India's Fourth National Report to the Convention on Biological Diversity

Ministry of Environment and Forests
Government of India
New Delhi

2009

सत्यमेव जयते

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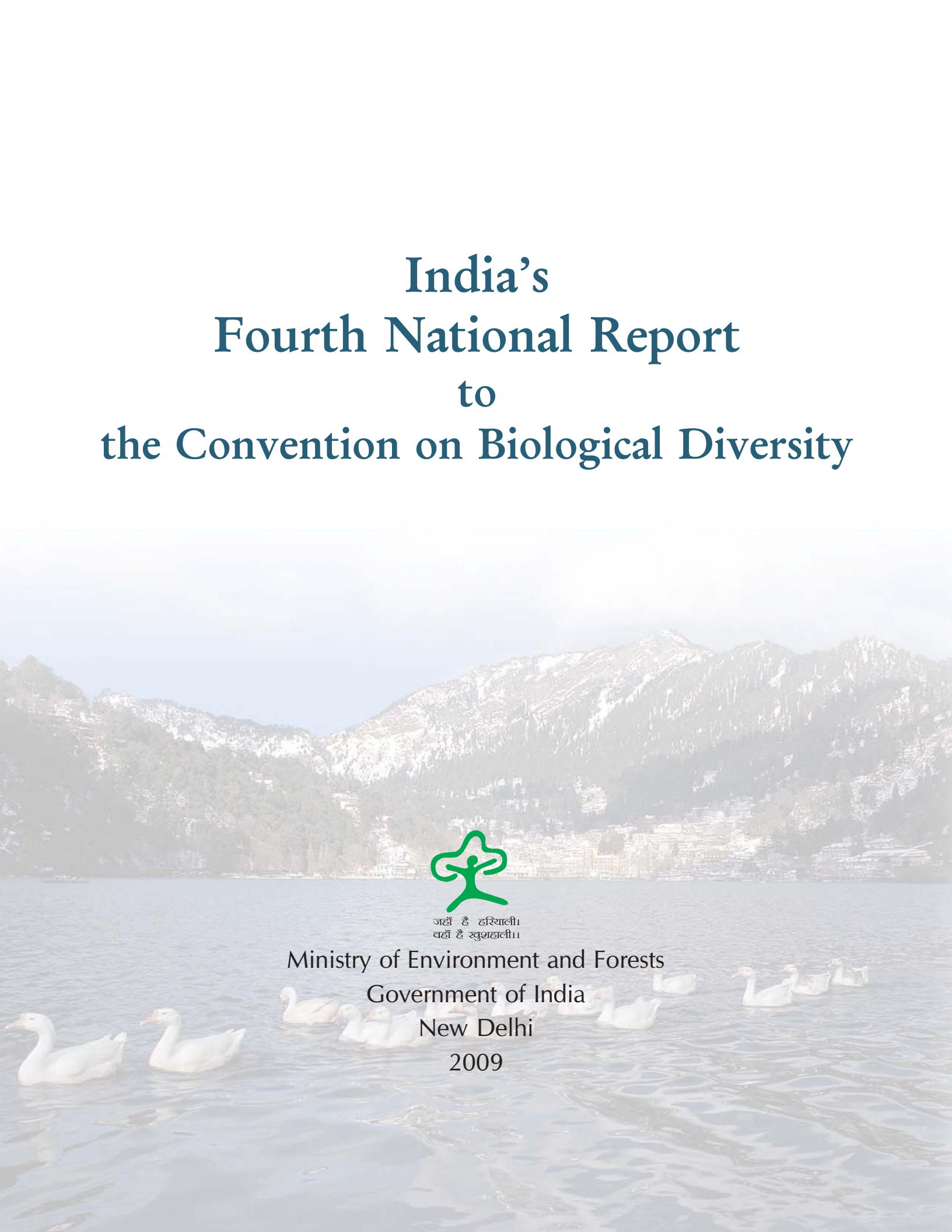

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Ministry of Environment and Forests
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FOREWORD

I am pleased to present India's Fourth National Report to the Convention on Biological Diversity. To say that India is immensely rich in biodiversity would be to state the obvious. With only 2.5% of the world's land area, India accounts for 7.8% of the recorded species of the world including 45,500 recorded species of plants and 91,000 recorded species of animals. India is also rich in traditional and indigenous knowledge, both coded and informal. It possesses an exemplary diversity of ecological habitats like forests, grassland, wetlands, coastal and marine ecosystems, and desert ecosystems. It is not surprising therefore, that India is considered one of the world's 17 "megadiverse" countries in terms of biodiversity.

India takes its commitment to preserving biodiversity very seriously. This is not only because of India's international obligations as a signatory to the Convention on Biological Diversity. It is also because India believes that protecting our biodiversity is a critical national priority as it is linked to local livelihoods of millions of people in the country. Sustainable use of our biodiversity therefore has both ecological and economic value. It is with this objective that India set up a National Biodiversity Authority (NBA) in 2003 with an explicit mandate of conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner.

This Report focuses on the threats to biodiversity, the status of implementation of the National Biodiversity Action Plan and the progress achieved towards meeting the 2010 biodiversity target. It has been prepared in terms of the mandatory requirements under Article 26 of the Convention to which India is a Party.

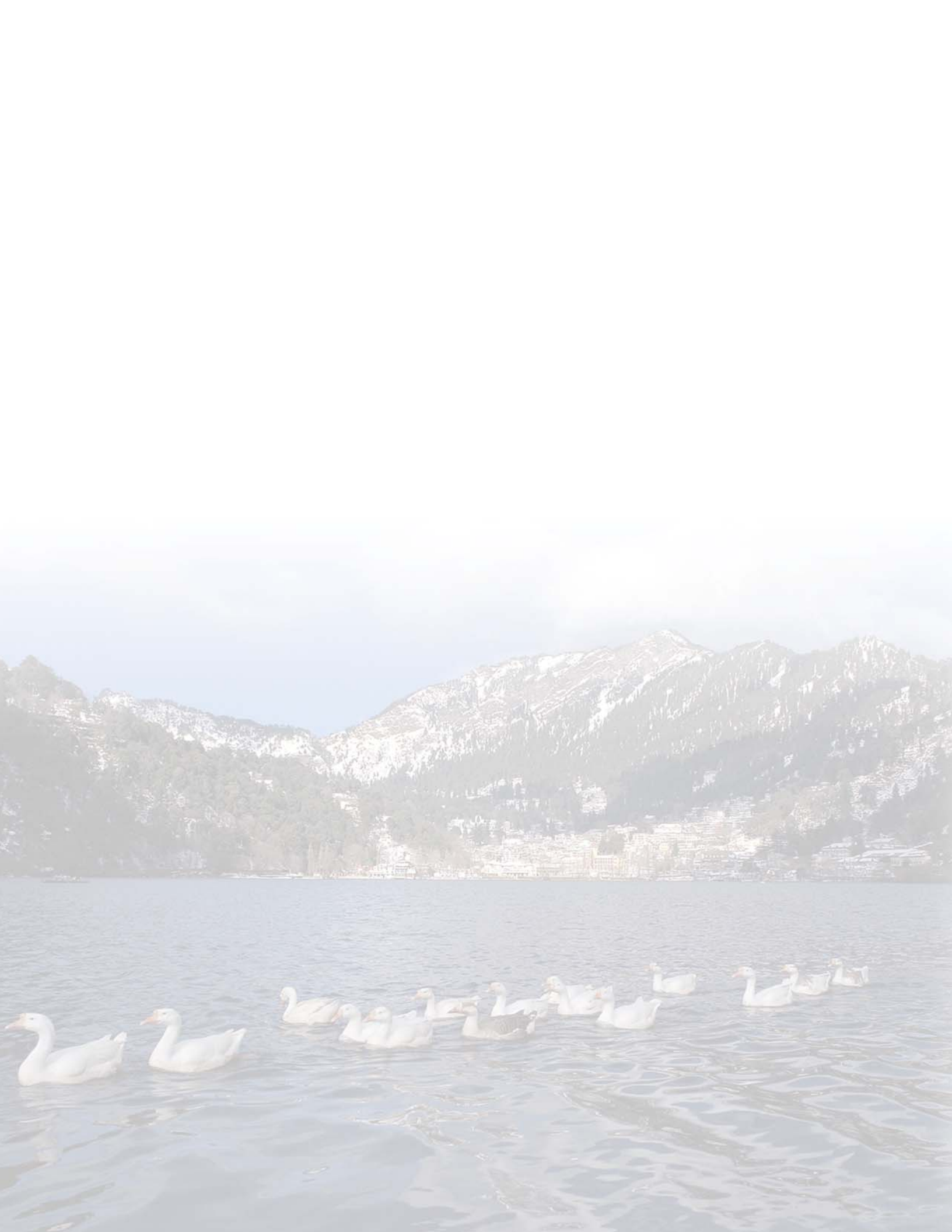
Considering the inherently multidisciplinary nature of biodiversity, it is imperative that any national document on the subject is prepared by involving the various stakeholders, experts and concerned organization and Ministries/Departments. I am happy to note that this Report has been prepared based on such a through consultative process.

I congratulate all those who were involved in this assignment. I especially wish to put on record the overall guidance and support provided by Shri Bir Singh Parsheera, Special Secretary, and the diligent efforts put in by Shri A.K. Goyal, Joint Secretary and Dr. Sujata Arora, Additional Director in this endeavour. I am confident that sharing of experiences with other Parties through the National Reports would immensely help in addressing the challenges we face today in perpetuating evolutionary process and maintaining our world's biodiversity.

Jairam Ramesh

Dated: June 8, 2009
Place: New Delhi

(Jairam Ramesh)



सत्यमेव जयते

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Special Secretary

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PREFACE

Preparation of National Reports is an unqualified obligation on all the Contracting Parties to the Convention on Biological Diversity. Towards fulfillment of these reporting obligations, India had earlier submitted its First, Second and Third National Reports in 1998, 2001 and 2005, respectively. National reporting is a continuing requirement under the Convention, and these reports are called for on a four yearly basis. Preparation of National Reports on regular intervals helps the Party to monitor and review the status of implementation of the Convention, while identifying gaps in its capacity, constraints and impediments.

The format of the Fourth National Report is narrative and the contents are outcome oriented, elucidating the national status and trends of biodiversity, progress in implementation of the National Biodiversity Action Plan, and national actions with respect to achievement of 2010 biodiversity target. In accordance with the guidance provided by the Conference of the Parties, the text is supplemented by graphics, figures, tables, boxes, pictures, and appendices.

The Report has been prepared with the support of a UNDP/GEF project. I express my appreciation for the sincere and dedicated efforts put in by Shri A.K.Goyal, Joint Secretary, and Dr. Sujata Arora, Additional Director, in preparation of the Report. I also wish to thank Dr. U. Dhar, the Consultant, Dr. J.R. Bhatt, Director and Shri Pramod Krishnan, Joint Director for their contributions, and UNDP/GEF for the financial support.

(Bir Singh Parsheera)

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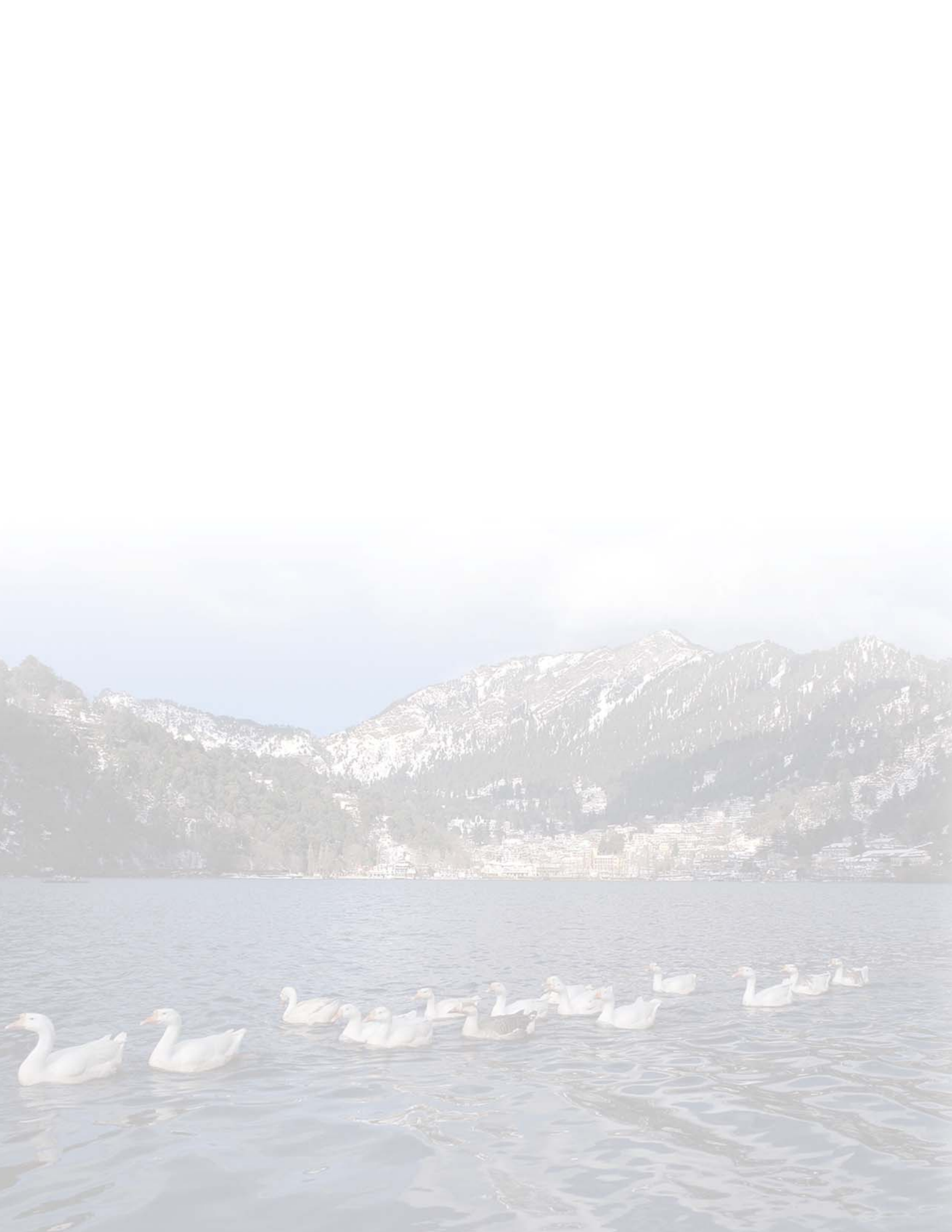


EXECUTIVE SUMMARY

INDIA'S BIODIVERSITY : STATUS, TRENDS AND THREATS

India, known for its rich heritage of biological diversity, has so far documented over 91,200 species of animals and 45,500 species of plants in its ten bio-geographic regions. Besides, it 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, which are still evolving under natural conditions. India is also a vast repository of Traditional Knowledge (TK) associated with biological resources.

India ranks among the top ten species-rich nations and shows high endemism. India has four global biodiversity hot spots (Eastern Himalaya, Indo-Burma, Western Ghats and Sri Lanka, and Sundaland). The varied edaphic, climatic and topographic conditions and years of geological stability have resulted in a wide range of ecosystems and habitats such as forests, grasslands, wetlands, deserts, and coastal and marine ecosystem.

Inventories of faunal diversity in India are being progressively updated and analyzed with several new discoveries. So far, nearly 91,212 of faunal species (7.43% of the world's faunal species) have been recorded in the country. Endemic rich Indian fauna is manifested most prominently in Amphibia (61.2%) and Reptilia (47%). Likewise, Indian fish fauna includes two endemic families and 127 monotypic genera. As per the International Union for Conservation of Nature (IUCN) Red List (2008), India has 413 globally threatened faunal species, which is approximately 4.9% of the world's total number of threatened faunal species.

Continuous surveys and explorations have added new discoveries – 41 plant species in 2007 by Botanical Survey of India (BSI) alone. The unique features of the plant diversity, among others, include 60 monotypic families and over 6000 endemic species. Recent estimates indicate the presence of over 256 globally threatened plant species in India.

Likewise, India's contribution to crop biodiversity has been impressive with repositories of over 50,000 varieties of rice, 5,000 of sorghum, 1,000 varieties of mango, etc. The National Genebank, primarily responsible for *ex-situ* conservation of unique germplasm on long-term basis, holds 3,66,933 unique accessions of plant genetic resources. India is also endowed with vast and diverse forms of domesticated animal genetic resources, e.g., cattle, buffalo, sheep, goat, pig, camel, horse, donkey, yak, mithun, duck, goose, quail, etc. Besides, a rich diversity of wild relatives of domesticated animals exists here. The molecular characterization has been undertaken so far only in a few animals such as cattle, sheep, pig and poultry, using internationally recommended DNA markers.

India, endowed with vast inland and marine bioresources, is the third largest producer of fish in the world. A database on 2,182 fishes found in Indian waters has been developed, which includes 327 fresh water species listed in IUCN threat categories and 192 endemic fishes. A macro level fish occurrence map of India has been prepared and DNA barcodes of 100 Indian marine fish species developed.

The country has also initiated isolation and identification of agriculturally important microorganisms following strict quality and bioasfety standards. The repository includes 2,517 cultures of filamentous fungi, bacteria, Actinomycetes and yeasts. The sources of fungi collection include plants, soil, insects, air flora, etc.

Realizing the crucial role of forests in maintaining ecological balance and socio-economic development, the National Forest Policy (NFP) aims at maintaining a minimum of 33% of country's geographical area under forest and tree cover. With over 16 major forest types and 251 subtypes, the total forest and tree cover of the country constitutes 23.39 % of the geographical area with most north-eastern states maintaining more than 75% of the forest cover. Against the prevailing global trend of decreasing forest cover, India has been successful in stabilizing its area under forests over the years.

The mountain ecosystems of India are largely described under two global hot-spots, viz., the Eastern Himalaya, and the Western Ghats and Sri Lanka They contribute prominently in geographic extent, bio-physical and socio-cultural diversity and uniqueness. The extent of species endemism in vascular plants alone ranges from 32 to 40% in the mountain ecosystems. Other groups, such as reptiles, amphibians and fish show more than 50% of species endemism in Western Ghats. Of the 979 bird species recorded from the Himalayan region, four Endemic Bird Areas have been delineated for priority conservation measures and likewise, identification of "Key Biodiversity Areas (KBAs)" has been initiated in Western Ghats. At present, there are 137 Protected Areas (PAs) (47,208 sq km) in the Indian Himalayan Region (IHR) and 88 PAs (13,695 sq km) in Western Ghats. Over the years, there has been a steady progression in the number and area covered under PA network in both the regions. Besides, the multi-ethnic composition within the mountain ecosystems makes it a distinct microcosm of biodiversity. Human interventions, including developmental activities and rampant poverty are leading to change in land use patterns, habitat loss and fragmentation in the IHR. Similarly, in Western Ghats, in the past, selective logging, and conversion to agriculture and cash crop plantations, river valley projects, etc., have contributed to the decline of biodiversity. Of late, mass tourism, unsustainable land use practices, excessive subsistence dependence on forests, etc., are major challenges.

Arid and semi-arid regions spread over ten states, cover 38.80% of India's total geographical area. The cold arid zone located in Trans-Himalayan region covers 5.62% area of the country. The region is stronghold of three cat predators – the lion, leopard and tiger. Of the 140 species of birds known, the Great Indian Bustard is a globally threatened species. The flora of the Indian desert comprise 682 species with over 6% of total plant species as endemics. The cold desert is the home of rare endangered fauna, such as, Asiatic ibex, Tibetan argali, Wild yak, Snow leopard, etc., and the flora is rich in endemic and economically important species. India's Third National Report on the implementation of United Nations Convention to Combat Desertification (UNCCD) indicates that most of arid, semi-arid and dry sub-humid areas of India are either subject to desertification, identified as drought prone, or considered wastelands.

India has a variety of wetland ecosystems ranging from high altitude cold desert wetlands to hot and humid wetlands in coastal zones with its diverse flora and fauna. At present, 115 wetlands have been identified under the National Wetland Conservation Programme (NWCP) and 25 wetlands of international importance under Ramsar Convention. About 4,445 sq.km area of the country is under mangroves. The major threats to wetland ecosystems include uncontrolled siltation, weed infestation, discharge of waste effluents, surface run-off, habitat destruction, encroachment and hydrological perturbations.

With a long coastline and a vast Exclusive Economic Zone (EEZ), India has a very wide range of coastal ecosystems. Such regions are prone to overexploitation of bioresources, poorly planned human settlements, improper location of industries, and pollution from industries and settlements.

India's major strength in *in-situ* conservation lies in its impressive PA network, which currently comprises 661 PAs [National Parks (NPs) (99), Wildlife Sanctuaries (WLSs) (515), Conservation Reserves (ConR) (43) and Community Reserves (ComR) (4), established under the Wildlife (Protection) Act (WPA), 1972] covering approximately 4.80% of the total geographical area of the country. India also has special flagship programmes for the conservation of tiger and elephant. India's PAs grew by 15% since the adoption of the Programme of Work on PAs in 2002.

NBAP: MAINSTREAMING OF BIODIVERSITY CONSIDERATIONS

India is committed to contributing towards achieving three objectives of the Convention on Biological Diversity (CBD), the 2010 target and the Strategic Plan. Strategies and plans for conservation and sustainable use of biological resources based on local knowledge systems and practices are ingrained in Indian ethos and are enshrined in the Constitution of India [Article 48A and Article 51 A(g)] in the form of environment protection. In recent times, the major building blocks of policy frameworks, legislations and action plans that drive the country in achieving all the three objectives of the CBD include, among others, Biological Diversity Act (BDA), 2002, National Wildlife Action Plan (NWAP) (2002-2016), National Environment Policy (NEP) 2006, National Biodiversity Action Plan (NBAP), 2008 and National Action Plan on Climate Change (NAPCC), 2008.

India's strategy for conservation and sustainable utilization of biodiversity evolved from various initiatives framed and formulated largely by the Ministry of Environment and Forests (MoEF), focal point for biodiversity conservation at the Central Government level, appropriately complemented by other related Ministries/Departments and affiliated agencies dealing with Agriculture, Health, Water Resources, Rural Development, Power, Industry, New and Renewable Energy, Urban Development, and Science and Technology.

Pursuant to the CBD, a first major step was the development of National Policy and Macrolevel Action Strategy (1999) that called for consolidating existing biodiversity conservation programmes and initiating new steps in conformity with the spirit of the Convention. This was followed by implementation of a United Nations Development Programme (UNDP)/Global Environment Facility (GEF) sponsored National Biodiversity Strategy and Action Plan (NBSAP) Project (2000-2004) that yielded micro-level action plans adequately integrating crosscutting issues and livelihood security concerns. Besides, a number of policies and plans are relevant to the Convention, such as, National Forest Policy (NFP), 1988 setting goals and guidelines to areas under forests, National Conservation Strategy and Policy Statement on Environment and Development (1992) evaluating the nature and dimensions of environmental problems in India, National Agricultural Policy (2000) seeking to actualize vast untapped growth potential of Indian agriculture, National Seeds Policy (2002) covering plant variety protection and seed production, NWAP emphasizing on peoples' participation in wildlife conservation, comprehensive Marine Fishing Policy (2004) aiming at balancing the development needs of various categories of fishing communities, etc.

The NBAP, based on the evaluation of existing legislations, regulatory systems, implementation mechanisms, existing strategies, plans and programmes, using the final technical report of NBSAP report

as one of the inputs, was prepared by MoEF involving wide consultations with various stakeholders across the country. The NBAP is consistent with the ecological, social, cultural and economic mosaic of the country and its preparation is in pursuance of Article 6 (a) of CBD as well as Section 36 (1) and (3) of BDA, 2002.

The actions proposed in NBAP are comprehensive and in tune with the CBD framework in all its dimensions. Some of the major programmes that contribute to its implementation include: PA network and its steady growth over the years, consolidation of Biosphere Reserves (BRs) (15), establishment of more species specific reserves, growth in designated Ramsar Sites, augmentation of *ex-situ* efforts through the establishment of network of Lead Gardens and initiatives in conservation of genetic resources, etc.

Augmentation of natural resource base, its sustainable utilization and ensuring inter and intra generational equity is being achieved through various mechanisms that include, among others, management and rehabilitation of degraded forests, coastal areas, drylands, etc., replicating good agricultural practices, increasing production in forage, livestock and fish, enhancing mangrove cover for complementing livelihood needs and involvement of Non-Governmental Organizations (NGOs) and community institutions in developing forest villages, watershed models, water harvesting, etc. The extent and magnitude of their involvement, for example, can be gauged by the fact that about 22 m ha of forests is managed by more than 1,06,000 Joint Forest Management Committees (JFMCs).

In accordance with Article 8(h) of the CBD, India duly recognizes the importance of regulating introductions and managing Invasive Alien Species (IAS) because they pose severe threat to biodiversity next only to habitat destruction. In this context, India is proactive, follows international quarantine regulations, is a partner of the Asia Pacific Forest Invasive Species Network, and is implementing strategies to restore mined-out areas and the landscapes weed-free.

India's actions on assessment of vulnerability, and adaptation to climate change and desertification have been manifold ranging from establishment of National Clean Development Mechanism Authority for approving projects on biomass based cogeneration, energy efficiency, municipal solid waste, and above all implementation of the NAPCC. Likewise, the country ensures integration of biodiversity concerns and social development through various instruments and mechanisms, which include, greater participation of community groups in Forest Development Agencies (FDAs), JFMCs, technology dissemination through a network of Krishi Vigyan Kendras and Agricultural Technology Management Agency, and implementation of National Rural Employment Guarantee Scheme (NREGS) that offers a unique opportunity for economic and social enrichment and at the same time guarantee people's participation in environmental conservation.

