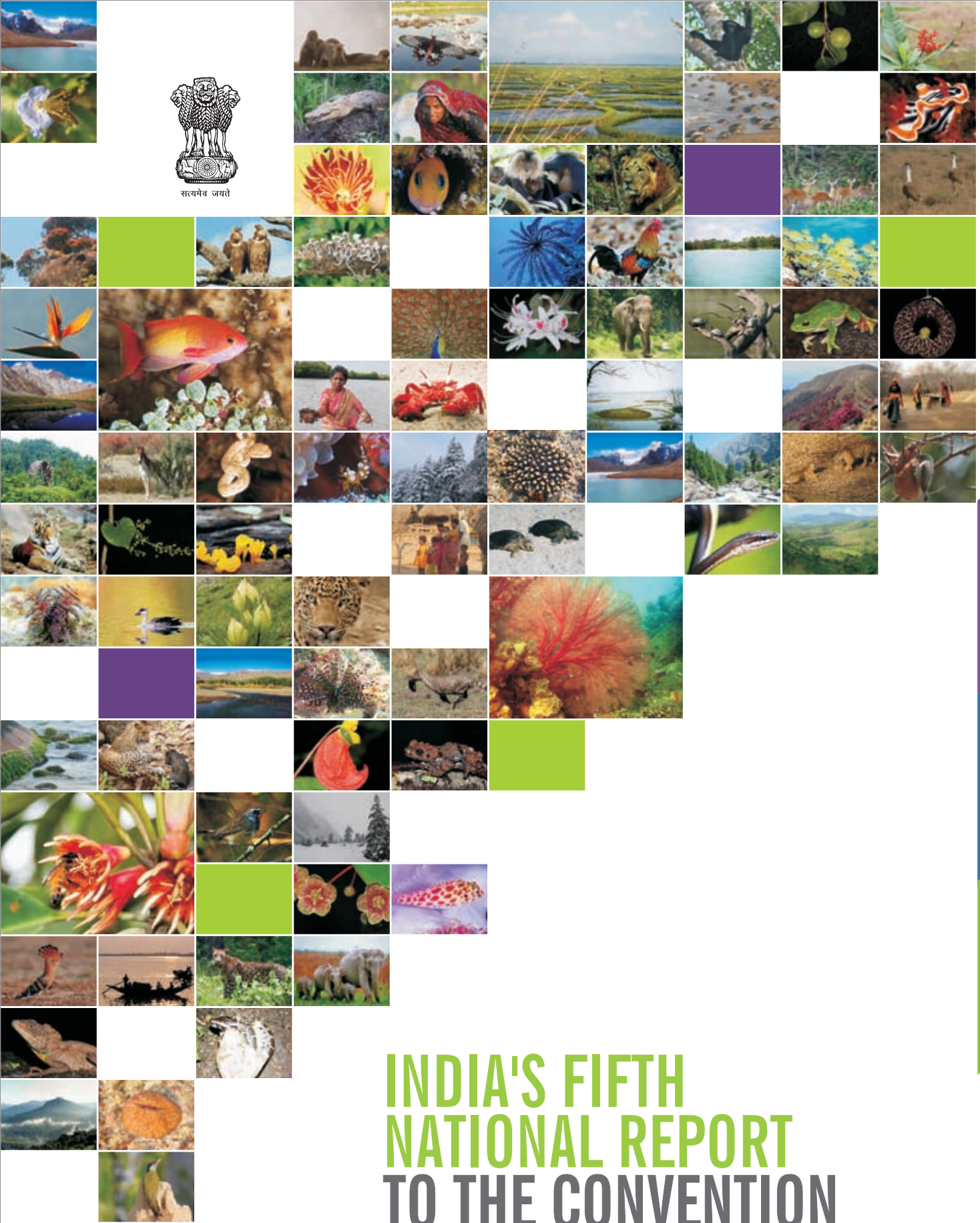

सत्यमेव जयते

INDIA'S FIFTH NATIONAL REPORT TO THE CONVENTION ON BIOLOGICAL DIVERSITY 2014

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Government of India

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Government of India

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INDIA'S FIFTH NATIONAL REPORT TO THE CONVENTION ON BIOLOGICAL DIVERSITY

2014

Contents

Dr. V. Rajagopalan
Secretary

Ministry of Environment and Forests
Government of India
New Delhi - 110 003

31st March, 2014

FOREWORD

I am pleased to present India's Fifth National Report (NR5) to the Convention on Biological Diversity (CBD). India, a megadiverse country with only 2.4% of the world's land area, accounts for 7–8% of all recorded species in the world. It harbours a tremendous diversity of ecological habitats including forests, grasslands, wetlands, desert, coastal and marine ecosystems.

India has made sustained efforts in fulfilling her commitments towards conservation of biodiversity, its sustainable use and the fair and equitable sharing of benefits arising from the use of biodiversity and natural resources. As a Party to the CBD, India honours and strives to meet the international obligations and commitments under the Convention. But most importantly, India has a firm belief in conservation of biodiversity as a national priority and recognizes its crucial linkages with the livelihoods and well-being of millions of her people, particularly the poor and vulnerable.

India's National Biodiversity Action Plan (NBAP), formulated through a comprehensive interministerial process and approved by the Union Cabinet in 2008, was developed prior to CBD's Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets. The broad action points in India's NBAP are generally aligned with the targets laid down by the five strategic goals of the Strategic Plan for Biodiversity 2011–2020 and the corresponding Aichi Biodiversity Targets. In order to enhance alignment between the Aichi Biodiversity Targets and India's NBAP, updating the NBAP has been undertaken as part of NR5 preparation, wherein India has developed her own National Biodiversity Targets through an extensive consultative process. A multi-tier mechanism has been developed for implementation of the NBAP, led by the Ministry of Environment and Forests (MoEF) and supported by 23 Ministries/Departments of the Government of India (GoI) along with the National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs) and Biodiversity Management Committees (BMCs), which have been established under the National Biological Diversity Act, 2002.

NR5 focuses on the status of and trends in biodiversity, threats to biodiversity and implications for human well-being. It describes the process of updating the NBAP and its implementation and reports on progress achieved towards meeting the Aichi Biodiversity Targets and on linkages with fulfillment of India's commitment to the Millennium Development Goals.

I am happy to note that NR5 has been prepared following a consultative process involving a very wide range of stakeholders. I congratulate all those who were involved in this task particularly the NBA. I especially wish to place on record the overall guidance and support provided by Shri Hem Pande, Additional Secretary, Dr. JR Bhatt, Advisor, Dr. Sujata Arora, Director, MoEF, and Dr. V.B. Mathur, Director, Wildlife Institute of India (WII), and his team in this endeavour.

India is now amongst the select countries in the world that has their own National Biodiversity Targets. I am confident that sharing experiences with other Parties through the National Reports will immensely help in addressing the challenges we face today in conserving our planet's biodiversity.

(V. Rajagopalan)

Hem K. Pande
Additional Secretary &
Chairman
National Biodiversity Authority

Ministry of Environment and Forests
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New Delhi - 110 003

31st March, 2014

PREFACE

Preparation of National Reports is an unqualified obligation on all the Contracting Parties to the Convention on Biological Diversity. Towards fulfilment of these reporting obligations, India had earlier submitted her First, Second, Third and Fourth National Reports in 1998, 2001, 2005 and 2009 respectively.

Preparation of National Reports at regular intervals helps a Party monitor and review the status of implementation of the Convention while identifying gaps in its capacity, constraints and impediments.

The format of the NR5 is narrative, and the contents are outcome oriented, elucidating the national status and trends of biodiversity, progress in implementation of the NBAP and national actions with respect to achievement of biodiversity targets. In accordance with the guidance provided by the Conference of the Parties (CoP), the text is appropriately supplemented by graphics, figures, tables, boxes, pictures and appendices.

In addition to reporting on the status, trends and threats to biodiversity and updating India's NBAP, the NR5 provides an assessment of the funding support for biodiversity conservation in India. In this exercise, a special effort has been made to collate and present an analysis of the most recent data available for 2013–2014 on funding for biodiversity conservation in the country. At a conservative estimate, India is now spending approximately ₹ 9200 crores or USD1483 million in 2013–2014 on activities that have a direct as well as indirect bearing on conservation of biodiversity.

NR5 has been prepared with support from a Global Environment Facility (GEF) project. I express my deep appreciation for the sincere and dedicated efforts put in by Dr. V.B. Mathur, Director, Wildlife Institute of India and his team and Dr. Sujata Arora, Director, Ministry of Environment and Forests in preparation of NR5. I also wish to thank GEF for the financial support. I wish to acknowledge the valuable assistance provided by the CBD-Secretariat during the preparation of NR5.

NR5 has also been prepared during India's Presidency of the CoP-11 to the CBD and I am confident that it will help provide guidance to Parties to the CBD. Despite the daunting challenges to biodiversity conservation faced by the country, I am hopeful that India will be able to make rapid progress towards achieving the goals and biodiversity targets, both Aichi and National, for effective biodiversity conservation. I am happy to inform that deliberations at the third meeting of the Intergovernmental Committee for the Nagoya Protocol (ICNP) held in Republic of Korea in February 2014, have given us confidence that Aichi Biodiversity Target 16 is going to be achieved ahead of its deadline in 2015.

(Hem K. Pande)

ACKNOWLEDGEMENTS

A very large number of institutions and individuals have provided valuable information for preparing NR5, and we would like to gratefully acknowledge their contributions. We are thankful to the secretaries of the 23 Ministries of the GoI for providing information relevant to biodiversity conservation, enabling us to compile data regarding investments being made in conservation of the biodiversity in the country. We would like to thank the Chairman, NBA, the Secretary, NBA and their team for providing valuable assistance and for organizational support in organizing stakeholder consultations.

We thank the Planning Commission for valuable support and for providing us details regarding the funds allocated to the States and Union Territories for activities related to biodiversity conservation. It would have been difficult to undertake this professionally challenging task without the support of the State Biodiversity Boards of the country also, and we sincerely thank them all.

The NR5 is based on valuable contributions from several national-level scientific institutions, and we would like to thank their Heads for sharing their experience and providing relevant information. We especially acknowledge the contributions from the Agharkar Research Institute, Botanical Survey of India, Central Marine Fisheries Research Institute, Centre for Marine Living Resources and Ecology, Department of Space and its institutions, Fishery Survey of India, Forest Survey of India, Indian Council of Forestry Research and Education, Indian Institute of Forest Management, National Institute of Oceanography, Sálim Ali Centre for Ornithology and Natural History and Zoological Survey of India for providing information on biodiversity and natural resources.

We are also grateful to the Ministry of Agriculture and its six Bureaus, especially the National Bureau of Plant Genetic Resources, National Bureau of Animal Genetic Resources, National Bureau of Fish Genetic Resources, National Bureau of Agriculturally Important Microorganisms and National Bureau of Agriculturally Important Insects, for sharing their knowledge, experience and case studies and responding to queries related to specific information.

We would like to acknowledge inputs received from the Central Pollution Control Board and Indian Metrological Department. We also extend our gratitude to several Non-Governmental Organizations, especially the Ashoka Trust for Research in Ecology and the Environment, Bombay Natural History Society, Centre for Environment Education, Centre for Media Studies, C.P.R. Environmental Education Centre, Foundation for Ecological Research, Advocacy and Learning, Foundation for Revitalisation of Local Health Traditions, International Union for Conservation of Nature - India Country Office, Kalpavriksh, Wildlife Trust of India, World Wildlife Fund—India and Zoo Outreach Organization for providing data and information related to biodiversity conservation. We would like to thank the Confederation of Indian Industry for sharing valuable information in the preparation of NR5.

We would like to acknowledge information received from the Gesellschaft für Internationale Zusammenarbeit, International Collective in Support of Fishworkers, Wetlands International-South Asia, United Nations Development Programme, United Nations Educational, Scientific and Cultural Organization and the World Bank.

We express our sincere appreciation of the professional support and untiring efforts of the Technical Review Committee constituted by the MoEF for their critical comments and suggestions when finalizing the report. We are especially indebted to the faculty and staff of the Wildlife Institute of India for their valuable support in accomplishing the task of preparing NR5.

The WII NR5 & NBAP Team
(Dr. V.B. Mathur, Dr. K.Sivakumar,
Dr. Malvika Onial, Anant Pande,
Yashaswi Singh, Biba Jasmine,
Dr. C. Ramesh, Lima Rosalind and
Ipshita Bhattacharya)

List of Abbreviations

ABS	:	Access and Benefit Sharing
AERF	:	Applied Environmental Research Foundation
AFLP	:	Amplified Fragment Length Polymorphism
AICOPTAX	:	All India Co-ordinated Project on Taxonomy
AIDS	:	Acquired Immunodeficiency Syndrome
AIMs	:	Agriculturally Important Microorganisms
AMH	:	Ajrekar Mycological Herbarium
ARI	:	Agharkar Research Institute
ATREE	:	Ashoka Trust for Research in Ecology and Environment
AYUSH	:	Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy
AZE	:	Alliance for Zero Extinction
BC	:	Black Carbon
BCRLIP	:	Biodiversity Conservation and Rural Livelihood Improvement Project
BD	:	Biological Diversity
BHS	:	Biodiversity Heritage Site
BMCs	:	Biodiversity Management Committees
BNHS	:	Bombay Natural History Society
BOO	:	Build, Own and Operate
BRLF	:	The Bharat Rural Livelihoods Foundation
BRs	:	Biosphere Reserves
BSI	:	Botanical Survey of India
ca	:	Approximately
CAA	:	Costal Aquaculture Authority
CAAQMS	:	Continuous Ambient Air Quality Monitoring Stations
CABI	:	Commonwealth Agricultural Bureaux International
CAF	:	Central Asian Flyway
CAMPA	:	Compensatory Afforestation Fund Management and Planning Authority
CBD	:	Convention on Biological Diversity
CBOs	:	Community Based Organizations
CBSE	:	Central Board of Secondary Education
CCAs	:	Community Conservation Areas
CDA	:	Chilika Development Authority
CEC	:	Conservation Education Centre
CEE	:	Centre for Environment Education
CEIA	:	Cumulative Environment Impact Assessment
CEPF	:	Critical Ecosystem Partnership Fund
CFR	:	Community Forest Rights
CHM	:	Clearing House Mechanism
CIFT	:	Central Institute of Fisheries Technology
CITES	:	Convention on International Trade in Endangered Species of Flora and Fauna
CMFRI	:	Central Marine Fisheries Research Institute
CMLRE	:	Centre For Marine Living Resources & Ecology
CMPDI	:	Central Mine Planning and Design Institute
CMS	:	Convention on Migratory Species /Centre for Media Studies

CoP	:	Conference of Parties
CPCB	:	Central Pollution Control Board
CPREEC	:	C.P.R. Environmental Education Centre
CR	:	Critically Endangered
CRZ	:	Coastal Regulation Zone
CSB	:	Community Seed Banks
CSIR	:	Council for Scientific and Industrial Research
CSR	:	Corporate Social Responsibility
CZA	:	Central Zoo Authority
DBT	:	Department of Biotechnology
DCFR	:	Directorate of Coldwater Fisheries Research
DMS	:	Disaster Management System
DNA	:	Deoxyribonucleic Acid
DNA Clubs	:	Department of Biotechnology 's Natural Resource Awareness Clubs
DoS	:	Department of Space
DSS	:	Decision Support System
DST	:	Department of Science and Technology
EE	:	Environmental Education
EESS	:	Environmental Education in the School System
EEZ	:	Exclusive Economic Zone
EN	:	Endangered
ENVIS	:	Environmental Information System
EPI	:	Environmental Performance Index
ESAs	:	Ecologically Sensitive Areas
ESD	:	Education for Sustainable Development
ETF	:	Eco Task Force
FAO	:	Food and Agriculture Organization
FDAs	:	Forest Development Agencies
FICCI	:	Federation of Indian Chambers of Commerce and Industry
FRA	:	Forest Right Act
FRCs	:	Forest Right Committees
FRI	:	Forest Research Institute
FRLHT	:	Foundation for Revitalisation of Local Health and Traditions
FSI	:	Forest Survey of India / Fishery Survey of India
GDP	:	Gross Domestic Product
GEER	:	Gujarat Ecological Education and Research Foundation
GEF	:	Global Environment Facility
GEMS	:	Global Environment Monitoring System
GFCS	:	Global Framework for Climate Service
GHG	:	Green House Gases
GIB	:	Great Indian Bustard
GIM	:	Green India Mission
GIS	:	Geographical Information System
GNP	:	Gir National Park
GoI	:	Government of India
GPS	:	Global Position System

GSMP	:	Globally Significant Medicinal Plants
GTZ	:	Deutsche Gesellschaft für Technische Zusammenarbeit
GWS	:	Gir Wildlife Sanctuary
HIV	:	Human Immunodeficiency Virus
HLWG	:	High Level Working Group
HSMD	:	Hazardous Substances Management
IARI	:	Indian Agriculture Research Institute
IBAs	:	Important Bird Areas
ICAR	:	Indian Council of Agriculture Research
ICCA	:	Indigenous Peoples and Community Conserved Territories and Areas
ICFRE	:	Indian Council of Forest Research and Education
ICMAM	:	Integrated Coastal and Marine Area Management
ICSE	:	Indian Certificate of Secondary Education
ICZM	:	Integrated Coastal Zone Management
ICZMP	:	The Integrated Coastal Zone Management Project
IDWH	:	Integrated Development of Wildlife Habitats
IEG	:	Institute for Economic Growth
IFCS	:	Indian Framework for Climate Services
IGIDR	:	Indira Gandhi Institute for Development Research
IGRMS	:	Indira Gandhi Rashtriya Manav Sagrahalaya
IIFM	:	Indian Institute of Forest Management
IIRS	:	Indian Institute of Remote Sensing
IISc	:	Indian Institute of Science
IMD	:	Indian Meteorological Department
InAZE	:	Indian Alliance for Zero Extinction
INCCA	:	The Indian Network for Climate Change Assessment
INCOIS	:	Indian National Centre for Ocean Information Services
IRS	:	Indian Remote Sensing
IRV	:	Indian Rhino Vision
ISC	:	Indian School Certificate
ISFR	:	Indian State of Forest Report
ISRO	:	Indian Space Research Organisation
ISSRs	:	Inter-simple Sequence Repeats
ITC	:	India Tobacco Company Limited
IUCN	:	International Union for Conservation of Nature
IWMP	:	Integrated Water Management Programme
JBIC	:	Japan Bank for International Cooperation
JFM	:	Joint Forest Management
JFMCs	:	Joint Forest Management Committees
JICA	:	Japan International Cooperation Agency
JNNSM	:	Jawaharlal Nehru National Solar Mission
JNTBGRI	:	Jawaharlal Nehru Tropical Botanical Garden and Research Institute
KBAs	:	Key Biodiversity Areas
km	:	Kilometer
MDF	:	Moderately Dense Forests
MDGs	:	Millennium Development Goals

MEE	:	Management Effectiveness Evaluation
MGNREGA	:	The Mahatma Gandhi National Rural Employment Guarantee Act
MGNREGS	:	The Mahatma Gandhi National Rural Employment Guarantee Scheme
MINARS	:	Monitoring of Indian National Aquatic Resource Systems
MKSP	:	Mahila KIsan Sashaktikaran Pariyojana
MoA	:	Ministry of Agriculture
MoCA	:	Ministry of Corporate Affairs
MoEF	:	Ministry of Environment and Forests
MoES	:	Ministry of Earth Science
MoHRD	:	Ministry of Human Resources Department
MoRD	:	Ministry of Rural Development
MoSPI	:	Ministry of Statistics and Programme Implementation
MoST	:	Ministry of Science and Technology
MoSYA	:	Ministry of Sports and Youth Affairs
MoTA	:	Ministry of Tribal Affairs
MoU	:	Memorandum of Understanding
MPA	:	Marine Protected Area
MPCAs	:	Medicinal Plant Conservation Areas
MSME	:	Micro, Small and Medium Enterprises
MtC	:	Metric Tons of Carbon
NABU	:	Natural And Biodiversity Union
NACOR	:	National Centre for Antartic and Oceanic Research
NAEB	:	National Afforestation and Eco-development Board
NAIMCC	:	National Agriculturally Important Microbial Culture Collection
NAMP	:	National Air Quality Monitoring Programme
NAP	:	National Agriculture Policy
NAPCC	:	National Action Plan for Climate Change
NBA	:	National Biodiversity Authority
NBAGR	:	National Bureau of Animal Genetic Resources
NBAII	:	National Bureau of Agriculturally Important Insects
NBAIM	:	National Bureau of Agriculturally Important Microorganisms
NBAP	:	National Biodiversity Action Plan
NBFGR	:	National Bureau of Fish Genetic Resources
NBPGR	:	National Bureau of Plant Genetic Resources
NBSAP	:	National Biodiversity Strategy and Action Plan
NBSS&LUP	:	National Bureau of Soil Survey and Land Use Planning
NBT	:	National Biodiversity Targets
NCERT	:	National Council of Educational Research and Training
NCF	:	Nature Conservation Foundation
NCMP	:	National Coastal Management Programme
NCSCM	:	National Centre for Sustainable Coastal Management
NEP	:	National Environment Policy
NFAP	:	National Forestry Action Programme
NFCCI	:	National Facility for Culture Collection of Fungi
NFDB	:	National Fisheries Development Board
NGO	:	Non-Government Organization

NGRBA	:	National Ganga River Basin Authority
NGT	:	National Green Tribunal
NIF	:	National Innovation Foundation
NIO	:	National Institute of Oceanography
NIOT	:	National Institute of Ocean Technology
NKC	:	National Knowledge Commission
NLCP	:	National Lake Conservation Plan
NMMI	:	National Mission on Micro Irrigation
NMNH	:	National Museum of Natural History
NMPB	:	National Medicinal Plant Board
NMSHE	:	National Mission for Sustaining the Himalayan Ecosystem
NPCAE	:	National Programme on Conservation of Aquatic Ecosystem
NPCBB	:	National Project for Cattle and Buffalo Breeding
NPOF	:	National Project on Organic Farming
NPV	:	Net Present Value
NR4	:	Fourth National Report
NR5	:	Fifth National Report
NRAA	:	National Rainfed Area Authority
NRCD	:	National River Conservation Directorate
NRCP	:	National River Conservation Plan
NRI	:	Non-Resident Indian
NRLM	:	National Rural Livelihoods Mission
NRMS	:	National Natural Resources Management System
NRSC	:	National Remote Sensing Centre
NTCA	:	National Tiger Conservation Authority
NTFP	:	Non Timber Forest Product
NWCP	:	National Wetland Conservation Programme
OF	:	Open Forest
PA	:	Protected Area
PBR	:	People's Biodiversity Register
PCCF	:	Principal Chief Conservator of Forests
PGR	:	Plant Genetic Resources
PM10	:	Particulate Matter of 10
PoWPA	:	Programme of Work on Protected Areas
PPV&FRA	:	Protection of Plant Varieties and Farmer's Rights Authority
PRIs	:	Panchayati Raj Institutions
RAPD	:	Ramdom Ampliefied Polymorphic DNA
REDD	:	Reducing Emissions from Deforestation and Forest Degradation
RFD	:	Result Framework Documents
RMNH	:	Regional Museums of Natural History
RSPM	:	Respirable Suspended Particulate Matter
SACON	:	Sálim Ali Centre for Ornithology and Natural History
SAPCC	:	State Action Plan on Climate Change
SAYEN	:	South Asia Youth Environment Network
SBAPs	:	State Biodiversity Action Plans
SBBs	:	State Biodiversity Boards

SEA	:	Strategic Environment Assessment
SEBS	:	Science Express - Biodiversity Special
SFDs	:	State Forest Departments
SHG	:	Self Help Group
SICOM	:	Society of Integrated Coastal Management
SLEM CPP	:	Sustainable Land and Ecosystem Management Country Programme Partnership
SP	:	Strategic Plan for Biodiversity
SPA	:	School of Planning and Architecture
SPCBs	:	State Pollution Control Boards
SSC	:	Species Survival Commission
SSRs	:	Simple Sequence Repeats
TAG	:	Turtle Action Group
TBPA	:	Transboundary Protected Areas
TEEB	:	The Economics of Ecosystems and Biodiversity
TK	:	Traditional Knowledge
TKDL	:	Traditional Knowledge Digital Library
TOF	:	Trees Outside Forests
TRC	:	Technical Review Committee
UN	:	United Nations
UNDP	:	United Nations Development Programme
UNEP	:	United Nations Environmental Programme
UNESCO	:	United Nations Education, Scientific and Cultural Organization
UNFCCC	:	United Nations Framework Convention on Climate Change
USD	:	United States Dollar
UT	:	Union Territory
VDF	:	Very Dense Forest
VEDCs	:	Village Ecodevelopment Committees
WCS	:	Wildlife Conservation Society
WII	:	Wildlife Institute of India
WIPO	:	The World Intellectual Property Organization
WNBR	:	World Network of Biosphere Reserves
WPA	:	Wildlife Protection Act
WTI	:	Wildlife Trust of India
WWF	:	World- Wide Fund for Nature
ZSI	:	Zoological Survey of India
₹	:	Indian Rupee

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EXECUTIVE SUMMARY

Part I. An update on biodiversity status, trends and threats in India and implications for human well-being

India, a megadiverse country with only 2.4% of the world's land area, harbours 7-8% of all recorded species, including over 45,000 species of plants and 91,000 species of animals. It is also amongst the few countries that have developed a biogeographic classification for conservation planning, and has mapped biodiversity-rich areas in the country. Of the 34 global biodiversity hotspots, four are present in India, represented by the Himalaya, the Western Ghats, the North-east, and the Nicobar Islands. Considering the outstanding universal values and exceptionally high levels of endemism in the Western Ghats, 39 sites in the States of Kerala, Karnataka, Tamil Nadu and Maharashtra have been inscribed on the United Nations Education Scientific and Cultural Organization (UNESCO) World Heritage List in 2012.

India has taken significant steps in inventorizing her vast and diverse biological heritage. Studies on freshwater and marine ecosystems, mycological work related to taxonomy and floristic studies have been recently carried out on various groups of fungi. India harbours large number of lichen species, which are nature's most remarkable alliances with at least 2300 species belonging to 305 genera and 74 families having been reported from India.

With over 200 diatom species, 90 dinoflagellates, 844 marine algae and 39 mangrove species, the marine floral biodiversity of India is remarkable. Endemism is significant across different plant groups in India. About 4045 species of flowering plant (angiosperms) endemic to India are distributed amongst 141 genera belonging to 47 families. In terms of endemism of vertebrate groups, India's global ranking is 10th in birds, with 69 species, fifth in reptiles, with 156 species, and seventh in amphibians, with 110 species. As a centre of origin of cultivated plants, India has 15 agro-climatic zones. It is considered to be the primary centre of origin of rice. A total number of 811 cultivated plants and 902 of their wild relatives have been documented so far. India also has a vast and rich repository of farm animals, represented by a broad spectrum of native breeds of cattle (34), buffaloes (12), goat (21), sheep (39) and chicken (15). The great diversity of traditional farming systems and practices in different parts of India contribute to the food security of hundreds of millions of people across the country. The livestock sector too plays an important role in the Indian economy and is an important sub-sector of Indian agriculture.

India has established six National Bureaus dealing with genetic resources of plants, animals, insects, microorganisms, fish and soil sciences. These are the National Bureau of Plant Genetic Resources (NBPGR), with a total of 4,08,186 plant genetic resource accessions; the National Bureau of Animal Genetic Resources (NBAGR),which has a total holding of 1,23,483 frozen semen doses from 276 breeding males representing 38 breeds of cattle, buffalo, sheep, goat, camel, yak and horse for *ex situ* conservation; the National Bureau of Agriculturally Important Microorganisms (NBAIM), with a repository of 4668 cultures, including 4644 indigenous and 24 exotic accessions; and the National Bureau of Agriculturally Important Insects (NBAII), with 593 insect germplasm holdings. The National Bureau of Fish Genetic Resources (NBFGR), with a repository of 2553 native finfishes and Fish Barcode Information System were updated with 2570 microsatellite sequences. In terms of fish diversity, the Zoological Survey of India (ZSI) has also recorded 3022 species in India, constituting about 9.4% of the known fish species of the world.

Forests in India are spread over an area of 692,027 km^2, covering 21.05% of the geographical area of the country. While the forest cover has either remained static or has reduced in many developing countries, India has added around 3 million hectares of forest and tree cover over the last decade. MoEF, has been persistently working towards increasing the total forest cover in India by initiating targeted afforestation programmes such as the Green India Mission (GIM). The total tree cover in India is estimated to be 9.08 million hectares, accounting for about 3% of the total geographic area of the country. The Wildlife Institute of India (WII) has prepared a biogeographic classification for the country, which has been designed to facilitate conservation planning, and to review the adequacy of existing protected areas to conserve the range of biological diversity in the country. From a network of 54 National Parks covering 21,003 km^2 and 373 Sanctuaries covering 88,649 km^2, giving a combined coverage of 1, 09,652 km^2 or 3.34% of the country's geographical area in 1988, the network has grown steadily, and as of 2014 there are 690 Protected Areas (PAs;102 National Parks, 527 Wildlife Sanctuaries, 57 Conservation Reserves and 4 Community Reserves) covering 1, 66,851 km^2 or 5.07% of the country's geographical area. The country has 23 marine Protected Areas (PAs) in peninsular India and 106 in the islands.

In India, wildlife conservation faces several challenges as a large number of wild animal species occur outside the PA

system. Thus, the recovery of critically endangered species and their habitats requires priority. With this in view, the erstwhile MoEF scheme of 'Assistance for the Development of National Parks and Sanctuaries' was reformulated and renamed as 'Integrated Development of Wildlife Habitats (IDWH)' during the 11th Plan period (2007-2012). The MoEF, in consultation with WII and other scientific institutions/organizations, has identified 16 terrestrial and seven marine species with the objective of saving critically endangered species/ecosystems that cannot be covered under the conservation of PAs and that need protection outside PAs, across the wider landscape/seascape. The Lion (*Panthera leo persica*) and Rhinoceros (*Rhinoceros unicornis*) populations are showing an increasing trend, and the Sangai (*Rucervus eldii eldii*) and Hangul (*Cervus elaphus hanglu*) populations are stable; but the populations of the Great Indian bustard (*Ardeotis nigriceps*) and the Nicobar megapode (*Megapodius nicobariensis*) have recorded declines. Vulture populations, in particular *Gyps bengalensis,* that had declined substantially in recent times have registered a small upward trend, indicating that conservation measures taken for the species are showing a positive outcome. Efforts are underway for developing protocols for monitoring the status and trends of the remaining IDWH species.

The country's biodiversity faces a variety of threats, ranging from land use changes in natural habitats to overexploitation of natural resources, proliferation of invasive species and climate change. A range of measures including enabling policy and legal framework, especially the National Environment Policy (NEP), 2006 have been put in place to mainstream environment, including biodiversity, in development planning processes.

Part II. Updating India's National Biodiversity Action Plan (NBAP)

In 1999, the GoI prepared the National Policy and Macrolevel Action Strategy on Biodiversity through a consultative process. This document was a macro-level statement of policies and strategies needed for conservation and sustainable use of biological diversity. Thereafter, the MoEF implemented an externally aided project, the National Biodiversity Strategy and Action Plan (NBSAP), from 2000 to 2004.

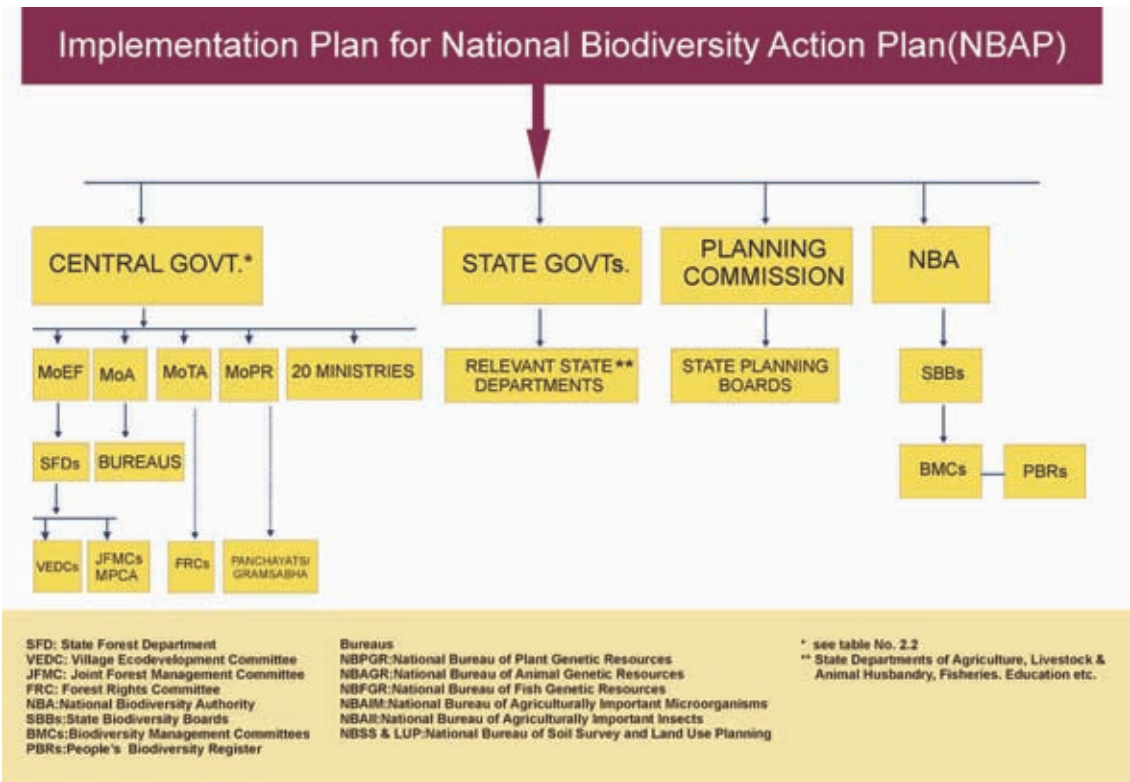
India was one of the first countries to have a proactive legislation and enacted a comprehensive Biological Diversity Act in 2002 to implement the provisions of Convention on Biological Diversity (CBD). The Biodiversity Rules were notified in 2004. The Act is being implemented through a three-tier structure, National Biodiversity Authority (NBA) at the national level, State Biodiversity Boards (SBBs) at the provisional level, and Biodiversity Management Committees (BMCs) at the local level. Following India's adoption of the National Environment Policy (NEP) in 2006, the NBAP was prepared by revising and updating the National Policy and Macrolevel Action Strategy on Biodiversity, developed in 1999, and using the final technical report of the NBSAP project in order to achieve consonance between the NBAP and the NEP 2006. India's NBAP, formulated through a comprehensive interministerial process and approved by the GoI in 2008, was developed prior to CBD Strategic Plan for Biodiversity 2011-2020. NBAP (2008) outlined broad actions and detailed actionable points (see Appendix II) generally aligned with the targets laid down by the five Strategic Goals of Strategic Plan for Biodiversity (SP) 2011-2020 and the corresponding 20 Aichi Biodiversity Targets.

In the light of the SP 2011-2020 and the Aichi Biodiversity Targets, India has undertaken a process of updating its NBAP in order to further build synergies between the NBAP and Aichi Biodiversity Targets. India is among the select countries in the world that have developed their own National Biodiversity Targets aligned with the Aichi Biodiversity Targets (Box I). A monitoring framework with indicators, agencies responsible for monitoring and reporting and frequency of monitoring/reporting has been developed for monitoring the trends and reporting progress in implementation of the National Biodiversity Targets (Box II). The National Biodiversity Targets and monitoring framework have been developed on the basis of consultations with a range of stakeholders and a review of the programmes and activities being undertaken by relevant Ministries/Departments in the GoI, SBBs and Non-Governmental Organizations (NGOs).

Implementation of NBAP

The road map for implementation of the NBAP involves the MoEF and 23 Ministries/Departments of the GoI that have been identified for achieving the National Biodiversity Targets (NBT; Table 2.2), NBA, the SBBs, State Forest Departments (SFDs), State Planning Boards and relevant departments of State Governments such as fisheries, forests, agriculture, livestock and animal husbandry, mining and education. Local-level institutions, including BMCs, Forest Rights Committees (FRCs), Village Ecodevelopment Committees (VEDCs), Joint Forest Management Committees (JFMCs) and Gram sabhas (village assemblies) are critical elements for implementation of the NBAP. A multi-tier mechanism for implementation as depicted in Figure 1 will be used in NBAP implementation.

Figure I
A multi-tier mechanism for implementation of NBAP



Assessment of funding support for biodiversity conservation in India

Resource flows to the biodiversity sector include direct core funding and non-core funding (which originates from the budgetary resources of the MoEF), and indirect peripheral funding, which comprises development budgetary resources that are allocated by other scientific and development Ministries/Departments of the GoI towards programmes that have a bearing on biodiversity conservation. For the year 2013-2014, the core funding for biodiversity (under the MoEF's biodiversity-related programmes) is ₹ 15,643.4 million (₹ 1564.34 crores); the net leveragable non-core funding (on MoEF's other schemes) is ₹ 2598 million (₹ 259.8 crores). This amounts to a total core and non-core funding by the MoEF of ₹ 18,241.4 million (₹ 1824.14 crores) for the year 2013-2014. Adding the outlay for States of ₹ 50,255.7 million (₹ 5025.57 crores) takes the combined core and non-core funding by the MoEF and States to ₹ 68,497.1 million (₹ 6849.71 crores). Along with the estimated peripheral funding of ₹ 2354.74 crores, the overall funding for biodiversity conservation amounts to ₹ 92044.5 million (₹ 9204.45 crores or USD 1482.68 million) for 2013-2014. This is however a work-in-progress estimate and the overall investment/expenditure in activities relating to biodiversity conservation may change as quality of datasets further improves (see Part II, Section 2.3).

National Biodiversity Targets and Millennium Development Goals

India is committed towards achieving the Millennium Development Goals (MDGs) for progress in human development and poverty reduction. India's National Biodiversity Targets (NBTs) are also directly and indirectly relevant to the MDGs. Efforts towards meeting the NBTs and MDGs will synergize progress towards achieving targets for biodiversity conservation and human development (see Box III).

Part III. India's progress towards Aichi Biodiversity Targets and contributions to the relevant 2015 targets of the MDGs

India is taking significant steps towards achieving the 20 Aichi Biodiversity Targets (see Part III, Section 3.1-3.2). India has put in place an enabling legal mechanism by enacting the Biological Diversity Act 2002. The NBA established under the act performs facilitative, regulatory and advisory functions for the GoI on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits of use (www.nbaindia.org). The NBA works with SBBs at the provincial level and BMCs at the local level to implement biodiversity strategies *inter alia* through development of People's Biodiversity Registers (PBRs) (see Part III, Section 3.1.5, Aichi Biodiversity Target 18). In addition to the foregoing, a mapping of the Ministries/Departments of the GoI has been done to identify relevant Ministries/Departments for implementation of the NBAP (see Table 2.2). Effective implementation of NBAP will contribute to achieving the Strategic Goals and Aichi Biodiversity Targets. Delivering on the Aichi Biodiversity Targets will also contribute both directly and indirectly to India's efforts towards achieving the eight MDGs (see Part III, Sections 3.1-3.2).

Black necked crane in Ladakh | Subharanjan Sen

Box I: Relationship between 20 Aichi Biodiversity Targets and 12 National Biodiversity Targets

	Aichi Biodiversity Targets	India's National Biodiversity Targets
Strategic Goal A	1 2 3 4	1 2 10
Strategic Goal B	5 6 7 8 9 10	3 4 5 6
Strategic Goal C	11 12 13	6 7
Strategic Goal D	14 15 16	3 8 9
Strategic Goal E	17 18 19 20	10 11 12

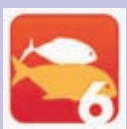
Saussurea obvallata | B. S. Adhikari

Box II: National Biodiversity Targets: Indicators and monitoring framework

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
 By 2020, a significant proportion of the country's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.		Trends in incorporating awareness and attitudes towards environmental conservation through communication and mainstream education	Number of students opting for higher-level elective subjects and specialization in Environmental Education (EE)	Indian School Certificate (ISC)/ Indian Certificate of Secondary Education (ICSE) and Central Board of Secondary Education (CBSE) boards	2 years
			Numbers of schools enrolled in the National Environment Awareness Campaign, National Green Corps—Eco Clubs Programme, Paryavaran Mitra (Friends of the Environment) Programme, Global Learning and Observations, Gyan Vigyan Vidyalaya, birdwatching clubs, DNA clubs (DBT's Natural Resource Awareness Clubs), etc.	MoEF, Youth for Coastal Marine Conservation, South Asia Youth Environment Network (SAYEN), Ministry of Human Resource Development (MoHRD)—Department of Education, Centre for Environment Education (CEE), C.P.R. Environmental Education Centre (CPREEC), Centre for Media Studies (CMS), Department of Biotechnology (DBT)	2 years
			Trends in coverage of environment-related programmes and projects with enhanced involvement of youth	Ministry of Sports and Youth Affairs (MoSYA)	2 years
			Trends in visits to PAs, natural history museums and exhibitions and zoological/botanical gardens	SFDs (Wildlife Wing), Central Zoo Authority (CZA), CEE	2 years
		Trends in promoting awareness at local levels	Trends in number of BMCs constituted/operationalized Trends in number of PBRs prepared	NBA/ SBBs	2 years
			Trends in numbers of JFMCs constituted/ operationalized Trends in number of civil society organizations/ NGOs, Panchayati Raj Institutions and Community Forest Rights (CFR) committees (under Forest Right Act (FRA) 2006 engaged in creating environmental awareness	SFDs, MoEF CEE Ministry of Panchayati Raj (MoPR) Ministry of Tribal Affairs (MoTA)	2 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
 By 2020, values of biodiversity are integrated in National and State planning processes, development programmes and poverty alleviation strategies.		Trends in incorporating natural resource/biodiversity/ecosystem service values in national and state planning processes and development programmes	Trends in biodiversity and ecosystem services valuation studies Trends in number and coverage of studies- The Economics of Ecosystems and Biodiversity (TEEB), Net Present Value (NPV) relating to biodiversity Trends in number and effectiveness of measures developed in the Mahatma Gandhi National Rural Employment Guarantee Act programme (MGNREGA) and Integrated Watershed Management Programme (IWMP) for protection and enhancement of ecosystem services and biodiversity Trends in biodiversity-inclusive climate change adaptation and mitigation measures formulated/ implemented Trends in area covered by	Institute of Economic Growth (IEG), Indira Gandhi Institute for Development Research (IGIDR), Indian Institute of Forest Management (IIFM), MoEF Ministry of Rural Development (MoRD), MoTA, SFDs State climate change cells	3 years
		Trends in integration of biodiversity and ecosystem service values into sectoral and development policies and programmes	Trends in studies on economic and non-economic valuation of selected ecosystem services Trends in reflection of biodiversity and ecosystem services in policy decisions, planning and reporting processes	IIFM, IGIDR, IEG, MoEF, NBA	3 years
		Trends in policies considering biodiversity and ecosystem services in environmental impact assessment and strategic environmental assessment	Trends in numbers of studies on biodiversity-inclusive environment impact assessment, Cumulative Environment Impact Assessment (CEIA) and strategic environment assessment (SEA) Trends in identification, assessment, establishment and strengthening of incentives that reward positive contributions to biodiversity and ecosystem services	Ministry of Corporate Affairs (MoCA)	3 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
 Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in place by 2020 for environmental amelioration and human well-being.	 	Trends in forest cover	Changes in proportions of forest cover in different forest categories i.e., Very Dense Forest (VDF), Moderately Dense Forest (MDF), Open Forest (OF) and Scrub)	Forest Survey of India (FSI)	3 years
		Trends in aquatic ecosystems	Changes in areas in riverine ecosystems and wetlands (terrestrial and coastal) Number of wetlands under integrated management plans	Department of Space (DoS), Wetlands International—South Asia/Sálim Ali Centre for Ornithology and Natural History SACON	3 years
		Trends in mangrove cover and coastal area management	Change in mangrove cover over the years Trends in area covered by integrated coastal area management	FSI; Integrated Coastal and Marine Area Management (ICMAM), Ministry of Earth Sciences; (MoES) Integrated Coastal Zone Management (ICZM) Project Unit of Society of Integrated Coastal Management (SICOM); National Centre for Sustainable Coastal Management (NCSCM), MoEF; DoS	2 years
		Trends in river water quality	Changes in water quality (by interception, diversion and treatment of domestic sewage and preventing agricultural runoff, toxic wastes, industrial effluents, chemical wastes and unburnt bodies from entering water bodies)	National Ganga Authority, National River Conservation Directorate (NRCD) (Ganga Action Plan, Yamuna Action Plan and other action plans for polluted water bodies), State Pollution Control Boards (SPCBs), Central Pollution Control Board CPCB	2 years
		Trends in afforestation and restoration Combating desertification	Monitoring canopy cover, grasslands and traditional grazing lands Monitoring carbon stock Assisted natural regeneration Rehabilitation of mined-out areas Trends in land degradation Status of and trends in area of deserts, water levels in wells/groundwater table	GIM, NRSC, DoS, ICFRE, SFDs, FSI, Central Mine Planning and Design Institute (CMPDI) National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Department of Agriculture & Cooperation, Disaster Management Support Programme, DoS, Department of Land Resources, Ministry of Rural Development (MoRD), Ministry of Water Resources (MoWR)	2 years
		Species restoration after forest and water body restoration	Status of selected indicator species	GIM, SFDs	3 years
		Trends in maintenance of fertility in agricultural lands using natural methods and means	Soil health records Organic carbon and humus build up Trends in maintaining the health of near-pristine soils, being awarded titles under FRA in forest areas	Ministry of Agriculture (MoA), SFDs	

