सत्यमेव जयते

Implementation of

India's National Biodiversity Action Plan

An Overview

2019

Ministry of Environment, Forest and Climate Change

National Biodiversity Authority, India

Implementation of
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An Overview 2019

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Implementation of **India's National Biodiversity Action Plan** An Overview 2019

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GOVERNMENT OF INDIA
MINISTER OF ENVIRONMENT, FOREST & CLIMATE CHANGE

FOREWORD

Globally, biodiversity is facing increasing pressure on account of various factors including habitat fragmentation and destruction, climate change, over use and unsustainable use of resources. The concern relating to biodiversity conservation in the face of its continuing loss is indeed universal. The Convention on Biological Diversity is a collective commitment of the nations to conserve and sustainably use the biological diversity for the benefit of the present and future generations.

India, a recognised megadiverse country, is committed to protecting the rich heritage of biodiversity which is so vital to our economic and social development. Biodiversity is also directly linked with providing livelihoods to and improving socio-economic conditions of millions of our local people, thereby contributing to sustainable development and poverty alleviation.

India has reported progress in implementation of its National Biodiversity Action Plan and achievement of the 12 National Biodiversity Targets in the Sixth National Report to the Convention on Biological Diversity submitted online in December 2018. The present document which is based on this Report is and endeavour to reach out to the wider community, our contribution towards achieving the objectives of the Convention.

I hope the publication would be found useful by various stakeholders involved in the conservation of biodiversity.

Date: 13.05.2019

(Dr. Harsh Vardhan)

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PREFACE

India is a mega-diverse country rich in biodiversity and associated traditional knowledge. With only 2.4% of the world's land area, India accounts for nearly 7-8% of all recorded species in the world. With a strong institutional, legal and policy framework on biodiversity, India has made sustained efforts in fulfilling her commitments towards conservation of biodiversity, its sustainable use, and fair and equitable sharing of benefits arising from their use.

As a Party to the Convention on Biological Diversity, India submitted her Sixth National Report online on 29th December, 2018, providing a review of progress towards the 20 global Aichi biodiversity targets, since the last National Report which was submitted in 2014. The Sixth National Report was prepared through an extensive nationwide consultative process with all concerned stakeholders including the State Governments, extending over a period of nearly one and a half years. As per this Report, India has exceeded / met two of its national biodiversity targets, and is on course to achieve most of the other targets.

Drawing upon the Sixth National Report, the present document reports India's achievements in a narrative format, while following a thematic rather than target-wise approach in reporting progress so as to avoid repetitive references.

As a responsible country, India has never reneged on any of its international commitments and would continue to contribute to the achievement of the three objectives of the Convention on Biological Diversity.

I take this opportunity to compliment everyone associated with the preparation of this document, in particular my colleagues Shri A.K. Jain, Additional Secretary and Dr. Sujata Arora, Adviser in the Ministry of Environment, Forest and Climate Change.

[C.K. Mishra]

Dated: 8th May, 2019
Place: New Delhi

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MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE

PROLOGUE

National reporting at periodic intervals is an essential component of all international agreements, including the Convention on Biological Diversity, which helps in reviewing the status of implementation.

India submitted online her Sixth National Report to the Convention on Biological Diversity on 29 December 2018. The focus of this Report was progress in implementation of the Strategic Plan for Biodiversity 2011-2020 and its 20 Aichi biodiversity targets, and the relevant national biodiversity targets. This report is available on the link https://chm.cbd.int/database/record?documentID=241351. While all the five previous National Reports were prepared with the involvement of stakeholders, consultations for preparation of the Sixth National Report have been so for the most extensive and elaborate.

India has been contributing significantly towards attainment of the global biodiversity targets, in particular those relating to protected areas, and access and benefit sharing. With well over 20 percent of its total geographical area under biodiversity conservation, India has exceeded the terrestrial component of 17 percent of the global target and 20 percent of corresponding national target. Similarly, India has made noteworthy achievement in the target relating to access and benefit sharing. India is on track to achieve most other biodiversity targets.