Augmentation of pollution abatement is being undertaken through initiatives such as Ganga or Yamuna Action Plans, network programme on pesticide degradation, integrated biotechnological approach for bioremediation etc.

Developing and integrating biodiversity databases is a key action that would help to identify gap areas and better understand the potential linkages among various sectors for implementing appropriate actions. Databases and networks for forestry, fisheries, livestock, Environmental Information System (ENVIS), notified and released crop varieties and germplasm, and plant varieties registration have been generated.

In recent years, India has further strengthened implementation mechanisms in policy, legislative and administrative measures for biodiversity conservation and management. In this context, the major initiatives include: i) Entities of Incomparable Value (EIVs), as defined in NEP; ii) Scheduled Tribes and Other

Traditional Forest Dwellers (Recognition of Forest Rights) Act (2006); iii) Wildlife Crime Control Bureau; iv) Integrating biodiversity concerns in environmental impact assessment of development projects under Environmental Impact Assessment (EIA) Notification (2006) and draft Coastal Management Zone (CMZ) Notification (2008); v) promoting best practices by awarding "Plant Genome Savior Community Recognition" to farming communities; vi) creation of National Tiger Conservation Authority (NTCA) (2006); and vii) setting up of National Fisheries Development Board (NFDB) (2006), etc.

Various initiatives to develop national capacities for biodiversity conservation and appropriate use of new technologies have been undertaken at different levels involving wide range of stakeholders. While an All India Coordinated Project on Capacity Building in Taxonomy (AICOPTAX) provided impetus to taxonomic capacity building for lesser known groups of plants, animals and microorganisms, India further intensified research on genetic fingerprinting of captive stock. Regarding capacity building, India made remarkable progress in areas related to: i) forest based micro-enterprises; ii) development of Self Help Groups (SHGs) for synergy of Joint Forest Management (JFM); with other schemes of the Government, iii) biosafety; iv) environmental education and awareness involving over 10,000 organizations, 84,000 eco-clubs and 40,000 schools; v) poultry, bee-keeping, fisheries and other related sectors (participation of 0.5 m youth) and extension activities (for 1.2 m farmers); and vi) forest management, policy and legal issues, international conventions, wildlife management, etc.

India duly recognizes the importance of using economic incentives for biodiversity related decision making processes, and in this direction new schemes and programmes, such as, livestock insurance, welfare of fishermen, bamboo mat manufacture Public Private Partnership (PPP) mode, "Sanjeevani" outlets [alternate system of marketing Non Timber Forest Products (NTFPs)] and formation of women SHGs to promote their participation in JFM have been initiated.

Most of India's policies, plans and programmes relevant to biodiversity conservation and sustainable development, including the actions proposed in the NBAP, manifest sectoral and cross sectoral elements that promote and facilitate mainstreaming of biodiversity considerations. The process of preparation and approval of NBAP itself has contributed in mainstreaming to a large extent, since inter-ministerial and intra-ministerial consultations were essential in this exercise. The NBSAP project activities substantially extended outreach across sectors and a large number of stakeholders including diverse community groups and students contributed substantially in the preparation of micro-level action plans.

India has made significant strides in agriculture to integrate and mainstream biodiversity considerations through a strong back-up of policies (e.g. National Policy for Farmers, 2007), institutions including four National Bureaus and agricultural universities, missions (e.g. National Bamboo Mission), and projects, especially the ones that follow ecosystem approach (such as National Agriculture Innovation Project and Conservation and Management of Pollinators for Sustainable Development). Major achievements include: i) creation of a National Gene Fund for conservation and development of plant genetic resources; ii) establishment of Protection of Plant Varieties and Farmer's Rights Authority (PPV&FR Authority) and granting incentives to farmers in the form of " Plant Genome Savior Community Recognition"; iii) establishment of a multilateral system to facilitate access to plant genetic resources for food and agriculture (PGRFA) through International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA); iv) integration of pest management programmes, and v) promotion of organic farming; and vi) identification of agro-biodiversity heritage sites.

Likewise, in forestry sector, a large number of central sector schemes of the MoEF, such as National Afforestation and Eco-Development Board (NAEB), National Afforestation Programme (NAP), Conservation and Management of Mangroves, Coral Reefs and Wetlands, Gram Van Yojna, Forest Extension and Market Support, Eco Task Forces, Augmentation of Bamboo Resources, Conservation of Medicinal Plants, Integrated Development of Wildlife Habitats, Project Tiger and Project Elephant, etc., have helped in achieving conservation and sustainable development, eco-development of degraded forests, incentivising concerned stakeholders for afforestation, decentralizing JFM activities, ensuring higher levels of protection through the involvement of Panchayati Raj Institutions (PRIs), development of community conservation reserves outside PAs, development of medicinal plants sector, economic valuation of ecosystem services and climate change, inculcating awareness and imparting training to a range of stakeholders including school students, ex-servicemen, farmers, PRIs, extension workers, community groups, etc.

With regard to livestock genetic resources and animal husbandry, India ranks first in respect of buffaloes, second in cattle and goats, and third in sheep population of the world and has substantially enhanced livestock and fish production through various mechanisms, such as, setting up of NFDB, central fodder and poultry development organizations, central sector scheme on fodder development, etc.

Inland water, marine and fishery resources have been effectively mainstreamed through various national plans/programmes on river conservation, lake conservation, wetland conservation, water quality monitoring in water bodies and development of marine fisheries infrastructure and post harvest operations. These initiatives have contributed significantly in preventing pollution from point sources, catchment area treatment and eco-development (in 42 lakes in 12 states), public participation, financial assistance to poor fishermen for sustainable development and also promoting inter-sectoral synergies in conservation efforts among various Ministries.

India's rich wildlife bioresources offer numerous opportunities for ensuring livelihood security and development of wildlife based small enterprises. NWAP duly recognizes the importance of people's support for wildlife conservation and calls for promoting ecotourism that primarily involves and benefits local communities. In this context, successes in implementing community oriented wildlife based tourism in states like Madhya Pradesh, Kerala, Himachal Pradesh, Sikkim, Jammu & Kashmir, Uttarakhand, etc., is noteworthy. Similarly, National Commission on Agriculture, Tribal Co-operative Marketing Development Federation, Girijan Co-operative Corporation in Andhra Pradesh, Adivasi Multipurpose Societies have significantly contributed in promoting and harnessing the economic potential of NTFPs and improvement in the economic status of poor NTFP collectors.

The collection and trade in medicinal plants constitutes a major share of livelihood means for forest dwellers in India. Over one and a half million practitioners of Indian Systems of Medicine and Health (ISM&H) in the oral and codified streams use medicinal plants, animals and mineral products in preventive, promotive and curative applications. Realizing the potential of mainstreaming medicinal plants use following measures have been taken: i) constitution of National Medicinal Plants Board (NMPB) with the aim to bring in much needed coordinaton among different players for development of this sector; ii) as a livelihood strategy, development of 13 community owned enterprises for value addition and marketing of medicinal plants in seven states; iii) constitution of State Medicinal Plants Boards (SMPBs); and iv) creation of market opportunities with appropriate fiscal and policy support.

A multidisciplinary, holistic and integrated institutional mechanism is in place to address the elements of mainstreaming biodiversity concerns at various levels of governance, including at the state level. These include relevant departments in the states such as forest, agriculture, horticulture, irrigation, science and technology, and various specialized national and state level institutions, which predominantly deal with biodiversity issues.

As economic incentives play an important role in sectoral and cross-sectoral integration of biodiversity, efforts are being made to ensure that various sectors and schemes receive adequate attention as is evident from the 11th Five Year Plan (2007-08 to 2011-12) provisioning for the MoEF and other Central Ministries, States and Union Territories (UTs), which is steadily increasing over the years. Financial assistance is provided to State Governments and UTs to rehabilitate degraded forest areas, and to provide alternate livelihoods. India is committed to ensuring sustainability of the PA network, as envisaged in the NWAP, which lays emphasis on enhancing financial allocations integrating the action plan with other sectoral plans. Budgetary allocation is also made for several cross-cutting national priority programmes.

Other forms of incentives include conferment of awards and fellowships in recognition of significant contribution to the protection of biodiversity. Some examples are: Indira Gandhi Paryavaran Puruskar, Pitamber Pant National Environmental Fellowship, Amrita Devi Bishnoi Wildlife Protection Award, Rajiv Gandhi Wildlife Conservation Award, Janaki Ammal National Award on Plant/Animal Taxonomy, etc.

Relevant policies, legislations and institutional framework and the implementation mechanisms offer much needed enabling environment for facilitating cross-sectoral integration of biodiversity considerations into economic sectors and development models. The recent major initiatives in this context are: i) NEP, that seeks to achieve balance between conservation and development by mainstreaming environmental concerns in all developmental activities, is one of the landmark policy initiatives of the Government of India (GOI); ii) NAPCC which addresses concerns of the country through eight envisaged national missions, of which four, namely, national missions on water, sustainable agriculture, sustaining Himalayan ecosystems, and Green India, are directly relevant to the CBD; iii) EIA Notification 2006 that adopts progressive measures to make environmental clearance a democratic and accommodative process, and comprehensively factors in biodiversity concerns; iv) draft CMZ Notification 2008, that while addressing protection and sustainable development of the coastal stretches and marine environment, designates ecologically sensitive areas for intensive conservation and management; and v) enactment of the BDA (2002), Biological Diversity Rules (2004) and National Biodiversity Authority (NBA), established in 2003, aim at safeguarding the biodiversity and regulating access to biological resources and associated traditional knowledge to ensure sharing of benefits. Besides, a strong policy framework is also available in the form of NFP (1988), National Agriculture Policy (2000) and National Water Policy (2002), etc. The MoEF has notified the "Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/ Genetically Engineered Organisms or Cells 1989" under the Environment (Protection) Act (EPA) 1986.

India's capacity building initiatives that have made significant impact in coordination within and among different sectors, build skills to promote bilateral and multilateral trade agreements, and strengthened framework of decision making processes include: i) strengthening of institutional and legal framework to improve capacity and coordination in decision making within and across Ministries; ii) improved capacity for risk evaluation and management; iii) strengthening of laboratories for analytical detection of

Living Modified Organisms (LMOs); iv) Biosafety Clearing House (BCH) and enhanced information sharing and public awareness; v) specialized training on spatial referencing of monitoring of illegal killing of elephants; vi) creation of synergy between commerce and industry; vii) standardization of applied rates and import duties of forestry products; viii) collaborative training programmes on wetland conservation; ix) training in plant and animal biosystematics; x) promotion of linkages between NAP with other developmental programmes to ensure sustainability of JFM; and xi) extensive training and awareness initiatives through National Green Corps (NGC) and National Environment Awareness Campaign (NEAC), etc.

Major capacity building programmes organized through specialized institutions and centres of excellence include: i) advanced forest management and policy and legal issues at Indira Gandhi National Forest Academy (IGNFA); ii) diploma and vocational courses for Human Resource Development (HRD) needs of wood industry, post-graduate programme in forestry management at Indian Plywood Industries Research and Training Institute (IPIRTI); iii) post-graduate diploma course in wildlife management at Wildlife Institute of India (WII)); iv) post-graduate diploma in forest management at Indian Institute of Forest Management (IIFM); v) mountain specific rural technologies for rural communities and conservation science to students and teachers at G. B. Pant Institute of Himalayan Environment and Development (GBPIHED); vi) taxonomy of plants and animals (BSI and ZSI); vii) collaborative programmes on environmental education and awareness [Centre for Environmental Education (CEE)]; and vii) green school initiatives and publications on sacred animals, water bodies, etc., at CPR Environmental Education Centre (CPREEC). Besides, ENVIS, a comprehensive network of environmental information and dissemination with 76 network partners for variety of users is making a huge difference in India's outreach and mainstreaming. Likewise, Information Facilitation Counter (IFC) of the Ministry updates the database on NGOs working on environment problems and provides a unique interface between the Government and civil society.

Presently, various cross-cutting initiatives of Department of Agriculture and Cooperation, Ministry of Agriculture (MOA) provide appropriate environment for sectoral and cross-sectoral integration of land use. These among others, include: i) scheme on macro management of agriculture being implemented in states through State Land Use Board; ii) scheme on All India Soil and Land Use Survey; iii) preparation of land use policies and perspective plan for optimum utilization of land resources through National Land Use and Conservation Board; iv) Watershed Development Project in Shifting Cultivation Areas of Northeastern States, etc.

In India, research and technology upgradation and diversification across sectors is proving immensely valuable in addressing and promoting cross-sectoral integration of biodiversity related issues. This is achieved through various interdisciplinary programmes/projects of various Ministries, departments, institutions and collaborative mechanisms. Some major initiatives in this direction are: i) green channel project to seek public support on conservation of endangered species [Department of Science and Technoogy (DST)]; ii) scientific methodology evolved and mainstreamed for estimating tiger population; iii) new projects on snow and glaciers, mapping of WLSs, NPs, coastal areas, wetlands, etc., through National Natural Resource Management System (NNRMS); iv) Eco-development Forces (EDF) scheme implemented through the Ministry of Defence (MoD) for ecological restoration of difficult and degraded terrains; v) seven regional centres of the NAEB promote sustainability of JFM beyond NAP scheme; vi) setting up of demonstration units for bamboo mat manufacture in Public Private Partnership (PPP) mode; vii) design of solar heated kiln developed and standardized for accelerated seasoning; viii) evaluation of

butterfly communities as bioindicators in Western Ghats; ix) adaptation and tolerance of birds to urbanization; x) monitoring of climate change and forest sector in India; xi) wide range of technology development in medicinal plants sector; xii) super speciality services and diagnostic facilities for better healthcare of wild animals; xiii) digital inventorization of bioresources covering medicinal and other economically important plants, animals, marine and microbial resources; xiv) All India coordinated research project on prospecting of food grade natural dyes from bioresources; xv) All India coordinated research project on development of environment friendly pesticides; xvi) promoting use of bioinformatics for plant diversity databases; xvii) monitoring of genetic variation through DNA fingerprinting, establishment of cell and gene banks, development of assisted reproductive technologies, etc., through internationally acclaimed inter-ministerial and inter-departmental project on Laboratory for Conservation of Species (LaCONES); xviii) a major initiative to tap bio-resources and bio-molecules through a path breaking programme involving 20 laboratories of the Council of Scientific & Industrial Research (CSIR), 13 universities and institutes of traditional medicine, under which 23,000 samples have been screened and 4 potential bio-active molecules identified; xix) Traditional Knowledge Digital Library (TKDL), a collaborative project of CSIR, Ministry of Science and Technology, and the Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry of Health and Family Welfare (MoHFW) documents traditional knowledge on Ayurveda, Unani, Siddha and Yoga available in public domain in digitized format; and xx) the strategy and implementation plan of Science and Technology Policy (2003) that emphasises technology development, transfer, diffusion and promotion of innovation.

Participation of diverse stakeholders is critical for promoting integration and mainstreaming of biodiversity considerations. In this context, a large number of NGOs have been making significant contribution and playing a pivotal role as an interface between the Government and community groups. Their contribution has helped a great deal in taking forward the three main objectives of the CBD.

India has all along shown deep commitment for biodiversity conservation and sustainable development and has responded effectively to relevant international treaties and conventions. Partnerships and cooperation in different sectors have further strengthened and consolidated India's efforts in cross-sectoral integration of biodiversity considerations. Among others, the sectors and programmes include: i) plant, animal, human and microbial genomics (joint centres in biotechnology with France, Germany, Indo-ASEAN Institute of Biotechnology, Indo-ASEAN Biotechnology Network); ii) International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi (an autonomous UN organization); iii) cooperation with Consultative Group on International Agricultural Research (CGIAR) centres for development of high quality seed material of some crops; iv) partnership building through FDAs and JFMCs, partnerships with industries; v) CSIR Strategic Alliances; vi) new initiatives in agriculture sector to promote agriculture research and education through collaboration with a large number of countries; vii) promoting investment in coastal ecosystem conservation with IUCN; viii) wildlife protection and care with USA; and ix) collaboration with GEF through wide ranging twelve on-going projects.

Other major cross-sectoral initiatives include: i) a flagship NREGS (2005), implemented through coordinated efforts of various Ministries [Ministry of Rural Development (MoRD), MoEF, MoA, MoHFW, Ministry of Water Resources (MoWR), Ministery of Power (MoP), augments wage employment (33% participation for women)] through different activities, such as, natural resource management, afforestation, flood protection, water harvesting, etc.; ii) environmental education in schools and colleges that includes modules on biodiversity conservation implemented by education department through Centre and State Education Boards; iii) documenting grassroots green innovation through 'Honey Bee Network', value addition and dissemination supported by DST and National Innovation Foundation; and iv) development

of bioprocesses and bioproducts, technology upgradation and transfer through DST, State and local institutions.

In keeping with India's robust democratic institutional framework and mechanisms, the Indian judiciary plays a facilitative role in implementing programmes and commitments relating to conservation of biological diversity. This owes its origin to the advent of public interest litigation in India. Towards this end, the courts have elaborated and interpreted various extant provisions of domestic legislations on biodiversity.

ACHIEVING 2010 TARGET : A SYNOPSIS

India, with a strong commitment to contribute towards achieving the 2010 target is making concerted efforts to significantly reduce the current rate of biodiversity loss. It has broadly followed the framework of goals and targets that are in conformity with those adopted by the CBD. Realizing its priorities and specific needs, however, India has come up with policy framework, legislation, strategies and action plans which define national goals and targets. NEP 2006, seeks to achieve balance between conservation and development by mainstreaming environmental concerns in all developmental activities. Subsequent to the approval of NEP, preparation of NBAP was taken up by revising the National Policy and Macro level Action Strategy on Biodiversity, 1999, and using the NBSAP project report as one of the inputs, so that it is in consonance with NEP. More recently, with the development of NAPCC (2008), India has responded to issues of concern relating to climate change. NAPCC has outlined a number of steps to simultaneously advance development paradigms and climate change-related objectives of adaptation and mitigation. Eight national missions form the core of the NAPCC and represent multipronged, long-term and integrated strategies for achieving key goals. Pursuant to the CBD objectives, India enacted the BDA in 2002 following a widespread consultative process over a period of eight years. The Act gives effect to the provisions of the CBD. It also addresses access to biological resources and associated traditional knowledge to ensure equitable sharing of benefits arising out of their use to the country and its people, thereby contributing to achieving the third objective of the CBD. India is one of the first few countries to have enacted such legislation. In this context, NBA has been set up in 2003. Efforts are being made to strengthen the implementation of this Act, including through capacity building of the institutional structures under a United Nations Environment Programme (UNEP)/GEF project.

India has taken a wide range of measures to achieve 2010 target. Some examples include: (i) holistic community-based sustainable forestry programmes such as JFM is now operational on more than 17 million ha of land spread all over the country; (ii) National Bureau of Plant Genetic Resources (NBPGR) that has been engaged in documenting a large number of varieties of crop plants in the country, and National Bureau of Agriculturally Important Microorganisms (NBAIM) which is acting as a nodal centre for the acquisition and management of indigenous and exotic microbial genetic resources for improved utilization in food and agriculture; (iii) the Tiger Project that now incorporates 37 tiger reserves in seventeen states; (iv) 38 mangrove areas identified for intensive conservation and management; (v) Project Elephant which helps in ensuring long-term survival of identified viable elephant populations in their natural habitats and presently India has 26 such reserves; (vi) development of TKDL, an easily navigable computerized database of documented information available in published texts of Indian systems of medicine, with the objective of preventing the grant of patents on non-original invention; and vii) the National Policy on Farmers (2007) which contributes to protect and improve land, water, biodiversity

and genetic resources essential for sustained increase in productivity, profitability and stability of major farming systems by creating an economic stake in conservation.

Likewise, initiatives in PAs include an innovative strategy, as envisaged in NEP, 2006, to increase forest cover from 23% to 33% of the national territory by 2012 and the goal to establish 163 NPs and 707 WLs ensuring appropriate representation across all ecosystems. The monitoring committee of the NWAP periodically monitors the status of establishment and management of PAs.

For ensuring Access and Benefit Sharing (ABS), India has taken significant legislative measures. BDA that *inter alia* provides for 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 provision of the CBD. The PPV&FR Act, 2001 and the PPV&FR Rules 2003, provide measures to protect plant breeder's rights over new varieties developed by them and the entitlement of farmers to register new varieties and also to save, breed, use, exchange, share or sell the plant varieties, which the latter have developed, improved and maintained over many generations. The Patent Second Amendment Act 2002 and Patent Third Amendment Act 2005, provide for: exclusion of plants and animals from the purview of patentability (Section 4e); exclusion of an invention which in effect is traditional knowledge from patentability (Section 4p); mandatory disclosure of the source and geographical origin of the biological material in the specification when used in an invention (Section 8d); and provision for opposition to grant of patent or revocation of patent in case of non-disclosure or wrongful disclosure of the source of biological material and any associated knowledge.

Initiatives relevant to Article 8(j) of the CBD include: i) involvement of several institutions and organizations in field studies on the status, trends and threats related to the Knowledge, Innovations and Practices of indigenous and local communities; ii) TKDL – a digital database developed by the Government for preservation of traditional knowledge; prevention of misappropriation of traditional knowledge, and creation of linkages with modern science to initiate active research projects for new drug discovery and development; and iii) documentation of local health traditions and preparation of community health knowledge register in 10 States that have been deposited with the community and local administration.

A brief synopsis of the main activities undertaken by India corresponding to the 11 goals of the 2010 target is given below.

Goal 1: Promote the conservation of biological diversity of ecosystems, habitats and biomes

i) Setting a target of achieving 33% forest and tree cover by 2012 (at present 23.39%); ii) Scheme on NPs and WLSs modified to cover wildlife habitats outside PAs; iii) Protection of sacred groves; iv) Conservation of entities of incomparable value – draft notification issued; v) Biodiversity heritage sites identified; vi) Increase in coverage of PAs (661 numbers covering 4.8% geographical area of the country); vii) Conservation of mangroves and coral reefs; viii) 15 BRs set up, four with international recognition and 15 more potential sites identified; and x) regulatory regime for conservation of wetlands under finalization.

Goal 2: Promote conservation of species diversity

i) Revised NWAP; ii) NTCA set up; iii) Species-specific conservation programme undertaken, and sanctuaries for orchids, banana, rhododendron, citrus set up; iv) Reintroduction of threatened

species into their natural habitats, e.g., mass propagation of pitcher plant, rehabilitation of mangroves, relocation of rhinoceros; v) propagation protocols for regeneration, and promotion of cultivation for conservation of threatened species, LaCONES established at Hyderabad; vi) Wildlife Crime Control Bureau (WCCB) set up; vii) Taxonomy capacity building project; viii) Assistance to botanic gardens for conservation of endemic and endangered species; and ix) Sea-ranching of threatened marine species.

Goal 3: Promote the conservation of genetic diversity

i) National gene banks for plants, animals, fish and agriculturally important micro-organisms; ii) Community gene banks by NGOs and others; iii) Research and on-farm conservation initiatives specifically with regard to medicinal plants.

Goal 4: Promote sustainable use and consumption

i) Sustainable use ingrained in Indian ethos; ii) Sustainable use integrated into national decision making through policy statements (NEP, NFP, WLAP, NBAP), laws (EPA, WLPA, BDA, Notification on CRZ, CMZ, EIA, eco-sensitive areas), and programmes (JFM, NAEB, project on household food and nutritional security; iii) All India coordinated research project on under-utilised and under exploited plants; iv) Honey bee network to protect and encourage customary use that has over 10,000 examples of customary innovations of use of traditional knowledge in sustainable management; and v) As Party to the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), international trade of endangered wild species prohibited.

Goal 5: Pressures from habitat loss, degradation reduced

i) Participatory and sustainable management of degraded forest areas promoted with the help of NGOs, PRIs, etc., through programmes of the NAEB; ii) Hill area development programme promotes community participation to improve their livelihoods through sustainable use; iii) Some public and private sector initiatives include reclamation and afforestation of mined-out areas by native species

Goal 6: Control threats from invasive alien species

i) Phytosanitory certificates for export, and permits for import of germplasm required under Plant Quarantine Order 2003 and Destructive Insects and Pests (DIP) Act, 1914; ii) Health certificates for livestock to be exported required under Livestock Importation Act, 1898; iii) Licenses required for export of living organism by Director General of Foreign Trade (DGFT); iv) Quarantine certificates required for export of wild animals/articles under WLP Act; v) New scheme on integrated forest protection to cover IAS; vi) Forest Invasive Species Cell set up; and vii) Implementation of LMO regulations in ballast water exchanges in practice in all major ports.

Goal 7: Address challenges to biodiversity from climate change

i) NAPCC launched in 2008 under which eight national missions set up for multi-pronged, long term and integrated strategies; ii) Challenges from pollution addressed through legislative framework contained in EPA, 1986, Water (Prevention and Control of Pollution) Act, 1974, Water Cess Act, 1977, and Air (Prevention and Control of Pollution) Act, 1981; iii) India has identified five

potential trans-boundary PAs along India's borders with Bhutan, Bangladesh and Nepal; and iv) Signatory to Antarctica Treaty – committed to conserve the resources of southern ocean.

Goal 8: Maintain capacity of ecosystems to deliver goods and services and support livelihoods

i) Participation of communities for forest conservation through 1,06,000 JFMCs covering 22.02 mha of forest area; and ii) Substantial increase in coverage area for promoting livelihood opportunities.