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
 By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed.		Trends in invasive alien species management	Number and coverage of management plans developed for prioritized invasive species and integration with PA management plans and wetland management plans Changes in area affected by invasive species	Forest departments, DoS, Wetlands International—South Asia/SACON, ICFRE (Forest Invasive Species Cell), WII, Center for Marine Living Resources and Ecology (CMLRE), National Institute of Oceanography (NIO), Annamalai University Faculty of Marine Sciences, Commonwealth Agricultural Bureaux Interanational (CABI) South Asia	3 years
 By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries.	  	Trends in sustainable agriculture	Trends in area under organic farming, integrated pest management Trends in organic farming certification Trends in the production/usage of agrochemical fertilizers Trends in the use of bio-fertilizers/bio-fuels, organic manure and vermicompost Trends in soil quality and land use Trends in energy consumption (by types/source) in farms Trends in groundwater table Trends in increased acreage under organic production on farms of agricultural research institutions and universities Trends in enhanced use of landraces Trends in proliferation of local crops and varieties that are more adapted to the environment, requiring less external inputs and therefore being more integrated in the ecosystem, at the same time enhancing prospects of greater household food security Trends in analysis of agricultural policies and programmes that adversely affect ecosystem services such as pollination	Department of Agriculture, Indian Council for Agriculture Research (ICAR) Department of Fertilizers, APEDA NBSS&LUP ICAR ICAR MoA, MoRD, Ministry of Consumer Affairs, Food and Public Distribution, district administration	3 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
		Monitoring agricultural extension	Trends in awareness levels of farmers Trends in awareness levels of extension service staff, scientists and agricultural research system with relation to agro-biodiversity and associated knowledge	Department of Agriculture ICAR	3 years
		Trends in sustainable forestry	Trends in area of degraded forests Trends in area of restored forests Trends in proportion of products derived from sustainable sources	GIM, IIFM FSI, ICFRE, FRI	3 years
		Trends in stock sizes of target and bycatch fish species (freshwater and marine)	Trends in catch per unit effort	FSI, Central Marine Fisheries Research Institute (CMFRI), National Fisheries Development Board (NFDB), CMLRE (for deeper water marine fishes), NBFGR	3 years
		Trends in intensity of destructive fishing practices	Trends in sale of large-scale or destructive fishing gear (e.g. purse-seine, bottom trawlers) Trends in area covered by trawlers Trends in frequency of trawling	Department of Animal Husbandry, Dairying & Fisheries NFDB, Central Institute of Fisheries Technology (CIFT), FSI	3 years
		Trends in sustainable fishing practices	Trends in certification of fish produce	Marine Products Export Development Authority	Annual
		Trends in number of fishing boats/fishing capacity	Trends in number of licenses issued to fishing boats in coastal States Trends in fishing effort capacity	NFDB, Department of Fisheries of each coastal State	3 years
 Ecologically representative areas on land and in inland waters, as well as coastal and marine zones, especially those		Trends in PA coverage under four legal categories (National Park, Wildlife Sanctuary, Community Reserve and Conservation Reserve)	Change in number/area/percentage of PAs over time	WII	3 years
		Trends in other area-based conservation measures	Area/number of initiatives	Indigenous Peoples' and Community Conserved Territories and Areas (ICCA) consortium, United Nations Development Programme (UNDP India), World Wide Fund for Nature (WWF-India)	3 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
of particular importance for species, biodiversity and ecosystem services, are conserved effectively and equitably, on the basis of PA designation and management and other area-based conservation measures and are integrated into the wider landscapes and seascapes, covering over 20% of the geographic area of the country, by 2020		Trends in coverage under Biodiversity Heritage Sites (BHS) under the Biological Diversity Act 2002	Change in number/area/ percentage of BHSs over time	NBA, SBBs	3 years
		Trends in wetlands brought under integrated management	Changes in area and ecological status of wetlands through implementation of integrated management plans Changes in abundance and diversity of waterbird species in wetlands over time Trends in coverage of sites of international importance for migratory species under CMS	SACON, Wetlands International—South Asia, DoS Wetlands International—South Asia, Bombay Natural History Society (BNHS), SACON Wetlands International—South Asia, BNHS, SACON	3 years
		Trends in Important Bird Areas (IBAs)	Changes in number/area of IBAs over time	BNHS	3 years
		Status and population trends of 16 IDWH terrestrial species and 7 marine species	Population trends of selected species (16 terrestrial and 7 marine species)	For terrestrial species: ZSI, WII, SACON, BNHS, Nature Conservation Foundation (NCF), Wildlife Trust of India (WTI), WWF, Indian Institute of Science (IISc) For marine species: CMLRE, ZSI, Fishery Survey of India, National Centre for Antarctic & Oceanic Research (NCAOR), CMFRI	5 years
		Trends in forest cover in four designated categories	Changes in proportions of forest cover in different forest categories (VDF, MDF, OF, Scrub)	FSI	2 years
		Trends in status of Indian plant and animal species included in International Union for Conservation of Nature (IUCN) Red Data Book	Conservation status of species, subspecies and varieties and even selected subpopulations at a national scale highlighting taxa threatened with extinction and therefore promoting their conservation	IUCN-India, ZSI, BSI, WII	4 years
		Trends in air and water quality and in noise pollution	Status and trends of ambient air quality; monitoring water quality for physico-chemical and bacteriological parameters, trace metals and pesticides at selected sites; trends in noise levels	CPCB, SPCBs	Yearly

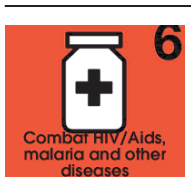
National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
		Status of ecosystem services of selected ecosystems	Status of ecological services of selected ecosystems including agricultural landscapes	IIFM, IEG	5 years
		Trends in areas of exceptional agricultural biodiversity and their threat status	Assessing the conservation status of landraces and varieties to highlight threatened status and therefore promote conservation	MoA, SBBs	
		Trends in areas of exceptional agricultural biodiversity and their threat status	Assessing the conservation status of landraces and varieties to highlight threatened status and therefore promote conservation	MoA, SBBs	
 By 2020, genetic diversity of cultivated plants, farm livestock and their wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.		Animal genetic diversity	Trends in number of indigenous/domesticated breeds (*in situ*) Trends in populations of domestic breeds (*in situ*) Effectiveness of initiatives/measures taken to conserve indigenous animal varieties Trends in germplasm accessions in *ex situ* collections	NBAGR Department of Agriculture Agriculture universities	3 years
		Plant genetic diversity	Trends in numbers of indigenous varieties (*in situ*) Trends in area under cultivation, production/yield (*in situ*) Effectiveness of initiatives/measures taken to conserve indigenous crop varieties and their wild relatives Trends in germplasm accessions in *ex situ* collections	NBPGR Department of Agriculture Agriculture universities National Bureau of Forest Genetic Resources	3 years
 By 2020, ecosystem services, especially those relating to water,		Human development index—standard of living in India	Trends in number of people with access to primary/secondary education/health services/safe drinking water/electricity/road connectivity Trends in number of women with access to primary/secondary education/health services/safe drinking water/electricity/road connectivity	MoHRD Ministry of Health and Family Welfare (MoH&FW)	2 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
human health, livelihoods and well-being, are enumerated and measures to safeguard them are identified, taking into account the needs of women and local communities, particularly the poor and vulnerable sections.		Level of toxic contaminants in wetlands/rivers/aquatic fauna	Trends in pollution status of wetlands of international (Ramsar sites) and national (identified by State Governments) importance Levels of toxic contaminants in rivers that provide freshwater for human use Levels of toxic contaminants in aquatic/terrestrial fauna	CPCB Indian Institute of Toxicology Research (IITR)	2 years
		Extent of restored forest cover in India	Trends in area of forests under restoration Trends in area under plantations in rural/urban areas Trends in very dense forest/moderately dense forest in PAs	ICFRE/FRI	2 years
		Extent of groundwater pollution and groundwater levels	Trends in groundwater levels Trends in proportion of groundwater available for use	Central Ground Water Board	2 years
		Trends in use of chemicals and fertilizers in agriculture/organic products	Agricultural area under chemical/fertilizer/pesticide use Agricultural area under organic farming in agro-ecosystems Levels of nitrogen/ phosphorus/essential nutrients in soil	Department of Agriculture Indian Agriculture Research Institute (IARI) NBSS&LUP	2 years
		Trends in wetlands significant for delivering freshwater being brought under integrated management	Area of wetlands such as lakes and ponds under integrated management	SACON, Wetlands International—South Asia, BNHS, DoS	3 years
		Trends in proportion of people using improved water services	Trends in number of people with access to potable water Trends in number of households with tap water connections	Ministry of Drinking Water and Sanitation (MoDWS)	2 years
		Trends in availability of urban greenspaces	Area under green spaces in urban centres (as a proxy to conservation of urban biodiversity)	Ministry of Urban Development, School of Planning and Architecture	3 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
 By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislation.		Trends in access to genetic resources and equitable sharing of benefits	Trends in number of proposals for intellectual property rights Trends in number of cases seeking third party transfer for accession of biological resources and associated Traditional Knowledge (TK) Trends in number of cases seeking prior approval of NBA for transferring the results of research to foreign nations, companies and NRIs for commercial purposes Trends in number of cases seeking approval of use of bio-resources and associated TK for commercial utilization	NBA, SBBs Departments of Agriculture, Animal Husbandry and Fisheries, ICAR; Controller General of Patents, Designs & Trademarks	3 years
 By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance.		Progress in implementing NBAP	Trends in preparation of State Biodiversity Action Plans (SBAPs) Trends in implementing the activities envisaged under SBAPs	SBBs and State Planning Boards, NBA MoEF, Departments of Forests, Agriculture, Animal Husbandry and Fisheries	3 years
 By 2020, national initiatives using communities' traditional knowledge relating to biodiversity are strengthened, with a view to protecting this knowledge in accordance with national legislations and international obligations.		Trends in documentation/data abstraction and management	Number of traditional herbal formulations documented from codified systems of Indian medicine Number of transcriptions Number of folk uses of medicinal plants documented from PBRs prepared by BMCs	Traditional Knowledge Digital Library - Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy - Council for Scientific and Industrial Research (TKDL- AYUSH-CSIR) Unit NBA	3 years
		Trends in access agreements related to traditional knowledge (TK)	Number of potential 'bio-piracy'/wrong patent cases prevented Number of patents and Access and Benefit Sharing (ABS) based on TK derived from folk knowledge	TKDL-AYUSH-CSIR unit Controller General of Patents, Designs & Trademarks, NBA	3 years

National Biodiversity Target	Corresponding Aichi Biodiversity Target	Composite indicator	Description of indicator	Responsible agencies (Indicative list)	Frequency of monitoring/ reporting
		Trends in grassroots innovations and traditional practices	Number of innovations and traditional practices documented	National Innovation Foundation (NIF), NBA	3 years
		Trends in capacity building related to TK and PBRs	Training/capacity building at local and community levels Numbers of BMCs and Panchayti Raj Institutions (PRI) institutions trained Training/capacity building at local and community levels Numbers of BMCs and PRI institutions trained	NBA, SBBs and Foundation for Revitalisation of Local Health Traditions (FRLHT), Botanical Survey of India (BSI), State Forest Academies and training centres, ICFRE	3 years
		Trends in conservation and sustainable use of medicinal plants used by India's medical heritage	Number of medicinal plant conservation areas (MPCAs) established in the country Trends in collection of plants providing raw drugs used in Indian systems of medicine	MoEF, National Medicinal Plant Board (NMPB), FRLHT NMPB	3 years
		Trends in documentation and awareness of the conservation traditions in TK	Documentation and awareness meetings/capacity building workshops/seminars/conferences for various target groups (NGOs, Community-Based Organisations (CBOs), Mahila Mandals, academicians) Trends in number of PBRs prepared	CPREEC MoHRD NBA	3 years
 By 2020, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011–2020 and the national targets are identified and the Strategy for Resource Mobilization is adopted.		Trends in availability of financial, human and technical resources for achieving 20 Aichi Biodiversity Targets and 12 National Biodiversity Targets	Trends in financial resources made available for implementing Aichi and National Biodiversity Targets Trends in human resources made available for implementing Aichi and National Biodiversity Targets Trends in technical resources made available for implementing Aichi and National Biodiversity Targets	Planning Commission, MOEF NBA SBBs SFDs, MoHRD DoS, MoST, Indian Meteorological Department (IMD)/MoES	3 years

Box III
National Biodiversity Targets and Millennium Development Goals

	Millennium Development Goals	National Biodiversity Targets
	**Goal 1—Eradicate Extreme Poverty and Hunger** Targets 1. Halve, between 1990 and 2015, the proportion of people whose income is less than USD1 a day. 2. Halve, between 1990 and 2015, the proportion of people who suffer from hunger.	2 3 6 7 8 9 10 11
	**Goal 2—Achieve Universal Primary Education** Target 3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.	1 3 8
	**Goal 3—Promote Gender Equality and Empower Women** Target 4. Eliminate gender disparity in primary and secondary education preferably by 2005 and in all levels of education no later than 2015.	1 3 8 11
	**Goal 4—Reduce Child Mortality** Target 5. Reduce, by two-thirds, between 1990 and 2015, the under-five mortality rate.	5 8 11
	**Goal 5—Improve Maternal Health** Target 6. Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio.	8 11
	**Goal 6—Combat HIV/AIDS, Malaria and other Diseases** Targets 7. Have halted by 2015 and begun to reverse the spread of HIV/AIDS. 8. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.	4 8 11
	**Goal 7—Ensure Environmental Sustainability** Targets 9. Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. 10. Halve, by 2015, the proportion of people without sustainable access to safe drinking water. 11. Have achieved, by 2020, a significant improvement in the lives of at least 100 million slum dwellers	2 8 3 9 4 10 5 11 6 12 7
	**Goal 8—Develop a Global Partnership for Development** Target 18. In cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies.	2 9 12

Aseem Srivastava

STATUS & TRENDS

AN UPDATE ON BIODIVERSITY STATUS, TRENDS AND THREATS IN INDIA AND IMPLICATIONS FOR HUMAN WELL-BEING

1.1 BIODIVERSITY PROFILE OF INDIA

India, a megadiverse country with only 2.4% of the world's land area, accounts for 7-8% of all recorded species, including over 45,000 species of plants and 91,000 species of animals. It is situated at the tri-junction of the Afrotropical, Indo-Malayan and Palaearctic realms, all of which support rich biodiversity. Being one of the 17 identified megadiverse countries, India has 10 biogeographic zones and is home to 8.58% of the mammalian species documented so far, with the corresponding figures for avian species being 13.66%, for reptiles 7.91%, for amphibians 4.66%, for fishes 11.72% and for plants 11.80%. Four of the 34 globally identified biodiversity hotspots, namely the Himalaya, Indo-Burma, the Western Ghats-Sri Lanka and Sundaland, are represented in India. India is an acknowledged centre of crop diversity and harbours hundreds of varieties of crop plants such as rice, maize, millets etc. The diverse physical features and climatic conditions have resulted in a variety of ecosystems such as forests, grasslands, wetlands, desert, coastal and marine ecosystems which harbour and sustain high biodiversity and contribute to human well-being.

1.1.1

Common kingfisher | GS Bhardwaj

Biogeographic classification and biodiversity characterisation

India is amongst the few countries that have developed a biogeographic classification based on which conservation planning has been taken up. This has been done to ensure that different biogeographic zones are represented in area-based conservation approaches at the landscape level (Rodgers et. al., 2002). This classification uses four levels of planning units: the biogeographic zone, the biotic province, the land region and the biome (www.wii.gov.in). Within India, the biogeographic classification recognizes 10 zones, divided into 27 provinces (Figure 1.1).

The Biogeographic Zone

Large distinctive units of similar ecology, biome representation, community and species, e.g., The Himalaya, The Western Ghats.

The Biotic Province

Secondary units within a zone, giving weight to particular communities separated by dispersal barriers or gradual change in environmental factors, e.g., North-west and West Himalaya either side of the Sutlej River.

The Land Region

A tertiary set of units within a province, indicating different land forms, e.g., Aravalli Mountains and Malwa Plateau in Gujarat-Rajwara Province.

I

GS Bhardwaj

The Biome

A biome is an ecological unit, not a biogeographic unit, such as swamp/wetland or temperate broad leaved forest.

A national level assessment of biodiversity richness was undertaken for the first time in India using spatial data on a 1:50,000 scale to identify and to map potential biodiversity-rich areas in the country (Roy et. al., 2012). The study was conducted by the DoS and DBT. It generated a baseline database, providing information on the vegetation type, fragmentation, disturbance index and biological richness for the entire country (http://bis.iirs.gov.in/).

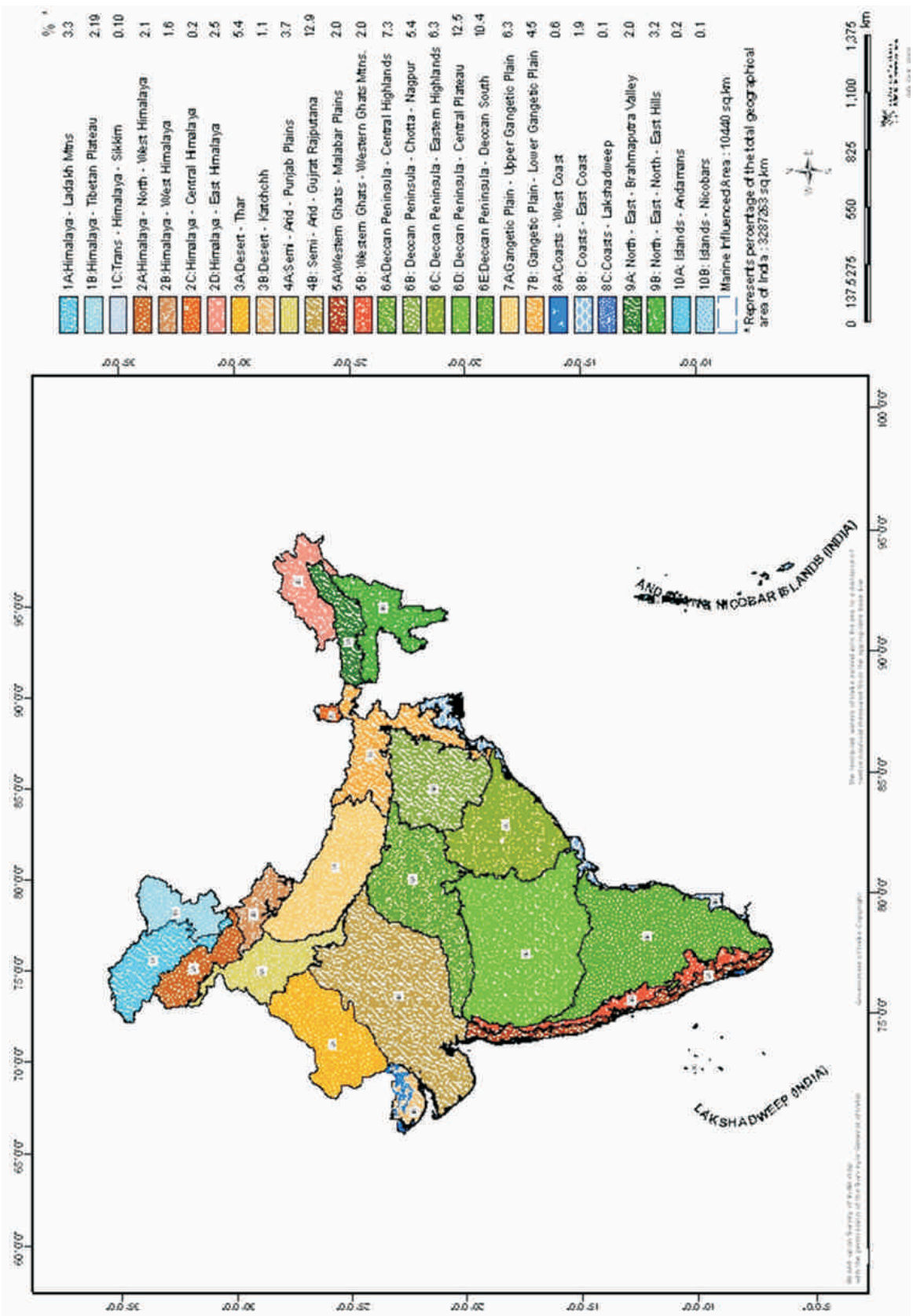


Figure 1.1: Biogeographic classification of India (Source: Rodgers et. al., 2002)

The biological richness map generated by this study (Figure 1.2) has biological richness values categorized as low (17-33), medium (34-49), high (50-69), and very high (70-91). North-eastern India, the Andaman and Nicobar Islands and the Western Ghats as well as some patches of the Eastern Ghats (especially Araku Valley, Andhra Pradesh) were classified as having maximum biological richness.

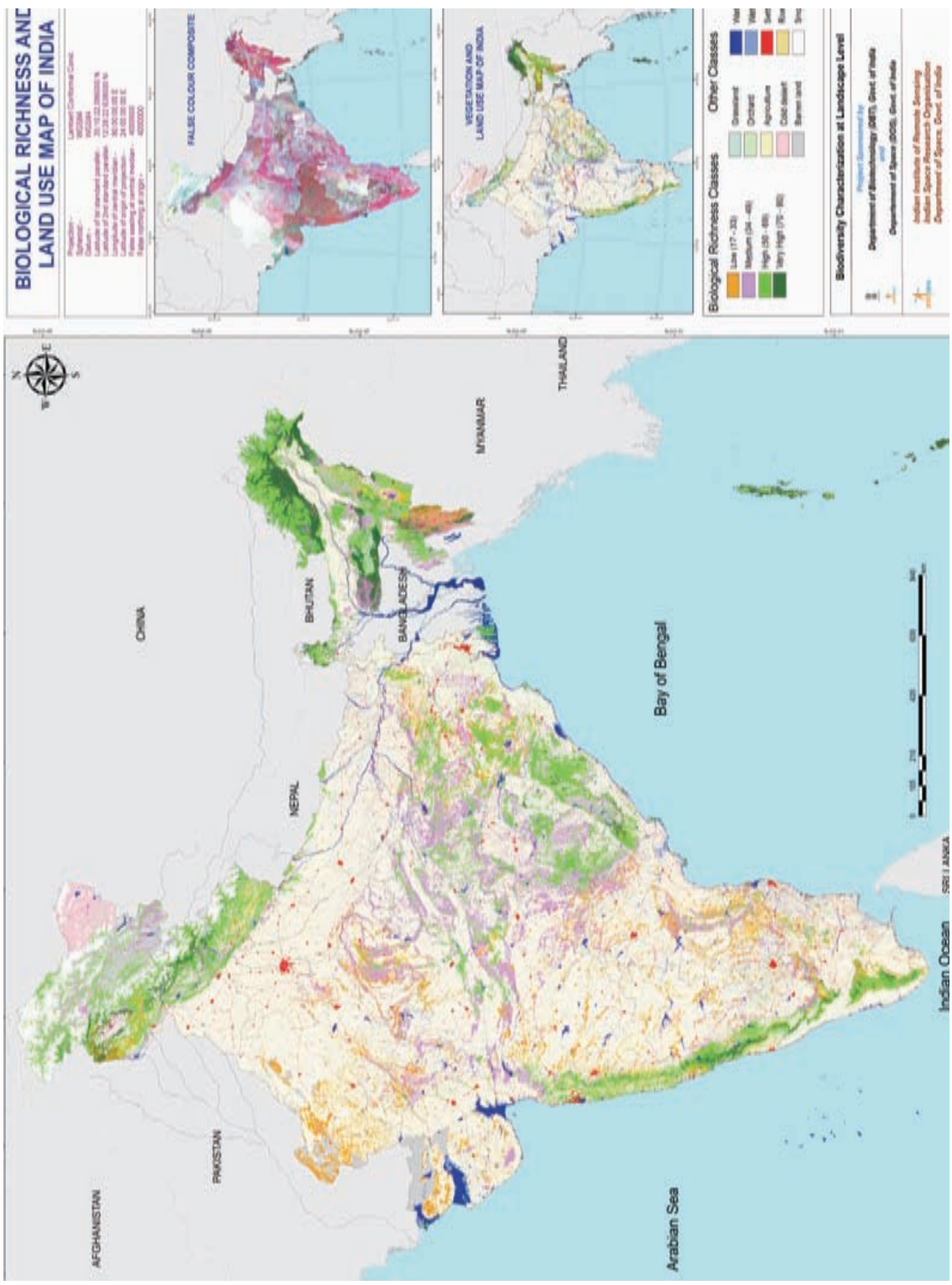


Figure 1.2: Biological characterisation at landscape level in India: mapping biological richness (Source Roy et. al., 2012)

1.1.2 Biodiversity hotspots

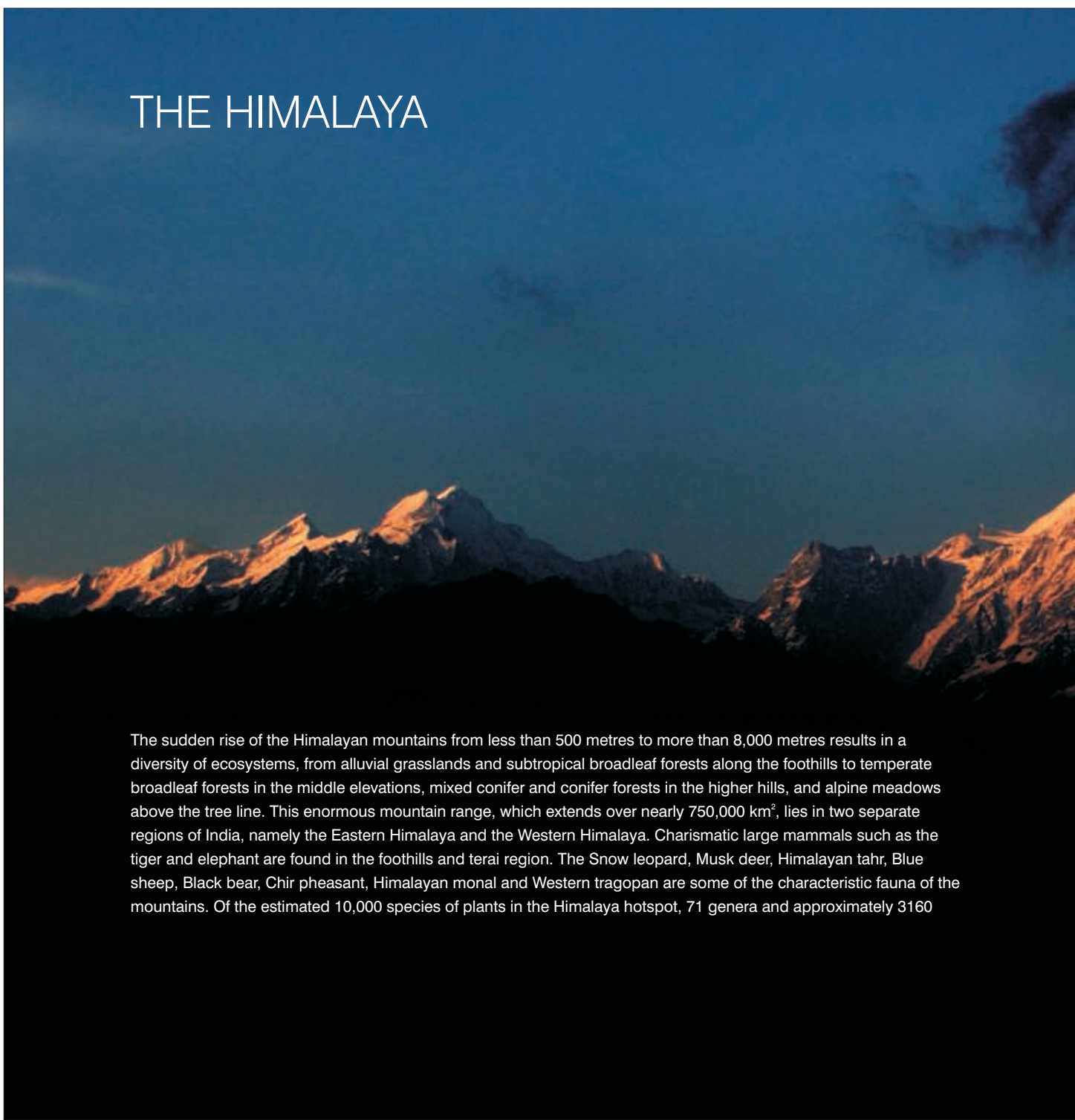
The idea of hotspots was first mooted in 1988 by ecologist Norman Myers, who defined a hotspot as an area of exceptional plant, animal and microbe wealth that is under threat. The key criteria for determining a hotspot are endemism (the presence of species found nowhere else on earth) and degree of threat. Out of the 34 global biodiversity hotspots, four are present in India (Conservation International 2013):

THE HIMALAYA

Western and Eastern Himalaya form part of Himalayan global biodiversity hotspot.

THE WESTERN GHATS

part of Western Ghats-Sri Lanka global biodiversity hotspot.



THE HIMALAYA

The sudden rise of the Himalayan mountains from less than 500 metres to more than 8,000 metres results in a diversity of ecosystems, from alluvial grasslands and subtropical broadleaf forests along the foothills to temperate broadleaf forests in the middle elevations, mixed conifer and conifer forests in the higher hills, and alpine meadows above the tree line. This enormous mountain range, which extends over nearly 750,000 km^2, lies in two separate regions of India, namely the Eastern Himalaya and the Western Himalaya. Charismatic large mammals such as the tiger and elephant are found in the foothills and terai region. The Snow leopard, Musk deer, Himalayan tahr, Blue sheep, Black bear, Chir pheasant, Himalayan monal and Western tragopan are some of the characteristic fauna of the mountains. Of the estimated 10,000 species of plants in the Himalaya hotspot, 71 genera and approximately 3160

NORTH-EAST

part of Indo-Burma global biodiversity hotspot.

NICOBAR ISLANDS

part of the Sundaland global biodiversity hotspot.

species are endemic. The Eastern Himalayan region is exceptionally rich in diversity and endemism and hence is of great significance. The Eastern Himalaya on the whole has an estimated 9000 plant species, out of which 3500 (39%) are endemic. In the Indian portion of the Eastern Himalaya there occur 5800 plant species, approximately 2000 (36%) of which are endemic. The area is also rich in wild relatives of plants of economic significance, for example, rice, banana, citrus, ginger, chilli, jute and sugarcane. The region is also a rich centre of avian diversity-more than 60% of the bird species found in India have been recorded in the North-east. The region also harbours 35 endemic reptilian species including two genera of lizards and two turtle species. Out of 341 Indian amphibian species recorded so far, at least 68 species are known to occur in the North-east, 20 of which are endemic (Conservation International 2012).

The Himalayas | GS Bhardwaj

Western Ghats

The Western Ghats are part of the Western Ghats-Sri Lanka global hotspot, running roughly in a North-south direction for about 1500 kilometres parallel to the coast bordering the Arabian Sea. The importance of the Western Ghats in terms of their biodiversity can be seen from the known inventory of their plant and animal groups and the levels of endemism in these taxa. Western Ghats harbour 7388 species of flowering plants. Of these, 5584 species are indigenous, 377 are exotic naturalised and 1427 are cultivated or planted. Of the indigenous 5584 species, 2242 species are Indian endemics (found only in India) and 1261 are the Western Ghats endemics. Apart from the above, there are 586 taxa with subspecies and variety status, bringing total taxa in the Western Ghats to 7974 (Nayar, et. al., 2014).

Among the invertebrate groups, about 350 ant species (20% endemic), 330 butterfly species (11% endemic), 174 odonate species (dragonflies and damselflies, 40% endemic) and 269 mollusc species (land snails, 76% endemic) have been described from this region. The known fish fauna of the Ghats comprises 288 species, with 41% of these being endemic to the region. The Western Ghats are particularly notable for their amphibian fauna, with about 220 species, of which 78% are endemic. A frog, *Nasikabatrachus sahyadrensis*, with Indo-Madagscan affinity, was recently discovered in the Southern Western Ghats. The discovery of this frog, which belongs to a genus new to science, affirms the importance of the region in harbouring ancient Gondwana lineages. The Ghats are unique in their caecilian diversity, harbouring 16 of the country's 20 known species, with all 16 species being endemic. Of the 225 described species of reptiles, 62% are endemic. Special mention must be made of the Burrowing shield tail snakes of the family Uropeltidae, which are mostly restricted to the Southern hills of the Western Ghats.

Over 500 species of birds and 120 species of mammals are also known from this region. The Western Ghats region harbours the largest global populations of the Asian elephant and possibly of other mammals such as the tiger, dhole and gaur. The Western Ghats also support a number of wild relatives of cultivated plants, including pepper, cardamom, mango, jackfruit and sandal.

Thirty nine sites in the Western Ghats in the States of Kerala, Karnataka, Tamil Nadu and Maharashtra were inscribed in the UNESCO World Heritage List in 2012, considering their outstanding universal value and high levels of endemism (http://whc.unesco.org/).

A View of Silent Valley in the Western Ghats | S Suresh

North-east

Some parts of the North-eastern region of India, excluding the Himalayan region, are contiguous with the Indo-Burma biodiversity hotspot, centred on the Indo-Chinese Peninsula, and comprising Cambodia, the Lao People's Democratic Republic, Myanmar, Thailand, Vietnam and parts of Southern China. The topography of the hotspot is complex and is characterised by a series of North-south mountain ranges that descend from the Himalayan chain and its South-eastern extensions.

The plant diversity of the entire hotspot is estimated to comprise about 13,500 vascular plant species, of which about 7000 (52%) are endemic. Of the 1277 bird species found in Indo-Burma, 74 are endemic. Similarly, 71 of the 430 mammal species in the hotspot are endemic. Other vertebrate groups show much higher levels of endemism, with 189 of the 519 non-marine reptile species and 139 of the 323 amphibian species being endemic to the hotspot. Indo-Burma probably supports the highest diversity of freshwater turtle in the world. The hotspot also has a remarkable freshwater fish fauna, with 1262 documented species, accounting for about 10% of the world total, including 566 endemics (Tordoff et. al., 2012).

Gurudongmar lake, North Sikkim | Shilpa Gautam

Nicobar Islands

The Nicobar Islands are part of the Sundaland hotspot, which includes a small portion of Southern Thailand; nearly all of Malaysia; Singapore, at the tip of the Malay Peninsula; all of Brunei Darussalam; and all of the western half of the megadiverse country of Indonesia, including Kalimantan. They belong to the Andaman and Nicobar group of islands, consisting of some of the most pristine island ecosystems in the world. These island groups form a distinct ecoregion and are classified as one of the 10 biogeographical zones of India by Rodgers et. al., (2002). These islands are fringed by one of the most spectacular reefs of the Indian Ocean region and are considered to be globally

Nancowrie bay, Nicobar Islands | P. Nehru

significant. Mangrove forests found in most of these islands comprise species including *Rhizophora mucronata, Bruguiera gymnorrhiza, Excoecaria agallocha, Carallia brachiata, Sonneratia acida, Timonius jambosella* and *Nypa fruticans*.

Of the 3500 plant species that have been reported from the Andaman and Nicobar group of islands, 422 floral genera and 648 species (13.11% endemic) have been reported from Great Nicobar Island. These belong to 142 families, of which 14% are endemic. Out of the 120 pteridophyte species of the Andaman and Nicobar Islands, 50% are from Great Nicobar Island alone. A total of 110 wild orchids are reported from these islands, of which 19 genera, with 25 species, are endemic.

The Nicobar Islands are characterised by an absence of large mammals and the presence of a significant number of endemics, such as Nicobar tree shrew (*Tupaia nicobarica*), among the island's vertebrates. The only primate, the Nicobar Crab-eating macaque (*Macaca fascicularis umbrosa*), occurs in the Southern group of the Nicobar Islands. In the Nicobars, the mega herpetofauna include the Malayan box turtle (*Cuora amboinensis*), found on Great and Little Nicobar, the Sunbeam snake (*Xenopeltis unicolor*), the Saltwater crocodile (*Crocodylus porosus*) and the Reticulated python (*Python reticulatus*), found in the Southern Nicobar group, besides several species of Pit viper in the central Nicobars. Fifteen reptile species are reported to be endemic to the Nicobars. Four species of marine turtle, the Leatherback turtle (*Dermochelys coriacea*), Hawksbill turtle (*Eretmochelys imbricata*), Green sea turtle (*Chelonia mydas*) and the Olive ridley turtle (*Lepidochelys olivacea*) also feed and nest around the Andaman and Nicobars. The nesting population of Leatherbacks in the Nicobars is one of the last four colonies that exceed 1000 individuals in the Indo-Pacific and hence has global significance.

Sources: Conservation International (2013); UNESCO (2012); and Planning Commission (2007)

1.1.3 Importance of biodiversity and its implications for human well-being

Biodiversity underpins the form and function of ecosystems, which are of high value due to the life-supporting services they provide that meet human needs, both material and non-material. Biodiversity supports ecosystem services that have economic value for humans in terms of direct or indirect use. They are provisioning services, such as supplying of fuel and fodder, and regulating services, such as carbon sequestration and prevention of soil erosion. Moreover, biodiversity has non-use or existence value. For millions of Indians, biodiversity supports their very livelihoods and ways of life. In the Indian context especially, a range of socio-cultural values are derived from biodiversity that are philosophical, cultural and religious. Biodiversity and ecosystem diversity are reflected in the cultural and religious diversity of India through the varied values attached to biodiversity components and landscapes. India's many traditional knowledge systems and ethno-medicinal practices are based on a close understanding of and dependence on biodiversity. The cultural or religious importance of species and designation of sacred areas are well-known in India (see Part III, Section 3.1.5, Aichi Biodiversity Target 18). The socio-cultural as well as aesthetic values attached to species and landscapes are reflected not only in the age-old tradition of sacred groves but also through formal designation of natural heritage sites which are most often also sites of significant local, regional or national cultural heritage.

Contemporary systems of accounting do not fully capture the value of India's biodiversity, natural resources and ecosystem services. The national Gross Domestic Product (GDP) so far incorporates mainly market-based commodities such as some Non Timber Forest Products (NTFPs) and timber from forestry. Forests are estimated to contribute barely 1.5% to the GDP even though, with a geographical area of more than 20% of the country, they provide multiple benefits that are not reflected in the national accounts (Parikh et. al., 2012). The intangible nature of many of the benefits that are derived from ecosystem services and the different values that are attached to biodiversity make it challenging to define these monetarily and have them reflected in national accounting. However, through concerted efforts made nationally over the last several years, this gap is being closed. Valuation studies are being carried out to capture specific ecosystem service values; at the same time, holistic approaches are being adopted to cover multiple values (Parikh et. al., 2012, Singh 2007,Chopra & Adhikari 2002, Verma 2000, Chopra & Kadekodi 1997, Chopra 1993). Direct contributions to economies through market values often contribute only a proportion to the total value of ecosystem services. For example, the value of direct consumptive benefits from forests in Himachal Pradesh was estimated to be approximately 1% of the total benefits, while the value of indirect benefits from their ecosystem services accounted for nearly 93% of the total benefits (Verma 2000). Similarly, other studies have estimated the total values as well as those of certain provisioning and regulating services (Table 1.1).

Table 1.1: Valuation of biodiversity and ecosystem services

Biodiversity component	Location	Ecosystem service	Economic value
Provisioning services			
Oak and pine forests	Himalaya, Uttarakhand	Fuelwood, fodder, minor timber, medicinal plants, wild edible fruits, manure	Oak forests, ₹ 5676/person/ annum; pine forests, ₹ 4640/person/annum
Dry deciduous forests	Odisha, eastern India	NTFPs	Coastal area, ₹ 36,584/hectare; inland area, ₹ 48,535/ hectare
Regulating services			
All Indian forests	All of India	Carbon sequestration	₹ 96,203/hectare
All Indian forests	All of India	Prevention of soil erosion	₹ 47072.56 million (in 2003)
All Indian forests	All of India	Augmentation of groundwater	₹ 1238.58 million (in 2003)
Cultural services			
Dry and moist deciduous forest	Corbett Tiger Reserve, Uttarakhand	Recreation	USD167,619/annum

Source: Adapted from Parikh et. al., (2012)

Recognising the importance of biodiversity and natural resources, India's 12th Five Year Plan (2012-2017) has, for the first time, mainstreamed sustainability as a primary goal, noting that greater attention needs to be paid to addressing issues of forests, water and land resources and the incorporation of environmental aspects into the national accounting system. India has also initiated Green National Accounting at the country level with the release (in April 2013) of a report of an expert group titled 'Green National Accounts in India-A Framework' (www.pib.nic.in). The report outlines concepts that go beyond conventional measures of wealth (measured in terms of GDP alone) and guide the development of tools for green measurement (see Part III, Section 3.1.1, Aichi Biodiversity Target 2).

Faunal and floral diversity

1.1.4

With only about 2.4% of world's total land surface, India is known to have over 6.7% of the animal species that theworld holds. This percentage represents nearly 96,373 known species, including 63,423 insect species (Table 1.2). The numbers of threatened faunal species in different categories and those listed in the International Union for Conservation of Nature (IUCN 2013) are given in Figures 1.3 and 1.4. Figure 1.5 represents the number of endemic species in the different threat categories.

Table 1.2: Estimated faunal diversity in India

Taxonomic group	Number of species		
	World	India	Percentage in India
Protista (Protozoa)	31,250	3500	11.20
Animalia	1,53,122	13,033	8.51
Mesozoa	71	10	14.08
Porifera	5000	500	10.00
Cnidaria	10,105	1042	10.31
Ctenophora	100	12	12.00
Platyhelminthes	17,511	1,650	9.42
Rotifera	2500	330	13.20
Gastrotricha	3000	100	3.33
Kinorhyncha	100	10	10.00
Nematoda	30,028	2902	9.66
Acanthocephala	800	229	28.63
Sipuncula	145	35	24.14
Mollusca	66,535	5169	7.77
Echiura	127	43	33.86
Annelida	17,000	1000	5.88
Onychophora	100	1	1.00
Arthropoda	11,81,398	74,175	6.28
Crustacea	60,000	3549	5.91
Insecta	10,20,007	63,423	6.22
Arachnida	73,451	5850	7.96
Pycnogonida	600	17	2.83
Chilopoda	8000	101	1.26
Diplopoda	7500	162	2.16
Symphyla	120	4	3.33
Merostomata	4	2	50.00
Phoronida	11	3	27.27
Bryozoa (Ectoprocta)	4000	200	5.00
Entoprocta	60	10	16.67
Brachiopoda	300	3	1.00
Chaetognatha	111	30	27.03
Tardigrada	514	30	5.84
Echinodermata	6600	779	11.80
Hemichordata	120	12	10.00
Chordata	64,669	5,665	8.76
Protochordata	2106	119	5.65
Pisces	32,120	3,022	9.41
Amphibia	6771	342	5.05
Reptilia	9230	526	5.70
Aves	9026	1,233	13.66
Mammalia	5416	423	7.81
Total (Animalia)	13,99,189	92,873	6.64
Grand total (Protista + Animalia)	14,30,439	96,373	6.74

Source: ZSI (2014)

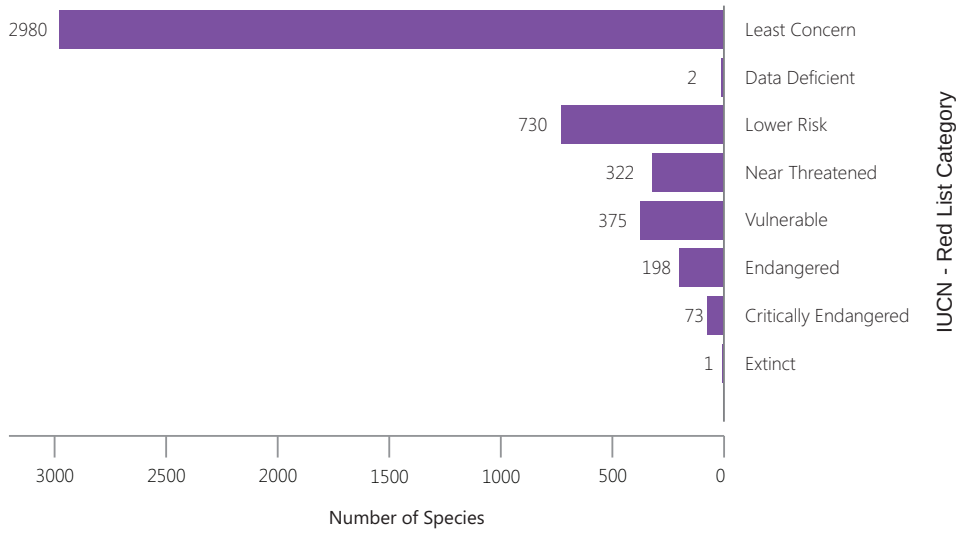


Figure 1.3: Representation of evaluated Indian fauna (n = 4681) under IUCN (2013) threat categories

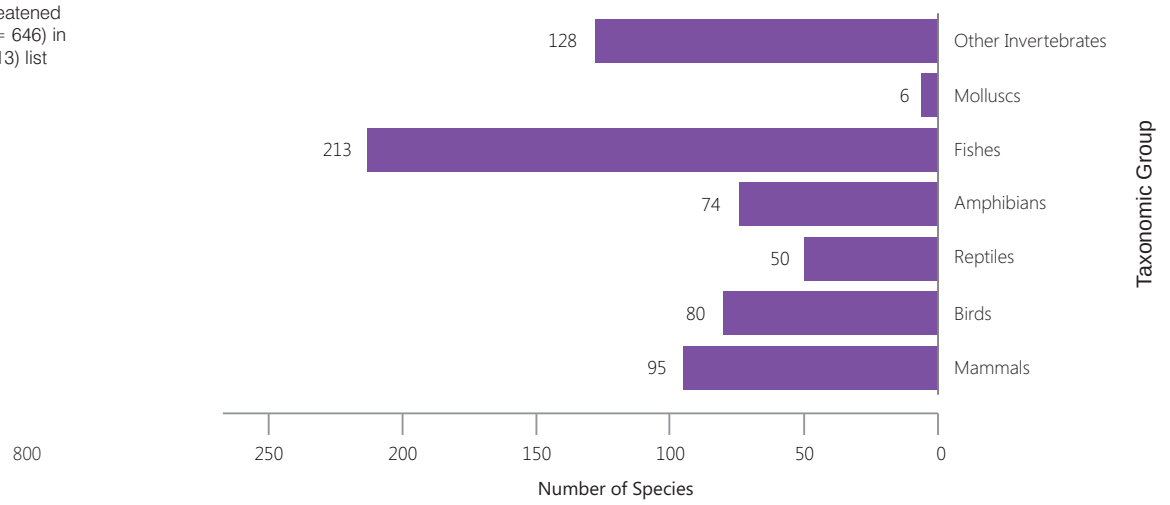


Figure 1.4: Indian threatened fauna (n = 646) in IUCN (2013) list

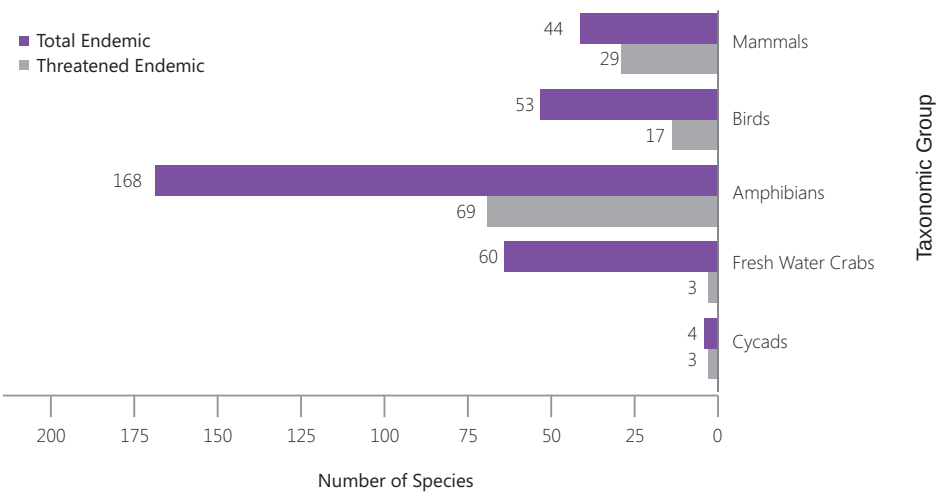


Figure1.5: Total numbers of endemic and threatened endemic species in India

Source: IUCN (2013)

With an estimated 29,105 species of algae, bryophytes, pteridophytes, gymnosperms and angiosperms, India holds 9.13% of the world's known floral diversity in these groups. The richness of Indian plant species as compared with the world is shown in Table 1.3. The numbers of Indian plants in various IUCN (2013) threat categories are shown in Figure 1.6.