Considering that the format of the Sixth National Report was largely questionnaire, the present document has been prepared in a narrative format making use of the information contained in the Sixth National Report. Designed to cover various components and dimensions of biodiversity in an issue-based manner, the publication presents an overview of the progress in implementation of India's National Biodiversity Action Plan. The document has chapters inter alia on the country's biodiversity profile, policy and legislative framework, ecosystems such as forests, coastal and marine, and wetlands and riverine, along with thematic areas such as agro-biodiversity, fisheries, integrating values of biodiversity in planning and poverty alleviation strategies, invasive alien species, traditional knowledge, access and benefit sharing, and financial, technical and human resources.

I congratulate all those who were involved in this task, which was undertaken with support from Global Environment Facility through United Nations Development Program by the National Biodiversity Authority. I wish to place on record the diligent efforts put in by Dr Sujata Arora, Adviser, Ministry of Environment Forest and Climate Change in this national endeavor.

Date: 14.05.2019

(Anil Kumar Jain)

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ACKNOWLEDGMENTS

Biodiversity is a multidisciplinary and cross sectoral subject. Collecting information from stakeholders from all over the country for a national report on biodiversity therefore was a challenging task. A large number of institutions and individuals, including Ministries/Departments of the Central Government, Departments of state governments and their agencies provided information for the Sixth National Report, based on which this document has been prepared. We would like to gratefully acknowledge the contributions of all those who have enriched this document. The listing that follows is not exhaustive, and we apologise for any omissions, which in no way belittles their contributions.

We would like to thank all the participants including the state governments and State Biodiversity Boards (SBBs) for contributing in the national, regional and state level workshops with government and non-government stakeholders facilitated by the Ministry of Environment, Forest and Climate Change and National Biodiversity Authority, that set off a meaningful process of involvement of all the sections of stakeholders concerned in providing information relevant to the report.

We are thankful to the Secretaries of the Ministries of the Government of India for providing biodiversity relevant information. We especially acknowledge the contributions of several national-level technical and scientific institutions that shared their experience and data which has not only enriched the report but also paved the way for future coordination and coherence in the implementation of National Biodiversity Strategy and Action Plan. These inter alia include: the Agharkar Research Institute, Botanical Survey of India, Central Arid Zone Research Institute, Central Institute of Fisheries Technology and Centre for Environmental Management of Degraded Ecosystems, Central Institute of Fisheries Technology, Central Marine Fisheries Research Institute, Centre for Marine Living Resources and Ecology, Department of Space and its institutions, Directorate General of Foreign Trade, Fishery Survey of India, Forest Survey of India, G B Pant Institute of Himalayan Studies, Indian Council of Forestry Research and Education, Indian Institute of Forest Management, National Botanical Research Institute, National Institute of Oceanography, Sálim Ali Centre for Ornithology and Natural History, Wildlife Institute of India and Zoological Survey of India. We are also grateful to the Ministry of Agriculture and Farmers' Welfare and its six Bureaux under the Department of Agricultural research and Education (DARE), namely 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, National Bureau of Agriculturally Important Insects and National Bureau of Soil Survey and Land Use planning, for sharing their knowledge, experience, case studies and readily responding to any queries thrown up by the analyses of their data. We would like to acknowledge inputs received from the Central Pollution Control Board and the Indian Metrological Department. We acknowledge the contribution of all the technical organisations under the Ministry of Earth Sciences.

We also extend our gratitude to the large number of NGOs which participated in the workshops and offered valuable information from time to time. We especially recognise 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, Participatory Learning Action Network and Training (PLANT), TREE Foundation, World Wildlife Fund India for providing data and case studies for the report. We would like to thank the Confederation of Indian Industry (CII) and other members of industry and business for sharing valuable information in the preparation of this report.