Goal 9: Protect traditional knowledge, innovations and practices

i) Documentation of traditional knowledge (TKDL, PBRs, etc.); ii) Two new categories of PAs: Community and Conservation Reserves – 45 set up so far; and iii) Setting up of Biodiversity Management Committees (BMCs) for chronicling of knowledge under BDA.

Goal 10: Ensure fair and equitable sharing of benefits arising out of the use of genetic resources

i) Enactment and implementation of BDA 2002, ii) Amendments to the Patent Act, 1970; iii) PPV&FR Act, 2001; iv) Geographical indications Act, 1999 and v) Contribution to ABS negotiations.

Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention

i) NEP, 2006; ii) NBAP, 2008; iii) Hosting of CBD meetings; iv) Celebration of the International Day for Biological Diversity (IDB); v) 12 projects on biodiversity for accessing GEF funds; and vi) Programmes and courses on specialized biodiversity research.

As can be seen from the foregoing, India's contribution in addressing the envisaged goals, as detailed in Chapter IV of this Report, has been commendable.

The overall performance in successfully implementing policies and programmes is determined, to a large extent, by the involvement and participation of the community groups at the grass root level. In this context, community efforts to effectively minimize the loss of biodiversity and at the same time augment the resource base for securing livelihood options has been the hallmark of India's initiatives. Some examples include: protection of 1800 hectares of forests by Mendha (Lekha) village in Maharashtra, by Gond tribal community; regeneration and protection of 600-700 hectares of forests, and revival of several hundred varieties of agricultural crops, by Jardhargaon village in Uttarakhand state; protection of sea turtle eggs, hatchlings, and the nesting sites by a fisherfolk community and an NGO in Kolavipalam, Kerala; traditional conservation of painted stork and globally threatened spot-billed pelican nesting sites by the residents of Kokkare Bellur village, Karnataka; community-based monitoring and enterprise by the Soliga tribals at the Biligiri Rangaswamy temple sanctuary, Karnataka; and community forestry initiatives in several thousand villages of Orissa, etc.

While the foregoing account reflects the progress made by the country to achieve 2010 target, it is imperative to highlight major gap areas and future course of action so as to keep pace and capitalize on the positive trends achieved so far. The areas that need urgent attention of all concerned stakeholders in the Indian context are as follows: i) Integrated database development at all organizational and

management levels to effectively utilize the datasets as one of the important tools for decision support systems and establishment of national information system; ii) Skill development at all levels, especially the ones related to new biotechnologies, benefit sharing mechanisms, contemporary tools in monitoring biodiversity biosafety protocol procedures, and sets of methodologies for evaluating ecosystem services; iii) Encouraging and providing adequate incentives to younger generation of scientists who are willing to take up taxonomy related research; iv) Monitoring and assessing biodiversity of representative landscapes need to be taken up as long–term continuous processes for robust scenario building and effective response; v) Biodiversity conservation based research projects and programmes should factor in climate change parameters at the concept through implementation, vi) Development of tools, methodologies and models to assess desertification and climate change induced processes; vii) Development of a national action plan on control of IAS that takes into consideration the importance of building early warning and rapid assessments; viii) PPSs committed to respond to national and CBD goals, and targets; ix) Development of functional land use planning system to promote sustainability issues; x) Special incentives for promoting sustainable and rational utilization of NTFP resources including medicinal plants; xi) Sustained research and development (R&D) efforts to focus on underground biodiversity, genetic diversity, diversity of lower plants, functional attributes of macro and micro-habitats; xii) Paucity of organizations especially those with interdisciplinary skills and expertise; xiii) Efforts to substantially increase international collaborations for exchange visits, information flow and quantum of funding; and xiv) Development of innovative awareness approaches in biodiversity conservation focusing on the importance of mainstreaming.

The overall progress on all the three objectives of the Convention has been commendable considering the analysis of the achievements made over the last decade. India's commitment to further strengthen efforts to achieve 2010 target is best summed up by the major recommendations of XI Five Year Plan (2007-2012) document that calls upon all concerned stakeholders to effectively integrate environment considerations into policy making in all sectors of economy, augment species recovery and conservation programmes for endangered species/ecosystems, universalize JFM, integrate coastal and marine environments with human well being, coordinate programmes for combating desertification, and need for delineating more PAs for conservation of coral reefs.

CHAPTER 1

OVERVIEW OF BIODIVERSITY : STATUS, TRENDS AND THREATS

1.1 INTRODUCTION

Biodiversity, encompassing variety and variability of all life on earth, is the product of over 3.5 billion years of evolutionary history. Biodiversity benefits human societies in a myriad of ways by providing wide range of ecological, economic, social, cultural, educational, scientific and aesthetic services. Extensive anthropogenic interventions in the natural ecosystems in recent times have been resulting in loss of biodiversity.

The CBD is the most comprehensive international agreement that addresses all aspects of biodiversity in a holistic manner. The CBD was adopted during the Earth Summit in Rio de Janeiro in 1992, and has 191 countries as Parties. Reaffirming sovereign rights of nations over their biological resources, the Convention has set three main objectives: (i) conservation of biological diversity; (ii) sustainable use of its components; and (iii) fair and equitable sharing of benefits arising out of the use of genetic resources. India signed the Convention on 5th June 1992 and ratified it on 18th February 1994. The country is committed to achieve the goals of the Convention.

Conservation and sustainable use of biodiversity have been an integral part of Indian ethos. It is amply reflected in our ancient religious scriptures, and in the continuing practices of respect for nature and natural resources such as mountains, rivers, forests, plants and animals. The vast array of Community Conserved Areas (CCAs), encompassing diverse ecosystems, is a testimony to this tradition. Formal laws, policies and programs for conservation and sustainable use of biodiversity date back to several decades. Further, over the years, India has also developed a robust institutional structure and a strong legal and policy framework for the conservation of biodiversity. Keeping in view the needs and national priorities and in conformity with the commitments to the CBD, India is making significant progress towards achieving the 2010 target.

India, with an area of 329 mha, is the seventh largest country in the world. The varied eco-climatic conditions coupled with unique geological and cultural features have contributed to an astounding diversity of habitats, which harbour and sustain immense biological diversity at all levels. With only 2.4% of world's land area, India accounts for 7-8% of recorded species of the world. While the profile and conservation measures undertaken by India in compliance with the provisions of the CBD have been well documented in the previous three National Reports to the CBD, this chapter of the Fourth National Report (FNR) attempts to capture the current status, trends and challenges to India's biodiversity.

1.1.1 India – Biogeographically diverse landscape

India is situated north of the equator between 66°E to 98°E and 8°N to 36°N. It is bordered by Nepal, China and Bhutan in the north; Bangladesh and Myanmar in the east; the Bay of Bengal in the south east; the Indian Ocean in the south; the Arabian Sea in the west; and Pakistan in the north-west.

The varied edaphic, climatic and topographic conditions have resulted in a wide range of ecosystems and habitats such as forests, grasslands, wetlands, coastal and marine ecosystems, and deserts. The mountainous region covers an area close to 100 mha, arid and semi-arid zones are spread over 30 mha and the coastline is about 8000 km long.

India represents: (i) Two 'Realms'- the Himalayan region represented by Palearctic Realm and the rest of the sub-continent represented by Malayan Realm; (ii) Five Biomes e.g. Tropical Humid Forests; Tropical Dry Deciduous Forests (including Monsoon Forests); Warm Deserts and Semi-deserts; Coniferous Forests; Alpine Meadows; and (iii) Ten biogeographic zones and Twenty-seven biogeographic provinces **(Fig. 1.1**; **Table 1.1)**.

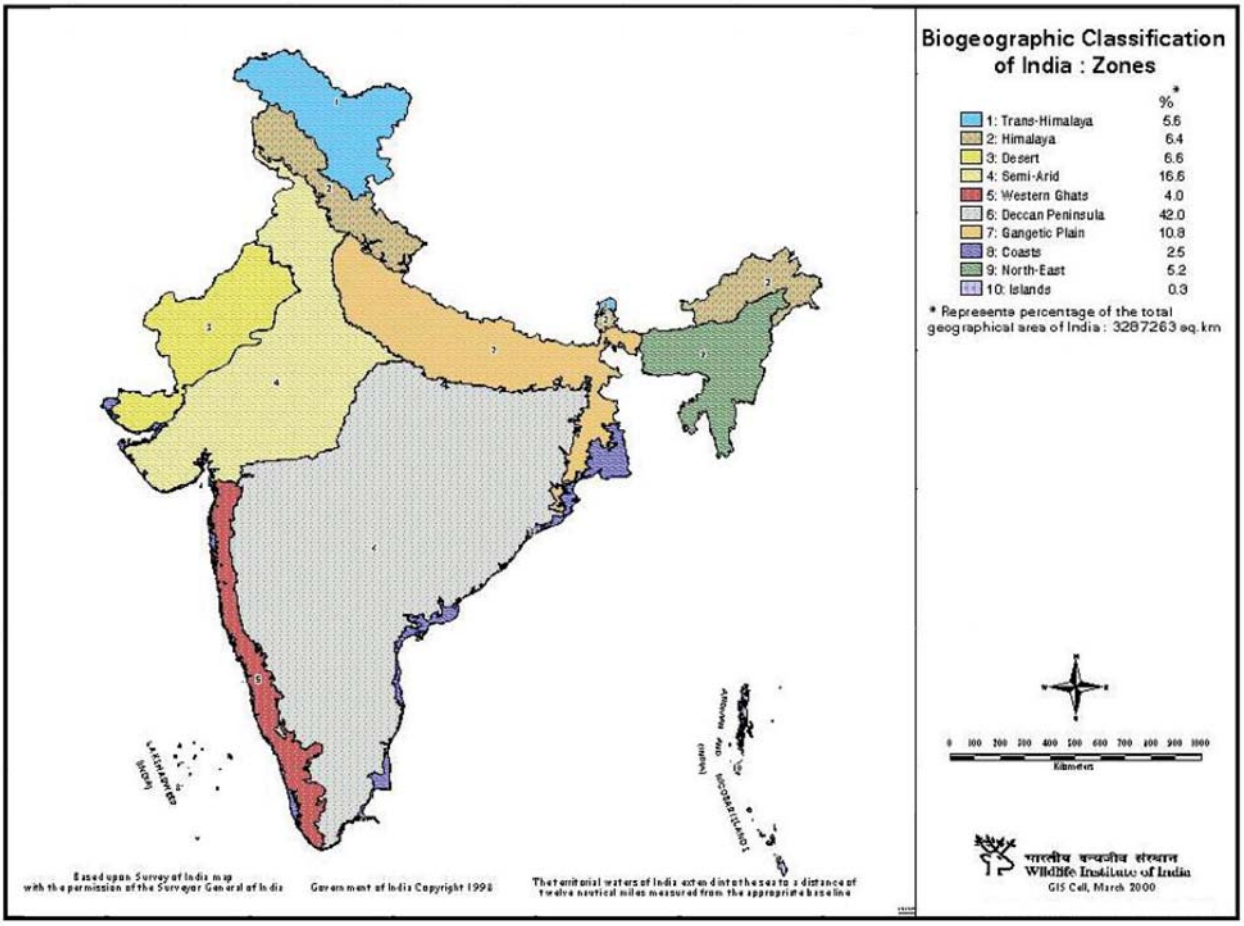


Figure: 1.1 Biogeographic zones in India
Source: Rodgers and Panwar, 1988

Table 1.1: Biogeographic zones of India

S.N.	Biogeographic Zones	Biogeographic Provinces	% of geographical area of India
1.	Trans Himalaya	1A: Himalaya - Ladakh Mountains	3.3
		1B: Himalaya -Tibetan Plateau	2.2
		1C: Trans - Himalaya Sikkim	<0.1
2.	The Himalaya	2A: Himalaya - North West Himalaya	2.1
		2B: Himalaya - West Himalaya	1.6
		2C: Himalaya - Central Himalaya	0.2
		2D: Himalaya - East Himalaya	2.5
3.	The Indian Desert	3A: Desert – Thar	5.4
		3B: Desert – Katchchh	1.1
4.	The Semi Arid	4A: Semi - Arid - Punjab Plains	3.7
		4B: Semi - Arid - Gujarat Rajputana	12.9
5.	The Western Ghats	5A: Western Ghats - Malabar Plains	2.0
		5B: Western Ghats -Western Ghats Mountains	2.0
6.	The Deccan Peninsula	6A: Deccan Peninsular - Central Highlands	7.3
		6B: Deccan Peninsular - Chotta Nagpur	5.4
		6C: Deccan Peninsular - Eastern Highlands	6.3
		6D: Deccan Peninsular - Central Plateau	12.5
		6E: Deccan Peninsular - Deccan South	10.4
7.	The Gangetic Plains	7A: Gangetic Plain - Upper Gangetic Plains	6.3
		7B: Gangetic Plain - Lower Gangetic Plains	4.5
8.	The Coasts	8A: Coasts - West Coast	0.6
		8B: Coasts - East Coast	1.9
		8C: Coasts – Lakshdweep	<0.1
9.	Northeast India	9A: North - East - Brahamputra Valley	2.0
		9B: North - East – North East Hills	3.2
10.	Islands	10A: Islands – Andamans	0.2
		10B: Islands – Nicobars	0.1

Source: Wildlife Institute of India, 2009

1.1.2 India - A megadiverse country

Taking into consideration the three different kinds of priority setting concepts across the globe: the megadiversity country, threatened biodiversity hotspots, and major tropical wilderness areas (Mittermeier et al., 2001), India is one of the recognized megadiverse countries of the world. Comparative account of India's position on species diversity shows that it is well placed in several groups as shown in **Table 1.2**.

In terms of species richness, India ranks seventh in mammals, ninth in birds and fifth in reptiles. In terms of endemism of vertebrate groups, India's position is tenth in birds with 69 species, fifth in reptiles

with 156 species and seventh in amphibians with 110 species. India's share of crops is 44% as compared to the world average of 11%. India also has 23.39% of its geographical area under forest and tree cover.

Table 1.2: Comparative position of species biodiversity in India

Group	Estimated number of species	Rank amongst Megadiverse countries
Higher plants	18664	IX
Mammals	390	VII
Birds	458	IX
Reptiles	521	V
Amphibian	231	IX
Fishes	5749	I

Source: Based on Arora & Ahuja 2006 (original source: http://earthtrends.wri.org)

Of the 34 globally identified biodiversity hotspots, India harbours four hotspots, i.e., Himalaya, Indo-Burma, Western Ghats and Sri Lanka and Sundaland. The main attributes of these hotspots are given in **Table 1.3**.

Table 1.3: Attributes of Indian biodiversity hotspots

S. No.	Attributes	Hotspots			
		Himalaya	Indo-Burma	W. Ghats & Sri Lanka	Sundaland
1.	Hotspot original extent (km^2)	741,706	2,373,057	189,611	1501,063
2.	Hotspot vegetation remaining (km^2)	185,427	118,653	43,611	10,0571
3.	Endemic plant species	3,160	7000	3,049	15,000
4.	Endemic threatened birds	8	18	10	43
5.	Endemic threatened mammals	4	25	14	60
6..	Endemic threatened amphibians	4	35	87	59
7.	Extinct species*	0	1	20	4
8.	Human population density (people/km^2)	123	134	261	153
9.	Area protected (km^2)	112,578	235,758	26,130	179,723
10.	Area protected (km^2) in categories I-IV**	77,739	132,283	21,259	77,408

**Recorded extinction since 1500., **Categories I-IV afford higher levels of protection*
Source: www.biodiversityhotspots.org

1.2 INDIA'S BIODIVERSITY PROFILE

1.2.1 Faunal diversity

So far, nearly 91,212 faunal species (7.43% of the world's faunal species) have been recorded in the country. Whereas inventories of mammals, birds, reptiles, amphibians and fishes are fairly complete, a large number of other life forms are yet to be described. Diversity of known faunal species in different taxonomic groups is given in **Table 1.4**.

The Indian faunal groups show diverse range of endemism across groups **(Table 1.5)**. Some of the lower groups such as Mesozoa (100%), Acanthocephala (88.6%), Oligochaeta (77.8%), Platyhelminthes (71.9%), Kinorhyncha (70%) show high degree of endemism. Among higher groups, Amphibia (61.2%) and Reptilia (47%) deserve special mention.

As per the IUCN Red List (2008), India has 413 globally threatened faunal species, which is approximately 4.9% of the world's total number of threatened faunal species **(Figures 1.2** and **1.3)**.

Table 1.4: Estimated faunal diversity in India

Taxonomic group	No. of species World	No. of species India	% in India
PROTISTA (Protozoa)	**31250**	**2577**	**8.24**
ANIMALIA			
Mesozoa	71	10	14.08
Porifera	4562	500	10.70
Cnidaria	9916	842	8.49
Ctenphora	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
Nematophora	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
Onycophora	100	1	1.0
Arthropoda	**987949**	**68389**	**6.90**
Crustacea	35534	2934	8.26
Insecta	867391	61151	6.90
Arachnida	73440	5818	7.90
Pyconogonida	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	4000	200	5.00
Entoprocta	60	10	16.66
Brachiopoda	30	3	1.00
Pogonophora	80	-	-
Pariapulida	8	-	-
Pentastomida	70	-	-
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	248	4.80
Reptilia	5817	460	7.91
Aves	9026	1232	13.66
Mammalia	4629	397	8.58
Total(Animalia)	**1196903**	**88391**	**7.25**
Grand Total (Protista+ Animalia)	**1228103**	**91212**	**7.43**

Source: National Biodiversity Action Plan, 2008

Table 1.5: Percentage endemism in Indian faunal groups

Group	Percentage Endemism
Protozoa	
Free living	7.21
Parasitic	41.33
Mesozoa	100.00
Porifera	
Freshwater	41.93
Cnidaria	-
Platyhelminthes	71.88
Rotifera	7.00
Gastrotricha	64.00
Kinorhyncha	70.00
Nematoda	-
Acanthocephala	88.64
Mollusca	
Terrestrial	33.50
Freshwater	41.80
Echiura	28.00
Annelida	28.00
Oligochaeta	77.80
Hirundinea	42.37
Arthropoda	
Crustacea	17.07
Insecta	34.90
Arachnida	45.08
Phoronida	1.00
Bryozoa	-
Entoprocta	1.00
Chaetognatha	2.70
Chordata	
Pisces	8.75
Ambhibia	61.24
Reptilia	47.00
Aves	14.28
Mammalia	9.23

Source: Alfred, J. R. B. (2006). *In: Verma, D.D., Arora, S. and Rai, R.K. (Eds.), Perspectives on Biodiversity: A Vision for Megadiverse, Countries; New Delhi. pp 272-293*

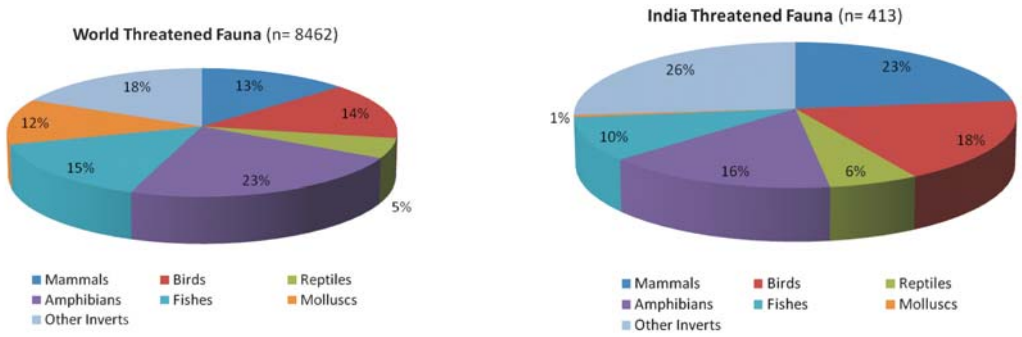


Figure 1.2: Representation of globally threatened Indian fauna

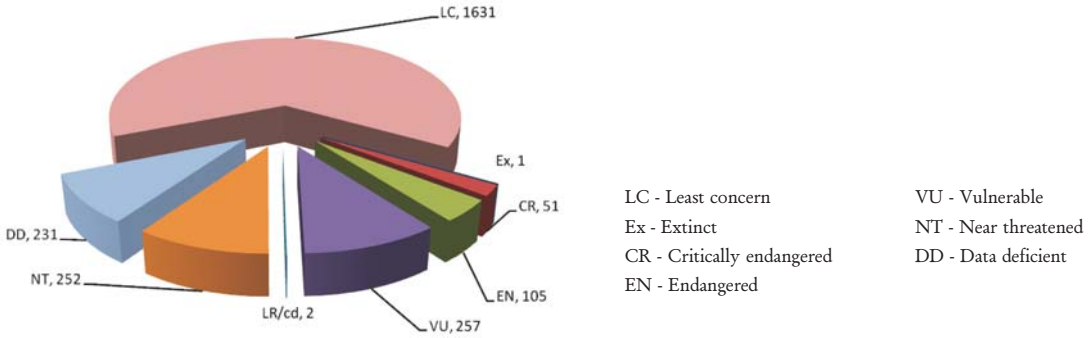


Figure 1.3: Representation of evaluated Indian fauna (n=2530) under IUCN threat categories

The number of threatened faunal species in different categories which are listed in the WPA and the Appendices of CITES, and Convention on Migratory Species (CMS) are given in **Table 1.6**.

Table 1.6: Threatened Indian species listed in WPA and appendices of CITES and CMS

Group	Schedules of IWPA					Appendices of CITES			Appendices of CMS		
	I	II	III	IV	V	I	II	III	I	I/II	II
Mammals	16	6	1	-	-	56	31	5	4	4	10
Birds	10	-	-	23	-	87	55	5	4	18	-
Reptiles	10	-	-	1	-	10	8	-	1	4	-
Amphibia	18	11	-	28	-	-	-	-	-	-	-
Pisces	-	2	-	-	-	-	3	-	-	-	-
Crustacea	-	-	-	-	-	-	-	-	-	-	-
Mollusca	3	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	-	-	-	-	-
Lepidoptera	-	-	-	-	-	-	-	-	-	-	-
Odonata	1	-	-	-	-	-	-	-	-	-	-
Anoplura	-	-	-	-	-	-	-	-	-	-	-
Total	**58**	**19**	**1**	**52**	**-**	**153**	**97**	**10**	**9**	**26**	**10**

Source: www.wii.gov.in/indianfauna/globally%20threatened%20indian%20fauna.pdf

The global estimates as per IUCN Red List, 2008 suggest that 10% (5,966 species) of vertebrate and 0.20% (2,496 species) of invertebrate described fauna is threatened. The number of globally threatened species has shown an increasing trend in recent years. For example, species of vertebrate threatened fauna has increased from 3314 in 1996-98 to 3507 in 2000, 3521 in 2002, 3524 in 2003, and to 5622 in 2006. In the Indian context, the number of species under different categories of threat has also shown an increase in recent years **(Figure 1.4)**.

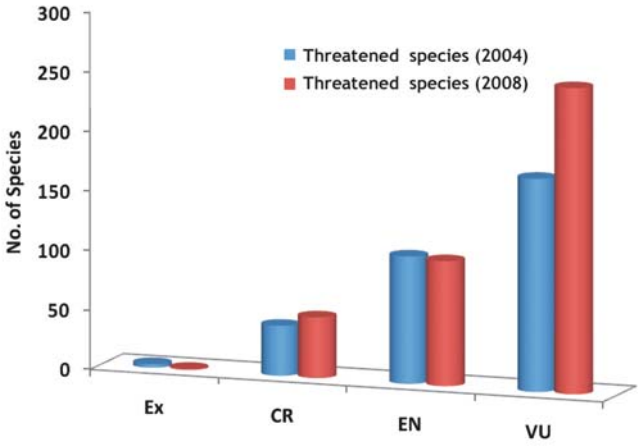


Figure 1.4: India - change in threatened species in 2004 and 2008

In 2004, one species, *Megaptera* novaeangliae, showed an upward trend of population while eleven species showed stable populations. Further, of the total 447 threatened species, for which trends are available, 218 are showing decreasing trend of population as per the 2004 status **(Table 1.7)**. The 2008 report, however, indicates upward population trend of one-horned rhinoceros in the country, as a result, the threat category has improved from endangered to vulnerable.

Table 1.7: Population trends in threatened Indian species (IUCN Red list 2004)

Group	Threatened	No change or stable	Upwards or improving	Downwards or decreasing	Indeterminate	Trends not available
Mammals	213	4	1	47	87	74
Birds	149	2	-	80	10	57
Reptiles	033	-	-	2	2	29
Amphibia	148	5	-	68	73	2
Pisces	75	-	-	21	42	12
Crustacea	12	-	-	-	-	12
Mollusca	5	-	-	-	1	4
Hymenoptera	5	-	-	-	-	5
Lepidoptera	4	-	-	-	1	4
Odonata	3	-	-	-	1	3
Anoplura	1	-	-	-	-	1
Total	**648**	**11**	**1**	**218**	**217**	**201**

India, through its strong initiatives for survey and monitoring of biodiversity, is contributing towards new discoveries. For example, ZSI has discovered 65 faunal species in 2007 and National Bureau of Fish Genetic Resources (NBFGR) reported 36 new fin fish species from diverse biogeographic zones of India **(Box 1.1)**.