Table 1.3: Number of species in major groups of plants

Plant group	Number of species described		
	India	World (estimated)	Percentage in India
Algae	7,244	40,800	17.75
Bryophytes	2,504	14,500	17.27
Pteridophytes	1,267	12,000	10.56
Gymnosperms	74	650	11.38
Angiosperms	17,926	250,000	7.17
Total	**29,015**	**317,950**	**9.13**

Source: BSI (2013)

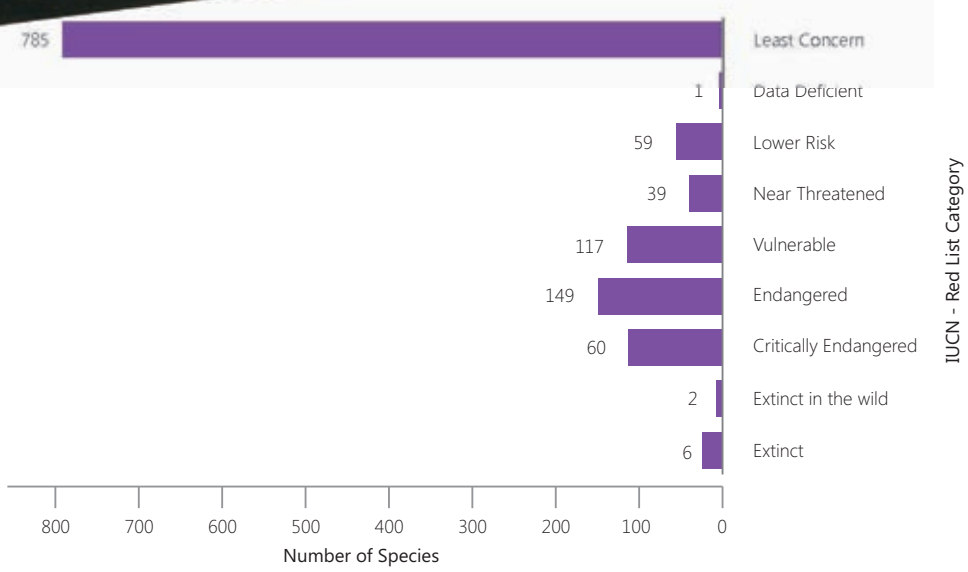


Figure 1.6: Numbers of evaluated Indian flora (n = 1218) in IUCN (2013) threat categories

1.1.5 Fungi and lichen diversity

Anil Rajbhar | *Clathrus delicatus*

The fungi, comprising diverse groups, are ubiquitous and constitute the major decomposer community in the biosphere. Out of an estimated over 90,000 fungal species recognized in the world, nearly 30% have been recorded from the tropics in the last six decades. It is believed that global estimates are conservative and it is possible that as many as 1.43 million species have remained undetected. The Indian subcontinent and other warmer belts of the globe are a storehouse of known and hitherto unknown fungi. Out of the 27,500 fungi described from India, 15,500 are terrestrial litter fungi, 327 are coprophilous and about 450 are endophytic fungi (Bhat 2010).

The fungi are the largest group of organisms by number on earth next only to insects, and are different from animals and plants, they belong to a separate biological kingdom that probably contains far more species than does the plant kingdom. Fungi are threatened by climate change, habitat destruction, invasive species, pollution, overexploitation and various other threats. It is for these reasons that fungal conservation and the sustainable utilization of fungi have been recognized by IUCN to be just as important as animal and plant conservation. In recognition of the expertise available at Agharkar Research Institute (ARI), Department of Science & Technology (DST), set up in 2008 the National Facility for Culture Collection of Fungi (NFCCI) with the primary aim of conserving germplasm of indigenous fungi in a repository, extending knowledge-based services, undertake researches in defined thrust areas and building capacity at the national level through workshops/training programmes. NFCCI is an exclusive repository, holding over 2800 strains belonging to 260 genera in two phyla: Fungi and Chromista (according to current classification system, Table 1.4). More than 9000 herbarium samples belonging to more than 800 different genera of fungi are also stored in the Ajrekar Mycological Herbarium (AMH) at the ARI.

India also has a large number of species of lichens. Lichens are nature's most remarkable alliances and the first recognized symbionts, combining the growth of fungi and algae or cyanobacteria in an intimate biological union. Such an association, besides conferring several advantages on lichens, has enabled them to thrive in all sorts of diverse environments in different parts of the world. At least 2300 species belonging to 305 genera and 74 families of lichen are reported from India. ARI is one of the leading centres of lichen studies in India. There are about 30,000 dried herbarium samples of lichens in this collection at the AMH, belonging to more than 86 genera classified under 28 families of Ascomycota and collected from various biodiverse regions of India (Table 1.4).

(http://nfcci.dinpl.com/, http://www.iisc.ernet.in/~currsci/jul102005/58.pdf, http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue16/main_index.htm)

Name of phylum	Number of genera	Percentage
Ascomycota - Fungi	175	66.92
Basidiomycota - Fungi	61	24.61
Glomeromycota - Fungi	1	0.38
Zygomycota -Fungi	18	6.92
'Incertae sedis' - Fungi	1	0.38
Oomycota - Chromista	3	1.15

Table 1.4. Details of fungi conserved in live form in NFCCI

Marine biodiversity 1.1.6

India's coastal and marine areas hold many biological treasures. Dense mangrove forest of Sunderbans, the world's largest congregations of nesting turtles in Odisha, beautiful seagrass beds in Palk Bay, dolphins and dugongs in the Gulf of Mannar, majestic whale sharks in the Gulf of Kachchh and some of the world's most beautiful coral reefs are just a few examples of the treasures of India's coastal and marine biodiversity. The marine floral and faunal biodiversity of India is remarkable, with over 200 diatom species, 90 dinoflagellates, 844 marine algae, 560 species of corals and 39 mangrove species, more than 10,000 invertebrate species and 2,500 vertebrate species (Table 1.5).

Plantae	Number of Species
Diatoms	200+
Dinoflagellates	90+
Macroalgae	844
Seagrasses	14
Mangroves	39
Protista	
Protozoa	532+
Foraminifera	500+
Tintinnids	32+
Animalia	
Porifera	486+
Cnidaria	842+
Ctenophora	12+
Platyhelmintha	350
Annelida	338
Chaetognatha	30+
Sipuncula	35
Echiura	33
Gastrotrocha	75
Kinorhyncha	10
Tardigrada	10+
Crustacea	3498
Mollusca	3370
Bryozoa	200+
Echinodermata	765
Hemichordata	12
Protochordata	119+
Pisces	2546
Reptilia	35
Mammalia	25
Total number of species	**15,042+**

Table 1.5 Marine species diversity in India

Source: Wafar et. al., (2011)

Mangroves | K. Sivakumar

1.1.7 Endemism

Endemism in plants is significant across different plant groups in India (Table 1.6). About 4045 species of flowering plants (angiosperms) endemic to India are distributed amongst 141 genera belonging to 47 families. These are concentrated in the floristically rich areas of North-east India, the Western Ghats, the North-west Himalaya and the Andaman and Nicobar Islands.

Table 1.6: Endemism in different plant groups of India

Sl. No.	Plant group	Total number of species in India	Number of endemic species	Percentage
1	**Angiosperms**	17,926	4,045	22.57
2	**Gymnosperms**	74	8	10.81
3	**Pteridophytes**	1,267	196	15.47
4	**Bryophytes**	2,504	642	25.64
5	**Algae**	7,244	1,949	26.91

Source: BSI (2013)

In terms of endemism of vertebrate groups, India's global ranking is 10th in birds, with 69 species, fifth in reptiles, with 156 species, and seventh in amphibians, with 110 species. Endemism is manifested most prominently in the Indian fauna among the Amphibia (61.2%) and Reptilia (47%). It is estimated that 62% of the known amphibian species are endemic to India, of which a majority are found in the Western Ghats (Source: http://www.vigyanprasar.gov.in). Endemism is also reported to be high in freshwater fishes of the Western Ghats (Molur et. al., 2011).

Taking into account the urgent need to protect endemic species and to spread awareness about their conservation, Department of Posts in collaboration with Ministry of Environment and Forests (MoEF), issued stamps on key endemic species of the four Indian biodiversity hotspots in presence of the Prime Minister during the inauguration of the High Level Segment of the Conference of Parties (CoP-11) to the Convention on Biological Diversity (CBD) held in Hyderabad in October, 2012 (Figure 1.7).

Figure 1.7: Department of Posts issued stamps on endemic species of the four Indian biodiversity hotspots at CBD COP-11, 2012.

Hoolock gibbon

Venated gliding frog

Bugun liocichla

Nicobar megapode

Domesticated biodiversity

1.1.8

India, as a centre of origin of cultivated plants, has as many as 15 different agro-climatic zones. India is also considered to be a primary centre of origin of rice. A total number of 811 cultivated plants and 902 of their wild relatives (Table 1.7) have been documented thus far. India also has a vast and rich repository of farm animals, represented by a broad spectrum of native breeds of cattle (34), buffaloes (12), goat (21), sheep (39) and chicken (15). To conserve India's rich domesticated biodiversity and promote underutilized crops and animal breeds, the Ministry of Agriculture (MoA) has set up six national bureaus namely, plant genetic resources, animal genetic resources, fish genetic resources, agriculturally important insects, agriculturally important microorganisms and soil sciences. These bureaus serve as the nodal organisations for characterisation, evaluation, cataloguing and establishing of national databases of living organisms corresponding to their mandates.

Table 1.7: Cultivated plants and their wild relatives in India

Sl. No.	Category	Number of cultivated plants	Number of wild relatives
1	Cereals	15	37
2	Millets	13	33
3	Grain legumes	18	36
4	Vegetables	105	168
5	Fruits and nuts	117	176
6	Oilseeds	19	13
7	Sugar-yielding plants	3	18
8	Fibre crops	12	23
9	Forage/fodder crops	96	33
10	Spices and condiments	46	123
11	Plantation crops	20	21
12	Medicinal and aromatic plants	89	58
13	Ornamental plants	182	90
14	Agro-forestry species	35	31
15	Other crops	41	42
	Total	**811**	**902**

Source: Singh et. al., (2013)

Plant genetic diversity

Agriculture remains the mainstay and one of the dominant drivers of economic growth in India. The large mosaic of distinct agro-ecosystems, characterised by variations in edaphic, climatic and geographical features, has contributed to diverse cropping patterns and systems across the country. The great diversity of traditional farming systems in India and practices in different parts of the country and the thousands of species that are locally cultivated, grow semi-domesticated in home gardens or other polycultures or are harvested from the wild in nearby habitats that make a major and essential contribution to the food security of hundreds of millions of people across the country. A reduction in agro-biodiversity would make the farming communities vulnerable to future environmental changes and accentuate poverty.

Plant genetic resources (PGRs), as components of agro-biodiversity, cover not only the whole gamut of genetic resources (from advanced cultivars to primitive landraces, domesticates, semi-domesticates, wild and weedy relatives) but the diversity of ecosystems and agro-ecosystems within landscapes that are exploited in some way for agriculture and forestry. The Indian PGR management system, led by NBPGR, has been addressing the challenges of PGR management at the national level (Table 1.8).

Table 1.8: National gene bank holdings at NBPGR, 2013

	Crop group/category	Number of accessions
1)	Seed conservation at -18°C	
	Cereals	1,56,526
	Millets and forage	56,472
	Pseudo cereals	6682
	Grain legumes	58,160
	Oilseeds	57,479
	Fibre crops	11,943
	Vegetables	25,084
	Fruits	530
	Medicinal and aromatic plants and narcotics	6771
	Spices and condiments	3721
	Agro-forestry	2443
	Duplicate safety samples	10,235
	Sub-total	3,96,189 (1584 spp.)
2)	Cryo-preservation in liquid nitrogen at -150°C to -196°C	9915 (729 spp.)
3)	*In vitro* conservation at 25 ± 5°C	2082 (138 spp.)
	Total	4,08,186

Source: NBPGR (2013)

DNA fingerprinting protocols using different molecular markers techniques such as simple sequence repeats, amplified fragment length polymorphism, inter-simple sequence repeats and random amplified polymorphic DNA have been developed for 33 crops of national importance. A total of 2215 varieties of these crops have been fingerprinted using a variety of experimental protocols and analytical procedures.

The gene bank at NBPGR has seen a significant increase in its holdings/accessions over the years (Figure 1.8).

Hudkia Ball | Dhirendra Singh Bisht

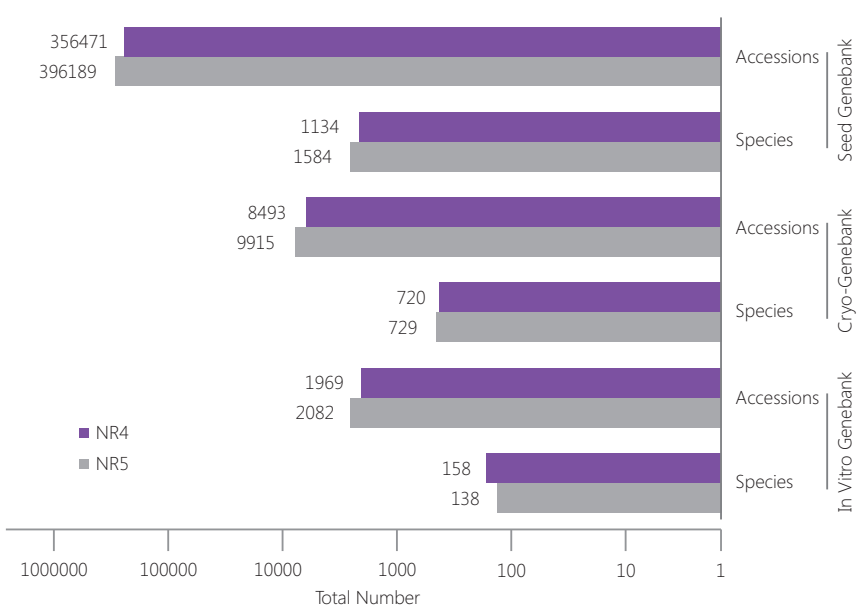


Figure 1.8: Increase in NBPGR holdings since India's Fourth National Report (NR4) to the CBD-2009 (MoEF 2009).

Source: NBPGR (2013)

Livestock diversity

The livestock sector plays an important role in the Indian economy and is an important sub-sector of Indian agriculture. This sector helps supplement food of the people with animal protein, supporting family incomes and generating gainful employment in the rural sector, particularly among the landless or small, marginal farmers and women. Livestock also provides fibre, manure for crops and draught power. The breakdown of livestock in the country is cattle, 37.6%; buffaloes, 19.9%; sheep, 13.5%; goats, 26.5%; and other livestock species (camels, horses, ponies, pigs, donkeys, etc.), 2.1%. Although the cattle, sheep, goat and yak populations have increased by 7.5%, 16.4%, 13% and 28%, respectively, the population of other livestock species has decreased.

Of the indigenous breeds, 10 of cattle, four of buffalo, eight of sheep, six of goat, four of camel, six of horse and 13 of poultry are showing declining trends in the country. In this context, the National Bureau of Animal Genetic Resources (NBAGR) has taken steps to characterise the indigenous farm animals. Presently 90% of the indigenous farm animal breeds registered at the NBAGR have been characterised phenotypically and genetically. The National Gene Bank at NBAGR has a total holding of 1,23,483 frozen semen doses from 276 breeding males representing 38 breeds of cattle, buffalo, sheep, goat, camel, yak and horse for *ex situ* conservation. An *in situ* model of conservation developed at NBAGR has been implemented at nine conservation sites. The conservation of the Krishna valley cattle, Beetal goat and Kilakarsal sheep in the field is a success story of the NBAGR (see Part III, Section 3.1.3, Aichi Biodiversity Target 13).

GS Bhardwaj

Fish diversity

Geographically, India occupying a position at the confluence of three major bio-geographic realms *viz.*, the Palaearctic, Afrotropical and Indo-Malayan, exhibits a great variety of ecological habitats which harbours rich ichthyofaunal diversity. So far, Zoological Survey of India (ZSI) has recorded 3,022 species which constitute about 9.41% of the known fish species of the world. Assessments of freshwater fish diversity in the Western Ghats and Eastern Himalayan hotspots have recently been conducted (Dahanukar et. al., 2011; Molur et. al., 2011; Allen et. al., 2010). National Bureau of Fish Genetic Resources (NBFGR) is mandated to carry out research related to cataloguing, characterization and conservation of country's fish germplasm resources. The Bureau has built up a database on about 2553 native fish species of India; generated information on population genetic structure of 23 prioritized endemic and commercially-important species; development of molecular markers to document intra-and inter-specific genetic divergence in fish species, development of functional genomics resources, Deoxyribonucleic Acid (DNA) barcodes of several aquatic species, developed sperm cryopreservation protocols of 28 important finfish species; cell lines including embryonic stem cells of 10 important species and a National Cell Line Repository with deposition of 35 cell lines; impact assessment of exotic fish species and diagnostic capabilities for emerging pathogens of aquatic organisms; and contributed significantly in bringing out several policy documents for the country.

Genetic diversity of agriculturally important microorganisms

India is home to billions of diverse microbes, many of which are found nowhere else in the world. The country is also endowed with enormous variability in agriculturally important microorganisms. The variability in fungi, bacteria, actinomycetes, viruses, cyanobacteria, etc. appears to have evolved with their hosts *vis-à-vis* the environment and forms invaluable gene pool resources. Due to intensification of agricultural practices and population pressure, the microbial variability is eroding. Despite the well-recognized importance of microorganisms, less than 5% of the world's microorganisms have been described. The NBAIM is a microbial bioresource centre for conserving and preserving microorganisms. The National Agriculturally Important Microbial Culture Collection (NAIMCC) facility at National Bureau of Agriculturally Important Microorganisms (NBAIM) has a repository of 4668 cultures, which includes 4644 indigenous and 24 exotic accessions. These microorganisms have been isolated from different agro-ecological regions all over India from various sources such as soil, plant, water and insects. The diversity of fungi, as well as bacteria, in the collection is very wide. There are more than 700 species belonging to 250 genera of fungi and more than 100 species belonging to 35 genera of

bacteria. During the 11th plan period (2007-2012), NBAIM successfully implemented a research programme for analysis of the microbial diversity of extreme regions and a programme for conservation of microorganisms. The NBAIM also implemented an Indian Council of Agriculture Research (ICAR) network project 'Application of Microorganisms in Agriculture and Allied Sectors', to initiate and strengthen research and development efforts related to various microbe-based technologies for increasing crop production, utilizing agro-waste, managing abiotic stress, carrying out biocontrol of important insect pests and performing post-harvest technology. Also, under this project, kits have been developed for studying the diversity of aquatic ecosystems, detecting and identifying fish pathogens (http://www.nbaim.org.in).

Genetic diversity of agriculturally important insects

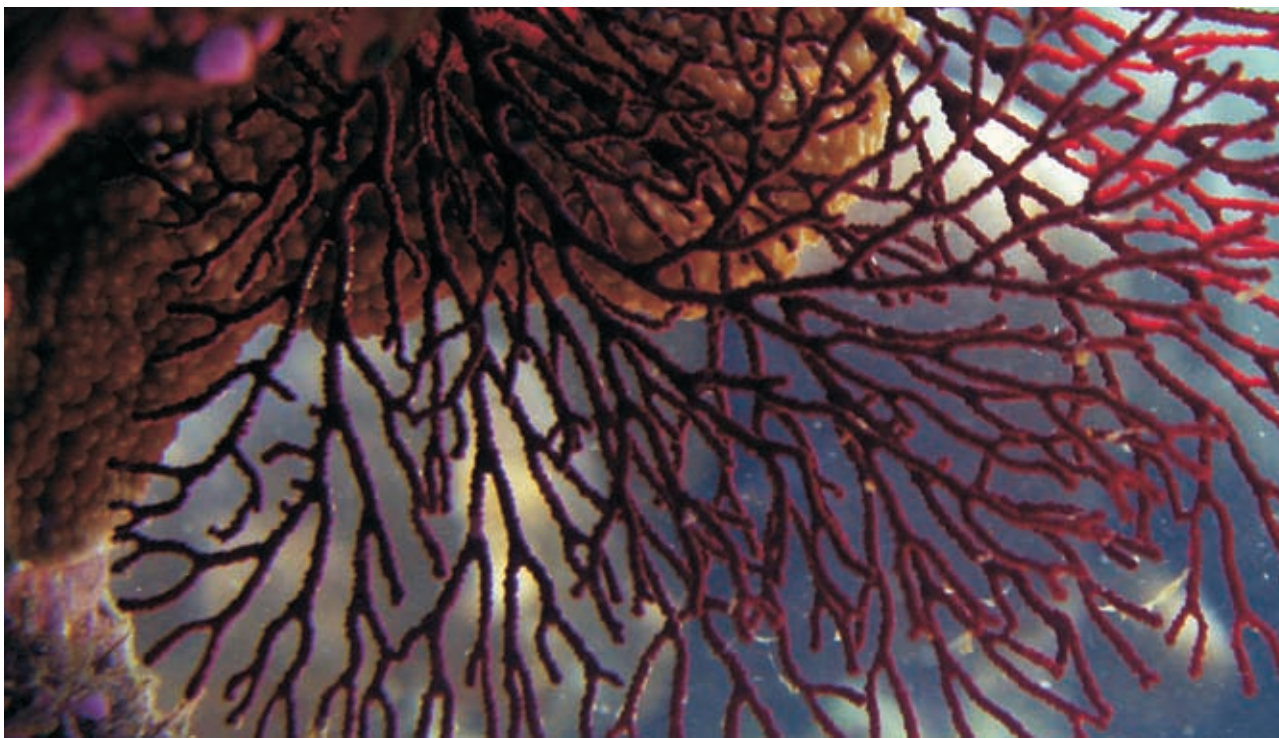
While the diversity of plants is discussed at length, insects, which form nearly 75% of all animals, representing tremendous diversity, remain poorly explored and documented. They outnumber by far all other terrestrial animals and occur practically everywhere. Several hundred thousand different kinds have been described - three times as many as there are in the rest of the animal kingdom - and some authorities believe that the total number of different kinds may approach 30 million. The National Bureau of Agriculturally Important Insects (NBAII), (www.nbaii.res.in) is an insect bioresource centre for collection, characterisation, documentation, conservation, exchange and utilisation of agriculturally important insect resources (including mites, spiders and related arthropods) for sustainable agriculture (Table 1.9).

Table 1.9: National Gene Bank holdings at NBAII

Sl. No.	Insect group (maintained in live insect repository)	Number of accessions/holdings Indigenous	Exotic
1	Host insects	14	-
2	Predators	25	2
3	Parasitoids	72	19
4	Silkworms	297	162
5	Veterinary insects	2	-
6	Total insect germplasm holdings	593	

Source: NBAII (2013)

1.2 Status and Trends in Terrestrial and Aquatic Ecosystems



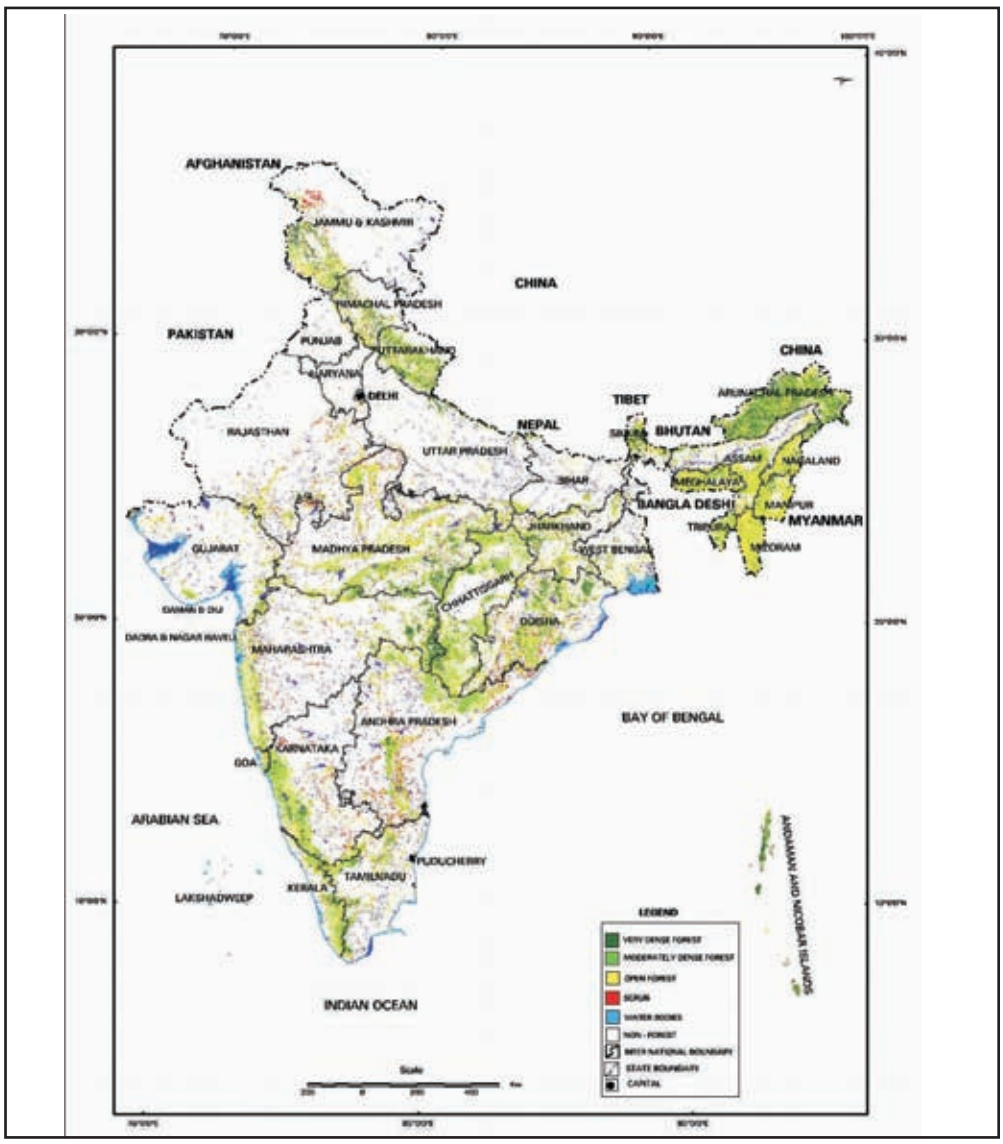


Figure 1.9: Forest cover map of India

Source: FSI (2011)

Sea Fan | Rajkumar Rajan

Forests 1.2.1

The forests in India are spread over an area of 692,027 km^2, covering 21.05% of the geographical area of the country. There are 16 major forest types and 251 sub-types (FSI 2011). The forest cover of the country has been classified on the basis of the tree canopy density into pre-defined classes: Very Dense Forest (VDF), Moderately Dense Forest (MDF) and Open Forest (OF). Scrub, though shown separately, is not counted as forest cover (Figure 1.9). Details of the forest cover at the country level are provided in Table 1.10. The area under VDF, MDF and OF includes areas under mangrove cover of the corresponding density classes.

Table 1.10: Forest cover of India

Class	Area (km^2)	Percent of geographical area
Forest cover		
a) VDF	83,471	2.54
b) MDF	3,20,736	9.76
c) OF	2,87,820	8.75
Total forest cover	**6,92,027**	**21.05**
Scrub	42,176	1.28
Non-forest	2,533,060	77.67
Total geographical area	**3,287,263**	**100.00**

Source: FSI (2011)

While in many developing countries, forest cover has either remained static or has reduced, India has added around 3 million hectares of forest and tree cover over the last decade. Forests neutralise approximately 21.17% of India's Green House Gases (GHG) emissions (arrived at data from NATCOM-II 2012). The MoEF, through its various programmes, is addressing critical issues such as deforestation, degradation of forests and sustenance of forest-dependent communities. The Ministry has been persistently working towards increasing the total forest cover in India by initiating targeted afforestation programmes such as the Green India Mission (GIM) (see Part III, Aichi Biodiversity Target 5, Section 3.1.2; moef.nic.in/downloads/public-information/GIM-Report-PMCCC.pdf).

Tree cover

Tree cover comprises tree patches with an area less than one hectare but not less than 0.1 hectare, which lies outside the recorded forest area (FSI 2011). The total tree cover in India is estimated to be 9.08 million hectares, accounting for about 3% of the total geographic area of the country (Table 1.11).

Table 1.11: Total tree cover in India

Sl. No.	Physiographic Zone	Geographical Area (km^2)	Tree Cover Area (km^2)	Percentage of Geographical Area
1	Western Himalayas	329,255	7,859	2.39
2	Eastern Himalayas	74,618	356	0.48
3	North East	133,990	2,275	1.70
4	Northern Plains	295,780	9,366	3.17
5	Eastern Plains	223,339	5,168	2.31
6	Western Plains	319,098	7,038	2.21
7	Central Highlands	373,675	9,886	2.65
8	North Deccan	355,988	7,007	1.97
9	East Deccan	336,289	10,718	3.19
10	South Deccan	292,416	8,012	2.74
11	Western Ghats	72,381	4,083	5.64
12	Eastern Ghats	191,698	4,420	2.31
13	West Coast	121,242	8,863	7.31
14	East Coast	167,494	5,791	3.46
	Total	**3,287,263**	**90,844**	**2.76**

Source: FSI (2011)

Growing stock

Forest growing stock is a crucial indicator of forest health and productivity and is important for developing national policies and strategies for sustainable use of forest resources. Carbon stock stored as biomass can be estimated from the forest growing stock and is particularly relevant in the context of climate change situations (Table 1.12).

Geographical area (km^2)	Recorded forest area (km^2)	Volume of growing stock (m^3) In forest	In TOF	Total
3,287,263	7,69,538	4498.731	1548.427	6047.158

Source: FSI (2011)

Table 1.12: Growing stock in forests and trees outside forests (TOF)

Carbon stock

Forests play a very significant role in the dynamics of the global carbon cycle. To address climate change scenarios and assist policy makers, the FSI (2011) presents carbon stock estimates for all the five carbon pools, namely soil, litter, deadwood, below-ground biomass and above-ground biomass for both forestland remaining forestland and for land converted to forestland. Estimates of the overall component-wise carbon stocks and change in carbon stock during 1994-2004 are presented in Table 1.13.

Component	Carbon Stock in forest land in 1994 (MtC)	Carbon Stock in forest land in 2004 (MtC)	Net change in Cabon-stock in forest land remaining forest land (MtC)	Annual Change in Carbon-stock in land remaining forest land during 1994-2004 (MtC)	Carbon stock change from land converted to forest land in 2004 (MtC)	Annual change in Carbon stock land converted to forest land during the period 1994-2004 (MtC)
Above Ground Biomass	1784	1983	199	19.9	118	11.8
Bellow Ground Biomass	563	626	63	6.3	37	3.7
Dead wood	19	24	5	0.5	1	0.1
Litter	104	114	10	1.0	7	0.7
Soil	3601	3542	-59	-5.9	211	21.1
Total	**6071**	**6288**	**217**	**21.7**	**375**	**37.5**

Source: NATCOM-II (2012);FSI (2011)

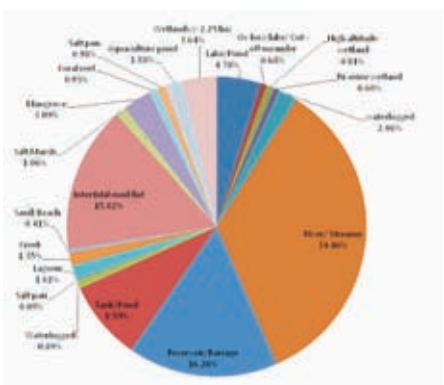
Table 1.13: Changes in carbon stock

Wetlands

India is bestowed with a rich diversity of wetlands, ranging from high altitude lakes of the Himalayas, floodplains and marshes of the Gangetic - Bramhaputra alluvial plains, saline flats of Green Indian Desert to extensive mangroves marshes bordering the country's East and West coastline. As per remote sensing imagery based assessment (at 1:50,000 scale based on data of 2006-2007), India has total of 757,060 wetlands covering a total area of ca. 15.26 million ha, roughly equal to 4.6% of its land area. Of this, inlands wetland constitute 69.22% (10.56 million ha). There are 0.556 million wetlands with area less than 2.25 ha (Figure 1.10, Figure 1.11, National Wetland Atlas 2011)

India is a signatory to Ramsar Convention and is committed to 'wise use' of all wetlands in her territory. As on date, 26 sites have been designated as Wetlands of International importance under the Convention.

Conservation of wetlands is one of the high priority areas of MoEF. The Ministry has been providing financial support to State Governments for implementing action plan for conserving wetlands under the National Wetland Conservation Programme (NWCP) since 1986. In 2001, National Lake Conservation Plan (NLCP) was introduced to address pollution issues in urban and semi-urban environment through interception, diversion and/or treatment of pollution load entering the lake. As on December 2012, nearly 150 priority sites have been prioritized for conservation and management under the two schemes. In February 2013, the Ministry has since launched the National Programme on Conservation of Aquatic Ecosystem (NPCAE) for conservation of both lakes and wetlands with a significant increase in allocation of resources.



Source: National Wetland Atlas (2011)

Figure 1.10: Type-wise (level-III) Wetland distribution in India

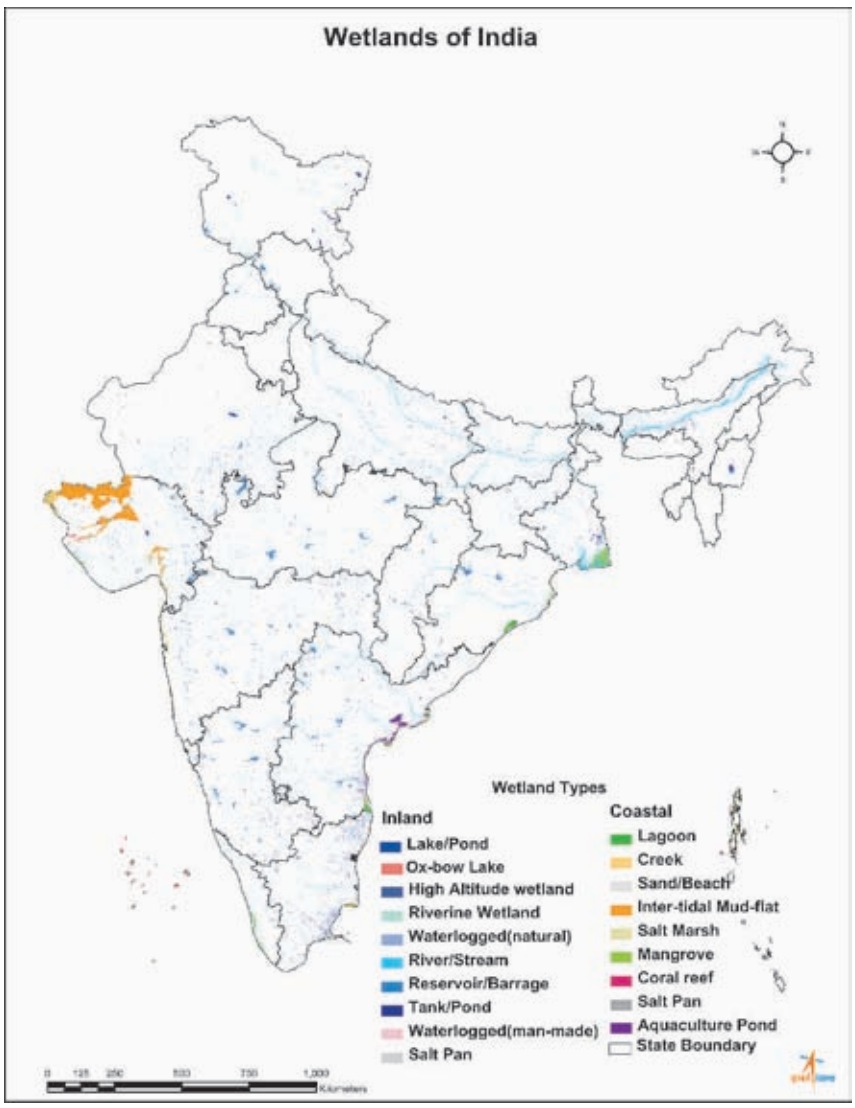


Figure 1.11: Wetland map of India

Source: National Wetland Atlas: India (2011)

Mangroves, corals and seagrasses

India has a long coastline of about 7,517 km in length- consisting of 2,383 km^2 of extensive coral reef beds (Figure 1.12) and 4,667 km^2 of mangrove habitats that are home to more than 12,000 species of flora and fauna. Along with these, other ecosystems, such as lagoons, estuaries and seagrasses, spread over an area of 4500 km^2, sustain and provide a source of livelihood to over 250 million people. The coral reef beds in the Gulf of Kachchh, Gulf of Mannar, Lakshadweep Islands and Andaman and Nicobar Islands are inhabited by several rare and threatened species such as the dugong, the Hawksbill turtle and Giant clams, which indicate the health of these ecosystems. A total of 478 species of corals belonging to 89 genera have so far been recorded from India, forming 60% of the known hermatypic genera of the world (ICMAM-PD 2001, SAC 2010).

The mangrove cover of India (2.69% of the global mangrove area and 8% of Asia's mangroves) is home to umbrella species such as the tiger as well as many threatened species such as the River terrapin, Gangetic river dolphin, Estuarine crocodile and Fishing cat. About 59% of this cover is on the East coast, along the Bay of Bengal, 28% on the West coast, bordering the Arabian Sea, and 13% on the Andaman and Nicobar Islands. These mangroves are also inhabited by 12 species of salt marsh vegetation and 11 species of seagrass (Kathiresan 2004). Two globally threatened mangrove species are also found in India: *Sonneratia griffithii* and *Heritiera fomes* (Kathiresan 2010). The largest mangrove habitat is found in the Sundarbans, West Bengal. It is the single largest block (>10,000 km^2) of tidal halophytic mangroves in the world.

Seagrasses are submerged aquatic vegetation specialised to live in marine environments though they constitute less than 0.02% of angiosperms representing 72 species and 14 genera. They have leaves, roots, conducting tissues, flowers and seed and prepare their own food through photosynthesis and represents one of the most productive ecosystems in the marine environment, with an average net production of about 1012 g/m^2/yr. They are acting as the carbon sink in the coastal environment by sequestering 12% of the carbon fixed in the global oceans. This

ecosystem provides food, habitat and nursery areas for a myriad of vertebrates (such as Dugong and Green turtle) and invertebrate organisms. Seagrass ecosystems support rich biodiversity, are sensitive to changes in water quality and being the sedentary primary producer, they have been recognized as important indicator species reflecting the health of the coastal environment. Besides mangroves and coral reefs, this ecosystem is also being subjected to a lot of stress mainly from point and nonpoint sources of pollution, sedimentation and turbidity. In India, extensive seagrass meadows are reported from Gulf of Mannar, Palk Bay, Gulf of Kachchh, Lakshadweep and Andaman and Nicobar group of islands. India is bestowed with 15 species of seagrasses belonging to six genera. Remote sensing measurements indicate that about 14000 ha of seagrasses are found distributed within 5 m depth contours and the seagrasses beyond 5 m depth are not yet quantified in the aforesaid seagrass sites. *Cymodocea rotundata, Cymodocea serrulata, Thalassia hemprichii, Halodule uninervis* and *Halophila ovalis* are the major contributors to the biomass in these regions.

Reef of Andaman | Deepak Apte

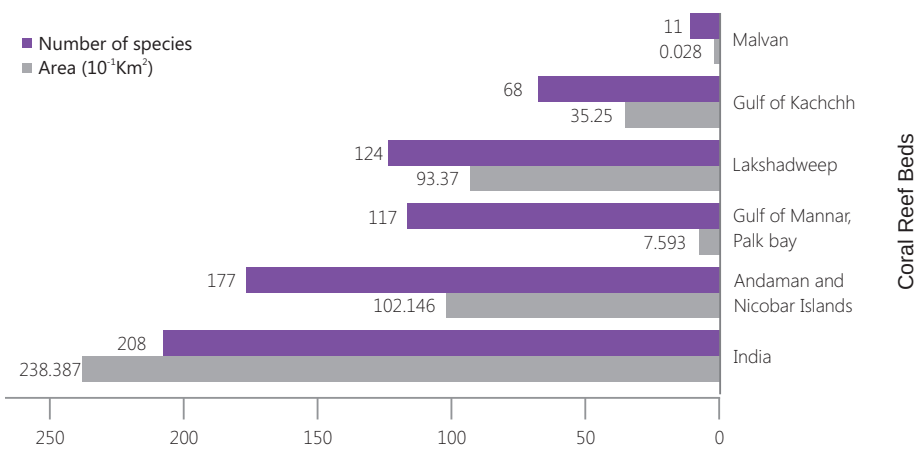


Figure 1.12: Status of coral reefs in India

Source: (ICMAM-PD 2001, SAC 2010).

PA network, ESAs, corridors and connectivity, BRs, IBAs, KBAs, AZEs, CCAs 1.2.2

PA Network

India has a very long tradition of setting aside areas for conservation of wild flora and fauna. After independence, several Protected Areas (PAs) were designated in the form of National Parks and Wildlife Sanctuaries, but the approach was largely ad hoc. In 1983, the Government of India (GoI) decided that rational planning and implementation of a comprehensive network of PAs would be the keystone of the National Wildlife Action Plan and entrusted the Wildlife Institute of India (WII) to formulate plans for such a network (Rodgers et. al., 2002). The WII prepared a biogeographic classification of India (see Section 1.1.1) designed to facilitate conservation planning with a review of existing protected areas and recommendation of new PAs to ensure an adequate network covering the range of biological diversity in the country. Thus, from a network of 54 National Parks covering 21,003 km^2 and 373 Sanctuaries covering 88,649 km^2, giving a combined coverage of 109,652 km^2 or 3.34% of the country's geographical area in 1988, this network has grown steadily, and as of 2014 there are 690 PAs (102 National Parks, 527 Wildlife Sanctuaries, 57 Conservation Reserves and 4 Community Reserves) covering 166,851 km^2 or 5.07% of the country's geographical area (Table 1.14). India has also established 18 MPAs in peninsular India and 100 in the islands (see Box 1.1).

Table 1.14: PA network growth in India (1988-2014)

Category	1988			2014			Percentage increase		
	Number	Area (km^2)	Percentage	Number	Area (km^2)	Percentage	Number	Area	Increase in net area (km^2)
National Park	54	21,003	0.64	102	40,074	1.22	89	91	19,072
Wildlife Sanctuary	373	88,649	2.7	527	124,738	3.78	41	40	36,089
Conservation Reserve	-	-	-	57	2,018	0.06	-	-	21
Community Reserve	-	-	-	4	21	0	-	-	2,018
Protected Areas	427	109,652	3.34	690	166,851	5.07	62	52	57,199

Source: WII (2014)

Box 1.1

Marine protected area network in India

India has a vast coastline of 7517 km, of which 5423 km is in peninsular India and 2094 km in the Andaman, Nicobar and Lakshadweep Islands, with an exclusive economic zone of 2.02 million km^2. This coastline also supports a huge human population, which is dependent on the rich coastal and marine resources. It is estimated that nearly 250 million people live within a swath 50 km wide along the coastline of India. Therefore, the ecological services of the marine and coastal ecosystems of India play a vital role in India's economic growth and in ensuring human well-being.

The MPA network in India has been used as a tool to manage natural marine resources for biodiversity conservation and for the well-being of people dependent on these resources. India has designated four legal categories of PAs, National Parks, Wildlife Sanctuaries, Conservation Reserves and Community Reserves. Scientific monitoring and traditional observations confirm that depleted natural marine resources are getting restored and/or pristine ecological conditions have been sustained in well managed MPAs. There are 23 MPAs present in peninsular India and more than 100 MPAs in the country's islands. Of the 23 MPAs in the peninsula, Gulf of Mannar Marine National Park, Sundarbans National Park, Gulf of Kachchh National Park, Gahirmatha Marine Sanctuary, Coringa Wildlife Sanctuary, Chilika Wildlife Sanctuary have unique marine biodiversity and provide a range of ecological services to the local communities. These 23 MPAs cover an area of about 6158 km^2, which is 3.85% of the total area covered under the entire PA network of India or less than 0.2% of the total land area of India. The total area of the Andaman and Nicobar Islands is 4947 km^2, of which 1510 km^2 is protected under the provisions of India's Wildlife (Protection) Act, 1972. There are 105 PAs in the Andaman and Nicobar Islands, of which about 100 include marine areas. These MPAs cover more than 30% of the terrestrial area of the islands and protect more than 40% of the coastal habitat. Mahatma Gandhi Marine National Park and Rani Jhansi Marine National Park are important MPAs here. In the Lakshadweep group of islands, Pitti Island (0.01 km^2) is the only island having the status of an MPA.

