deserts. India is also one of the eight primary centres of origin of cultivated plants and is an acknowledged centre of crop diversity, including about 375 closely related wild species mainly of rice, and several important pulses, millets, vegetables, fruits and fibre plants **(Table 4)**. In addition, nearly 140 breeds of domesticated animals (such as cattle, sheep, goat, camel, horse and poultry) are also found here **(Table 5)**.

Table 2: Recorded plant species

Taxonomic group	Number of species		% of world flora
	World	India	
Angiosperms	250000	17500	7.0
Gymnosperms	650	48	7.4
Pteridophytes	10000	1200	12.0
Bryophytes	14500	2850	19.7
Lichens	13500	2075	15.0
Fungi	70000	14500	20.7
Algae	40000	6500	16.3
Virus/Bacteria	8050	850	10.6
Total	**406700**	**45523**	**11.8**

Source: India's Third National Report to CBD, 2006

Table 3: Recorded animal species

Taxonomic group	Number of species		% in India
	World	India	
PROTISTA (Protozoa)	**31250**	**2577**	**8.24**
ANIMALIA			
Mesozoa	71	10	14.08
Porifera	4562	500	10.70
Cnidaria	9916	842	8.49
Ctenophora	100	12	12.00
Platyhelminthes	17500	1622	9.22
Nemertinea	600	-	-
Rotifera	2500	330	13.20
Gastrotricha	3000	100	3.33
Kinorhyncha	100	10	10.00
Nematoda	30000	2850	9.50
Nematomorpha	250	-	-
Acanthocephala	800	229	28.62
Sipuncula	145	35	24.14
Mollusca	66535	5072	7.62
Echiura	127	43	33.86
Annelida	12700	840	6.61
Onychophora	100	1	1.00
Arthropoda	**970670**	**69903**	**7.20**
Crustacea	35534	2934	8.26
Insecta	861696	61151	7.10
Arachnida	73440	5818	7.90
Pycnogonida	600	16	2.67
Pauropoda	360	-	-
Chilopoda	3000	100	3.33
Diplopoda	7500	162	2.16
Symphyla	120	4	3.33
Merostomata	4	2	50.00
Phoronida	11	3	27.27
Bryozoa (Ectoprocta)	4000	200	5.00
Entoprocta	60	10	16.66
Brachiopoda	300	3	1.00
Pogonophora	80	-	-
Priapulida	8	-	-
Pentastomida	70	-	-

Table 3: Recorded animal species (contd.)

Taxonomic group	Number of species		% in India
	World	India	
Chaetognatha	111	30	27.02
Tardigrada	514	30	5.83
Echinodermata	6223	765	12.29
Hemichordata	120	12	10.00
Chordata	**48451**	**4994**	**10.40**
Protochordata	2106	119	5.65
Pisces	21723	2546	11.72
Amphibia	5150	240	4.66
Reptilia	5817	460	7.91
Aves	9026	1232	13.66
Mammalia	4629	397	8.58
Total (Animalia)	1191208	88730	7.45
Grand Total (Protista+ Animalia)	**1222458**	**91307***	**7.46**

* Updated upto January 2007

Source: Faunal Resources of India, 2007. Zoological Survey of India

Table 4: Wild relatives of crop plants in India

Crop	Number of wild relatives
Cereals & Millets	46
Pulses	81
Fruits	91
Spices and Condiments	28
Vegetables	76
Fibre crops	15
Oilseeds	14
Miscellaneous plants	28
Total	**379**

Table 5: Indian native breeds of domesticated animals

Group	Number
Cattle	30
Buffalo	10
Sheep	42
Goat	20
Camel	9
Horse	6
Donkey	2
Poultry	18
Total	**137**

Environment protection is enshrined in the Constitution of India. Article 48-A and Article 51-A(g) of the Directive Principles of State Policy in the Constitution of India state that "the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife in the country", and it is a duty of every citizen "to protect and improve the national environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures". Under the system of democratic decentralization of responsibilities enshrined in Constitution amendment No. 73 of 1993, local bodies consisting of elected representatives, one third of whom are women, have been entrusted with the responsibility of safeguarding the local environmental capital stocks.

At the Central Government level, MoEF is the focal point for biodiversity conservation, as well as the nodal Ministry for all environment and forest related matters. Biodiversity being a multi-disciplinary subject, several other Ministries/Departments and affiliated agencies at the central and state levels are also undertaking biodiversity related programmes. At the Central level, the Ministries/Departments of Agriculture, Health, Water Resources, Rural Development, Power, Industry, New and Renewable Energy, Urban Development, Science and Technology, and others have important programmes relating to biodiversity.

India's strategy for conservation and sustainable utilization of biodiversity focuses on according special status and protection to biodiversity rich areas by declaring them as national parks, wildlife sanctuaries, biosphere reserves, and ecologically fragile and sensitive areas; diverting pressure on reserve forests by supporting alternative measures for meeting fuel wood and fodder needs of people; afforestation of degraded areas and wastelands; and creation of *ex situ* conservation facilities such as gene banks, within the overall ambit of a stable institutional framework. Conservation programmes for species such as tiger and elephant, and species-specific sanctuaries for wild and domesticated biodiversity have been established so as to strengthen conservation efforts. Setting up of zoos, botanical gardens, and captive breeding centres, and also promoting genetic mapping, gene banking and research activities on *ex situ / in situ* conservation, are other initiatives. Protected areas are the cornerstones of biodiversity conservation in India, and approximately 4.74% of the total geographical area of the country is already under in situ conservation of habitats and ecosystems.

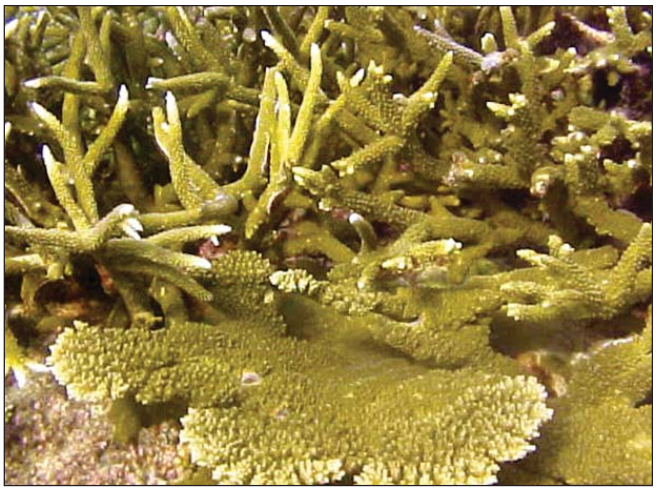
India has participated in all major international events on environment issues, since the Stockholm Conference on Human Environment and Development in 1972. The country has contributed to and ratified several key multilateral agreements on environment issues, including the Convention on Biological Diversity (CBD). Pursuant to the CBD, following a widespread consultative process, a 'National Policy and Macrolevel Action Strategy on Biodiversity' was developed in 1999 to consolidate and augment existing strategies and programmes relating to biodiversity. India has also enacted the Biological Diversity Act, 2002, which was developed through an extensive and intensive consultation process initiated in 1994. India is one of the few countries to have enacted such a legislation. This Act primarily aims at giving effect to the provisions of the Convention, including regulating access to biological resources and associated traditional knowledge so as to ensure equitable sharing of benefits arising out of their use, in accordance with the provisions of Article 15 of the CBD. The Government has also promulgated the Biological Diversity Rules in 2004.

The National Environment Policy (NEP) 2006 seeks to achieve balance and harmony between conservation and development. The policy is intended to mainstream environmental concerns in all

development activities. The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resources. The NEP prescribes that human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature.

The principal aim of the National Forest Policy, 1988 is to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all life forms, human, animal and plant. The derivation of direct economic benefit must be sub-ordinated to this principal aim. The national goal should be to have a minimum of one-third of the total land area of the country under forest or tree cover. In the hills and in mountainous regions, the aim should be to maintain two-third of the area under such cover in order to prevent erosion and land degradation and to ensure the stability of the fragile ecosystem.

India, over the past sixty years, is witness to transition from a predominantly rural based agrarian society into a diversified economy. India's planned approach to socio-economic development and poverty



eradication has underlined sustainability of natural resources. Conservation and resource management is integral to development plans. A sound environmental policy and legal framework is also in place. Recent economic liberalization policies have seen new strides in technology upgradation, cleaner fuels, efficiencies in production and environmentally sound practices. At the same time, Indian society's traditional respect for the ecology, rivers and nature continues to remain as strongly rooted as ever. The planning process also seeks to diversify the economy further into the industrial and service sectors, while accelerating the growth rate. Development has to be long-standing and inclusive, involving both the private and public sectors as partners. The national planning process emphasizes promotion of people's participatory institutions and social mobilization, particularly through women-empowerment, for ensuring the environmental sustainability of the development process. Socio-economic development consists of increase in the production, distribution, sale and consumption of food, goods and services. Planning in India seeks to increase wealth, and thereby, human welfare, and provide a safety net for the environment.

The current phase of graduated economic liberalization in India which began in 1991, proceeds hand in hand with a sustained process of political decentralization which aims at devolving works and responsibilities on culturally diverse populations to implement local development plans. Project and

programme designs for biodiversity conservation need to be predicated on socio-cultural convergence and user harmony.

A major concern now is to formulate and implement a National Biodiversity Action Plan (NBAP) taking in view the prevailing threats to biodiversity as well as challenges to the ongoing conservation efforts. The NBAP needs to be consistent with the ecological, social, cultural and economic mosaic of the country. India's cultural diversity which is closely linked with its biogeographic features, itself offers a major challenge to prepare and implement a biodiversity action plan. Preparation of NBAP is also in pursuance of Article 6a of the CBD, as well as Sections 36(1) and (3) of the Biological Diversity Act, 2002.

The process of preparing the NBAP for India was carried out by the Ministry of Environment and Forests involving wide consultations and planning with various stakeholders across the country, including an externally aided project on 'National Biodiversity Strategy and Action Plan' (NBSAP). Under the NBSAP project, 33 state level, 10 ecoregion level, 18 local level, and 13 thematic action plans were prepared. On the basis of these action plans, a final technical report of NBSAP was prepared under the project. This NBAP document is broadly based on the evaluation of existing legislations, regulatory systems, implementation mechanisms, existing strategies, plans and programmes, using the report of NBSAP project as one of the inputs. It proposes to design actions based on the assessment of current and future needs of conservation and sustainable utilization, and of physical and fiscal instruments, with particular reference to implications and impact of such instruments on short and long term basis. Considering the multidisciplinary nature of biodiversity, the actions identified in the NBAP are aimed towards integration of the three objectives of the CBD into relevant sectoral or cross-sectoral plans, programmes and policies. The NBAP takes into account ecosystem approach, where appropriate, and promotes mainstreaming of gender considerations. The challenge before India is not only to sustain the efforts of the past, but also to further consolidate the endeavour in accordance with a rational need assessment.

Chapter 3 of this NBAP document describes the major threats and constraints facing biodiversity conservation. For the purpose of addressing these threats, objectives of NBAP have been outlined in Chapter 4, followed by corresponding action points emanating from the objectives in Chapter 5. A tabulated matrix for implementation of the key activities of NBAP indicating the implementing agencies and timeframe is given in Chapter 6.

CHAPTER 3

BIODIVERSITY CONSERVATION: THREATS AND CONSTRAINTS

In the backdrop of varying socio-cultural milieu and often conflicting demands of various stakeholders, there is an urgent need for augmenting and accelerating the efforts for the conservation and sustainable use of biological diversity, and for fair and equitable sharing of benefits arising from the utilization of genetic resources. Threat to biodiversity stems mainly from habitat fragmentation; degradation and loss; shrinking genetic diversity; invasive alien species; declining forest resource base; climate change and desertification; overexploitation of resources; impact of development projects; and impact of pollution. The constraints and challenges to biodiversity conservation which flow inter alia from these threats relate to biodiversity information base; implementation of Biological Diversity Act and safeguarding traditional knowledge; new and emerging biotechnologies; economic valuation and natural resource accounting; policy, legal and administrative measures; and institutional support.

3.1 Habitat fragmentation, degradation and loss, and shrinking of genetic diversity

Habitat destruction is identified as the main threat to biodiversity. Under diverse natural conditions, over a billion people in rural and urban areas live in harmony under a democratic system in India. Their pressing needs for food, fibre, shelter, fuel and fodder combined with compelling need for economic development exert enormous pressure on natural resources. With half the total land under agriculture, and approximately 23 per cent under forests, the protection of diverse habitats poses a formidable challenge.

The loss and fragmentation of natural habitats affect all animal and plant species. We need to not only stop any further habitat loss immediately but also restore a substantial fraction of the wilderness that has been depleted in the past. Various species of plants and animals are on the decline due to habitat fragmentation and over-exploitation, e.g. habitats of Great Indian Bustard in Madhya Pradesh, Gujarat and Rajasthan, and of the Lion-tailed Macaque in Western Ghats.

The major impact of developmental activities involves diversion of forest land. Since the enactment of Forest (Conservation) Act in 1980, 11.40 lakh hectares of forest area, for about 14,997 development projects, has been approved for diversion. Against this diversion, compensatory afforestation has been stipulated for over 12.10 lakh hectares of land.

Habitat fragmentation and loss is also one of the primary reasons leading to cases of man-animal conflict. Common property resources like pastures and village forests, which served as buffer between wildlife habitat and agriculture, have been gradually encroached upon and converted into agricultural fields and habitation. Due to this, the villagers are brought into a direct conflict with wild animals. The usual cases regarding man-animal conflicts relate to leopards, elephants, tigers, monkeys, blue-bulls, wild boars and certain birds. Section 11 of the Wildlife (Protection)

Act, 1972 authorizes the Chief Wildlife Warden of a State/UT to permit the translocation/capturing/killing of a wild animal in the following circumstances:

- Schedule-I animals (elephant, tiger, leopard, etc.) only when they pose threat to human life or have become so disabled or diseased beyond recovery; and
- Other wild animals (blue bull, wild boar, monkey, etc.) when they pose threat to human life, crops and other properties or have become so disabled or diseased beyond recovery.

Sacred groves, initiatives of communities for conserving biodiversity due to their religious beliefs (India has over 19,000 sacred groves) are also getting degraded or converted to plantations. Because there are several medicinal plants and wild relatives of crop plants occurring naturally in these areas, the sacred groves need to be conserved. Traditional norms and practices for conservation of neighbourhood forests and common land are also diminishing, although certain rural and tribal communities continue to safeguard their biological resource base even at the cost of their livelihood and sustenance **(Box 1)**.

Box 1: Bishnois – Committed to Conservation

The Bishnoi tribe of Western Rajasthan has, over the centuries, protected the trees and wild animals in and around their villages. Bishnois do not cut trees for fuel and timber; they remove only the dead trunks and twigs. Spotted deer, black buck and blue bull can be seen foraging fearlessly in their fields. Even if the crop is consumed by herds of deer, the Bishnois do not chase away the animals.

In 1730 A.D. Maharaja Abhaya Singh of Jodhpur ordered cutting of trees in large numbers to provide timber for building a fortress. He sent soldiers to Bishnoi villages to cut down khejari trees growing in the area. When soldiers applied the axe, the Bishnoi villagers pleaded to spare the trees., When the soldiers did not relent, they hugged the trees and as many as 363 of them laid down their lives to save the trees.

The Bishnois worship nature in all its manifestations, conserve trees and medicinal plants, provide food and water to animals, and are vegetarians in their diet, as advocated by their Guru Jambaji.

Loss of habitats and over- exploitation have led to depletion of genetic diversity of several wild animals and cultivated plants. Shrinking genetic diversity leads to more vulnerability to diseases and pests and lesser adaptability to environmental changes. This lesson has emerged from the world-wide experience of drastically curtailed genetic diversity in agricultural biodiversity following the so-called Green and White Revolutions in agriculture-based economies, including India.

Conserving the flagship large animal species (such as the lion, tiger, rhino and elephant) has also highlighted the concern that these projects should aim at broadening the genetic base (gene pool) in breeding populations besides focusing on habitat protection. The decisive factor in saving critically endangered species is maintaining the minimum size and genetic base of inter-mating individuals rather than their total number which may include the non-breeding individuals also.

An assessment of plant genetic resources for food and agriculture illustrates this point. These resources contribute to people's livelihoods while providing food, medicine, feed for domestic animals, fibre, clothing, shelter, energy and a multiple of other products and services. India is remarkably rich in agriculturally important genetic resources. However, both the number of crops grown on commercial scale and the number of their varieties grown under different agro-ecosystems, have severely declined in recent decades reducing thereby the agricultural biodiversity maintained in diverse farming systems.

About 150 crops feed most of the human population at present, but just 12 of them provide 80% of food energy (with wheat, rice, maize and

potato alone providing 60%). Also, about 30 mammalian and bird species are used extensively, but just 15 of them account for over 90 per cent of global livestock production. The Indian scenario is not very different. Choice of crops and farm livestock in agricultural production systems is now getting largely influenced by market trends and changing lifestyles, affecting the variety, taste and nutrition value of our food basket.

Landraces, developed and grown traditionally by farming communities through generations, locally adapted obsolete cultivars and their wild relatives comprise crop genetic resources. These provide the building blocks used by farmers and scientists as the raw material for breeding new plant varieties and also act as a reservoir of genes sought after for manipulation using new tools of biotechnology. Indigenous cultivars, adapted to local situations are, however, mostly low yielding (largely because of not receiving due breeding effort) and are, hence, getting fast replaced by just a few high-yielding and pest-resistant superior varieties/hybrids under each crop. Alarm bells are ringing because narrow genetic base means more vulnerability to widespread epidemics. A large number of over 300,000 samples of these cultivars kept under long term storage in the National Gene Bank, has gone out of cultivation. Many among the well-known nearly 140 native breeds of farm livestock and poultry are also facing similar threat to their survival. This is happening even when local breeds are genetically better adapted to their environment and are more cost-effective being productive even whilst consuming lower quality feedstuffs. The local breeds are also more resilient to climatic stress, are more resistant to local parasites and diseases, and serve as a unique reservoir of genes for improving health and performance of 'industrial' breeds. Conservation and greater use of local breeds will be most effective in achieving food and nutrition security objectives at the local level.

Wild species, related closely to their cultivated forms, are valued by plant breeders for obtaining genes for resistance to virulent diseases and tolerance to stresses like drought, salinity and temperature. Continuing evolutionary development of these valuable species depends on adequate genetic diversity in their natural populations. Increasing fragmentation, degradation and loss of their habitats over the years have seriously limited their availability and threatened their survival.

Efforts to conserve plants and animals in gene banks are vital but an even more important task is to maintain biodiversity on farms and in natural habitats where it can continue to evolve and adapt to changing conditions. As custodians of agricultural biodiversity, farmers are better suited to conserving and developing these genetic resources, ensuring their survival and availability to serve present and future needs. Developing fruitful national partnership for this purpose, while working towards sustainable agriculture, presents a challenge to all the concerned government agencies, scientific institutions and rural communities.

3.2 Declining natural resource base and over-exploitation of resources

India is endowed with diverse forest types ranging from the tropical wet evergreen forests in North-East to the tropical thorn forests in the Central and Western India. The forests of the country can be classified into five major groups based on climatic factors. These major groups have been divided into 16 forest types based on temperature. They are further divided into 202 sub-groups and type groups based on location specific climatic factors and plant species constitution. Forests face threats on account of diversion of forest land for agriculture, industry, human settlements, and other developmental projects. Construction of roads and canals, quarrying, shifting cultivation and encroachments are other threats. Degradation of forests results from illicit felling, excess removal of forest products, fodder, fuel wood, forest floor litter, overgrazing and forest fires. As a result, some of the floristic and faunal components, including many keystone and endemic forest species are now left with narrow eroding populations which need to be urgently conserved.

Even though forestry is the second largest land use in India after agriculture, covering approximately 23.57 percent (recorded forest area) of the total geographical area, the contribution to the Gross Domestic Product from forestry is minimal (it was barely 1.1 percent in 2001). An estimated 41 percent of the country's forest cover has been degraded to some degree. As much as 78 percent of forest area is subject to heavy grazing and about 50 percent of the forest area is prone to forest fires. Domestic demand for timber and fuelwood is well above the sustainable level.