We express our sincere appreciation for the professional support and untiring efforts of the core expert group for their critical comments and suggestions for finalizing the report. We would like to thank Dr. Ms. B. Meenakumari, former Chairperson, Mr. T. Rabikumar, former Secretary, and our entire team in the National Biodiversity Authority for providing organisational, logistical and technical support for holding consultations, meetings and dialogues with stakeholders at various levels. We owe our thanks to Biotech Consortium India Limited (BCIL) for assisting in holding regional and national consultations and for their scientific and technical inputs from time to time. The meticulous work of Dr. Vibha Ahuja, Chief General Manager, BCIL and her team in editing the final text and annexures of the report is especially acknowledged.

We would like to acknowledge the support received from the Global Environment Facility through the United Nations Development Programme (UNDP) India for preparation of Sixth National Report. UNDP India also contributed from their core budget, and we acknowledge their support in the entire process of the preparation of the report under the leadership of the Resident Representative, UNDP. We would like to recognize the support from Dr. Ruchi Pant, Head (Biodiversity and Natural Resource Management) and her team in the process of developing the report.

We would like to acknowledge with gratitude the tremendous and untiring efforts of Ms. Amarjeet Ahuja, Senior Consultant, in putting together this document. She was supported by UNDP project associates Ms. Ritu Narwaria and Ms. Aditi Chaturvedi in collecting, sifting and interpreting the vast data received from various government and non-government sources. We also recognize the contribution of Ms. Srimoyee Mitra (UNDP project associate), Ms. Kritika Katyayan and Ms. Utakarsha (UNDP consultants) for their contribution in secondary research and analysis, Ms. Pavithra (UNDP intern) and Ms. Sasha Nijhara (UNDP Consultant) for their contribution and logistical support from time to time and Ms. Anusha Sharma (Project Officer) in coordinating with designing and printing of the document.

We wish to express our deepest gratitude to Dr. Sujata Arora, Adviser, Ministry of Environment, Forest and Climate Change, without whose guidance, strong support, involvement and contributions, it would not have been possible to bring out this document.

Dr. Purvaja Ramachandran
Secretary, National Biodiversity Authority
and her team

LIST OF ABBREVIATIONS

ABS-CHM	ABS Clearing-House Mechanism
ABS	Access and Benefit Sharing
ATMA	Agricultural Technology Management Agency
ABTs	Aichi Biodiversity Targets
AWC	Asian Waterbird Census
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ADMA	Ayurvedic Drug Manufacturers' Association
AB-NHPM	Ayushman Bharat-National Health Protection Mission
ANR	Assisted Natural Regeneration
BER	Biodiversity Expenditure Review
BIOFIN	Biodiversity Finance Initiative
BHSs	Biodiversity Heritage Sites
BMCs	Biodiversity Management Committees
BZs	Biogeographic Zones
BD Act	Biological Diversity Act, 2002
BNHS	Bombay Natural History Society
BSI	Botanical Survey of India
BIS	Bureau of Indian Standards
CIFT	Central Institute of Fisheries Technology
CIPMCs	Central Integrated Pest Management Centres
CPCB	Central Pollution Control Board
CWPRS	Central Water and Power Research Station
CABI	Centre for Agriculture and Bioscience International
CEE	Centre for Environment Education
CEMDE	Centre for Environment Management of Degraded Ecosystems
CEC	Centre for Environmental Communication
CMLRE	Centre for Marine Living Resources & Ecology
CMFRI	Central Marine Fisheries Research Institute
CPC	Checkpoint Communiqué
CDA	Chilika Development Authority
CSOs	Civil Society Organisations
CRZ	Coastal Regulation Zone
CRZN	Coastal Regulation Zone Notification
CCRF	Code of Conduct for Responsible fisheries
CEPA	Communication, Education and Public Awareness
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CII	Confederation of Indian Industry
CoP	Conference of Parties
ICVs	Conservation of Indigenous Crop Varieties
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CSR	Corporate Social Responsibility
CSIR	Council for Scientific & Industrial Research
CWRs	Crop Wild Relatives
DSS	Decision Support System
DAY-NRLM	Deendayal Antyodaya Yojana -National Rural Livelihoods Mission
DDA	Delhi Development Authority