Box 1.1: New faunal discoveries in 2007

ZOOLOGICAL SURVEY OF INDIA (65):

Western Ghats: 20 (*Nyctibatrachus sholai, Phatus ochlandrae, Gegenophis mahadeinsis, Lyubanta longigastra, Orasema nirupama, Duta tuberculata, Duta polita, Psilanteris ferruginus, Psilanthus coriacea, Psilanthus orbitus, Paridris armigera, Anacylotropu keralensis, Callitula heydoni, Panchyneuron bangalorensis, Panstenon, lankaensis, Pseudocatolaccus bouceki, Sphegigaster karanatakensis, Oxysychus lankaensis, Cphalobium caudatum*)

Eastern Himalaya: 28 (*Brachydanio jaintianensis, Bhavania auranachalnsis, Marpissa mizoramensis, Cheiracanthium aizwalensis, Larinia teireansis, Tyderus wallachii, Phytoscius mizoramensis, Graptoppia jyotikanae, Basilobelba papillata, Corticaromus rueckeri, Lasconotus lushaicus, Squamofilaria indica, Kuntzistronoylus indicus, Trichoskrjabininia mabuyi, Heterakis mizoramensis, Meteterakis gekkonis, Syphasia pearsoni, Spirura tupiae, Pterygodermatites viverriculae, Diplotriaena coracinae, Diplotriaena enicuri, Aphasmatylenchus mizoramensis, Scutellonema scutellonema, Hirschmanniella mannai, Helicotylenchus medinipurensis, Mylonchulus wasimi, Mesodorylaimidae sushili, Odopoia reticulate*)

Western Himalaya: 9 (*Amurobius sharmai, Agroeca gangotrae, Misumenoides naginae, Lathys musooriensis, Gnaphosa kankhalae, Flanona harduarae, Galumna crenata uttarakashi, Gynacantha pallampurica*)

Central and Western India: 8 (*Dieta kanishkai, Misumena ritujae, Hister puncticephalus, Protodytiscus johollaensis, Dorylaimus mulii,Ischidorylaimus baqrii, Nygolaimus shamimi, Isolaimimium rajasthanicus*)

OTHERS (4):

Gegeneophis mhadeiensis G. Bhatta, K.P. Dinesh, P. Prashanth & N.U. Kulkarni (*Amphibia*: *Gymnophiona: Caeciliidae*). Current Science, 93(10): 1442-1445, 2007. (from Mahadayi Wildlife Sanctuary, Western Ghats). *Hemidactylus anamallensis* V. B. Giri & A.M. Bauer (*Squamata: Gekkonidae*). Zootaxa 1700: 21–34. 2008. (from Western Ghats) *Haemaphysalis knobigera* K. Prakasan & N. Ramani (Acarina: Ixodida). International Journal of Zoological Research 3(4): 170-172, 2007. (from Kerala). *Nosomma keralensis* K. Prakasan & N. Ramani (*Acarina: Ixodida*). International Journal of Zoological Research 3(4): 173-175, 2007. (from Kerala).

NATIONAL BUREAU OF FISH GENETIC RESOURCES (36):

North East and Western Ghats: *Akysis manipurensis; Puntius bizonatus; Puntius shalyniuscorscans; Rasbora ornatus; Schistura khugae; Pterocryptis barakensis; Puntius ornatus; Schistura tigrinum; Acantopsis multistigmatus; Garra paralissorhynchus; Schistura minutes; Badis tuivaiei; Garra nambulica; Bangana orientalis; Glyptothorax ventrolineatus; Schistura reticulatum; Garra travancoria; Garra emarginata; Garra mlapparaensis; Homaloptera silasa; Nemacheilus periyarensis; Salarius reticulates; Garra nilamburensis; Tor ramadevi; Tor moyarensis; Neolissochilus tamiraparaniensis; Neolissochilus acutirostris; Neolissochilus microphthalmus; Neolissochilus capudelphinus; Neolissochilus minimus; Garra robustus; Puntius ater; Puntius khugae; Glyptothorax chindwinica; Glyptothorax granules; Glyptothorax ngapang*

Source: ZSI and NBFGR, 2008

1.2.2 Floral diversity

In terms of plant diversity, India ranks tenth in the world and fourth in Asia. With over 45,500 plant species, India represents nearly 11% of the world's known floral diversity. As elsewhere in the world, many organisms especially in lower groups such as bacteria, fungi, algae, lichens and bryophytes are yet

to be described and remote geographical areas are to be comprehensively explored. The richness of Indian plant species as compared to the world is shown in **Table 1.8**.

Table1.8: Number of species in major groups of plants and microorganisms

Plant groups	No. of species described		% of India to the world
	India	World	
Virus/Bacteria	850	8,050	10.6
Algae	7175	40,000	17.9
Fungi	14,500	72,000	20.1
Lichens	2223	13,500	16.4
Bryophytes	2500	14500	17.2
Pteridophytes	1,200	10,000	12.0
Gymnosperms	67	650	10.3
Angiosperms	17,527	2,50,000	7.0

Source: BSI, 2009

Important floral groups found in India are described below:

Angiosperms: India has about 17,527 species of flowering plants (more than 7% of the world's known flowering plants) in 247 families and 2984 genera. The dominant families with more than 500 species are Poaceae-1291; Orchidaceae-1229; Leguminosae-1225; Asteraceae-892; Rubiaceae-616; Cyperaceae-545; Euphorbiaceae-527; and Acanthaceae-510.

Gymnosperms are represented by about 67 species. Pinaceae (6 genera and 15 species) is the largest family, followed by Cupressaceae (13 genera and 13 species), Ephedraceae (1 genus, 7 species) and Gnetaceae (1 genus and 5 species). The species of *Gnetum* and *Cycas* are mostly confined to North Eastern region, Eastern and Western Ghats, and Andaman & Nicobar Islands.

Pteridophytes: India has about 1200 species under 204 genera. While species of *Marsilea, Azolla* and *Salvinia* grow in aquatic habitats, those of *Acrostichum* occur in mangrove ecosystems. The north-eastern region (including Eastern Himalaya) is rich in pteridophytic diversity with about 845 species, followed by south India (including Eastern and Western Ghats) with 345 species and north India (including Western Himalaya) with 340 species. About 17% of the species are endemic to India. The families such as Polypodiaceae (137 species), Dryopteridaceae (125 species), Athyriaceae (97 species), Thelypteridaceae (83 species), Selaginellaceae (62 species), and genera like *Selaginella* (62 species), *Asplenium* (45 species) and *Polystichum* (45 species) are some of the dominant families and genera of the pteridophytic flora of Indian region.

Bryophytes represented by 2500 species are the second largest group of green plants in India distributed largely in Eastern Himalaya, North-eastern India, Western Himalaya and the Western Ghats. Mosses constitute the major component of Indian bryoflora with 1576 species followed by liverworts and hornworts (924 species). Lejeuneaceae (155 species) is the largest family followed by Pottiaceae (129), Dicranaceae (119), Bryaceae (98) and Sematophyllaceae (92 species). *Fissidens* (67 species) is the largest genus followed by *Plagiochila* (65) and *Frullania* (63). Nineteen genera and 629 species are endemic to India.

Lichens representing symbiotic association of fungi and algae, constitute a dominant component of epiphytic and saxicolous vegetation, and comprise 2,223 species in 283 genera and 72 families. Western Ghats are the richest region with 800 species (38%) followed by Eastern Himalaya with 759 species (37%) and Western Himalaya with 550 species (27%). Families such as Parmeliaceae, Graphidaceae, Physciaceae, Usneaceae, Cladoniaceae, and genera like *Parmelia, Graphina, Usnea, Graphis* and *Lecanora* are among the dominant families and genera of Indian lichens. About 23% species, mainly belonging to genera *Graphina, Trypethelium, Graphis* and *Porina,* are endemic to India. Andaman & Nicobar Islands (24%), Western Ghats (20%) and Eastern Himalaya (18%) show high percentage of endemic species.

Fungi: India has 14,500 species of fungi in 2,300 genera and 250 families with maximum diversity in the Western Ghats followed by the eastern Himalaya and the western Himalaya. Deuteromycetes with 900 genera and 6000 species (40 %) is the largest group of Indian mycoflora, followed by Ascomycetes [680 genera / 3500 species (25 %)] and Basidiomycetes [520 genera/3400 species (23 %)]. *Cercospora* with 707 species is the largest genus of Indian fungi followed by *Puccinia* (328 species) and *Phyllosticta* (280 species). About 3500 species are endemic to the country.

Algae are represented by over 7,175 species in 666 genera. They are found in a variety of habitats ranging from aquatic (both fresh water and marine) to terrestrial. Chlorophyceae with 4,495 species is the largest family followed by Cyanophyceae (1,453 species) and Bacillariophyceae (516 species).

Eighteen families of flowering plants occurring in India such as Ancistrocladaceae, Biebersteiniaceae, Martyniaceae, Tetracentraceae and Trichopodaceae, etc., are monogeneric. About 2,863 (16.4 %) are trees, which include some of the highly valued timber species of the world. India is also a storehouse of primitive flowering plants, confined mainly in North Eastern region of the country. Diversity of such plants led Takhtajan (1969) to designate this region as the ''Cradle of Flowering Plants'. The Indian flora also shows a rich diversity in aquatic flowering plants. Some important families of aquatic plants include Hydrocharitaceae (13 species), Pontederiaceae (13 species), Alismataceae (8 species), Aponogetonaceae (6 species), Potamogetonaceae (6 species), Typhaceae (4 species), Salviniaceae (3 species), etc. The insectivorous plant families, yet another group of unique plants, are represented by Lentibulariaceae (36 species), Droseraceae (3 species), and Nepenthaceae (1 species).

About 11,058 species are endemic to Indian region, 6,200 of which belong to flowering plants alone. Eastern Himalaya and north-eastern region (about 2,500 species), peninsular India including western and Eastern Ghats (about 2,600 species), north-western Himalaya (about 800 species) and Andaman & Nicobar Islands (about 250 species) are the areas rich in endemic plants. Endemism in different plant groups of India is given in **Table 1.9**

Table 1.9: Endemism in different plant groups of India

S. No.	Plant group	Total number of species in India	Number of endemic species	Percentage
1.	Angiosperms	17,527	6200	35.3
2.	Gymnosperms	67	7	14.9
3.	Pteridophytes	1200	193	16.0
4.	Bryophytes	2500	629	25.1
5.	Lichens	2223	527	23.7
6.	Fungi	14500	3500	24.0
7.	Algae	7175	1925	26.8

Source: BSI, 2009

As per the IUCN Red List (2008), India has 246 globally threatened floral species, which constitute approximately 2.9% of the world's total number of threatened floral species (8457). Distribution of various IUCN threat categories of Indian plants as compared to global trends is given in **Figure 1.5** and **1.6**.

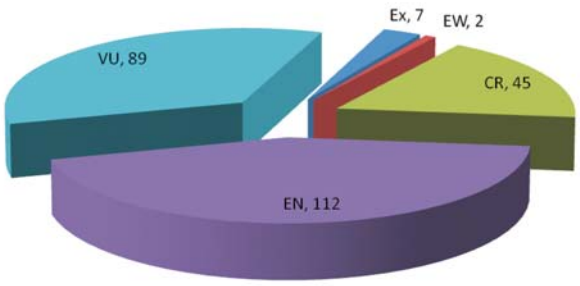


Figure 1.5 : Indian plants – representation in IUCN threat categories

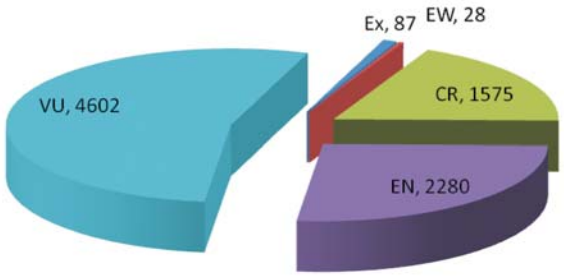


Figure 1.6 : Plants – global representation in IUCN threat categories

As in the case of fauna, new plant species are continually being discovered in the country. For example, 41 plant taxa were discovered by BSI and other researchers from diverse bio-geographic zones of India during 2007 **(Box 1.2)**. Similarly in cryptogams (Lichens and Bryophytes), the National Botanical Research Institute (NBRI), Lucknow described 11 new species during 2007-08. Under the AICOPTAX, 493 taxa new to science have been discovered **(Box 1.3).**

Box 1.2: New discoveries by BSI in 2007

Agapetes acuminata D.Don *ex* G.Don var. *tipiensis* Banik & Sanjappa, *A. arunachalensis* Banik & Sanjappa, *A. dalaiensis* Banik & Sanjappa, *A. flava* (Hook. f.) Sleumer var. *nagensis* Banik & Sanjappa, *A. megacarpa* W.W. Sm. var. *lohitensis* Banik & Sanjappa, *A. odontocera* (Wight) Hook.f. var. *mizoramensis* Banik & Sanjappa, *A. salicifolia* C.B. Clarke var. *glanduliflora* Banik & Sanjappa, *A. siangensis* Banik & Sanjappa, *Beilschmiedia tirunelvelica* Manickam, Murugan, Jothi & Sundaresan, *Caralluma stalagmifera* C.E.C.Fisch. var. *intermedia* Karupp. and Pull., *C. stalagmifera* C.E.C.Fisch. var. *longipetala* Karupp. & Pull., *Cephalozia schusteri* Sushil K. Singh & D.K. Singh, *Crotalaria kurisumalayana* Sibichen & Nampy, *Cycas indica* A.Lindstr. & K.D.Hill, *Dasya ulhasii* Jadiye & P.S.N. Rao, *Dendrobium eriiflorum* Griff. var. *sikkimense* Lucksom, *Eclipta angustata* Umemoto & H.Koyama, *Eulalia madkotiensis* Kandwal, B.K. Gupta & S.K. Srivast., *Fibraurea darshani* P. S. Udayan, K. Ravikumar, D. K. Ved and K. Udaiyan, *Gomphia barberi* Manikam & Murugan, *Graphis sundarbanensis* J. Ram & G.P. Sinha, *Hedyotis nairii* M. Murugesan and V. Balasubramaniam, *Humboldtia sanjappae* N. Sasidharan and P. Sujanapal, *Ischaemum yadavii* Gad & Janarth., *Jasminum agastyamalayanum* Sabeena, Asmitha, Mulani, E.S.S.Kumar & Sibin, *Juncus benghalensis* Kunth var. *kyangnoslae* G. Chhettri, Hynniewta & A. A. Ansari, *Jungermannia indrodayana* Sushil K. Singh & D.K. Singh, *Megalaria bengalensis* J. Ram, Aptroot, G.P. Sinha & Kr. P. Singh, *Memecylon courtallense* Manickam, Murugan, Jothi & Sundaresan, *Momordica sahyadrica* Kattuk. & V.T.Antony, *Odisha cleistantha* S. Misra, *Piper nirjulianum* P. R. Gajurel, P. Rethy and Y. Kumar, *Psychotria henryana* Murugan & Gopalan, *Ranunculus uttaranchalensis* Pusalkar & D.K. Singh, *Roscoea purpurea* Sm. forma *alba* Cowley, *R. purpurea* Sm. forma *rubra* Cowley, *Schefflera agasthiyamalayana* Manickam, Murugan, Sundaresan & Jothi, *Spilanthes vazhachalensis* Sheela, *Stellaria pinvalliaca* Chandra Sek. & S.K. Srivast., *Trachys copeana* Kabeer & V.J. Nair and *Vanilla sanjappae* R.P. Randey, J.J. Wood & S.K. Srivast.

Source: http://www.ipni.org; and Sanjappa, M. & Singh, P. 2008. Plant Discoveries 2007. Botanical Survey of India, Kolkata. pp. 7-17

Box 1.3 : Characterisation of new species under the AICOPTAX

The MoEF is implementing an All India Co-ordinated Project on Taxonomy. The project has organized specialist groups drawn from universities, BSI and ZSI to take up taxonomic work on animal viruses, bacteria and archaea, algae, fungi, lichens, bryophytes, pteriodophytes, gymnosperms, palms, grasses, bamboos, orchids, helminthes and nematodes, microlepidoptera and mollusca. Training in plant and animal biosystematics has also been recognized as an important component. The significant achievements of the AICOPTAX since its inception are as under:

1.	Augmentation of national reference collection of species	53,715
2.	Total identification and taxonomical characterization of species	12,789
3.	Documentation of flora (with descriptions)	6,759
4.	Human resource development/training in biosystematics (Capacity Building) No. of persons trained in taxonomy	 450
5.	No. of taxa new to science No. of taxa new to India No. of taxa new to different regions in India	493 449 Many
6.	Number of species, collected after a gap of over 50 years and above	189

1.3.1 Domesticated biodiversity

1.3.1.1 Crop genetic diversity

Agriculture remains one of the dominant drivers and mainstay of economic growth in India. The large mosaic of distinct agro-ecosystems, characterized by variations in edaphic, climatic and geographic features, has contributed to diverse cropping patterns and systems across the country. India is one of the eight Vavilov's centers of origin of cultivated plants in the world. Details of the wild varieties of important crop plants in India are given in the **Table 1.10**.

Table 1.10: Wild relatives of crop plants in India

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

Source: NBAP, 2008

India stands seventh in the world in terms of contribution of species to agriculture and animal husbandry. In qualitative terms too, the contribution has been significant. The National Bureau of Soil Survey and Land Use Planning distinguished 20 broad agro ecological zones, based on natural features and crop growing periods. The region-wise crop diversity in India is depicted in **Table 1.11**.

India has over 800 crop species and 320 wild relatives: millets (51); legumes (31); fruits (109); spices and condiments (27); vegetables (54); fiber crops (24); oil seeds, tea, coffee, tobacco and sugarcane (12); and, medicinal plants (3,000).

Table 1.11: Agro-ecological regions harbouring rich crop diversity in India

Agro-ecological regions	Crops
Western Himalaya	• Barley, wheat, maize, buckwheat, amaranth, prosomillet, finger millet • French bean, soyabean, lentil, black gram, peas • Pumpkin, cucumber, Alliums pp., ginger, Brassicae • Pome, stone, soft and nut fruits
Eastern Himalaya	• Barley, maize, buckwheat, amaranth, finger millet, foxtail millet • French bean, soyabean, cowpea, black gram, peas, scarlet bean • Pumpkin, cucumber, Alliums pp. ginger, chayote, tree tomato, Brassicae • Pome and stone fruits
North-Eastern Region	• Rice, maize, sorghum, finger millet, foxtail millet, job's tears • French bean, soyabean, pigeonpea (perennial), black gram, rice bean, Dolichos bean, winged bean • Pumpkin, chayote, cucumber, okra, eggplant, chilli/capsicum spp., Pointed gourd, ash gourd • Taros,yams • Citrus-Lime/lemon/orange/grape fruit, banana • Tea, tree cotton, jute, kenaf and mesta, large cardamom, ginger, long pepper, sugarcan
Gangetic Plains	• Rice, sorghum, barnyard millet, little millet/Panicum • Chickpea, cowpea, mung bean • Okra, eggplant, bitterground, cucumis spp., Luffa spp. • Jackfruit, mango, lemon/lime, orange, jujube, Indian gooseberry/Emblica, jumun/Syzygium, melons • Linseed, niger, sesame, Brassicae • Sugarcane, mulberry
Indus Plains	• Durum wheat, pearl millet • Moth bean, cluster bean, chickpea, black gram • Okra, Cucumis spp. • Jujube, Khirni/Mimusops, Phalsa/Grewia • Sesame, Taramira/Eruca,Cotton
Eastern Peninsular Region/E.Ghats/ Deccan	• Rice, sorghum, finger millet, pearl millet, foxtail millet, little millet, prosomillet, kodo millet • Black gram, green gram, cowpea, horse gram, Mucuna, pigeonpea,Dolichos bean, rice bean • Taros, yams, elephant-food yam • Banana, mango, lemon/lime, jackfruit • Niger, Brassicae, sesame • Ginger, turmeric, chilli, kenaf, sugarcane, coconut, cotton
Western Peninsular Region/Western Ghats/Malabar	• Rice, sorghum, finger millet, small millet/Panicum • Black gram, green gram, cowpea, pigeonpea, Dolichos bean, horse gram, sword bean • Okra, eggplant, cucumber, chilli/Capsicum • Taros, yams, elephant-foot yam • Jackfruit, banana, lime/lemon, orange, jumun/Syzygium • Sugarcane, black pepper, turmeric, ginger, coconut, arecanut, cotton
The Islands Regions	• Coconut, breadfruit, chilli, taros, yams, Xanthosoma

Source: http://www.bioversityinternational.org/publications/Web_version/174/ch06.htm

The National Gene Bank at NBPGR is primarily responsible for conservation of unique accessions on long-term basis, as base collections for posterity, predominantly in the form of seeds. Presently, 3,56,471 accessions belonging to 1,134 species have been conserved, the details of which are given in **Table 1.12**.

Table 1.12: National Gene Bank holdings at NBPGR

Crop group/ categories	No. of accessions
(a) Seed conservation at -18° C.	
Cereals	1,40,435
Millets and forages	50,260
Pseudo cereals	6,118
Grain legumes	55,341
Oilseeds	50,660
Fibre crops	9,850
Vegetables	22,954
Fruits	166
Medicinal & aromatic plants & narcotics	5,801
Spices & condiments	2,275
Agro-forestry	2,376
Duplicate safety samples	10,235
Sub total	**3,56,471 (1,134 spp.)**
(b) Cryo-preservation in liquid nitrogen at -150 to 196° C	**8,493 (720 species)**
(c) In-vitro conservation as tissue culture at 25 +/- 5° C	**1,969 (158 species)**
Total	**3,66,933**

In India, agro-biodiversity deserves special attention to ensure conservation of valuable germ plasm for posterity, sustainable development, livelihood security and to deal with potential climate change impacts. Some of the key issues for consideration are as follows:

- *In-situ* on-farm conservation, which involves identification of hotspots of agro-biodiversity, on-farm conservation measures, provisions for economically feasible and socially acceptable incentives, and development of appropriate models for on-farm conservation.
- In order to ensure that farming remains an attractive option, appropriate policy and institutional reforms need to be promoted to address the rapid changes affecting the farming sector.
- There is a need to promote greater awareness among farmers on the current policy, debates and developments relating to farmers' rights to enable them to make informed decisions.
- Assessment of direct drivers of agricultural production systems and their services such as demand for food consumption, availability of crop diversity and their management, land use patterns, climate variability and change, energy provisions and availability of labour, and their individual and combined impact on agricultural production systems, are critical to ensure development of suitable agricultural and economic packages.

Most agro-biodiversity occurs in areas where subsistence farming is practiced owing to difficult growing conditions. Appropriate interventions may be encouraged through policy and development packages to deliver access to credit, capital and assets.

1.3.1.2 Livestock genetic diversity

India, endowed with varied forms of animal genetic resources, is traditionally considered as an important rearing centre for domesticated animals. India has vast resources of livestock (485 million) and poultry (489 million), which play a vital role in rural livelihood security. In terms of population, India ranks first

in buffaloes, second in cattle and goats, third in sheep, fourth in ducks, fifth in chicken and sixth in camels in the world. The genetic resources of farm animals in India are represented by a broad spectrum of native breeds of cattle, buffaloes, goats, sheep, swine, equines, camel and poultry. There are around 140 listed breeds of livestock and poultry in India, with 30 breeds of cattle, 10 of buffalo, 42 of sheep, 20 of goat, 3 of pig, 6 of horse and pony, 8 of camel and 18 of poultry. Besides, there are breeds of yak, mithun, ducks, quails and several nondescript populations.

Over the years, animal husbandry has intensified in India with widespread introduction of exotic breeds. There is a perceptible increase in the population of limited specialized breeds. This has led to the reduction in total genetic variability and population size of many local breeds. The majority (85%) of the domestic livestock in India is reared under low input production systems. Of the indigenous breeds, 14 of cattle, 3 of buffalo, 9 of sheep, 4 of goat and almost all breeds of horse and poultry are showing declining trends in the country. Estimates indicate that 50% of indigenous goat, 30% of sheep, 20% of cattle and almost all poultry breeds are threatened.

In this context, the National Bureau of Animal Genetic Resources (NBAGR) undertakes suitable programmes for identification, evaluation, characterization, conservation and sustainable utilization of animal genetic resources. Main activities of NBAGR are given in **Box 1.4**.

Box 1.4 : Main activities of NBAGR

Characterization: Almost 80% of breeds have been characterized phenotypically and 75% genetically for recognized breeds of livestock and poultry. The process of identification of other population and recognizing them as breed after their survey and characterization has also been initiated to assess the complete domesticated diversity available in India.

***Ex-situ* conservation:** The collection includes deep frozen semen of endangered breeds of cattle (8), buffaloes (6), sheep (1), goats (2), camels (1); somatic cells include cattle (1), buffaloes (2), sheep (3), goats (2), camel (1) and DNA repository of 100 breeds of different species.

***In-situ* conservation:** An *in-situ* model of conservation was developed by giving incentives to the farmers and was adopted under network projects through the state agricultural and veterinary universities/ state animal husbandry departments/Indian Council of Agricultural Research (ICAR) institutions and NGOs.

Digitized database: An Information System on Animal Genetic Resources of India has been developed and the available data on animal resources have been digitized. The data are now being widely used in decision making for project and policy planning and monitoring.

Registration of livestock and poultry genetic resources: Various steps have been taken up to protect and check the biopiracy of indigenous animal genetic resources.

- Accession numbers have been given to each of extant breeds of various species of livestock and poultry.
- Breed descriptors of extant breeds are being prepared in consultation with species specific institutes.
- A total of 41 breed descriptors have been published including 8 breeds of buffaloes, 12 of cattle, 4 of sheep, 13 of goat and 4 of horse.
- Guidelines, descriptors and application form for registration of new breeds have been prepared.

Documentation: The breed monographs of about 70 livestock and poultry breeds have been published to document livestock and poultry genetic resources of India.

Breed wise census: Department of Animal Husbandry, Dairying & Fisheries, MoA has introduced breed wise census so as to know the status of different listed breeds of livestock and poultry.