The rich diversity of medicinal plants (over 6,500 species) in the country needs conservation and sustainable utilization, as their habitats are either degraded or the species are being over-exploited. In fact, nearly 90% of the medicinal plants in trade are harvested from the wild. The medicinal plants constitute critical resource for health care of rural communities and for the growth of Indian herbal industry. Currently, India's share in the complementary medicine related global market is only 0.3% and there exists immense scope for expanding its share in the 62 billion US$ world market from the present level of Rs. 5,000 crores (approximately 1.2 billion US$). But, it is a sad reflection that while it has the knowledge, skills and resources, India has not yet seized opportunities in the global market. Even its 0.3% share is largely (70%) through export of raw materials and only in a limited way (30%) through value addition and sale of finished products. Indian exports are thus guided by what may be termed as a trader's vision rather than by a knowledge-products vision.

The MoEF has mooted a Multi-Stakeholder Partnership (MSP) framework involving the three partners, namely, the land owning agency/ forest department, the local village community and the sponsor, for afforestation on degraded forest lands and other lands, as one of the measures to achieve the National Forest Policy goal of one-third forest and tree cover in the country.

Unsustainable exploitation of biodiversity resources, particularly by developed countries, have serious adverse impacts, both local and global. The global impacts are largely manifest in developing countries, and may further accentuate poverty in these countries. Failure on the part of developed countries to provide incentives for conservation in the form of financial resources, technology transfer and scientific cooperation, as envisaged under the CBD, further dampen the conservation efforts in the developing countries.

The increasing population of the country has led to diversion of natural forest for agricultural use, fuelwood, timber and human settlements. The five grassland types in India (namely, Sehima-Dicanthium type, Dicanthium-Cenchrus-Lasiurus type, Phragmites-Saccharum-Imperata type Themada-Arundinella type and Temperate-Alpine type) too are under severe threat. There is dearth of both trained manpower and targeted research on grasslands and their carrying capacities. Similarly, the wetlands and coastal and marine ecosystems such as mangroves and coral reefs are also facing threats from increased resource use, pollution, reclamation and illegal poaching.

Although population growth and resource consumption are the proximate threats to biodiversity today, in the long run their impact on biodiversity will be determined by more than one variable, including social and economic progress of the country. The steps that are taken to improve literacy, empower women, invest in health and child welfare, and stimulate sustainable economic development, will in the end also determine the level where human population, and the demands it places on natural resources, stabilize.

3.3 Invasive alien species

Among the major threats faced by native plant and animal species (and their habitats), the one posed by the invasive alien species is considered second only to habitat loss. The major plant invasive species include *Lantana camara, Eupatorium odoratum, E.adenophorum, Parthenium hysterophorus*, *Ageratum conyzoides, Mikania micrantha, Prosopis juliflora, Cytisus scoparius,* etc. Alien aquatic weeds like water hyacinth are increasingly choking waterways and degrading freshwater ecosystems. *Lantana* and carrot grass cause major economic losses in many parts of India. Highly invasive climbers like *Chromolaena* and *Mikania* species have over-run the native vegetation in North-East Himalayan region and Western Ghats. Numerous pests and pathogens such as coffee berry borer, turnip stripe virus, banana bunchy top virus, potato wart and golden nematode have invaded agro-ecosystems becoming serious menace.

In addition, illegally introduced catfishes (like the African magur) and also the big head carp are known to have adversely affected native fish diversity. Accidental entry of silver carp in Govindsagar lake and its subsequent dominance over the native catla and mahseer fish is a shocking experience. Tilapia has similarly been reported to have adverse effects on indigenous species in Vaigai reservoir in Tamil Nadu. A recent intruder, the African catfish (also called Thai magur) seem to have posed even far greater threats to native fish fauna.

In view of the severe damage that has been done to major ecosystems and taking note of the alarming environmental degradation caused by the invasive alien species, some states have adopted legislative and administrative measures for eradicating/preventing their further spread. These welcome initiatives notwithstanding, the threat posed by the exotic invasive species is not yet contained and awaits more effective steps to be taken at the ground level.

3.4 Climate change and desertification

Climate change, on account of build-up of greenhouse gases in the atmosphere leading to global warming, poses another significant threat to biodiversity, ecosystems, and the goods and services they provide. There are indications that the projected changes in temperature and CO_2 concentration may alter growth, reproduction and host-pathogen relationships in both plants and animals. It is believed that the ecosystems with undiminished species

diversity, and species with their genetic diversity intact, are likely to be in a much better position to face the impact of climate change. The Intergovernmental Panel on Climate Change in its summary report released in February, 2007, has estimated huge loss of biodiversity for biodiversity-rich megadiverse countries such as India because of higher greenhouse gas emissions. Targeted research on impacts of climate change on forest types, eco-sensitive zones, crop yields and biodiversity is required under the changing climatic regime.

Similarly, scientific studies have brought out that strong interlinkages exist between desertification and biodiversity loss. This calls for undertaking focused research on the impact of desertification as also synergizing efforts to combat desertification and promote biodiversity conservation.

3.5 Impact of development projects

India, with its large population, is poised for rapid economic growth. Large infrastructural and industrial projects, including highways, rural road network, and the special economic zones, are coming up. With cities and townships expanding, often at the cost of agriculture, and agriculture expanding at the cost of tree cover, fresh threats to biodiversity are emerging. In addition, changing lifestyles of the people, with rising incomes, in both rural and urban areas, are placing increasing demands on biodiversity.

In order to harmonise developmental efforts with protection of environment, Environmental Impact Assessment (EIA) was made mandatory through a notification issued in 1994 for notified categories of developmental projects in different sectors of the industry, thermal and nuclear power, mining, river valley and infrastructure projects. To make the EIA process more efficient, decentralized and transparent, a revised notification was issued on September 14, 2006.

Biodiversity in India is facing threats from various sources of pollution, both point and non-point. The major threats are from improper disposal of municipal solid waste, inadequate sewerage, excessive use of chemical pesticides and continuous use of hazardous chemicals even where non-hazardous alternatives are available. New industrial processes are generating a variety of toxic wastes, which cannot be dealt with by currently available technology in the country. Besides, economic constraints and problems related to the indigenization makes the substitution of these technologies difficult.

Although India's per hectare use of pesticide is very low as compared with many other countries, pesticide residues in land, water and food have been detected over the last three decades. Varying amounts of DDT and BHC residues have been found in agricultural produce including milk, meat and fodder. Levels found have been mostly below stipulated norms but their presence is a matter of concern.

There is a need for significant body of research and development seeking new biologically based methods for abatement of pollution.

3.6 Biodiversity information base

So far, almost 70% of the country's land area has been surveyed and around 45,500 species of plants and 91,000 species of animals have been described. It is estimated that about 4,00,000 more species may exist in India which need to be recorded and described. The baseline data on species and genetic diversity, and their macro-and micro-habitats, is inadequate. Further, although a number of organizations/agencies are working on various aspects of biodiversity, the information on the subject is scattered and not yet integrated into a national database. Some of the databases being developed are not upto the standard, primarily because of lack of infrastructure, skilled manpower and coordination among experts in different fields. The different sectoral networks therefore need to establish a nationwide information system with a uniform format for collection, retrieval and dissemination of data.

The underground biodiversity, particularly soil microbes, are poorly understood. The degradation of land has led to the loss of underground biodiversity. Similarly, the microbial diversity of fresh water and marine ecosystems is less known and may yield novel compounds of therapeutic and industrial value. For sustainable agriculture, microorganisms play a decisive role. They have very wide potential for stimulating plant growth, increasing nutrient availability and accelerating decomposition of organic materials, and are anticipated to increase crop production as well as maintain sound environment for sustainable harvests.

Hence, it is necessary to explore, preserve, conserve and utilize the unique microbial flora of our country for fulfilling the emerging food, fodder and fibre needs, clean environment and improved soil health. There is a need to conserve microbial diversity from various niches for varied applications.

The information on biodiversity of freshwater, coastal and marine areas of the country is highly fragmentary, although it has vast economic potential. Nearly 50% of the aquatic plants of the world are recorded from the Indian sub-continent but only a few have been studied in detail. In order to address some of these concerns, a National Institute on Mangroves and Coastal Bioresources is being set up by the MoEF in Sunderbans. Human induced changes in terrestrial ecosystems have been adversely impacting the marine biodiversity too. Efficient management system for marine protected areas is lacking. Documentation, conservation and sustainable utilization of marine biodiversity are urgently needed. In India, conservation biology studies have been carried out only on a few marine organisms (viz. estuarine crocodiles, olive ridley, leather back and hawkbill turtles). Other important life forms such as coral reefs, sea horses, sea cucumbers, dolphins, dugongs, whales, sharks, mollusks and crustaceans have not been properly studied so far. Information on several taxa is insufficient to categorise them as extinct, endangered, vulnerable or rare. This is mainly

because of the lack of expertise on specific groups, lack of resources to work on groups having only scientific importance, lack of coordination in exchanging data, and lack of proper technology in culturing/growing the organisms.

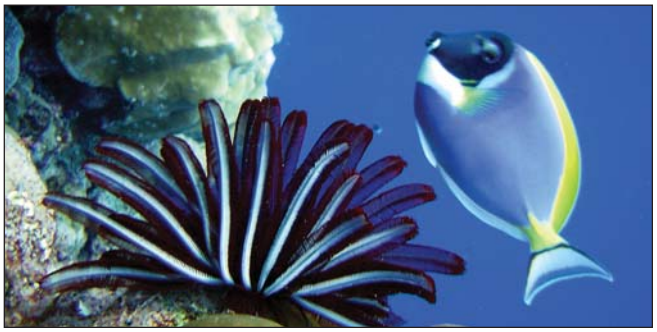
It is evident that the taxonomists are ageing and declining in number and there is insufficient expertise in identification of several groups of organisms mainly because of failure in transferring the capacity in taxonomic identification to the next generation. Similarly, the frontline forestry staff requires training for equipping them for undertaking research and monitoring activities.

India has a strong base of indigenous knowledge on various aspects of biodiversity including that of coastal and marine biodiversity. This traditional knowledge has to be scientifically validated through screening of biological diversity for commercially valuable products, so as to make bio-prospecting useful and effective. Department of AYUSH through its research councils is undertaking validation of traditional systems of medicines.

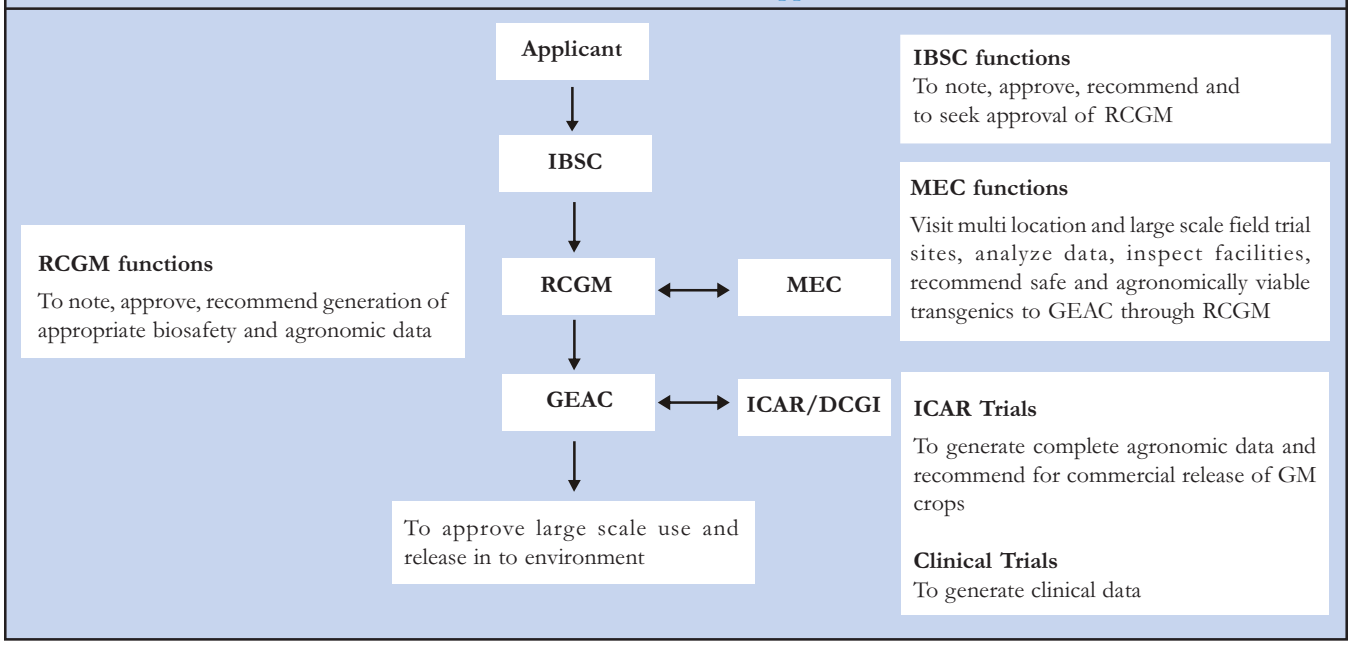
Our understanding of the underlying causes of the loss of biodiversity is incomplete as is the assessment of the consequences of such a loss for the functioning of ecosystems. Available data does not help in unequivocally establishing cause-effect relationships. There is also a lack of any widely accepted indicator(s) of biodiversity. We need to strengthen institutional framework and human capacity to generate new knowledge, create greater awareness on the linkages of biodiversity with other components of our life-support system, and apply scientific solutions to the problem of erosion of species and genetic diversity. The loss is allied with increasing human demands and decreasing productivity in ecosystems.

3.7 New and emerging biotechnologies

Development and introduction of transgenic or genetically modified organisms (GMOs), developed through the use of r-DNA technology , are already in the process of revolutionising all facets of human life, be it agriculture, industry or health care. Significant investments in biotechnology research have been made in India and many research projects are at advanced stages of development. About 20 recombinant therapeutics and a transgenic crop, Bt cotton, have already been approved for commercial use in the country. The area under Bt cotton cultivation has increased substantially in the last six years. Further,



Box 2: Procedures Involved in the Approval of GMOs in India



11 transgenic crops are under various stages of field trials. Among various biosafety issues, there are concerns with respect to impact on biodiversity.

A multi-tiered mechanism is already in place in India to evaluate and regulate such organisms and their products **(Box 2)**. However, the long-term impact of introduction of transgenics on biodiversity, particularly on genetic diversity of domesticated animals and crops, is far from clear. The sheer magnitude of potential benefits of transgenics, and the perceived fears of their possible harmful consequences, call for urgent steps to review the existing mechanisms and protocols for biosafety assessment of transgenic organisms on a continuous basis.

The application of Genetic Use Restriction Technologies (GURTs) or terminator technologies is prohibited and import of GURTs based products is also banned in the country **(Box 3)**. Hence, there is a need to further develop state-of-the-art containment facilities and diagnostic tools for GURTs in the country.

Policies and programmes, aimed at securing biotechnological capacity building of the country for realizing the actual and potential value of biodiversity, along with its conservation, also need to be strengthened.

3.8 Economic valuation and natural resource accounting

Sensitivity to conservation issues and decision making has been insufficient as a result of non-accounting of intrinsic value of biodiversity and non-visibility of serious damage caused to ecosystems and ecological balance in the immediate and long run. Despoilers of environment will not find it economically viable if an economic value is put on the goods and services provided by the ecosystem. In India, natural resource accounting systems are likely to play an important role in decision-making and resource allocation in the future. However, such systems are still evolving and easily usable methods are not yet available. Cess, user charges and other fiscal instruments are to be used to confer value on biological resources. Among other things, an overt objective of such suggestions is to generate revenue,

Box 3 : Genetic Use Restriction Technologies

GURT, also called terminator technology, is a biotech-based strategy that prevents seeds from germinating in the next growing season unless treated chemically by the seed company prior to planting. When seeds of crop varieties (containing this kind of genetic manipulation) are purchased from the company and planted, they germinate and grow normally but produce seeds that do not germinate when saved by the farmers for sowing during the following season. Thus, healthy and high yielding plants are genetically commanded to produce 'sterile' seeds preventing the farmers to use them for the next season's planting. The technology was first developed by the Delta & Pine Land, a multinational seed company, and the US Department of Agriculture. If commercialized, 'terminator' would compel farmers to purchase fresh seeds from the company every year. It is bad for agricultural biodiversity and worse for the small and marginal farmers.

Farmers have to purchase seeds of high yielding hybrid varieties because seeds produced by the hybrid plants are not uniform and their production capacity decreases in successive seasons. Hybrid varieties are not yet popular in self-fertilised crop plants like wheat and rice whose seeds are normally replaced after five years or so and that too on exchange among the farmers. Multinational seed companies intend to prevent this traditional practice through GURTs.

It is noteworthy that India opted to enact its sui generis system (PPVFR Act 2001) for protection of crop varieties as required under the WTO-TRIPS provisions. The Indian system is largely compliant to an accepted international system for variety protection, called UPOV 1978, that permits farmers to use saved-seeds and also exempts researchers in using seeds of protected varieties. These two exemptions distinguish this system from its more recent version called UPOV 1991 which does not permit them and operates more like the patenting system. GURTs can be employed to achieve this objective without the need to seek protection or patenting of new seed varieties.

The International Agricultural Research Centre, operating under CGIAR, decided in 2000 against the use of this technology and India was the first country to block its entry. The Government of India has further strengthened this action through Protection of Plant Varieties and Farmers' Rights Act, 2001. Its section 29 (3) states that "Notwithstanding anything contained in sub-section (2) and sub-sections (1) and (3) of section 15, no variety of any genus or species which involves 'any technology' injurious to the life or health of human beings, animals or plants shall be registered under this Act. For the purposes of this sub-section, the expression "any technology" includes genetic use restriction technology and terminator technology."

which could provide much needed financial support for biodiversity conservation programmes. However, feasibility and the eventual usefulness of these controls and fiscal instruments deserve evaluation.

3.9 Policy, legal and administrative measures

Although a number of policy, legal and administrative measures are in place to address various aspects of biodiversity conservation [including Wildlife (Protection) Act, 1972, Forest (Conservation) Act, 1980, Biological Diversity Act, 2002, etc.], there is need to promote greater harmony and synergy in these measures. Another major identified gap is lack of effective enforcement of existing laws. For tribal dominated areas, the implementation of existing laws is to be gauged in the light of sixth schedule of the Constitution.

Further, role of macro-economic policies and measures on biodiversity is least understood. Policies, which directly or indirectly work as incentives for indiscriminate use of biodiversity, are insensitive to biodiversity concerns. On the other hand, biodiversity

and wildlife conservation policies that rely on denying people access to their natural resource base can inflict hardships on the poor, as there is no accounting of the costs of conservation thrust on them for the benefit of distant interest groups. There is a need to promote people's participation and, solicit their cooperation, particularly of those living inside the Protected Areas (PAs) and fringe areas.

Some of the good practice initiatives taken by the Ministry of Environment and Forests include

rationalizing and streamlining the processes for environmental and forestry clearances for achieving greater transparency and inducting expertise in decision-making, and for ensuring that decisions are taken within a fixed time frame on each proposal. In addition, some developmental schemes of the Ministry have provision for entry point activities which include providing supplementary and alternative livelihood support, and creation of minor infrastructure facilities such as construction of paths and roads, jetties, drinking water, medical and health, irrigation facilities, etc., with the objective of improving the quality of life of people living in and around forests.

Even though the Biological Diversity Act was enacted in 2002, and the Rules notified in 2004, its provisions are yet to be fully and effectively implemented. This progressive legislation has the potential to address the lacunae in several aspects relating to conservation and management of biodiversity and associated traditional knowledge. However, its implementation is proving to be quite challenging.

The Act provides for setting up of a National Biodiversity Authority (NBA) at national, State Biodiversity Boards (SBBs) at state and Biodiversity Management Committees (BMCs) at local levels. The Act also stipulates preparation of People's Biodiversity Registers (PBRs) by the BMCs involving local people and with guidance from SBBs and NBA, for documenting traditional knowledge relating to biodiversity. The preparation of PBRs across the country is an enormous task. Further, it has many limitations. The programme is being implemented in a phased manner after addressing the limitations. The institutes/agencies which have already initiated such programmes should be strengthened to complete the task in States where the programme has made some progress. SBBs and BMCs should be set up in all the States and local bodies, respectively.