DBT	Department of Biotechnology
DIP Act	Destructive Insects and Pests Act, 1914
ETF	Eco Task Forces
ENM	Ecological Niche Modelling
EBSAs	Ecologically and Biologically Significant Areas
ESZs	Eco-Sensitive Zones
EC Act	Energy Conservation Act, 2001
EP Act	Environment (Protection) Act, 1986
EE	Environmental Education
EIA	Environmental Impact Assessment
ENVIS	Environmental Information System
EEZ	Exclusive Economic Zone
EAP	Externally Aided Projects
FF	Farmer Friend
FFSs	Farmers Field Schools
FIGs	Farmers Interest Groups
FPCs	Farmers Producer Companies
FCO	Fertiliser Control Order
FC	Finance Commission
FNA	Financial Needs Assessment
FC Act	Forest (Conservation) Act, 1980
FDA	Forest Development Agency
FSI	Forest Survey of India
FTC	Forest/Tree Cover
GAP	Ganga Action Plan
GB	Gender budgeting
GR	Genetic Resource
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit
GPG	Good Practices Guidance
GAGAN	GPS Aided GEO Augmented Navigation
GIM	Green India Mission
GSDP	Gross State Domestic Product
HCVF	High Conservation Value Forests
HDI	Human Development Index
IAS	Invasive Alien Species
IBA	India Biodiversity Awards
IBBI	India Business and Biodiversity Initiative
ICMBA	Important Coastal and Marine Biodiversity Area
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
ICMR	Indian Council of Medical Research
IF Act	Indian Forest Act, 1927
IGBC	Indian Green Building Council
IGNFA	Indira Gandhi National Forest Academy
IIFM	Indian Institute of Forest Management
INCOIS	Indian National Centre for Ocean Information Services
NR 5	India's Fifth National Report to the CBD
NR 6	India's Sixth National Report to the CBD
ICDS	Integrated Child Development Services

ICZM	Integrated Coastal Zone Management
ICZMP	Integrated Coastal Zone Management Programme
IMW	Integrated Management of Wetlands
IMP	Integrated Management Plan
IWDP	Integrated Wasteland Development Programme
IFMS	Intensification of Forest Management Scheme
IPCC	Intergovernmental Panel on Climate Change
IPIRTI	Indian Plywood Industries Research & Training Institute
IPO	International Patent Office
IPPC	International Plant Protection Convention
IRCC	Internationally Recognized Certificate of Compliance
ISFR	India State of Forest Report
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
JFM	Joint Forest Management
JFMCs	Joint Forest Management Committees
KUSUM	Kisan Urja Suraksha evam Utthan Mahabhiyan
KVK	Krishi Vigyan Kendra
LAG	Legal Advisory Group
LRB	Living Root Bridges
LDA	Loktak Development Authority
MEE	Management Effectiveness Evaluation
MPEDA	Marine Product Export Development Authority
MPAs	Marine Protected Areas
MSC	Marine Stewardship Council
MPCDAs	Medicinal Plants Conservation and Development Areas
mBRCs	microbial Bioresource Centres
million ha	million hectares
MCDR	Mineral Conservation and Development Rules
MLS	Minimum Legal Size
MoA&FW	Ministry of Agriculture and Farmers' Welfare
MCA	Ministry of Corporate Affairs
MDoNER	Ministry of Development of North Eastern Region
MoES	Ministry of Earth Sciences
MoEF	Ministry of Environment and Forest
MoEFCC	Ministry of Environment, Forests and Climate Change
MoWR, RD & GR	Ministry of Water Resource and River Development and Ganga Rejuvenation
MoYAS	Ministry of Youth Affairs and Sports
MIDH	Mission for Integrated Development of Horticulture
MOVCDNER	Mission Organic Value Chain Development for North Eastern Region
NG	Namami Gange
NAPCC	National Action Plan on Climate Change
NAP	National Afforestation Programme
NAIMCC	National Agriculturally Important Microbial Culture Collection
NAP, 2000	National Agriculture Policy, 2000
NBAP	National Biodiversity Action Plan
NBA	National Biodiversity Authority
NBTs	National Biodiversity Targets
NBGC-IB	National Bovine Genomic Centre for Indigenous Breeds
NBAIR	National Bureau of Agricultural Insect Resources
NBAIM	National Bureau of Agriculturally Important Microorganisms