Only a few indigenous breeds of cattle and buffalo, which are relatively well-known and economically important, are maintained at state-owned organized farms where information on growth, production and reproduction parameters is recorded and maintained. For other species, there are very few farms where performance parameters are recorded regularly. Systematic surveys and programmes need to be undertaken on conservation and genetic enhancement with respect to domesticated animal genetic diversity.

1.3.1.3 Fish genetic diversity

India is endowed with vast inland and marine bio-resources. It is the third largest producer of fish in the world and the second largest producer of inland fish. As such, fisheries and aquaculture play an important role in social development, economic upliftment of farmers and fisherfolks, apart from contributing to the nutritional security of the country. The NBFGR has taken up various research programmes and major achievements which are as under:

- Development of a database on 2,182 fishes found in Indian waters; total listing of 287 freshwater fishes of aquatic hotspot – the Western Ghats which include 192 endemic species.
- Identification of 47 potentially cultivable teleosts and 106 ornamental species endemic to Western Ghats.
- Assessment of 327 freshwater fish species for IUCN threat categories and listing of 79 threatened species.
- Preparation of a macro level fish occurrence map of entire India (1:1000000).
- Genetic characterization of 33 species using different markers and development of DNA barcodes for 100 Indian marine fish species.
- *Ex-situ* conservation of prioritized endangered species undertaken through successful captive breeding techniques for *Horabagrus brachysoma, Labeo dussumieri, L. dyocheilus, Chitala chitala, Ompok pabda, Puntius sarana, Anabas testudineus, Nandus nandus, Clarias btrachus* and *Heteropneustes fossilis*; sperm cryopreservation protocols for 16 threatened and commercial fish species; and, tissue culture bank for housing 11,600 accessions of 273 species.
- Publication of a bibliography on 'Fish Pathogens and Diseases in India', which contains 2,610 references of 1451 Indian research in different fields of fish pathology, quarantine and related topics across 104 years (1898-2001). Also, developed an information system 'Fish Diseases and Quarantine Information System'.
- Development of a new database on Indian fish diversity comprising information on 2,243 indigenous and 291 exotic fin fishes (globally recognized number of fin fishes is 29,300)(http://www.redlist.org /info/tables/table1.html)

Notwithstanding the above initiatives, the knowledge base on India's fish genetic resources faces limitations due to: inadequate expertise in fish taxonomy which poses hindrance in comprehensive inventorization; limitations in terms of capacity to conduct large-scale analysis; taxonomic ambiguity in marine fishes that needs to be resolved through molecular markers; development of viable techniques for embryo cryopreservation/embryonic stem cell cryopreservation and retrieval of genome from cryopreserved milt through androgenesis; and inadequate information on breeding of endangered species and transport of brood fishes over long distances.


Fish

1.3.1.4 Genetic diversity of agriculturally important microorganisms (AIMs)

Realizing the value of microorganisms in agriculture sector and considering the richness and diversity of such elements across diverse agro-climatic zones of the country, India has initiated isolation and identification of AIMs mainly through the efforts of NBAIM. Important initiatives *inter alia* include the following:

- NBAIM has a repository of 2,517 cultures which includes filamentous fungi (2,077), bacteria (394), Actinomycetes (36) and yeasts (10).
- The sources of fungi collections include plants (1,212), soil insects (641), air flora (39) and others (185).
- The special collections of microorganisms having importance in agriculture and industry include: bio-control agents (*Trichoderma viride, T. harzianum, T. aurioviride, Glocladium virens, Bacillus subtilis, Pseudomonas flurescens*); bio-pesticides (*Beauvaria bassiana, Bacillus thrungenensis*); bio-fertilizers (*Rhizobium* spp., *Azotobacter chrococcum, Azospirillum brasilense, Bacillus subtilis*, fluorescent *Pseudomonas*); bio-remedation (*Pseudomonas putida, P. flourescens, Alcligens*); industrial importance (*Aspergillus niger, Bacillus subtilis*).
- The Vision 2025 envisages that the NBAIM act as a nodal agency, responsible for taking appropriate measures for system-wide management of AIMs by various means, such as, (i) constituting microbial genetic resource advisory committee, (ii) preparing national exploration maps, developing and widely disseminating guidelines for handling and storage of microbial isolates, registration and notification of microbial deposits, (iv) developing/implementing coordination, linkages and cooperation mechanisms, (v) technical backstopping by development of national policy and its implementation, and (vi) handling matters/concerns related to biosafety, biopiracy and IPR issues, etc.

Linkage with NEP

NEP (2006) considers conservation of genetic diversity crucial for development of improved crop varieties resistant to particular stresses, new pharma products, etc., apart from ensuring the resilience of ecosystems. Traditional knowledge referring to ethno-biology knowledge possessed by local communities is the basis of their livelihoods, and also a potent means of unlocking the value of genetic diversity through reduction in search cost. The NEP highlights the need to formulate an appropriate system of prior informed consent and fair and equitable benefit sharing in respect of biological material and traditional knowledge of use of such biological material to enable the country and local communities, respectively to derive economic benefits from providing access.

1.3.2 Forest biodiversity

India is endowed with vast forest resources. Forests play a vital role in social, cultural, historical, economic and industrial development of the country and in maintaining its ecological balance. They are the resource base for sustenance of its population and a storehouse of biodiversity. Other land use practices, such as agriculture and animal husbandry are benefitted by forests.

Realizing the crucial role of forests in maintaining the ecological balance and socio-economic development, the NFP, 1988 aims at maintaining a minimum of 33% of country's geographical area under forest and tree cover. The forests in the country have been classified into 16 major types and 251 subtypes on the basis of climatic and edaphic features. Distribution of diverse forest types across the country is presented in **Table 1.13**.

Table1.13: Diversity and distribution of major forest types in India

Major Groups	Type and Group	Area (m ha)	% of forest area
Tropical Forests	Wet evergreen forest	4.5	5.8
	Semi-evergreen forest	1.9	2.5
	Moist deciduous forest	23.3	30.3
	Littoral and swamp forest	0.7	0.9
	Dry deciduous forest	29.4	38.2
	Thorn forest	5.2	6.7
	Dry evergreen forest	0.1	0.1
Sub-tropical Forests	Subtropical broad leaved hill forest	0.3	0.4
	Sub tropical pine forest	3.7	5.0
	Sub tropical dry evergreen forest	0.2	0.2
Temperate Forests	Montane wet temperate forest	1.6	2.0
	Himalayan moist temperate forest	2.6	3.4
	Himalayan dry temperate forest	0.2	0.2
Sub-alpine & Alpine Forests	Sub-alpine forest	-	-
	Moist alpine scrub	3.3	4.3
	Alpine scrub	-	-

Source: Indian Council of Forestry Research and Education (ICFRE), 2000

As per formal estimates, forestry and logging contributed to approximately 1.5% of the total gross domestic product (GDP) of the country in 2001-02. However, since most of the trade and use of forest products is informal and if one takes into account all kinds of removals of forest products, the estimate of the contribution from forestry is greatly enhanced. It increases even further, if the non-tangible benefits, e.g., ecological services of the forests, are also taken into consideration. Forests are increasingly being looked upon as major performers in poverty alleviation programmes.

According to Global Forest Resource Assessment Report (Food and Agricultural Organization (FAO) 2005), India ranks among the top ten countries in terms of forest area **(Fig. 1.7)**. India has 1.8 % of the global forest area with per capita forests of 0.08 ha. One noteworthy aspect in this regard is the fact that against the prevailing global trend of decreasing forest cover, India has been successful in stabilizing its area under forests.

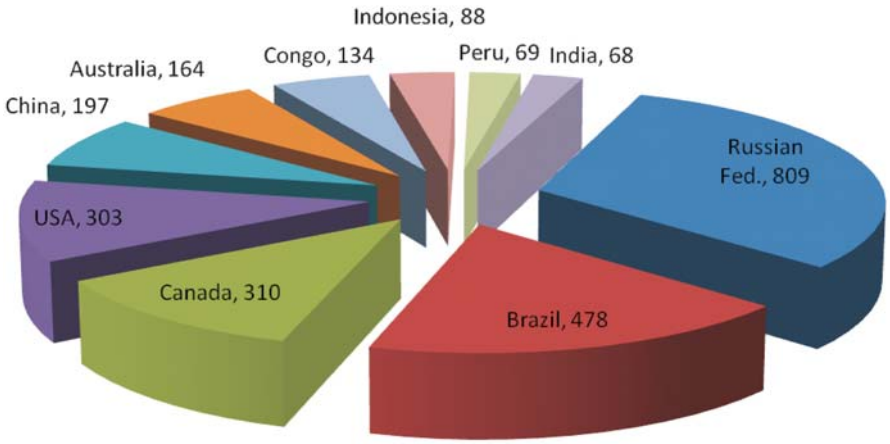


Figure 1.7 : Extent of forests (mha) in ten top countries of world

The extent, status and trends of forest biodiversity are detailed as under:

- Forest Survey of India (FSI) started undertaking systematic and periodic assessment of the forest cover of the country using remote sensing technology, since 1980s. As per the latest assessment in 2005, the forest cover of the country is 67.71 m ha, which is 20.60 % of its geographic area. Of this, 5.46 m ha (1.66%) is very dense forests, 33.26 m ha (10.12%) is moderately dense and the rest 28.99 ha (8.82 %) is open, including 0.44 m ha mangroves. The percentage of forest cover in the hilly region of the country is 38.85 % and, by excluding areas unavailable for plant growth (snow clad areas), it comes to 52.40 %.
- The forest resources are well distributed across the country; Madhya Pradesh has the largest area of 7.6 m ha under forest cover constituting 11.22% of the total forest cover followed by Arunachal Pradesh (10.01%), Chhattisgarh (8.25%), Orissa (7.15%) and Maharashtra (7.01%). In general, the northeastern Himalayan states [Mizoram (88.63%), Nagaland (82.75%), Arunachal Pradesh (80.93%), Tripura (77.77%), Manipur (76.53%)] maintain over 75% forest cover.
- The total tree cover of the country has been estimated to be 9.17 mha (2.79 % of country's geographic area).
- The total forest and tree cover of the country is estimated as 23.39% of the geographical area.
- The NFP is a comprehensive document with directives on afforestation, forestry and farm forestry, management of forests, rights and concessions, diversion of forestland, wildlife conservation, tribal communities, shifting cultivation, forest fires and grazing, forest based industries, forest extension, forest education, forestry research, personnel management, forest survey, legal and financial support.
- The subject of forestry is in the Concurrent list of the Indian Constitution. Three types of forests such as Reserve Forests (RF), Village Forests (VF) and Protected Forests (PF) are recognized in the Indian Forest Act (IFA), 1927. VFs are those reserve forests, which are assigned to the village communities for management. RFs and PFs are to be managed by the Government.
- The forests in India cater to the direct livelihood needs of about 200 million people in about 1.73 lakh villages residing in and around forest areas.
- The NFP calls for eliciting the active and meaningful participation of these communities in managing the forests. Subsequent legislative, judicial and executive support to this policy have led to setting up of about 1,06,000 JFMCs covering about 22.02 m ha of forest area.
- India practices the policy of Sustainable Management of Forests (SFM). The forests are being managed scientifically and through soliciting cooperation of the people, caring for their bonafide needs and ensuring sustained availability of goods and ecological services from the forests.
- NTFPs contribute significantly to the income of about 30 % of the rural people whereas 80 % of forest dwellers depend on NTFPs for their basic necessities. NTFP collection is the main occupier of about 17 % of landless labourers, and additional 39 % more are involved in NTFP collection as a subsidiary occupation.

Some of the actions required to address the major challenges/ constraints confronting the Indian forestry sector are listed below:

- Arrest habitat loss and degradation through diversion, forest fire and shifting cultivation, encroachment, etc.
- Improve the productivity of forests, particularly the plantation forestry.

- Scale up investments in afforestation and forest protection, management and development.
- Provide viable alternative energy sources to rural communities to divert the dependency on forests for energy.
- Address high cattle population with low productivity in rural areas and inadequate fodder production resulting in high grazing pressure on forest areas.

- Scale up the participation of local communities and private initiatives in forestry.
- Provide appropriate and innovative incentives and delivery mechanism in JFM schemes.
- Strengthening the legislation, institutions, programmes to conform to the objectives envisaged in the NFP.
- Prioritize forest research and extension in bringing knowledge and technology to field and forestry education in tune with the latest developments in the forestry sector.
- Strengthen the national and state forestry organizations with adequate linkages with related institutions.

Linkages with NEP

The NEP recognizes conversion of forests to agriculture, settlements, infrastructure and industries as the principal direct cause of forest loss. The NEP looks into the underlying causes of forest loss to take further steps to: give legal recognition of the traditional entitlements of forest dependent communities taking into consideration the provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996 (PESA); formulate an innovative strategy for increase in forest and tree cover from the 2003 level of 23.69% of country's land area to 33% in 2012, through afforestation of degraded forest land, wastelands, and tree cover on private or revenue lands; formulate an appropriate methodology for reckoning and restoring the environmental values of forests, which are unavoidably diverted to other uses; formulate and implement a "code of best management practices" for dense natural forests, to realize the objectives and principles of NEP. Forests of high indigenous genetic diversity should be treated as entities with incomparable value.

1.3.3 Mountain biodiversity

In India, mountains are mostly under two global hotspot areas (i.e. the Himalaya and the Western Ghats). Major features of these hotspots are already given **Table 1.4**. The biodiversity profile of these areas is given below:

1.3.3.1 The Himalaya

Richness and uniqueness

- Uniqueness of the region is manifested in its rich species endemism (over 40%) which is shown in **Table 1.15.**

Table 1.14: Richness and uniqueness of biodiversity in Himalayan hotspot

Taxonomic group	Species	Endemic species	% of endemism
Vascular plants	10,000	3160	31.60
Mammals	300	12	4.00
Birds	979	15	1.53
Reptiles	177	49	27.68
Amphibians	105	42	40.00
Freshwater fishes	269	33	12.26

Source: http://www.biodiversityhotspots.org

- The Himalayan flora represents 71 endemic genera and 32% endemic species. Also, five families are endemic to the region (i.e. Tetracentraceae, Hamamelidaceae, Circaeasteraceae, Butomaceae, and Stachyuraceae), while over 90% of the species in Berberidaceae and Saxifragaceae are endemic to the Himalaya. A large number of orchids, many representing neo endemic taxa, have been reported from Sikkim and Arunachal Pradesh.
- Of the nearly 300 recorded mammal species across region, 12 are endemic to the Himalaya. The endemics include the Golden Langur (*Trachypithecus geei*) with restricted range in the Eastern Himalaya; the Himalayan Tahr (*Hemitragus jemlahicus*); and the Pygmy Hog (*Sus salvanius*) restricted to grasslands in the Terai-Duar savannah and grasslands in the Manas National Park. The Namdapha Flying Squirrel (*Biswamoyopterus biswasi*) also represents the only endemic genus in the Himalaya described on the basis of a single specimen taken from Namdapha National Park. Around 979 bird species are recorded from the region, with 15 endemics. Four Endemic Bird Areas (EBAs) overlap entirely or partly with the Himalaya hotspot. Among reptiles (177 species), 49 are endemic. In case of amphibians, of the total 124 species, 41 are endemic and, 33 species (of the total 269) of fishe are endemic to this hotspot.
- Over 175 tribal groups inhabiting this region depend directly on diversified resource base for existence. The ecosystem services emanating from the region benefit the plains and contribute substantially towards sub-national, regional and global ecological security.

Threat status

- Notwithstanding the remoteness and inaccessibility, the Himalaya has been affected by anthropogenic activities, including developmental activities that are leading to change in land use patterns, habitat loss and fragmentation.
- Poaching is another threat particularly for large mammals like tigers and rhinoceros, along with unsustainable extraction of precious medicinal herbs.
- In spite of richness and uniqueness of natural resources, the region remains relatively under developed with widespread poverty, which may accentuate environmental degradation.

Conservation status

- Considering the conservation significance of the region, GOI has established 173 PAs in Himalayan States (NPs 28; WLSs 107, ConR 2 and ComR36), which cover approximately 47,500 sq km area.

The coverage under PA network in IHR has steadily expanded over the years **(Figure 1.8** and **1.9)** In the Himalayan biogeographic zone, the PAs include 12 NPs (7,367 sq km) and 65 WLS (16,066 sq km), which cover almost 11.12% of the zone.

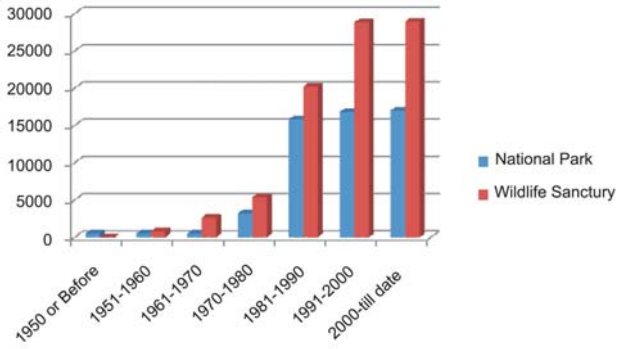


Figure 1.8 : Progression of numbers of PAs in Himalaya

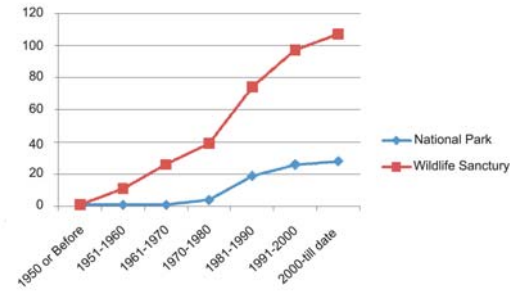


Figure 1.9 : Progression of PA coverage in Himalaya (in km²)

- Beside NPs and WLSs, the GOI has established 6 BRs (out of 15 in India) and 8 Ramsar sites (out of 25 in the country) in the Himalayan States.
- Out of the five natural World Heritage Sites (WHS) recognized by United Nations Educationmal, Scientific, and Cultural Organization (UNESCO) in India, three are located in the Himalayan region viz, Nanda Devi NP, Kaziranga NP and Manas NP. Further, the Valley of Flowers NP has been included in the list of WHS as an extension to Nanda Devi NP. In addition, Kangchendzonga NP and Namdapha NP are included in the tentative list of WHS. Considering the importance of natural sites, an externally aided project titled 'World Heritage Biodiversity Programme for India: Building Partnerships to Support UNESCO's WHS programme' is being undertaken.

1.3.3.2 The Western Ghats

Richness and uniqueness

- The Western Ghats comprise the mountain range that runs along the west coast of India, from the Vindhya-Satpura ranges in the north to the southern tip. The ecosystems of the Western Ghats include the tropical wet evergreen forests, the montane evergreen forests, moist deciduous forests, etc. The Shola grassland ecosystems found in the higher reaches of Western Ghats are unique to this region and harbour a number of endemic species **(Table 1.15)**.
- World Conservation Monitoring Centre (WCMC) has identified Western Ghats region as one of the important areas of freshwater biodiversity.
- The varied topographic, climatic and geological factors have made significant contribution to biodiversity. Almost one-third of all the flowering plant species in India are found in this region.
- The Nilgiri BR spread over three states in Western Ghats was the first BR to be set up in the country.

Table 1.15: Biodiversity of Western Ghats			
Group	Total species	Endemic species	% endemism
Angiosperms	4,000	1,500	38
Butterflies	332	37	11
Fishes	288	116	53
Amphibians	156	94	78
Reptiles	225	97	62
Birds	508	19	4
Mammals	137	14	12

Source: http://www.wii.gov.in/envis; ZSI 2008

- Fifty-six genera and 1,500 species (38%) of flowering plants and 63% of India's evergreen woody plants are endemic to the Western Ghats.
- Of the known mammals, 14 species are endemic. The mammalian fauna of the Western Ghats is dominated by insectivores (11 species), bats (41 species) and rodents (27 species including the porcupine). Among the 508 species of birds recorded from the Western Ghats, 144 (28%) are aquatic birds including those found in the coastal habitats. A total of 324 species (64%), predominantly land birds, are residents. Sixteen species of birds are endemic to the Western Ghats.

Threat status

- In the past, the forests of the Western Ghats had been selectively logged. Large tracts of forests were also converted to agricultural land for monoculture plantations of tea, coffee, rubber, oil palm, teak, eucalyptus, and wattle, building reservoirs, roads, and railways.
- Over 20% of the original forest cover remains more or less in pristine condition and the remaining is subject to varying degrees of human pressure including collection of fuel wood and NTFPs for subsistence. Mass tourism, grazing and forest fires are other concerns.
- The poverty is rife and economic development is poor in regions adjacent to forests including the PAs. The competing needs of the people residing in the forest fringes lead to human wildlife conflicts.
- Of the total known fauna, 102 species fall under different categories of threat (**Figure 1.10**), and of these, mammals (30 species; 21.9%); and amphibians (52 species; 33.3%) are the prominent groups.

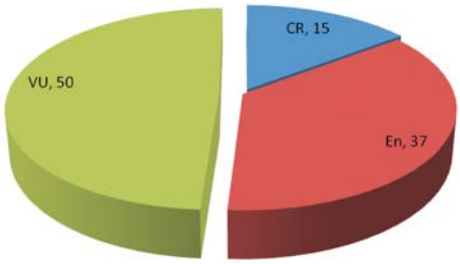


Figure 1.10: Representation of threatened faunal diversity in Western Ghats

Conservation status

- Over 10% area of Western Ghats (around 13,692 km^2) is under legally designated PAs. The conservation network in the Western Ghats include 2 BRs; 16 NPs and 47 WLSs.
- Realizing the importance of biodiversity of Western Ghats region, some of the state governments have initiated action for DNA barcoding of species **(Box 1.5)**. Barcoding is also being undertaken by the DBT.
- Western Ghats cluster (a network of high value biodiversity areas of the Western Ghats) is included in the tentative list of WHS.
- Identification and conservation of KBAs in the Western Ghats was initiated in 2003, coordinated locally by Ashoka Trust for Research in Ecology and the Environment (ATREE), and in collaboration with the Wildlife Conservation Society-India and the University of Agricultural Sciences, Bangalore. Using preliminary data on KBAs compiled by the Bombay Natural History Society (BNHS), 126 KBAs were delineated in the Western Ghats for high priority conservation action.

Box 1.5: Species in Western Ghats to be barcoded

The Kerala State is set to join the global race to identify and distinguish biological species in threatened natural habitats, such as rainforests and tropical ecosystems. The State Council for Science, Technology and Environment is preparing to embark on an ambitious project for DNA barcoding of life forms in the Western Ghats and Kerala. The DNA barcoding initiative is one of the priority projects identified by the Council for launch, which involves the establishment of a barcoding centre of life for species identification and documentation. A database of DNA barcodes will allow scientists to rapidly and cheaply identify species from samples.

Source: The Hindu, Monday, Nov 19, 2007

Linkages with NEP and NAPCC

- *Considering that the mountains are important but highly fragile ecosystems the NEP envisages some measures for conserving the mountain ecosystems in the country. These include, among others, i) adopting appropriate land-use planning and watershed management practices for sustainable development; ii) adopting "best practice" norms for infrastructure construction in mountain regions to avoid or minimize damage to sensitive ecosystems and despoiling of landscapes; iii) encourage cultivation of traditional varieties of crops and horticulture by promotion of organic farming, enabling farmers to realize a price premium; iv) encourage cultivation of traditional varieties of crops and horticulture by promotion of organic farming, enabling farmers to realize a price premium; v) promote sustainable tourism through adoption of "best practice" norms of eco-friendly and responsible tourism; and, vi) consider unique mountain scapes as entities with "Incomparable Values", in developing strategies for their protection.*
- *Further, under the recently released NAPCC, 2008, one of the eight national missions, namely the National Mission for Sustaining the Himalayan Ecosystem, is aimed at evolving management measures for sustaining and safeguarding the Himalayan glaciers and the mountain ecosystem.*

1.3.4 Biodiversity of arid and semi-arid lands

Arid and semi-arid region of India covers 127.3 mha i.e. 38.8% of total geographical area and spreads over 10 states. The hot arid zone occupies major part of Rajasthan (60%), Gujarat (20%), Punjab and Haryana (9 %), and Andhra Pradesh, Karnataka and Maharashtra (10 %). The cold arid zones are located

in the Trans-Himalayan region of Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Sikkim covering an area of 1,84,823 sq km i.e. 5.62% of the total geographical area.

Richness and uniqueness

Hot deserts and semi-arid region

- Thar desert is the world's seventh largest desert and is considered the most inhospitable ecoregion in Indo-Pacific region. This large eco-region lies to the west of Aravalli Range and characterized by extreme climate (annual temperature ranging from near freezing in the winters to over 50°C in summers). Rainfall is scanty in the range of 100-150 mm.
- Several species have adapted themselves to survive in these harsh conditions. The mammal fauna comprises 41 species that include three large cat predators – the lion, leopard and tiger. It is home to some of India's most magnificent grasslands and sanctuary for a charismatic bird, the Great Indian Bustard (GIB, *Chirotis nigricaps*). Among the mammal fauna, the blackbuck, wild ass, chinkara, caracal, and desert fox inhabit the open plains, grasslands, and saline depressions. Blackbuck, a globally threatened species is found in this area.
- Of the 140 birds known, the GIB is a globally threatened species. A migration flyway used by cranes (*Grus grus, Anthropoides virgo*) and flamingos (*Phoenicopterus* species) crosses this region. An example of special conservation efforts being undertaken are listed in **Box 1.6**

Box 1.6: Conservation of Sarus Cranes *(Grus antigone antigone)* in the wetlands of Gujarat

The Indian Sarus Crane *(Grus antigone antigone)* is one of the five species of cranes occurring in India. Due to its peculiar preference for water-logged agriculture fields and open areas around human habitations, the bird faces special conservation issues. It is listed under the Schedule-I of WPA, 1972. Often Sarus cranes build nests on the ground in the paddy fields during the cultivation season. This not only takes a small area out of cultivation but also the nest itself is usually made up of grasses and paddy plants etc. This does affect the agriculture productivity adversely to a small extent. Further, intensive agriculture activities close to the nests may also adversely affect the nesting and breeding success of the bird. In Gujarat, which was second largest population of Sarus Crane, commendable conservation efforts have been made by the local people- particularly farmers with support provided by Sarus Nature Club (a local NGO) and the Gujarat Forest Department. Once a Sarus nest is spotted by the farmers in their field, they avoid cultivating that area. They also help protect the nests against other natural predators. In this process, they are also able to gather regular information about the behavior of the bird. This community generated information, understanding and sensitivity about the bird has formed the basis of the conservation programme involving local people. Out of the financial support provided by the Gujarat Forest Department for Sarus conservation, an incentive to the extent of Rs.1,000/- to Rs.1,500/- per nest is given to the farmers. The incentive is calculated on the basis of perceived loss to the paddy production due to Sarus nesting.