The documentation of traditional knowledge available in our ancient texts is being undertaken by Council of Scientific and Industrial Research (CSIR), in the form of a computerized database called Traditional Knowledge Digital Library (TKDL). Preparation of PBRs is expected to document the un-coded oral traditional knowledge of local people. Considering that this would be a stupendous and time-consuming exercise, there is a need for an All India Coordinated Project on Traditional Knowledge for documenting the un-coded, oral traditional knowledge of local people, especially of little-known bioresources of potential economic value.

3.10 Institutional framework and capacity building

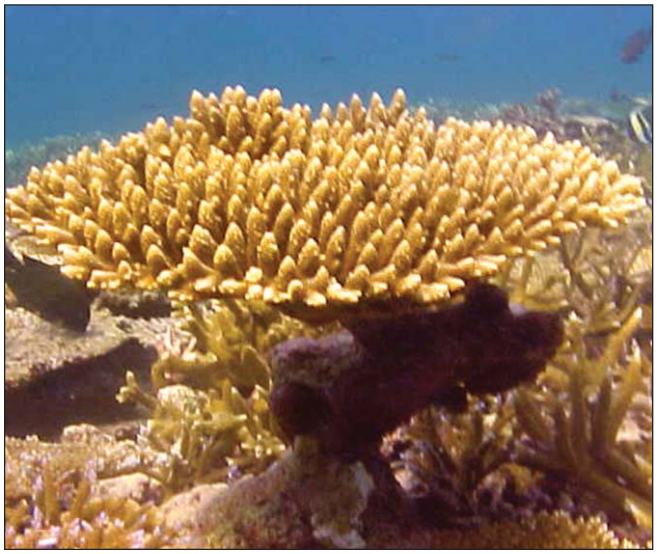
A reasonably sound institutional infrastructure is in place for adequate coverage of biodiversity concerns with specific mandates and activity profiles of existing institutes. However, there is a need for improving intersectoral coordination inter alia through continuous review and revision of their mandates, and networking of these institutions to ensure adequate coverage of biodiversity concerns and issues and also to avoid duplication/overlapping of efforts.

There is a need for human resource development and capacity building for scientific management of biodiversity. Capacity building in taxonomy requires particular attention since taxonomists are rapidly declining in number when the need for taxonomic stocktaking of earth's biodiversity is becoming increasingly important and urgent. Many groups of biota are yet to be catalogued, while biodiversity losses are rampant. The implementation of Biological Diversity Act and National Environmental Policy 2006 would be difficult without having adequate number of trained taxonomists.

CHAPTER 4

OBJECTIVES

The objectives of the NBAP, enumerated in the paragraphs that follow, are founded in the backdrop of the cardinal principles already set out in the NEP 2006. The most important of these principles is that human beings are at the centre of sustainable development concerns. The other relevant principles on which the objectives are premised include: right to development; precautionary approach; economic efficiency; entities with 'incomparable' value **(Box 4)**; equity; public trust doctrine; decentralisation; integration; preventive actions; and environmental offsetting. These principles, which have an established genecology, provide the necessary overall guidance for the implementation of the objectives. The objectives are broad-based and relate to current perceptions of key threats and constraints to biodiversity conservation. These may accordingly evolve over time. The objectives are to be realized through various strategic interventions by different public authorities at central, state and local government levels. They are also to form the basis of diverse partnerships.



4.1 Strengthening and integration of *in situ*, on-farm and *ex situ* conservation

- To protect and conserve through *in situ*, on-farm and *ex situ* conservation, major national bio-geographic zones, critical ecological systems and genetic resources, which are essential for life support, livelihoods, food and nutritional security; and are in consonance with the national economic growth and broad conception of human well-being.

4.2 Augmentation of natural resource base and its sustainable utilization: Ensuring inter and intra-generational equity

- To promote holistic approach to conservation, enhancement and sustainable utilization of biodiversity, providing access to bioresources for all sections of society, in particular the economically poor, who are directly dependent on them, thereby ensuring inter- and intra-generational equity.

4.3 Regulation of introduction of invasive alien species and their management

- To develop unified national system for regulation of all introductions including their quarantine check, assessment and release.
- To improve management of invasive alien species and restore the adversely affected ecosystems.

4.4 Assessment of vulnerability, and adaptation to climate change and desertification

- To develop appropriate tools, methodologies and indicators of impact of climate change, and desertification at the national level.

- To assess vulnerability of various important national economic sectors to global threats such as climate change and desertification.
- To devise appropriate strategies for mitigating the impact of and adaptation to climate change, and desertification.

4.5 Integration of biodiversity concerns in economic and social development

- To integrate biodiversity concerns into policies, plans, programmes and projects for economic and social development.
- To achieve sustainable development based on protection, enhancement and management of biological resources.

4.6 Pollution impacts

- To prevent, minimize and abate impacts of pollution from point and non-point sources on various components of biological diversity, keeping in view cost minimization, polluter-pays principle, and imperatives of international trade and investment.

Box 4: Entities of Incomparable Values

The National Environmental Policy (NEP) 2006 while defining the basic principles of environmental conservation and management, emphasizes need for priority allocation of societal resources for conservation of Entities of Incomparable Value (EIV), both natural and man-made, which may impact the well-being, broadly conceived, of a large number of persons. The country has already taken several measures to protect and conserve environmental life-support systems, besides certain other natural and human-made entities, and cultural heritages, which impact present and the future well-being and happiness of individuals and communities.

Some of the ecologically rich and sensitive areas are currently covered through the protected areas (PA) network and eco-sensitive zones, deriving power under diverse legal instruments and/or regulatory frameworks but the provisions of extant legal instruments have not been translated into regulatory frameworks and guidelines, and they do not fully cover certain EIVs such as biosphere reserves, natural heritage sites and man-made monuments, wetlands, mangroves, and sacred groves. It has therefore become necessary to set up a harmonized system for identification, constitution, rationalization and management of the diverse EIVs under a unified regulatory framework within the ambit of Environment (Protection) Act, 1986.

Taking into account the concerns expressed in the NEP and requirements for a specific regulatory framework, an EIV is defined as follows:

'Entities of Incomparable Values are sites containing unique natural or man-made entities, (living and/or non-living), that provide critical life support environmental services and/or are essential for the well-being, broadly conceived, of a large number of people of present and future generations.'

Criteria for Identification of EIV are:

a. Unique biodiversity (genetic, species and ecosystem). It includes species and ecosystems characterized by endemicity, rarity and representativeness (such as relevant components of biosphere reserves, natural heritage sites and other fragile ecosystems).
b. Life support systems (water, soil, geology, glaciers) impacting the well-being and health of large number of people, i.e. at least 100,000 population.
c. Entities of cultural, aesthetic and religious significance to a large number of people, i.e. at least 1,00,000 people.
d. Large economic potential in the context of specific unique natural resources to be conserved i.e. at least 25 crores potential annual income at 2007 prices and/or major livelihood support to 1,00,000 population.
e. Natural entities providing eco-system resilience.

4.7 Development and integration of biodiversity databases

- To collect, collate and integrate biodiversity information from diverse sources into a national database on different components of biodiversity with distributed networking systems and linkages.
- To intensify the survey, identification and inventorization of country's floristic, faunal and microbial resources with special attention to hitherto unexplored areas, and keystone, umbrella, endangered and endemic species which need to be conserved on priority basis.

4.8 Strengthening implementation of policy, legislative and administrative measures for biodiversity conservation and management

- To review and update the extant policy, legislative and administrative measures for conservation and management of biological diversity.
- To promote greater harmony, synergy and linkages among extant policy, legal and administrative measures for conservation and management of biological diversity and associated traditional knowledge.
- To accelerate effective implementation of provisions of Biological Diversity Act and Rules with special attention to protecting the traditional knowledge (both codified and un-codified), innovations and practices, and encouraging their use, while ensuring equitable sharing of benefits arising out of their use as stipulated under the CBD.

4.9 Building of national capacities for biodiversity conservation and appropriate use of new technologies

- To promote human resource development, institutional strengthening and capacity-building for biodiversity conservation and management with special attention to taxonomy and conservation biology.
- To build institutional and human capacity for biosafety, inter alia for undertaking risk assessment and management of genetically modified organisms.

- To increase public education, awareness and participation in decision making, management and sustainable use of biological resources.
- To promote targeted research in critical gap areas pertaining to biodiversity conservation and management.
- To ensure higher resource flows, comprising finance, technology management skills, traditional knowledge, and social capital, for biodiversity conservation through mutually beneficial mutlistakeholder partnerships between local communities, public agencies, the academic and research community, investors, and multilateral and bilateral development partners.
- To review and strengthen ongoing training, extension and on-site demonstration programmes at requisite levels to incorporate directed focus to conservation.

4.10 Valuation of goods and services provided by biodiversity and use of economic instruments in decision making processes

- To assign appropriate market value to the goods and services provided by various ecosystems and strive to incorporate these costs into decision making, management and sustainable utilization of biological diversity resources.

- To factor in natural resource accounting (NRA) in the national economic planning processes and encourage financial institutions to adopt appropriate NRA appraisal practices so that risks to biological diversity are adequately considered in the financing of projects.
- To facilitate integration of biodiversity concerns into cost-benefit analysis with a view to encouraging more efficient allocation of resources while making public investment decisions.

4.11 International cooperation

- To consolidate and strengthen bilateral, regional and multilateral cooperation on issues related to biodiversity

CHAPTER 5

ACTION PLAN

In the sections that follow, broad action points have been listed corresponding to the areas identified in Chapter 3. These are envisioned to be achieved in the backdrop of extant national policy framework and a large number of programmes and activities, currently underway in different Departments and Ministries of the central and state governments, complemented by NGOs and civil society organizations working in the field of biological diversity. In the long-term perspective, the state governments and Panchayati Raj Institutions would be encouraged to undertake their own action programmes consistent with the present NBAP under the overall ambit of the NEP. In the short-term perspective (eleventh plan period), the actions required, the functionaries, and corresponding capacities for attending to the major, imminent gap areas have been described. These action points are certainly not exhaustive and are intended to facilitate the process of conservation of biodiversity in the country. This is an iterative and dynamic process, which will continue to evolve on its own with experience.

5.1 Strengthening and integration of *in situ*, on-farm and *ex situ* conservation

A total of 605 Protected Areas covering approximately 4.74% of the total geographical area of the country are under *in situ* conservation through a PA network of National Parks (96), Wildlife Sanctuaries (509), and Conservation Reserves (3), established under the Wildlife (Protection) Act. A state-wise list of National Parks and Wildlife Sanctuaries in the country is given in **Table 6**. As may be seen in this table, the top five states in terms of PA coverage are Gujarat, Maharashtra, Jammu & Kashmir, Andhra Pradesh and Madhya Pradesh. The PA network covers about 24.2% of the forest area of the country, mainly with relatively larger populations of target species and associated ecological components. Many important habitats exist in the rest of the forests, which require special attention for conservation for ensuring sustainability of the populations. Habitats of sandalwood, red sanders, shola forests of southern tropical montane forests, alpine meadows in the Himalayan region, elephant habitats including corridors connecting PAs, southern tropical rain habitats, tropical swamps, mangroves outside forests in Sunderbans, etc., are some of such habitats existing in the forests outside the PAs. Hence, in the eleventh five year plan, it is envisaged to take up a new component for protection of wildlife outside PAs under the centrally sponsored scheme on 'Integrated development of wildlife habitats'.

Substantial chunk of India's biodiversity exists outside the precincts of 'formally declared conservation zones', which are owned and managed by the local communities. The livelihood security of these communities is delicately and intricately interwoven with the prudent resource management and conservation status of these areas. Further, any future plans to expand the Protected Area network in India,

would depend significantly in recognizing such Community Conserved Areas. Recent amendments to the Wildlife (Protection) Act provide for setting up of Community and Conservation Reserves. Voluntary relocation of villagers from critical habitats of PAs contributes to enhancing the quality of habitat for wildlife and also the quality of living for villagers by facilitating better access to mainstream development.

To conserve the representative ecosystems, a Biosphere Reserve (BR) programme is being implemented. Fifteen BRs have been notified, of which four have been recognized by the UNESCO under the World Network of BRs **(Table 7)**. Fourteen more potential sites have also been identified for this purpose.

Table 6: State-wise Details of the Protected Area Network of the Country

S.No.	States/UTs	No. of National Parks	No. of Wildlife Sanctuaries
1.	Andhra Pradesh	4	22
2.	Arunachal Pradesh	2	11
3.	Assam	5	20
4.	Bihar	1	11
5.	Chhattisgarh	3	10
6.	Goa	1	07
7.	Gujarat	4	21
8.	Haryana	2	10
9.	Himachal Pradesh	2	32
10.	Jammu & Kashmir	4	16
11.	Jharkhand	1	10
12.	Karnataka	5	21
13.	Kerala	6	13
14.	Madhya Pradesh	9	25
15.	Maharashtra	6	35
16.	Manipur	2	05
17.	Meghalaya	2	03
18.	Mizoram	2	07
19.	Nagaland	1	03
20.	Orissa	2	18
21.	Punjab	Nil	10
22.	Rajasthan	5	23
23.	Sikkim	1	06
24.	Tamil Nadu	5	20
25.	Tripura	Nil	04
26.	Uttar Pradesh	1	23
27.	Uttaranchal	5	06
28.	West Bengal	6	15
29.	Andaman & Nicobar	9	96
30.	Chandigarh	Nil	02
31.	Dadar & Nager Haveli	Nil	01
32.	Lakshadweep	Nil	01
33.	Daman & Diu	Nil	01
34.	Delhi	Nil	01
	Total	**96**	**509**
	GRAND TOTAL	**605**	

Table 7: Biosphere Reserves in India

S. No.	Name of the Biosphere Reserve & total Geographical Area (km^2)	Date of Notification	Location (State)
1.	**Nilgiri (5520)**	01.08.86	Parts of Wynad, Nagarhole, Bandipur and Madumalai, Nilambur, Silent Valley & Siruvani hills (Tamil Nadu, Kerala & Karnataka)
2.	**Nanda Devi (6497.03)**	18.01.88	Parts of Chamoli, Pithoragarh & Almora Districts and Valley of Flowers (Uttarakhand)
3.	Nokrek (820)	01.09.88	Parts of Garo Hills (Meghalaya)
4.	Manas (2837)	14.03.89	Parts of Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamprup and Darang Districts (Assam)
5.	**Sunderbans (9630)**	29.03.89	Parts of delta of Ganges & Brahamaputra river system (West Bengal)
6.	**Gulf of Mannar (10500)**	18.02.89	Indian part of Gulf of Mannar between India and Sri Lanka (Tamil Nadu)
7.	Great Nicobar (885)	06.01.89	Southern most islands of Andaman and Nicobar (A&N Islands)
8.	Similipal (4374)	21.06.94	Parts of Mayurbhanj district (Orissa)
9.	Dibru-Saikhowa (765)	28.07.97	Parts of Dibrugarh and Tinsukia districts (Assam)
10	Dehang Debang (5111.5)	02.09.98	Parts of Siang and Debang valley in Arunachal Pradesh
11	Kanchanjunga (2619.92)	07.02.2000	Parts of North and West Sikkim.
12.	Pachmari (4926.28)	03.03.99	Parts of Betur, Hoshangabad and Chindwara districts of Madhya Pradesh.
13.	Agasthyamalai (3500.36)	12.11.2001 (area expanded on 30.03.2005)	Parts of Thirunelveli and Kanyakumari Districts in Tamil Nadu and Thiruvanathapuram, Kollam and Pathanamthitta.
14.	Achanakmar-Amarkantak (3835.51)	30.03.2005	Parts of Anuppur and Dindori districts of Madhya Pradesh and Parts of Bilaspur district of Chhattisgarh State
15.	Kachch (12454)	29.01.2008	Parts of Kachch, Rajkot, Surendranagar and Patan district of Gujarat

**Sites with bold letters have been recognized by UNESCO on World Network of Biosphere Reserves.*

Specific programmes for scientific management and wise use of fragile ecosystems such as wetlands, mangroves and coral reef are under implementation **(Table 8)**. Internationally significant wetlands are declared as Ramsar sites under the Ramsar Convention **(Figure 1)**. Under the World Heritage Convention, natural sites are declared as world heritage sites.

Table 8: Statewise Distribution of Wetlands under National Wetland Conservation Programme

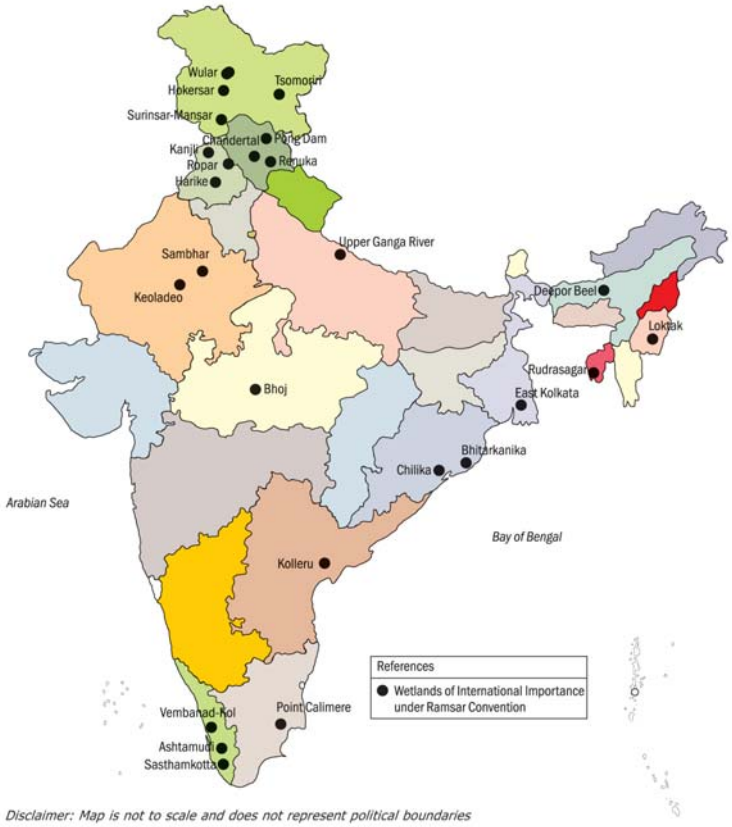
State	Number of Wetlands	Area (ha)
Andhra Pradesh	1	90100
Assam	2	4504
Bihar	3	11490
Chandigarh	1	148
Gujarat	8	1270875
Himachal Pradesh	5	15739
Haryana	2	288
Jammu and Kashmir	10	120450
Jharkhand	2	98965
Karnataka	7	4297
Kerala	5	213229
Madhya Pradesh	12	359814
Maharashtra	3	40298
Manipur	1	26600
Meghalaya	1	22150
Mizoram	2	185
Orissa	4	120407
Punjab	4	5965
Rajasthan	1	24000
Sikkim	6	164
Tamil Nadu	3	46283
Tripura	1	240
Uttar Pradesh	12	14080
Uttarakhand	2	1244
West Bengal	6	553099

A National Lake Conservation Plan (NLCP) is being implemented for conservation of polluted and degraded urban/semi-urban lakes, leading to lake rejuvenation in terms of improvement in water quality and biodiversity. As on March 2007, 31 projects for conservation of 46 lakes have been taken up **(Table 9)**. A National River Conservation Plan (NRCP) is also under implementation in 160 towns along polluted stretches of 34 rivers spread over 20 states, the major rivers being Ganga, Yamuna, Gomti, Damodar, Satluj, Krishna, Cauveri and Godavari. The objective of NRCP is to check pollution in rivers through implementation of various pollution abatement schemes.