Corridors and connectivity

PAs are increasingly becoming islands in a sea subject to various human uses such as agriculture, industry and mining. Moreover, many PAs are too small to be able to safeguard viable populations of landscape-dependent species such as the tiger and elephant in the long term. In the report produced by the National Tiger Conservation Authority (NTCA) and WII titled Status of Tigers, Co-predators, and Prey in India-2010, important corridors, their spatial context with coordinates and potential bottlenecks have been identified. Considering the importance of corridors in maintaining long-term viability of species, the High Level Working Group (HLWG) has endorsed the need for maintaining 'functional corridors' so as to ensure that permeability to movement of wild animals is not impaired (http://moef.nic.in). With this in view, efforts are being made to designate the identified 'corridors and connectivity' as Ecologically Sensitive Areas (ESAs).

Ecologically Sensitive Areas (ESAs)

As mentioned in the foregoing, India has established an impressive network of PAs comprising National Parks, Wildlife Sanctuaries, Community Reserves and Conservation Reserves. While the PAs are managed under the provisions of the Indian Wildlife (Protection) Act, 1972, areas falling within 10 km of the PA boundaries are often subjected to development, which may not be in harmony with the requirements of habitat and species conservation. Certain landscape-dependent species also move beyond PA boundaries into the larger landscapes for meeting their ecological requirements of food, cover and reproduction. In the XXI meeting of the Indian Board for Wildlife, held on 21 January 2002, the Wildlife Conservation Strategy 2002 was adopted, which envisaged that lands falling within 10 km of the boundaries of National Parks and Wildlife Sanctuaries should be notified as eco-fragile zones under the provisions of the Environment (Protection) Act, 1986. Several State Governments expressed concerns regarding the designation of such areas in the context of the presence of huge human populations and developmental pressures. In 2006, in response to a public interest litigation, the Supreme Court of India directed the MoEF to approach all States/Union Territories to expedite the notification of eco-sensitive zones. In February 2011, the MoEF issued its guidelines for Declaration of Eco-sensitive Zone around National Parks and Wildlife Sanctuaries. The basic objective of these guidelines is to regulate activities around National Parks and Wildlife Sanctuaries so as to minimize the negative impacts of such activities on the fragile ecosystems around PAs. The guidelines also provide an indicative list of activities categorised into three groups: (i) prohibited, (ii) restricted with safeguards and (iii) permissible. These guidelines have to be applied in the context of National Parks, Wildlife Sanctuaries, important corridors and connectivity areas with a view to minimising and preferably eliminating negative impacts on PAs. To date, 14 notifications and 16 draft notifications with respect to PAs have been prepared and hosted on the website of the MoEF (www.moef.nic.in). In addition, eight sites have been notified on the basis of the sensitivity of the ecosystems (fragility, ecosystem characteristics and environmental degradation levels; www.moef.nic.in). The establishment of ESAs would lead to achieving several objectives of CBD Aichi Biodiversity Targets.

The HLWG set up the MoEF under the chairmanship of Dr. K. Kasturirangan, Member, Planning Commission, has recommended identification of about 60,000 km^2 of natural landscape (approximately 37% of the total geographical area of Western Ghats Region) as ESA. This represents more or less a contiguous band of vegetation extending over a distance of 1500 km across six States of Western Ghats region and includes PAs and World Heritage Sites. The HLWG has recommended prohibitory and regulatory regime in ESAs for those activities with maximum interventionist and destructive impacts on the ecosystem (http://envfor.nic.in/sites/default/files/HLWG-Report-Part-1_0.pdf).

Biosphere Reserves (BRs)

The MoEF, initiated the National Biosphere Reserve Programme in 1986 with the primary aim of conservation of an entire range of living resources and their ecological foundations, along with sustainable use of natural resources and improvement of the livelihoods of local inhabitants. This programme also had the objective of ensuring community participation for effective management of biodiversity resources and integration of traditional knowledge and scientific research for conservation, education and training as a part of the overall management of BRs. Considering the diversity of ecosystems and recognising the importance of BRs in ensuring long-term conservation and sustainable use of India's representative and diverse biological diversity, so far 18 BRs have been notified by the GoI. Globally, the World Network of Biosphere Reserves (WNBR) has designated a total of 621 BRs, of which 9 are in India. These are the Achanakmar-Amarkantak, Nilgiri, Gulf of Mannar, Nanda Devi, Sundarban, Simlipal, Pachmarhi, Nokrek and Great Nicobar BR.

Important Bird Areas (IBAs)

Birds are good indicators of ecosystem health. The IBA programme of BirdLife International aims to identify, monitor and protect a global network of IBAs for conservation of the world's birds and other biodiversity. The IBAs are conservation areas of international significance for conservation of birds at the global, regional or sub-regional level. According to BirdLife International, designation of IBAs is based on standardised criteria, namely (i) hold significant numbers of one or more globally threatened bird species, (ii) be one of a set of sites that together hold a suite of restricted-range species or biome-restricted

Crimson Sunbird | Anchit

species and (iii) have exceptionally large numbers of migratory or congregatory birds. The IBAs contain a range of habitats, such as wetlands, mudflats, micro-habitats in biodiversity hotspots, grasslands and scrublands, making them excellent indicators of biodiversity richness. The Bombay Natural History Society (BNHS; www.bnhs.org) and BirdLife International have identified 465 IBAs in India (Islam and Rahmani 2004). Forty percent of these IBAs fall outside the PA network and thus form an important tool for landscape-level conservation planning. The BNHS is in the process of adding 100 more IBAs to the existing network of IBAs. As of now, a tentative list of 58 new IBAs has been proposed across nine States of India.

Key Biodiversity Areas (KBAs)

KBAs are nationally identified sites of global significance. In India, the identification 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 (WCS)-India and the University of Agricultural Sciences in Bengaluru. Building from preliminary data on Important Bird Areas, compiled by the BNHS, data on globally threatened species of mammals, birds, amphibians, plants, and to a lesser extent, reptiles and fish, were synthesized to identify and delineate 126 KBAs in the Western Ghats. These sites are high priorities for conservation action. KBAs comprise an 'umbrella' which includes globally important sites for different taxa and realms: IBAs, Medicinal Plant Conservation Areas (MPCAs), Important Sites for Freshwater/Marine Biodiversity; and Alliance for Zero Extinction (AZE) sites.

Alliance for Zero Extinction (AZE)

The AZE (www.zeroextinction.org) is a global alliance, which identifies threatened species (CR and EN), based on the global IUCN Red Listing, occurring in a single location, as the highest priority in initiating on-the-ground conservation action. The combination of vulnerability of species and irreplaceability of its site is a powerful prioritization to ensure species with the highest risk of extinction have a chance of survival in the long term. The AZE acknowledges and encourages the role of stakeholders in the habitat of the AZE species to work together holistically to ensure habitat integrity and prevent extinction. Currently there are 19 species recognized by the AZE in India, The Zoo Outreach Organization (ZOO; www.zooreach.org) and the Indian Alliance for Zero Extinction (In AZE; www.zooreach.org/indianaze/indianaze.html) have identified a further 40 species and sites based on the recent assessments of freshwater fish and aquatic plants. Conserving these species and their habitats will affirm India's commitment to zero extinction as outlined in Aichi Biodiversity Target 12 (see Part III, Section 3.1.3, Aichi Biodiversity Target 12).

Community Conservation Areas (CCAs)

CCAs can be defined as 'natural ecosystems (forest/marine/wetlands/grasslands/others), including those with minimum to substantial human influence, containing significant wildlife and biodiversity values, being conserved by communities for cultural, religious, livelihood, or political purposes, using customary laws or other effective means'. Recognising that there are several traditional community-initiated and driven conservation programmes, the GoI has decided to provide financial and technical support to such initiatives through Central Schemes. Support to such CCAs will ensure coverage to such otherwise neglected community-led conservation initiatives and widen the focus of conservation beyond conventional PAs. Further, wildlife protection in multiple use areas is one of the components of the National Wildlife Action Plan (2002-2016). The objective is to provide adequate protection to wildlife in multiple use areas such as Government forests outside PAs. A total of 141 CCAs covering a total area of ca. 157,046 ha have been identified for conservation measures.

(http://www.kalpavriksh.org/images/CCA/Directory/CCADirectory_Overview.pdf, http://www.kalpavriksh.org/images/CCA/Miscellaneous/RecogCCAsinIndia_DraftIMoEFcomments_15Jan09.pdf)

Medicinal Plant Conservation Areas (MPCAs)

India has one of the richest and oldest medicinal plant cultures of the world. The so far estimated number of 6560 species of medicinal plants of India are a great bio-cultural resource Foundation for Revitalisation of Local Health and Traditions (FRLHT; http://envis.frlht.org/traded-medicinal-plants-database.php#). The uniqueness of the Indian medical heritage draws from two streams of knowledge, folk and codified stream, which are coexisting living traditions that have historically enjoyed a symbiotic relationship. India is a global leader in *in-situ* conservation of medicinal plants having established the largest *in-situ* conservation network for medicinal plants in the tropical world. So far, 110 MPCAs, each of an average size of 200 ha, have been set up across 13 States of India. There is a felt need for expansion of the MPCA network at least three fold in order to capture breeding populations of all the currently known 315 species of threatened medicinal plants and its further strengthening through long term conservation research activities and sustainable community involvement programs.

Rauwolfia serpentina | Rakesh Dogra

Air and water quality trends 1.2.3

In India, the Central Pollution Control Boar (CPCB) is entrusted with the mandate of improving the quality of air and preventing, controlling or eliminating air pollution in the country as well as promoting cleanliness of streams and wells in different areas of the states by prevention, control and ending water pollution.

Air quality management

The CPCB is executing a nation-wide National Air Quality Monitoring Programme (NAMP) covering 573 operating stations spread out in 240 cities/towns and industrial areas in 26 States and 5 Union Territories. Under the NAMP, three air pollutants (sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and particulate matter with size less than or equal to 10 microns (PM10) have been identified for regular monitoring at all the locations. Monitoring of meteorological parameters such as wind speed, wind direction, relative humidity and temperature have also been integrated with the monitoring of air quality at selected locations. Monitoring of pollutants is carried out for 24 hours twice a week so that at least 104 observations are obtained in a year.

A need to modernise the existing national Air Quality Monitoring Network so as to bring it up to international standards has been recognised. This will involve gradually replacing the manual stations with Continuous Ambient Air Quality Monitoring Stations (CAAQMS) and involving the private sector in the development and operation of the system. Towards achieving this goal, the CPCB has decided to follow two new models: (a) Model I, operational contract, and (b) Model-II, build own and operate (BOO) contract. Model I is being piloted in four cities, namely Delhi, Lucknow, Bangaluru and Chennai, while a proposal is being developed to execute pilot projects following Model-II in Ahmedabad and Mumbai. The implementation would include a pilot network of three CAAQMS in each city (one in a residential area, one in an industrial area and one in a traffic hotspot).

Water quality management

The CPCB, in collaboration with State Pollution Control Boards (SPCBs), has established a water quality monitoring network, comprising 2500 stations in 28 States and 6 Union Territories of the country. The monitoring network covers 445 rivers, 154 lakes, 12 tanks, 79 ponds, 41 creeks, 25 canals, 45 drains and 807 wells. Presently, the inland water quality monitoring network is operated under a two-tier programme, the Global Environmental Monitoring System (GEMS) and the Monitoring of Indian National Aquatic Resources System. Monitoring is carried out on a monthly basis for surface waters and on a half-yearly basis in the case of groundwater. Water samples are analysed for 28 parameters (physico-chemical and bacteriological parameters). Selected samples are also analysed for 9 trace metals and 28 pesticides. Monitoring results obtained between 1995 and 2012 indicate that organic and bacterial contamination continue to be critical in water bodies. This is mainly due to discharge of untreated domestic wastewater from the urban centres of the country. The National Hydrology Project-II includes development of a Decision Support System (DSS) to be used by Indian states and central agencies for improved planning and management of water for domestic, industrial and agricultural uses.

1.3 Species population trends

Halting the loss of biodiversity has become an urgent issue facing humanity. Governments of 192 countries have committed under the aegis of CBD, to achieve a significant reduction in the current rate of biodiversity loss by 2020. Habitat loss has historically been an important contributing factor in the decline of species. While all species are important, priority actions are needed to conserve 'flagship species', which are generally high profile and charismatic species that play a significant ecological role and often have important cultural associations. Flagship species act as symbols of the broader ecosystems in which they occur and can thus act as catalysts for wide-ranging conservation action and activities. Thus, conservation efforts have to focus on the preservation of flagship species to stabilise the entire biological community, as the loss or decline of such a species within an ecosystem has serious consequences for the continued productivity, structure and function of the ecosystem. The population trends of three flagship species, the Tiger, Elephant and Wild ass have been presented in the following section.

1.3.1 Flagship species

Tiger

The Tiger *Panthera tigris* is an umbrella species for conservation of the biota of a majority of the eco-regions in Asia. Its role as a top predator is vital in regulating and maintaining ecological processes and systems. India is home to over 50% of the world's wild tigers in spite of having a growing human population of over a billion. The current populations of tigers in four tiger-occupied landscape complexes are shown in Figure 1.13. India is playing an important role in conserving tigers by accomplishing the objectives of the Global Tiger Recovery Plan, which was ratified at the meeting of world leaders held at St. Petersburg in 2010. The country has also established the NTCA, a statutory body for dealing with all matters related to tiger conservation (www.projecttiger.nic.in).

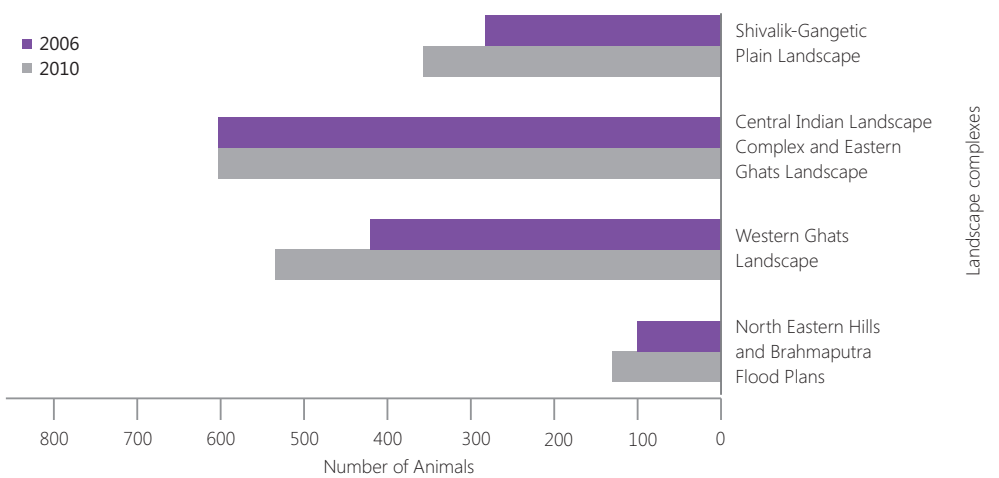


Figure 1.13: Tiger (*Panthera tigris*) populations in landscape complexes

Source: Jhala et. al., (2011)

Elephant

The Elephant (*Elephas maximus)* has enjoyed a unique association with the people of India since ancient times and is worshiped in Hindu and Buddhist cultures. It occurs in the central and Southern Western Ghats, North-east India, Eastern India and Northern India and in some parts of Southern peninsular India. It is included in Schedule I of the Indian Wildlife (Protection) Act, 1972 and in Appendix I of the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). In 1992 GoI launched Project Elephant, a flagship conservation project that aims to conserve the elephant and its habitat across 10 major landscapes (designated as Project Elephant Ranges), mitigate elephant - human conflict, and protect the animal from poaching for ivory. It occurs in 16 of the 28 States in the country and is showing an increasing trend across its distributional range. Its population in 2007 was estimated to be in the range from 27,657 to 27,682, whereas in 2012 the population was estimated to be between 27,785 and 31,368. The State-wise population estimates are given in Table 1.15.

Elephant | GS Bhardwaj

Sl. No.	State	Elephant population	
		2007	2012
1	Arunachal Pradesh	1690	1690*
2	Assam	5281	5281*
3	Meghalaya	1811	1811*
4	Nagaland	152	212
5	Tripura	59	59*
6	West Bengal	325-350	325-350*
7	Jharkhand	624	688
8	Odisha	1862	1930
9	Chattisgarh	122	215
10	Uttarakhand	1346	1346*
11	Uttar Pradesh	380	380
12	Tamil Nadu	3867	3726
13	Karnataka	4035	3900-7458**
14	Kerala	6068	6177
15	Andhra Pradesh	28	41
16	Maharashtra	7	4
		27,657-27,682	**27,785-31,368**

Table 1.15: Elephant (*Elephas maximus*) population estimates for 2007 and 2012

Source: MoEF 2013
*Census figures of 2007. The census reports of 2012 are still awaited from the States.
**3900-7458 (Confidence Limits)

Asiatic Wild ass

The Asiatic Wild ass *Equus hemionus* khur is restricted to the Rann of Kachchh in Gujarat and its surrounding areas. The population of this sub-species has been on the increase since the 1990s (Figure 1.14). The population estimate for the species in 2009 was 4000.

Asiatic Wild ass | Bitapi C. Sinha

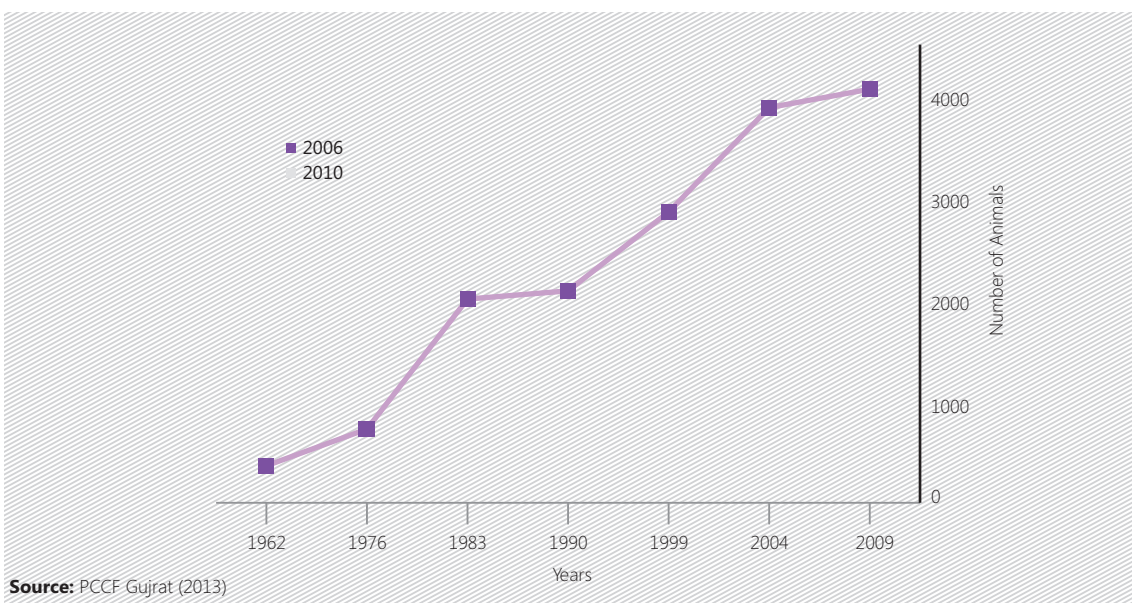


Figure 1.14: Population trend of Asiatic Wild ass (*Equus hemionus khur*) (1962-2009)

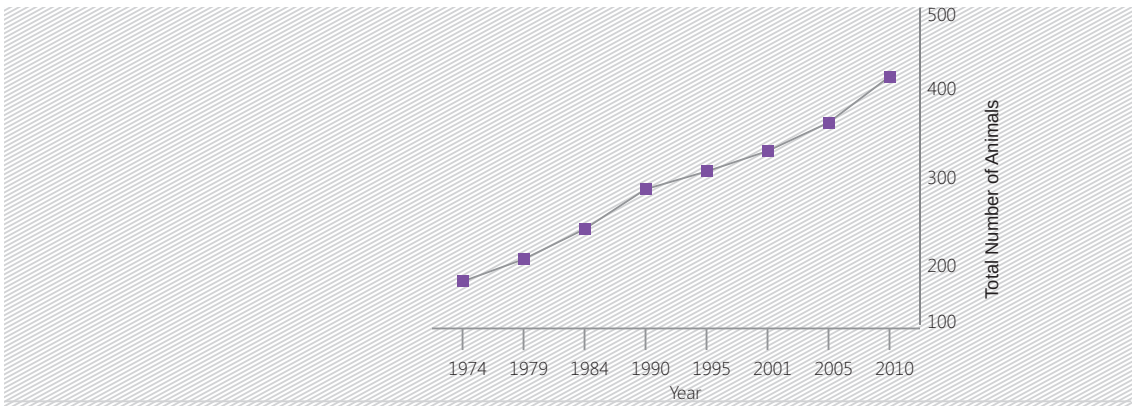
Source: PCCF Gujrat (2013)

1.3.2 Status and population trends of key terrestrial and aquatic/marine wild animal species

Wildlife conservation faces several formidable challenges. A large number of wild animal species occur outside the PA system. Recovery of critically endangered species and their habitats requires priority attention. With this in view, the erstwhile MoEF scheme of 'Assistance for the Development of National Parks and Sanctuaries' was reformulated and renamed as Integrated Development of Wildlife Habitats (DWH) during the 11th plan period (2007-2012). The scheme incorporates additional components/activities for implementing the provisions of the Wildlife (Protection) Act 1972, and National Wildlife Action Plan (2002-2016), the recommendations of the Tiger Task Force, 2005, and the National Forest Commission, 2006, and the necessities felt from time to time for conservation of wild animals and their habitats. The MoEF, in consultation with the WII and other scientific institutions/organisations, has identified 16 terrestrial and seven marine species with the objective of saving critically endangered species/ecosystems that cannot be covered under the conservation of PAs and need protection of wildlife and habitats outside PAs across the wider landscape/seascape (see part III, section 3.1.3, Aichi Biodiversity Target 12).

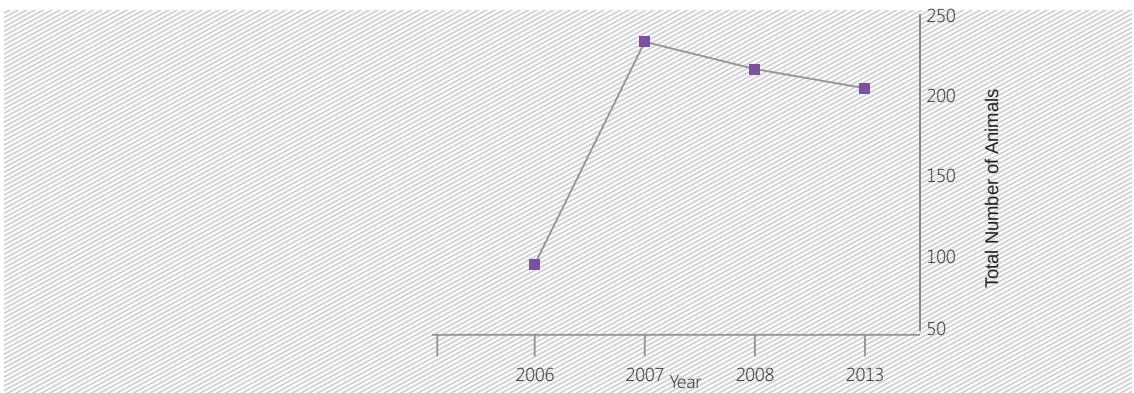
The population trends of seven endangered species out of 16 terrestrial and one marine specie out of seven marine species for which data are available are given in Figure 1.15a to 1.15h:

Manipur brow-antlered deer | S.A. Hussain



Source: Kumar and Meena (2011)

Figure 1.15a: Population trend of Asiatic lion (*Panthera leo persica*) in the Gir Forest (1974-2010)

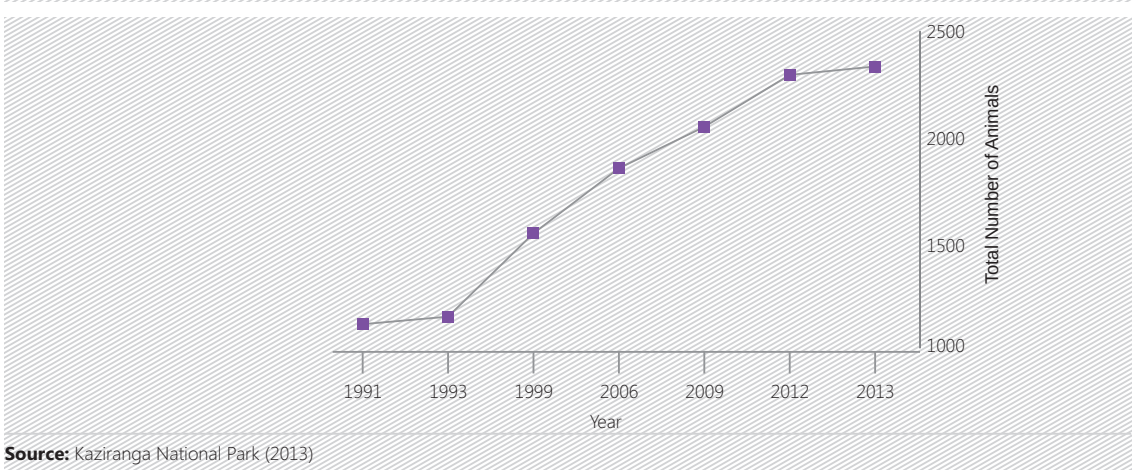


Sources: Angom (2012); Laithangbam (2013)

Figure 1.15b: Population trend of Manipur Brow-antlered deer (Ru*cervus eldii eldii*) (2006–2013)

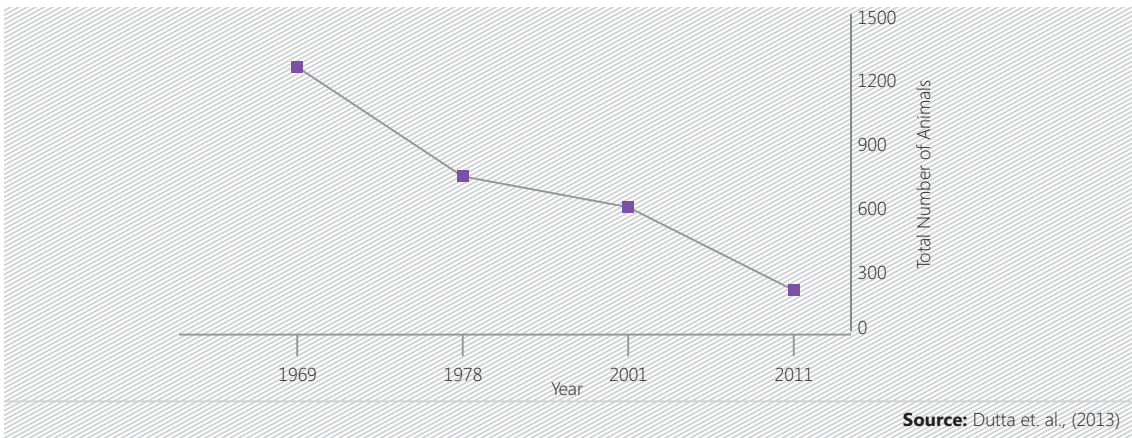
Sources: Ahmad et. al., (2009)

Figure 1.15c: Population trend of Hangul (*Cervus elaphus hanglu*) (1992–2011)



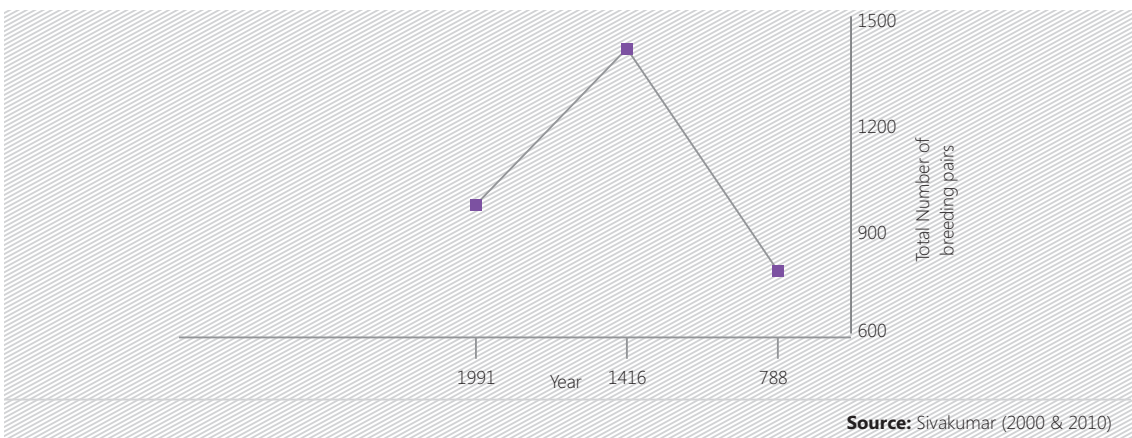
Source: Kaziranga National Park (2013)

Figure 1.15d: Population trend of Great one-horned rhinoceros (*Rhinoceros unicornis*) in Kaziranga National Park (1991-2013)



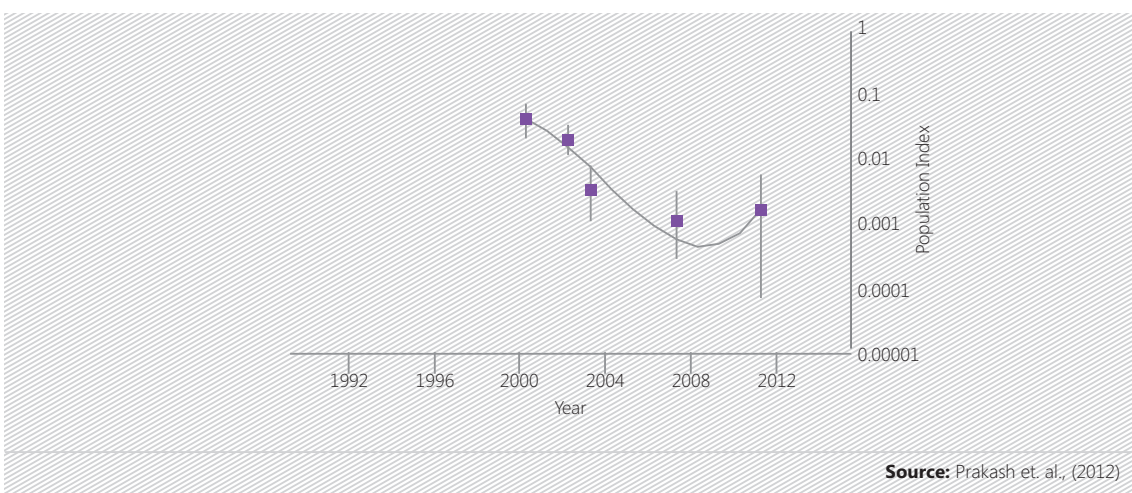
Source: Dutta et. al., (2013)

Figure 1.15e: Population trend of Great Indian bustard (*Ardeotis nigriceps*) (1969-2011)



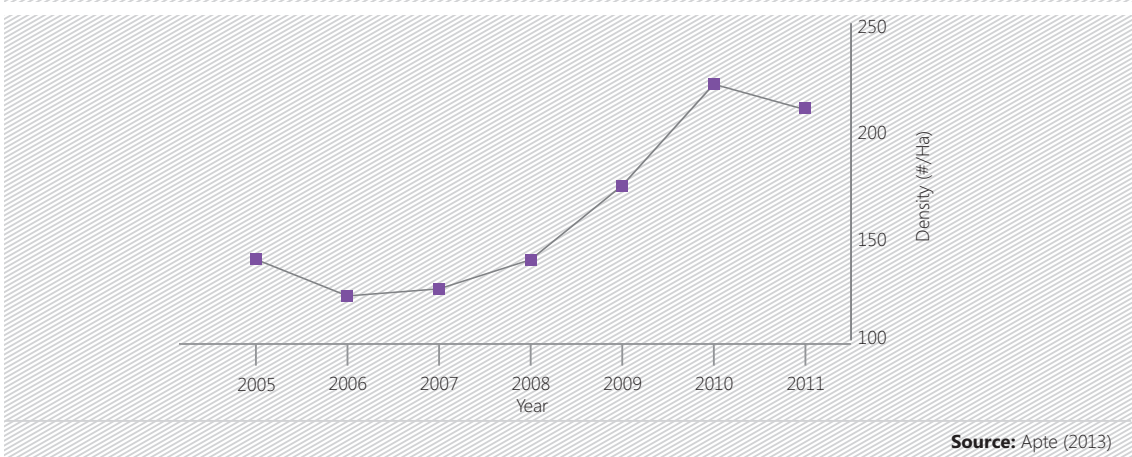
Source: Sivakumar (2000 & 2010)

Figure 1.15f: Population trend of Nicobar megapode (*Megapodius nicobariensis*) (1991-2006)



Source: Prakash et. al., (2012)

Figure 1.15g: Changes in population index of White-rumped vulture (*Gyps bengalensis;* 1992-2012)



Source: Apte (2013)

Figure 1.15h: Population trend of Giant clam *(Tridacna gigas)* in Lakshadweep Islands (2005-2011)

Aquatic biodiversity

1.3.3

India's freshwater, estuarine and marine ecosystems support a rich aquatic biological diversity that contributes to the economic, cultural, nutritional, social, recreational and spiritual betterment of human populations. These ecosystems are represented by charismatic species, some of which are discussed in the following.

Gharial *(Gavialis gangeticus)*

Gharial is Critically Endangered (IUCN), and listed in Schedule I Wildlife Protection Act (WPA, 1972). About 1300 animals are estimated to be left in the wild, of which only about 200 are breeding adults. The largest remaining populations are found in just four locations in India, along the Son, Katerniaghat, Girwa and Chambal rivers. The only currently known breeding populations in India are in the National Chambal Sanctuary, Katerniaghat Wildlife Sanctuary and Corbett Tiger Reserve. The Gharial Species Recovery Plan suggests an overall population assessment of the species. MoEF has constituted a three-tier decentralised coordination mechanism for conservation of the gharial in three States, namely Madhya Pradesh, Rajasthan and Uttar Pradesh.

Irrawaddy dolphin *(Orcaella brevirostris)*

Irrawaddy dolphin is found in Chilika Lake and the Sundarbans, these dolphins have suffered a rapid decline in their population mainly due to poaching and accidental catches in gill nets. Conservation work carried out by the Chilika Development Authority (CDA) has resulted in an increasing trend in the population of the Irrawaddy dolphin, with the numbers increasing from 70 in 2003 to 145 in 2012.

Freshwater turtles

Of the 28 species of tortoise and freshwater turtle (Figure 1.16), 21 species are globally threatened (IUCN 2013), and 2 are listed in the WPA, 1972. Twelve chelonian species are known to be harvested on a commercial scale; several others are exploited at subsistence levels, leading to the localised loss of several species and to declining turtle populations. Project Kachuga, an initiative undertaken by the Madras Crocodile Bank Trust in collaboration with Turtle Survival Alliance, has been launched for conservation of freshwater turtles in India. Five turtle priority areas have been identified for development and implementation of effective conservation plans under this programme.

GS Bhardwaj

Figure 1.16: Fresh water turtle

Marine turtles

Five of the seven species of sea turtles found worldwide are reported to occur in the Indian sub-continent, including the Olive ridley (*Lepidochelys olivacea*), Green (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricata*) and Loggerhead turtle (*Caretta caretta*). Except for the loggerhead, the remaining four species are known to nest along the Indian coastline. Olive ridleys nest along both the east and west coasts of India, with globally significant nesting sites at Gahirmatha and Rushikulya in Odisha. There are three mass nesting grounds of Olive ridley

turtles at Gahirmatha, Rushikulya and Devi in the State of Odisha, where more than hundred thousand turtles nest each year, though mass nesting has not been recorded at Devi for the last fifteen years. Leatherbacks are restricted to Great and Little Nicobar Islands, and to Little Andaman Island. Green turtles nest in Gujarat, Lakshadweep and the Andaman and Nicobar Islands. There are also important foraging grounds for Green turtles in the Gulf of Mannar, Lakshadweep Islands, and Andaman and Nicobar Islands.

The Indian sub-continent is an important region for marine biodiversity conservation in general and sea turtle conservation in particular in the world. However, turtle populations and their habitats are under threat due to fisheries and other anthropogenic related activities along the coast. India has been monitoring Olive ridley populations and their habitats in recent years with respect to coastal landscape dynamics, population dynamics and the impact of climate change on population sex ratios. Long term monitoring of nesting populations and impacts of climate change on sex ratios is being carried out since 2007 at Rushikulya by Indian Institute of Science (IISc) and Dakshin Foundation in collaboration with Odisha forest department. Long term monitoring of foraging Green turtle populations in the Lakshadweep Islands is being carried out by Nature Conservation Foundation (NCF). In addition, there are monitoring programmes for sea turtles by one or more Non-Governmental Organisations in each of the States on India's coast, some for as long as 25 years, and the organisations also contribute significantly to outreach and education.

All five species of sea turtles that occur in Indian coastal waters are protected under Schedule I of the IWPA (1972), as well as listed in Appendix I of CITES Wild Fauna and Flora which prohibits trade in turtle products by signatory countries. At present, there is no commercial or international trade of marine turtles or turtle products in India. However, incidental capture in trawl nets is a well-known cause of mortality for sea turtles; more than dead 10,000 turtles are washed ashore in Odisha alone each year. Both gill and trawl nets cause considerable mortality along the mainland coast. Marine turtles are also included in the IDWH programme of MoEF to effectively promote people-inclusive conservation programmes to conserve turtle habitats.

Several national and local organisations and individuals came together to form a national sea turtle network called Turtle Action Group (TAG) in January 2009 to work together towards sea turtle conservation in India (http://www.seaturtlesofindia.org).

In addition, fishing communities and conservation groups have formed the Orissa Marine Resources Conservation Consortium (OMRCC) to provide a platform for dialogue and collaborative action. A Leatherback Recovery Plan has been prepared to initiate long-term monitoring, identify potential threats and formulate effective management strategies to mitigate these threats in the Andaman and Nicobar Islands (Shanker and Choudhury 2006; www.seaturtlesofindia.org).

Dugong (*Dugong dugon*)

Listed as Vulnerable (IUCN 2013, Figure 1.17) and protected under Schedule I of the WPA, 1972, dugong occurs in the Gulf of Mannar, Palk Bay, Gulf of Kachchh and Andaman and Nicobar Islands. The MoEF, under the species recovery component of the IDWH scheme, aims at increasing Dugong numbers and preventing degradation of the habitat of the species. The GoI signed an Memorandum of Understanding (MoU) with United Nation Environmental Programme (UNEP) / Convention on Conservation of Migratory Species of Wild Animals (CMS) in April 2008 for the conservation and management of the dugong and its habitats throughout its range to strengthen its current status in Indian waters with the support of the international community. In 2010, Gujarat Ecological Education and Research Foundation (GEER), estimated the dugong population to be between 131 and 254 individuals, of which 77 to 158 individuals were believed to occur in the Gulf of Mannar, 44 to 81 individuals in the Andaman and Nicobar Islands and 10 to 15 dugongs in the Gulf of Kachchh region. A recent study conducted by the WII (Sivakumar and Nair, 2013) to assess the status of the dugong population in India found a decrease of about 85% decrease in the distribution range.

H. S Das

Figure 1.17:
Dugong dugon

Status and conservation of threatened plant species and their habitats 1.4

Though considerable efforts have been made to strengthen the PA network in the country, several macro and microhabitats which harbour unique assemblages of plants and threatened plant species still remain outside the current PA network and continue to face anthropogenic pressures. Information on conservation and restoration of highly threatened plants and special habitats in various biogeographic zones of India, has been brought out through an Environment Information System (ENVIS) bulletin entitled "Special Habitats and Threatened Plants of India" (Rawat 2008).

Myristica swamps

Myristica swamps are a type of freshwater swamp forest predominantly composed of species of *Myristica*, the most primitive of the flowering plants on earth. These are found in two localities in India, the Uttara Kannada district of the State of Karnataka and in the Southern parts of the State of Kerala. These swamps received attention in 1988 when Rodgers and Panwar described them as the most endangered forest ecosystem in India (Rodgers and Pawar 1988). The swamps are home to some of the wild relatives of cultivated plants such as *Myristica fatua, Piper nigrum, Piper hookeri, Garcinia spp., Cinnamomum spp.* and *Zingiber spp*. Myristica swamps are 'live museums' of ancient tree species and the home of proto-angiosperms. Through the Critical Ecosystem Partnership Fund (CEPF), large-scale production of seedlings and restoration of 45 species, over 10,000 seedlings have been raised. Restoration is being carried out in three corridors, namely, Kathlekan, Torme and Hasolli in Uttara Kannada. A 'swamp nursery' has been established at the College of Forestry, Sirsi. Workshops/awareness programmes are being conducted and training in nursery/grafting techniques is being imparted for local communities through the CEPF. So far, 49 swamps have been identified and mapped. Vegetation surveys and regeneration studies as well as soil and water analyses have been conducted in the Uttara Kannada area. Due to their evolutionary importance, watershed value and biological and economic importance, efforts are under way to conserve the remaining swamps that are highly threatened habitats (http://wgbis.ces.iisc.ernet.in).

Myristica swamp | K. Ramachandran

Cycads

Cycads (Figure 1.18) are the remnants of the most ancient seed plants. These plants date to the late Carboniferous period (300-325 million years ago). They are flagship species for conservation biology due to their unusual life histories, restricted distribution in special habitats and the globally threatened status of many species. In India, cycads are represented by a single genus, *Cycas*, of the family Cycadaceae, with seven species distributed in the Southern Western Ghats, the Eastern Ghats, Bihar, North-eastern States and the Andaman and Nicobar Islands. Cycads are used extensively for medicinal and other subsistence purposes. Cycads in India are now receiving much-needed attention for conservation through both *ex situ* and *in situ* measures (http://ipu.ac.in/usbas/lifescience/PlanttaxonomyCentre.html, http://www.jntbgri.in). Under the All India Coordinated Project on Taxonomy (AICOPTAX) of the MoEF, workshops are organized across villages in the distribution range of cycads towards preservation of these plants in their areas as well as conducting detailed scientific studies of these species.

Rita Singh

Figure 1.18: Cycads

GS Bhardwaj

Figure 1.19: *Rhododendron sp.*

Rhododendron

The genus *Rhododendron* (Figure 1.19) belongs to the family Ericaceae and is represented by 92 species, eight subspecies and nine varieties, adding up to 109 taxa, in various bio-geographic zones in India (Sastry 2010). It is a 'keystone element' in the Himalayan context (Singh et. al., 2009). The Eastern Himalayan region is particularly rich, being represented by 75 species. The hills of North-eastern India account for about 10 species, of which six are endemic (Sastry 2010). Many species have ethno-botanical significance and are used for medicinal purposes. They are also used for fuelwood. Anthropogenic pressures such as the rising population, an increase in the number of domesticated animals and construction of roads and hydel power stations and allied works have resulted in populations of *Rhododendron* species dwindling. As many as 46 *Rhododendron* species have been classified as rare or threatened in the Eastern Himalaya of India (Menon et. al., 2012). The State Government of Sikkim has specially declared two PAs as *Rhododendron* Sanctuaries, Shingba and Barsey. Fambonglho Wildlife Sanctuary, Kyongnosla Alpine Sanctuary and Maenam Wildlife Sanctuary are the other PAs in Sikkim that are known for *Rhododendron* conservation (Singh et. al., 2009). The total area under protection in the various sanctuaries is ca. 265 km^2.

Mukund Thakkar

Figure 1.20: Pitcher plant *(Nepenthes khasiana)*

Pitcher plant

Nepenthes khasiana (Pitcher plant, Figure 1.20) is the only representative of the genus *Nepenthes* in India and belongs to the monotypic family Nepenthaceae. It is rare, classified globally as endangered and included in Appendix I of CITES and the Negative List of Exports of the GoI. The plant is also included in the Botanical Garden List of Rare and Threatened Species of India, compiled by the IUCN (Mandal and Mukherjee 2011). The plant is endemic to the State of Meghalaya and is found at altitudes of approximately 1000-1500 m in the Khasi, Jaintia and Garo hills (Nokrek BR; Singh et. al., 2011). The tribal communities of this BR use the plant for its vast medicinal properties for treatment of various ailments and as a source of daily income. Habitat destruction due to overexploitation, various anthropogenic pressures and fragmentation of large contiguous populations into isolated and scattered ones are the major reasons for the decline in the population of this species. Organizations such as the Centre for Advanced Study in Botany (North-eastern Hill University), the National Orchidarium (Shillong), the Experimental Garden of the Botanical Survey of India (Yercaud) and the MoEF have taken steps for its *in situ* and *ex situ* conservation (Ghosh and Ghosh 2012).

Citrus

India is regarded as the home and one of the centres of origin of *Citrus* (Figure 1.21) due to the presence of a vast genetic diversity of important *Citrus* species (family Rutaceae). It is the third most important fruit crop of India. Vast reservoirs of genetically diverse *Citrus* species are found in the North-eastern and North-western parts of India. Studies carried out in North-eastern India have documented 23 species, one subspecies and 68 varieties of *Citrus*. Seven Indian *Citrus* species are categorized as endangered by the IUCN. An initiative was undertaken by NBPGR in 1981 to protect *Citrus* germplasm in the wild by establishing the Citrus Gene Sanctuary, covering an area of approximately 10,266 ha, located in the buffer zone of the Nokrek Biosphere Reserve, in the Garo Hills of Meghalaya, with support from the MoEF, under the Man and Biosphere Reserve Programme of the United Nations. *Citrus* species growing inside the Sanctuary are still safe though increasing human intervention and the slow regeneration rate of *Citrus* species are causes of serious concern. Further conservation efforts are needed to protect the existing genetic diversity and to promote the cultivation of rare, endangered and socio-economically important species. Approximately 1500 accessions of indigenous and exotic germplasm are being maintained in some 20 field gene banks throughout India. Also, a total number of 722 accessions are cryopreserved at the NBPGR for long-term conservation of germplasm (Malik et. al., 2012).