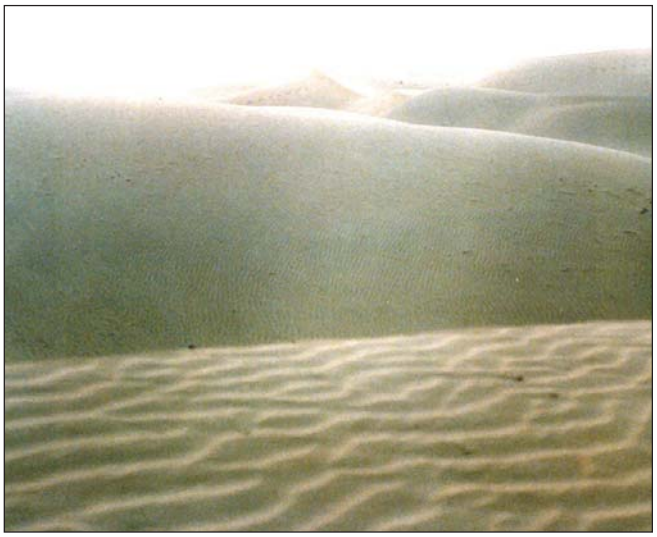
In addition, a Sarus Crane conservation awareness campaign has been launched in the state by the Forest Department and various NGOs. The increase in Sarus Crane population from 1,380 in 2001 to 1,963 in 2007 by regular census exercise by GEER Foundation clearly demonstrates the success of the above mentioned conservation initiatives.

- The flora of Indian desert comprises nearly 682 species (352 genera and 87 families; 86 angiosperm and a lone gymnosperm family). Of these, 8 families, 37 genera and 63 species are introduced. Ten largest families with maximum species diversity in the desert are listed in **Table 1.16**.
- The degree of endemism of plant species in Thar desert is 6.4% which is relatively higher than 3% endemism the Sahara desert. Some endemic species of Thar Desert includes *Calligonum polygonoides* (Polygonaceae), *Prosopis cineraria* (Mimosaceae), *Tecomella undulate* (Bignoniaceae), *Cenchrus biflorus* (Poaceae) and *Sueda fruticosa* (Chenopodiaceae), etc.

Table 1.17: Ten largest families with maximum species diversity in Indian deserts

Family	Species
Poaceae	111
Fabaceae	65
Asteraceae	44
Cyperaceae	36
Convolvulaceae	35
Malvaceae	28
Acanthaceae	22
Euphorbiaceae	23
Cucurbitaceae	19
Scrophulariaceae	15

Source: Flora of the Indian Desert (Bhandari 1990)



Cold desert region

- The cold desert regions of Trans-Himalayan zone of India are characterized by severe arid conditions, where temperature drops to –50°C during winter, insignificant monsoonal effects, enormous resources, endemic and highly specialized biological elements and diversity of indigenous socio-cultural systems.
- Cold desert comprises of alpine mesophytes and desert vegetation. Some of the endemic plants reported from the region include: *Corydalis adiantifolia*, *C. tibetica*, *Braya acnea*, *Capsella thomsonii*, *Dianthus deltoids*, *Stellaria tibetica*, *Astragalus ciotus*, *A. melanostachys*, *A. oxydon*, *A. tribuulifolius*, *Sedum crassipes*, *Chrysonthemum tibeticum*, *Crepis stoliczka*, *Inula falconeri*, *Leontopodium nanum*, *Saussurea subulata*, *S thomsonii*, *Senicio tibeticus*, *Tanacetum artemesioides*, *Acantholimon lycopodiodes* and *Waldhamia nivea*.
- Cold desert is the home of highly adaptive, rare endangered fauna, such as Asiatic Ibex, Tibetan Argali, Ladakh Uriyal, Bharal, Tibetan Antelope, Tibetan Gazelle, Wild Yak, Snow Leopard, Brown Bear, Tibetan Wolf, Wild Dog and Tibetan Wild Ass.
- Avifauna includes some restricted range species such as Black Necked Crane which breeds in the higher reaches of this region.

Threats and conservation status

- Third National Report on the Implementation of the UNCCD, 2007 states that most of the arid, semi-arid and dry sub-humid areas of India are either subject to desertification or drought prone or considered wastelands. About 92% area in arid Rajasthan is affected by desertification, about 76% area is affected by wind erosion, and 13% by water erosion. In the neighbouring arid Gujarat, about 93% area is affected by desertification and 39% by water erosion thereby affecting agriculture and wildlands.
- Land degradation is estimated to affect at least one-third of the 329 mha geographical area in India. Arid areas (49.5 mha) are the worst affected, especially in the western part of Rajasthan that includes the Thar desert (20.87 mha), as well as in arid Gujarat (6.22 mha).

- Recurrent drought, high wind, poor sandy soils and high human and livestock demand for food, fodder and firewood cause over-exploitation of fragile resources, resulting in wind and water erosion, water logging, salinity-alkalinity and vegetation degradation.
- Considering the conservation value of drylands, a number of PAs have been established in the region. These include NPs in 3,162 sq km of area which is 1.48% of India's geographical area and WLS in 12,914 sq km of area which is 6.03% of the area. The semi desert biogeographic zones have NPs spread over 1,506 sq km and WLS over 12,411 sq km. In addition, Rann of Kachchh (12454 sq km) has been designated as BR in January 2008. It is the largest BR in India.
- Similarly, in the cold desert region, the PA network include nearly 5,809 sq km under NPs and 10,438 sq km under WLS. The MoEF is actively considering establishment of cold desert BR in Jammu & Kashmir and Himachal Pradesh.
- GOI has initiated special programmes – 'Project Snow Leopard', 'Project Hangul' and 'Project Vulture' for the recovery of these threatened species and their habitats falling in the cold desert habitats.
- India has a national action programme for combating desertification. It harmonizes with other national programmes with a short-term (5-year) and two long-term (15 year) strategies over the next three decades at an estimated cost of over US$ 20 billion. The programme embodies a holistic approach covering all the dryland regions of the country with coordination framework for diverse set of activities through several agencies and implementation layers.

Linkages with NEP and Five-Year Plans

- *NEP underlines the necessity of adoption of innovative and integrated measures for conservation of desert ecosystems in the country. The needed measures include: a) intensive water and moisture conservation through practices based on traditional and science based knowledge, and relying on traditional infrastructure; b) enhancing and expanding green cover based on local species; and c) reviewing the agronomic practices in these areas, and promoting agricultural practices and varieties, which are well adapted to the desert ecosystem.*
- *Among others, the mid term review of 10th Five Year Plan had recommended special programme for dryland farming in arid and semi arid areas of country.*

1.4 INLAND WATER BIODIVERSITY

1.4.1 Wetland profile

Wetlands, transition between terrestrial and aquatic systems, are unique habitats that sustain substantial biodiversity. Wetlands are important for regulating water cycle, playing critical role in maintaining the health of rivers, estuaries and coastal waters. These are habitats for specialized animals and plants, many of which are threatened. The wetlands in India estimated to cover about 58.2 mha, are distributed in all the biogeographic regions and show significant ecological diversity ranging

from high altitude cold desert wetlands to hot and humid wetlands in coastal zones with a range of other types in between.

Uniqueness of biodiversity

The wetlands are home to many endemic and threatened species distributed across the country (**Table 1.17**).

Table 1.17: State-wise distribution of endemic wetland plants, threatened fishes and turtles

Sl	State	Endemic plants	Threatened birds	Threatened fishes	Threatened turtles
1	Tamil Nadu	46	3	35	4
2	Kerala	65	-	37	3
3	Karnataka	64	5	15	2
4	Goa	17	-	15	0
5	Andhra Pradesh	13	6	19	2
6	Orissa	6	-	22	6
7	Madhya Pradesh & Chhattisgarh	20	5	16	7
8	Maharashtra	69	2	19	3
9	Gujarat	11	6	12	1
10	Rajasthan	9	6	17	3
11	Haryana	0	6	15	1
12	Punjab	0	4	15	5
13	Jammu & Kashmir	2	2	20	2
14	Himachal Pradesh	0	2	19	0
15	Uttar Pradesh	3	13	34	10
16	Bihar & Jharkhand	5	3	19	9
17	West Bengal	5	6	32	11
18	Assam	2	10	35	10
19	NE States*	5	12	34	9
20	**Total**	**114**	**91**	**102**	**16**

** Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, Sikkim, Tripura*
Source: Vijayan et al. 2004; SACON, Coimbatore

Threats and conservation status

- Wetlands are threatened due to reclamation for developmental activities, pollution, increasing water demand, change in hydrological regime, over exploitation of resources, etc. Some of the threatened wetland bird species such as Finns' Weaver (*Ploceus megarhynchus*); Imperial Eagle (*Aquila heliacal*); Indian Skimmer (*Rynchops albicollis*); Lesser Kestrel (*Falco naumanni*); Sociable Lapwing (*Vanellus gregarious*); Bristled Grass Warbler (*Chaetornis striatus*); Masked Finfoot (*Helipais personata*) etc., have very small populations restricted to one or two sites.
- Under the NWCP, of the total 115 wetlands only 31 (27%) are covered under PAs. A study has indicated that conservation efforts of the Himalayan wetlands have largely been concentrated in the two western Himalayan States (J&K and HP). The eastern Himalaya, that contain 80% (1,529) of total Himalayan wetlands have received little attention. These wetlands are important wildlife habitats and have significant socio-cultural values.
- In recent years, India's response to international commitments under Ramsar Convention has resulted in steady progression of designating Ramsar sites. At present, 25 wetlands have been designated as Ramsar sites in India, (http://ramsar.org) which cover an area of 6,77,131 ha. Chilika

Lake (Orissa) and the Keoladeo NP (Rajasthan) were the first two followed by four additional sites designated in 1990. In 2000, 13 new wetlands were designated as Ramsar sites. In 2005, six more wetlands were designated as Ramsar sites.

Linkages with NEP

Recognizing the value of wetlands and taking cognizance of the fact that there does not yet exist a formal system of wetland regulation, the NEP seeks to set up a legally enforceable regulatory mechanism for identified valuable wetlands to prevent their degradation and enhance their conservation. Besides this, following action plan has been identified: develop national inventory of wetlands; formulate conservation and prudent use strategies involving local communities; formulate and implement eco-tourism strategies through multi-stakeholder partnerships; take explicit view of impact on wetlands of significant developmental projects; consider entities of wetlands with 'incomparable values' in developing strategies for their protection; integrate wetland conservation at the village ponds and tanks level in to sectoral developmental plans for poverty alleviation and livelihood improvement, and promoting traditional conservation techniques.

1.4.2 Mangroves

Mangrove ecosystem constitutes a bridge between terrestrial and marine ecosystems and are found in the inter-tidal zones of sheltered shores, estuaries, creeks, backwaters, lagoons, marshes and mud-flats and are regarded as most productive and biologically diverse ecosystems. Mangroves are habitats, spawning grounds, nurseries and nutrients for a number of animals. They harbour several endangered species ranging from reptiles (*e.g.* crocodiles, iguanas and snakes) and amphibians, to mammals (tigers, deer, otters and dolphins) and birds (herons, egrets, pelicans and eagles). Only a few plant families (*e.g.* Rhizophoraceae, Avicenniaceae and Combretaceae) have developed physiological and structural adaptations to the brackish water habitat in which mangroves occur.

Mangroves in India account for about 5% of the world's mangrove vegetation and are spread over an area of 4,445 km^2 along the coastal States/UTs of the country. State/UT wise mangrove cover as assessed by FSI in different assessments is given **(Table 1.18)**. West Bengal has the maximum of mangrove cover in the country, followed by Gujarat and Andaman & Nicobar Islands.

Table 1.18: State/UT wise mangrove cover (km^2) assessment since 1987

Sl. No.	State/UT	Assessment year									
		1987	1989	1991	1993	1995	1997	1999	2001	2003	2005
1.	Andhra Pradesh	495	405	399	378	383	383	397	333	329	329
2.	Goa	0	3	3	3	3	5	5	5	16	16
3.	Gujarat	427	412	397	419	689	901	1031	911	916	936
4.	Karnataka	0	0	0	0	2	3	3	2	3	3
5.	Maharashtra	140	114	113	155	155	124	108	118	158	158
6.	Orissa	199	192	195	195	195	211	215	219	203	203
7.	Tamil Nadu	23	47	47	21	21	21	21	23	35	35
8.	West Bengal	2,076	2,109	2,119	2,119	2,119	2,123	2,125	2,081	2120	2,118
9.	Andaman & Nicobar Islands	686	973	971	966	966	966	966	789	658	637
10.	Pondicherry	0	0	0	0	0	0	0	1	1	1
11.	Kerala	0	0	0	0	0	0	0	0	8	8
12.	Daman & Diu	0	0	0	0	0	0	0	0	1	1
	Total	**4,046**	**4,255**	**4,244**	**4,256**	**4,533**	**4,737**	**4,871**	**4,482**	**4,448**	**4,445**

Source: Forest Survey of India, 2005

The coastal zone of the mainland of India and Andaman & Nicobar Islands is endowed with the presence of extensive and diverse mangroves. On a macro scale, geomorphic settings of the mangrove ecosystems of the East Coast of India are different from those of the West Coast. The coastal zone of the West Coast is narrow and steep in slope, due to the presence of the Western Ghats. Secondly, there are no major west-flowing rivers. As a result, mangrove ecosystems of the West Coast of India are small in size, less in diversity and less complicated in terms of tidal creek network. The presence of larger brackish water bodies and a complex network of tidal creeks and canals characterize mangrove ecosystems of the East Coast.

Threats and conservation status

- Compared to 2003 assessment, there has been a marginal decrease in mangrove cover of the country mainly because of the tsunami that hit Andaman & Nicobar Islands on the 26th December 2004. Gujarat has shown an increase in mangrove cover mainly because of plantations and protection measures.
- Various researchers have identified different types of threats to mangroves in India **(Table 1.19)**.

Table 1.19: Threats to mangroves of various maritime states of India

Major threats	West Bengal	Orissa (Bhitar-kanika)	Andhra Pradesh (Godavari)	Tamil Nadu (Pichavaram)	Andaman & Nicobar	Gujarat	Mahar-ashtra	Goa	Karnataka	Kerala
Cattle / Goat / Deer / Camel grazing	+	+	+	+++	+	++	-	-	-	-
Tree felling for firewood & wood products	++	+	++	+++	+	+	+	+	-	-
Over exploitation of fishery resources	+++	+	+++	+++	+	-	-	+	-	++
Conversion of land for agriculture	++	+	+	-	-	-	+	-	+	++
Conversion of land for salt farming	~	~	~	~	~	+	~	~	~	~
Conversion of land for aquaculture	+	-	+	-	-	-	-	-	-	-
For urban development/ human settlement	++	+	-	-	+	+	++	+	-	+
Lack of fresh water due to bridge construction or sand bar formation	+	-	+	++	-	++	-	-	-	-
Tourism	-	-	-	+	+	-	-	-	-	-
Shoreline / geomorphic changes	+	-	+	++	-	++	+	-	-	++
Pollution & discharge of effluents	++	-	+	-	-	+++	++	+	-	++
Port / harbour	+	-	-	-	-	+++	-	-	-	-

Table 1.19: Threats to mangroves of various maritime states of India (Contd.)

Major threats	West Bengal	Orissa (Bhitar-kanika)	Andhra Pradesh (Godavari)	Tamil Nadu (Pichavaram)	Andaman & Nicobar	Gujarat	Mahar-ashtra	Goa	Karnataka	Kerala
development										
Mining	-	-	+	-	-	++	+	-	-	-
Hyper salinity	+	-	-	++	-	++	-	-	-	-
Natural calamities (Cyclone & Sea level rise)	+	+	++	++	++++	++	-	-	-	-
Siltation and sedimentation	++	+	++	++	-	++	-	-	-	-
Total number	20	7	16	20	9	23	8	4	1	9

- Reduction in freshwater flow has been identified as a factor affecting growth and perpetuation of mangroves in West Bengal, Andhra Pradesh and Tamil Nadu.
- M. S. Swaminathan's Committee Report has emphasized the regeneration of mangroves for ecological and livelihood benefits.
- Concept of Joint Mangrove Management (JMM) programme by involving multiple stakeholders for conservation and management of mangrove resources in Tamil Nadu, Andhra Pradesh and Orissa has been developed by the M.S. Swaminathan Research Foundation, Chennai.

Linkages to NEP and Mangroves for the Future (MFF)

- *National Conservation Strategy and Policy Statement on Environment & Development (1992) highlights conservation and sustainable development of mangroves, including coastal areas, riverine and island ecosystems. Similarly, National Forest Policy and National Wildlife Action Plan emphasize conservation of mangroves on scientific principles, including social and cultural aspects. At present, the mangroves are protected through a range of regulatory measures such as Coastal Regulation Zone Notification, 1991; EIA studies under the EIA Notification, 1994 for specialized industries; monitoring of compliance, with conditions imposed while according environmental clearances, by Regional Offices of the Ministry and State Pollution Control Boards; enforcement of emission and effluent standards by industries and other entities, and recourse to legal action against the defaulters. Mangroves located within the notified forest areas are also covered under the IFA, 1927 and Forest (Conservation) Act, 1980. The NEP also recognizes that mangroves, as indeed the other coastal resources like coral reefs and coastal forests, face threats from following quarters: poorly planned human settlements; improper location of industries and infrastructure; pollution from industries and settlements; over exploitation of living natural resources; inadequate institutional capacities for, and participation of local communities in, formulation and implementation of coastal management plans; lack of consensus on means of provision of sanitation & waste treatment; and the open access nature of many coastal resources.*
- *MFF is a regional initiative, being coordinated by IUCN, which focuses on tsunami-hit countries such as India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand. MFF adopts a new approach by promoting partnerships to stimulate investment, to move from reactive responses to proactive activities. India has agreed to participate in MFF project.*

1.5 MARINE AND COASTAL BIODIVERSITY

India with a coastline of about 8,000 km, and an EEZ of 2.02 million sq km, shows a very wide range of coastal ecosystems like estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, and stretches and coral reefs which are characterized by rich and unique biodiversity components (Venkataraman and Wafar 2005). Diverse range of coastal habitats and major ecosystems in coastal states of India is depicted in **Fig 1.11.**

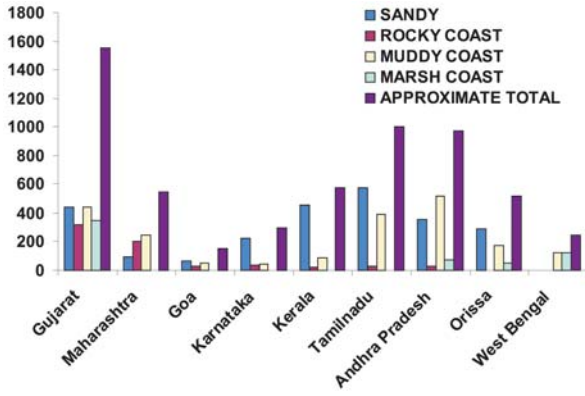


Figure 1.11 : Coverage of major ecosystems in coastal states of India (in sq km)

Status of marine flora and fauna

As elsewhere in the world, the extent of marine biodiversity in India is relatively less known. However, among the Asian countries, India is perhaps the only one country that has a long record of inventories of coastal and marine biodiversity dating back to at least two centuries. The synthesis of available information on coastal and marine biodiversity of India reveals that the number of species known is more than 13,000 **(Table 1.21)**. Analysis of current inventory of coastal and marine biodiversity of India reveals that many groups that are commercially and tropically important are the ones that have been extensively inventorised, leaving several groups, notably the minor phyla grossly understudied (Venkataraman and Wafar 2005). The interesting and fairly well-surveyed groups include: Marine algae – 844 species, 217 genera; Sponges and hard corals – sponges 451 species and hard corals – 218 species.; Crustaceans – 2,934(+) species (Copepoda- 1,925; Cirripedes – 104; Amphipoda – 139; Brachura – 705; Prawns – 243; Stomatopoda -121; Cladocera – 3; Ostracoda – 120; Isopoda; Anomura – 162; Lobesters – 26; Mysids – 3). Diversity of crustaceans in different known sites is as follows: Gulf of Kachchh – 69; Lakshadweep – 45; Palk Bay – 381; Andman Islands – 853 species). Mollusca, Echinodermata and Fishes – Mollusca 3,370 species; Echinodermata – 765; Fishes – 2,456.

A comparison of known Indian marine fauna vis-a-vis global estimates is given in **Table 1.20**.

Table 1.20: Comparison of marine faunal diversity in the world and India

Group	World	India	
		Total aquatic	Marine
Protista	31,250	2,577	750
Mesozoa	71	10	10
Porifera	4,562	519	486
Cnidaria	9,916	817	790
Ctenophora	100	12	12
Gastrotricha	3,000	88	88
Kinorhyncha	100	99	99
Platyhelminthes	17,500	4,920	550
Annelida	12,700	842	440
Mollusca	66,535	5,050	3,370
Bryozoa	4,000	194	184
Crustacea	35,534	2,994	2,440
Meristomata	4	2	2
Pycnogonidae	600	16	16
Sipuncula	145	38	38
Echiura	127	33	33
Tardigrada	514	30	10
Chaetognatha	111	30	30
Echinodermata	6,223	765	765
Hemichordata	120	12	12
Protochordata	2,106	116	116
Pisces	21,723	2,546	1,800
Amphibia	5,150	204	3
Reptilia	5,817	446	26
Aves	9,026	1,228	145
Mammalia	4,629	372	29
Total	**2,41,563**	**23,960**	**12,244+**

Status of coral reefs

Coral reefs are the protectors of the coastlines of the maritime states. The coastal populations of India mostly depend on the coral reef ecosystems. In India, major coral reef ecosystems are Gulf of Mannar, Gulf of Kachchh, Andaman & Nicobar and Lakshadweep Islands which embrace all the three major reef types (atoll, fringing and barrier) and include diverse and extensive reef areas of the Indian Ocean.

The total area of coral reefs in India has been estimated as 2,375 sq km (Ministry of Earth Sciences (MES) and and Space Application Centre (SAC), 1997). The GOI and UNDP GEF Field Mission reported a total of 234 species of scleractinian corals from Andaman group of islands of which 111 are supposed to be new records to India. The underwater field mission revealed that the coral reefs of the Andaman Islands are globally significant in terms of their diversity. The Andaman Islands have around 80% of the global coral diversity, suggesting that a final count could reach up to 400 species. These include 15 families, 60 genera and 208 species of Scleractinia (reef building and hermatypic corals) from four major reefs of India such as Gulf of Kachchh (36 species, 20 genera) Lakshadweep (91 species, 34 genera), Gulf of Mannar and Palk Bay (82 species 27 genera) Andaman and Nicobar Islands (177 species, 57 genera). Patterson *et al* (2007) updated the number of coral species in Gulf of Mannar to 117 belonging to 40 genera. The shallow reefs of the Gulf of Mannar had about 41% coral cover and a large proportion of old, dead and turfed corals (32%). The coral fauna of the Gulf of Kachchh includes 34 species of 20 genera of hermatype corals and three species of genera of ahermatype corals. The submerged reefs of this area can be classified into four zones such as shoreward reef, back reef, surface reef and oceanic reef. There are 12 families, 34 genera and 91 species of corals in Lakshadweep Islands. Families such as Astrocoeniidae, Pectiniidae and Trachyphylliidae are absent. Among the 60 genera recorded in India, only 34 are reported so far from here.

Threats and conservation status

- Among natural threats, storms and waves particularly cyclones are major stresses on marine ecosystems. Impacts of tsunami on various sites of marine ecosystems in India were devastating.
- Varied human activities which are a cause for concern over and above the natural disturbances include: runoff and sedimentation from developmental activities (projects), eutrophication from sewage and agriculture, physical impact of maritime activities, dredging, destructive fishing practices, pollution from industrial sources and oil refineries of anthropogenic disturbances.
- Fishing is a major activity in the fishing villages situated along the 8,000 km coastline of India. About one million people are occupied full time in marine capture fisheries. Commercial and unsustainable fishing activities pose a threat to marine biodiversity.
- India has over 32 marine and coastal PAs covering intertidal/sub-tidal or seawater-mangroves, coral reefs, lagoons, estuaries, beaches, etc. Besides, another 100 PAs have terrestrial and fresh water ecosystems which constitute boundaries with sea water or partly contain marine environment. In addition, there are four BRs in the marine and coastal environs.
- WPA provides for protection of marine species and coral reefs.
- India's CRZ Notification, 1991 under the EPA regulates onshore development activities which affect coastal environments.