Table 9: List of 31 Projects for Conservation of 46 Lakes as on March 2007

S.No.	Lake	State
1.	Banjara	Andhra Pradesh
2.	Dal Lake, Srinagar	Jammu & Kashmir
3.	3 lakes of Bangalore namely Vengaiahnkere, Nagavara and Jarganahalli	Karnataka
4.	Bellandur lake, Bangalore	Karnataka
5.	Kotekere, Belgaum	Karnataka
6.	Bhishma, Gadag	Karnataka
7.	Lal Bagh, Bangalore	Karnataka
8.	Sharanabasveshwara	Karnataka
9.	Akkamahadevi, Haveri	Karnataka
10.	Chanapatna, Hasan	Karnataka
11.	Veli Akkulum, Thiruvananthapuram	Kerala
12.	Powai	Maharashtra
13.	9 lakes in Thane	Maharashtra
14.	Mahalaxmi lake, Vadagaon	Maharashtra
15.	Mansagar, Jaipur	Rajasthan
16.	Ooty	Tamil Nadu
17.	Kodaikanal	Tamil Nadu
18.	3 lakes of Agartala	Tripura
19.	4 lakes of Nainital District	Uttarakhand
20.	Nainital lake	Uttarakhand
21.	Rabindra Sarovar, Kolkata	West Bengal
22.	Mirik	West Bengal
23.	Bindusagar, Bhubaneswar	Orissa
24.	Kundwad lake, Davengere	Karnataka
25.	Rani Talab, Riva	Madhya Pradesh
26.	Kotetavarekere, Chickmaglore	Karnataka
27.	Tripuranthekeshwar, Bidar	Karnataka
28.	Rankala, Kolhapur	Maharashtra
29.	Varhala Devi, Bhiwandi	Maharashtra
30.	Sagar, Sagar	Madhya Pradesh
31.	Mansi Ganga	Uttar Pradesh

Figure 1: Identified Ramsar Sites in India



Source: Conservation of Wetlands in India: A Profile, Ministry of Environment & Forests, Government of India, 2007

Box 5: Great Indian Bustard *(Ardeotis nigriceps)*

Indian Bustard *(Ardeotis nigriceps)*, alternate scientific name *Choriotis nigriceps,* is found in the short grass plains and desert plains of west Rajasthan and Gujarat. This bird is on the endangered red list of IUCN due to its small and declining population. Indian bustard is the most endangered member of the bustard family in the world and the total population in wild may not exceed 700.

Threats to the Great Indian Bustard (GIB) include degradation of grasslands due to development works, habitat fragmentation, expansion of agriculture, conversion of grasslands into other forms of land cover and change of floral composition of grasslands including conservation of grasslands and woodlands, habitat degradation due to invasive species and general increase in anthropogenic pressures.

Various conservation measures being undertaken include population and habitat monitoring exercises and awareness raising among people, policy makers, managers and other stakeholders. The MoEF has sanctioned a project to GEER Foundation, Gujarat for monitoring GIB population in Gujarat. BNHS is also engaged in research and population monitoring of GIB. With the above conservation measures, it is hoped that the conservation of Great Indian Bustard would be ensured in the long run.

Intensive conservation measures for other flagship species such as snow leopard, musk deer and Kashmir stag will be taken up during the eleventh five year plan. Gene sanctuaries for preserving the rich native diversity of citrus, banana, rhododendron and orchids have also been established. Measures undertaken for conservation of Great Indian Bustard and vultures are presented in **Box 5** and **Box 6,** respectively

Subsequent to amendments to the Wildlife (Protection) Act in the year 2006, National Tiger Conservation Authority and Wildlife Crime Control Bureau have been constituted.

Box 6: Vulture Crisis in India and Steps Taken for its Conservation

The following nine species of vultures are found in India:

1. White-rumped Vulture
2. Long-billed Vulture
3. Slender-billed Vulture
4. Red-headed (king) Vulture
5. Egyptian Vulture
6. Himalayan Griffon
7. Eurasian Griffon
8. Cinereous Vulture
9. Lammergier Vulture

It is believed that the population of three Gyps vultures (white-rumped vulture, long-billed vulture, and slender-billed vulture) has declined by about 95% since early 1990s in the Indian sub-continent. India too is witnessing this catastrophic vulture crisis, which is largely due to:

- Food scarcity caused by changes in disposal practice of dead cattle in developed areas, cities, etc., coupled with competition with other scavengers such as stray dogs, etc., whose populations have increased.
- Decline in the number of tall trees preferred by vultures for nesting and roosting.
- Anthropogenic pressures, industrialization, urbanization, etc.

Various measures initiated for conservation of vultures in India include awareness raising among people, policymakers, veterinarians and other stakeholders, establishment of two Vulture Breeding Centres in Haryana and West Bengal (a new Vulture Breeding Centre has been approved for Gujarat) and initiation of population monitoring of vultures. During 2005, state wide Gyps vulture population survey was carried out in Gujarat by GEER Foundation and 2,647 Gyps vultures were found in the state. The Ministry had also formulated an "Action Plan for Vulture Conservation in India" in April 2006. The population survey was repeated in 2007 under a project sanctioned by the MoEF. These measures would help in the revival of vulture population in the country.

In situ conservation of medicinal plants is being undertaken by various government and non-government organizations. A National Medicinal Plants Board was set up under a government resolution notified on 24th November 2000 under the Ministry of Health and Family Welfare to promote coordination and implementation of policies relating to medicinal plants both at the Central and State levels. There is a need to study the agronomy of medicinal plants to develop agro-techniques for their cultivation. Cultivation of medicinal and other economically important plants can also be promoted through home herbal and kitchen gardens, resident welfare associations in urban and semi-urban areas, village commons, etc.

This research component can be taken up by national institutions, universities, including state agricultural universities. The cultivation of medicinal plants can be taken by the State Forest Departments within the forests where they occur naturally or on lands situated close to their native habitat ranges.

Forest Departments should be strengthened by the MoEF to implement these programmes. Planting of trees of medicinal value on waste lands should be encouraged. This can be implemented through National Afforestation and Eco-Development Board. Bio-prospecting of native medicinal plants (nearly 6,500 species) needs to be undertaken on a priority basis. It can be done through institutions like National Institute of Pharmaceuticals Education and Research (NIPER), Chandigarh, CSIR labs, such as Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, National Botanical Research Institute (NBRI), Lucknow and India Institute of Integrative Medicine [(IIIM) (formerly known as RRL, Jammu)] which are at present concentrating only on 40-45 species. Their mandate should be enlarged to embrace all highly traded endemic medicinal plants. Simultaneously, the ICAR system should work on developing agro-technologies for bringing the endemic medicinal plants into the fold of cultivation. Growing medicinal plants should also receive priority in urban plantation programmes. This would reduce pressure

on forests as 95% of the medicinal plants at present are collected from the wild.

To compliment *in situ* conservation, attention has been paid to *ex situ* conservation measures through setting up of botanical gardens, zoos, deer parks, safari parks, aquaria, etc. Central Zoo Authority has been set up to ensure better management of zoos. Under a plan scheme 'Assistance to Botanic Gardens', financial assistance is provided to strengthen measures for *ex situ* conservation of threatened and endangered species. Guidelines for botanical gardens have been finalized and the vision is to have at least one botanical garden per district. The Indian Council of Agricultural Research has set up a number of gene banks for *ex situ* conservation under the National Bureau of Plant Genetic Resources (NBPGR), New Delhi **(Table 10)**, National Bureau of Animal Genetic Resources (NBAGR), Karnal, National Bureau of Fish Genetic Resources (NBFGR), Lucknow, and National Bureau of Agriculturally Important Microorganisms (NBAIM), Mau. A large number of microorganisms of agricultural importance also form a vital part of the diversified Indian agricultural ecosystem **(Table 11)**.

Table 10: Base Collections of Crop Genetic Resources in India

S. No.	Crop groups	Base collections holdings
1.	Cereals	134,953
2.	Pseudo Cereals	5,508
3.	Pulses	53,074
4.	Millets and minor millets	48,727
5.	Oilseeds	47,924
6.	Vegetables	21,334
7.	Medicinal & aromatic plants	5,461
8.	Fruits	265
9.	Fibre crops	9,572
10.	Spices & Condiments	1,681
11.	Agro-forestry	2,167
12.	Released crop varieties and Elite Genetic Stocks	3,978
13.	Reference samples (Medium term)	53,161
14.	Duplicate Safety Backup (for IARC Banks)	10,235
	Total	**393,040**

Source: The National Gene Bank, NBPGR, New Delhi

Table 11: Micro-organisms kept under Storage

Group	No. of Accessions
Fungi	1368
Yeast	40
Actinomycetes	18
Bacteria, and others	103
Total	1529

Source: National Bureau of Agriculturally Important Micro-organisms.

Projects have been initiated for reintroduction of threatened species into their natural habitats under appropriate conditions. Examples include mass propagation of pitcher plant, rehabilitation of mangroves in degraded open mud flats, and the effort towards relocation of rhinoceros from Kaziranga to Manas and tigers from Ranthambore to Sariska in Rajasthan.

The Department of Biotechnology (DBT) has been implementing focused programmes on biodiversity conservation through biotechnological interventions since 1991, inter alia by developing techniques, tools and technologies for ex situ conservation. Many tissue culture protocols have been developed for regeneration of endangered and threatened species. The DBT has established a national facility "Laboratory for conservation of species" – LaCONES, at Hyderabad jointly with the help of Central Zoo Authority (MoEF), CSIR and Andhra Pradesh Government for the conservation of endangered animal species like tiger, lion, black buck, vulture, etc. Some other programmes supported by the DBT have focus on animal biotechnology, medicinal plants and aromatic grasses including

societal programmes specifically for the cultivation of medicinal plants/aromatic grasses and extraction of valuable chemicals/products for economic upliftment of SC/ST and weaker sections.

Traditional Indian farming systems are characterized by remarkable diversity owing largely to wide spectrum of agro-climatic situations and indigenous cultivars and native breeds adapted to specific local conditions. Notable efforts to collect crop diversity and documenting of livestock breeds notwithstanding, there is a need for on-farm conservation providing appropriate incentives. *Ex situ* conservation is expected to provide a strong backup to the efforts to facilitate access and meet unforeseen natural calamities.

While there is an increasing coherence of policies and programmes on *in situ*, on-farm and *ex situ* conservation, there is need to further strengthen these efforts.

Action Points

***In situ* conservation**

- Expand the PA network of the country including conservation and community reserves, to give fair representation to all biogeographic zones of the country. In doing so, develop norms for delineation of PAs in terms of the objectives and principles of the National Environment Policy, in particular, participation of local communities, concerned public agencies, and other stakeholders, who have direct and tangible stake in protection and conservation of wildlife, to harmonize ecological and physical features with needs of socio-economic development.
- Establish self-sustaining monitoring system for overseeing the activities and effectiveness of the PA network.
- Ensure that human activities on the fringe areas of PAs do not degrade the habitat or otherwise significantly disturb wildlife.
- Mitigate man-animal conflicts.
- Promote site-specific eco-development programmes in fringe areas of PAs, to restore livelihoods and access to forest produce by local communities, owing to access restrictions in PAs.
- Promote voluntary relocation of villagers from critical habitats of PAs.
- Devise effective management and conservation techniques for the forest preservation plots to ensure conservation of representative areas of different forest types.
- Strengthen research work on PAs, biosphere reserves and fragile ecosystems by involving local research institutions and universities, so as to develop baseline data on biological and managerial parameters, and functional properties of ecosystems.
- Strengthen the protection of areas of high endemism of genetic resources (biodiversity hotspots), while providing alternative livelihoods and access to resources to local communities who may be affected thereby.
- Continue to promote inter-sectoral consultations and partnerships in strengthening biodiversity conservation activities.

- Strengthen capacities and implement measures for captive breeding and release into the wild of identified endangered species.
- Reintroduction and establishment of viable populations of threatened plant species.
- Control poaching and illegal trade in wild animals and plant species.
- Periodically revisit the norms, criteria and needs of data for placing particular species in different schedules of the Wildlife (Protection) Act.
- Promote ecological and socially sensitive tourism and pilgrimage activities with emphasis on regulated and low impact tourism on a sustainable basis through adoption of best practice norms.
- Formulate and implement partnerships for enhancement of wildlife habitat in conservation reserves and community reserves, on the lines of multistakeholder partnerships for afforestation, to derive both environmental and eco-tourism benefits.
- Promote conservation of biodiversity outside the PA network, on private property, on common lands, water bodies and urban areas.
- Formulate and implement programmes for conservation of endangered species outside PAs.
- Ensure conservation of ecologically sensitive areas, which are prone to high risk of loss of biodiversity due to natural or anthropogenic factors.
- Ensure that survey and bioprospecting of native economically important biological resources is undertaken on a priority basis.
- Integrate conservation and wise use of wetlands and river basins involving all stakeholders, in particular local communities, to ensure maintenance of hydrological regimes and conservation of biodiversity.
- Consider particular unique wetlands as entities of incomparable values, in developing strategies for their protection and formulate conservation and prudent use strategies for the identified wetlands with participation of local communities and other stakeholders **(Box 7)**.

On-farm conservation

- Identify hotspots of agro-biodiversity under different agro-ecozones and cropping systems and promote on-farm conservation.
- Provide economically feasible and socially acceptable incentives such as value addition and direct market access in the face of replacement by other economically remunerative cultivars.
- Develop appropriate models for on-farm conservation of livestock herds maintained by different institutions and local communities.
- Develop mutually supportive linkages between *in situ*, on-farm and *ex situ* conservation programmes.

***Ex situ* conservation**

Box 7: Regulatory Framework for Wetlands

Recognizing the value of wetlands and taking cognizance of the fact that there does not yet exist a formal system of wetland regulation, the National Environment Policy seeks to set up a legally enforceable regulatory mechanism for identified valuable wetlands to prevent their degradation and enhance their conservation. It also undertakes to develop an inventory of such wetlands. In pursuance of the policy resolution a draft regulatory framework for the wetlands has been formulated for wider consultation.

Source : Conservation of Wetlands in India: A Profile Ministry of Environment and Forests, Government of India 2007

- Promote *ex situ* conservation of rare, endangered, endemic and insufficiently known floristic and faunal components of natural habitats, through appropriate institutionalization and human resource capacity building. For example, pay immediate attention to conservation and multiplication of rare,

endangered and endemic tree species through institutions such as Institute of Forest Genetics and Tree Breeding.

- Focus on conservation of genetic diversity (*in situ, ex situ, in vitro*) of cultivated plants, domesticated animals and their wild relatives to support breeding programmes.
- Strengthen national *ex situ* conservation system for crop and livestock diversity, including poultry, linking national gene banks, clonal repositories and field collections maintained by different research centres and universities.
- Develop cost effective and situation specific technologies for medium and long term storage of seed samples collected by different institutions and organizations.
- Undertake DNA profiling for assessment of genetic diversity in rare, endangered and endemic species to assist in developing their conservation programmes.
- Develop a unified national database covering all *ex situ* conservation sites.
- Consolidate, augment and strengthen the network of zoos, aquaria, etc., for *ex situ* conservation.
- Develop networking of botanic gardens and consider establishing a 'Central Authority for Botanic Gardens' to secure their better management on the lines of Central Zoo Authority.
- Provide for training of personnel and mobilize financial resources to strengthen captive breeding projects for endangered species of wild animals.
- Strengthen basic research on reproduction biology of rare, endangered and endemic species to support reintroduction programmes.
- Encourage cultivation of plants of economic value presently gathered from their natural populations to prevent their decline.
- Promote inter-sectoral linkages and synergies to develop and realize full economic potential of *ex situ* conserved materials in crop and livestock improvement programmes.

5.2 Augmentation of natural resource base and its sustainable utilization: Ensuring inter and intra-generational equity

Conservation and sustainable use of biodiversity have been integrated into national decision-making through policy statements, legislative measures and programmes. Sustainable use of biological diversity is emphasized in various policy statements of the Government, notably the National Conservation Strategy and Policy Statement on Environment and Development, 1992, the National Forest Policy, 1988, the National Wildlife Action Plan (2002-2016), and the National Environment Policy, 2006. NEP does not substitute the preceding policy frameworks but is an adjunct to previous policies. Several initiatives have been taken to implement various aspects of these policy statements. Sustainable utilization, underscored in these policy statements, recognizes the interdependence of local communities and people on biological resources, and emphasizes the need to draw upon the existing resources keeping long-term conservation in view.

Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act enacted in 2006, is a tool to provide occupational and habitational rights to the people. Empowering people, particularly assigning the ownership of minor forest produce for the purpose of access, processing and trade would enhance their livelihood. The Ministry of Tribal Affairs have allocated financial resources to the development of forest villages which have hitherto been totally cut off from the mainstream development in the country. This Ministry also implements various schemes and programmes for socio-economic development of scheduled tribes such as special central assistance to tribal sub plan under which grants-in-aid to State Governments is provided, integrated

development of forest villages to raise Human Development Index, and 100% central grants-in-aid to States under Article 275(1) of the Constitution.

The National Rural Employment Guarantee Act, 2005 entitles a rural household for 100 days of work in a financial year. Many of the works permissible relate to forestry, like afforestation, tree plantation, water conservation and water harvesting, etc.

Pressure on natural resources in biodiversity-rich areas needs to be diverted by bringing additional areas under green cover to satisfy local demands, encouraging environment-friendly substitutes to meet the needs, promoting energy efficient devices, and creating awareness and an enabling environment. There is also a need to devise techniques/tools to restrict use and extraction of only desired part of the organism rather than the entire organism.

Economically effective and socially viable incentives for conservation and sustainable use of biological diversity are being encouraged. These include use of wood substitutes, alternative energy sources (biogas, wind mills, solar cookers, wave energy, fuel efficient stoves, etc.), establishment of nurseries, tree planting, stall feeding, water harvesting and pollution abatement measures.

The forestry sector in India is being reoriented with growing emphasis on poverty alleviation and livelihood opportunities, while at the same time ensuring sustainable management and use of forest resources. The current trend in forest management is towards greater participation and involvement of all stakeholders dependent on the forests. The National Forest Policy (1988) and National Forestry Action Programme (1999) also endeavour to address some of the concerns towards Sustainable Forest Management (SFM). According to National Status Report on Forests and Forestry in India, 2006, SFM would, *inter alia*, involve:

- Production of wood and non-timber forest products, first for meeting subsistence needs and then the surplus for commercial purposes.
- Protection and setting aside of areas to be managed as wild life reserves or plantations for recreational and environmental purposes.
- Regulating the conversion of forest lands for non-forestry uses.
- Regeneration of wastelands and degraded forests.

- Functional and land capability classification of forests and land use planning to ensure healthy and sustainable land use systems with acceptable safe minimum standards.
- Protection of adequate extent of natural forests for their long-term contributions including conservation of biodiversity.
- Management and utilization of forest resources for maximizing their sustainable contribution and value addition towards improved welfare of society.
- Promotion of efforts for producing forest goods and services outside forest areas (e.g. agroforestry plantations, home gardens) and development of potential substitutes for wood from non-forest sources (e.g. rubber wood, coconut wood).
- Waste reduction and recycling programme.
- Feasible medium for encouraging participation of people and the private sector.
- A proper and realistic system for cost, values and benefits attributable to forestry to ensure a strong ecology - economy interface.

The Joint Forest Management (JFM) programme in the country has emerged as a powerful tool to achieve sustainable management of forestry in India. A decentralized two-tier institutional structure [Forest Development Agency (FDA) and JFM Committee] facilitates greater participation of the local communities, both in planning and implementation, to conserve forests as well as secure livelihoods. At present, more than 22.02 million ha of forests are managed by around 1.06 lakhs JFM Committees

(JFMCs) involving 21.99 million people living in and around forest areas. The major problems faced under JFM include lack of permanent institutional arrangement and regular sustained income flows to participating communities. JFM's performance is also found to be highly varying across the participating States. Cases have been reported regarding conflict between Panchayati Raj Institutions (PRIs) and JFMCs. The need to forage linkages is essential to synergise the efforts and activities of both the Institutions i.e. PRIs and JFMCs. There is a need to involve JFMCs in biodiversity mapping and conservation for which synergy between JFM micro planning and biodiversity conservation activities needs to be promoted.

Indian forests are rich in several types of Non-Timber Forest Products (NTFPs) such as honey, bamboo, cane, gums and resins, leaves used for country smoke and plate- making, several types of flowers, dye plants, fruits, nuts, seeds and roots. Sustainable management of NTFPs is one of the main objectives of forest management. NTFPs contribute to over 75% of total forest export revenue, and add significantly to the income of about 30% of rural people. NTFPs play an important role in the social and traditional life of forest dependent populations. According to a study, about 67% of all gatherers are women and 13% are children.

Trade in some items such as tendu leaves, sal seeds, myrobolans, gums and resins is nationalized in some States. In Madhya Pradesh and Chhattisgarh, the major share of net revenue goes back to NTFP gatherers. Sustainability of the management of NTFPs is one of the major concerns which is being ensured through development and application of non-destructive methods of NTFP collection.