Figure 1.21: *Citrus* fruit

Orchids

Orchids (Figure 1.22) are a charismatic group that form 9% of India's flora and are the largest family among higher plants in India. The Himalayan region is their main home, and others are scattered in the Eastern and Western Ghats. Orchid diversity in India is high, comprising terrestrial, epiphytic and saprophytic orchids. In general, terrestrial orchids are more common in western India, epiphytic orchids in North-eastern India and small-flowered orchids in the Western Ghats. Most of the *Paphiopedilum* (lady's slipper) species are restricted to the North-eastern Himalaya, except for *P. druryi*. CITES has placed all species of the family Orchidaceae in Appendix II. Steps have also been taken to conserve Indian native species by establishing orchidaria, sanctuaries and germplasm conservation centres. The Botanical Survey of India (BSI) has established two orchidaria, one at Shillong (Meghalaya) and the other at Yercaud (Tamil Nadu), to conserve rare and endangered species. The ICAR research complex at Shillong, the Indian Institute of Horticultural Research at Hessaraghatta (Karnataka) and the Indian Botanic Gardens at Kolkata (West Bengal) maintain collections of orchids in their orchidaria. Some States have also established orchid Sanctuaries. For example, there are orchid Sanctuaries in Sikkim at Singtom and Deorali and in Arunachal Pradesh at Tapi. http://www.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue18/article1.htm#top

Meenakshi Subramanium

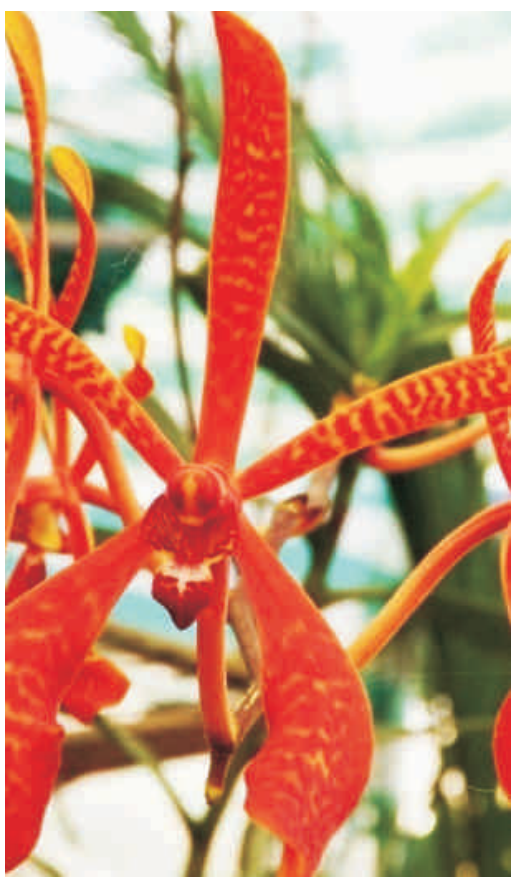


Figure 1.22: *Renanthera imschootiana*

Sessa Orchid Sanctuary, at Arunachal Pradesh, with more than 600 species, is the orchid paradise of the country. Nearly 175 rare and endangered species are found here, including *Paphiopedilum* or the Venus or Lady's slipper orchids. Of these, 30 species are endemic. The Narayana Gurukula Botanical Sanctuary has a large orchid collection and actively collects endangered plants such as the Golden tongue (*Chrysoglossum maculatum*), which can be multiplied by division and by seed, for conservation. The Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), Trivandrum has micropropagated the Blue vanda (*Vanda coerulea*) and *Paphiopedilum druryi*. It has also rescued endangered species from areas such as the Agastyamalai Hills, in southern Kerala, home to at least 150 endemics. Under the Dr. B.P. Pal National Environment Fellowship of the MoEF, a detailed study of rare and threatened orchids was made for a Red Data Book on Indian Orchids. Under MoEF, AICOPTAX project, orchid is one of the thematic areas being actively pursued.

1.5 Threats to biodiversity

The direct and indirect drivers of loss of biodiversity, particularly in developing economies, may include a high rate of human population growth and a high population density, increasing consumption, technological change-induced effects, economic activity and associated market failures and inadequate awareness of biodiversity values at the public and decision-making levels, in addition to a range of policy and institutional weaknesses (Parikh et. al., 2012).

Habitat loss, fragmentation and degradation through conversion of land use through agriculture, urbanisation and industrial development, Invasive Alien Species and overexploitation of natural resources, including plants and animals, are amongst the major threats faced by biodiversity globally and in India. Over 1.17 million hectares of forest land is estimated to have been diverted for more then 23,000 developmental projects since the enactment of the Forest Conservation Act in 1980 (MoEF 2008). Loss and degradation of grasslands across the country has affected grassland dependent species such as members of the bustard family - Bengal florican, Lesser florican, Houbara bustard and Great Indian bustard (see

Coal mining | Abhijit Das

R.K Dogra

Part III, Section 3.1.3, Aichi Biodiversity Target 12) as well as animals such as Blackbuck, Chinkara, Indian wolf, Golden jackal, Indian fox and Nilgai.

The demands of a growing human population for food, medicine, fibre, fodder, shelter and fuel, along with the need for economic development, are increasing the pressure on biodiversity and ecosystems throughout the country. Land use change, especially the expansion and intensification of agriculture, is creating pressure on habitats in some regions of the country through loss and fragmentation of forests, grasslands, scrublands, wetlands and other habitats. Agricultural intensification leading to loss of habitat heterogeneity, effects of agrochemicals on wild species and pollution and eutrophication due to agricultural runoff also threaten both species and the habitats they occur in. The Forest Survey of India (FSI), in its latest available State of Forests Report (FSI 2011), identifies shifting cultivation as one of the major drivers of deforestation in North-east India. Traditional hunting practices for wild meat for domestic consumption as well as for commercial markets also threaten populations of species in some regions such as North-east India (WWF 2013, Aiyadurai 2011, Datta et. al., 2008). Illegal felling and poaching, and overextraction of timber and NTFPs, particularly medicinal plants, are serious threats for species for which there is high commercial demand.

Mining and quarrying cause habitat loss and degradation, with severe consequences for the ecology of areas such as the Aravalli Range and the Western Ghats (MoEF 2013, Pillay et. al., 2011).

The impact of biological invasions by alien species is considered to be a major factor in the loss of biodiversity through effects on the persistence of native species and their habitats. Invasive Alien Species can transform landscapes and cause dramatic ecological changes that reduce the adaptability and competitiveness of native species. These effects may be felt by all taxonomic groups, from prokaryotes to higher plants and animals, and are widely found in all kinds of ecosystems throughout India (see Part III, Section 3.1.2, Aichi BiodiversityTarget 9).

The pressures of livestock grazing on forests and grasslands are severe, with India having the world's largest livestock population, constituting 15% of the global livestock population, in 2.4% of the global geographical area and the population density being nearly 1.5 per hectare of cattle, sheep and goats.

Factors such as increased parasite loads and disease transmission in wild animals due to proximity to humans and livestock, interbreeding with feral domesticated animals, and interspecific competition for food and water add to the pressures on populations of wild species (Hussain 2013, Hedges et. al., 2008).

An increasing incidence of forest fires is also a growing threat, particularly in the Himalaya and in areas with dry deciduous forests in southern India (Somashekhar et. al., 2007). Anthropogenic climate change remains an overarching threat, particularly for vulnerable ecosystems such as mountains and coastal areas. Habitat loss and degradation are the major threats to coastal and marine biodiversity in India (Box 1.2).

These pressures bring wild species into conflict with humans and cause escalation of human-wildlife conflicts across several parts of the country.

Box 1.2: Threats to costal and marine biodiversity

Threats to coastal and marine biodiversity

Habitat loss and degradation are the major threat to coastal and marine biodiversity in India, along with Invasive Alien Species, climate change, pollution, unsustainable use and overexploitation of fish. Despite their tremendous ecological and economic importance and the existence of policy and regulatory frameworks, coastal and marine ecosystems are under pressure arising from different types of economic development and associated activities. A large number of species in these ecosystems are already under globally threatened categories due to overexploitation, and habitat loss. Climate change is likely to exacerbate these stressors, leading to impacts on biodiversity. Other climate-related threats include erosion (especially in islands), flooding, submergence and deterioration of coastal ecosystems such as mangroves and salinisation. A rise in the sea level will have a serious impact on the population living along the coastline and the livelihoods of the people. This may also result in devastation of coastal infrastructure, shoreline erosion, flooding of low-lying agricultural fields and soil salination. Climate change, siltation from land based activities, release of domestic waste and algal overgrowth are the main threats to coral reef colonies in India.

Mangrove ecosystems are under external influences, leading to changes in their physiology and adaptability to the changing climate. Shoreline development due to urbanisation, industrialisation and conversion to aquaculture or salt pans are threats to mangrove habitats. Changes in local hydrology, salinity due to reduced tidal flows and pollution also negatively impact their survival. Mangrove roots are susceptible to oil pollution. Oil is also toxic to benthic fauna, including crabs and polychaetes. Harmful algal blooms have also been known to affect mangrove seedlings across the world.

Sources: Venkataraman et. al., (2012); Thinesh et. al., (2009); Planning Commission (2007); Patterson et. al., (2007); Bavinck (2003).

As per the State of Forest Report 2011, published by FSI, the mangrove cover in the country stands at 4662.56 km^2 which is 0.14% of the country's total geographical area. Compared with 2009 assessment, there has been a net increase of 23.56 km^2 in the mangrove cover of the country. This can be attributed to increased plantations and regeneration of natural mangrove areas. The Government has issued the Coastal Regulation Zone (CRZ) Notification (2011) and the Island Protection Zone (IPZ) Notification 2011. These Notifications recognize the mangrove areas as ecologically sensitive and categorize them as CRZ-I which implies that these areas are accorded protection of the highest order. To enforce and implement the CRZ and IPZ Notifications, the MoEF has constituted the National and State/UT level Coastal Zone Management Authorities. The Ministry also provides financial assistance to Coastal States/Union Territories, who so request, under its Centrally Sponsored Scheme for conservation and management of mangroves. The table below presents the mangrove cover as estimated through remote sensing assessments and also the change with respect to the previous assessment.

Table 1.16: Mangrove cover from 1987 to 2011

	Assessment Year											
Year of Assessment	**1987**	**1989**	**1991**	**1993**	**1995**	**1997**	**1999**	**2001**	**2003**	**2005**	**2009**	**2011**
Mangrove cover (ha)	4,046	4,255	4,244	4,256	4,533	4,827	4,871	4,482	4,448	4,581	4,639	4662.56
Change with respect to previous assessment	--	+209	-11	+12	+277	+294	+44	-389	-34	+133	+58	+23.56

1.5.1 Threat assessment in biogeographic zones of India

Threats to biodiversity occur across the 10 biogeographic zones in India, some of these threats being more pronounced in some zones than in others. Figure 1.23 depicts the major threats by biogeographic zone in the country.

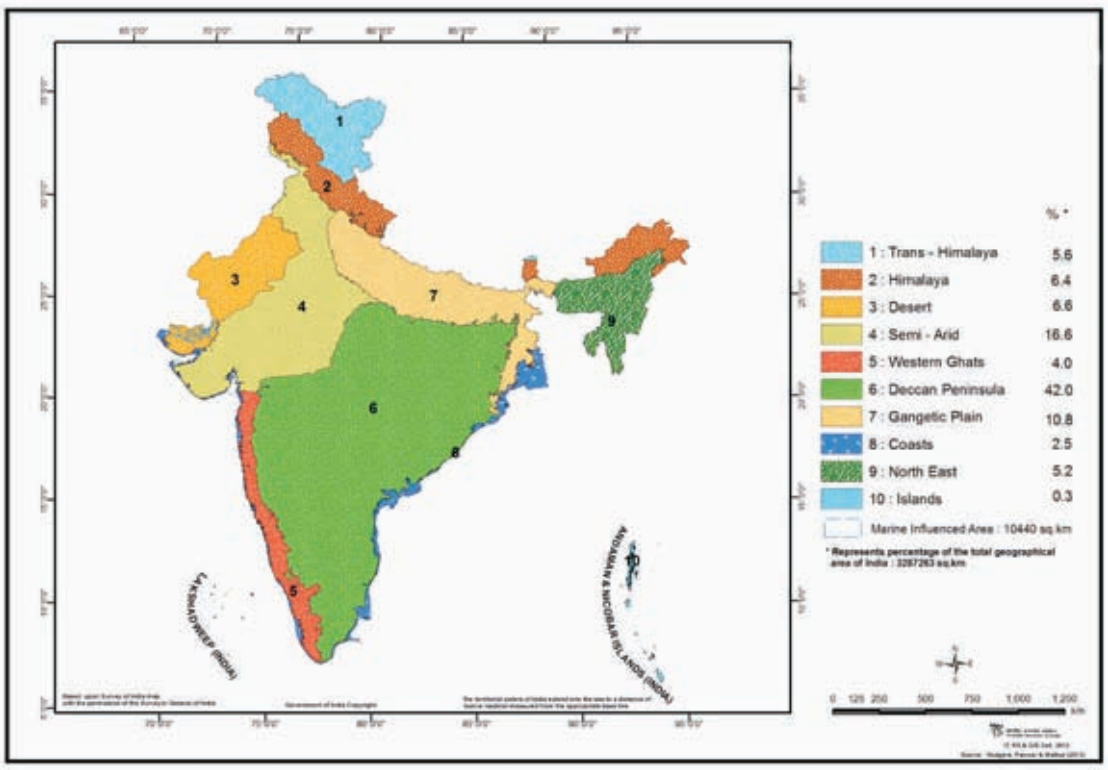


Figure 1.23: Threat assessment in biogeographic zones of India

	1. Trans-Himalaya	Livestock pressure, tourism, exotic plantations, extraction of medicinal plants and NTFPs, poaching, human-animal conflict, climate change.
	2. Himalaya	Climate change, deforestation, invasive species, extraction of medicinal plants and NTFPs, fire, land use change, development and urbanisation, mining, tourism.
	3. Desert	Invasive species, land use change, livestock pressure, grassland degradation, mining.
	4. Semi-arid	Land use change, mining, livestock pressure, grassland degradation poaching.
	5. Western Ghats	Invasive species, exotic plantations, encroachment, mining, extraction of medicinal plants and NTFPs, livestock pressure, poaching, fire, pathogens and disease transmission, climate change.
	6. Deccan Peninsula	Deforestation, grassland degradation, invasive species, development and urbanisation, mining, pathogens and disease transmission.
	7. Gangetic Plain	Deforestation, grassland degradation, invasive species, development and urbanisation, mining, land use change, pollution and eutrophication, livestock pressure.
	8. Coasts	Climate change, pollution, development and urbanisation, mining, tourism, aquaculture, invasive species.
	9. North-east	Deforestation, shifting cultivation, mining, hydropower development, poaching, climate change.
	10. Islands	Climate change, invasive species, development and urbanisation.

Deforestation leading to fragmentation and habitat degradation | Senthil Kumar

1.5.2 Habitat fragmentation at landscape level

A nationwide assessment involving geospatial characterisation of habitats, fragmentation, disturbance regimes and biological richness was carried out between 1998 and 2010 by the Indian Institute of Remote Sensing (IIRS, Roy et. al., 2012, see Part I, Section 1.1.1). Information from this study was used to assess the fragmentation status for the entire country. The assessment has reported that a considerable area of forests is under low fragmentation (49.63% of the total geographic area of the country), 21.89% under medium while 5.16% was under high fragmentation.

1.6 Legal framework and conservation jurisprudence

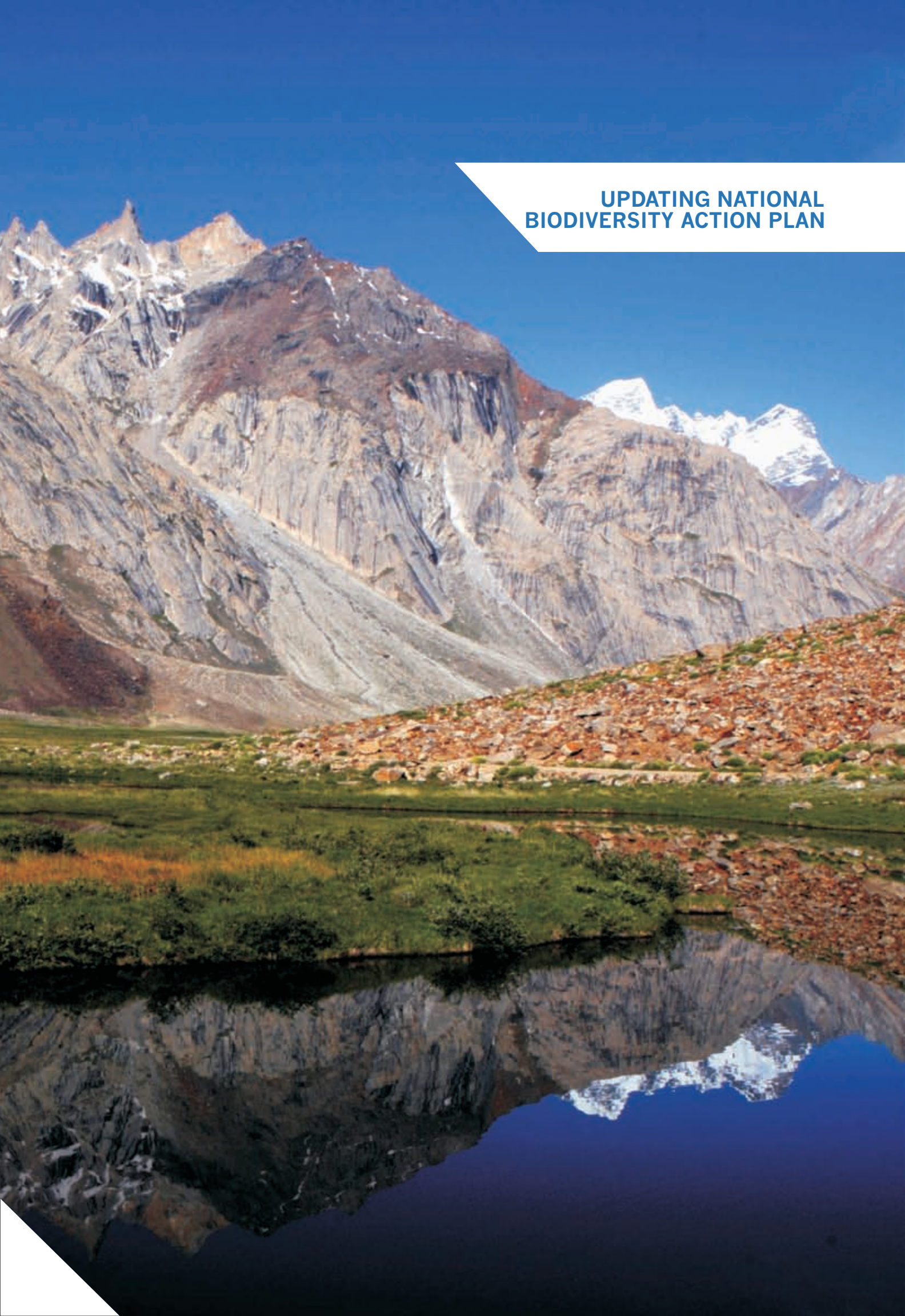
India has an extensive body of constitutional provisions, laws and policies to promote conservation and sustainable use of biodiversity and natural resources. The Indian Constitution clearly assigns responsibilities between the Union and State Governments (Part XI and article 246) on various subjects. India is a signatory to various international conventions and treaties related to environmental protection and has also taken numerous initiatives towards their implementation. The most relevant national policies and legislation are the Biological Diversity Act of 2002, National

Policy and Macrolevel Action strategy on Biodoversity of 1999, National Forest Policy of 1988, National Water Policy of 2002, National Environmental Policy (NEP) of 2006, Indian Forest Act of 1927 (and related state legislation), Forest (Conservation) Act of 1980, Wildlife (Protection) Act of 1972, Environmental (Protection) Act of 1986, Schedule Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act of 2006, Environmental Impact Assessment Notification of 2006, Factories Act of 1948, Mines and Minerals (Development and Regulation) Act of 1957, Energy Conservation Act of 2001, Air (Prevention & Control of pollution) Act of 1981,Water (Prevention & Control of pollution) Act of 1974. One of the most significant recent legislative steps taken by the GoI has been the setting up of the National Green Tribunal (NGT). The NGT is a dedicated statutory environmental court with the mandate to deal with civil cases which have substantial relation to environment including biodiversity. The NGT Act was passed by Parliament in 2010 and the Tribunal became functional on October, 18, 2010. In addition, the Supreme Court of India has also played a significant role in the conservation of biodiversity. Under Article 32 and Article 226, the Supreme Court and the High Court have played a proactive role in the conservation of biodiversity. In 2013, the Supreme Court of India set up a 'Green Bench' to deal with environmental issues replacing the existing Forest Bench. The jurisprudence on biodiversity is continuously evolving in India.

VII

Govind S. Bhardwaj

UPDATING NATIONAL BIODIVERSITY ACTION PLAN



UPDATING NATIONAL BIODIVERSITY ACTION PLAN

2.1 BACKGROUND

Article 6 of the CBD on General Measures for Conservation and Sustainable Use, states that each Contracting Party shall, in accordance with its particular conditions and capabilities:

- 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 that shall reflect, *inter alia*, the measures set out in this Convention relevant to the Contracting Party concerned. This has come to be known as the National Biodiversity Strategy and Action Plans (NBSAPs).
- Integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies.

Terrace farming | Threesh Kapoor

II

NBSAPs are the principal instruments for implementing the Convention at the national level. The Convention requires countries to prepare a national biodiversity strategy (or equivalent instrument) and to ensure that this strategy is mainstreamed into the planning and activities of all those sectors whose activities can have an impact (positive and negative) on biodiversity. While 179 Parties have developed NBSAPs in line with Article 6, the CBD Secretariat has received 23 NBSAPs (16 revised, 7 first as on 26 March 2014) that reflect varying degrees of compliance with CoP-11 decision XI/2.

Article 26 and Article 10(a) of the CBD are closely linked to Article 6. The first of these articles calls for Parties to present, through their national reports, information on measures that have been taken for implementation of the provisions of the Convention and on their effectiveness in meeting the objectives of the Convention. Article 10(a) encourages Parties to integrate considerations of conservation and sustainable use of biological resources with national decision-making. The requirement of integrating consideration of the conservation and sustainable use of biological resources into national decision-making and mainstreaming these issues across all sectors of the national economy and the policy-making framework are the complex challenges at the heart of the Convention. In recognition of the urgent need for action for biological diversity conservation, the United Nations (UN) General Assembly declared 2011-2020 as the UN Decade for Biodiversity.

The Strategic Plan for Biodiversity (SP) 2011-2020 and the Aichi Biodiversity Targets were adopted by the CoP to the CBD in 2010 at Nagoya, Japan. SP 2011-2020 outlines broad-based actions in support of biodiversity to be carried out over the next decade by all countries and stakeholders. In particular, Aichi Biodiversity Target 17 states that "*By 2015, each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.*"

In 1999, the GoI prepared the National Policy and Macrolevel Action Strategy on Biodiversity (MoEF 1999) through a consultative process. This document was a macro-level statement of policies and strategies needed for conservation and sustainable use of biological diversity. Thereafter, the MoEF implemented an externally-aided project, the NBSAP, from 2000 to 2004, under which a final technical report was prepared. In 2002, India also enacted the Biological Diversity Act. Following India's adoption of the NEP in 2006, the NBAP was prepared by updating the National Policy and Macrolevel Action Strategy on Biodiversity developed in 1999 (MoEF 1999) and by using the final technical report of the NBSAP project in order to achieve consonance between the NBAP and the NEP 2006. India's NBAP, formulated through a comprehensive interministerial process, was approved by GoI in 2008 (MoEF 2008).

However in the light of SP 2011-2020 and the Aichi Biodiversity Targets, there is a need to update the NBAP in order to align it to the former. Further, possibilities of leveraging substantial financial resources at the national level to implement India's NBAP in the light of SP 2011-2020 and the Aichi Biodiversity Targets also needs to be explored. An imaginative update of the NBAP may also offer policy options to seek catalytic financing from international financing sources, including multilateral grant-providing institutions such as the GEF.

The broad action points of India's NBAP 2008 are (i) strengthening and integration of *in situ*, on-farm and *ex situ* conservation, (ii) augmentation of the natural resource base and its sustainable utilization, (iii) ensuring inter- and intra-generational equity, (iv) regulation of introduction of invasive alien species and their management, (v) assessment of vulnerability and adaptation to climate change and desertification, (vi) integration of biodiversity concerns in economic and social development, (vii) pollution impacts, (viii) development and integration of biodiversity databases, (ix) strengthening the implementation of policy, legislative and administrative measures for biodiversity conservation and management, (x) building national capacities for biodiversity conservation and appropriate use of new technologies, (xi) valuation of goods and services provided by biodiversity and use of economic instruments in decision-making processes and (xii) international cooperation. The actionable points under each of these 12 broad action points are given in Appendix II. The broad action points in India's NBAP are generally aligned with the five Strategic Goals of SP 2011-2020 and the corresponding 20 Aichi Biodiversity Targets. In order to sharpen the inter-linkages between the Aichi Biodiversity Targets and India's NBAP, the plan schemes and programmes of the MoEF and those of other Ministries/Departments of the GoI

have to be further aligned for their outcomes in terms of indicators provided by the Aichi Biodiversity Targets in the coming years.

2.2 National Biodiversity Targets

The CoP-11 to the CBD urged Parties to develop national and regional targets, using SP and its targets as a flexible framework, in accordance with national priorities and capacities. Parties were also required to review, and as appropriate update and revise, their NBSAPs or equivalent instruments (in India's case it is NBAP) in line with the SP, by integrating their National Biodiversity Targets into their NBSAPs, and report thereon to CoP-12. Since India has prepared her NBAP recently in 2008, it was decided that the NBAP need not be completely overhauled or revised; but an exercise of updating the NBAP by developing National Biodiversity Targets, keeping in view the Aichi Biodiversity Targets as a framework, is to be undertaken.

2.2.1 Process of updating NBAP

Considering the aforementioned need for updating the NBAP, 12 National Biodiversity Targets (Table 2.1) and associated indicators and monitoring framework (see Box II, Executive Summary) that provide a road map for achieving the Aichi Biodiversity Targets (Box 2.1) have been developed. These National Biodiversity Targets are based on consultations with a range of stakeholders and a review of the programmes and activities being undertaken by Ministries/Departments in the GoI and by State Biodiversity Boards (SBBs). Icons for the National Biodiversity Targets have also been developed with a view to enhance their recall value and outreach (Box 2.1).

Box 2.1
Relationship between Aichi Biodiversity Targets and National Biodiversity Targets

	Aichi Biodiversity Targets	India's National Biodiversity Targets
Strategic Goal A		
Strategic Goal B		
Strategic Goal C		
Strategic Goal D		
Strategic Goal E		

MoEF initiated the process of preparing National Biodiversity Targets through a high level meeting with concerned Ministries/Departments in November 2011. This was followed by a series of interministerial meetings and stakeholders consultations organized in April 2012 and July 2012. Thereafter, under the GEF Direct Access project on 'Strengthening the Enabling Environment for Biodiversity Conservation and Management in India', consultations with stakeholders for preparation of NR5 and updating of NBAP were continued. A National Stakeholder Consultation for discussing the contents of NR5 was held on 30 July 2013. Following further discussions, the revised draft was then reviewed by a Technical Review Committee (TRC, Appendix III) set up by MoEF for this purpose. The National Biodiversity Targets were identified based on an extensive review of Result Framework Documents (RFDs) of the 52 Ministries/Departments of the GoI, information available in annual reports/websites of Ministries/Departments and institutions, as well as discussions and written submissions provided by officials, scientists and other stakeholders at the individual level and a range of organizations in the country. The National Biodiversity Targets were also discussed and communicated through an outreach and communication programme as part of the seventh CMS Vatavaran International Environment and Wildlife Film Festival and Forum, held between 30 January 2014 and 3 February 2014 at New Delhi, supported by the MoEF.

Twelve sessions were conducted for each target over the period, wherein panel discussions and public outreach programmes were conducted to create awareness, deliberate upon and communicate to the public about the development of India's National Biodiversity Targets, in harmony with the CBD's SP 2011-2020 and Aichi Biodiversity Targets. While the 12 National Biodiversity Targets have been conceptualized now, the country has been working on conservation of its unique biodiversity with multi-stakeholder participation for a long time. The fact that India harbours 7-8% of the world's known biological diversity in about 2.4% of the land area while supporting 18% of the human and cattle population, is an eloquent testimony to her conservation ethos and commitment to conserving biodiversity and to realizing the vision of living in harmony with nature.

Indicators for National Biodiversity Targets 2.2.2

Indicators have been developed for each of the National Biodiversity Targets for monitoring the trends and recording progress in their implementation (Box II, Executive Summary) through a consultative process.

Table 2.1 Numbers of indicators for 12 National Biodiversity Targets

	National Biodiversity Target	Number of indicators
	By 2020, a significant proportion of the country's population, especially the youth, is aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.	7
	By 2020, values of biodiversity are integrated in national and state planning processes, development programmes and poverty alleviation strategies.	9
	Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are finalized and actions put in place by 2020 for environmental amelioration and human well-being.	16
	By 2020, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed.	2
	By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries.	23
	Ecologically representative areas under terrestrial and inland water, and also coastal and marine zones, especially those of particular importance for species, biodiversity and ecosystem services, are conserved effectively and equitably, based on protected area designation and management and other area-based conservation measures and are integrated into the wider landscapes and seascapes, covering over 20% of the geographic area of the country by 2020.	14

	National Biodiversity Target	Number of indicators
	By 2020, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	8
	By 2020, ecosystem services, especially those relating to water, human health, livelihoods and well-being, are enumerated and measures to safeguard them are identified, taking into account the needs of women and local communities, particularly the poor and vulnerable sections.	17
	By 2015, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization as per the Nagoya Protocol are operational, consistent with national legislations.	4
	By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance.	2
	By 2020, national initiatives using communities' traditional knowledge relating to biodiversity are strengthened, with the view to protecting this knowledge in accordance with national legislations and international obligations.	12
	By 2020, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011-2020 and the national targets are identified and the Strategy for Resource Mobilization is adopted.	3

2.2.3 Agencies that will be responsible for monitoring progress in achieving National Biodiversity Targets

Agencies have been identified on the basis of their mandate, domain expertise and geographical coverage (see Box II, Executive Summary).

2.2.4 Monitoring and reporting frequency

While the frequency of monitoring of the 12 National Biodiversity Targets ranges from three to five years, data may be recorded yearly or less frequently by different agencies. Once the data are first reported for three years, these will be reviewed for any mid-course correction that may be required, and any changes will be incorporated appropriately.

2.2.5 Implementation of NBAP

The road map for implementation of the NBAP and for achieving the National Biodiversity Targets involves the MoEF and 23 Ministries/Departments of the GoI that have been identified (Table 2.2), the NBA, SBBs, BMCs, State Forest Departments (SFDs), State Planning Boards and the relevant Departments of State Governments such as Fisheries, Forests, Agriculture, Livestock and Animal Husbandry, Mining and Education. Local-level institutions, including BMCs, Forest Rights Committees (FRCs), Village Ecodevelopment Committees (VEDCs), Joint Forest Management Committees

(JFMCs) and Gram Sabhas (village assemblies) are crucial for implementation of the NBAP. A multi-tier mechanism for implementation as depicted in Figure 1 (Executive Summary) will be used.

Since the implementation of the National Biodiversity Targets will involve alignment of the programmes of the 23 Ministries/Departments of the GoI, an indicative list of Ministries/Departments has been prepared with respect to each target (Table 2.2).

Table 2.2 Indicative list of Ministries/ Departments and National Biodiversity Targets for implementation of the National Biodiversity Action Plan

Ministries/Departments of Government of India and Planning Commission	National Biodiversity Targets											
Ministry of Agriculture (MoA)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Chemicals and Fertilizers (MoCF)	3	4	5	6	7	8	9	10	11	12		
Ministry of Coal (MoC)	3	4	5	6	7	8	9	10	11	12		
Ministry of Commerce and Industry (MoCI)	2	3	5	7	8	9	10	12				
Ministry of Drinking Water and Sanitation (MoDWS)	3	4	6	9	10	11	12					
Ministry of Earth Sciences (MoES)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Environment and Forests (MoEF)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Health and Family Welfare (MoHFW)	1	3	4	5	6	9	10	11	12			
Ministry of Human Resource Development (MoHRD)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of New and Renewable Energy (MoNRE)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Panchayati Raj (MoPR)	1	3	4	5	6	7	8	9	10	11	12	
Ministry of Petroleum and Natural Gas (MoPNG)	3	4	5	6	7	8	9	10	12			
Ministry of Power (MoP)	2	3	4	5	6	7	8	9	10	12		
Ministry of Rural Development (MoRD)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Science and Technology (MoST)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Shipping (MoS)	3	4	6	7	8	9	10	12				
Ministry of Tourism (MoT)	3	4	5	6	7	8	9	10	11	12		
Ministry of Tribal Affairs (MoTA)	1	2	3	4	5	6	7	8	9	10	11	12
Ministry of Urban Development (MoUD)	1	3	4	5	6	7	8	9	10	11	12	
Ministry of Water Resources (MoWR)	1	2	3	4	5	6	7	8	9	10	11	12
Department of Space (DoS)	3	4	5	6	7	8	9	10	11	12		
Ministry of Youth Affairs and Sports (MoYAS)	1	2	3	9	10	11	12					
Ministry of Statistics and Programme Implementation (MoSPI)	1	2	3	5	7	8	9	10	11	12		
Ministry of Communications and Information Technology (MoCIT)	9	10	12									
Planning Commission of India	1	2	3	4	5	6	7	8	9	10	11	12

Assessment of funding support for biodiversity conservation in India 2.3

Resource flows to the biodiversity sector include direct core funding and non-core funding (that originates from the budgetary resources of the MoEF), and indirect peripheral funding, which comprises development budgetary resources that are allocated by other scientific and development Ministries/Depatments of the GoI towards programmes that have a bearing on biodiversity conservation. The MoEF undertook an assessment of funding for biodiversity conservation for the year 2010-2011 in which funding for core (direct and immediate biodiversity impact), net non-core (indirect), and net peripheral funding flows (from biodiversity relevant 29 schemes of seven Ministries/Departments other than MoEF), along with core funding by the State Governments was assessed (MoEF 2012). Building on this study and using similar methodology, the assessment conducted and reported here in NR5 refers (in most part) to the most recent data available for 2013-2014 and includes expanded datasets based on peripheral funding related to 77 schemes of 23 Ministries/Departments of the GoI.

As per CBD's Strategic Goals under SP 2011-2020 for resource mobilization and call to Parties for providing data on resource mobilization according to the indicators adopted in decision X/3 and Aichi Biodiversity Target 20, activities have

been classified into those that are directly related to biodiversity and others that are indirectly related to biodiversity for assessing funding for biodiversity conservation. Funding for activities directly related to biodiversity include activities taken up for *in situ*/*ex situ* conservation, for protected areas, for maintaining genetic diversity and for addressing threats to specific ecosystems and/or species. Funding considered under this category will generally be provided by environmental agencies that directly and purposely consider biodiversity within their mandates. Activities that have benefits for biodiversity but for which biodiversity conservation and sustainable use are not the main focus are considered to bear an indirect relation with regard to funding for biodiversity conservation.

This section provides an assessment of funding for core (direct and immediate biodiversity impact), net non-core (pollution, hazardous substances management, etc., which facilitate biodiversity conservation of river streams, wetlands) and net peripheral funding flows (from biodiversity relevant schemes of Ministries/Departments other than the MoEF) from the GoI and of core funding by the State Governments, for the year 2013-2014. The concept of net non-core and net peripheral flows has been worked out on the basis of a multiplier approach (see Sections 2.3.1.2 and 2.3.3.).

2.3.1 Financial overview of schemes of MoEF

As brought out in India's submission made in September 2012 prior to CoP-11 to the CBD, there has been a steady increase in the budgetary allocation of MoEF since 1992 under all major heads. From an average annual outlay of ₹ 2,800 million in 1992-1993 (96.55 million USD at April 1992 exchange rate), the outlay in 2013-2014 was ₹ 24,300 million (477.59 million USD at an exchange rate of 1 USD = ₹ 62.08 in February 2014). The 11th Plan (2007-2012) approved budgetary outlay for MoEF was ₹ 100,000 million whereas the 12th Plan (2012-2017) approved budgetary outlay for MoEF is ₹ 178,740 million. This is an increase of 78.74%.

Key externally aided schemes of MoEF

The outlay for key externally aided schemes in the MoEF for 2013-2014 is shown in Table 2.3.

Table 2.3 Externally aided schemes/projects during 2013-2014 (₹ in crores)

S. No.	Name of scheme/project	2013-2014 Budget estimate	Name of funding agency
1	National River Conservation Plan (NRCP)	25.00	JBIC/JICA
2	National Ganga River Basin Authority (NGRBA)	290.00	JBIC/JICA
3	Hazardous Substances Management (HSMD)	32.00	World Bank
4.	Biodiversity Conservation and Rural Livelihood Improvement Project (BCRLIP)	5.00	World Bank
5.	Biodiversity Conservation	2.00	GEF
6.	National Coastal Management Programme (NCMP)	125.00	World Bank
7.	Capacity Building for Forest Management Training of Personnel	48.50	JICA
	Total (1-7)	**527.50 or USD 85.07 million (at 1USD= ₹ 62.08 in February 2014)**	

2.3.1.1 MoEF's core funding for biodiversity conservation during 2013-2014

Out of the MoEF's aggregate budget of ₹ 2430 crores for the year 2013-2014, the amount of core funding for biodiversity conservation, i.e., funding of schemes which are directly relevant to biodiversity conservation, is ₹ 1564.34 crores. The same for years 2012-13, 2011-12 and 2010-11 is given in Table 2.4 below. (For 2013-2014, this is an increase of ₹ 486 crores or approximately 45% of the core funding amount for the year 2010-2011).

Schemes	2010-2011	2011-2012	2012-2013	2013-2014
Forestry and Wildlife	793.24	927.08	898.94	1195.83
Research and Development for Conservation	104.69	68.94	166.70	153.51
Conservation of Natural Resources	29.2	80.00	94.00	90.00
NCMP	151	267.60	25.00	125.00
Total	**1078.13**	**1343.62**	**1184.64**	**1564.34**

Table 2.4
Core funding for biodiversity conservation (₹ in crores)

MoEF's non-core funding for biodiversity conservation during 2013-2014 2.3.1.2

Out of the MoEF's total budget of ₹24,300 million (₹ 2430 crores) for 2013-2014, after excluding the funds for schemes directly relevant to biodiversity, the remaining amount, i.e., ₹ 8660 million (₹ 866 crores) was for schemes such as pollution control, hazardous substance management, impact assessment, etc. As these programmes contribute to biodiversity conservation only indirectly, a multiplier approach has been applied, as was done when India made its submission to CoP-11 of the CBD in September 2012, wherein 30% of the allocation under these schemes, i.e., ₹ 2598 million (₹ 259.8 crores) has been considered to be attributable to biodiversity conservation.

Outlays at the State level 2.3.2

Apart from the MoEF, each State and Union Territory (UT) in India also allocates part of its budget for expenditure on the environment. According to the Budget Document of States, provided by the Planning Commission, for 2013-2014, the core funding by State Governments is ₹ 50,255.7 million (₹ 5025.57 crores or USD 810.47 million at 1USD = ₹ 62.08 in February 2014).

States also contribute to peripheral funding for biodiversity conservation through allied activities such as animal husbandry, fisheries and rural development, etc. However, these data have not been included in the assessment as complete data were not available for all States.

The Finance Commission of India has been providing additional financial support to initiatives of biodiversity conservation. The 12th Finance Commission of India provided a grant-in-aid of ₹ 1000 crores (approximately USD 166 million) for a five-year period (2005-09) to be distributed to different States based on the proportion of forest area to their geographical area. The 13th Finance Commission of India went a step further in this direction and provided a grant-in-aid of ₹ 5000 crores (approximately USD 800 million) for a five-year period (2010-2014) to the States. Mechanisms are also emerging in India to incentivize States for conserving their forests and biodiversity. In a study conducted by IIFM for the 13th Finance Commission of India, it was recommended that bioprospecting value of forests within each State, apart from three other factors - namely growing stock of forests, ratio of dense forest cover to total forest cover, and total carbon stock of each State should be taken into account while determining allocation of grant-in-aid to different States (Brander et. al., 2014).

Peripheral funding: Biodiversity-related programmes of allied Ministries 2.3.3

Of the 52 Ministries/Departments of the GoI, 23 Ministries/Departments (in addition to the MoEF) were identified as having a bearing on biodiversity conservation as they fund and implement biodiversity-related programmes (see Table 2.2). These 23 Ministries/Departments were identified on the basis of an extensive review of the RFDs of the 52 Ministries/Departments, information available in annual reports/websites of Ministries/Departments and institutions, as well as inputs provided by officials, scientists and other stakeholders at the individual level and from a range of organizations from different regions of the country. Detailed Demands for Grants and budget documents of the 23 Ministries/Departments of GoI identified were reviewed, and 77 schemes were identified that contribute towards biodiversity conservation and for which budget allocations were obtained.

As in the case of non-core funding for biodiversity under the MoEF's schemes, a multiplier approach has been applied to assess the biodiversity component of leveragable peripheral funding of the schemes implemented by other Ministries/Departments since the entire amount allocated to them cannot be attributed to biodiversity.

Accordingly, depending on the potential ability of a scheme to contribute to biodiversity, varying multipliers have been used

for determining the funds attributable to biodiversity conservation as shown below.

Multipliers used for estimating peripheral funding related to 77 schemes of 23 Ministries/Departments of GoI

Multiplier	0.002	0.010	0.017	0.020	0.050	0.055	0.100	0.150	0.250	0.900
Number of schemes (n=77)	1	50	1	1	10	1	7	1	1	4

In this assessment of funding, the credibility of the data is high as data are from Ministries'/Departments' Demand for Grants and other publicly available budget documents. However, there is some degree of subjectivity with regard to the multipliers used for determining allocations considered to be attributable to biodiversity. To address this concern, consultations were undertaken with the concerned Ministries/Departments with a view to confirming these data.

Using this method of calculation, an amount of ₹ 2354.74 crores can be considered as the net leveragable peripheral funding for biodiversity for 2013-2014 under 77 relevant schemes of 23 Ministries/Departments of the GoI other than the MoEF. It is expected that in India's attempt to further mainstream biodiversity, the number of Ministries/Departments identified may change and the estimates for leveragable funding for biodiversity may increase.

There are a number of Non-Governmental Organizations (NGOs) that work very actively for the environment in general and for biodiversity in particular. In addition to Central and State Government funding, NGOs receive funding from corporates in India and from foreign sources. The amounts have however not been taken into account when calculating the total funding because of non-availability of reliable data.

2.3.4 Total estimated funding for biodiversity conservation during 2013-2014

Core, non-core and peripheral funding for biodiversity conservation

Details of the core and non-core funding by the MoEF for biodiversity conservation as well as those of States for 2013-2014 are provided in Table 2.5. As explained in the foregoing, peripheral funding pertains to funding related to biodiversity conservation under 77 schemes and programmes of 23 Ministries/Departments of the GoI other than the MoEF.

Table 2.5. Core, non-core and peripheral funding for biodiversity conservation in 2013–2014

Nature of funding	Amount (₹ in crores)
Core	1564.34
Non-core	259.8
Core + non-core	1824.14
States	5025.57
Peripheral	2354.74
	(23 Ministries/Departments, 77 schemes)
Total	**₹ 9204.45 crores or USD 1482.68 million**

For the year 2013-2014, the core funding for biodiversity (under the MoEF's biodiversity-related programmes) is ₹ 15,643.4 million (₹1564.34 crores); the net leveragable non-core funding (on MoEF's other schemes) is ₹ 2598 million (₹ 259.8 crores). This amounts to a total of core and non-core funding by MoEF of ₹ 18,241.4 million (₹ 1824.14 crores) for the year 2013-2014. Adding the outlay for States of ₹ 50,255.7 million (₹ 5025.57 crores) takes the combined core and non-core funding by MoEF and States to ₹ 68,497.1 million (₹ 6849.71 crores). Along with the estimated peripheral funding of ₹ 2354.74 crores, the overall funding for biodiversity conservation amounts to ₹ 92044.50 million (₹ 9204.45 crores or USD 1482.68 million) for 2013-2014.

2.4 National Biodiversity Targets and Millennium Development Goals

The Millennium Declaration, made during the UN Millennium Summit on 8 September 2000, was signed by 189 countries, including 147 heads of State and Government, and included eight goals called the Millennium Development Goals (MDGs). India is committed to efforts towards achieving the MDGs and related targets (1 to 11 and 18) for progress in human development and poverty reduction (MoSPI 2013). India's National Biodiversity Targets are also directly and indirectly related to the MDGs. Efforts towards meeting the National Biodiversity Targets and MDGs will synergize progress towards achieving targets for biodiversity conservation and human development (see Box III, Executive Summary).

Bhagirathi in Harsil Valley | Threesh Kapoor

III

Deepak Apte

INDIA'S PROGRESS TOWARDS AICHI BIODIVERSITY TARGETS

INDIA'S PROGRESS TOWARDS AICHI BIODIVERSITY TARGETS AND CONTRIBUTIONS TO THE RELEVANT 2015 TARGETS OF THE MILLENNIUM DEVELOPMENT GOALS

3.1 INTRODUCTION

Biodiversity plays a crucial role in functioning of the ecosystems on which humankind depends for food and fresh water, health, recreation and protection from natural disasters. Its loss also affects cultural and spiritual values that are integral to human well-being. Current trends in loss of biodiversity and environmental degradation can greatly reduce the capacity of ecosystems to provide these essential services. The poor, who tend to be most immediately dependent on them, would suffer first and most severely. At stake are the principal objectives outlined in the MDGs *viz.* food security, poverty eradication, environmental security and human health (see Part III, Section 3.2).

Conservation of biodiversity at the national level requires inputs from several Ministries/Departments at the Central and State Governments' levels thereby reiterating the need for mainstreaming of biodiversity concerns in development planning processes. The 20 Aichi Biodiversity targets cross-cut all sectors of the national economy and affect ecology and human well- being. The policies, programmes and projects of as many as 23 Ministries/Departments of the GoI, which are directly or indirectly related to biodiversity conservation are critical for achieving progress towards Aichi Biodiversity Targets.

The subsequent sections describe the progress made by India towards achieving the 20 Aichi Biodiversity Targets and contributions to the relevant 2015 targets of the MDGs, by briefly referring to the relevant programmes and initiatives.