Linkages with NEP

NEP has recognized the deeper cause of proximate factors of threats in inadequate institutional capacities for, and participation of local communities in, formulation and implementation of coastal management plans, the open access nature of many coastal resources, and lack of consensus on means of provision of sanitation and waste treatment. Further actions envisaged include: a) Mainstream the sustainable management of mangroves into the forestry sector regulatory regime, ensuring that they continue to provide livelihoods to local communities; b) disseminate available techniques for regeneration of coral reefs, and support activities based on application of such techniques; c) explicitly consider sea-level rise and vulnerability of coastal areas to climate change and ecological events, in coastal management plans, as well as infrastructure planning and construction norms; d) adopt a comprehensive approach to Integrated Coastal Management by addressing linkages between coastal areas, wetlands, and river systems, in relevant policies, regulations and programs; and e) develop a strategy for strengthening regulation, and addressing impacts, of ship-breaking activities on human health, and coastal and near marine resources.

1.6 PROTECTED AREAS

Article 8 of the CBD advocates importance of promoting *in-situ* conservation. The CBD as well as the World Parks Congress, Durban, 2003 have marked a significant shift in the historical perception of PAs. They are now steadily being linked with issues related to people's concern on livelihood, traditional knowledge, access to genetic resources, national sovereignty, equitable sharing of benefits, intellectual property rights and overall sustainable development.

PA management : Status

- PAs are the cornerstones of biodiversity conservation efforts. India has created a network of PAs and other conservation areas, which include a total of 661 units (i.e. 99 NPs, 515 WLs, 43 ConR and 4 ComR), besides identifying a number of wetlands under the NWCP for conservation

interventions and designating 25 wetlands as Ramsar sites, and declaring 15 areas in different biogeographic zones of the country (which encompass NPs & WLSs) as BRs.

- The area covered under PAs and other conservation sites accounts for around 9% of the total geographical area of the country. Details of the WLS and NPs of India are given in **Table 1.22**.

Table 1.21: NPs and WLS in various biogeographic zones of India

Zone No.	Zone Name	Zone Area	% of India's Geographic Area	No. of NPs	Area	% of Biozone Area	No. of WLS	Area	% of Biozone Area	No. NPs of + WLS	Area	% of Biozone Area
01	Trans Himalaya	184823	5.62	3	5809.00	3.14	4	10438.56	5.65	7	16247.56	8.79
02	Himalaya	210673	6.41	12	7366.92	3.50	65	16065.85	7.63	77	23432.77	11.12
03	Deserts	214014	6.51	1	3162.00	1.48	5	12914.09	6.03	6	16076.09	7.51
04	Semi-Arid	539479	16.41	10	1505.78	0.28	81	12410.66	2.30	91	13916.44	2.58
05	Western Ghats	132179	4.02	16	3673.52	2.78	47	10018.86	7.58	63	13692.38	10.36
06	Deccan Peninsula	1380339	41.99	24	9712.24	0.70	127	44329.08	3.21	151	54041.32	3.92
07	Gangetic Plain	354848	10.79	6	2363.62	0.67	32	5473.24	1.54	38	7836.86	2.21
08	Coasts	91319	2.78	5	1731.18	1.90	20	2959.45	3.24	25	4690.63	5.14
09	North East	171340	5.21	13	2674.00	1.56	36	3418.62	2.00	49	6092.62	3.56
10	Islands	8249	0.25	9	1156.91	14.02	96	389.39	4.72	105	1546.30	18.75
	Grand Total	**3287263**	**100**	**99**	**39155**	**1.19**	**513**	**118417**	**3.60**	**612**	**157572**	**4.79**

Source: National Wildlife Database, Wildlife Institute of India, 2009

- The PA network in India is based on a conservation planning framework and is in accordance with the biogeographical classification**.** As per this, 19 out of the 27 biogeographic provinces are adequately represented in the PA network.
- Through an amendment to the WPA in 2003, two more categories of PAs (ConR and ComR) have been recognized. These are largely community oriented PA management initiatives. So far, India has established 43 ConRs and four ComRs.
- Special flagship programmes for the conservation of tigers and elephants being implemented on landscape level have led to the recovery of these species and conservation of their habitats. Currently India has 37 Tiger Reserves and 26 Elephant Reserves.
- A Wildlife Crime Control Bureau (WCCB) has been established in 2007 to combat illegal trade in wildlife and its derivatives.

- A National Tiger Conservation Authority (NTCA) has been set up in 2006 to strengthen tiger conservation efforts.
- The WII, a premier training and research institution, maintains a 'National Wildlife Database', that provides up-to-date information on the PA network of the country.
- Since the adoption of the 'Programme of Work on PAs' by the CBD in 2002, India's PA network has increased by 15 per cent.
- India has a NWAP which envisages 10% of the geographical area of the country under PA coverage. The extent of the formal PA network, at present, is around 4.8%. However, it is pertinent to note that almost all state owned forests and other important ecosystems which are outside the PA network are under some kind of broad based conservation planning. In addition, there are several community driven conservation initiatives in the country in the form of sacred groves, ponds, turtle nesting sites, etc. If all these are taken into account, biodiversity conservation is the core management paradigm in around one-fifth of the geographical area of the country, whereas broad based conservation planning is also practiced in most of the other production sectors such as agriculture, fisheries, animal husbandry, etc.
- Expansion of PA network is envisaged in the NEP. In order to strengthen and consolidate the existing wildlife conservation/management efforts, a modified national scheme titled 'Integrated Development of Wildlife Habitats' has been launched in 2008. Apart from providing support to PAs, the scheme extends financial and technical support to high value biodiversity formations outside the formal PA network (including traditional and customary conservation practices like CCAs and also provide for initiating recovery programmes for select critically endangered species.
- Recommendations are in place to establish additional PAs (67 new NPs and 203 new WLSs) to make it more biogeographically representative. However, due process as per the provisions of the WPA and other relevant legislations needs to be followed for the establishment of new PAs. More efforts are also needed to plan and establish new marine PAs.
- A Task Force has been constituted with mandate to identify potential areas that can be declared as Trans-boundary PAs (TBPAs) and a national consultative process for planning and establishing TBPAs has been initiated. Five TBPAs have been identified for enhancing regional cooperation with neighboring countries out of the 24 PAs featured in the regional network of TBPAs under the IUCN framework. Provision for the implementation of TBPAs has been incorporated in the scheme of 'Integrated Development of Wildlife Habitats'.
- Management Plans of PAs have been developed by applying the 'ecosystem approach', which provides for a core-buffer strategy for wildlife conservation. It is envisioned that whereas the core areas/ critical wildlife habitats are to be largely inviolate, co-existence agenda is to be promoted in the buffer.

- India is committed to take appropriate management steps for migratory species under the relevant international conventions. India has signed a Memorandum of Understanding (MoU) with the CMS in 2007 for the conservation and management of marine turtles and their habitats. National Marine Turtle Advisory Committee has been constituted in 2008. India has also signed a MoU with the CMS for the conservation and management of Dugongs and their habitats in 2008.

- The Management Effectiveness Evaluation of PAs in the country is being carried out in the country through independent experts using international protocols. During 2006-08, an evaluation of 30 PAs was carried out which showed the following results: very good (7 PAs); good (20 PAs) and satisfactory (3 PAs). This process is being continued against measurable performance targets after further refinement. Similarly, in 2005-06, 28 TRs in the country, covering an area of 37,761 sq km were evaluated and peer reviewed by IUCN.
- India has enacted the 'Scheduled Tribes and Other Forest Dwellers (Recognition of Forest Rights) Act, 2006' for empowering the tribals and other traditional dwellers for protecting their access and use of forest resources.
- Efforts are underway to identify and recognize areas that can be conserved with active participation of communities. In 2008, GOI has also formed a Committee to look into the management and funding of CCAs.
- At the site level, PA managers engage with and ensure participation of local communities in PA management. Site specific eco-development programmes involving local communities and aimed at generating livelihoods for conservation are now initiated in almost all the PAs.
- The 2006 amendment to the WPA has provided for the creation of Conservation Foundations in the TRs with a mandate of supporting the PA management through independent revenue generation and recycling of the same.
- A capacity needs assessment for PA management has been undertaken. WII organizes regular and customized training programmes of different duration for a number of target groups, not only from the forest/wildlife sector but also for policy makers, defence, customs, revenue, enforcement agencies, etc.
- The State Forest Departments (SFDs) organize nature education and other awareness programmes and several PAs have established conservation education/ interpretation centres. Environment education has been introduced in the formal curriculum of schools and colleges.
- Modern tools and technologies such as remote sensing and Geographical Information System (GIS), information technology, wildlife forensics, satellite telemetry, camera traps, etc., are being used in the PAs.

- The functional needs of PAs have been identified at the Central as well as the State levels. These have been articulated in the planning process also. During the 11th Five Year plan, the allocation for wildlife sector has been tripled.
- Till date, 15 BRs have been designated **(Table 1.22)**, and another 11 potential areas are proposed.

Table 1.22: Biosphere Reserves – A profile

S.No.	Name of BR	Total Geo. Area(Km2) (Biogeographic Province)	Representative States
1.	Niilgiri**	5520 (6E: Deccan Peninsula E)	Tamil Nadu, Kerala & Karnataka
2.	Nanda Devi**	5860.69 (2B: West Himalaya)	Uttarakhand
3.	Nokrek	820 (9B: North East)	Meghalaya
4.	Manas*	2837 (9A: Brahamputra Valley)	Assam
5	Sunderban**	9630 (8 B: East Coasts)	West Bengal
6.	Gulf of Mannar**	10500 (8 B: East Coasts)	Tamil Nadu
7.	Great Nicobar	885 (10 A & 10B: Islands)	A& N Islands
8.	Simlipal*	4374 (6B: Chotta Nagpur)	Orissa
9.	Dibru-Saikhowa	765 (9A: Brahamputra Valley)	Assam
10.	Dehang –Debang	5111.5 (2D: East Himalaya)	Andhra Pradesh
11.	Kangchendzonga*	2619.92 (2C: Central Himalaya)	Sikkim
12.	Pachmari*	4926.28 (4B- Gujrat Rajputana	Madhya Pradesh
13.	Agasthymalai	3500.36 (5A- Western Ghats)	Tamil Nadu & Kerala
14.	Achanakmar Amarkantak	3835.51(6A- Deccan Peninsula)	M.P. & Chattisgarh
15.	Kachchh	12,454(3B—Kachchh)	Gujarat

*Source: www.envfor.nic.in; * Sites under consideration for UNESCO World Network of BRs, ** Sites under UNESCO World Network of BRs;*

PA management : Challenges

- Expansion of PAs remains a challenge. There is a general feeling that establishment of PAs leads to hardships to local communities mainly because of (a) restriction on access and use of resources inside PAs; and, (b) increase in human-wildlife conflicts. More concerted efforts are required for the expansion of PA network, particularly in areas where its representation is suboptimal.
- The connectivity of PA network is to be improved through establishment of corridors.
- A range of strategies need to be put in place to mitigate human-wildlife conflicts including payment of adequate compensation for losses suffered.
- Identifying, preventing and/or mitigating the negative impacts of key threats to PAs is a challenge.
- More efforts are needed to plan and establish new marine PAs to further strengthen conservation of rich and varied marine and coastal biodiversity.
- Inadequate capacity and resources to undertake the task of economic evaluation of environmental goods and services emanating from the PAs is a constraint.

- Develop a comprehensive sustainable financing strategy for PAs so as to plug gaps in PA funding.
- Ensuring up to date, site specific and scientific management planning of PAs.
- Linking the PAs into the larger landscapes and also integrating the livelihood aspirations of local people in PA management is a challenging task.
- Combating wildlife crime and illegal trade in wildlife continues to be a cause of concern.
- Strengthening and consolidating existing traditional wildlife conservation/enforcement efforts, habitat improvement practices, and infrastructure development requires concerted efforts.
- Efforts for the protection of wildlife outside PAs, critically endangered species and habitats, and initiating specific species/habitat recovery programmes needs to be strengthened.
- More attention is required for rationalization of PA boundaries, final notification and settlement of rights in areas of relocation of villages from crucial wildlife habitats, securing critical wildlife habitats such as corridors, etc.
- Eco-development programmes and landscape level interventions need to be invigorated.

CHAPTER 2

THE CURRENT STATUS OF THE NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN

2.1 INTRODUCTION

Article 6(a) of the CBD calls upon Parties to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes which shall reflect, inter alia, the measures set out in this Convention relevant to the Contracting Party concerned.

At the Central Government level, MoEF is the focal point for biodiversity conservation as well as 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, and Science and Technology, and others have important programmes relating to biodiversity.

India's strategy for conservation and sustainable utilization of biodiversity has evolved through various initiatives addressing specific issues viz., National Forestry Action Plan, National Conservation Strategy, National Environment Action Programme, NWAP, etc.

In pursuance of Article 6 of the CBD, India within five years of ratifying the Convention, had developed a National Policy and Macro-level Action Strategy on Biodiversity, in 1999 through an extensive consultative process. Thereafter, an externally aided project on NBSAP was also implemented in the country during 2000 – 2004, adopting a highly participatory process involving various stakeholders, under which several sub-national level action plans were developed **(Table 2.1)**. On the basis of these action plans, a final technical report of NBSAP was prepared.

Table 2.1: Details of BSAPs

S.No.	Level	Number of outputs	Purpose
1.	States and Union Territories	33	Status of knowledge, and strategies and priorities for action
2	Local (sub-state) sites	18	Status of knowledge highlighting unique features of biodiversity components
3.	Eco-regions	10	Unique features of selected eco-regions and potential strategies for action
4.	Thematic Working Groups	13	Covered all the aspects in tune with the objectives of the Convention
5.	Sub-thematic reviews	34	Included the areas of cross sectoral aspects such as mining, community conserved areas, tourism, dams, etc.

Meanwhile, India also enacted the BDA in 2002, Section 36 of which empowers the Central Government to develop National Biodiversity Action Plan (NBAP). After the approval of NEP in 2006, preparation of 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 2008 draws upon the main principle in 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 programs, action points have been designed so as to integrate biodiversity concerns into various other 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. The NBAP also provides for a tabulated matrix for implementation of key activities, indicating the implementing agencies and timeframe for each of these activities.

This chapter highlights the current status of national policies, plans, strategies, and legislations relevant to the CBD. It also provides information on the progress of implementation of the action points listed in the NBAP.

2.2 NATIONAL LEGISLATIONS, POLICIES AND PLANS RELEVANT TO CBD

The Constitution of India contains specific provisions for environmental conservation [articulated in the Directive Principles of State Policy (48-A) & (51-A(g)) and Fundamental Duties (51-A)]. Numerous legislations (acts, rules, circulars and orders) relating to environmental protection as well as specific laws relating to forests, wildlife and biodiversity have been passed taking into account governmental and civil society concerns. Some key legislations relevant to biodiversity are listed in **Table 2.2**.

Table 2.2: Legislations relevant to biodiversity conservation

Relevant key legislation	Key features
Wildlife (Protection) Act, 1972	Deals with protection of wildlife and habitats and provides for the protection of wild animals, birds and plants and related matters, with a view to ensuring the ecological and environmental security of the country.
Indian Forest Act, 1927	Designed for forest management and protection, the transit of forest- and the duty leviable on timber and other forest produce.
Forest (Conservation) Act, 1980	Designed for the conservation of forests and related matters
Biological Diversity Act, 2002	Provides for conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and related matters.
Biological Diversity Rules, 2004	Deals with operationalising the Biological Diversity Act.

Table 2.2 : Legislations relevant to biodiversity conservation (Contd.)	
Relevant key legislation	**Key features**
Protection of Plant Varieties and Farmers' Rights Act, 2001	Provides for the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders, and to encourage the development of new varieties of plants.
The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	Recognizes and vests the traditional rights to forest dwelling communities over access to forest goods and occupation in forest lands.

Some of the key policy documents of the Government along with a brief outline of their priorities are given in **Table 2.3**.

Table 2.3: A brief outline of policies, plans and strategies dealing with biodiversity	
Policies, plans & strategies	**Brief outline of priorities**
National Forest Policy, 1988	Provides for national goals and guidelines relating to areas under forests, afforestation, social forestry and farm forestry, management of state forests, rights and concessions, diversion of forest lands for non-forest purposes, wildlife conservation, tribal people and forests, shifting cultivation, damage to forests from encroachments, fire and grazing, forest-based industries, etc. The policy also covers forestry education, research, management, survey and database, legal support, infrastructure development and financial support.
National Conservation Strategy and Policy Statement for Environment and Sustainable Development, 1992	Outlines the nature and dimensions of environmental problems in India as well as actions taken and constraints and agenda for action.
National Policy and Macro-level Action Strategy on Biodiversity, 1999	Outlines a series of macro-level statements of policies, gaps and strategies needed for conservation and sustainable use of biodiversity.
National Agricultural Policy, 2000	Seeks to actualize the vast untapped growth potential of Indian agriculture, rural infrastructure, value addition, secure a fair standard of living for the farmers and agricultural workers, discourage migration to urban areas and face the challenges arising out of economic liberalization and globalization.
National Seeds Policy, 2002.	Thrust areas include varietal development production, quality assurance, seed distribution and marketing, infrastructure facilities, etc.
National Wildlife Action Plan (2002-2016)	Calls for adoption and implementation of strategies covering strengthening and enhancing the PA network, effective management of PAs, conservation of wild and endangered species and their habitats, restoration of degraded habitats outside PAs, control of poaching, and illegal trade in wild animal and plant

Table 2.3: A brief outline of policies, plans and strategies dealing with biodiversity (Contd.)	
Policies, plans & strategies	**Brief outline of priorities**
	species, monitoring and research, HR development, ensuring peoples' participation, awareness and education, wildlife tourism, domestic legislation and international conventions, enhancing financial allocation and integration with other sectoral programmes.
Comprehensive Marine Fishing Policy, 2004	Aims to maximize yield from marine fishery resources while balancing the development needs of the various categories of fishing communities.
National Environment Policy, 2006	Stated objectives include: i) conservation of critical environmental resources; ii) intra-generational equity: livelihoods security for the poor; iii) inter-generational equity; iv) integration of environmental concerns in economic and social development; v) efficiency in environmental resource use; vi) environmental governance; and vii) enhancement of resources for environmental conservation.
11th Five Year Plan (2007-2012)	Calls for a development strategy that is sensitive to growing environmental concerns and calls for careful evaluation of threats and trade-offs.
National Forestry Action Programme (2000-2020)	Envisages developing coordinated programme for the sustainable management of forests and forest lands to meet the environmental, socio-economic and cultural needs of the present and the future generations.
National Biotechnology Development Strategy (2007)	Prioritizes key policy recommendations and interventions relating to human resource, infrastructure development and manufacturing and regulatory mechanisms.
National Forestry Commission Report (2006)	Contains over 350 recommendations regarding organizational structure and functions of the forestry sector.
Final Technical Report National Biodiversity Strategy and Action Plan Project (2005)	Identified a detailed set of priority issues for the overall planning and governance as well as for the conservation of wild as well as domesticated biodiversity.
National Action Plan on Climate Change (2008)	Eight national missions envisaged and among these four (National Mission on Water, Sustaining Himalayan Ecosystems, Sustainable Agriculture and Green India) are directly relevant to biodiversity conservation.

2.3 THE NATIONAL BIODIVERSITY ACTION PLAN – PROGRESS IN IMPLEMENTATION

The action points in the NBAP have been given under 11 sub-heads. In this section, an attempt has been made to indicate the progress in implementation under each of these 11 sub-heads by listing out the major activities taken up along with major challenges and constraints. The Articles of the CBD relevant to these 11 headings have also been indicated. Much of the information in this section is drawn primarily from NBAP 2008.

2.3.1 Strengthening and integrating *in-situ*, on farm and *ex-situ* conservation (Artilces 8, 9)

- India's major strength in *in-situ* conservation lies in the impressive PA network, the details of which are covered in Chapter 1.

- Besides, 15 BRs have been designated, of which four have so far been recognized by the UNESCO under World network of BRs, and three are under consideration. Fourteen more potential sites have also been identified for this purpose.
- Considering that several high value biodiversity areas lie outside the formal PA network requiring special attention, a national programme has been launched for "Protection of Wildlife Outside Protected Areas".
- Through an amendment to the WPA in 2003, the Central Government has also recognized ConR and ComR as formal PAs.
- Specific programmes for scientific management and wise use of fragile ecosystems such as wetlands, mangroves and coral reef are under implementation and so are internationally significant wetlands designated as Ramsar sites under the Ramsar Convention. Under the World Heritage Convention, natural sites are declared as World Heritage sites.
- 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. A National River Conservation Plan (NRCP) is under implementation in 160 towns along polluted stretches of 34 rivers spread over 20 states.
- Large mammal species targeted projects (e.g. Project Tiger, Project Elephant) based on the perception of threat to them have been under implementation over the last two decades. In addition, in 2008, a national programme has been launched for recovery of 15 select critically endangered species such as Snow Leopard, Hangul deer, Vulture, Rhino, Dugong, Great Indian Bustard, etc.
- Various measures are being taken to address the declining population of vultures in India.
- *In-situ* conservation of the medicinal plants is being undertaken by various government and non-government organizations. The NMPB, set up in 2000, promotes coordination and implementation of policies relating to medicinal plants both at the Central and State levels. The research component is also being taken up by national institutions and universities including state agricultural universities. Besides, 55 Medicinal Plant Conservation Areas (MPCA) have been established in five States (Kerala, Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra) covering an area of over 11,000 ha.
- To complement *in-situ* conservation, attention has been paid to *ex-situ* conservation measures through setting up of botanic gardens, zoos, deer parks, safari parks, aquaria, etc. A Central Zoo Authority (CZA) has been set up to secure better management of zoos. A plan scheme on 'Assistance to Botanic Gardens' provides adequate assistance to strengthen and institute measures for *ex-situ* conservation of threatened and endangered species. Guidelines for botanical gardens have been finalized.

- The vision is to have at least one botanical garden per district. Also, Ethno Medical Garden (EMG) at Bangalore, MPCAs in four States and 1,70,000 home herbal gardens in 10 States for primary health care have been established. The ICAR has set up a number of gene banks for *ex-situ* conservation under the NBPGR, NBAGR, NBFGR and NBAIM.
- Thirteen repositories for different components of biological diversity in India have been notified in 2008 under the BDA.
- The DBT implements 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. DBT has established a national facility "Laboratory for conservation of species – LaCONES" jointly with the help of CZA, CSIR and Andhra Pradesh Government at Hyderabad for the conservation of endangered animal species like tiger, lion, black buck, vulture, etc. Some other programmes supported by DBT 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 Schedule Castes (SC)/Schedule Tribes (ST) and other weaker sections.
- Traditional Indian farming systems practiced under suitable situations in different States include, among others, irrigated rice-fish farming by Apatani tribals of Arunachal Pradesh, rice cultivation in hilly areas of Jeypore tract in Orissa and Chhattisgarh. These 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.

Challenges and constraints

- To arrest habitat loss and fragmentation.
- To address adverse impact of developmental activities on biodiversity.
- To mainstream biodiversity conservation into production sectors.
- Expansion of PA network.
- To secure sustainable financing for PAs and voluntary relocation of villagers from critical wildlife habitats for enhancing the quality of habitat for wildlife and also the quality of living for villagers by facilitating better access to resources need to be participatory at all levels of implementation.
- Conservation of traditional land races of wild varieties.
- Bioprospecting of native medicinal plants (nearly 6,500 species), developing agro techniques for endemic medicinal plants and raising suitable medicinal plants in urban lands.

- Need to develop fruitful and workable national partnerships among all concerned government agencies, scientific institutions and rural communities for *in-situ*, on farm and *ex-situ* conservation of biodiversity.

2.3.2 Augmentation of natural resource base and it sustainable utilization (Article 10)

- As reported earlier, conservation and sustainable use of biodiversity have been integrated into national decision-making through policy statements, legislative measures, and programmes and several initiatives are underway to implement various elements to this effect which are summarized at the end of this chapter.
- Some of the main activities being promoted to divert pressure from natural resources in biodiversity rich areas include: a) bringing in additional areas under green cover; b) meeting local demands; c) encouraging environment-friendly substitutes; d) promoting energy efficient devices; e) restricting use and extraction of only desired part of the organism rather than the entire organism; and f) creating awareness and an enabling environment.
- Economically effective and socially viable incentives for conservation and sustainable use of biological diversity, such as, 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 are encouraged.
- Growing emphasis on poverty alleviation and livelihood opportunities and at the same time ensuring sustainable management and use of forest resources is explicitly mentioned in National Status Report on Forests and Forestry in India (2006).
- GOI has enacted the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of the Forest Rights) Act, 2006 for empowering the tribal and other communities and protecting their access and use of forest resources.
- Funds have been generated as part of food for work activities done by United Nations World Food Programme in collaboration with SFDs of a number of States. The funds thus generated provide resources for sustaining the maintenance of natural resource management related interventions.
- The JFM programme implemented through FDAs and JFMCs has emerged as a powerful tool to achieve sustainable forestry in India.
- NTFPs play an important role in the social and traditional life of forest dependent populations, including women and children. Therefore, it is essential that women play a greater role in the management of resources. In this context, the relevant provisions of NEP for empowerment of women provide a framework for incorporating elements of proposed action.