Despite very high potential of NTFPs, their sustainable management is a major issue requiring urgent action. NTFP gatherers are highly unorganized with little market access. Because of lack of inventory data or value addition, and resultant non-remunerative prices, the gatherers often resort to unsustainable and destructive harvesting to maximize their collection. Further, in the forestry sector, the local organizations such as cooperatives are either still rare or in infancy. There is a need to strengthen the useful link between NTFP management and JFM so that the benefits accruing from NTFPs can be profitably channelised for the well-being of the forest dependent communities, ensuring sustainable forest management. The high potential of NTFPs is to be rationally and optimally utilized through scientific approaches, research, acquisition of appropriate technology and greater people's participation.

The constraints in forestry sector, among others, include: (i) lack of adequate awareness about the multiple roles and benefits of forests and their relevance to poverty alleviation and sustainable development; (ii) low priority for forestry in national planning process; (iii) slow pace of policy reforms and inadequate implementation of regulatory mechanisms; (iv) over-emphasis on government control and involvement, and difficult administrative procedures; (v) weak forestry information system rendering decision-making difficult; (vi) inadequate investment in forestry, not-commensurate with its role in sustainable development; (vii) inadequate space for

private participation; (viii) lack of full realization of people's participation; (ix) inadequate targeted research and extension studies; (x) inadequate frontline staff and that too of older age group; (xi) less emphasis on forestry research; (xii) lack of on-job training and capacity building for forest officers especially for the frontline staff; (xiii) general neglect of full potential of NTFPs; and (xiv) lack of supportive land use policy.

Remedial actions for restoration of degraded areas have been undertaken through eco-restoration programmes by involving local people. Special attention has been given to coastal zones through Coastal Zone Regulation Rules, 1991 under the Environment (Protection) Act. This notification is under reformulation based on scientific principles as recommended by Swaminathan Committee (2005), and a draft notification on Coastal Management Zone 2008 has been issued.

NAEB in the MoEF gives special attention to regeneration of degraded forests and lands adjoining forest areas, national parks, sanctuaries and other PAs as well as ecologically fragile areas such as the Himalayas, Aravallis and Eastern Ghats. The functions of NAEB involve evolving mechanisms for ecological restoration of degraded forests and adjoining lands through systematic planning and implementation in a cost effective manner. It also sponsors projects for extension of research findings to disseminate new and proper technologies for the above. To complement the initiatives of JFMCs, a new programme called National Afforestation Programme (NAP) was launched during 2002-03. Under this programme, an extent of 14.1 lakh ha is being covered by 28,181 JFMCs under 782 FDAs in 28 states.

Various programmes initiated by the MoEF including NAP, setting up of JFMCs and Hill Area Development Programme focus on greater participation of the communities with the objective of improving their livelihoods. These programmes also help in poverty alleviation in the respective areas.

The involvement of private sector is encouraged in activities for the sustainable use of biodiversity. For example, both public and private sectors – comprising individuals, companies, cooperatives, and industry -

are playing key roles in the management of forests. The private sector has also demonstrated its ability to enhance the productivity of wastelands and is dominant in the areas of wood harvesting and processing.

'Honey Bee Network' is an important example to illustrate the measures taken to protect and encourage customary use of biological resources in India.

Current efforts at promoting conservation and sustainable use notwithstanding, there is a need to further augment the natural resource base and integrate sustainable use concept in all relevant economic sectors (such as agriculture, animal husbandry, fisheries, forestry and industry) so as to ensure intra- and inter-generational equity .

Action Points

- Secure integration of biodiversity concerns into inter-sectoral policies and programmes to identify elements having adverse impact on biodiversity and design policy guidelines to address such issues. Make valuation of biodiversity an integral part of pre-appraisal of projects and programmes to minimize adverse impacts on biodiversity.
- Promote decentralized management of biological resources with emphasis on community participation.
- Promote sustainable use of biodiversity in sectors such as agriculture, animal husbandry, dairy development, fisheries, apiculture, sericulture, forestry and industry.
- Promote conservation, management and sustainable utilization of bamboos and canes, and

establish bambusetum and canetum for maintaining species diversity and elite germplasm lines.

- Promote best practices based on traditional sustainable uses of biodiversity and devise mechanisms for providing benefits to local communities.
- Build and regularly update a database on NTFPs, monitor and rationalize use of NTFPs ensuring their sustainable availability to local communities.
- Promote sustainable use of biological resources by supporting studies on traditional utilization of natural resources in selected areas to identify incentives and disincentives, and promote best practices.
- Encourage cultivation of medicinal plants and culture of marine organisms exploited for drugs to prevent their unsustainable extraction from the wild.
- Promote capacity building at grassroot level for participatory decision-making to ensure eco-friendly and sustainable use of natural resources.
- Develop *sui generis* system for protection of traditional knowledge and related rights including intellectual property rights.
- Encourage adoption of science-based, and traditional sustainable land use practices, through research and development, extension of knowledge, pilot scale demonstrations, and large scale dissemination including farmer's training, and where necessary, access to institutional finance.
- Promote reclamation of wasteland and degraded forest land through formulation and adoption of multistakeholder partnerships involving the land owning agency, local communities, and investors.
- Promote sustainable alternatives to shifting cultivation where it is no longer ecologically viable, ensuring that the culture and social fabric of the local people are not disrupted.
- Encourage agro-forestry, organic farming, environmentally sustainable cropping patterns, and adoption of efficient irrigation techniques.
- Incorporate a special component in afforestation programmes for afforestation on the banks and catchments of rivers and reservoirs to prevent soil erosion and improve green cover.
- Integrate wetland conservation, including conservation of village ponds and tanks, into sectoral development plans for poverty alleviation and livelihood improvement, and link efforts for conservation and sustainable use of wetlands with the ongoing rural infrastructure development and employment generation programmes.
- Promote traditional techniques and practices for conserving village ponds.
- Mainstream the sustainable management of mangroves into the forestry sector regulatory regime so as to ensure the protection of coastal belts and conservation of flora and fauna in those areas.
- Disseminate available techniques for regeneration of coral reefs and support activities based on application of such techniques.
- Adopt a comprehensive approach to integrated coastal management by addressing linkages between coastal areas, wetlands, and river systems, in relevant policies, regulations and programmes.

5.3 Regulation of introduction of invasive alien species and their management

Plants, animals and micro-organisms that are not indigenous to a specific ecosystem and become established in a new environment, then proliferate and spread in ways that are destructive to human interests, ecosystems and environment are considered as Invasive Alien Species (IAS). These species cause billions of dollars of damages annually across a wide range of sectors including agriculture, forestry,

fisheries, ecosystem services, human health and tourism threatening economic growth, prosperity as well as the overall environment. Their spread has been aggravated by rapid developmental activities. IAS recognize no borders **(Box 8)**.

Invasive alien species (obnoxious weeds, fish, pathogens and pests, etc.) pose a serious threat to native species, their habitats and functioning of different ecosystems. In India, a multi-agency and multi-programme approach, involving several Ministries and agencies, is being followed for regulating introductions and managing invasive alien species. Major activities include regulation of introduction of exotic living materials, their quarantine clearance and release for research and direct use. In general, Ministry of Agriculture deals with cultivated plants, fish and farm livestock including poultry. It has sponsored projects on eradication and management of invasive weedy plants, pathogens, pests and harmful fish. The MoEF deals with all forest and wildlife related invasives. It also supports and coordinates programmes on eradication/control measures/ utilization of such species in different forest areas and conducts national surveys on their spread, prepares reports on damage caused and undertakes restorative measures. There is, however, a need to develop a unified national system for regulation of introduction and management of all invasive alien species across jurisdiction of all concerned Ministries and relevant sectors.

Box 8: Invasive Species

- India follows international quarantine regulations
- Presently, there is no exclusive legislation or policy in India to deal with the invasive alien species
- Directorate of Plant Protection, Quarantine and Storage, Faridabad, Ministry of Agriculture is the nodal agency to enforce the regulations.
- Latest regulations are 'Plant Quarantine Order 2003'
- On preliminary assessment, 61 species of plants (including 12 species of fungi) and 14 species of insects have been identified as invasive having national distribution and 36 species having regional distribution.
- About 28 species native to India have been found to be invasive to other biogeographical zones.
- ICFRE has established a 'FIS Cell' in FRI to deal with various aspects of management of FIS in the country.

Source: India's Forests, MoEF, 2007

Action Points

- Develop a unified national system for regulation of all introductions and carrying out rigorous quarantine checks.
- Strengthen domestic quarantine measures to contain the spread of invasive species to neighbouring areas.
- Promote intersectoral linkages to check unintended introductions and contain and manage the spread of invasive alien species.
- Develop a national database on invasive alien species reported in India.
- Develop appropriate early warning and awareness system in response to new sightings of invasive alien species.
- Provide priority funding to basic research on managing invasive species.
- Support capacity building for managing invasive alien species at different levels with priority on local area activities.
- Promote restorative measures of degraded ecosystems using preferably locally adapted native species for this purpose.
- Promote regional cooperation in adoption of uniform quarantine measures and containment of invasive exotics.

5.4 Assessment of vulnerability and adaptation to climate change, and desertification

India's vast majority of people depend directly on agriculture and forestry for food security and livelihoods. These sectors are considered more vulnerable to the projected climate change, particularly affecting water availability and temperature regimes. Preliminary assessments have indicated decline in agricultural productivity and shifts in cropping patterns, changes in species assemblage or forest types, changes in net primary productivity, and potential loss or distribution pattern of biodiversity. These consequences may have adverse socio-economic implications for farming and forest dependent communities, and national economy. Thus, there is a need for developing and implementing adaptation strategies to minimize and mitigate possible adverse impacts of climate change. Natural ecosystems such as grasslands, mangroves and coral reefs are also likely to be drastically affected by the projected climate change.

Preliminary research has been initiated on vulnerability assessment due to climate change on various production systems, socio-economic sectors and natural ecosystems in India. Some research activities have already been initiated in this direction and the Indian Agricultural Research Institute has undertaken research on impacts of climate change on crop productivity. Climate friendly initiatives being adopted in agricultural sector include water use efficiency, nutrient uptake, better crop management, enhanced organic fertilizer use and integrated pest management. Weather data collection and forecasting capabilities are being strengthened while taking lead in regional initiatives. Research efforts are also on to develop and refine capabilities in forecasting and assessment by developing suitable criteria and indicators.

India has established National Clean Development Mechanism Authority (NCDMA) for according host country approval to CDM projects as mandated under the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC). One of the criteria used for approval of CDM projects is impact on biodiversity. Host country approvals have so far been accorded to 404 CDM projects facilitating investment of more than Rs, 22,000 crores.

The Government has set up an 'Expert Committee on the Impacts of Climate Change' on 7th May 2007 under the chairmanship of Dr. R. Chidambaram Principal Scientific Adviser to the Government of India to study the impacts of anthropogenic climate change on India and to identify the measures that may have to be taken for addressing vulnerability to anthropogenic climate change impacts. A high level coordination committee chaired by Prime Minister, namely, 'Prime Minister's Council on Climate Change' has been set up on 6th June 2007 to coordinate national actions for assessment, adaptation and mitigation of climate change. The Government of India has released 'National Action Plan on Climate change' on 30th June 2008, which outlines a number of steps to simultaneously advance India's development and climate change - related objectives of adaptation and mitigation, including through setting up of eight National Missions.

Nearly 228 mha (69%) of geographical area of India falls under drylands (arid, semi arid and dry sub humid). These ecosystems support large human and livestock populations, contain unique genetic adaptation mechanisms for stress tolerance, and are rich in flora, fauna and microorganisms adapted to extremes of climate. The Ministry of Rural Development through its various programmes such as Integrated Wasteland Development Programme (IWDP), Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP) on watershed basis, strives for development of land resources, controlling desertification, and livelihood generation with the overall objective of poverty alleviation. The Ministry has invested Rs. 6714.11 crores since 1995-96 on these three programmes covering 32.40 mha in 576 districts of 28 states across the country. There is also a provision for development of forest lands forming part of watersheds through involvement of JFMCs in close coordination with the village Panchayats.

Accelerated desertification processes are likely to further compound the adverse impacts of climate change. Against this backdrop, there is also a pressing need for developing tools, methodologies and indicators for assessing impacts of climate change and desertification as well as developing appropriate mitigation and adaptation strategies.

Action Points

- Identify the key sectors of the country vulnerable to climate change, in particular impacts on water resources, agriculture, health, coastal areas and forests.
- Promote research to develop methodologies for tracking changes and assessing impacts of climate change on glaciers, river flows and biodiversity.
- Assess the need for adaptation to future impacts of climate change at national and local levels, and the scope for incorporating the outputs of such assessments in relevant programmes, including watershed management, coastal zone planning and regulation, agricultural technologies and practices, forestry management, and health programmes.
- Explicitly consider vulnerability of coastal areas and their biodiversity to climate change and sea-level rise in coastal management plans, as well as infrastructure planning and construction norms.

- Participate in voluntary partnerships with other countries both developed and developing, to address the challenges of sustainable development and climate change, consistent with the provisions of the UNFCCC.
- Identify the most important gaps in knowledge that limit the national ability to develop and implement climate change adaptation strategies for species, and ecological processes and functions.
- Enhance the capacity of climate modeling in the country substantially to get clear idea on the impacts of climate change on biodiversity at national and local levels.
- Develop ecological criteria for identifying the species and ecosystems that are at great risk from climate change and identify their priority habitats.
- Identify information requirements and priorities, through expert consultative processes, for long-term monitoring of climate change impacts on biodiversity.
- Establish a climate change and biodiversity website for decision makers concerned with national resource management to facilitate information exchange about the actual and potential impacts of climate change and relevant policies, strategies and programmes.
- In view of the multidisciplinary nature of the subject, undertake an 'All India Coordinated

Research Project on Impacts of Climate Change' on various facets of wild and agricultural biodiversity.

- Integrate biodiversity concerns into measures for energy conservation and adoption of renewable energy technologies with a focus on local biomass resources and dissemination of improved fuelwood stoves, and solar cookers.
- Strengthen efforts for partial substitution of fossil fuels by bio-fuels, through promotion of biofuel plantations, promoting relevant research and development, and streamlining regulatory certification of new technologies.
- Strengthen and augment the existing programmes and activities of the Central and State Governments relating to drylands.
- Prepare and implement thematic action plans incorporating watershed management strategies, for arresting and reversing desertification and expanding green cover.
- Promote reclamation of wastelands by energy plantations for rural energy through multistakeholder partnerships involving the land-owning agencies, local communities, and investors.

5.5 Integration of biodiversity concerns in economic and social development

Policies and legislations enabling proper assessment and adopting measures towards minimizing adverse impacts of developmental activities are in place. The Environment (Protection) Act is an umbrella Act which enables Central Government to promulgate notifications and rules thereunder for regulating various activities for conservation of environment. The EIA notification, 2006, the Coastal Regulation Zone notification 1991 and the notification pertaining to ecologically sensitive areas have been issued to regulate development activities **(Box 9)**. To address biodiversity related issues in EIA, the baseline status of biological diversity and its components is ascertained and information on habitat resilience is also collected for assessing the likely impacts of proposed developmental activities.

Ecologically sensitive areas are also notified under the Environment (Protection) Act with the objective of imposing restrictions on the industries, operations, and other developmental activities in the region which have detrimental effect on the environment, to provide for restoration of denuded areas, management of catchment areas, watershed management etc., for a planned development. It is also intended to ensure sustainable livelihood for the local communities and stakeholders.

Box 9: Management of Coastal Zones

The MoEF had constituted an expert committee under the chairmanship of Prof. M.S. Swaminathan in July, 2004, to review and make recommendations with regard to implementation and amendments if necessary, of Coastal Regulation Zone Notification, 1991. The Expert Committee submitted its report alongwith recommendations, which were accepted by the MoEF in April, 2005. The major recommendations include:

- Implementation of Integrated Coastal Zone Management Plan rather than uniform regulatory approach.
- Development along the coastal stretches based on the vulnerability of the coast, taking into account the natural and manmade hazards.
- Inclusion of the ocean zone for regulation.
- Setting up of an Institute for Coastal Zone Management to address the policy and legal issues.
- Abatement of the pollution of coastal areas and marine waters in a time-bound manner.
- Identification and mapping of the coastal eco-sensitive areas such as mangroves, corals, and turtle breeding areas.
- Development of coastal bio-shield.

The MoEF has initiated steps for implementing the above recommendations which include:

- Preparation of a national action plan for control of pollution of coastal waters from land based activities.
- Pilot scale studies for demarcation of vulnerability line along identified coastal stretches through scientific organizations namely, Survey of India, Dehradun, Space Application Centre, Ahmedabad and Centre for Earth Science Studies, Thiruvananthapuram.
- Seeking technical and financial assistance from multilateral agencies for implementing the recommendations pertaining to mapping of ecologically sensitive areas along the coastline, control of pollution in the coastal waters from land based activities and capacity building and institutional development.

The development of these areas and setting up of industries therein are regulated in accordance with the provisions made in the respective notifications issued in this regard. The various areas which have been declared ecologically fragile/eco-sensitive or where development/setting up of industries has been regulated are: (i) Murud-Janjira area in Raigarh District, Maharasthra (6th January, 1989); (ii) Doon Valley, Uttarakhand (1st February, 1989); (iii) Dahanu Taluka, District Thane, Maharasthra (20th June 1991); (iv) Aravali Range, Gurgaon District, Haryana and Alwar District, Rajasthan (7th May, 1992); (v) No Development Zone around Numaligarh Refinery Site in Assam (5th July, 1996); (vi) Mahabaleshwar, Panchgani, Satara District, Maharashtra (17th January, 2001); and (vii) Matheran, Maharashtra (4th February, 2003).

Recognizing the importance of disaster management as a national priority, a National Disaster Management Authority (NDMA) headed by the Prime Minister, and State Disaster Management Authorities (SDMAs) headed by the respective Chief Ministers, have been set up under the Disaster Management Act, 2005, to spearhead and implement a holistic and integrated approach to disaster management in India.

Policies and programmes are in place for management of chemical emergencies, hazardous wastes and solid wastes. Planning and overseeing the implementation of the extant policies and programmes are carried out to promote safe handling, management and use of hazardous chemicals and wastes, in order to avoid damage to health and environment. For example, handling of 70 cancer causing azo dyes and the processes incidental thereto in the course of which these substances are found or transported throughout the country, have been prohibited vide notification dated March 26, 1997 **(Box 10).**

India is a Party to Rotterdam Convention on the Prior Informed Consent Procedure for Hazardous Chemicals, Stockholm Convention on Persistent Organic Pollutants, and the Basel Convention on Transboundary Movement of Hazardous Waste and their Disposal.

Box 10: Azo dyes

- Azo dyes are dye stuffs used for colouring textiles and leather products. Such dye stuffs have significance in production of rubber, epoxy resins, polyurethane foam, fibres and polyamids.
- Seventy azo dyes derived from 20 arylamines, a number of them confirmed human carcinogens, have been prohibited for handling by the Ministry of Textile and Department of Chemicals and Petrochemicals considering the number of safe substitutes, both of chemical and natural origin and also keeping in view nominal increase in the cost of these substitutes.

Action Points

- Develop strong research base on impact assessment and conduct rigorous impact assessment of development projects, with a focus on biodiversity and habitats.
- Integrate biodiversity concerns across development sectors (such as industry, infrastructure, power, mining, etc.) and promote use of clean technologies.
- Accord priority to the potential impacts of development projects on biodiversity resources and natural heritage while undertaking EIA. In particular, ancient sacred groves and biodiversity hotspots should be treated as possessing incomparable values.
- Take steps to adopt and institutionalize techniques for environmental assessment of sectoral policies and programmes to address any potential adverse impacts, and enhance potential favourable impacts.