Indus River Ladakh | K Ramesh

III

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

3.1.1.

By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

Conservation and sustainable use of biodiversity is one of the thrust areas of the Government for public education and awareness. The MoEF along with the University Grants Commission (UGC), National Council of Educational Research and Training (NCERT) and the Ministry of Human Resources Development (MoHRD) play an important role in raising awareness. The All India Council for Technical Education (AICTE) and State Education Departments promote the integration of environmental concepts and issues in the curricula of schools and colleges. Environment education has been introduced as a mandatory subject in schools. In the area of formal education, the National Policy on Education, 1986 stresses on creating consciousness about the environment including biological diversity. The NCERT has been assigned the responsibility of developing a prototype syllabi and instructional material in ten core curricular areas of which protection of environment is one. MoHRD has launched the Environment Orientation to School Education scheme, wherein special cells have been created in the State Departments of Education for environmental education. Support is also extended through this cell to NGOs to facilitate the development of locale-specific programmes and materials. In order to generate awareness regarding the need to conserve and sustainably utilise biological resources, the communication media such as TV, Radio and Press are being extensively used.

The MoEF implements policies and programmes relating to conservation of the country's natural resources, including lakes and rivers, biodiversity, forests and wildlife, ensuring the welfare of animals, plants and human beings along with prevention and abatement of pollution. 'Environmental Education, Awareness and Training' is a flagship scheme of the MoEF for enhancing the understanding of people at all levels about the relationships between human beings and the environment and to develop capabilities/skills to improve and protect the environment. Some of the initiatives of the MoEF are National Environment Awareness Campaign, National Green Corps Programme, Paryavaran Mitra (Friends of the Environment) Programme, Global Learning and Observations to Benefit the Environment. Environment Education in the School System (EESS) has been an outcome of India's National Policy on Education, 1986 and the Supreme Court ruling of 2003 that Environment Education (EE) should be a compulsory curricular component at all levels of education, starting 2004-2005.

EESS seeks to build capacity of teacher trainers, textbook writers and curriculum developers. The flagship programmes of the MoEF such as National Green Corps (Co-curricular Eco Club approach), offer great insights and opportunities to support universalization of Environment Education. Some of the key initiatives for making people aware of the values of biodiversity conservation and some important organizations working in this area are described below.

Environmental Information System (ENVIS) was established by MoEF in 1983 as a plan programme of GoI for collation and dissemination of environmental information to various users, which include decision-makers, researchers, academicians, policy planners etc. ENVIS exists as a comprehensive network of 39 thematic centers and 28 State centers, located in the notable organizations/institutions/State/UT Government Departments/Universities throughout the country, providing information on all aspects of environment (www.envis.nic.in).

Centre for Environment Education (CEE) was established in August 1984 as a Centre of Excellence supported by the MoEF. CEE, with its headquarters in Ahmedabad, Gujarat, has a mandate to promote environmental awareness nationwide. CEE's primary objective is to improve public awareness and understanding of the environment with a view to promote the conservation of nature and sustainable use of the natural resources, leading to a better environment and a better quality of life. To this end, CEE develops and implements innovative programmes and educational material, and builds capacity in the field of Education for Sustainable Development (ESD) (www.ceeindia.org).

The C.P.R. Environmental Education Centre (CPREEC) is a Centre of Excellence of the MoEF, established jointly by the Ministry and the C.P. Ramaswami Aiyar Foundation (www.cpreec.org). The centre has been a pioneer in environmental education efforts in South India and has conducted a variety of programmes to spread awareness among local communities and women about conservation of nature and its resources by emphasizing conservation of the ecological traditions of India.

The Centre for Ecological Sciences (CES), Indian Institute of Science, Bengaluru maintained an ENVIS Centre on Western Ghats in addition to carrying out long term studies of biodiversity in this region.

The World -Wide Fund for Nature (WWF) India has been working to promote harmony between human beings and nature for more than four decades. It is recognized as a premier conservation NGO in the country dealing with nature conservation, environmental protection and development-related issues. The organization believes that environmental education is a lifelong process and in order to create interest and awareness about nature conservation and environment protection, the Environment Education Programme of WWF carries out activities with school and college networks to form nature clubs and organize national camping programmes across the country (www.wwfindia.org).

BNHS is India's oldest nature conservation and conservation education organization. Established in 1883, the Society's guiding principle is that conservation must be based on scientific research- a tradition exemplified by its former president, late Dr Sálim Ali. BNHS is a nodal agency for bird-ringing, and conducts research and action on critically endangered species. BNHS also has one of the largest marine conservation programmes in India, with major sea-scape and species level programmes such as Project Giant Clam, Project Mangrove, Invertebrate Taxonomy Studies, Ecologically and Biologically Significant Coastal and Marine Areas.

The Conservation Education Centre (CEC) is the education wing of the BNHS. The CEC's main objectives are to develop effective methodology in conservation education for formal and non-formal education sector. The Centre is fully equipped with the tools and education materials required to impart conservation education among its audience. It also engages with schools, colleges and corporates and offers a bouquet of programmes for EE (www.bnhs.org).

The Centre for Media Studies has been involved in policy research and programmes evaluation aimed at creating sustainable solutions for environment protection. One of the popular initiatives of CMS Environment team is the CMS VATAVARAN- Environment and Wildlife Film Festival and Forum supported by MoEF through which CMS VATAVARAN has reached out to over 200,000 people since 2007 (www.cmsindia.org, www.cmsvatavaran.org).

The Wildlife Trust of India (WTI) is a national conservation organisation committed to effective action for the protection of India's natural heritage. WTI's principal objectives include managing or preventing wildlife crises and mitigating threats to individual wild animals, their populations and habitats through holistic strategies and practical interventions in partnership with communities and Governments and to promote alternative livelihoods to minimise human dependence on forest resources (www.wti.org.in).

The National Museum of Natural History (NMNH), New Delhi is an institution of the MoEF devoted to EE and was opened to the public in 1978 on June 5 on the occasion of World Environment Day. The Museum undertakes EE through the means of exhibition programmes and educational activities. Even though the primary target audience of the Museum is school students, it has developed programmes for other categories of people as well. The NMNH is the pioneer Museum which has initiated several specialized programmes to cater to the needs of Persons with Disabilities. The Museum also undertakes many outreach programmes such as Temporary Exhibitions, Mobile Exhibitions and a large number of Nature Camps. It also arranges many local and national level competitions leading to Young Environmentalist of the Year Award (YEYA). In order to expand the geographical coverage of its activities, the NMNH has established Regional Museums of Natural History (RMNH) in South India (Mysore) in 1995, Central India (Bhopal) in 1997 and Eastern India (Bhubaneswar) in 2004. RMNH are also being established for Western India (Sawai Madhopur) and North-eastern India (Gangtok) (www.nmnh.nic.in).

The Biological Diversity Act, 2002, mandates the local level BMCs to prepare People's Biodiversity Registers (PBRs) in consultation with local people. PBRs contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or traditional knowledge associated with them. NBA and SBBs provide guidance and technical support to BMCs for preparing PBRs. So far, over 1900 PBRs have been prepared in 14 States.

Citizen Science for conservation, sometimes called public participation in scientific research, is a movement in which volunteers help professional scientists collect and analyse data while also promoting biodiversity awareness and conservation. A few initiatives by various organisations are mentioned here. MigrantWatch (www.migrantwatch.in) and SeasonWatch (www.seasonwatch.in), conceived in 2007 and 2010 respectively for studying India-wide patterns in ecological phenomena associated with seasonality, are collaborative efforts involving National Centre for Biological Sciences (NCBS), Bengaluru, NCF, Mysore and Wipro, a corporate body, along with a journal Indian Birds. Wildlife Conservation Society (WCS India) and the Centre for Wildlife Studies (www.wcsindia.org, www.cwsindia.org) has engaged with naturalists, photographers, teachers, journalists, and people from varied backgrounds in its conservation programmes. BNHS Conservation Education Centre, Mumbai (www.bnhs.org/conservation-education-centre-programmes) conducts citizen science programmes across the country, such as, "Be a Scientist For a Day" programme. Other programmes such as 'Common Bird Monitoring of India' involving many partner groups have also been launched in recent years.

In addition to the above, India as the host of CoP-11 to the CBD has undertaken some unique measures towards enhancing awareness on biological diversity which are given below.

The Science Express Biodiversity Special (SEBS) train is an innovative mobile exhibition mounted on a specially designed 16-coach air-conditioned train for creating awareness about biodiversity and other environmental issues in the country. The state-of-the-art exhibition aboard SEBS aims to create widespread awareness on the unique biodiversity of India. Eight coaches of SEBS are dedicated to biodiversity, and the remaining coaches are on climate change, water, energy conservation, sustainable development, kids zone and joy of Science Lab. The first phase of SEBS was launched on World Environment Day on 5th June 2012, as the brand ambassador of CoP-11 hosted by India in Hyderabad in October 2012. The SEBS in its first phase covered 51 locations and received over 23 lakh visitors up to 22nd December 2012, including six lakh students and 32,000 teachers from 7,000 schools who enjoyed learning in a fun way. The second phase of SEBS was flagged off on 9th April 2013 from New Delhi and travelled to different States covering 62 stations till 28th October 2013. An exclusive website www.sciencexpress.in provides details and up-to-date information on the SEBS. This flagship venture is a collaborative initiative between MoEF, Indian Railways and DST.

Efforts are underway to establish a National Biodiversity Museum and a garden at Hyderabad on the site where the Prime Minister unveiled the Commemorative Pylon, and planted the first tree on behalf of India. Hyderabad is the first host city of CBD-CoP to establish Commemorative Pylon, park and museum related to biodiversity conservation.

By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

There are a number of legal, policy and administrative measures supported by several programmes which contribute to achievement of Aichi Biodiversity Target 2. These are described briefly below.

India enacted the Mahatma Gandhi National Rural Employment Guarantee (MGNREG) Act in 2005 to promote livelihood security in rural areas. The objective of the Act is to create durable assets and strengthen the livelihood resource base of the rural poor. MGNREGS works are largely focused on land and water resources and includes water harvesting and conservation; soil conservation and protection; irrigation provisioning and improvement; renovation of traditional water bodies; land development and drought proofing; afforestation; horticulture development; and pastureland development. The MGNREGS works have the potential to generate environmental benefits such as groundwater recharge; soil, water and biodiversity conservation; sustenance of food production; halting of degradation of land; and building resilience to current climate risks such as moisture stress, delayed rainfall, droughts and floods. The total financial outlay of MGNREGS for 2012-2013 is ₹ 33,000 crores or USD 5.5 billion. The 'green jobs' created by the scheme are contributing to replenishing the depleting the water table and afforestation. MGNREGS currently covers 632 districts in the country, and is considered the world's largest social security scheme, in terms of people covered and money spent to combat rural poverty.

In order to ensure that the values of biodiversity conservation get mainstreamed into development programmes, the Planning Commission of India is working on developing an Environmental Performance Index (EPI). The EPI is to serve as a measure of a state's green initiatives and is to be linked to financial assistance from the Centre to the States. The approach is to focus on pollution abatement, promotion of adherence to environmental standards, natural resource conservation and the three 'R's (Reuse, Recycle, Recover). Environment performance will account for 2% of a State's overall performance. The measure is meant to be both an incentive and compensation to States for green initiatives.

The MoEF has initiated a programme to value the immense wealth of the natural resources and biodiversity in India. Under The Economics of Ecosystems and Biodiversity (TEEB)-India initiative, the MoEF has begun the process of evaluating the natural capital and ecosystem services of India in terms of their economic values for three ecosystems, namely (i) Forest (ii) Wetland and (iii) Coastal and marine ecosystem.

India has also initiated Green National Accounting at the country level with the release (in April 2013) of a report of an expert group titled 'Green National Accounts in India-A Framework' (www.pib.nic.in). The report outlines concepts that go beyond conventional measures of wealth (measured in terms of GDP alone) and guide the development of tools for green measurement.

The National Mission on Medicinal Plants, under the Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH), MoHFW, is implementing a centrally sponsored scheme through the NMPB is primarily aimed at supporting market- driven cultivation of medicinal plants on private lands with backward linkages for establishment of nurseries for supply of quality planting materials and forward linkages for post-harvest management, processing, marketing infrastructure, certification and crop insurance in project mode. This is being achieved by cultivation of medicinal plants in identified zones/clusters within selected districts of States having potential for cultivation of certain medicinal plants and promotion of such cultivation, following good agricultural practices, through farmers, cultivators, growers' associations/federations, self-help groups, corporates and cooperatives. The achievements under the scheme

include: (i) setting up 636 nurseries of medicinal plants, (ii) coverage of 51,308 hectares of land for cultivation of medicinal plants, (iii) provision of support to 25 post-harvest infrastructure units, and (iv) putting in place five processing units and two market promotion units. During the 12th Plan, it is proposed to expand the cultivation status of medicinal plants to over 200,000 hectares of land and develop 20 Medicinal Plants Processing Zones by raising 2000 nurseries and providing a minimum support price to collectors of medicinal plants and marketing support to farmers.

The National Rural Livelihoods Mission (NRLM) initiated livelihood enhancement and vulnerability reduction interventions through a special programme, Mahila Kisan Sashaktikaran Pariyojana (MKSP), launched in 2010-2011. The programme envisages empowering women in agriculture by making systematic investments to enhance their participation and productivity, as also create and sustain agriculture-based livelihoods among rural women. The programme is being implemented by NRLM in partnership with State Departments, as implementing partners, across the country. The main focus of NRLM is to stabilize and promote the existing livelihoods portfolio of the poor, in farm and non-farm sectors. NRLM looks at the entire portfolio of livelihoods of each household and facilitate support for the activities at the individual/household level or in a collective, or at both levels. As agriculture is the mainstay of livelihoods activities for a large proportion of the rural poor, NRLM specially focuses on sustainable agriculture and allied activities such as animal husbandry, collection non-timber forest produce and fisheries.

MoEF in collaboration with United Nations Development Programme (UNDP) has instituted 'Biodiversity Governance Awards'. The first such awards were given during CoP-11, in October 2012. The awards for 2013-2014 will be given on 22nd May 2014, the International Day for Biological Diversity.

By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

In the budgetary context, subsidies are generally taken as unrecovered costs of public provision of goods that are not classified as public goods. These are private goods where user charges can be levied according to individual consumers or according to groups of consumers. Subsidies are often justified in the presence of positive externalities and for re-distribution objectives. Financing of subsidies however induces its own cost and over subsidization can adversely affect allocation of resources and environment. In the context of huge resource dependent population and under several poverty alleviation programmes India has been providing subsidies in the agriculture, irrigation, energy and industry sectors, as a means of providing livelihood security to the underprivileged sections of the society. Major threats to biodiversity in India do not emanate from such subsidies. India has embarked on a regime to reduce/ remove some of the subsidies, and to make them better targeted and to promote efficiency in their administration. India has nevertheless taken significant measures to promote positive incentives that encourage activities beneficial to biodiversity. Studies have been carried out on mechanisms that incentivize States to conserve forests and biodiversity, by providing a 'green bonus' or determining State funding allocations based on growing stock of forests, ratio of dense forest cover to total forest cover, and total carbon stock.

Implementation of Access and Benefit Sharing (ABS) provisions of Nagoya Protocol on ABS at the international level and under India's Biological Diversity Act 2002 at the national level would provide positive incentives for biodiversity conservation (see Part III, Section 3.1.4, Aichi Biodiversity Target 16).

Organic farming is being promoted across the country under the National Project on Organic Farming (NPOF), a central sector scheme (www.ncof.dacnet.nic.in) continuing since India's 10th Five Year Plan (2002-2007). A variety of incentives are disbursed to farmers under the NPOF scheme to encourage organic farming, which reduces negative impacts on the environment and biodiversity. Area under certified organic farming increased from 42,000 hectares during 2003-2004 to 10,50,000 hectares in 2009-2010.

'Green certification', such as the Green Thumb Certification Programme of the Applied Environmental Research Foundation, Pune, encourages conservation initiatives taken up by the private sector.

To sustain and increase the rate of agricultural productivity, the GoI is taking steps to encourage balanced fertilizer use so as to maintain soil biodiversity. A recent reform of fertilizer pricing has been brought into effect. The prices of potassic (K) and phosphate (P) fertilisers have been liberalized so that farmers are encouraged to use more P, K and micro-nutrient-based fertilizers, compared with damaging urea, the price of which has been increased by 10%.There is a proposal to provide nutrient-based subsidies only to small and marginal farmers in the future.

A number of measures have been taken to reform the fuel subsidy system to discourage consumption and encourage investment in cleaner forms of energy. After liberalizing petrol pricing in 2010, the GoI has stated her intention of limiting all

central subsidies (including those on fuels) to less than 1.75% of GDP over three years, starting from 2012-2013. From January 2013 onwards, bulk users of diesel are paying unsubsidized prices, and the diesel prices are largely completely market driven.

The use of renewable energy by the private sector is given 100% depreciation benefits. Moreover, term loans are offered to enterprises in the small and medium sectors that utilize bio-resources on a sustainable basis by the Small Industries Development Bank of India.

Government schemes such as the Rajiv Gandhi Gramin Vidyutikaran Yojana have been facilitating rural electrification, thus providing an alternative to kerosene. This will further help reduce wastage of kerosene.

Positive incentive schemes involving various local communities in conservation through joint forest management and management of irrigation water by farmers' guilds have been promoted so that local communities have greater power over public lands and waters in their own localities and are encouraged to conserve natural resources and biodiversity. Local communities are also encouraged to maintain biodiversity through financial rewards, linking payments to the conservation value of elements making up biological communities within their territories.

India has recently embarked on Direct Benefit Transfer scheme from 1st January 2013 to be implemented in a phased manner for identified welfare schemes, including the direct transfer of subsidies for fertilizers, cooking gas, kerosene directly to farmers, aimed towards poverty elimination, inclusive growth and delivering better welfare measures.

By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Sustainable use of biological diversity is emphasized through various legislative measures and policy statements of the Government (Table 3.1). Several initiatives have been taken to promote sustainable use, recognizing the inter dependence of local communities and people on biological resources and emphasizing the need to draw upon the existing resources keeping biodiversity-rich areas and resources is being diverted by bringing additional areas under green cover to satisfy local demands, encouraging environment friendly substitutes to meet the needs met from bioresources, promoting energy efficient devices, creating awareness and an environment among the stakeholders and collectors to restrict use and extraction of only desired parts of an organism rather than the entire organism.

Table 3.1 Key Policy Statements Emphasizing Sustainable Use of Biodiversity

Sl. No.	Policy	Relevant Features on Sustainable Use
1	National Forest Policy, 1988	Aims at maintaining environmental and ecological balance, calls upon the forest based industries to raise their own raw materials, lays stress on meeting the fuel, fodder, NTFPs and other requirements of rural and tribal people, and increasing forest productivity at the national level through community involvement.
2	National Conservation Strategy and Policy Statement for Environment and Sustainable Development, 1992	Provides the basis for integration and internalization of environmental considerations in the policies and programmes of different sectors. It also emphasizes sustainable lifestyle and proper management and conservation of resources.
3	National Policy and Macrolevel 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.
4	National Agriculture Policy, 2000	Seeks to actualize the vast untapped growth potential on Indian agriculture, rural infrastructure and value addition; secures a fair standard of living for the farmers and agricultural workers; discourage migration to urban areas; faces the challenges arising out of economic liberalization and globalization.
5	National Seeds Policy, 2002	Includes thrust areas such as seed varietal development production, quality assurance, seed distribution and marketing, infrastructure facilities, etc.
6	National Tourism Policy, 2002	Lays emphasis on ecotourism for helping in eliminating poverty ensuring employment, creating new skills, enhancing the status of women, preserving cultural heritage and improving overall environment.

Sl. No.	Policy	Relevant Features on Sustainable Use
7	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.
8	National Environment Policy, 2006	Includes the conservation of critical environmental resources; intra-generational and inter-generational equity; livelihood security for the poor, integration of environmental concerns in economic and social development; efficiency in environmental resource use; and improve environmental governance.
9	National Biotechnology Development Strategy, 2007	Calls for promotion of mass use technologies for sustainable utilization of bioresources.

Various steps are being taken to ensure an integrated approach with participation of various stakeholders to protect the environment, some of which are described below.

Federation of Indian Chambers of Commerce and Industry (FICCI) and Earthwatch Institute India have come together to promote the concept of 'citizen science' for conservation and protection of urban water bodies. This initiative aims to create opportunities for citizens and corporate executives to contribute to water conservation.

The GoI has enacted the National Action Plan for Climate Change (NAPCC), and one of the most important missions of the plan is the Jawaharlal Nehru National Solar Mission (JNNSM). The JNNSM envisages a capacity addition of 20 gigawatts of solar energy generation by 2022. One of the key objectives of JNNSM is to create a strong manufacturing base for solar energy production in India. This will contribute to employment generation and to the long-term sustainability of the solar energy sector in India. The potential for solar energy, including grid and off-grid solar applications, in India in the next 10 years is projected to be in the range of 35,000-60,000 megawatts.

The GoI had also launched a Centrally Sponsored Scheme on micro irrigation during the financial year 2005-2006. This was scaled up as the National Mission on Micro Irrigation in 2010 with the objective to enhance the efficiency of water usage, increase crop productivity and enhance farmers' incomes.

The watershed programme of India Tobacco Company Limited (ITC) promotes development and local management of water resources by facilitating village-based participation in the planning and execution of watershed projects in eight States across India-Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttar Pradesh. Adopting a bottom-up participatory approach, with disadvantaged sections as the primary target, ITC works with NGOs as implementation partners to mobilize them to form Water User Groups. ITC's integrated watershed development programme conserves soil and moisture in over 90,000 hectares of land in water-stressed areas.

Tata Power's hydroelectric plants are located in the biodiversity-rich Western Ghats of Maharashtra and are almost 100 years old. Tata Power has been actively involved in conservation efforts and in the protection of biodiversity in these catchment areas of six lakes in the Western Ghats of Maval and Mulshi Taluka in Pune District. Tata Power has also been working towards conservation of endangered Mahseer (*Tor putitora;* http://www.tatapower.com/media-corner/presslease/press-release-12-july-2011.aspx).

Tata Power's Trombay power station has preserved marshes near its facility for flamingos, which migrate in winter to this natural habitat to feed on algae that grow there. The area has been declared as an IBA by the BNHS and Bird Life International. This area has been identified as an important nesting site for many migratory birds such as sandpipers, plovers, gulls and terns apart from having a large population of flamingos. Several other corporates are also getting engaged in promoting biodiversity conservation activities.

Widely regarded as the backbone of the Indian economy, the Micro, Small and Medium Enterprises (MSME) sector is highly diverse and heterogeneous in its structure. A major part of the Indian MSME sector is 'local' in its operations and outlook. Yet it impacts the environment and society in its own way. One of the critical aspects of responsible business practices, regulated by National Voluntary Guidelines, is that businesses should not only be responsible but also be seen as being socially, economically and environmentally responsible. While the guidelines, encompassing nine Principles and related Core Elements, identify the areas where responsible practices need to be adopted, the Reporting Framework provides a standard disclosure template that is used by businesses to report on their performance in these areas. The objective of incorporating this framework in the Guidelines is to help businesses reach out to their stakeholders with necessary information and data demonstrating the adoption of the Guidelines (National Voluntary Guidelines-2011-2012 of the Ministry of Corporate Affairs (MoCA), (http://www.mca.gov.in/Ministry/latestnews/National_Voluntary_Guidelines_2011_12jul2011.pdf).

Corporate social responsibility (CSR) is way of conducting business, by which corporate entities visibly contribute to the social good. Socially responsible companies do not limit themselves to using resources to engage in activities that increase only their profits. They use CSR to integrate economic, environmental and social objectives with the company's operations and growth. In this context, the GoI has enacted the Companies Act 2013 which makes CSR spend mandatory for every company with a net worth of ₹ 500 crore or more or turnover of ₹1000 crore or more or a net profit of ₹ 5 crore or more during any financial year. Two percent of the average net profits made by the company during every block of 3 years are to be used for CSR activities. Ensuring environmental sustainability has been identified as one of the nine activities to be covered under CSR activities.

A grant-in-aid scheme, Development and Promotion of Clean Technologies, was initiated in 1994. The main objective of the scheme related to waste minimization was to optimize the consumption of raw materials and reduce waste generation by adopting suitable production techniques that are cleaner in nature and can be adopted by existing units without necessarily changing production processes or unit operations. Important activities being undertaken since the inception of the scheme in 1994 include (a) demonstration projects; (b) life cycle assessment; (c) carrying capacity studies; (d) creation of a database for clean technologies; (e) conducting training programmes for adoption of clean technologies; and (f) developing waste minimization circles for small and medium enterprise clusters. Under the scheme on development and promotion of clean technology and waste, over 25 projects have been completed, 18 projects are ongoing and six new projects have been recommended by project monitoring committee (http://envfor.nic.in/sites/default/files/guidelines-c1t.pdf).

Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use

3.1.2.

By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

India is endowed with vast forest resources which have been an important part of her culture and a defining feature of her landscape. In order to deal with critical issues like deforestation and degradation of the forests, along with the sustenance of forest-dependent communities, the National Afforestation and Eco-Development Board (NAEB) provides support to Forest Development Agencies through the National Afforestation Programme. In 2010-2011, the State Forest Development Agency has been constituted to facilitate the flow of funds to Forest Development Agencies. The National Forest Policy (1988) aims at maintaining a minimum of 33% of the country's geographical area under forests and tree cover.

REDD (Reducing Emissions from Deforestation and Forest Degradation) is a global endeavour to create an incentive for developing countries to protect, manage better and save their forest resources and, thus contribute to the global fight against climate change. India is playing a positive role and has taken a firm stance in favour of a comprehensive REDD+ approach (see section 3.1.4 Aichi Biodiversity Target 15; http://www.moef.nic.in/sites/default/files/ProceedingsoftheREDDWorksho18-4- 2012.pdf).

In February 2013, MoEF launched the NPCAE scheme for conservation of lakes and wetlands (see Part I, Section 1.2.1 and Part III, Section 3.1.2, Aichi Biodiversity Target 14). The NPCAE scheme seeks to prevent degradation of aquatic ecosystems through implementation of sustainable conservation plans.

Green India Mission (GIM)

Box 3.1

GIM is one of the eight missions under the NAPCC. The objectives of the Mission include increased forest/tree cover on 5 m ha of forest/non- forest lands and improved quality of forest cover on another 5 m ha of non-forest/ forest lands. This is expected to improve ecosystem services including biodiversity, hydrological services, carbon sequestration from the 10 m ha of forest/non-forest lands as mentioned above, increased forest-based livelihood income of about 3 million households, predominantly tribals living in and around the forests, and additional enhanced annual CO_2 sequestration by 50 to 60 million tonnes annually by year 2022. The total projected Mission cost is ₹ 46,000 crores spread over 10 years. The Mission provides funding of ₹ 2000 crores under 13th Plan outlay, along with ₹ 400 crores from 13th Finance Commission Grants towards States' share. It also spells out convergence with CAMPA to the tune of ₹ 6000 crores, with MNREGS to the tune of ₹ 4000 crores and with National Afforestation Programme for ₹ 600 crores. Thus total expenditure proposed for GIM will be ₹ 13,000 crores during the 12th Plan and a one year spill-over into the 13th Plan. The plan outlay in interim budget of 2013-14 is ₹ 80 crores. The Mission during 12th Plan period, with one year spill over in 13th Plan will generate 670.82 million person days costing about ₹ 6782 crores. Similarly, the Mission is likely to generate 1352 crores worth of skilled employment for about 28,000 community youths. The Mission provides key roles to Gram Sabha and the Committees mandated by it to carry out the activities of the Mission at the village level. All the plans at village level will have to be approved by the Gram Sabha, before they could be implemented. Provision of Social Audit by the Gram Sabha, as done in MGNREGS will ensure accountability of local level institutions. Similarly, planning at landscape level will be done by the revamped Forest Development Agencies (FDAs) with a clear role for PRI institutions.

Box 3.2

Ecological Restoration of Chilika Lagoon: Success to be replicated

Chilika brackish water lagoon, situated in the State of Odisha in India, forms the base of livelihood security of more than 200,000 fishers and 400,000 farmers living in and around the wetland and its adjoining catchments. Siltation from degraded catchments choked the connection of lagoon with the Bay of Bengal leading to a rapid decline in fisheries (from 8,000 mt to less than 1,000 mt) invasive weeds proliferated, and there was shrinkage of the area and volume. This had a tremendous impact on the livelihoods of communities, especially fishers who depended on the lake for sustenance. Introduction of shrimp culture also led to pressures on the ecology of the lake.

The objectives of the intervention were to restore Chilika with an ecosystem approach by restoring its biodiversity and securing the livelihoods of the dependent communities. CDA was constituted in 1991 to implement an ecological restoration programme. Hydrological intervention in the form of a new mouth was done in September 2000. Programmes for watershed management, fisheries development, ecotourism development, education and outreach were initiated.

Several positive changes have taken place in the lake system, as indicated below:

- Reappearance of 6 species of fish-in addition, 43 fish, 4 prawn, 7 crab and 2 Indian spiny lobster species have been added to the list of animals recorded from the lake.
- Decrease in area under the freshwater weed *Eichhornia crassipes* (water hyacinth).
- Expansion of seagrass meadows and species diversity.
- Increase in population and habitat of Irrawaddy dolphin from 70 in 2003 to 152 in 2013.

Building on the recovery of the ecosystem, the lake fisheries have revived significantly-the annual catch grew from 1747 million tonnes in 2000 to 14,228 million tonnes in 2012. The tourist inflow to Chilika has also increased substantially, from 200,000 visitors during 1994-2000 to 430,000 during 2000-2008 (http://www.chilika.com/coastal_zone_project.htm ; http://www.iczmpodisha.org/).

By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

India has a vast Exclusive Economic Zone (EEZ), representing different types of ecosystems that range from those in the open ocean or shelf regions to the intertidal or sub-tidal ecosystems, mangroves, corals, and estuaries. Fisheries in the coastal zone determine the livelihood of a large number of fishermen, who are economically more vulnerable to changes in the environment.

ZSI a premier institute of MoEF works for survey and inventorization of faunal diversity in India. Its national zoological collection with voucher specimens of identified species of fauna of India helps address issues relating to bio-prospecting and establishing India's sovereign rights over her fauna. Marine Biological Regional Centre of ZSI was established in 1973 to promote surveying and inventorying the marine fauna in Indian waters. It is actively involved in studying the distribution and status of marine and coastal fauna, its assessment in less explored areas, inventorying the coastal and marine habitats, and its management and conservation. A new unit of ZSI was also established in Jamnagar, Gujarat to assess the faunal diversity of marine protected areas (www.zsi.gov.in).

BSI, another leading organization of MoEF, is involved in exploration, inventorying and documentation of floral diversity in protected areas, hot spots, fragile ecosystems and sacred groves in particular through National, State and District floras. BSI is also involved in floristic survey of fragile ecosystems such as mangroves and seagrass (www.bsi.gov.in).

The National Centre for Sustainable Coastal Management (NCSCM), an autonomous body under the MoEF supports integrated management of the coastal and marine environment for livelihood security, sustainable development and

hazard risk management by enhancing knowledge and research, providing advisory support, developing partnerships, fostering networks and providing a coastal community interface (www.ncscm.org).

The National Institute of Oceanography (NIO), one of the constituent laboratories of Council of Scientific and Industrial Research (CSIR) established in 1966 following the International Indian Ocean Expedition, works in four traditional branches of oceanography-physical, chemical, biological and geological oceanography and some other areas of marine instrumentation and archaeology. Over 90% of the world cargo is mobilized trans-oceanically, and nearly 10 billion tonnes of ballast water is collected at one part of the ocean and discharged at the other, which introduces a wide range of living organisms, including pathogens, into alien regions. The NIO is also working to address ballast water management issues and prepare comprehensive port-specific management plans for the country (www.nio.org).

Central Salt and Marine Chemical Research set up in 1954 is actively pursuing research to understand the utilization potential of coastal and marine bio-resources. The activities are also centered on isolation and characterization of salt tolerant genes in the halophytes (www.csmcri.org).

The Central Marine Fisheries Research Institute (CMFRI) under the MoA is working towards development and refinement of the unique national marine fishery database. Currently, involved in the development of the Strategic Multistage Random Sampling method, implementation of a trawl ban as a long-term management measure, assessment of stocks of major marine fishery resources in the EEZ and development of artificial reefs to enhance the sustainability of artisanal fisheries and increase in natural productivity. Efforts are being made to develop a model to estimate and forecast potential fish yields at regular intervals and thus increase the accuracy of forecasts, leading to better management of effort and fishery resources (www.cmfri.org.in).

The Central Institute of Brackish Water Aquaculture established under MoA at Chennai promotes research and provides technology support for the country's growing brackish water aquaculture sector. Currently, it is involved in developing economically viable and environmentally sustainable culture technologies for finfish and shellfishes, evaluating the economically important brackish water resources and its utilization, provide policy and plans to support socio-economic development and undertake human resource development measures through training and extension (www.ciba.res.in).

The Central Institute of Fisheries Education under MoA is a premier fisheries university in India and has contributed immensely in the development of fisheries sector through teaching, research and extension. It conducts basic and frontier research for different stakeholders and provides technical support for policy development and consultation services (www.cife.edu.in).

The Department of Animal Husbandry, Dairying and Fisheries one of the departments of MoA, involved in management and expansion of aquaculture of fresh water, brackish water and welfare of fisher folk (http://dahd.nic.in/dahd/default.aspx). The Directorate of Coldwater Fisheries Research (DCFR) under ICAR is currently involved in fish production enhancement through aquaculture, genetic improvement of commercially important species, disease diagnosis and value addition. DCFR is also developing technologies for upland aquaculture and hill resource management for sustainable utilization and development of fishery resources in the cold water regions of the country (http://www.dcfr.res.in/index.php).

The National Fisheries Development Board focuses on sustainable management and conservation of natural aquatic resources, including fish stocks. It is also involved in research and development for improving the production of capture and culture-based fisheries, value added products and marketing (http://nfdb.ap.nic.in/index.htm). The MoA has also established Central Inland Fisheries Research Institute at Kolkata to focus on sustainable productivity of inland fisheries and its ecosystem health and benefits (http://www.ifsi.in/cifri/cifri.htm).

The Centre for Marine Living Resources and Ecology (CMLRE) of the MoES established at Kochi facilitates implemention of the marine living resources programme. The centre is developing management strategies for marine living resources through ecosystem monitoring and modeling efforts (http://cmlre.gov.in/).

The Integrated Coastal and Marine Area Management (ICMAM) programme promotes and facilitates sustainable management of the coastal zone and rational utilization of resources by incorporating environmental and social concerns in all sectoral developmental activities. It is currently involved in predicting the primary production of coastal waters under changing environmental conditions and to suggest appropriate environmental conditions to achieve the same. ICMAM is also involved in detecting the water quality changes in the coastal, estuarine and marine system and mapping shoreline along the Indian coast to estimate the sediment transport (http://www.icmam.gov.in/).

The Indian National Centre for Ocean Information Sciences, an autonomous body under the MoES at Hyderabad, studies coral reefs in the coastal zone. With the commissioning of OCEANSAT, real-time satellite pictures of ocean color (chlorophyll a) are being provided, which is allowing identification of fish aggregations. Identification of potential fishing zones, including the type and quantity of fish available, is one of the main requirements of economical fishing activities (www.incois.gov.in).

The National Institute of Ocean Technology (NIOT) under the MoES has been established with the main aim of developing reliable indigenous technology to solve the various engineering problems associated with harvesting of non-living and living resources in the Indian EEZ (http://www.niot.res.in/).

The Fishery Survey of India (FSI) is a nodal agency under the MoA with the responsibility of surveying and assessing fishery resources in the Indian EEZ and promoting sustainable exploitation and management of fishery resources (http://fsi.gov.in/).

By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

The increasing demand for food, fibre and fuel can have a direct impact on loss of biodiversity and ecosystem services, if issues related to their sustainable management are not addressed. On the other hand, sustainable management not only contributes to biodiversity conservation but can also deliver benefits to production systems in terms of services such as soil fertility, erosion control, enhanced pollination and reduced pest outbreaks, as well as contributing to the well-being and sustainable livelihoods of local communities engaged in the management of local natural resources. India seeks to sustain, augment and manage its forests, agricultural lands and fisheries by regulatory (laws) and promotional (institutional schemes) measures.

The National Agriculture Policy (NAP) 2007 focuses on the economic well-being of farmers. The major goals of the NAP are, *inter alia*, to protect and improve land, water, biodiversity and genetic resources essential for sustained increases in the productivity, profitability and stability of major farming systems by creating an economic stake in conservation, to strengthen the bio-security of crops, farm animals, fish and forest trees (http://www.indg.in/agriculture/rural-employmentschemes/national-policy-for-farmers-2007).

The National Project on Promotion of Organic Farming of the Department of Agriculture and Cooperation, MoA was launched as a pilot project in 2004 during the second half of the 10th Five Year Plan, with a budget outlay of ₹57.04 crores. The project has been continued in the 12th Plan (see Part III, Section 3.1.1, Aichi Biodiversity Target 3 for more details, http://ncof.dacnet.nic.in/).

The National Mission for Sustainable Agriculture is one of the eight missions under the NAPCC and aims to endow resilience to Indian agriculture against climate change, devising appropriate adaptation and mitigation strategies for ensuring food security and enhancing livelihood opportunities (http://www.nicraicar.in/nicrarevised/images/Mission%20Documents/National%20Mission%20For%20Sustainable%20Agriculture-DRAFTSept-2010.pdf).

The Coastal Aquaculture Authority (CAA) was established under the Coastal Aquaculture Authority Act, 2005. The main objective of the CAA is to regulate coastal aquaculture activities in order to ensure sustainable development without causing damage to the coastal environment (see Aichi Biodiversity Target 6 for more detailed information; http://caa.gov.in/; http://dahd.nic.in/dahd/coastal-aquaculture-authoritycaa.aspx).

The National Fisheries Development Board (NFDB) set up in September 2006, to realize the untapped potential of the fisheries sector, in fish culture, processing and marketing of fish, and to apply modern tools of research and development to optimizing the production and productivity in fisheries (http://nfdb.ap.nic.in/ ; http://dahd.nic.in/dahd/division/fisheries/national-fisheries-development-board-nfdb.aspx).

The Joint Forest Management (JFM) was initiated in the context of the National Forest Policy of 1988 wherein SFDs support local forest dwelling and forest fringe communities to protect and manage forests and share the costs and benefits from the forests with them. Communities organize themselves into a JFM Committee to protect and manage nearby forests, guided by locally prepared bye-laws and micro plans. It is an ambitious attempt by the GoI at regenerating and sustainably using forests. The major task is to rehabilitate degraded forests and enhance the area under forest/tree cover to 33% of the total area, as envisaged in the National Forest Policy. JFM is being implemented by a two tier decentralization institutional set up, namely (i) FDA to the Territorial/Wildlife Forest Division level, and (ii) JFMCs at the village level. Presently, there are 1,06,479 JFMCs managing an extent of 220.2 lakh ha involving 219.9 lakh people living in and around forests and the number is increasing every year. JFMCs have full rights over all the NTFPs except the nationalized minor forest produce, i.e., tendu leaves, sal seeds, cashew, etc, In Andhra Pradesh, 50% of the net proceeds from sale of tendu leaves are shared with JFMCs and in Madhya Pradesh and Chhattisgarh, 100% of net profit goes to the collectors of NTFPs. To compliment this initiative, a new scheme of National Afforestation Programme was launched during 2002-2003. Under the scheme, an extent of 9.24 lakh ha is being covered by 23,750 JFMCs under 715 FDAs in 29 States. During the last 18 years of implementation, JFM programme has emerged as a powerful tool in sustainable management of forests in India.

To reverse the process of degradation and to achieve the goals of the National Forest Policy, a National Forestry Action Programme (NFAP) was formulated and released by the MoEF on 9th August 1999. The objective of NFAP is to evolve issue-based programmes in line with the National Forestry Policy 1988. It is a comprehensive strategic plan for addressing the key issues underlying the major problems of the forestry sector. Its programme structure is based on the proposals in the 26 State Forestry Action Programmes. Apart from forest conservation and development, the NFAP also stipulates a substantially enhanced outlay for holistic forest management. The NFAP recognizes that a rational and balanced combination of different forest functions - production, protection, conservation and provision of environmental amenities - is essential to help conserve the sustainability of forests.

The National Bamboo Mission is an initiative of the Department of Agriculture and Cooperation, MoA, launched in 2006 - 2007 with a total outlay of ₹568.23 crores. Being implemented in 27 States of the country, the major thrust of the mission is on an area based regionally differentiated strategy for both forest and non-forest areas for sustainable utilization of bamboo and generation of employment opportunities (http://nbm.nic.in/).

Integrated land use management to combat land degradation in Madhya Pradesh

Box 3.3

The GEF project being executed by the Madhya Pradesh State Forest Department (August 2010-November 2014) is located in nine forest divisions in Betul, Chhindwara, Sidhi, Singrauli and Umaria districts. Developed as a part of the Sustainable Land and Ecosystem Management Country Programme Partnership (SLEM CPP), this project aims to promote community-driven sustainable land and ecosystem management at the landscape level through integration of watershed management, Joint Forest Management, and sustainable livelihoods development so as to balance ecological and livelihood needs. The project contributes to mainstreaming land degradation concerns into national level policies and the regulatory framework through a SLEM partnership. The project addresses the regulatory and institutional constraints in mainstreaming biodiversity conservation into livelihood activities in the wider agricultural production landscape surrounding protected areas. It seeks to enhance the resilience of land and forest ecosystems and reduce the vulnerability of local communities to climate change, including variability. The expected outcomes are creation of an enabling environment for climate-resilient, sustainable land and ecosystem management; community-driven, demonstration of climate-resilient approaches for sustainable land and ecosystem management in four micro-catchments; and development of capacities for adaptive management, learning and replication of project lessons.

Source: UNDP-GEF Project (http://www.mpforest.org/pdf/UNDP-GEF.pdf)

By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

Various sources of pollution, both point and non-point sources, pose threats to biodiversity in India. Major threats are from improper disposal of municipal solid wastes, improper/inadequate sewerage disposal, excessive use of chemical pesticides and hazardous chemicals.

The CPCB established in 1974 by MoEF has been playing a key role in abatement and control of pollution in the country by generating, compiling and collating data, providing scientific information, rendering technical inputs for formation of national policies and programmes, training and development of manpower and through activities for promoting awareness.

CPCB is executing a nation-wide programme of ambient air quality monitoring known as NAMP (see Part I, section 1.2.3). CPCB has identified a list of polluted cities in which the prescribed National Ambient Air Quality Standards (NAAQS) have been violated. These cities have been identified based on ambient air quality data obtained (2008-2010) under NAMP. Action plans are being formulated and implemented to control air pollution in non-attainment cities by the respective States.

The urban areas of the country are facing problems of deterioration of environmental and socio-economic conditions. The major concerns are unplanned and haphazard development, poor sanitary and living conditions, urbanisation and associated problems, including slums, poor/inadequate infrastructure and pollution problems. There are several causes for urban degradation, such as population migration and environmental considerations not being incorporated adequately into plans. Pilot studies were conducted for urban areas by the Centre for Spatial Environmental Planning created at the CPCB under the World Bank funded Environmental Management Capacity Building Project and supported by the GTZ-CPCB Project under the Indo-German Bilateral Programme. The Ecocity programme has been conceptualized for improving the environment and achieving sustainable development through a comprehensive urban improvement system employing practical, innovative and non-conventional solutions.

Water quality is being monitored through the Water Quality Monitoring network at rivers, lakes, ponds, tanks and

groundwater locations (see Part I, Section 1.2.3). Biological monitoring to determine cumulative impact of pollution using benthic macro-invertebrates has been carried out for entire stretch of River Yamuna and tributaries.

Noise has been notified as a pollutant under the Air (Prevention and Control of Pollution) Act, 1981. CPCB is making efforts towards implementation of Noise (Regulation and Control) Rules, 2000 and establishment of Noise Monitoring Network.

The Department of Agriculture and Cooperation, MoA, is running a central sector scheme, Monitoring of Pesticide Residues at National Level for food commodities and environmental samples since 2005-2006. Various laboratories representing MoA, ICAR, MoFHW, MoEF, CSIR, MoCF, Ministry of Commerce and State agricultural universities across the country participate in the scheme. The main objectives of the scheme include identifying crops and regions having high levels of pesticide residues in order to focus extension efforts for Integrated Pest Management (IPM) and Good Agriculture Pesticides (GAP) and testing pesticide residues and other contaminants in food commodities and environmental samples such as soil and water. The MoA encourages a judicious use of chemical fertilizers in conjunction with nutrients, bio-fertilizers, etc. from organic sources based on deficiencies of nutrients in soils.

By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

Among the major threats faced by native plant and animal species (and their habitats), the one posed by the Invasive Alien Species, is considered second only to habitat loss. Invasive Alien Species are species whose introduction and/or spread outside their natural habitats threaten biological diversity. While only a small percentage of organisms transported to new environment become invasive, their negative impacts on food security, plant, animal and human health, and economic development can be extensive and substantial. Identification, monitoring and management of all Invasive Alien Species in India is a major challenge as in other parts of the world. Addressing the problem of Invasive Alien Species is urgent because the threat is increasing due to global trade, transport, and tourism with several social, economic and environmental impacts.

India has an estimated 18,000 plants, 30 mammals, 4 birds, 300 freshwater fishes and 1100 arthropods that are invasive (Ali & Pelkey 2013). Moreover, species that are native to one part of the country may be invasive in another, such as Spotted deer (*Axis axis*), Common myna (*Acridotheres tristis*), and House crow (*Corvus splendens*) in the Andaman Islands (Ali & Pelkey 2013). Eighteen species of alien animals and plants have been documented along the Indian coasts which may have been introduced through ballast water and may be potentially invasive (Anil et. al., 2002). Further work is needed on marine invasive species as this is a growing concern for tropical nations including India (Namboothri et. al., 2012).

Many fresh water and marine algae including species of *Kappaphycus, Microcystis, Caulerpa, Cladophora*, etc. causing extensive damage to the ecosystems and affecting aquatic biodiversity adversely in India have been identified. The invasive *Carijoa riisei* is found in Andaman and Nicobar Islands, Gulf of Mannar and Gulf of Kachchh. A recent report on the occurrence of the Spider crab *Acanthonyx euryseroche*, a seaweed associate along the Central West Coast of India suggests that the epidemic outburst of such population might be dangerous to native marine biodiversity in India.