- 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. Sustainable management of NTFPs is one of the major concerns which is being ensured through development and application of non-destructive methods of NTFP collection.
- 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 CRZ Rules, 1991 and draft CMZ Notification, 2008 (details in chapter 3).
- Various programmes initiated by the MoEF, including NAP, setting up of JFMCs, etc., focusing on greater participation of the community to improve their livelihoods. These programmes also help in poverty alleviation in the respective areas.
- The involvement of private sector is encouraged in initiatives on the sustainable use of biodiversity. For example, both public and private sectors comprising individuals, companies, cooperatives, and industry, are playing key roles in the commercial forestry. 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. Development of community knowledge register on medicinal plants undertaken in various states, being implemented by UNDP/ GEF, is yet another example of this kind.

Challenges and constraints

- Lack of permanent institutional arrangement and regular sustained income flows to participating communities under JFM.
- Need to strengthen and synergize linkages between the PRIs and JFMCs.
- Organizational support is lacking and little or no incentives for NTFP gatherers for access to market; unsustainable and destructive harvesting and lack of inventory data or value addition and non-remunerative prices in NTFPs; rational harvesting of potential of NTFPs through scientific approaches and greater people's participation.
- Lack of adequate awareness on the multiple roles and benefits of forests and its relevance to poverty alleviation and sustainable development.
- Relatively low priority for forestry in national planning process.
- Slow pace of policy reforms and inadequate regulatory mechanism.
- Over-emphasis on government control and involvement and difficult administrative procedures.

- Weak forestry information system rendering decision-making difficult.
- Inadequate investment in forestry, non-commensurate with its role in sustainable development.
- Inadequate space for private participation and lack of full realization of people's participation.
- Inadequate frontline staff and targeted research and extension studies.

2.3.3 Regulating introductions and managing invasive alien species (Article 8 (h))

Some of the measures undertaken for regulating introduction of invasive alien species are given in **Box 2.1.**

Box 2.1: Invasive alien species

- 173 alien plant species recorded in India.
- India follows international quarantine regulations.
- 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'
- Environmental (Protection) Act, 1986 (Rules 1989) states ' to prohibit or restrict substances having potential to cause damage to environment, plants and animals'.
- ICFRE has established a 'Forest Invasive Speces (FIS) Cell' in Forest Research Institute (FRI) to deal with various aspects of management of FIS in the country.

Source: India's Forests, 2007

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, MoA deals with cultivated plants, fish and farm livestock including poultry. It also has projects on eradication and management of invasive weedy plants, pathogens, pests and harmful fish. The MoEF deals with all forest materials and wild animals. 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 IAS across jurisdiction of all concerned Ministries and relevant sectors.

Challenges and constraints

- There is a need to augment the existing capacity for the control and regulation of IAS especially at entry points of the country (at airport and seaports).
- Effective site-eradication procedures require multi-year treatments, continued monitoring and follow-up.
- Effective tools to employ early warning, rapid and risk assessments and management methods need to be further developed.
- Mechanisms for the mass removal of IAS from PAs/ forests/ wetlands with the participation of local communities need to be developed.

- There is a need to promote inter-sectoral linkages to check unintended introductions and contain and manage the spread of IAS.
- National database on IAS reported in India to be developed.
- Restoration measures of degraded ecosystems using preferably locally adapted native species need to be promoted.

2.3.4 Assessment of vulnerability and adaptation to climate change and desertification (Article 14)

Agriculture and forestry are the sectors considered to be relatively more vulnerable to the projected climate change and the preliminary assessments have indicated decline in agricultural productivity and shifts in cropping patterns, forest boundary, 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.

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 (IARI) 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.

The GOI attaches great importance to climate change issues and has outlined its strategy in the NAPCC to meet the challenge of climate change. Through its eight missions, NAPCC advocates a strategy that promotes, firstly, the adaptation to climate change and secondly, further enhancement of the ecological sustainability of India's development path. Missions on Agriculture, Green India and Himalayan Ecosystems, detailed in NAPCC are directly relevant to the CBD goals. The GOI, is involved in ensuring a follow-up action on the strategies envisaged in the missions.

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

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 climate extremes. The Ministry of Rural Development (MoRD) through its various programmes such as Integrated Wasteland Development Programme, Drought Prone Area Programme and Desert Development Programme on watershed basis strives for development of land resources, controlling desertification and

livelihood generation with the overall objective of poverty alleviation.

Challenges and constraints

- To further develop methodologies, tools and models to assess accelerated desertification processes.
- There is a need to assess and integrate biodiversity concerns in developing indicators of climate change vulnerability and adaptation for various thematic sectors at national and local levels. 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.
- There is a need to 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 polices, strategies and programmes.
- In view of the multi-disciplinary nature of the subject, an "All India Coordinated Research Project on Impacts of Climate Change" is needed 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 fuel wood stoves, and solar cookers.

2.3.5 Integration of biodiversity concerns in economic and social development (Article 6(b) & 10(a))

The EPA, 1986; the EIA Notification, 2006; the CRZ Notification, 1991 and the notification pertaining to ecologically sensitive areas provide enabling environment for proper assessments and measures to minimize adverse impact of developmental activities.

Ecologically sensitive areas, notified under the EPA, 1986 **(Box 2.2)** envisage 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 2.2: Areas declared ecologically fragile/eco-sensitive or where development/ setting up of industries has been regulated

- Murud-Janjira area in Raigarh District, Maharasthra (6th January, 1989),
- Doon Valley, Uttarakhand (1st February, 1989),
- Dahanu Taluka, District Thane, Maharasthra (20th June 1991),
- Aravali Range, Gurgaon District, Haryana and Alwar District Rajasthan (7th May, 1992),
- No Development Zone around Numaligarh Refinery Site in Assam (5th July, 1996),
- Mahabaleshwar, Panchgani, Satara District, Maharashtra (17th January, 2001) and
- Matheran, Maharashtra (4th February, 2003.)

Source: NBAP: 2008

Considering the importance of disaster management as a national priority, a National Disaster Management Authority (NDMA) has 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 waste management and solid waste management to promote safe handling. For example, handling of 70 cancer causing azo dyes and the processes incidental thereto in the course of which these substances are found or carried on throughout the country, have been prohibited vide notification dated March 26, 1997.

Besides, 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.

Challenges and constraints

- There is a need to strengthen EIA initiatives to monitor response of agro-biodiversity to land use changes.
- Further augmenting the mechanisms to consider 'conservation offsets' in EIAs.
- To delineate eco-sensitive zones around PAs.
- To integrate the livelihood aspirations of local communities in and around PAs and forests.
- 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.
- 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.

2.3.6 Impact of pollution (Article 14)

Biodiversity in India is facing threat from various sources of pollution especially at a time when new industrial processes are generating a variety of toxic wastes and also increased mushrooming of urban sprawls. Generation of wastes from anthropogenic activities involving production and consumption adds to the pressures on ecosystems.

The impact of air and water pollution is maximum on vulnerable sections of society particularly the poor, women and children, who contribute the least to its generation. Accordingly, the costs and benefits of abatement may have important implications for intra-generational and inter-generation 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 EPA, 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.

Challenges and constraints

- Integration of cross cutting issues for improvement in decision making on pollution abatement measures
- Minimize 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 organic farming of locally adapted and traditional crop varieties through appropriate incentives, and direct access to markets duly supported by credible certification systems.
- Promote R&D on impacts of air, water and soil pollution on biodiversity and use of biological methods for pollution amelioration.

2.3.7 Developing and integrating biodiversity databases (Article 7)

Although 70% of the India's land area has been surveyed, the estimates indicate a wide gap in the information with regard to the number of species recorded and described in India.

In order to ensure a unified format for collection, retrieval and dissemination of data on biodiversity, the Central Government while framing Biological Diversity Rules, 2004 under BDA, mandated the NBA to build up database and to create documentation system for biological resources and biological diversity registers and electronic databases to ensure effective management, promotion and sustainable use [Rule 12 (xiii)].

There is a 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 through a coordinated network of institutions including CSIR, with focus on endangered, endemic and insufficiently known species.

Challenges and constraints

- The baseline data on species and genetic diversity, and their macro and micro-habitats, is inadequate.
- The sub terrainian /underground biodiversity, particularly soil microbes, are poorly understood.
- The information on the subject is scattered and not yet integrated into a national database.
- Infrastructure, skilled manpower and coordination among experts in different fields are inadequate.

2.3.8 Strengthening implementation of policy, legislative and administrative measures for biodiversity conservation and management (Articles 8 (k), 14, 15)

Environment and forests being in the Concurrent List of the Constitution of India, both Central and State Governments legislate and formulate policies and programmes. Salient features on national policies relevant to biodiversity conservation are given (in the begining of this Chapter and Chapter III). As our development challenges evolved and understanding of the centrality of environmental concerns in development sharpened, the overarching NEP was developed in 2006. The NEP builds on the earlier policies and further strengthens them.

Major central legislations (mentioned earlier) are supported by a number of State laws and statutes as provided under the Constitution. The Inter-State Council has been set up under Article 263 of the Constitution for co-ordination of inter-state matters.

The BDA enacted in 2002 in pursuance to the CBD is a comprehensive legislation, the primary aim of which is to conserve biodiversity through *inter alia* 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 Indian Patent Act 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. The Patent 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 mega diverse 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 accelerated. Experience gained in implementation of the national legislation on ABS would be of much value in strengthening and effectively articulating the developing country perspective for the international regime on ABS presently being negotiated under the CBD.

Challenges and constraints

- Accelerate effective actions at the central, state and local levels to implement provisions under the BDA.
- Review enabling policies to prevent transfer of prime agricultural land to non-agricultural purposes, and promote sustainability of agricultural lands.
- 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 of new legislation, based on better scientific understanding, economic and social development, and development of multi-lateral environment regimes, in line with the NEP.
- 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.
- Sustainable models of traditional rights and knowledge systems.
- Linkages between research and policy in marine and coastal environments.
- Very few national strategies for many lower and neglected taxa.
- Insufficient attention paid to urban ecosystems and biodiversity.
- Limited policy approach to maintenance of ecosystem services and goods.

2.3.9 Developing national capacities for biodiversity conservation and appropriate use of new technologies (Article 12, 13)

Over the years, India has developed a robust institutional structure for promoting human resource development and capacity building through inter–ministerial arrangements to enrich the understanding of concepts, themes and complex inter-linkages on biodiversity conservation and sustainable utilization of bioresouces. These initiatives are further augmented through electronic and print media for awareness generation among the masses.

A number of Ministries/Departments, agencies, and organizations are supporting research relating to biodiversity (Chapter III). Coordination among these organizations needs to be enhanced. There is also a need to effectively integrate findings of research projects into policy-making.

Some initiatives in capacity building in the field of livelihood diversification opportunities for local communities to meet their economic needs compatible with ecological sustainability have been taken up by NGOs. An illustrative example **(Box 2.3)** indicates the potential of involving a large number of stakeholders, especially women, for enhancing technology-based- livelihood opportunities to reduce their dependency on bio-resources.

Box 2.3: Participatory technical innovation and research for enhancing livelihood opportunities (Himalayan Environmental Studies and Conservation Organization, Uttarakhand)

- Pioneered up-gradation and renovation of watermills commonly known as 'Gharats' for power generation and improving their efficiency.
- As pulses of mountains are in high demand, developed pulse villages and conducted trials of improved varieties of seeds and good agricultural practices.
- Over 120 village women (25 from each village) were imparted_training on cultivation practices, grading and packaging and making value added products.
- Activities on improved fodder cultivation (12 locations) to meet the fodder demand in rural areas involving women.
- Development of nursery technology with bio-fertilizer packages using VAM fungi and plant growth promoting Rhizo-microorganisms (PGPRs) with multi-locational trials for regeneration of degraded forests and waste lands.

Challenges and constraints

- Infrastructure and human resource for conducting research and development especially in the emerging areas of biodiversity conservation need to be augmented.
- Insufficient training programmes for various stakeholders.
- Need to focus research and capacity building 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.
- Participation of private sector in R&D also needs to be further encouraged.

2.3.10 Use of economic instruments/valuation in biodiversity related decision- making processes (Article 11)

In India, natural resource accounting systems are still evolving and concerted efforts are being made to incorporate costs associated with the degradation and depletion of natural resources into decision-making. This is vital to reverse the tendency of treating these resources as free goods.

The costs and benefits associated with various activities as outlined above need to be factored in decision-making.

Challenges and constraints

- Need to build capacities on different protocols of valuation techniques and tools.
- A judicial mix of incentives and regulatory instruments need to be developed
- A system of natural resource accounting at macro level is required to assess the swings in natural resource capital and economic growth
- There is a need to integrate natural resource accounting results into micro level planning.

2.3.11 International cooperation (Article 5)

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: CBD, CITES, Ramsar Convention on Wetlands, World Heritage Convention, and the Bonn Convention on CMS. Some other international agreements which have bearing on biodiversity to which India is a Party include UNFCCC, UNCCD, UN Commission on Sustainable Development (UNCSD), World Trade Organization (WTO), International Treaty on Plant Genetic Resources (ITPGR) for food and agriculture and UN Law of the Seas.

GEF is the designated financial mechanism for the CBD, and India is both a donor and recipient of the GEF grant. It provides grants to developing countries for meeting the objectives of the CBD.

India has also actively supported numerous regional and bilateral programmes on biodiversity. MoEF, the nodal Ministry for the CBD and other biodiversity related conventions, is also the nodal agency in

the country for the UNEP, South Asia Cooperative Environmental Programme (SACEP), International Centre for Integrated Mountain Development (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 harmonize 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 chaired the Like Minded Megadiverse Countries (LMMCs) (holding 70% of all biodiversity) 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.

In order 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, an international regime on ABS is being negotiated by a Working Group under the aegis of the CBD, pursuant to a landmark decision of seventh Conference of Parties (COP) to the CBD. The COP-8 held in March 2006 has set a deadline of 2010 for completing the negotiations of IR on ABS and COP-9 held in May 2008 has developed a road map for completing these negotiations.

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.

Challenges and constraints

- 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.
- Promote regional cooperation for effective implementation of suitable strategies for conservation of biodiversity, especially through organisations such as South Asian Association for Regional Cooperation (SAARC), Association of Southeast Asian Nations (ASEAN), and Economic and Social Commission for Asia and the Pacific (ESCAP).
- Further consolidate and strengthen global cooperation, especially with UN agencies and other international bodies on issues related to biodiversity.

- Inadequate attention/ priority for funding biodiversity conservation by bilateral and multilateral donors

2.4 NBAP : RATING THE PROGRESS

Many of the actions and activities proposed in NBAP are ongoing and are being implemented through existing policies and institutional framework. As can be seen from the preceding section, the progress of implementation under many of the 11 sub heads has been quite satisfactory. However, there are constraints that need to be addressed to further upscale the action on ground. Based on some of the important initiatives undertaken in this regard, which are listed in the **Box 2.4** below, an attempt has been made to rate or measure the progress.

(A single asterisk denotes fair, double asterisks good and three asterisks very good progress.)

Box 2.4: NBAP – Rating the progress

Sub head 1: Strengthening and integrating *in-situ*, on farm and *ex-situ* conservation (Articles 8,9,10,12) [***]

- 10 State of Forest Reports (SFR) published using RS; forest cover maps of different scales in public domain; 80% Trees outside Forests (TOF) inventoried comprehensively; coral reef atlas using RS data and assessment of mangroves; 38 mangrove areas and four coral reefs recognized as ESAs; designated 15th BR (Kachchh, Gujarat) in 2008; seven BRs included in the World network of BRs.
- Recovery programmes initiated for critically endangered species and habitats. Financial and technical support extended to the protection of high value biodiversity areas outside PAs including community conserved areas.
- Greening efforts in urban areas like Delhi have resulted in a remarkable increase in the green cover and efforts are on to further strengthen this activity through continuous monitoring and public involvement.
- "Green Channel" project initiated in Botanic Garden of the Indian Republic (BGIR) for *ex-situ* conservation of endangered species; *ex-situ* conservation of endemic plant species in Lead Gardens in different phytogeographic zones initiated; implementation of Action Plan on Vulture Conservation and identification of 61 critically endangered wild animal species for coordinated conservation breeding in zoos.
- Eight new Tiger Reserves and three more Elephant Reserves created; a scientific methodology for estimating tiger populations developed; elephant population increased compared to 2002 census.
- 33 projects for conservation of 49 lakes approved in 13 States; number of wetlands under NWCP increased from 27 in 2004 to 115 in January 2009; 25 sites designated as Ramsar sites.
- Pharmacognostic studies on prioritized medicinal plants, biodiversity status of lichens conducted; DNA fingerprinting in 33 major crops completed; conserved over 3,79,4000 germplasm accessions of crops and their wild relatives and 2517 microorganism cultures and digitized database of over 175,000 insect species; conservation of select breeds in their native tracts under Indigenous Development Project and DNA barcoding of 300 Indian fish species undertaken.
- Molecular markers were used for wildlife identification; methods standardized for forensic identification of hides of wildlife species; cloned buffalo embryos raised through nuclear transfer of somatic cells
- The PA network in India has grown by 15% since the adoption of POW on PAs
- 2 new categories of PAs (ConR and ComR) have been recognized in national wildlife legislation.
- Strengthen *ex-situ* conservation measures through setting up of gene banks, botanical gardens, zoos, aquaria, etc.

Box 2.4: NBAP – Rating the progress (contd.)

Sub head 2. Augmentation of natural resource base in its sustainable utilization; ensuring inter and intra generational equity (Articles 10, 11, 15, 16) [***]

- Sustainable Forest Management Cell established; projects initiated in coastal States/ UTs to rehabilitate degraded mangrove areas and enhance mangrove cover and provide supplementary livelihoods
- Fascinating shades of eco-friendly dyes prepared from poplar, eucalyptus, lantana, parthenium etc.; bamboo propagation macro proliferation technique standardized; improved techniques for disease free quality plating material developed for citrus, banana, potato, cassava, etc.
- Mapping of lesser known florican breeding sites for developing fodder producing grassland network in western India; livestock production including fish and fish products enhanced substantially; additional area brought under fish and shrimp culture; productivity of horticulture crops increased.
- NGOs and community institutions involved in development of grassland reserves; established seven regional stations for forage production and demonstration.
- Good agricultural practices develop for medicinal plants; doubled the seed production of cultivable improved varieties; a network of 47 model watersheds developed under NWDPRA.
- Provision of funds (Rs. 450 crores) to the development of forest villages, conservation and water harvesting etc; over 22.02 million ha of forests is managed by around 1.06 lakhs JFMCs.
- Assigned ownership of minor forest produce to the people living in and around forest through a national legislation named as the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.
- Under NAP an extent of 14.1 lakh is being covered under afforestation/ reforestation.

Sub head 3. Regulating introductions and managing invasive alien species (Article 8 (h). [**]

- Centre for Environmental Management of Degraded Ecosystems (CEMDE) is developing strategies to restore mined out areas, eradicate lantana and restore weed free landscapes.
- List of forest invasive species compiled in APFIS Network.
- International quarantine regulations on IAS being followed.
- Financial and technical support provided for research and eradication programs of IAS.

Sub head 4. Assessment of vulnerability, and adaptation to climate change and desertification (Articles 6, 7, 14) [**]

- A NAPCC prepared in 2008. Follow-up action on NAPCC initiated on the eight missions.
- Process of revising NAP (prepared in 2001) on desertification has been initiated.
- Projections in forest sector indicate a shift towards wetter forest types in northeastern region and drier forest types in northwestern region in absence of human influence; NCDMA has approved 772 projects in biomass based cogeneration, energy efficiency, municipal solid waste, etc.

Sub head 5. Integration of biodiversity concerns in economic and social development [Articles 6 (b), 10 (a)] [**]

- The EPA, 1986; the EIA Notification, 2006; the CRZ Notification, 1991 and the notification pertaining to ecologically sensitive areas provides enabling environment for proper assessments and measures to minimize adverse impact of developmental activities.
- Ecologically sensitive areas, notified under the EPA envisages imposing restriction 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.
- Revising the coastal zone regulation has been initiated.
- Most of the GEF projects under biodiversity focal area primarily aim at mainstreaming biodiversity concerns with social and economic development.

Box 2.4: NBAP – Rating the progress (contd.)

Sub head 6. Impact of pollution (Article 14) [***]

- Sewage treatment capacity under Ganga Action Plan and Yamuna Action Plan augmented; pollution abatement works have been undertaken in 14 States; water quality monitoring stations have been further up-scaled to over 158 in 10 rivers.
- Network programme on pesticide degradation involving four research institutes launched.
- An integrated biotechnological approach (IBA) for bioremediation of mine spoil dumps and degraded ecosystems has been successfully demonstrated.
- An auto fuel policy enunciated to holistically address the issues of vehicular emissions, technologies and auto fuel quality in a cost efficient manner.
- General as well as industry specific emissions and effluent standards are being notified for various categories of industries under EP Act.
- Noise pollution rules notified in 2000.
- Charter on Corporate Responsibility for Environment Protection adopted in 2003.
- Environment Pollution Authority for national capital region (NCR) was constituted under EPA in 1998.
- National Environment Appellate Authority established in 1997.
- Waste minimization being adopted as preventive strategy to address in small and medium enterprises
- EIA made mandatory for identified categories of development projects

Sub head 7. Developing and integrating biodiversity databases (Articles 7, 10, 12) [**]

- Development of National Forestry Database Management System initiated.
- Strengthened database and information network for fisheries sector.
- Integrated databases maintained on livestock, agro-ecological (epidemiological). Functional livestock disease relational database software supported by GIS NADRES is made available on the internet.
- ENVIS network further strengthened (76 network partners).
- Developed four online databases viz; NORV, IINDUS, GPVR and capacity building on biosafety and bio-security issues.

Sub head 8. Strengthening implementation of policy, legislative and administrative measures for biodiversity conservation and management (Articles 8, 9, 10, 12) [***]

- Entities of Incomparable Value (EIVs) within buffer zones as defined in NEP, 2006 shall be identified in new regulation; 18 States have formed SBBs under BDA and PBR actively operationlized; extensive capacity building activities undertaken for efficient management of genetically modified crops covering 12 States.
- Assigned ownership of minor forest produce to the people living in and around forest through a national legislation named as the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (also called 'Forest Rights' Act).
- WCCB constituted.
- NTCA established in 2006.
- Under EIA Notification 2006 and CMZ Notification (2008) ensuring compliance to environmental clearances under various sectors; draft report on regulatory framework for wetland conservation prepared.
- NEP, 2006 recognized as one of the important building blocks of ensuring effective response to the Convention objectives.
- Recognition of agricultural heritage sites recommended by the Farmers' Commission and work initiated by NBA's Expert Committee on Biodiversity Heritage Sites.
- ITPGRFA establishes multilayer system for facilitated access to PGR for food and agriculture.
- Under PPV&FR awarded certificates "Plant Genome Savior Community Recognition" to farming communities.
- Global Crop Diversity Trust (GCDT) established for maintenance of crop diversity.

Box 2.4: NBAP – Rating the progress (contd.)

- A comprehensive strategy for wetland conservation, 2007 formulated; guidelines for sustainable development and management of brackish water aquaculture has been drawn up; National Fisheries Development Board (NFDB) formally set up in 2006; National Bamboo Mission launched in 2006.

Sub head 9. Developing national capacities for biodiversity conservation and appropriate use of new technologies (Articles 7, 9, 10, 12, 14, 15, 17) [**]

- AICOPTAX has taken up capacity building on lesser known groups of plants, animals and microorganisms.
- MoU between MoEF and Centre for Cellular and Molecular Biology (CCMB) for initiating research on genetic fingerprinting of captive stock, frozen zoo and assisted reproduction.
- Training in forest based micro-enterprise, development of SHGs for synergy of JFM with other schemes of the Government.
- Extensive capacity building for efficient management of GM crops.
- Under NEAC over 10, 000 organizations associated with campaign; about 84, 000 eco-clubs supported by MoEF; CEE covers over 40,000 schools through country wide awareness programme.
- Induction and advanced training on forest management and wildlife management by ICFRE and WII, policy and legal issues imparted to forest officials; training cum workshop on policy, legal issues and international conventions periodically organized.
- PGDC and certificate courses on wildlife management offered.
- More than one lakh youth are trained every year on poultry, bee-keeping, fisheries and other related sectors; Extension activities are benefiting about 12 lakh farmers.
- Developed database 'Fish Chromosome World', containing karyo-morphological information on 16 finfish species.

Sub head 10. Use of economic incentives/valuation in biodiversity related decision making processes (Article 11) [**]

- New scheme of livestock insurance launched.
- Welfare programme for fishermen through the development of model fishermen villages.
- Under PPP demonstration unit set up for bamboo mat manufacture in collaboration with private enterpreneurs.
- NTFP – 'Sanjeevani' outlets formed by forest samitis as alternate system of marketing channel to save exploitation of collectors by middlemen; women SHGs formed to promote participation in JFM.
- Eco-development initiated in PAs.
- Assigned ownership of minor forest produce to the people living in and around forest through a national legislation also called as Forest Rights Act, 2006.
- Over 22.02 mha of forests is managed by around 1.06 lakhs JFMCs.

Sub head 11. International cooperation (Article 5) [**]

- India is Party to major MEAs on biodiversity conservation and management.
- India's GEF project portfolio under biodiversity is worth USD 52.96 million (1991 – till date) of GEF grant.
- Under the auspices of UNESCO World Heritage Biodiversity Programme for India is being implemented; coalition against wild trafficking being undertake in collaboration with USA; signed a joint statement on Indo-Canada Forum for Environmental Cooperation;Indo-German technical collaboration, among other advisory services on environmental management, works on CDMs MoU on sustainable fisheries development was signed between MoA and Ministry of Foreign Affairs of Iceland in 2007.
- The MoEF and World Bank (WB) assess major gaps in relevant policies and acts; India has entered into MoU with 13 CG Centres; 7th Framework Programme (including energy, environment and biotechnology) of European Union (EU) launched in 2007.