- Develop and integrate pre-project plans for reallocation and rehabilitation of local people likely to be displaced by development projects keeping in view their socio-cultural and livelihood needs.
- Ensure that in all cases of diversion of forest land, the essential minimum needed land for the project or activity is permitted. Restrict the diversion of dense natural forests, particularly areas of high endemism of genetic resources, to non-forest purposes, only to site-specific cases of vital national interest.
- Give priority to impact assessment of development projects on .wetlands; in particular, ensuring that environmental services of wetlands are explicitly factored into cost-benefit analysis.
- Promote integrated approaches to management of river basins considering upstream and downstream inflows and withdrawals by season, pollution loads and natural regeneration capacities, in particular, for maintenance of in-stream ecological values.
- Consider and mitigate the impacts on river and estuarine flora and fauna, and the resulting change in the resource base for livelihoods, of multipurpose river valley projects, power plants and industries.
- Adopt best practice norms for infrastructure construction to avoid or minimize damage to sensitive ecosystems and despoiling of landscapes.
- Support practices of rain water harvesting and revival of traditional methods for enhancing groundwater recharge.
- Give due consideration to the quality and productivity of lands which are proposed to be converted for development activities, as part of the environmental clearance process.
- Ensure provision for environmental restoration during commissioning and after decommissioning of industries. For example, in all approvals of mining plans, institutionalize a system of post-monitoring of projects to ensure safe disposal of tailings and ecosystem rehabilitation following the principles of ecological succession.
- Promote, through incentives, removal of barriers and regulation, the beneficial utilization of wastes such as fly ash, bottom ash, red mud, and slag, minimizing thereby their adverse impacts on terrestrial and aquatic ecosystems.
- Promote sustainable tourism through adoption of best practice norms for tourism facilities and conservation of natural resources while encouraging multistakeholder partnerships favouring local communities.
- Develop and implement viable models of public-private partnerships for setting up and operating secure landfills, incinerators, and other appropriate techniques for the treatment and disposal of toxic and hazardous wastes, both industrial and biomedical, on payment by users, taking the concerns of local communities into account. The concerned local communities and State Governments must have clear entitlements to specified benefits from hosting such sites, if access is given to non-local users. Develop and implement strategies for clean-up of toxic and hazardous waste dump legacies, in particular in industrial areas, and abandoned mines, and reclamation of such lands for future, sustainable use.
- Survey and develop a national inventory of toxic and hazardous waste dumps, and an online monitoring system for movement of hazardous wastes. Strengthen capacity of institutions responsible for monitoring and enforcement in respect of toxic and hazardous wastes.
- Strengthen the legal arrangements and response measures for addressing emergencies arising out

of transportation, handling and disposal of hazardous wastes as part of the chemical accidents regime.

- Promote organic farming of traditional crop varieties through research in and dissemination of techniques for reclamation of land with prior exposure to agricultural chemicals, facilitating marketing of organic produce in India and abroad, including by development of transparent, voluntary and science-based labeling schemes.
- Develop and enforce regulations and guidelines for management of e-waste as part of the hazardous waste regime.
- Promote, through incentives, removal of barriers, and regulations, the beneficial utilization of generally non-hazardous waste streams such as fly ash, bottom ash, red mud, and slag, including in cement and brick-making, and building railway and highway embankments.

5.6 Pollution impacts

Pollution is inevitable generation of waste from the anthropogenic activities involving production and consumption. Ecosystems have some natural capacities to assimilate pollution, however, these vary considerably with the nature of the pollutant and the ecosystem. In general, it is cheaper to reduce the emission of pollution, than to mitigate it after generation, or to treat the receiving medium or receptor. The impacts of air and water pollution may differentially affect the poor, women, children, and developing regions, which may also be having relatively low contributions to its generation. Accordingly, the costs and benefits of abatement may have important implications for equity.

Similarly, the immediate and deeper causes of soil pollution as well as management of industrial and municipal wastes are serious challenges in terms of magnitude and required resources.

The present legislative framework is broadly contained in the umbrella Environment (Protection) Act, 1986; the Water (Prevention and Control of Pollution) Act, 1974; the Water Cess Act, 1977; and

the Air (Prevention and Control of Pollution) Act, 1981.

Action points

- Minimise and eliminate activities leading to loss of biodiversity due to point and non-point sources of pollution and promote development of clean technologies.
- Strengthen the monitoring and enforcement of emission standards for both point and non-point sources.
- Develop location-specific work plans focusing on biodiversity conservation while managing pollution problems.
- Treat and manage industrial effluents so as to minimize adverse impacts on terrestrial and aquatic biological resources.
- Promote biodegradable and recyclable substitutes for non-biodegradable materials, and develop and implement strategies for their recycle, reuse, and final environmentally benign disposal, including through promotion of relevant technologies, and use of incentive based instruments.
- Avoid excessive use of fertilizers, pesticides and insecticides while encouraging integrated pest management practices, and use of organic manures and biofertilisers.
- Promote organic farming of locally adapted and traditional crop varieties through appropriate incentives, and direct access to markets duly supported by credible certification systems.

- Develop a strategy for strengthening regulation, and addressing impacts, of ship-breaking activities on human health, coastal and near marine bio-resources.
- Accord priority to potential impacts on designated natural heritage sites in view of their incomparable values that merit stricter standards than in otherwise comparable situations.
- Promote R&D on impacts of air, water and soil pollution on biodiversity and use of biological methods for pollution amelioration.

5.7 Development and integration of biodiversity databases

Developing national strategy and action plans for biodiversity conservation are severely constrained because of inadequate database on different components of biodiversity and their geographical distribution. Even the limited available information is scattered and held by a number of organizations working independently on the subject. Further, there is no unified format for collection, retrieval and dissemination of data on biodiversity. Realizing this need, the Central Government while framing Biological Diversity Rules, 2004 under the Biological Diversity Act, mandated the NBA to build up database and to create documentation system for biological resources, develop PBRs and electronic databases to ensure effective management, promotion and sustainable use (Rule 12 (xiii). There is thus an urgent need for integrating data from all available sources into a national network with distributive linkages for facilitating data dissemination and interface with managers and users. There is also a need to accelerate and intensify the survey and inventorization of unexplored areas, with focus on endangered, endemic and insufficiently known species.

Action Points

- Develop an integrated national biodiversity information system with distributive linkages for easy storage, retrieval and dissemination including through augmentation of extant efforts of spatial mapping of natural resources and development of interactive databases at national level.

Box 11: Important Central Acts and Rules having Relevance to Biodiversity Conservation

- Fisheries Act, 1897.
- Destructive Insects and Pests Act, 1914.
- The Indian Forest Act, 1927.
- Agricultural Produce (Grading and Marketing) Act, 1937.
- Indian Coffee Act, 1942
- Import and Export (Control) Act, 1947.
- Rubber (Production and Marketing) Act, 1947.
- Tea Act, 1953.
- Mining and Mineral Development (Regulation) Act, 1957
- Prevention of Cruelty to Animals Act, 1960.
- Customs Act, 1962.
- Cardamom Act, 1965.
- Seeds Act, 1966.
- The Patents Act, 1970.
- Wildlife (Protection) Act, 1972.
- Marine Products Export Development Authority Act, 1972.
- Water (Prevention and Control of Pollution) Act, 1974.
- Tobacco Board Act, 1975.
- Territorial Water, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976.
- Water (Prevention and Control of Pollution) Cess Act, 1977.
- Maritime Zones of India (Regulation and Fishing by Foreign Vessels) Act. 1980.
- Forest (Conservation) Act, 1980.
- Air (Prevention and Control of Pollution) Act, 1981.
- Agricultural and Processed Food Products Export Development Authority Act, 1985/ 1986.
- Environment (Protection) Act, 1986.
- Spices Board Act, 1986.
- National Dairy Development Board, 1987.
- Rules for the manufacture, use/import/export and storage of hazardous microorganisms/ genetically engineered organisms or cells, 1989
- Foreign Trade (Development and Regulation) Act, 1992.
- Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001
- Biological Diversity Act, 2002
- Plant Quarantine (Regulation of Import into India) Order, 2003
- Biological Diversity Rules, 2004
- The Food Safety and Standards Act, 2006
- Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

- Intensify survey, identification and inventorization activities, involving local institutions and giving priority to hitherto unexplored areas.
- Conduct regular surveys to monitor changes in populations of target species (wild and domesticated), using remote sensing and other updated tools and techniques.
- Update list of endangered species of flora and fauna on priority, based on internationally accepted criteria.
- Extend listing of keystone, umbrella and endemic species for conserving them on priority basis, and develop models/packages for their conservation.
- Update database on sacred groves and sacred ponds documenting bio-resources and associated knowledge conserved at these sites.
- Promote DNA fingerprinting, other molecular analytical techniques and studies on genetic diversity of critically endangered species to develop appropriate conservation strategies.
- Expand area specific surveys of land races, traditional cultivars of crops, wild relatives of crop plants and breeds of domesticated animals inter alia through application of appropriate statistical techniques.
- Use modern taxonomic methods for documentation/identification of species.
- Strengthen and build capacity for taxonomy and biosystematics, particularly for groups of plants, animals and microorganisms which are as yet inadequately understood.

5.8 Strengthening implementation of policy, legislative and administrative measures for biodiversity conservation and management

Subject relating to environment and forests is on the concurrent list of the Constitution of India. Both Central and State Governments legislate and formulate policies and programmes on this subject.

Policies on environmental management include the National Forest Policy, the National Conservation Strategy and Policy Statement on Environment and Development, and National Policy and Macrolevel

Action Strategy on Biodiversity. Some other sectoral policies (e.g. National Agriculture Policy and National Water Policy) have also contributed towards environmental management. As our development challenges evolved and understanding of the centrality of environmental concerns in development sharpened, the National Environment Policy was developed in 2006. The NEP builds on the earlier policies and strengthens them.

Major Central Acts having direct bearing on biodiversity issues are: Indian Forest Act, Wildlife (Protection) Act, Forest (Conservation) Act, Environment (Protection) Act, and the Biological Diversity Act. In addition, there are several other Acts which have relevance to biodiversity **(Box 11)**. These Central Acts are supported by a number of State laws and statutes as provided under the Constitution. An Inter-State Council has been set up under article 263 of the Constitution for co-ordination on inter-state matters.

While there exists a strong body of legislative and policy framework relevant to biodiversity, there is need to develop synergies among various Acts. Some efforts have been made in this direction which would have to be further strengthened.

The Biological Diversity Act enacted in 2002 in pursuance to the CBD is a comprehensive legislation, the primary aim of which is to conserve biodiversity through regulating access to biological resources and associated traditional knowledge, and to ensure

equitable sharing of benefits arising out of their use as envisaged under the CBD.

The Patents Act, 1970 provides for mandatory disclosure, in patent application, of the source and geographical origin of the biological material and associated traditional knowledge used in the invention. This Act also provides for pre and post grant opposition of applications and revocation of granted patents on grounds of non-disclosure or wrongful disclosure of source or geographical origin of biological resources and traditional knowledge.

Issues relating to benefit sharing and protection of traditional knowledge are rather complex and still evolving. Being a megadiverse country rich in associated traditional knowledge, effective implementation of the Biological Diversity Act and Rules is in the interest of the country and its people, and therefore needs to be strengthened. Experience gained in implementation of the national legislation on Access and Benefit Sharing (ABS) would be of much value in strengthening and effectively articulating the developing country perspective for an international regime on ABS presently being negotiated under the CBD.

Action Points

- Accelerate effective actions at the central, state and local levels to implement provisions under the Biological Diversity Act.
- Review enabling policies to prevent transfer of prime agricultural land to non-agricultural purposes, and promote sustainability of agricultural lands.
- Formulate suggestive policies for strengthening and supporting conservation and management of grasslands, pastoral lands, sacred groves and other areas significant for biodiversity conservation.
- Support preparation of PBRs with technical help by the scientific institutions.
- Strengthen systems for documentation, application and protection of biodiversity-associated traditional knowledge, providing adequate protection to these knowledge systems while encouraging benefits to communities.
- Revive and revitalize sustainable traditional practices and other folk uses of components of biodiversity and associated benefits to local communities with a view to promoting and strengthening traditional knowledge and practices.
- Create public education and awareness about the need to conserve, protect and gainfully use traditional knowledge systems.
- Identify emerging areas for new legislation, based on better scientific understanding, economic and social development, and development of multilateral environmental regimes, in line with the NEP.
- Review the body of existing legislations relevant to biodiversity conservation to develop synergies among relevant statutes and regulations, eliminate obsolescence, and amalgamate provisions with similar objectives, in line with the NEP. Further, encourage and facilitate review of legislations at the level of state and local governments with a view to ensuring their consistency with this policy.
- Review the regulatory processes for LMOs so that all relevant scientific knowledge is taken into account, and ecological, health, and economic concerns are adequately addressed.
- Periodically review and update the national biosafety guidelines to ensure that these are based on current scientific knowledge.
- Ensure conservation of biodiversity and human health while dealing with LMOs in transboundary movement in a manner consistent with the multilateral biosafety protocol.
- Develop appropriate liability and redress mechanisms to internalize environment costs and

address economic concerns in case of any damage to biodiversity.

- Harmonise provisions concerning disclosure of source of biological material and associated knowledge used in the inventions under the Patents Act, Protection of Plant Varieties and Farmers' Rights Act, and Biological Diversity Act, to ensure sharing of benefits by the communities holding traditional knowledge, from such use.
- Develop supportive regulatory regime for protection of identified wetlands and biosphere reserves.
- Develop appropriate system and modalities for operationalizing provisions for prior informed consent and benefit sharing under the Biological Diversity Act, working towards greater congruence between these provisions and trade related aspects of intellectual property rights.

5.9 Building of national capacities for biodiversity conservation and appropriate use of new technologies

By and large, the country has, over a period of time, developed a stable institutional structure for environmental management.

The MoEF interacts with the Ministry of Human Resource Development, University Grants Commission, National Council of Educational Research and Training and other educational bodies for introducing and expanding environmental concepts, themes and issues in the curricula of schools, colleges and universities. In order to generate awareness regarding the need to conserve and sustainably utilize biological resources, the various means of communication such as TV, radio and press are being utilized. The education system, both formal and non-formal, is also being mobilized to this end.

The Indian Council of Forestry Research and Education (ICFRE) is the premier organization which imparts education, creates awareness and undertakes research and extension activities on forestry and environmental issues, through its institutes located in various regions of the country. The Indian Institute of Forest Management imparts education and training in forest management. The Wildlife Institute of India imparts training on wildlife management and undertakes research on various related issues.

The Centre for Environment Education (CEE), CPR Environment Education Centre, and other Centres of Excellence supported by the MoEF, organize activities aimed at creating environmental awareness among all sections of the society.

The National Museum of Natural History is devoted to environment education and creation of conservation awareness among public through exhibit galleries, mobile museums, discovery rooms and various other activities.

However, there are still a number of gaps which need to be adequately addressed. Human resource development for scientific management of biodiversity has suffered because of inadequate infrastructure for research and development, shortage of organizations capable of imparting technical skills, limitations of education and public awareness through formal and non-formal means, and inadequate training facilities for various stakeholders.

The current efforts for environmental education and awareness should be strengthened to highlight the importance of conservation and sustainable use of biodiversity especially focusing on new and emerging issues such as biosafety, climate change, and biofuels. Towards this, the audio, visual and the print media could be more effectively used. There is a need to strengthen the in-service training and orientation courses for personnel engaged in conservation programmes.

There are a number of Ministries/Departments, agencies, and organizations which are supporting research relating to biodiversity. To illustrate, the major thrust areas of Department of Biotechnology (DBT) and Ministry of Tribal Affairs relating to conservation and management of biodiversity are given in **Boxes 12 and 13**. Coordination among these organizations needs to be enhanced. There is also need to effectively integrate findings of research projects into policy-making and implementation of programmes.

There is a need for capacity building in the field of livelihood diversification opportunities for local

Box 12: Biotechnological Approaches to Biodiversity Conservation: Some Initiatives by Department of Biotechnology, Ministry of Science and Technology

1. **Ecosystem conservation**
   - Restoration of degraded habitats/landscapes/ecosystems
   - Molecular markers for assessing evolutionary potential of populations/species in ecosystems.
   - Molecular ecology of invasive species and their control through development of host specific biological methods.
   - Assessment of genomic diversity and conservation of gene pools and establishment of DNA banks of grasses, legumes, orchids, etc.
   - Assessment of genetic diversity of rare and endemic species and species that are critical for ecosystems functioning.
   - Use of bioinformatics.
   - Training and capacity building in molecular tools and techniques.
2. **Environmental biotechnology**
   - Bio and phyto remediation for restoration of environmental quality.
   - Biodegradation of xenobiotics
   - Resources/wastes utilization/treatment through application of rDNA technology.
   - Augmentation of production of biodegradable plastics.
   - Use of GMOs for pollution control.
   - Biotechnological interventions for crop protection.
3. **Medicinal plants and aromatic grasses**
   - Scaling up of research leads, product development and value addition in respect of medicinal plants.
   - Development of standard and safe herbal products or isolation and characterization of therapeutically active compounds from medicinal plants.
   - Cell-culture production of therapeutic agents from plants.
   - Studies on herbal drug-modern drug interaction
   - Network projects, mission mode programmes and creation of associated infrastructural facilities for optimal utilization of selected medicinal and aromatic plants species.
4. **Animal biotechnology**
   - Genomics, genetic characterization and development of vaccines and diagnostics for livestock.
5. **Bioresources development and utilization**
   - Biodiversity characterization through remote sensing and database development.
   - Bioprospecting of plants, microbes, marine organisms etc. for development of novel products.
6. **Societal programme**
   - Promote entrepreneurship development, public private partnership particularly in agro - food processing, self-help groups and Anganwadi workers for undertaking village based activities and micro-financing.
   - Create and strengthen herbal venture fund to support product development through linking traditional knowledge base with various biotechnology labs in private, public and NGO sectors.
   - Establish model bio-villages, support mobile research labs, organize training programmes, bio-melas, traditional food festivals / shows etc. and use other mass communication tools to create education and awareness among local people including panchayat members for judicious use of bioresources.

Box 13: Integration of Biodiversity Concerns in Programmes of Ministry of Tribal Affairs

- Grants-in-aid to State Governments for supporting family/self-help groups/ community towards employment and income generation in sectors such as agriculture, horticulture, land reforms, watershed development, animal husbandry, ecology and environment, development of forests and forest villages, etc., with priority to be accorded to the tribals living in forest villages and synchronization of these programmes with JFM.
- In pursuance of article 275(1) of the Constitution of India, 100% central grants-in-aid to the states for promoting welfare of scheduled tribes for raising the level of administration of scheduled areas.
- Programme for integrated development of forest villages with a view to raise the Human Development Index (HDI) of their inhabitants and provision of basic facilities and services.
- Programme for infrastructure development relating to basic services and facilities such as approach roads, healthcare, primary education, minor irrigation, rainwater harvesting, drinking water, sanitation, community halls, etc., covering 2338 forest villages in 11 States.
- The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, which has come into force with effect from 31.12.2007; and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007, which have come into force with effect from 01.01.2008.

communities to meet their economic needs compatible with ecological sustainability. For instance, use of invasive species like Lantana for making value added products; and building upon traditional technologies like watermill for power generation in mountains as clean technology developed and customized at field level. The seminal idea is to involve all possible stakeholders, especially women, who are the custodians of natural resources and their management, to provide technology-based- livelihood opportunities to reduce their dependency on bio-resources. Participation of private sector in R&D also needs to be further encouraged. Institutional and human capacity needs to be constantly strengthened and updated to meet the new and emerging challenges relating to biodiversity, e.g. in the fields of biosafety, climate change, and invasive alien species.

There is need to look at the profiles of on-going education, training and extension programmes to lay directed focus on biodiversity conservation.

Action Points

- Develop consortium of lead institutions engaged in conservation providing linkages and networking across public and private sectors.
- Outsource research and promote joint ventures on key conservation issues.

- Promote application of biotechnology tools for conserving endangered species.
- Encourage DNA profiling for assessment of genetic diversity in endangered species to assist conservation.
- Develop DNA-probe based technology for tracking of LMOs.
- Develop specific pilot gene banks for LMOs approved for undertaking research and commercial use.
- Develop capacity for risk assessment, management and communication on LMOs.
- Support pilot studies on use of biotechnology tools for conservation where appropriate.

- Develop specific complimentary capacity building measures based on national needs and priorities for the formulation and implementation of national rules and procedures on liability and redress to strengthen the establishment of baseline information and monitoring of changes.
- Develop protocols for monitoring products based on genetic use restriction technologies.
- Strengthen participatory appraisal techniques and encourage formation of local institutional structures for planning and management of natural resources for ensuring participation of women.
- Preserve and strengthen traditional, religious, ritualistic, ethical and cultural methods of conservation.
- Promote livelihood diversification opportunities for making value added bioresource based products and building upon traditional as well as emerging environmental technologies customized at local/field level.
- Strengthen manpower, infrastructure and other pertinent capacities including upgradation of skills of officials of the MoEF to enable it to address new and emerging requirements in the field of biodiversity conservation and management.
- Strengthen capabilities of BSI and ZSI and promote their technical cooperation with SBBs and BMCs.
- Augment human resource development and personnel management in forestry and wildlife sector.
- Strengthen multidisciplinary R&D efforts on key areas pertaining to conservation and management of biological diversity.
- Strengthen and support departments of biology, botany, zoology, sociology, anthropology and other relevant disciplines in central, state and deemed universities/ colleges, with a view to raising the standard of research and producing faculty who could guide the process of environmental education in schools.
- Promote both formal and non-formal means for environment education and biodiversity conservation.
- Design and implement awareness programmes, particularly for rural women, and also benefit from their wisdom. Women's organizations such as women's councils and mahila mandals could be used for this purpose.
- Incorporate modules on conservation and sustainable utilization of biodiversity in foundational and professional training courses for the officers of various services.