Of the eight worst invasive fish species in the world, five species are present in India. For example, Mosquito fish (*Gambusia affinis*) was introduced in India as a biological control. Brown trout (*Salmo trutto*) and Rainbow trout (*Oncorhynchus mykiss*) were introduced in streams and rivers of Himalayas for recreational as well as consumption purposes. These three highly predatory fishes eat the eggs of economically desirable fish and prey on an endanger rare indigenous fish and invertebrate species. Common carp (*Cyprinus carpio*) and Mozambique tilapia (*Oreochromis mossambucus*), were introduced in Indian aquaculture but later these species spread into large parts of India and are now competing with native species in for food and habitat. African cat fish *Clarias gariepinus* has been identified as a highly invasive fish in the Indian freshwater ecosystem and is posing a threat to native fish as well as other aquatic animals.

Some of the alien plant species invasive in India are *Lantana camara, Prosopis juliflora, Parthenium hysterophorus, Argemone mexicana, Eupatorium adenophorum, Eupatorium odoratum, Mimosa spp., Ageratum conyzoides, Mikania micrantha, Ageratum spp., Galinsoga parviflora, Chromolaena odorata, Cytisus scoparius, Cuscuta sp*. Several aquatic invasive alien plant species such as *Eichornia crassipes, Salvinia molesta, Ipomoea carnea, Microcystis, Caulerpa, Cladophora* etc. have become a nuisance for aquatic ecosystems. For control of invasive species, the Forest Departments of various States along with NGOs and communities have been managing the spread of invasive species through their utilisation in the making of furniture and artefacts (e.g. lantana furniture) along with other methods of control.

Distribution of plant invasive species was surveyed by WII in 17 States across India. Data was collected by NTCA, WII, under 'All India Tiger Monitoring Project' and published in the report 'Status of tigers, co-predators and their prey in India'. Data analysis revealed that there were 15 invasive species in the States that were surveyed. This study mapped the probability of occurrence of these 15 species, out of which maps for four representative species are shown in Figure 3.1.

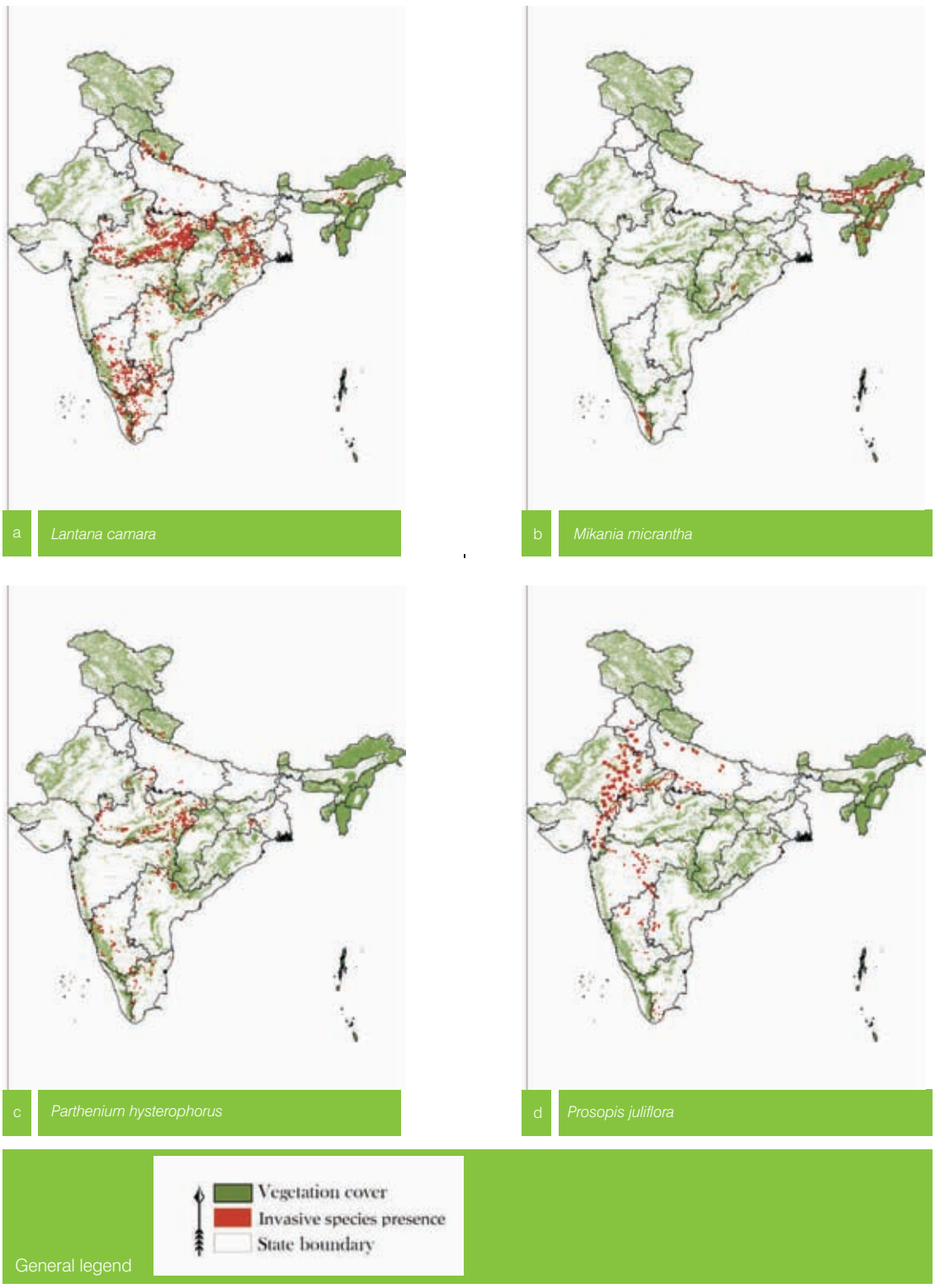


Figure 3.1
Distribution of plant invasive species

Source: Mungi (2013)

Although so far there is no exclusive legislation or policy in India to deal with the invasive alien species and their eradication, the NBAP 2008 in its objectives has enumerated ways for the regulation of introduction of invasive alien species and their management. India has established 'Forest Invasive Species Cell' in the Indian Council of Forest Research and Education, Dehradun. The major objectives of this cell are to establish database on forest invasive species in India, networking and capacity building towards management of invasive species and development of better technology to eradicate invasive species.

Plant Quarantine Order 2003 under Destructive Insects and Pests Act, 1914 has been issued by Directorate of Plant

Protection, Quarantine and Storage to prevent introduction of alien insects, fungal or other pest species (http://ppqs.gov.in/).

Ministry of Shipping has identified NIO as a lead Research and Development agency for helping address ballast water management issues including port biological baseline survey, ballast water risk assessment and identification of ballast water discharge sites under 'Global Ballast Water Management Programme' and 'GoI'. NIO is preparing a comprehensive ballast water management plan for major ports during 2010-2016 (http://www.nio.org).

The 12th Five Year Plan (2012-2017) has emphasised the need for a national invasive species monitoring system to track the introduction and spread of invasive species and advised that such a system should be linked to the State Forest Departments, and field staff should be trained to collect information on invasive species.

By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

India's second national communication to the United Nation Framework Convention on Climate Change (UNFCCC), submitted in 2012 has emphasised the need to generate resources for conducting research and long-term observational studies on the effects of climate change on marine ecosystems, vulnerability assessment, coastal zone management, sustainable habitat development, with support from international and intergovernmental organizations.

The NAPCC released in 2008, prioritizes recycling, wastewater utilization, energy efficiency and solar initiatives. The 12th Five Year Plan (2012-2017) aims to integrate low carbon growth in the current climate change initiatives so that by 2020 emissions can be reduced by 25-35% relative to 2005 levels (Planning Commission 2011).

The ICZMP has been initiated by the MoEF in 2010 in the States of Gujarat, Odisha and West Bengal for mapping, delineation and demarcation of ecologically sensitive areas along the mainland coast of India, conservation of coastal and marine resources, pollution management and improving livelihood opportunities for coastal communities. The significant achievements are completion of aerial photography of 70,000 km^2 of the coastal zone; plantation of over 9000 ha of mangrove; offering protection to more than 100,000 sea turtles, of which more than 10,000 hatched and were released to the sea; first successful regeneration of corals on the mainland coast; and conversion of 20 villages into 'solar villages' (http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/SAR/2013/05/24/090224b081be924f/1_0/Rendered/PDF/India000Integr0Report000Sequence006.pdf). A report has been prepared on the status of all the beaches in Gujarat. Other reports that have been prepared for the State are related to evaluation of sea turtle nesting sites, seaweed diversity, seawater monitoring and assessment of carbon sequestration by mangroves. In Odisha, an ecosystem health report card has been prepared. The benthic flora, fauna and avifauna of Chilika lagoon have been assessed. A coastal process study has been carried out along 480 km of the coastline. Assessment of the Sundarbans mangroves and genetic sequencing of over 40,000 microbes have been carried out in West Bengal (http://sicommoef.in).

The National Centre for Sustainable Coastal Management has been established under the ICZMP to assess, using satellite imagery, the changes that have taken place in the shoreline of the Indian coast from 1972 to 2010 (http://ncscm.org/).

The MoEF introduced in 2011 a new notification under the Environment (Protection) Act, 1986, declaring all the coastal stretches as CRZ and imposing restrictions on certain human activities. Vulnerable ecosystems such as mangroves, coral reefs, sand dunes and seagrass beds have been accorded the highest protection in CRZ Category I under this notification. It also includes Critically Vulnerable Coastal Areas such as the Sundarbans, which are to be managed with the involvement of coastal communities. Similarly, the islands of the Andamans and the Nicobars were brought under the Island Protection Zone to regulate developmental activities in CRZ areas and for preparation of the Coastal Zone Management Plan.

The Coral Bleaching Alert System developed by Indian National Centre for Ocean Information Services (INCOIS), MoES, helps monitor and predict coral bleaching events in the Andaman, Nicobar and Lakshadweep Islands, the Gulf of Kachchh, the Gulf of Mannar, and Malvan. Bi-weekly alerts are being generated using remote sensing data for each of these sites to watch effectively over any concurrent coral bleaching event (Figure 3.2; http://incois.gov.in).

Deepak Apte

Figure 3.2
Soft Coral *Loophyton* spp.

Box 3.4

Mangroves for the Future (MFF-India)

- Initiated in five focal States including Gujarat, West Bengal, Andhra Pradesh and Odisha.
- The National Strategy and Action Plan drafted to promote conservation and management of coastal and marine biodiversity, coastal restoration, and coastal livelihoods and integrated coastal zone management.
- USD328,511 allocated for 21 small projects spread across the country, linking Governmental, Non-Governmental and private sector stakeholders.
- A national workshop conducted on the current status of coral reefs in India. The mangrove forests mapped and over 50,000 mangrove seedlings transplanted in southern Gujarat.
- Sustainable mangrove fishery farming system developed in Cuddalore, Tamil Nadu.
- Alternative livelihood generation opportunities in Sundarban mangroves evaluated.
- Shelter beds along western Indian coastline documented in Mithapur, Gujarat.

A. D. Baruah

Figure 3.3
Fishing in a creek in Muthupet

3.1.3. Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

India is one of the select nations that have applied modern biogeographic knowledge and concepts to the planning of rational conservation strategies. Conservation planning has been taken up in India on the basis of the Biogeographic Classification of India (Rodgers et.al., 2002) to ensure the representation of regions with different biogeography and facilitate rational conservation planning at the national and intra-state levels. India's major strength *in situ* conservation lies in the impressive network of representative and scientifically managed PAs. As of 26 March January 2014, there are 690 PAs covering 166,851 km^2 or 5.07% of the country's geographical area. This is a significant increase of 1.72% and a net increase of 56,694 km^2 since 1988, when there were 54 National Parks covering 21,003 km^2 and 373 Sanctuaries covering 88,649 km^2, giving a combined coverage of 109,652 km^2 or 3.34% of the country's geographical area. So far, 18 MPAs have been identified in peninsular India, and more than 100 MPAs have been designated in the islands (see Section 1.2.2). Other important conservation approaches include CCAs, sacred groves, natural world heritage sites, biodiversity heritage sites, Biosphere Reserves, KBAs, AZE sites, Ramsar sites, IBAs, IPAs, MPCAs and ESAs (see Section 1.2.2). Further sites are being identified across the country under these programmes.

Species-specific projects (Project Tiger, Project Elephant and Project Snow Leopard, for example) are under implementation across the PAs as well as in areas outside the PA network. A national programme has been launched for the recovery of 16 species under the IDWH scheme (see Part I, Section 1.3.2 and Part III, Section 3.1.3, Aichi Biodiversity Target 12) to strengthen wildlife conservation outside the legally designated PA network.

In addition to India's PA network coverage of 5.06% of the country's geographical area, the managed forests under the State and UT Forest Departments are also contributing towards biodiversity conservation. Thus India has over 20% of the total geographical area under effective biodiversity conservation, thereby exceeding the 17% figure envisaged in Aichi Target 11.

Under India's Action Plan for CBD's Programme of Work on Protected Areas (PoWPA), actions have been identified for development of site-specific management plans, securing identified corridors and connectivity areas for the integration of PAs, participatory wildlife monitoring for strengthening management and conducting targeted studies on PA valuation assessment as well as on climate change resilience and adaptation assessment in selected PAs.

India has institutionalized the process of conducting Management Effectiveness Evaluation (MEE) of PAs. A total of 125 National Parks and Wildlife Sanctuaries have been evaluated so far under the MEE process. Keeping a focus on tiger conservation, India initiated Project Tiger in 1973. Twenty eight of the tiger reserves established under the Project Tiger were subjected to independent MEE in 2005-2006. These reserves were taken up for repeat independent MEE in 2010-2011 along with 11 new tiger reserves (39 in all; Mathur et. al., 2011). In 2013-2014, a total of 44 tiger reserves are being taken up for independent MEE with a repeat of the evaluation process for the 39 tiger reserves evaluated in previous years. This evaluation has been a step forward in achieving the goal 'to expand and institutionalize management effectiveness assessments to work towards assessing 60% of the total area of PA by 2015'.

Considering the global significance of establishing Transboundary Protected Areas (TBPAs), India has initiated a process of identifying and prioritizing TBPAs. Twenty one PAs were identified as occurring along or adjacent to the Indian border in mountains, forests, deserts and coastal regions. Sufficient data for evaluation were collected for 12 of these 21 sites. In order to further cooperation for TBPA management, India has adopted a pragmatic approach that encompasses obtaining high-level policy agreements among Governments through Memorandum of Understanding (MoUs) and by initiating a 'bottom-up' approach for enhancing cooperation at the ground level by organizing periodic meetings at the park level, especially with Nepal and Bhutan. The initial steps for regional cooperation through TBPAs have been taken, and efforts are under way to further enhance coordination and cooperation at the park level for strengthening conservation for a range of landscape-dependent species such as the elephant and tiger (Mathur 2010).

The Indian subcontinent serves as the main terminus for the Central Asian Flyway (CAF) for birds breeding from across the northernmost regions of Russia (Siberia) as far west as Europe through west and central Asia to China. A 'flyway' is the total area used by (groups of) populations or species of birds, throughout their annual cycle, including the breeding areas, migration stop-over and non-breeding (wintering) sites. Many of these sites tend to be highly productive and are thus also of importance to non-migratory birds and other biodiversity as well as to human livelihoods and well-being. The flyway

covers at least 279 migratory waterbird populations of 182 species, including 29 globally threatened and near-threatened species such as the Critically Endangered Sociable lapwing (*Vanellus gregarious*), Endangered White-bellied heron (*Ardea insignis*), and Critically Endangered Siberian crane (*Grus leucogeranus*). Migratory birds are popular symbols and indicators of the state of the region's environment and are vulnerable in India and along their flyways due to serious threats to wetlands and inter-tidal habitats, grasslands and other habitats upon which they depend. Because of these vulnerabilities, national efforts are being complemented with programmes of international cooperation along the flyways to conserve these shared resources and common heritage. The CAF Action Plan (including the CMS West/Central Asian Flyway Site Network to which India has nominated the Keoladeo Ghana National Park) strongly supports national efforts towards meeting Aichi Biodiversity Targets 11 and 12 (www.wetlands.org).

The Indian Army and Indo-Tibetan Border Police have played an important role in preparing a road map to protect the Black-necked crane and its habitat in the high altitude wetlands in Ladakh, which are the only known breeding grounds for Black-necked crane (*Grus nigricollis*) in India. Joint initiatives taken up by WWF-India and the Department of Wildlife Protection, Government of Jammu & Kashmir and the armed forces have led to a remarkable recovery from 38 birds in 1998 to 139 in 2012. Besides various education and awareness programmes have also been taken up to sensitize the armed forces about various threats being faced by this species in Ladakh.

By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

India has taken significant steps to reduce/minimize the decline in population of key threatened species and enhance their conservation status. Species recovery plans for 16 terrestrial and 7 marine species (Dugong, four species of Sea turtle, Irrawaddy dolphin and Whale shark) are being prepared. Some of these are at various stages of implementation with the active support of an array of scientific institutions, civil society organisations and scientists. The conservation measures taken for some rare, endangered and threatened species are described below. Recovery plan for species viz. Edible-nest swiftlet, Nilgiri tahr, Malabar civet, Swamp deer and Jerdon's courser are under preparation.

Gir National Park (GNP) and Gir Wildlife Sanctuary (GWS) are the only abode of the Asiatic lion in the world. The last surviving population of Asiatic lions occupies a dry deciduous forest and open grassy scrublands in the south-western part of the Saurashtra region, in the State of Gujarat. The conservation initiatives taken so far have arrested the declining trend of this population (Figure 1.21a). As per the 2010 census, the total population of lions was 411. Considering various threats faced by the lions, the Gujarat State Lion Conservation Society was formed. A management plan for GNP and GWS is being implemented for the long term survival of the Asiatic lion.

The Manipur brow-antlered deer, popularly known as the 'sangai' is a unique animal found only in Manipur and nowhere else in the world. The sangai population dwindled rapidly at the beginning of 20th century under heavy hunting pressure and continuous habitat destruction. The current population of sangai according to the March 2013, Census is 204. The overall population trend indicates that the populations of sangai is stable (Figure 1.21b). The recovery plan for the sangai (2009) focuses on (i) strengthening the population in the Keibul Lamjao National Park, which includes preserving and restoring the habitat and reducing mortalities and (ii) advocating the establishment of a second population within Manipur.

The Kashmir stag, or hangul, is one of the most critically endangered species found in the temperate grasslands of the western Himalaya. Dachigam National Park, in Jammu and Kashmir, represents one grassland habitat that supports the hangul. This highly threatened deer is the only subspecies of the Red deer (*Cervus elaphus*) found in India. The formulation of species recovery programme for hangul was initiated with the preparation of the Long Term Conservation Plan for Hangul in 2009, which is under implementation. The size of the hangul population was 218 in 2011 (Figure 1.21c).

The Greater one-horned rhinoceros (*Rhinoceros unicornis*) is listed as Vulnerable in the IUCN Red List of Threatened Species. Poaching, habitat degradation, and natural calamities (recurrent floods) are the main threats to the rhino population. The Indian Rhinoceros Recovery Plan and Indian Rhino Vision (IRV) 2020 have been prepared in response to these threats and are being implemented actively. IRV 2020 is a partnership between with the Assam Forest Department, the Bodoland Territorial Council, the WWF, the International Rhino Foundation, and the US Fish and Wildlife Service. The goal of IRV 2020 is to attain a wild population of at least 3,000 Greater one-horned rhinos spread over seven protected areas in the Indian State of Assam by 2020. Currently the population of Indian rhinoceroses in the wild has is 2329 animals (Figure 1.21d).

The Bustards (including floricans) are an extremely endangered group of birds that are dependent on grassland ecosystems. There are four species of bustards in India: Great Indian Bustard (GIB), the Lesser florican, the Bengal florican and the Houbara bustard. The population of the GIB has been declining and the bustards have disappeared from about 90% of their range. The present population of the GIB (according to the 2011 census) is made up of 209 individuals in six States in India (Figure 1.21e). Currently, the Bengal florican is found only in Uttar Pradesh (70-80), Assam (180-220) and Arunachal Pradesh (40-50). Looking at the current trend in the bustard population, the MoEF, has formulated the

Resident Bustards Recovery Programme-2013. The document advocates a holistic conservation approach that integrates research and monitoring; protection and management; local livelihood concerns; conservation awareness; and the possibility of a conservation breeding programme.

The Nicobar megapode, *Megapodius nicobariensis*, a mound nesting megapode, is endemic to the Nicobar group of islands, in the Bay of Bengal, separated from its nearest congener by a distance of over 1500 km. It is included in Schedule I of the Wildlife (Protection) Act, 1972 and is considered as globally 'Vulnerable' (IUCN 2012). Around 70% of the population of Nicobar megapode had disappeared over the last 12 years, the major reason being a sharp decline because of the tsunami of December 2004. A survey of the status, ecology and conservation of the Nicobar megapode was jointly carried out by the WII and the Andaman and Nicobar Forest Department in 2007. On the basis of this survey, it was estimated that about 800 breeding pairs of the Nicobar megapode occur in the Nicobar Islands, 70% less than what was reported a decade before (Figure 1.21f). The population of the Nicobar megapode during 1991-2006 was estimated to be 405. A recovery plan has been prepared for the species, and its habitat along the west coast of Great Nicobar Island is being restored.

Millions of vultures used to occur across the Indian subcontinent due to the large numbers of livestock reared in this region and adequate availability of carcasses. However, sharp declines were reported in populations of species of Gyps vultures since the mid-1980s in all regions across northern India through extensive surveys conducted by the BNHS. Responding to the urgent need for action to prevent extinction of vultures, MoEF prepared a "Vulture Action Plan" in 2006 to take steps needed urgently for conservation of vulture species. Vultures have been successfully bred in captivity at the Captive Breeding Centres in the country. By 2011, a network of Provisional Vulture Safe Zones was also established. Efforts of the GoI, State Governments, BNHS and other Government/Non-Government organizations in cooperation with international organizations such as The Royal Society for the Protection of Birds (RSPB) to save vultures from extinction are showing positive results (http://www.bnhs.org/vultureprogramme/html; http://www.save-vultures.org/).

The Giant clams, largest living bivalves, are distributed in tropical reefs in the Indo-Pacific faunal region. Five species of Giant clam (*Hippopus hippopus, Tridacna maxima, Tridacna squamosa, T. crocea and T. gigas*) are found in Indian waters. The first three of these species are protected under Schedule I of the Wildlife (Protection) Act, 1972. The BNHS conducted long-term studies on Giant clams in the Lakshadweep archipelago from 2005 to 2011 investigating their population structure, recruitment, growth rates, habitat use and existing threat levels (Figure 1.21h). Based on the results of the study, a comprehensive action plan was formulated to conserve the Giant clam population in the Lakshadweep and Andaman & Nicobar islands for the years 2010-2020.

The Gangetic river dolphin (*Platanista gangetica gangetica*) occurs in the Ganges-Brahmaputra river system, primarily in India and Bangladesh. It is listed as Endangered by the IUCN due to a probable population decline of at least 50% over the last 50 years and projected future population declines. No quantitative estimates of abundance are available for the Ganges river dolphin although an overall estimate about 2000 individuals has been made. Due to its highly threatened status, the action plan of the IUCN/SSC Cetacean Specialist Group draws calls attention to the need for range-wide population assessments in support of conservation efforts. Recent surveys have provided a best estimate of 264 dolphins in the entire Brahmaputra river system, with 212 in the Brahmaputra river and 52 in two tributaries. The occurrence of dolphins is not uniform throughout the river system they are distributed as individuals and in groups of 2-12, in 82 locations. The Gangetic dolphin has recently been declared as the National Aquatic Animal of India.

The Snow leopard is perhaps the most endangered of the large cats, with an estimated population of only 400-700 individuals in five Himalayan States in India. India, as one of the 13 range countries of the Snow leopard, supports the Global Snow Leopard Ecosystem Conservation Programme, an initiative of the Government of the Kyrgyz Republic, funded by the World Bank along with other partners such as Snow Leopard Network, Snow Leopard Trust, Natural And Biodiversity Union (NABU), CITES, CMS, U.S. Agency for International Development (USAID), UNDP, International Business Council, Asian Development Bank (ADB), UNDP, WWF etc. The MoEF has also prepared the National Snow Leopard Ecosystem Conservation Programme, which is aligned with the Global Snow Leopard Ecosystem Conservation Programme for conservation of the entire high-altitude range of the snow leopard.

The wild buffaloes (*Bubalus arnee*) were once widely distributed over the tracts of tall grasslands and riverine forests in India and Nepal. Today, wild buffaloes in India are found in only two States and that too in a few scattered wildlife protected areas, namely Kaziranga and Manas National Parks in Assam and Indravati National Park, and Udanti, Sitanadi, Bhairamgarh and Pamed Sanctuaries in Chattisgarh. With less than 4000 individuals estimated to be remaining globally in the wild, the species is also classified as Endangered in the IUCN Red List of Threatened Species. The wild buffalo population in Kaziranga Tiger Reserve has increased considerably due to active protection and the adoption of appropriate conservation strategies. The Forest Department of Chhattisgarh, with the help of the WTI, has prepared a five year action plan for the recovery of the wild buffalo population in Udanti Wildlife Sanctuary.

The species recovery plans are playing a significant role in enhancing the conservation status of key threatened wild animal species. The Indian Alliance has been formed along the same lines as the Global AZE to network with Government organizations, NGOs and other stakeholders to conserve irreplaceable Critically Endangered and Endangered species. The CBD has formed a group Friends of Aichi Biodiversity Target 12, of which Zoo Outreach is the partner in India.

AICOPTAX was launched in 1999, for filling the existing gaps in taxonomic knowledge base, and building capacity in taxonomy it provides the basic knowledge underpinning efforts to conserve biological diversity, optimize the use of

biological resources in a sustainable way, thereby enhances the quality of life. BSI and ZSI and specialist groups drawn from Universities, have taken up taxonomic work on animal viruses, bacteria and archaea, algae, fungi, lichen, bryophytes, pteridophytes, gymnosperms, palms, grasses, bamboo, orchids, helminthes and nematodes, microlepidoptera and mollusc.

In addition to the above mentioned efforts focusing on species recovery, some other measures being taken for conservation of threatened species of plants and animals include: (i) Listing of threatened species of plants and animals under various schedules of the Wildlife (Protection) Act; (ii) Notification States-wise of threatened species of plants and animals which are on the verge of extinction; (iii) Under Section 38 of the Biological Diversity Act, guidelines to prohibit and regulate their collection and rehabilitate and preserve the species; and (iv) strengthening of botanic gardens aimed at *inter alia* conservation of threatened and endemic plant species.

By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Plant and animal genetic diversity is vulnerable to 'genetic erosion', the loss of individual alleles/genes and of combinations of alleles/genes, such as those found in locally adapted landraces. According to the Food and Agriculture Organization (FAO), replacement of local varieties by modern varieties resulting in reduction of the sheer number of cultivars is the main cause of genetic erosion. This is intensified by the emergence of new pests, weeds and diseases, environmental degradation, urbanization and land clearing. An individual genotype with seemingly not useful set of characters today may become important tomorrow due to changing climatic conditions or outbreaks of disease. Therefore, it has been long realized that India conserves all the diversity she has.

The national bureaus of plant and animal genetic resources are working towards *ex situ* conservation of genetically indigenous breeds of agriculturally important plants and domesticated animals, respectively. They also have vast holdings/accessions of agriculturally important plants and animals and their wild relatives (see Part I, Section 1.1.8).

Under the NPA, the ICAR initiated a World Bank-aided National Agricultural Innovation Project in 2010. The NAIP gives top priority to generation and transfer of agricultural technologies and suggest innovations in the technology system (http://www.naip.icar.org.in/index.html).

The National Project for Cattle and Buffalo Breeding (NPCBB) has focused on development and conservation of indigenous breeds. The cattle and buffalo genetic resources of India are represented by 34 indigenous breeds of cattle. During Phase I of the project, an amount of ₹ 58 crores was released exclusively for development and conservation of indigenous breeds. Phase II of the NPCBB envisages the development of indigenous breeds, for which ₹ 477.30 crores has been earmarked (http://www.dahd.nic.in/dahd/schemes/animal-husbandary/f-no-48-72009-ts-sheep/national-projectfor-cattle-buffalo-breeding.aspx).

The BSI currently has 11 botanic gardens in different bio-geographic regions of the country, for promoting *ex situ* conservation of plant genetic resources. These gardens are collectively maintaining about 73,000 plants belonging to over 5,000 species. The Botanic Garden of Indian Republic, once fully developed, will have over 30% of country's indigenous flora in different thematic sections of the garden and well-planned conservatories.

To further augment the *ex situ* conservation programme in the country, the MoEF launched 'Assistance to Botanic Garden' scheme in 1991-92 to promote *ex situ* conservation and propagation of threatened and endemic plants through a network of botanic gardens and centers of *ex situ* conservation. Financial assistance has so far been provided for 295 projects, which have helped in *ex situ* conservation of more than 400 endemic and threatened plant species in the country.

Box 3.5

Community-based seed bank for *in situ* agro-biodiversity conservation

Primary target  Secondary targets 

Community seed banks (CSBs) have been set up with the objective of conserving, promoting and reviving lost agro-biodiversity through on-farm seed conservation with the help of farmers, thus providing seed security to village communities. Among the many organizations facilitating the development of CSBs are the Green Foundation, M.S. Swaminathan Research Foundation, the Keystone Foundation, the Centre for Indian Knowledge Systems, Satvik and the Deccan Development Society (http://www.nbaindia.org/).

Source: NBA 2013

Conservation of indigenous livestock

Figure 3.4 (a,b,c)

(a)

Conservation of Beetal goat

The Beetal goat was the first wild herbivore to be domesticated and could have triggered livestock domestication in the region. The Beetal goat plays a critical role in the livelihoods of the locals owing to its large size, high fecundity and being a good milker. Surveys conducted by the NBAGR showed a declining trend in its population. To reverse the declining trend of the Beetal population, an *in situ* project was initiated in 2005. Between 2008 and 2010, a total of 5478 elite Beetal kids were added to the dwindling population of the breed, with goat rearing being adopted by many landless goat farmers, which improved their socio-economic status (http://www.nbagr.res.in/succstorey.html).

(b)

Conservation of Deccani sheep

Anthra, a civil society organization in India, mobilized local communities to conserve the local Deccani sheep, a native of the Deccan Plateau. This native breed plays a critical role in the livelihoods of the tribal community. The breed is ideally suited to the extreme temperatures of the region and is adapted for long-distance migration. It is valued for its wool, meat and manure. The breed is closely intertwined with culture and with religious festivals. Challenges such as enhancing grazing grounds and improving the availability of water were addressed in partnership with the village panchayats. The health care system was improved by capacity building among community members (http://www.wassan.org/apdai/apdai_7.htm).

(c)

Revival of Krishna Valley Cattle

The Krishna Valley breed of cattle, a dual purpose breed found in the State of Karnataka in India is reported to be endangered. Surveys conducted in its native habitat indicated that the number of cattle is less than 500 in the breeding tract. At this juncture, the NBAGR, along with BAIF Development Research Foundation, initiated a project to conserve the breed. From late 2007 till September 2011, a total of 4485 artificial inseminations were performed, with an overall conception rate of 53% in the field. So far 939 calves have been born. With this concerted effort, the number of Krishna Valley Cattle in its native tract is more than 2500 (http://www.icar.org.in/node/4150).

Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services

3.1.4.

By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

In order to harmonize the development efforts with conservation of environment and ecology, initiatives have been taken towards adapting measures for minimizing adverse impacts of developmental activities as well restoration of degraded areas.

National River Conservation Programme (NRCP) under the MoEF, is engaged in creating the required waste management systems related to all urban water bodies. The NRCP works towards reducing the pollution load flowing into rivers through a scheme of interception and diversion of sewage, sewage treatment, low-cost sanitation, riverfront development and afforestation through public participation.

Compensatory Afforestation Fund Management and Planning Authority (CAMPA) launched by the Supreme Court on 10 July 2009 on the premise that it will be the national advisory council, under the chairmanship of the Union Minister of Environment & Forests, for monitoring, providing technical assistance and evaluating compensatory afforestation activities. CAMPA is meant to promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses. State-level CAMPAs have been created for providing an integrated framework for utilization of multiple sources of funding and for promoting afforestation, reforestation and regeneration activities. As of November 2006, the amount lying with the Ad-hoc CAMPA was ₹ 1,200.31 crores. This had increased to ₹ 9,932.13 crores as of 30 June 2009, and further to ₹ 23,608 crores on 31st March 2012.

The National Rural Livelihoods Mission was established by the GoI to implement the new strategy of poverty alleviation woven around community-based institutions. The mission's primary objective is to reduce poverty by promoting diversified and gainful self-employment and wage employment opportunities for increase in incomes sustainably. The mission works in conjunction with the MGNREGS of the MoRD and primarily focuses on creating self-employment and wage/job employment opportunities for the rural poor so that they can cross the threshold of poverty and become productive agents. The potential power of the NRLM lies in the economies of scale created by Self Help Group (SHG) federations comprising 150-200 SHGs each. They can also provide larger loans for housing and health facilities to their members by tying up with large service providers or loan providers for health, livestock and weather insurance (http://rural.nic.in/sites/downloads/latest/NRLM%20Procurement%20Manual.pdf).

The Bharat Rural Livelihoods Foundation (BRLF) fosters and facilitates civil society action in partnership with the Government for transforming the livelihoods and lives of people in areas such as the Central Indian adivasi belt. Initial BRLF support is provided to civil society partners as 'trigger funding', that is, to develop proposals that reflect this partnership with State Governments/Panchayati Raj Institutions (PRIs)/banks. BRLF assists its civil society partners in ensuring that the design of their proposals incorporates a collaborative mode of functioning with Governments/PRIs/banks. The aim is to support grassroots-level action towards empowerment of people, particularly the Adivasis, and scaling up approaches that are innovative in terms of both programme content and strategy. Innovation can be in many directions-technology, social mobilisational approaches, local institution building, architecture of partnerships, management techniques and so on.

The Integrated Wastelands Development Programme which was launched in 2009-2010 is aimed to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water. The outcomes are prevention of soil runoff, regeneration of natural vegetation, rainwater harvesting and recharging of groundwater. This enables multi-cropping and the introduction of diverse agro-based activities, which help provide sustainable livelihoods to the people residing in the watershed.

For conservation of lakes and wetlands, the MoEF was implementing two separate Centrally Sponsored Schemes, namely the NWCP and the NLCP. To avoid overlap, promote better synergies and to ensure conservation and management works, an integrated scheme, NPCAE is proposed, with the objective of conserving aquatic ecosystems (lakes and wetlands), through implementation of sustainable conservation plans and governed with application of uniform policy and guidelines. The Cabinet Committee on Economic Affairs approved the proposal for the merger of NLCP and NWCP into a new scheme called the NPCAE. The merged scheme has an estimated cost of ₹ 900 crore on 70:30 cost sharing between the Central Government and respective State Governments (90:10 for North-east States).

The National Mission for Sustaining Himalayan Ecosystem (NMSHE) under NAPCC was launched in February 2014, with a budget outlay of ₹550 crore during the 12th Five Year Plan period (2012-2017). The primary objective of the mission is to develop in a time bound manner a sustainable national capacity to continuously assess the health status of the Himalayan

Ecosystem and enable policy bodies in their policy-formulation functions as also to assist States in the Indian Himalayan Region with implementation of actions selected for sustainable development. The NMSHE will attempt to address a variety of important issues like, Himalayan glaciers and associated hydrological consequences, assist in restoration and rehabilitation process of Uttarakhand Himalayas and overall biodiversity conservation and protection. The marginalized and vulnerable communities of the Himalayan region will be the major beneficiaries of the Mission.

The National Rainfed Area Authority was set up in 2006 by the MoA to provide coordination within and among agricultural and wasteland development programmes being implemented in rainfed areas of the country. It also helps develop plans/programmes for capacity building and for Centre/State Government functionaries in rainfed areas and helps establish institutional linkages with prioritized watersheds to strengthen national and state-level institutions.

MGNREGS works largely focus on land and water resources, which include water harvesting and conservation, soil conservation and protection, irrigation provisioning and improvement, renovation of traditional water bodies, land development and drought-proofing, afforestation, horticulture development and pastureland development. MGNREGS are positively impacting the forest conservation through directly giving sufficient purchasing power and diverting local poor population from forest based livelihood like fuel wood cutting and selling and other unsustainable use of forest produce and through engaging local poor on their lands and secondly through soil and moisture conservation works and plantations. It also tackles issues of poverty alleviation and development by creating alternate opportunities.

The CEPF with a portfolio of more than 100 CEPF grants totalling more than USD 6 million has catalyzed innovative partnerships involving NGOs, corporate sector, academia, local Government and other civil society partners with the ATREE as regional implementer to help safeguard biodiversity hotspots particularly in the Western Ghats and Eastern Himalaya (www.cepf.net). Synergies have been established between the management of production landscapes and natural ecosystems, and promoting connectivity and building value chains for biodiversity-friendly commodities.

By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

The major process of land degradation is soil erosion (due to water and wind erosion), which contributes to over 71% of the land degradation in the country. Soil erosion due to water alone contributes to about 61.7% and that by wind erosion to 10.24%. The other processes include problems of water logging and salinity/alkalinity. According to the Desertification and Land Degradation Atlas of India, about 32.07% of the land is undergoing various forms of degradation, and 25% of the geographical area is affected by desertification. About 228 mha (69%) of India's total geographical area (about 328 mha) is dry land (arid, semi-arid and dry sub-humid), and degradation of this land has severe implications for the livelihood and food security of millions (http://envfor.nic.in/division/introduction-5). In order to tackle the issues of desertification, land degradation and droughts, 22 major programmes are being implemented in the country, including the Green India Mission, one of the missions under the NAPCC, which will address dryland forests, in addition to other ecosystems, which will help increase the quality and extent of forest cover in 10 mha of land. Due to various remedial activities, India's forest cover is increasing by 0.8 mha every year and is helping to neutralize more than 21.17% of India's GHG emissions.

REDD+ is the global endeavour to create an incentive for developing countries to protect, better manage and save their forest resources, thus contributing to the global fight against climate change. REDD+ goes beyond merely checking deforestation and forest degradation, and includes incentives for positive elements of conservation, sustainable management of forests and enhancement of forest carbon stocks. REDD+ mechanism has opened the possibilities for pro-conservation approach and sustainable management of forests resulting in even further increase of forest cover and thereby its forest carbon stocks. (http://moef.nic.in/downloads/public-information/REDD-report.pdf)

The Eco Task Force (ETF), a unit of the Territorial Army raised under the aegis of MoEF and Ministry of Defence in collaboration with the States in 1982, has done yeoman's service in controlling ecological degradation through plantation and soil conservation works. ETF battalions also work towards creating environment awareness amongst people living around the project areas and school children across the country.

The eight national missions, which form the core of the NAPCC represent multi-pronged long-term and integrated strategies for achieving key goals in the context of climate change. These are the (1) Solar Energy Mission, (2) National Mission for Enhanced Energy Efficiency, (3) National Mission on Sustainable Habitat, (4) National Water Mission, (5) National Mission for Sustaining the Himalayan Ecosystem, (6) Green India Mission (7) National Mission for Sustainable Agriculture and (8) National Mission on Strategic Knowledge for Climate Change. The MoEF has requested each State Government to prepare a State Action Plan on Climate Change (SAPCC). So far, 18 States have prepared and submitted draft SAPCC documents to the MoEF.

Box 3.6

Khasi Hills community REDD+ initiative, Meghalaya, India

Primary target  Secondary targets 

The Khasi tribal community of the Umiam watershed, East Khasi Hills district of Meghalaya, initiated a REDD+ project. Under this project, 10 indigenous Governments of 62 villages are restoring and protecting 27,000 ha of forest, connecting sacred forests and regenerating forest fragments at the landscape level. The Khasi Hills are experiencing extremely rapid deforestation and degradation due to social, economic and market forces. Satellite imagery from 2006-2010 revealed an annual forest loss of 4%. According to project estimates this REDD+ activity would yield approximately 318,000 tonnes of CO_2 over the first 10 years of the project plus additional benefits including biodiversity and conservation of unique montane cloud forest ecosystems as well as 500 year old sacred groves. Carbon revenues will be used to fund project activities that enhance the hydrology of the watershed, improving the water storage capacity and dry season flows. Of the total carbon credits projected, approximately 69% will be from avoided deforestation and forest degradation, while an additional 31% will be generated through sequestration as degraded forests are restored through assisted natural regeneration.

Table 3.2 An estimate of the amount of CO2 offsets to be generated over 10 years

Type of REDD+ activity	2012-2013 (CO_2)	2014-2015 (CO_2)	2016-2017 (CO_2)	2018-2019 (CO_2)	2020-2021(CO_2)	2012-21(CO_2)
Emissions-reduction from denser forests	40.13	42.31	44.13	45.66	46.99	219.22
ANR annual benefit	6114	14,266	65,677	71,878	77,868	318,246
Total	46,245	56,578	65,677	71,878	77,868	318,246

Figure 3.5 (a,b)
Khasi Hills community REDD+ initiative, Meghalaya, India: Restoration of degraded forests

Source: http://www.cseindia.org/userfiles/watershed_redd.pdf

The Indian Network for Climate Change Assessment (INCCA), established by MoEF in October 2009, is a network based programme to make science, particularly the three 'M's (measuring, modelling and monitoring) the essence of India's policy making in the climate change space. It brings together over 120 institutions and over 220 scientists from across the country. The INCCA has been devised to ascertain climate change impacts in 2030. The Indian Meteorological Department has initiated implementation of Climate Related Environmental Monitoring, a multi-agency project for monitoring GHGs and aerosols on a long-term basis. Black Carbon Research Initiative of the National Carbonaceous Aerosols Programme, devised under the aegis of the INCCA, was launched during 2009 in order to build understanding of the issue of 'Black Carbon' (BC) and its relationship with climate change (http://moef.nic.in/downloads/publicinformation/Black%20Carbon%20Research%20Initiative.pdf). In 2010, the INCCA established a network-based scientific programme for monitoring key aerosol parameters by establishing long-term monitoring stations across the country. These stations are maintained by Indian Space Research Organisation's (ISRO) Aerosol Radioactive Forcing over India programme. The programme is designed to assess the various aspects of climate changes in India.

By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

Having played a leading role in the negotiations for Nagoya Protocol on ABS, and as the President of CoP-11 to the CBD, India has been working with the CBD Secretariat and other Parties to expedite ratifications of this important international agreement, with a view to ensure its early entry into force. It is expected that requisite number of ratifications would be received for the Nagoya Protocol to be operational and have its first meeting of the Parties in October 2014. Aichi Biodiversity Target 16 could thus become the first Aichi Biodiversity Target to be achieved.

India signed the Nagoya Protocol on 11th May 2011, and ratified it on 9th October 2012. India already has a domestic legislation on ABS, the Biological Diversity Act 2002. Nagoya Protocol would be implemented by India through this Act.

3.1.5. Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building

By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

In pursuance to Article 6 of the CBD, India within five years of ratifying the Convention, had developed a National Policy and Macrolevel Action Strategy on Biodiversity in 1999. Thereafter, an externally-aided project on NBSAP was also implemented in the country during 2000-2004, adopting a highly participatory process involving various stakeholders. Meanwhile, India also enacted the Biological Diversity Act in 2002, Section 36 which empowers the Central Government to develop NBAP. After enactment of the 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 draws upon the main principle in the NEP that human beings are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature. The NBAP which has been developed in consultation with various stakeholders, attempts to identify threats and constraints in biodiversity conservation. It is the principal instrument for implementing the Convention at the national level.

The Strategic Plan on Biodiversity 2011-2020 the Aichi Biodiversity Target were adopted by the CoP to the CBD in 2010 at Nagoya, Japan, which provides broad-based actions in support of biodiversity over the next decade by all countries and stakeholders. India has formulated 12 National Biodiversity Targets in line with the Strategic Plan for Biodiversity and the 20 Aichi Biodiversity Targets. Indicators to monitor trends in process of implementation have also been developed. An NBAP implementation plan has been developed (Figure 1). It is anticipated that India's NBAP (see Part II), updated through identification of National Biodiversity Targets would be implemented in a participatory and effective manner.

By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

India is rich in traditional knowledge associated with biological resources. This traditional knowledge is both coded, as in the texts of Indian systems of medicine such as Ayurveda, Unani and Siddha; and non-coded, which exists in the oral undocumented traditions. There is a separate Department in the Government, AYUSH that deals with developing and propagating officially recognized ancient and holistic systems namely, Ayurveda, Yoga, Naturopathy, Siddha, Unani and

Homeopathy which have been making significant contributions towards the health care of the people. As on date, 6560 species of Indian medicinal plants have been recorded across these codified systems as well as folk traditions of health practices across 4635 ethnic communities of the country.

Issues relating to protection of traditional knowledge though quite complex are of particular interest to India. Several attempts have been made for protection of traditional knowledge in the country. Some of the efforts to record traditional use of biological resources are given below:

'The Wealth of India' series, one of the exhaustive scientific pursuits prepared by the CSIR, is an encyclopedia series on India's raw material resources of plants, animals and minerals. It consists of eleven volumes and two supplements.

The All India Coordinated Research Project on Ethnobiology of the MoEF launched in 1982 has unearthed a large spectrum of uses that tribal populations of the country make of plants and animals. The project has recorded use of over 10,000 wild plants known to tribals for varied purposes from across the country.

BSI and ZSI, responsible agencies for the survey and inventorization of flora and fauna of the country, have covered about 70% of the territory of India by field survey and published over the years, documents on flora and fauna at national, State and, in some cases, district level and for selected ecosystems. The surveys have also published Red Data Books on endangered species.

BMCs have been setup under Biological Diversity Act for conservation, sustainable use and documentation of biodiversity and chronicling traditional knowledge. This is also in line with constitutional amendment number 73 of 1993 that enshrines democratic decentralization of responsibilities, wherein local bodies consisting of elected representatives, one third of whom are women, are entrusted with the responsibility of safeguarding local environmental capacity stocks. So far 32,210 BMCs have been constituted by local bodies in 23 States (nbaindia.org).

The Biological Diversity Act mandates preparation of PBRs by the BMCs involving local people with guidance from SBBs and NBA, for documenting traditional knowledge relating to biodiversity. Though, the preparation of PBRs across the country is an enormous task, the programme is being implanted in a phased manner. A total of 1901 PBRs have been registered in 14 States (Fig. 3.6).