- Promote and/or strengthen education, training, awareness and extension programmes on biodiversity issues for various stakeholders including all levels of students, professionals (such as engineers, doctors, lawyers, CAs, etc.), elected representatives (such as representatives of PRIs, MLAs, MPs, Mayors, etc.), judiciary, NGOs, public and private sectors (e.g. corporate representatives, industrial associations etc.), defence and para military forces, customs, police, media, cultural, spiritual and religious institutions/ individuals.
- Enhance public education and awareness for biodiversity conservation through audio, visual and print media.
- Promote activities relating to animal welfare.

5.10 Valuation of goods and services provided by biodiversity, and use of economic instruments in decision making processes

It is necessary that the costs associated with the degradation and depletion of natural resources be incorporated into decision-making, to reverse the tendency to treat these resources as free goods. At the macro-level, a system of natural resource accounting is required to assess whether in the course of economic growth, we are drawing down, or enhancing the biological resource base. In addition, the costs and benefits associated with various activities, including sectoral policies, should be evaluated to ensure that these factors are duly taken into account in decision-making.

There is also a need to move from the current near exclusive reliance on regulations, to a judicious mix of incentives and regulatory instruments.

Action Points

- Develop a system of natural resource accounting reflecting the ecological as well as economic values of biodiversity, with special attention to techniques of green accounting in national accounts and estimation of positive and negative externalities for use of various types of natural resources in the production processes as well as in household and government consumption.
- Develop suitable valuation models for adoption at national, state and local levels.
- Support projects and pilot studies aimed at validating methods of valuation of bioresources.
- Identify key factors and indicators to assess effectiveness of valuation methods and models, taking into consideration the UN guidelines on monitoring and evaluation of socio-economic projects.
- Assess the utility of traditional and innovative fiscal instruments for promoting conservation and sustainable utilization of biodiversity.
- Develop systems for partial ploughing back of the revenues generated in protected areas, zoological parks, botanical gardens, aquaria, etc., for improving their management.
- Mobilize additional resources based on project formulation for biodiversity conservation.

5.11 International cooperation

India has participated in major international events on environment and biodiversity conservation since

1972. India has also contributed to developing the agreed texts, ratified, and complied with the commitments in various international conventions relating to biodiversity. These agreements are: Convention on Biological Diversity (CBD), Convention on International Trade in Wild Species of Endangered Flora and Fauna (CITES), Ramsar Convention on Wetlands, World Heritage Convention, and the Bonn Convention on Conservation of Migratory Species (CMS). Some other international agreements which have bearing on biodiversity to which India is a Party include UNFCCC, UNCCD, Commission on Sustainable Development, World Trade Organisation, International Treaty on Plant Genetic Resources for food and agriculture and UN Law of the Seas.

A 'Global Tiger Forum' of tiger range countries has been created for addressing international issues related to tiger conservation.

India has also actively supported numerous regional and bilateral programmes on biodiversity. The MoEF, the nodal Ministry for the CBD and other biodiversity related conventions, is also the nodal agency in the country for the United Nations Environment Programme (UNEP), SACEP, ICIMOD, and IUCN. It has institutionalized the process for developing country's position on major issues for negotiations under different international conventions.

In this context, the MoEF is continuously taking steps to harmonise national policies and programmes in implementation of various multilateral environment agreements, based on active involvement of various stakeholders. The MoEF functions in partnership with a number of institutions for developing and implementing national strategies on conservation and sustainable use of biological diversity. These partners include Ministries, State Government departments, universities, other academic institutions, autonomous bodies, women's organizations and NGOs.

India along with sixteen other megadiverse countries, rich in biodiversity and traditional

knowledge, has formed a group known as the Like-Minded Megadiverse Countries (LMMCs). These countries are Bolivia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, Indonesia, Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa and Venezuela. The LMMCs hold nearly 70% of all biodiversity. India chaired the LMMCs for a two-year period from March 2004 to March 2006,and coordinated the activities of this group focusing particularly on access and benefit sharing issues under the CBD.

Access to genetic resources and sharing of the benefits arising out of these resources form the core elements of the Convention. While access and benefit sharing is subject to national legislations, as provided for in Article 15 of the CBD, national action alone is not sufficient to ensure benefits to the country that provides the resources, particularly in instances where the genetic resource is utilized in another country for developing processes and products on which protection is obtained. In this bac kground, an international regime (IR) on ABS is presently being negotiated by a Working Group on ABS under the aegis of the CBD, pursuant to a landmark decision of seventh Conference of Parties (COP) to the CBD. The eighth COP held in March 2006 has set a deadline of 2010 for completing the negotiations of IR on ABS. The ninth COP held in May 2008 has developed a detailed road map for completing the negotiations before COP-10 to be held in 2010.

Notable progress in this area notwithstanding, concerted efforts are now required to further improve bilateral, regional and multilateral cooperation, as also cooperation with UN agencies and other international organizations on issues related to biodiversity. There is also a need to enhance our own capacities to comply with commitments, and ensure sustained flow of resources for biodiversity management.

Action Points

- Further consolidate and strengthen global cooperation, especially with UN agencies and other international bodies on issues related to biodiversity.
- Promote regional cooperation for effective implementation of suitable strategies for conservation of biodiversity, especially with neighbouring countries through fora such as SAARC, ASEAN and ESCAP.
- Develop projects for accessing funds for conservation and sustainable use of biodiversity from external sources, earmarked for conservation through bilateral, regional and other multilateral channels.
- Promote technology transfer and scientific cooperation towards conservation of biological resources, their sustainable use and equitable sharing of benefits arising out of their use, taking also into account extant regulations including those relating to taxation.

CHAPTER 6

MATRIX FOR IMPLEMENTATION

The preceding chapter outlines a number of new and continuing activities for augmenting biodiversity conservation. Considering that the subject of biodiversity is cross sectoral in nature, the implementation of these activities would be heavily dependent on coordinated efforts of diverse actors, including the concerned Central Ministries/ Departments, State Governments, local institutions, research institutions, various organizations both government and non-government, and people themselves. The NBA established on 1st October, 2003 under the Biological Diversity Act and the SBBs and local BMCs which are in process of being established under the same Act, would also have to be actively involved in a number of actions.

Since many of the activities envisioned in the NBAP are ongoing, these would be taken up and mainstreamed under the ambit of existing schemes

and programmes by the Central and State governments, public and private sector as well as civil society organizations, securing full utilization of available infrastructure and funds, with marginal to substantial augmentation and further inputs, wherever required. In addition, sources of external funding would also be explored and availed of, in accordance with the extant policies and regulations. Thus, no separate scheme or allocation for implementation of NBAP is envisaged.

As regards the time frame for implementation of these activities, these would be taken up in the short term (within 5 years), medium term (between 5 and 10 years), or long term (beyond 10 years) basis. Most of the activities are already operational or planned, and the time frame as mentioned against each in the matrix is indicative of the term when optimal level of implementation will be achieved.

A tabulated matrix for implementation of the key activities of NBAP, indicating the implementing agencies and time frame for each of these activities is given below. The list of implementing agencies listed in the matrix is only indicative.

MATRIX FOR IMPLEMENTATION OF KEY ACTIVITIES OF NBAP

S. No.	Actions	Activities	Coordinating agency	Associated agencies	Time frame
1	Strengthening and integrating *in situ*, on-farm and *ex situ* conservation	• Expand the Protected Area (PA) network of the country giving representation to all bio-geographic zones.	- MoEF	➢ State/U.T. Governments with inputs from research institutions, other stakeholders.	- Medium
		• Establish self-sustaining monitoring system for overseeing the activities and effectiveness of the protected area network.	- MoEF	➢ State/U.T. governments.	- Medium
		• Mitigate man-animal conflicts.	- MoEF	➢ WLBI, MoTA in partnership with State/U.T. Governments, research institutions, local people and CSOs.	- Medium
		• Promote site-specific eco-development programmes in fringe areas of PAs.	- MoEF	➢ MoTA, MoT, MoPR in partnership with State Governments, research institutions, local people and CSOs.	- Short
		• Promote voluntary relocation of villagers from critical habitats of PAs.	- MoEF	➢ State/U.T. governments, district and panchayat level authorities local people and CSOs.	- Medium
		• Devise effective management and conservation techniques for the forest preservation plots.	- MoEF	➢ MoST, DoS, MoPR, ICFRE, WII, IIFM, IGNFA in association with SFDs, SFRIs etc.	- Short
		• Strengthen research work on protected areas, biosphere reserves and fragile ecosystems.	- MoEF	➢ MoST, DoS, MoES, MoA, universities, research institutions and CSOs.	- Short
		• Strenghthen the protection of ecologically sensitive areas of high endemism of genetic resources (biodiversity hotspots).	- MoEF	➢ NBA, MoA, MHRD, MoTA, State/U.T. Governments, SBBs.	- Medium
		• Promote inter-sectoral consultations and partnerships in strengthening biodiversity conservation activities.	- PC	➢ MoEF, MoA, MoES, MoCI, MoT, MoH&FW, AYUSH, MoRD, MoWR.	- Short
		• Control poaching and illegal trade in wild animals and plant species.	- MoEF	➢ CBEC, Coast Guards, SFDs, State/U.T. Governments.	- Medium
		• Strengthen capacities and implement measures for captive breeding and release into the wild, of identified endangered species.	- MoEF	➢ SFDs, CZA, Botanic Gardens, WII, BSI, ZSI, NBRI, TBGRI, CSIR institutions, universities and other research institutions.	- Medium
		• Promote ecologically and socially sensitive tourism and pilgrimage activities.	- MoT	➢ MoEF, State/U.T. governments, public and private travel & tour operators, religious and cultural institutions, CSOs.	- Medium
		• Promote conservation of biodiversity outside the protected area network, on private property, on common lands and water bodies.	- MoEF	➢ NBA, SBBs, BMCs, MoA, MoWR, MoTA, MoRD, AYUSH, l DRDO, private land owners, PRIs, public and private sector.	- Medium
		• Identify hotspots of agro-biodiversity under different agro-ecozones and cropping systems and promote on-farm conservation.	- MoA	➢ ICAR, State/U.T. governments, NBA, SBBs, BMCs, PPVFRA, MoTA, ZSI, SAUs, CSOs.	- Medium
		• Provide economically feasible and socially acceptable incentives like value addition and direct market access in face of replacement by other economically remunerative cultivars.	- MoA	➢ ICAR, State/U.T. governments including agriculture, animal husbandry and horticulture depts., MoTA, NAFED, NABARD, NIF, PC, research institutions, PRIs, public and private sector, CSOs and other innovation promoting agencies.	- Medium
		• Develop appropriate models for on-farm conservation of livestock herds maintained by different institutions and local communities.	- DAHD&F	➢ State/U.T. governments including agriculture, animal husbandry and horticulture depts., NAFED, NABARD, NIF, PC, research institutions, PRIs, public and private sector, CSOs and other innovation promoting agencies.	- Medium
		• Develop mutually supportive linkages between *in situ*, on-farm and *ex situ* conservation programmes.	- MoA & MoEF	➢ ICAR, AYUSH,State/U.T. governments, CSIR institutions, NBA, SBBs, BMCs, national gene banks, clonal repositories, PC etc.	- Short
		• Focus on conservation of genetic diversity (*in situ, ex situ*, *in vitro*) of cultivated plants, domesticated animals and their wild relatives to support breeding programmes.	- MoA	➢ ICAR, DAHD&F, MoEF, AYUSH CZA, State/U.T. governments, SAUs, research institutions, CSIR institutions.	- Long
		• Strengthen national *ex situ* conservation system for crop and livestock diversity including poultry linking national gene banks, clonal repositories and field collections, maintained by different research centers and universities.	- MoA/ ICAR	➢ DAHD&F, State/U.T. governments, SAUs, research institutions, CSIR institutions, community gene banks, CSOs.	- Long

S. No.	Actions	Activities	Coordinating agency	Associated agencies	Time frame
		• Develop cost effective and situation specific technologies for medium and long term storage of seed samples collected by different institutions and organizations.	- MoA/ICAR	➢ State/U.T. governments, SAUs, research institutions, CSIR institutions, community gene banks, CSOs.	- Medium
		• Undertake DNA profiling for assessment of genetic diversity in rare, endangered and endemic species to assist in conservation programmes.	- DBT	➢ DAHD&F, NRC on DNA Fingerprinting, CCMB, CDFD, SAUs, research institutions and universities.	- Medium
		• Develop a unified national database covering all *ex situ* conservation sites.	- MoA	➢ NBA, PPVFRA, DBT, PC, public and private institutions.	- Short
		• Develop networking of botanical gardens and consider establishing a unified command.	- MoEF	➢ BSI, NBA, State/U.T. governments, CSIR institutions, universities, colleges and research institutions.	- Short
		• Encourage cultivation of plants of economic value, gathered from their natural populations and promote development of elite varieties of such plants.	- MoA	➢ SAUs, AYUSH, DBT, CSIR institutions, public and private sector, CII, FICCI, ASSOCHAM and other industry associations.	- Medium
		• Promote inter-sectoral linkages and synergies to develop and realize full economic potential of *ex situ* conserved materials in crop and livestock improvement programmes.	- MoA	➢ ICAR, NABARD, PC, State/U.T. governments, SAUs, CSIR institutions, research institutions and universities.	- Medium
		• Strengthen basic research on reproduction biology of rare, endangered and endemic species to support reintroduction.	- MoEF	➢ MoA, MoST, BSI, ZSI, research institutions and universities.	- Medium
2	Augmentation of Natural Resource Base and its sustainable utilization: Ensuring inter and intra-generational equity	• Promote sustainable use concept and best practices for sustainable use of biodiversity in relevant economic sectors.	- PC	➢ MoEF, MoA, MoCI, MoT, MoRD, MoTA, MoES, AYUSH, CII, ASSOCHAM, FICCI and other industry associations.	- Long
		• Promote decentralized management of biological resources with emphasis on community participation.	- PC & MoPR	➢ MoEF, MoA, MoRD, MoES, MoH&FW, MoTA. AYUSH	- Medium
		• Integrate biodiversity concerns into sectoral and inter-sectoral policies and programmes.	- PC, DoLR & MoEF	➢ MoEF, MoA, MoCI, AYUSH CII, ASSOCHAM, FICCI and other industry associations.	- Short
		• Promote conservation, management and sustainable utilization of bamboos and canes, and establish bambusetum and canetum.	- MoEF & MoA	➢ State governments, SFRIs, CSIR institutions, research institutions and universities.	- Medium
		• Encourage cultivation of medicinal plants and culture of marine organisms utilized for drugs to prevent their unsustainable extraction from the wild.	- MoA & MoES	➢ AYUSH, MoEF, PC, MoST, MoPR, ICMR, CSIR institutions, universities and research institutions.	- Medium
		• Promote capacity building at grassroot level to ensure eco-friendly and sustainable use of natural resources.	- MoEF	➢ NBA, SBBs, BMCs, MoA, MHRD, State/U.T. governments, SFDs, PRIs, CSOs.	- Short
		• Develop suitable mechanisms for protection of traditional knowledge associated with genetic resources.	- MoEF	➢ NBA, PPVFRA, AYUSH,CSIR institutions, MoCI.	- Medium
		• Adopt a comprehensive approach to Integrated Coastal Zone Management by strengthening linkages among coastal areas, wetlands and river systems.	- MoEF	➢ MoES, MoA, MoWR, NIO, ZSI, Centres of Excellence, State/U.T. government including science, technology and environment departments, Coast Guards, research institutions and universities, public and private sector.	- Short
		• Promote techniques for conservation and regeneration of coral reefs and mangroves.	- MoEF	➢ MoES, NIO, ZSI, SDMRI, State/U.T. governments, Coast Guards and private sector.	- Short
		• Encourage agro-forestry, organic farming, environmentally sustainable cropping patterns, diversified farming systems and more efficient irrigation techniques.	- MoA	➢ SAUs, State/U.T. governments including agriculture, horticulture and forest departments, MoTA, MoFPI, APEDA, NABARD, private sector.	- Medium

S. No.	Actions	Activities	Coordinating agency	Associated agencies	Time frame
3	Regulating introductions, and managing invasive alien species	• Develop unified national system for regulation and quarantine check of all introductions.	- MoA & MoEF	➢ PC, CBEC, State/U.T. governments, research institutions and universities.	- Medium
		• Develop domestic quarantine to contain the spread of invasive species to neighbouring areas.	- MoA	➢ ICAR, MoEF, MoCI,/ State/U.T. governments, research institutions and universities.	- Medium
		• Promote intersectoral linkages to check accidental introductions.	- MoA	➢ ICAR, MoEF, MoCI, PC, State/U.T. governments, research institutions and universities.	- Medium
		• Develop a national database on invasive alien species reported in India.	- MoA	➢ ICAR, MoEF, State/U.T. governments, research institutions and universities.	- Short
		• Develop appropriate Early Warning and Awareness System.	- MoA	➢ State/U.T. Governments, CSOs, media, research institutions and universities.	- Short
		• Provide priority funding to basic research on managing invasive species.	- MoA	➢ ICAR, MoST, MoEF, PC, research institutions and universities.	- Short
		• Promote capacity building for managing invasive alien species.	- MoA	➢ ICAR, DAHD&F, MoEF, NBA, BSI, ZSI, State/U.T. governments, research institutions and universities.	- Medium
		• Promote restorative measures of degraded ecosystems using native species.	- MoEF	➢ MoA, MoRD, PC, CSOs, PRIs, State/U.T. governments, research institutions and universities.	- Long
		• Promote regional cooperation in adoption of uniform quarantine measures.	- MoEF	➢ MoA, MEA, MoF (Department of Revenue through CBEC), MHA.	- Medium
4	Assessment of vulnerability, and adaptation to climate change & desertification	• Identify key vulnerabilities to climate change in the Indian context.	- MoST & MoEF	➢ MoES, DoS, DRDO, MoM, PC, research institutions and universities.	- Medium
		• Focus on sea- level rise and vulnerability of coastal areas and their biodiversity to climate change and geological events.	- MoST & MoEF	➢ MoES, DoS, MoM, PC, research institutions and universities.	- Medium
		• Participate in voluntary partnerships with other countries both developed and developing, to address the challenges of sustainable development and climate change, consistent with the provisions of the UN Framework Convention on Climate Change.	- MoEF & MoST	➢ MEA, DEA, MHA.	- Long
		• Identify the most important gaps in knowledge that limit the national ability to develop and implement climate change adaptation strategies for species and ecological processes and functions.	- MoEF & MoST	➢ DoS, research institutions and universities, centres of excellence, CSOs.	- Medium
		• Develop ecological criteria for identifying the species and ecosystems that are at great risk from climate change and identify their priority habitats.	- MoEF & MoST	➢ DoS, research institutions and universities, centres of excellence, CSOs.	- Medium
		• Identify information gaps and priorities, through expert consultative process, for long-term monitoring of climate change impacts on biodiversity.	- MoEF	➢ MoST, MoEs, DoS, research institutions and universities, CSOs.	- Long
		• Establish a climate change and biodiversity website for decision makers.	- MoEF & MoST	➢ NIC.	- Medium
		• Adopt watershed management strategies for arresting and reverting desertification and for expanding the green cover.	- DoLR, MoA & MoEF	➢ MoRD, MoPR, State/U.T. governments, research institutions and universities.	- Long

S. No.	Actions	Activities	Coordinating agency	Associated agencies	Time frame
5	Integration of biodiversity concerns in economic and social development	• Integration of biodiversity concerns across development sectors and promote use of clean technologies.	- MoEF & PC	➢ MoST, MoA, MoCI, MoPNG, AYUSH, public and private sector, CII, FICCI, ASSOCHAM and other industry associations.	- Medium
		• Develop strong research base on impact assessment.	- MoEF & MoST	➢ Research institutions, CSOs, public and private sector, CII, FICCI, ASSOCHAM and other.	- Short
		• Integrate plans for reallocation and rehabilitation of local people likely to be displaced by development projects.	- PC & concerned State govt. agencies	➢ MoWR, MoTA, MoEF, MoPR, CSOs, public and private sector, CII, FICCI, ASSOCHAM and other.	- Short
		• Promote integrated approach to management of river basins, according priority to mitigating the impacts on river and estuarine flora and fauna.	- MoWR & PC	➢ MoEF, MoA, State/U.T. governments, universities and research institutions, public and private sector, BSI, ZSI.	- Short
		• Adopt "best practice" norms for infrastructure development projects.	- MoUD & PC	➢ Min. of Surface Transport, MoT, NHAI, MoEF, MoCI, research institutions, public and private sector, CII, FICCI, ASSOCHAM and other industry associations.	- Short
		• Strengthen traditional practices of rain water harvesting.	- MoUD	➢ MoRD, MoEF, MoCI, research institutions, State Governments, public and private sector, CSOs.	- Short
		• Ensure provision for environmental restoration during commissioning and after decommissioning of industries.	- MoCI & MoEF	➢ MoM, NHAI, MoST, public and private sector, CII, FICCI, ASSOCHAM and other industry associations, CSOs.	- Medium
		• Promote sustainable tourism through adoption of "best practice" norms.	- MoT	➢ MoEF, MHRD, public and private tour operators, CSOs.	- Short
6	Impact of pollution	• Strengthen monitoring and enforcement of emission standards, for both point and non-point sources, minimizing adverse impacts on biodiversity.	- MoEF	➢ CPCB, SPCBs, State Environment Departments, CSOs.	- Short
		• Treat and manage industrial effluents to minimize adverse impacts.	- MoEF	➢ CPCB, SPCBs, public and private sector, CII, FICCI, ASSOCHAM and other industry associations, CSOs.	- Medium
		• Promote biodegradable and recyclable substitutes for non-biodegradable materials.	- MoEF	➢ CPCB, SPCBs, public and private sector, CII, FICCI, ASSOCHAM and other industry associations, research institutions, CSOs, BIS.	- Long
		• Avoid excessive use of fertilizers and pesticides; promote organic farming of locally-adapted traditional crop varieties where feasible.	- MoA	➢ MoPR, State/U.T. governments, farming communities, public and private sector, CSOs.	- Short
		• Develop a strategy for strengthening regulation, and addressing impacts, of ship-breaking activities.	- Min. of Shipping & MoEF	➢ Min. of Surface and Transport, MoCI, public and private sector, CSOs.	- Medium
7	Developing and integrating biodiversity databases	• Develop an integrated national biodiversity information system with distributive linkages for easy storage, retrieval and dissemination.	- NBA	➢ MoEF, BSI, ZSI, CSIR institutions, universities and research institutions, CSOs.	- Medium
		• Collect, collate and consolidate all available information.	- MoEF	➢ NBA,BSI, ZSI, MoA, MoST, CSIR institutions, research institutions and universities, Centres of excellence, SAUs.	- Short
		• Intensify area-specific survey, identification and inventorization activities.	- MoEF	➢ BSI, ZSI, MoA, Centres of excellence, universities and research institutions.	- Medium
		• Strengthen research base on taxonomy and genetic diversity.	- MoEF	➢ BSI, ZSI, MoA, centres of excellence, universities and research institutions.	- Short
8	Strengthening	• Accelerate effective actions at the central, state and local levels to implement provisions under the Biodiversity Act 2002 and its Rules 2004.	- MoEF	➢ NBA, SBBs, BMCs, State/U.T. governments, CSOs.	- Medium
		• Review enabling policies regarding agricultural lands	- MoA	➢ MoEF, MoRD, MoUD.	- Long

S. No.	Actions	Activities	Coordinating agency	Associated agencies	Time frame
		• Formulate policies for grasslands, pastoral lands, sacred groves etc.	- MoEF	➢ State/U.T. governments, MoA, MoRD.	- Medium
		• Revitalize traditional practices and other folk uses of bio-resources.	- MoEF	➢ NBA, SBBs, BMCs, AYUSH, State/U.T. governments, CSIR institutions, research institutions and universities, Centres of excellence, CSOs.	- Medium
		• Develop synergies among relevant statutes and regulation in line with the NEP and identify areas for new legislation.	- MoEF	➢ Concerned Ministries, State/U.T. Governments.	- Short
		• Review and update regulatory processes for LMOs (including national biosafety guidelines keeping in view biodiversity and human health.	- MoEF & DBT	➢ MoA, MoH&FW, DGFT, MFPI, State/U.T. governments, SAUs, ICAR, ICMR.	- Short
		• Harmonise provisions concerning disclosure of source of biological material and associated knowledge relevant to the Patents Act, 1970, Plant Varieties Protection and Farmer's Rights Act, 2001 and Biological Diversity Act 2002.	- MoEF	➢ MoA, PPVFRA, MoCI, NBA.	- Short
		• Develop appropriate system and modalities for operationalizing provisions for prior informed consent and benefit sharing under the Biological Diversity Act.	- MoEF	➢ NBA, SBBs, BMCs.	- Medium
		• Support preparation of PBRs.	- MoEF	➢ NBA, SBBs, BMCs.	- Long
		• Reorient and converge national policies on use of natural resources (including forestry, agriculture, fisheries, industry, mining etc.) and integrate biodiversity concerns.	- MoEF & PC	➢ NBA, MoCI, MoA, MoM, public and private sector, CII, FICCI, Assocham and other industry associations.	- Long
9	Developing national capacities for biodiversity conservation and appropriate use of new technologies	• Develop consortium of lead institutions and promote joint research on key conservation issues.	- MoEF & MoST	➢ MoES, MoA, universities and research institutions, CSIR institutions, public and private sector.	- Medium
		• Promote application of biotechnology tools for conserving endangered species.	- DBT	➢ MoEF, universities and research institutions, CSIR institutions, public and private sector.	- Medium
		• Consolidate follow up studies on released LMOs.	- MoEF & DBT	➢ MoA, ICAR, SAUs, State/U.T. governments.	- Medium
		• Implement ban on 'genetic use restriction technologies'	- MoA	➢ NBA, DBT, MoEF.	- Short
		• Strengthen local institutional structures ensuring participation of women.	- MoEF & DoWCD	➢ MoA, MoRD, MoPR, CSOs, State/U.T. governments.	- Medium
		• Integrate traditional knowledge and practices into biodiversity conservation.	- MoEF	➢ NBA, MoC, MoA, MoRD, MoTA, AYUSH & CSIR institutions.	- Long
		• Promote use of non-conventional sources of energy.	- MNRE	➢ MoEF, State/U.T. governments, CSOs, public and private sector.	- Long
		• Support traditional, religious, ritualistic, ethical and cultural methods of conservation.	- MoEF	➢ MoC, religious and cultural organizations, State/U.T. governments, CSOs, public and private sector.	- Medium
		• Strengthen manpower, infrastructure and capacities of MoEF	- DoPT	➢ PC, MoEF.	- Short
		• Strengthen BSI and ZSI capabilities and link them to assist SBBs and BMCs.	- MoEF	➢ ZSI, BSI, State/U.T. governments, universities and research institutions.	- Long
		• Augment human resource development and personnel management in forestry and wildlife sector.	- MoEF	➢ WII, State/U.T. governments, universities and research institutions.	- Short
		• Develop a unified national system for conservation of all components of agricultural biodiversity.	- MoA	➢ State/U.T. governments including agriculture, horticulture and animal husbandry department, SAUs, public and private sector, research institutions, CSIR institutions.	- Long
		• Expand the network of botanical gardens and zoological parks.	- MoEF	➢ State/U.T. governments, BSI, ZSI, CSIR institutions, universities and research institutions, public & private sector.	- Long

S. No.	Actions	Activities	Coordinating agency	Associated agencies	Time frame
		• Evolve suitable mechanism to coordinate all activities related to conservation (wildlife, forestry, agriculture, animal husbandry, fisheries, etc.).	- PC, MoA & MoEF	➢ State/U.T. governments, research institutions and universities, CSIR institutions and CSOs.	- Medium
		• Strengthen and support relevant departments of central, state and deemed universities/colleges	- MHRD	➢ UGC, AICTE, central, state and deemed universities/ colleges, MoEF.	- Medium & Long
		• Promote both formal and non-formal means for environment education and biodiversity conservation.	- MoEF	➢ MoHRD, UGC, NCERT, AICTE, CBSE, State Councils and Boards.	- Medium
		• Incorporate modules on conservation and sustainable use of biodiversity in foundational and professional training for All India and State Services.	- MoEF, MoST & MHRD	➢ BSI, ZSI, NBA, CSIR institutions, universities and research institutions, CSOs.	- Medium
		• Promote and augment public education and awareness	- MoEF	➢ MHRD, UGC, media, CSOs, public and private sector.	- Short
		• Support research on threats to biodiversity, 'Hot Spot' areas and lower taxa.	- MoEF & MoST	➢ State/U.T. governments, MHRD, MoA, DBT, universities and research institutions, CSIR institutions.	- Medium
		• Upgrade technologies for conservation and use.	- MoEF	➢ TIFAC, MoST DoS, MoES, universities and research institutions.	- Short
		• Conservation and management of biodiversity through biotechnological interventions	- DBT	➢ DST, MoA, MoEF and their associated organizations	- Medium & Long
		• Enhance research on bio-fertilizers, bio-pesticides and IPM.	- MoA & MoST	➢ State/U.T. governments, universities and research institutions.	- Long
		• Improve capability for impact assessment.	- MoEF MoST & PC	➢ CPCB, SPCBs, public and private sector, CSOs, research institutions.	- Short & Medium
		• Strengthen taxonomic capacity.	- MoEF & MoST	➢ BSI, ZSI, State/U.T. governments, universities and research institutions, CSIR institutions, CSOs.	- Short & Medium
		• Promote activities relating to animal welfare.	- AWB	➢ MoEF, MoA, DAHD&F, CSOs, universities and research institutions, public and private sector.	- Short
10	Use of economic instru-ments/ valuation in biodiversity related decision making processes	• Develop valuation models and a system for natural resource accounting (reflecting ecological and economic values of biodiversity).	- MoEF & MoSPI	➢ PC, State/U.T. governments, IEG, IGIDR, Central Statistical Organization, universities and research institutions, CSIR institutions, CSOs, TERI.	- Long
		• Develop valuation models and validate through pilot studies.	- MoEF & MoSPI	➢ PC, State/U.T. governments, IEG, IGIDR, Central Statistical Organization, universities and research institutions, CSIR institutions, CSOs, TERI.	- Long
		• Develop systems for greater return of revenues (generated in protected areas, zoological parks, botanical gardens, aquaria etc.) for strengthening biodiversity conservation.	- MoEF	➢ MoSPI, PC, State/U.T. governments, IEG, IGIDR, Central Statistical Organization, universities and research institutions, CSIR institutions, CSOs, TERI.	- Long
11	Interna-tional cooperation	• Strengthen cooperation with international agencies on biodiversity issues.	- MEA & MoEF	➢ MoST, MoA, PC, DEA, MHA.	- Medium
		• Promote regional cooperation.	- MEA & MoEF	➢ DEA, MoA, MoST, MHA.	- Long
		• Mobilise external funding.	- MoF & MoEF	➢ MEA, DEA, MoA, MoST.	- Medium
		• Enable technology transfer.	- MoEF & MoST	➢ MEA, DEA, MoA.	- Medium

ABBREVIATIONS

ABS	:	Access and Benefit Sharing
AICTE	:	All India Council for Technical Education
APEDA	:	Agricultural and Processed Food Products Export Development Authority
ASEAN	:	Association of South East Asian Nations
ASSOCHAM	:	The Associated Chambers of Commerce and Industry of India
AWBI	:	Animal Welfare Board of India
AYUSH	:	Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy
BIS	:	Bureau of Indian Standards
BHC	:	Benzene Hexachloride
BMCs	:	Biodiversity Management Committees
BNHS	:	Bombay Natural History Society
BSI	:	Botanical Survey of India
BR	:	Biosphere Reserve
Bt	:	*Bacillus thuringiensis*
CAs	:	Chartered Accountants
CBD	:	Convention on Biological Diversity
CBEC	:	Central Board of Excise and Customs
CBSE	:	Central Board of Secondary Education
CCMB	:	Centre for Cellular & Molecular Biology
CDFD	:	Centre for DNA Fingerprinting and Diagnostics
CDM	:	Clean Development Mechanism
CDRI	:	Central Drug Research Institute
CEE	:	Centre for Environment Education
CGIAR	:	Consultative Group on International Agricultural Research
CII	:	Confederation of Indian Industry
CIMAP	:	Central Institute of Medicinal and Aromatic Plants
CITES	:	Convention on International Trade in Wild Species of Endangered Flora and Fauna
CMS	:	Bonn Convention on Conservation of Migratory Species
CoE	:	Centre of Excellence
COP	:	Conference of Parties
CPCB	:	Central Pollution Control Board
CSIR	:	Council of Scientific and Industrial Research
CSOs	:	Civil Society Organizations
CZA	:	Central Zoo Authority
D/o Energy	:	Department of Energy
D/o Mining	:	Department of Mining
DAHD&F	:	Department of Animal Husbandry, Dairying and Fisheries
DBT	:	Department of Biotechnology
DCGI	:	Drug Controller General of India
DEA	:	Department of Economic Affairs
DDP	:	Desert Development Programme
DDT	:	Dichloro-Diphenyl-Trichloroethane
DGFT	:	Director General of Foreign Trade
DoLR	:	Department of Land Resources

DoPT	:	Department of Personnel & Training
DoRD	:	Department of Rural Development
DoS	:	Department of Space
DoWCD	:	Department of Women & Child Development
DPAP	:	Drought Prone Area Programme
DRDO	:	Defence Research Development Organization
DST	:	Department of Science & Technology
EIA	:	Environmental Impact Assessment
EIVs	:	Entities of Incomparable Value
ESCAP	:	Economic and Social Commission for Asia and the Pacific
FDA	:	Forest Development Agency
FICCI	:	Federation of Indian Chambers of Commerce and Industry
FIS	:	Forest Invasive Species
GEAC	:	Genetic Engineering Approval Committee
GIB	:	Great Indian Bustard
GMOs	:	Genetically Modified Organisms
GURTs	:	Genetic Use Restriction Technologies
HDI	:	Human Development Index
IBSC	:	Institutional Biosafety Committee
IAS	:	Invasive Alien Species
ICAR	:	Indian Council of Agricultural Research
ICFRE	:	Indian Council of Forest Research and Education
ICIMOD	:	International Centre for Integrated Mountain Development
ICMR	:	Indian Council of Medical Research
IEG	:	Institute of Economic Growth
IFGTB	:	Institute of Forest Genetics and Tree Breeding
IGIDR	:	Indira Gandhi Institute of Development & Research
IGNFA	:	Indira Gandhi National Forest Academy
IIFM	:	Indian Institute of Forest Management
IIIM	:	Indian Institute of Integrative Medicine
IR	:	International Regime
IUCN	:	International Union for Conservation of Nature
IWDP	:	Integrated Wasteland Development Programme
JFM	:	Joint Forest Management
JFMCs	:	JFM Committees
LaCONES	:	Laboratory for Conservation of Species
LMMCs	:	Like Minded Megadiverse Countries
LMOs	:	Living Modified Organisms
M/o Culture	:	Ministry of Culture
MEA	:	Ministry of External Affairs
MEAs	:	Multilateral Environment Agreements
MEC	:	Monitoring cum Evaluation Committee
MHA	:	Ministry of Home Affairs
MHRD	:	Ministry of Human Resource Development
MLAs	:	Member of Legislative Assembly
MNRE	:	Ministry of New & Renewable Energy
MoA	:	Ministry of Agriculture
MoCI	:	Ministry of Commerce & Industry

MoD	:	Ministry of Defence
MoEF	:	Ministry of Environment and Forests
MoES	:	Ministry of Earth Sciences
MoF	:	Ministry of Finance
MoFPI	:	Ministry of Food Processing Industries
MoHFW	:	Ministry of Health andFamily Welfare
MoIT	:	Ministry of Information Technology
MoM	:	Ministry of Mines
MoPNG	:	Ministry of Petroleum & Natural Gas
MoPR	:	Ministry of Panchayati Raj
MoRD	:	Ministry of Rural Development
MoSPI	:	Ministry of Statistics & Programme Implementation
MoST	:	Ministry of Science & Technology
M/o Surface Transport	:	Ministry of Surface Transport
MoT	:	Ministry of Tourism
MoTA	:	Ministry of Tribal Affairs
MoUD	:	Ministry of Urban Development
MoWR	:	Ministry of Water Resources
MPs	:	Member of Parliament
MSP	:	Multi-Stakeholder Partnership
NABARD	:	National Bank for Agriculture and Rural Development
NAEB	:	National Afforestation and Eco-Development Board
NAFED	:	National Agricultural Cooperative Marketing Federation of India Ltd.
NAP	:	National Afforestation Programme
NBA	:	National Biodiversity Authority
NBAGR	:	National Bureau of Animal Genetic Resources
NBAIM	:	National Bureau of Agriculturally Important Microorganisms
NBAP	:	National Biodiversity Action Plan
NBFGR	:	National Bureau of Fish Genetic Resources
NBPGR	:	National Bureau of Plant Genetic Resources
NBRI	:	National Botanical Research Institute
NBSAP	:	National Biodiversity Strategy and Action Plan
NCDMA	:	National Clean Development Mechanism Authority
NCERT	:	National Council of Education Research and Training
NDMA	:	National Disaster Management Authority
NEERI	:	National Environmental Engineering Research Institute
NEP	:	National Environment Policy, 2006
NGOs	:	Non Government Organizations
NHAI	:	National Highways Authority of India
NIC	:	National Informatics Centre
NIF	:	National Innovation Foundation
NIO	:	National Institute of Oceanography
NIPER	:	National Institute of Pharmaceuticals Education and Research
NISCAIR	:	National Institute of Science Communication and Information Resources
NLCP	:	National Lake Conservation Plan

NRA	:	Natural Resource Accounting
NRCDNAF	:	National Research Centre on DNA Fingerprinting
NRCP	:	National River Conservation Plan
NTFPs	:	Non-Timber Forest Products
PAs	:	Protected Areas
PBRs	:	People's Biodiversity Registers
PC	:	Planning Commission
PEs	:	Public Enterprises
PRIs	:	Panachayati Raj Institutions
PPVFRA	:	Protection of Plant Varieties and Farmers' Rights Authority
RCGM	:	Review Committee on Genetic Manipulation
RIs	:	Research Institutions
SAARC	:	South Asian Association for Regional Cooperation
SACEP	:	South Asia Cooperative Environment Programme
SAHDs	:	State Animal Husbandry Departments
SAUs	:	State Agricultural Universities
SBBs	:	State Biodiversity Boards
SC	:	Schedule Caste
SDMAs	:	State Disaster Management Authorities
SDMRI	:	Suganthi Devadasan Marine Research Institute
SFBs	:	State Forest Boards
SFDs	:	State Forest Departments
SFM	:	Sustainable Forest Management
SFRIs	:	State Forest Research Institutes
SPCBs	:	State Pollution Control Boards
ST	:	Schedule Tribe
TBGRI	:	Tropical Botanic Garden And Research Institute
TIFAC	:	Technology Information, Forecasting and Assessment Council
TKDL	:	Traditional Knowledge Digital Library
TRIPS	:	Trade-Related Aspects of Intellectual Property Rights
UGC	:	University Grant Commission
UN	:	United Nations
UNCCD	:	United Nations Convention to Combat Desertification
UNEP	:	United Nations Environment Programme
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
UNFCC	:	United Nations Framework Convention on Climate Change
UPOV	:	International Union for the Protection of New Varieties of Plants
US$	:	US Dollar
U.T.	:	Union Territories
WII	:	Wildlife Institute of India
WLBI	:	Wildlife Board of India
WTO	:	World Trade Organization
ZSI	:	Zoological Survey of India

LIST OF PHOTOGRAPHS

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Deer
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Peacock
Bulbul – a bird
Coral
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Mangrove forests
Rose

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