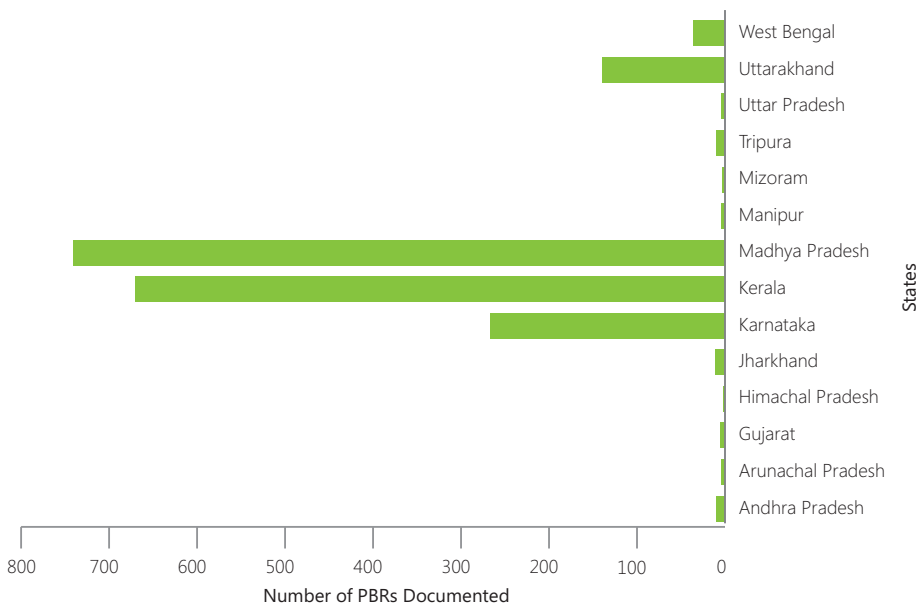


Figure 3.6
Number of PBRs documented

Source: NBA 2014

The Patent Act, 1970, provides for mandatory disclosure of source and geographical origin of biological material in the specifications when used for an invention. Non-disclosure or wrongful disclosure of the source of biological material and any associated knowledge results in refusal to the grant of patent or revocation of the patent.

The Protection of Plant Varieties and Farmers Right's (PPV&FR) Act provides for 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 Act recognizes the necessity of protecting the rights of farmers in respect of their contribution made in conserving, improving and making available plant genetic resources for the development of new plant varieties.

The Traditional Knowledge Digital Library (TKDL) database is a value added digital database developed by the GoI for (i) preservation of traditional knowledge; (ii) prevention of misappropriation of traditional knowledge by breaking the language and format barriers of traditional knowledge systems, and providing access of these knowledge systems to patent

examiner (s) in five international languages i.e., English, German, French, Spanish and Japanese, for establishing the prior art; and (iii) creation of linkages with modern science to initiate active research projects for new drug discovery and development, based on the time tested traditional knowledge systems leading to more affordable health care for the poor.

The TKDL database has been created to prevent misappropriation of traditional knowledge at international patent offices so that cases of bio-piracy can be prevented. India has already signed TKDL Access Agreement with (i) European Patent Office (February 2009), (ii) United State Patent & Trademark Office (November 2009), (iii) Canadian Intellectual Property Office (September 2010), (iv) German Patent Office (October 2009), (v) United Kingdom Patent & Trademark Office (February 2010) and (vi) Intellectual Property, Australia (January 2011). Meanwhile, negotiations are under way to conclude the Access Agreement with the Intellectual Property Office of New Zealand. TKDL references as prior art have led to significant strides towards achieving the goal of preventing misappropriation of Indian traditional knowledge. This includes cancellation of grant of two patents, withdrawal of 75 patent application, amendments/modifications of claims in 32 applications, and rejection/cancellation of two applications.

National Innovation Foundation (NIF) an autonomous society established under the DST in 2000, for recognizing, respecting and rewarding innovations and outstanding traditional knowledge at grass roots. SRISTI, an NGO involved in this work through its Honey Bee network scouts for documenting local innovations and linking these with scientific experts, investors and entrepreneurs. NIF has scouted over 1,00,000 innovations from 545 districts, of which more than 85% are on biodiversity.

To promote traditional practices and value systems in conservation of biodiversity rich area, the MoEF, assisted by other organizations, is helping in maintenance of a large number of sacred groves across the country. Indira Gandhi Rashtriya Manav Sagrahalaya (IGRMS), Bhopal, launched an initiative relating to sacred groves in 1999, in which *in situ* and *ex situ* conservation of sacred groves in different parts of the country is undertaken. Replicas of 80 different types of sacred groves have been established on the IGRMS campus. Applied Environmental Research Foundation is involved in restoration of sacred groves in the northern Western Ghats, and it has prioritized 20 sacred groves in urgent need of conservation and restoration. CPREEC, an ENVIS centre on Conservation of Ecological Heritage and Sacred Sites of India, works towards restoration and conservation of sacred groves across the country (Table 3.3). CPREEC has successfully restored 52 sacred groves in the States of Tamil Nadu, Andhra Pradesh and Karnataka (http://cpreec.org/eco_news_oct_dec10.pdf).

Table 3.3
Distribution of Sacred Groves in India

Sl.No	State	Number of documented Sacred groves
1	Andhra Pradesh	580
2	Arunachal Pradesh	101
3	Goa	55
4	Jharkhand	29
5	Karnataka	1531
6	Kerala	303
7	Maharashtra	2820
8	Manipur	166
9	Meghalaya	101
10	Orissa	322
11	Puducherry	108
12	Rajasthan	560
13	Tamil Nadu	1265
14	Uttarakhand	22
15	West Bengal	39
16	Gujarat	22

Source: http://www.cpreecenvis.nic.in/

The Department of AYUSH, Ministry of Health and Family Welfare, has been making efforts to promote and propagate Indian systems of medicine to facilitate international promotion, development and recognition of AYUSH systems of medicine. Through AYUSH, the NMPB provides support to 39 projects involved with cultivation of medicinal plants, to 86 projects relating to storage godowns and JFMCs for conservation of medicinal plants on 26,158 hectares of land and to setting up 3123 school/home herbal gardens. One of the new initiatives of AYUSH for the 12th Five Year Plan includes the NMPB. The scheme is primarily aimed at supporting market-driven medicinal plant cultivation on private lands. The scheme has helped set up 636 nurseries of medicinal plants bring 51,308 hectares of land under medicinal plant cultivation. It has provided support to 25 post-harvest infrastructure units.

FRLHT Bangalore, is the Center of Excellence for 'Medicinal Plants and Traditional Knowledge (www.envis.frlht.org, www.iaim.edu.in), recognised by the MoEF. FRHLT has undertaken significant activities that contribute towards National Biodiversity Target 11 and Aichi Biodiversity Target 18. For example, it has developed the raw drug repository, which specializes in collection of plant raw drugs used in Indian systems of medicine. It has also developed the ethno medicinal garden, which houses different medicinal plants used in the traditional systems of medicine. These are planted in different assemblages, each representing a definite theme or usage group. One of FRLHT's activities is aimed at distribution mapping using Geographical Information System and identification issues of traded medicinal plants. The Geographical Distribution Atlas incorporates geographical distribution maps for 1670 species (2243 botanical names) and Eco-distribution maps for 180 prioritized species. The MPCAs in India, is a unique and pioneering programme for conservation of wild medicinal plants, was initiated in 1993. This involved the establishment of a network of MPCAs focused on conservation of prioritized wild medicinal plants occurring in different regions of the country. So far, a total of 108 such MPCAs have been established across 12 States.

By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

Activities for improving financial, human, scientific, technical, and technological capacity to implement the Convention on Biological Diversity are being undertaken through various policies, plans and programmes. Multidisciplinary, holistic and integrated institutional mechanisms are in place to address mainstreaming of biodiversity concerns at various levels of governance. These include relevant Departments in the States such as forest, agriculture, horticulture, irrigation, science and technology, and various specialized national and State level institutions, that deal with biodiversity issues. The GoI attached high priority to the promotion of research and development in multidisciplinary aspects of environment protection and biodiversity conservation. The MoEF, MoST, MoA, MoHRD, MoH&FW, are the key Ministries of the GoI that promote research on the biodiversity issues in the country.

India has established a large number of research and training institutions in the field of biodiversity which have comprehensive programmes and activities relating to conservation of biodiversity. These institutions include the following:

Government organizations:

ZSI, BSI, FSI, IIFM, FRI, ICFRE, WII, G.B. Pant Institute of Himalayan Environment and Development, Centre for Ecological Sciences (CES), IISc, ICAR, CSIR, NBRI, NIO, CIMAP, NEERI, ISRO, NRSC, Indian Council for Social Science Research (ICSSR) etc.

Non Governmental Organizations:

BNHS, WWF, WTI, Wildlife Protection Society of India (WPSI), Centre for Wildlife Studies, (CWS), ATREE, International Society of Naturalists (INSONA), The Energy Research Institute (TERI), Centre for Science and Environment (CSE), MSSRF, Environment Protection Training and Research Institute (EPTRI), etc.

In addition, the MoEF has set up nine Centres of Excellences with a view to strengthening awareness, research and training in priority areas of environmental science and management. These are: CEE, Ahmedabad; CPREEC, Chennai; CES, Bangalore; CME, Dhanbad; SACON, Coimbatore; CEMDE, Delhi; TBGRI, Thiruvananthapuram; MSE, Chennai; FRLHT, Bengaluru.

A large number of scientific institutions and civil society organizations are also currently engaged in monitoring various physical, biological and ecological parameters to understand the vital linkages of these parameters with ecosystem structure and functioning, and conservation of biological diversity.

The ability of a nation to use and create knowledge capital determines its capacity to empower and enable its citizens by increasing human capabilities. In the next few decades, India will have the largest set of young people in the world. Following a knowledge-oriented paradigm of development would enable India to leverage this demographic advantage. With this broad task in mind, the National Knowledge Commission (NKC) was constituted in 2005 as a high-level advisory body to the Prime Minister of India. The NKC has been given a mandate to guide policy and direct reforms, focusing on certain key areas such as education, science and technology, agriculture, industry, e-governance etc. Easy access to knowledge, creation and preservation of knowledge systems, dissemination of knowledge and better knowledge services are core concerns of the commission.

By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

India was amongst the first few countries which had undertaken an assessment of funding for biodiversity conservation. In a study by MoEF, funding for core (direct and immediate biodiversity impact), net non-core (indirect), and net peripheral funding flows (from biodiversity relevant 29 schemes of seven Ministries/Departments other than MoEF), along with core funding by the State Governments, was assessed for the year 2010-2011 (MoEF 2012). The concept of net non-core and net peripheral flows was worked out on the basis of the multiplicative factor.

Building on this study and using similar methodology, but by considerably expanding the dataset, an assessment of funding for biodiversity conservation in India for the year 2013-2014 has been undertaken as part of updating India's NBAP and preparation of NR5 (see Part II). The core funding for biodiversity (under the MoEF's biodiversity-related programmes) is ₹ 15,643.4 million (₹ 1564.34 crores); the net leveragable non-core funding (on MoEF's other schemes) is ₹ 2598 million (₹ 259.8 crores). This amounts to a total of core and non-core funding by MoEF of ₹ 18,241.4 million (₹ 1824.14 crores) for the year 2013-2014. Adding the outlay for States of ₹ 50,255.7 million (₹ 5025.57 crores) takes the combined core and non-core funding by MoEF and States to ₹ 68,497.1 million (₹ 6849.71 crores). Along with the estimated peripheral funding of ₹ 2354.74 crores, the overall funding for biodiversity conservation amounts to ₹ 92044.5 million (₹ 9204.45 crores or USD 1482.68 million) for 2013-2014 from 77 schemes of 23 Ministries/ Departments. This is however a work-in-progress estimate and the overall investment/expenditure in activities relating to biodiversity conservation may change as quality of datasets further improves. It is relevant to state that despite expanded datasets in terms of number of Ministries/ Departments and programmes considered as compared to the previous study undertaken for 2010-2011, the amount arrived at for 2013-2014 is lower. This is attributed to efforts made to reduce subjectivity in using the multiplicative factor by directly consulting the concerned Ministries/Departments for confirming contribution of schemes implemented by them towards biodiversity conservation, as also to the significant difference in Rupee-U.S. Dollar conversion rate in 2014.

It is expected that with an increasing focus and emphasis on integrating biodiversity concerns into other sectors, additional funds would be mobilized for activities that would contribute towards implementation of the SP 2011-2020. The activities envisioned for achievement of the National Biodiversity Targets would be taken up and mainstreamed under the ambit of existing schemes and programmes by the Central and State Governments, public and private sector as well as civil society organisations, securing full utilization of available infrastructure and funds, with augmentation and further inputs, wherever required.

3.2 Millennium Development Goals (MDGs) and Aichi Biodiversity Targets

India is committed to efforts towards achieving the vision of the Strategic Plan for Biodiversity 2011-2020 and the 20 Aichi Biodiversity Targets. As part of updating the NBAP, India has developed its own National Biodiversity Targets in harmony with the Aichi Biodiversity Targets and an implementation mechanism for NBAP linking governance levels from the Centre and State to the local level and thus providing a road map for achieving the Aichi Biodiversity Targets (see Part II).

India's efforts towards achieving the 20 Aichi Biodiversity Targets are also relevant to fulfillment of the MDGs. India is committed to efforts in achieving the MDGs and relevant 12 targets (targets 1 to 11 and 18) for progress in human development and poverty reduction. Delivering on the Aichi Biodiversity Targets will contribute not only to MDG 7 of ensuring environmental sustainability but also both directly and indirectly to the other seven MDGs as depicted in Table 3.4.

Table 3.4
Linkages between Millennium Development Goals and Aichi Biodiversity Targets

	Millennium Development Goals	Aichi Biodiversity Targets
	**Goal 1 - Eradicate Extreme Poverty and Hunger** Targets 1. Halve, between 1990 and 2015, the proportion of people whose income is less than USD1 a day; 2. Halve, between 1990 and 2015, the proportion of people who suffer from hunger.	1 2 4 6 7 10 13 18 19
	**Goal 2 - Achieve Universal Primary Education** Target 3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	1 2 7 14
	**Goal 3 - Promote Gender Equality and Empower Women** Target 4. Eliminate gender disparity in primary and secondary education preferably by 2005 and in all levels of education no later than 2015.	2 7 14 15 18
	**Goal 4 - Reduce Child Mortality** Target 5. Reduce, by two-thirds, between 1990 and 2015, the under-five mortality rate	1 2 13 14 18 19
	**Goal 5 - Improve Maternal Health** Target 6. Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio.	1 2 6 13 18 19
	**Goal 6 - Combat HIV/AIDS, Malaria and other Diseases** Targets 7. Have halted by 2015 and begun to reverse the spread of HIV/AIDS; 8. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases.	5 14 7 15 8 18 9 19 13 20
	**Goal 7 - Ensure Environmental Sustainability** Targets 9. Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources; 10. Halve, by 2015, the proportion of people without sustainable access to safe drinking water; 11. Have achieved, by 2020, a significant improvement in the lives of at least 100 million slum dwellers.	3 10 4 11 5 12 6 14 7 15 8 18 9 19
	**Goal 8 - Develop a Global Partnership for Development** Target 18. In cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies.	16 19 20

Source: Brander et. al. 2014, MoSPI (2013), Unnikrishnan & Suneetha (2012) and Pisupati & Rubian (2008).

Appendix I

References

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Useful Weblinks

Information / Organization	Website address
Alliance for Zero Extinction	www.zeroextinction.org
Applied Environmental Research Foundation	www.aerfindia.org
A-Z Areas of Biodiversity Important	http://www.biodiversitya-z.org/areas/22
Biodiversity Information System- Indian Institute of Remote Sensing	http://bis.iirs.gov.in/
Black Carbon Research Initiative Science Plan-Ministry of Environment and Forests	http://moef.nic.in/downloads/public-information/Black%20Carbon%20Research%20Initiative.pdf
Bombay Natural History Society	www.bnhs.org
Bombay Natural History Society -Conservation Education Centre	www.bnhs.org/conservation-education-centre-programmes
Botanical Survey of India	www.bsi.gov.in
Business House Initiatives	http://natgrp.files.wordpress.com/2013/06/kpmg_rising-sun-2-full.pdf
C.P.R. Environmental Education Centre	www.cpreec.org
C.P.R. Environmental Education Centre-ENVIS	http://www.cpreecenvis.nic.in/
Central Asian Flyway Action Plan-Wetlands International	www.wetlands.org
Central Inland Fisheries Research Institute	http://www.ifsi.in/cifri/cifri.htm
Central Marine Fisheries Research Institute	http://www.cmfri.org.in/
Central Pollution Control Board	http://cpcb.nic.in/
Central Salt & Marine Chemical Research Institute	http://www.csmcri.org/
Centre for Environment Education	www.ceeindia.org
Centre for Marine Living Resources and Ecology	http://cmlre.gov.in/
Centre for Media Studies - Environment	www.cmsindia.org
Centre for Media Studies -Vatavaran	www.cmsvatavaran.org
Centre for Wildlife Studies	www.cwsindia.org
Chilika Development Authority	http://www.chilika.com/coastal_zone_project.htm
Coastal Aquaculture Authority	http://caa.gov.in/
Combating Desertification - Ministry of Environment and Forests	http://envfor.nic.in/division/introduction-5
Community Conservation Areas- Kalpavriksh1	http://www.kalpavriksh.org/images/CCA/Directory/CCADirectory_Overview.pdf
Community Conservation Areas- Kalpavriksh2	http://www.kalpavriksh.org/images/CCA/Miscellaneous/RecogCCAsinIndia_DraftIMoEFcomments_15Jan09.pdf
Conservation International	http://www.conservation.org/where/priority_areas/hotspots/asia-pacific/western-ghats-and-sri-lanka/pages/conservation.aspx
Conservation International-2012	http://www.conservation.org/where/priority_areas/hotspots/asia-pacific/Himalaya/Pages/default.aspx
Conservation International-2013	http://www.conservation.org/hotspots
Conservation of Beetal Goat- National Bureau of Animal Genetic Resourcesh	http://www.nbagr.res.in/succstorey.htm
Costal Aquaculture Authority	http://caa.gov.in/ http://dahd.nic.in/dahd/coastal-aquaculture-authoritycaa.aspx
Council for Scientific and Industrial Research - Central Salt & Marine Chemical Research Institute	http://www.csmcri.org/Pages/Research/Marine_Biotechnology_and_Ecology.php
Council for Scientific and Industrial Research - National Institute of Oceanography	http://www.nio.org/index/option/com_newsdisplay/task/view/tid/4/sid/23/nid/267
Critical Ecosystem Partnership Fund	http://www.cepf.net/Pages/default.aspx
Cycads: Centre for Plant Taxonomy Department of Life Sciences, Delhi	http://ipu.ac.in/usbas/lifescience/PlanttaxonomyCentre.html
Cycads: Jawaharlal Nehru Tropical Botanic Garden and Research Institute	http://www.jntbgri.in
Deccani Sheep Breed Improvement Program	http://www.wassan.org/apdai/apdai_7.htm
Department of Animal Husbandry, Dairying & Fishery-National Fisheries Development Board	http://dahd.nic.in/dahd/division/fisheries/national-fisheries-development-board-nfdb.aspx
Department of Animal Husbandry, Dairying and Fisheries	http://dahd.nic.in/dahd/default.aspx
Directorate of Coldwater Fisheries Research	http://www.dcfr.res.in/index.php
Directorate of Plant Protection, Quarantine and Storage	http://ppqs.gov.in/
Environmental Information System	www.envis.nic.in
Environmental Information System - Central Pollution Control Board	http://cpcbenvis.nic.in/airpollution/finding.htm
Environmental Information System centre on Medical Plants	http://envis.frlht.org/
Fishery Survey of India	http://fsi.gov.in/
Forest Cover: Forest Survey of India	http://www.fsi.org.in/
Fungi and Lichen Diversity in India	http://nfcci.dinpl.com/, http://www.iisc.ernet.in/~currsci/jul102005/58.pdf, http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue16/main_index.htm
G.B. Pant Institute of Himalayan Environment and Development	http://unesdoc.unesco.org/images/0021/002166/216695e.pdf
Green India Mission- Ministry of Environment and Forests	http://moef.nic.in/downloads/public-information/GIM%20presentation%20Feb%2022%202011.pdf
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India's Forests and REDD+	http://moef.nic.in/downloads/public-information/REDD-report.pdf
Indian Council of Agriculture Research	http://www.icar.org.in/node/4150
Indian Council of Agriculture Research	http://www.naip.icar.org.in/index.html
Indian Council of Agriculture Research	http://www.nicra-icar.in/nicrarevised/images/Mission%20Documents/National%20Mission%20For%20Sustainable%20Agriculture-DRAFT-Sept-2010.pdf
Indian Institute of Science	http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue16/main_index.htm
Indian Institute of Science	http://www.iisc.ernet.in/~currsci/jul102005/58.pdf
Indian Meteorological Department	http://www.imd.gov.in
Indian National Centre for Ocean Information Sciences	http://www.incois.gov.in/
Indian Space Research Organisation - Indian Remote Sensing	http://www.isro.org/satellites/satelliteshome.aspx
Integrated Coastal and Marine Area Management	http://www.icmam.gov.in/
Irrawady Dolphin -Chilika Development Authority	http://www.chilika.com/Import%20docum/Annual%20Dolphin%20Census-2013.pdf
Khasi Hills community REDD+ initiative, Meghalaya	http://www.cseindia.org/userfiles/watershed_redd.pdf
Madhya Pradesh Forest Department	http://www.mpforest.org/pdf/UNDP-GEF.pdf
Marine turtles: Sea Turtles of India	www.seaturtlesofindia.org
Medicinal Plant Conservation- FRLHT	http://envis.frlht.org/traded-medicinal-plants-database.php#
Medicinal Plants and Traditional Knowledge	www.iaim.edu.in
MigrantWatch	www.migrantwatch.in
Ministry of Agriculture-1	http://dahd.nic.in/dahd/coastal-aquaculture-authority-caa.aspx
Ministry of Agriculture-2	http://dahd.nic.in/dahd/division/fisheries/national-fisheries-development-board-nfdb.aspx
Ministry of Agriculture-3	http://ncof.dacnet.nic.in/
Ministry of Agriculture-4	http://www.dahd.nic.in/dahd/schemes/animal-husbandary/f-no-48-72009-ts-sheep/national-project-for-cattle-buffalo-breeding.aspx
Ministry of Agriculture-5	http://www.indg.in/agriculture/rural-employment-schemes/national-policy-for-farmers-2007
Ministry of Environment and Forests-1	www.moef.nic.in
Ministry of Environment and Forests-2	http://www.moef.nic.in/downloads/public-information/Wetlands-Rules-2010.pdf
Ministry of Environment and Forests-3	http://www.moef.nic.in/sites/default/files/ProceedingsoftheREDDWorksho18-4-2012.pdf
Ministry of Environment and Forests-3	moef.nic.in/downloads/public-information/GIM-Report-PMCCC.pdf
Myristica swamps; Environmental Information System - Indian Institute of Science	http://wgbis.ces.iisc.ernet.in
National Afforestation and Eco-development Board	http://www.naeb.nic.in/documents/GIM_Brochure_26March.pdf
National Agriculture Policy (NAP) 2007	http://www.indg.in/agriculture/rural-employmentschemes/national-policy-for-farmers-2007
National Bamboo Mission	http://nbm.nic.in/
National Biodiversity Authority	http://www.nbaindia.org/
National Bureau of Agriculturally Important Insects	www.nbaii.res.in
National Bureau of Agriculturally Important Microorganisms	http://www.nbaim.org.in
National Bureau of Animal Genetic Resources	http://www.nbagr.res.in/succstorey.html
National Bureau of Plant Genetic Resources	http://www.nbagr.res.in/
National Centre for Sustainable Coastal Management	http://www.ncscm.org/
National Fisheries Development Board	http://nfdb.ap.nic.in/
National Fungal Culture Collection of India	http://nfcci.dinpl.com/
National Institute of Ocean Technology	http://www.niot.res.in/
National Institute of Oceanography	http://www.nio.org/
National Mission for Sustainable Agriculture	(http://www.nicraicar.in/nicrarevised/images/Mission%20Documents/National%20Mission%20For%20Sustainable%20Agriculture-DRAFTSept-2010.pdf)
National Museum of Natural History	www.nmnh.nic.in
National Policy on Agriculture-National Agricultural Innovation Project	http://www.naip.icar.org.in/index.html
National Project for Cattle and Buffalo Breeding	http://dahd.nic.in/dahd/schemes/animal-husbandary/f-no-48-72009-ts-sheep/national-project-for-cattle-buffalo-breeding.aspx
National Project Management Unit of India- Society for Integrated Coastal Management	http://sicommoef.in
National Project on Organic Farming	www.ncof.dacnet.nic.in
National Project on Promotion of Organic Farming	http://ncof.dacnet.nic.in/
National Rural Livelihoods Mission	http://rural.nic.in/sites/downloads/latest/NRLM%20Procurement%20Manual.pdf
National Tiger Conservation Authority	www.projecttiger.nic.in
National Voluntary Guidelines-2011-2012 of The Ministry of Corporate Affairs	http://www.mca.gov.in/Ministry/latestnews/National_Voluntary_Guidelines_2011_12jul2011.pdf
Orchids- Indian Institute of Science	http://www.ces.iisc.ernet.in/biodiversity/sahyadri_enews/

	newsletter/issue18/article1.htm
Planning Commission Report -2007	http://planningcommission.nic.in/aboutus/committee/wrkgrp11/tf11_Islands.pdf
Ramsar Convention	http://www.ramsar.org/
Reducing emissions from deforestation and forest degradation	http://www.moef.nic.in/sites/default/files/ProceedingsoftheREDDWorksho18-4-2012.pdf
Report of the High Level Working Group on Western Ghats	http://envfor.nic.in/sites/default/files/HLWG-Report-Part-1_0.pdf
Revival of Krishna Valley cattle breed- ICAR	http://www.icar.org.in/node/4150
Sangai census at Keibul Lamjao	http://articles.timesofindia.indiatimes.com/2013-01-08/guwahati/36215686_1_migratory-birds-loktak-resident-birds
Saving Asia's Vulture from Extinction	http://www.save-vultures.org/
Science Express - Biodiversity Special	www.sciencexpress.in
SeasonWatch	www.seasonwatch.in
Sustainable forest management in India	http://www.currentscience.ac.in/Downloads/article_id_094_08_0996_1002_0.pdf
TATA	http://www.tatapower.com/media-corner/presslease/press-release-12-july-2011.aspx
TATA Power	http://www.tatapower.com/media-corner/presslease/press-release-12-july-2011.aspx
The Coral Bleaching Alert System Indian National Centre for Ocean Information Service	http://incois.gov.in
The Ramsar Convention on Wetlands	http://www.ramsar.org/
The World Intellectual Property Organization	www.wipo.int
Traditional Knowledge Digital Library Initiative	www.tkdl.res.in
United Nations Development Programme	www.undp.org
United Nations Development Programme - Global Environment Facility	http://www.mpforest.org/pdf/UNDP-GEF.pdf
United Nations Education Scientific and Cultural Organization	http://whc.unesco.org/
Vigyan Prasar Science Portal	http://www.vigyanprasar.gov.in
Vulture Programme- Bombay Natural History Society	http://www.bnhs.org/vultureprogramme.html
Water Monitoring	http://cpcb.nic.in/water.php
Watershed Support Services and Activities Network	http://www.wassan.org/apdai/apdai_7.htm
Wetlands (Conservation & Management) Rules 2010	http://www.moef.nic.in/downloads/public-information/Wetlands-Rules-2010.pdf
Wildlife Conservation Society	www.wcsindia.org
Wildlife Institute of India	www.wii.gov.in
Wildlife Trust of India	www.wti.org.in
World Heritage List-UNESCO	http://whc.unesco.org/
World- Wide Fund for Nature	www.wwfindia.org
Zoo Outreach-1	www.zooreach.org
Zoo Outreach-2	www.zooreach.org/indianaze/indianaze.html
Zoological Survey of India	http://zsi.gov.in/

Appendix II

Action Points from NBAP 2008

1) *In situ* conservation

- Expand the PA network of the country including conservation and community reserves, to give fair representation to all biogeographic zones of the country. In doing so, develop norms for delineation of PAs in terms of the objectives and principles of the National Environment Policy, in particular, participation of local communities, concerned public agencies, and other stakeholders, who have direct and tangible stake in protection and conservation of wildlife, to harmonize ecological and physical features with needs of socio-economic development.
- Establish self-sustaining monitoring system for overseeing the activities and effectiveness of the PA network.
- Ensure that human activities on the fringe areas of PAs do not degrade the habitat or otherwise significantly disturb wildlife.
- Mitigate man-animal conflicts.
- Promote site-specific eco-development programmes in fringe areas of PAs, to restore livelihoods and access to forest produce by local communities, owing to access restrictions in PAs.
- Promote voluntary relocation of villagers from critical habitats of PAs.
- Devise effective management and conservation techniques for the forest preservation plots to ensure conservation of representative areas of different forest types.
- Strengthen research work on PAs, biosphere reserves and fragile ecosystems by involving local research institutions and universities, so as to develop baseline data on biological and managerial parameters, and functional properties of ecosystems.
- Strengthen the protection of areas of high endemism of genetic resources (biodiversity hotspots), while providing alternative livelihoods and access to resources to local communities who may be affected thereby.
- Continue to promote inter-sectoral consultations and partnerships in strengthening biodiversity conservation activities.
- Strengthen capacities and implement measures for captive breeding and release into the wild of identified endangered species.
- Reintroduction and establishment of viable populations of threatened plant species.
- Control poaching and illegal trade in wild animals and plant species.
- Periodically revisit the norms, criteria and needs of data for placing particular species in different schedules of the Wildlife (Protection) Act.
- Promote ecological and socially sensitive tourism and pilgrimage activities with emphasis on regulated and low impact tourism on a sustainable basis through adoption of best practice norms.
- Formulate and implement partnerships for enhancement of wildlife habitat in conservation reserves and community reserves, on the lines of multi-stakeholder partnerships for afforestation, to derive both environmental and eco-tourism benefits.
- Promote conservation of biodiversity outside the PA network, on private property, on common lands, water bodies and urban areas.
- Formulate and implement programmes for conservation of endangered species outside PAs.
- Ensure conservation of ecologically sensitive areas, which are prone to high risk of loss of biodiversity due to natural or anthropogenic factors.
- Ensure that survey and bioprospecting of native economically important biological resources is undertaken on a priority basis.
- Integrate conservation and wise use of wetlands and river basins involving all stakeholders, in particular local communities, to ensure maintenance of hydrological regimes and conservation of biodiversity.
- Consider particular unique wetlands as entities of incomparable values, in developing strategies for their protection and formulate conservation and prudent use strategies for the identified wetlands with participation of local communities and other stakeholders.
-

On-farm conservation

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

2) *Ex situ* conservation

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

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

- Secure integration of biodiversity concerns into inter-sectoral policies and programmes to identify elements having adverse impact on biodiversity and design policy guidelines to address such issues. Make valuation of biodiversity an integral part of pre-appraisal of projects and programmes to minimize adverse impacts on biodiversity.
- Promote decentralized management of biological resources with emphasis on community participation.
- Promote sustainable use of biodiversity in sectors such as agriculture, animal husbandry, dairy development, fisheries, apiculture, sericulture, forestry and industry.
- Promote conservation, management and sustainable utilization of bamboos and canes, and establish bambusetum and canetum for maintaining species diversity and elite germplasm lines.
- Promote best practices based on traditional sustainable uses of biodiversity and devise mechanisms for providing benefits to local communities.
- Build and regularly update a database on NTFPs, monitor and rationalize use of NTFPs ensuring their sustainable availability to local communities.
- Promote sustainable use of biological resources by supporting studies on traditional utilization of natural resources in selected areas to identify incentives and disincentives, and promote best practices.
- Encourage cultivation of medicinal plants and culture of marine organisms exploited for drugs to prevent their unsustainable extraction from the wild.
- Promote capacity building at grassroot level for participatory decision-making to ensure ecofriendly and sustainable use of natural resources.
- Develop sui generis system for protection of traditional knowledge and related rights including intellectual property rights.
- Encourage adoption of science-based, and traditional sustainable land use practices, through research and development, extension of knowledge, pilot scale demonstrations, and large scale dissemination including farmer's training, and where necessary, access to institutional finance.
- Promote reclamation of wasteland and degraded forest land through formulation and adoption of multistakeholder partnerships involving the land owning agency, local communities, and investors.
- Promote sustainable alternatives to shifting cultivation where it is no longer ecologically viable, ensuring that the culture and social fabric of the local people are not disrupted.
- Encourage agro-forestry, organic farming, environmentally sustainable cropping patterns, and adoption of efficient irrigation techniques.
- Incorporate a special component in afforestation programmes for afforestation on the banks and catchments of rivers and reservoirs to prevent soil erosion and improve green cover.
- Integrate wetland conservation, including conservation of village ponds and tanks, into sectoral development plans for poverty alleviation and livelihood improvement, and link efforts for conservation and sustainable use of wetlands with the ongoing rural infrastructure development and employment generation programmes.
- Promote traditional techniques and practices for conserving village ponds.
- Mainstream the sustainable management of mangroves into the forestry sector regulatory regime so as to ensure the protection of coastal belts and conservation of flora and fauna in those areas.

- Disseminate available techniques for regeneration of coral reefs and support activities based on application of such techniques.
- Adopt a comprehensive approach to integrated coastal management by addressing linkages between coastal areas, wetlands, and river systems, in relevant policies, regulations and programmes.

4) Regulation of introduction of invasive alien species and their management

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

5) Assessment of vulnerability and adaptation to climate change, and desertification

- Identify the key sectors of the country vulnerable to climate change, in particular impacts on water resources, agriculture, health, coastal areas and forests.
- Promote research to develop methodologies for tracking changes and assessing impacts of climate change on glaciers, river flows and biodiversity.
- Assess the need for adaptation to future impacts of climate change at national and local levels, and the scope for incorporating the outputs of such assessments in relevant programmes, including watershed management, coastal zone planning and regulation, agricultural technologies and practices, forestry management, and health programmes.
- Explicitly consider vulnerability of coastal areas and their biodiversity to climate change and sealevel rise in coastal management plans, as well as infrastructure planning and construction norms.
- Participate in voluntary partnerships with other countries both developed and developing, to address the challenges of sustainable development and climate change, consistent with the provisions of the UNFCCC.
- Identify the most important gaps in knowledge that limit the national ability to develop and implement climate change adaptation strategies for species, and ecological processes and functions.
- Enhance the capacity of climate modeling in the country substantially to get clear idea on the impacts of climate change on biodiversity at national and local levels.
- Develop ecological criteria for identifying the species and ecosystems that are at great risk from climate change and identify their priority habitats.
- Identify information requirements and priorities, through expert consultative processes, for longterm monitoring of climate change impacts on biodiversity.
- Establish a climate change and biodiversity website for decision makers concerned with national resource management to facilitate information exchange about the actual and potential impacts of climate change and relevant policies, strategies and programmes.
- In view of the multidisciplinary nature of the subject, undertake an 'All India Coordinated Research Project on Impacts of Climate Change' on various facets of wild and agricultural biodiversity.
- Integrate biodiversity concerns into measures for energy conservation and adoption of renewable energy technologies with a focus on local biomass resources and dissemination of improved fuelwood stoves, and solar cookers.
- Strengthen efforts for partial substitution of fossil fuels by bio-fuels, through promotion of biofuel plantations, promoting relevant research and development, and streamlining regulatory certification of new technologies.
- Strengthen and augment the existing programmes and activities of the Central and State Governments relating to drylands.
- Prepare and implement thematic action plans incorporating watershed management strategies, for arresting and reversing desertification and expanding green cover.
- Promote reclamation of wastelands by energy plantations for rural energy through multistakeholder partnerships involving the landowning agencies, local communities, and investors.

6) Integration of biodiversity concerns in economic and social development

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

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

7) Pollution impacts

- Minimise and eliminate activities leading to loss of biodiversity due to point and non-point sources of pollution and promote development of clean technologies.
- Strengthen the monitoring and enforcement of emission standards for both point and non-point sources.
- Develop location-specific work plans focusing on biodiversity conservation while managing pollution problems.
- Treat and manage industrial effluents so as to minimize adverse impacts on terrestrial and aquatic biological resources.
- Promote biodegradable and recyclable substitutes for non-biodegradable materials, and develop and implement strategies for their recycle, reuse, and final environmentally benign disposal, including through promotion of relevant technologies, and use of incentive based instruments.
- Avoid excessive use of fertilizers, pesticides and insecticides while encouraging integrated pest management practices, and use of organic manures and biofertilisers.
- Promote organic farming of locally adapted and traditional crop varieties through appropriate incentives, and direct access to markets duly supported by credible certification systems.
- Develop a strategy for strengthening regulation, and addressing impacts, of ship-breaking activities on human health, coastal and near marine bioresources.
- Accord priority to potential impacts on designated natural heritage sites in view of their incomparable values that merit stricter standards than in otherwise comparable situations.
- Promote R&D on impacts of air, water and soil pollution on biodiversity and use of biological methods for pollution amelioration.

8) Development and integration of biodiversity databases

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

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

- Accelerate effective actions at the central, state and local levels to implement provisions under the Biological Diversity Act.
- Review enabling policies to prevent transfer of prime agricultural land to non-agricultural purposes, and promote sustainability of agricultural lands.
- Formulate suggestive policies for strengthening and supporting conservation and management of grasslands, pastoral lands, sacred groves and other areas significant for biodiversity conservation.
- Support preparation of PBRs with technical help by the scientific institutions.
- Strengthen systems for documentation, application and protection of biodiversityassociated traditional knowledge, providing adequate protection to these knowledge systems while encouraging benefits to communities.
- Revive and revitalize sustainable traditional practices and other folk uses of components of biodiversity and associated benefits to local communities with a view to promoting and strengthening traditional knowledge and practices.
- Create public education and awareness about the need to conserve, protect and gainfully use traditional knowledge systems.
- Identify emerging areas for new legislation, based on better scientific understanding, economic and social development, and development of multilateral environmental regimes, in line with the NEP.
- Review the body of existing legislations relevant to biodiversity conservation to develop synergies among relevant statutes and regulations, eliminate obsolescence, and amalgamate provisions with similar objectives, in line with the NEP. Further, encourage and facilitate review of legislations at the level of state and local governments with a view to ensuring their consistency with this policy.
- Review the regulatory processes for LMOs so that all relevant scientific knowledge is taken into account, and ecological, health, and economic concerns are adequately addressed.
- Periodically review and update the national biosafety guidelines to ensure that these are based on current scientific knowledge.
- Ensure conservation of biodiversity and human health while dealing with LMOs in transboundary movement in a manner consistent with the multilateral biosafety protocol.
- Develop appropriate liability and redress mechanisms to internalize environment costs and address economic concerns in case of any damage to biodiversity.
- Harmonise provisions concerning disclosure of source of biological material and associated knowledge used in the inventions under the Patents Act, Protection of Plant Varieties and Farmers' Rights Act, and Biological Diversity Act, to ensure sharing of benefits by the communities holding traditional knowledge, from such use.
- Develop supportive regulatory regime for protection of identified wetlands and biosphere reserves.
- Develop appropriate system and modalities for operationalizing provisions for prior informed consent and benefit sharing under the Biological Diversity Act, working towards greater congruence between these provisions and trade related aspects of intellectual property rights.

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

- Develop consortium of lead institutions engaged in conservation providing linkages and networking across public and private sectors.
- Outsource research and promote joint ventures on key conservation issues.
- Promote application of biotechnology tools for conserving endangered species.
- Encourage DNA profiling for assessment of genetic diversity in endangered species to assist conservation.

- Develop DNA-probe based technology for tracking of LMOs.
- Develop specific pilot gene banks for LMOs approved for undertaking research and commercial use.
- Develop capacity for risk assessment, management and communication on LMOs.
- Support pilot studies on use of biotechnology tools for conservation where appropriate.
- Develop specific complimentary capacity building measures based on national needs and priorities for the formulation and implementation of national rules and procedures on liability and redress to strengthen the establishment of baseline information and monitoring of changes.
- Develop protocols for monitoring products based on genetic use restriction technologies.
- Strengthen participatory appraisal techniques and encourage formation of local institutional structures for planning and management of natural resources for ensuring participation of women.
- Preserve and strengthen traditional, religious, ritualistic, ethical and cultural methods of conservation.
- Promote livelihood diversification opportunities for making value added bioresource based products and building upon traditional as well as emerging environmental technologies customized at local/field level.
- Strengthen manpower, infrastructure and other pertinent capacities including upgradation of skills of officials of the MoEF to enable it to address new and emerging requirements in the field of biodiversity conservation and management.
- Strengthen capabilities of BSI and ZSI and promote their technical cooperation with SBBs and BMCs.
- Augment human resource development and personnel management in forestry and wildlife sector.
- Strengthen multidisciplinary R&D efforts on key areas pertaining to conservation and management of biological diversity.
- Strengthen and support departments of biology, botany, zoology, sociology, anthropology and other relevant disciplines in central, state and deemed universities/ colleges, with a view to raising the standard of research and producing faculty who could guide the process of environmental education in schools.
- Promote both formal and non-formal means for environment education and biodiversity conservation.
- Design and implement awareness programmes, particularly for rural women, and also benefit from their wisdom. Women's organizations such as women's councils and mahila mandals could be used for this purpose.
- Incorporate modules on conservation and sustainable utilization of biodiversity in foundational and professional training courses for the officers of various services.
- Promote and/or strengthen education, training, awareness and extension programmes on biodiversity issues for various stakeholders including all levels of students, professionals (such as engineers, doctors, lawyers, CAs, etc.), elected representatives (such as representatives of PRIs, MLAs, MPs, Mayors, etc.), judiciary, NGOs, public and private sectors (e.g. corporate representatives, industrial associations etc.), defence and para military forces, customs, police, media, cultural, spiritual and religious institutions/ individuals.
- Enhance public education and awareness for biodiversity conservation through audio, visual and print media.
- Promote activities relating to animal welfare.

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

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

12) International cooperation

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

Appendix III

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Appendix IV

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Signature of officer responsible for submitting national report	
Date of submission	31/03/2014

Appendix V

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8 Malvika Onial
9 Mohammed Zahir
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11 Satyaranjan
12 Deepak Apte
13 Nagarajan
14 Deepak Apte
15 Rakesh K. Dogra
16 Kaushik Baneerjee
17 Sangeeta Angom
18 Kamlesh Kumar
19 Mohammed Zahir
20 B.S. Adhikari
21 N.S. Bisht
22 Deepak Apte
23 Subharanjan Sen
24 K. Sivakumar
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29 Arun P. Singh
30 Govind S. Bharadwaj
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62 K. Ramesh
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65 Shilpa Gautam
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67 S. Suresh
68 Abhijeet Das
69 Nagarajan
70 Subharanjan Sen
71 Komal Singh
72 S. Suresh
73 Deepak Apte
74 Govind S. Bharadwaj
75 Pradeep Vyas
76 Bivash Pandav
77 Udayan Borthakur
78 Abhijit Das
79 C. Ramesh
80 S. Suresh
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Appendix VI

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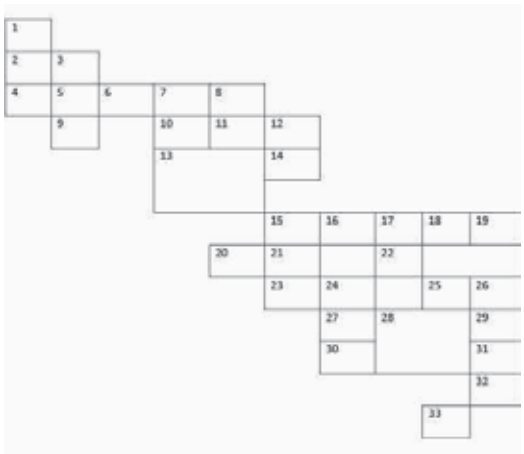

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3 Govind S. Bharadwaj
4 Bivash Pandav
5 Govind S. Bharadwaj
6 Vaneet Jishtu
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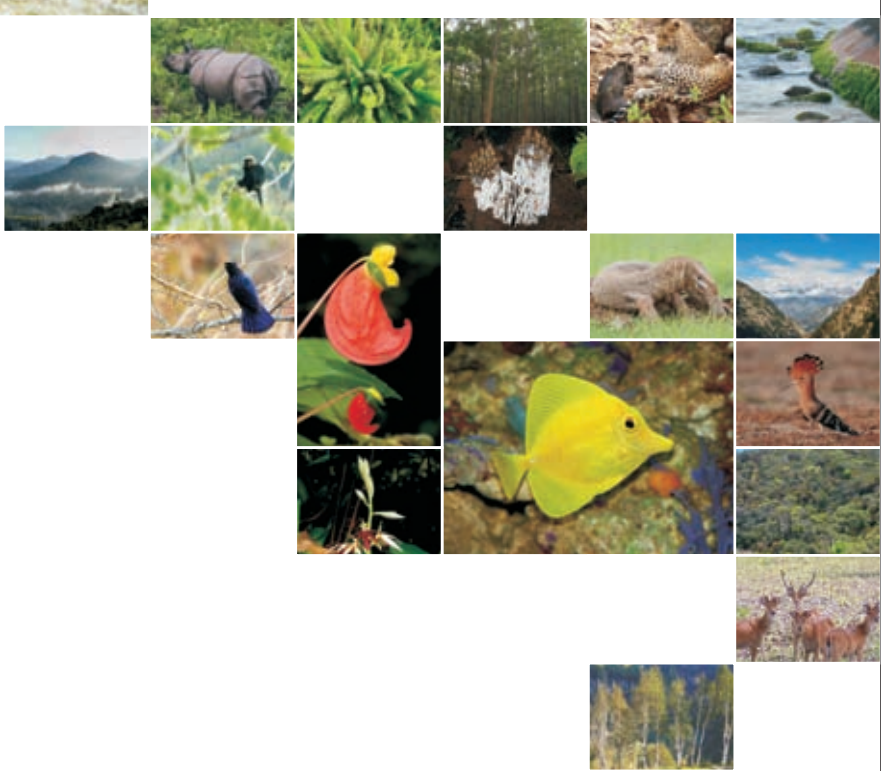
33 V.K.Bahuguna

Thar Desert | E. Thomas



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