NBSSLUP	National Bureau of Soil Survey and Land Use Planning
NCCR	National Centre for Coastal Research
NCSCM	National Centre for Sustainable Coastal Management
NEP	National Environment Policy, 2006
NFP	National Forest Policy, 1988
NGRBA	National Ganga River Basin Authority
NGT	National Green Tribunal
NHM	National Health Mission
NHCP	National Herbarium of Cultivated Plants
NIF	National Innovation Foundation
NICRA	National Innovations on Climate Resilient Agriculture
NIOT	National Institute of Ocean Technology
NIO	National Institute of Oceanography
NMFMC	National Marine Fisheries Management Council
NMEEE	National Mission for Enhanced Energy Efficiency
NMAET	National Mission of Agricultural Extension and Technology
NMOOP	National Mission on Oilseeds and Oil Palm
NMSA	National Mission on Sustainable Agriculture
NNRMS	National Natural Resource Management System
NPCA	National Plan for Conservation of Aquatic Ecosystems, 2013
NPMF	National Policy on Marine Fisheries, 2017
NPP	National Population Policy, 2000
NRFC	National Repository of Fish Cell Line
NRCP	National River Conservation Plan
NRDWP	National Rural Drinking Water Programme
NRHM	National Rural Health Mission
NUHM	National Urban Health Mission
NWP	National Water Policy, 2002
NWPC	National Working Plan Code, 2014
NCF	Nature Conservation Foundation
NPV	Net Present Value
NGOs	Non-Governmental Organisations
NTFPs	Non-timber Forest Products
NTAC	Normally Traded As Commodities
OBC	Other Backward Classes
PRIs	Panchayati Raj Institutions
PESA Act	Panchayats (Extension to the Scheduled Areas) Act, 1996
PGS	Participatory Guarantee System
PBRs	People's Biodiversity Registers
PQSs	Plant Quarantine Stations
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
PPVFRA	Protection of Plant Varieties and Farmers' Rights Authority
RAD	Rainfed Area Development
RTWQM	Real Time Water Quality Monitoring
R&D	Research and Development
SACON	Sálim Ali Centre for Ornithology and Natural History
SAF	Society for Assistance to Fisherwomen
SHM	Soil Health Management
STLs	Soil Testing Laboratories

SOPs	Standard Operating Procedures
SBAPs	State Biodiversity Action Plans
SBBs	State Biodiversity Boards
SFDA	State Forest Development Agency
SPCBs	State Pollution Control Boards
SPB (2011-20)	Strategic Plan for Biodiversity 2011-20
SMPP	Sub-Mission on Plant Protection and Plant Quarantine
SDWRML	Sustainable Development and Water Resources Management of Lake
SDGs	Sustainable Development Goals
SBA	Swachh Bharat Abhiyan
SRI	System of Rice Intensification
NGT Act	The National Green Tribunal Act, 2010
PQO, 2003	The Plant Quarantine (Regulation of Import into India) Order, 2003
PPVFR Act	The Protection of Plant Varieties and Farmers' Rights Act, 2001
TK	Traditional Knowledge
TKDL	Traditional Knowledge Digital Library
TFRI	Tropical Forest Research Institute
UTs	Union Territories
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VMEs	Vulnerable Marine Ecosystems
WISA	Wetlands International South Asia
WP Act	Wildlife (Protection) Act, 1972
WAP	Wildlife Action Plan
WII	Wildlife Institute of India
WRIS	Water Resources Information System of India
WR, 2017	Wetlands (Conservation and Management) Rules, 2017
WTI	Wildlife Trust of India
WHO	World Health Organisation
WWF	World Wildlife Fund
ZSI	Zoological Survey of India

CHAPTER 1

Cosmos flowers blooming in the mountains

Introduction

Biodiversity provides the basic goods and services for human society to exist and secure economic and social development. Health, wealth, food security and many other needs of human beings are dependent on natural resources, and yet human beings have used these with scant regard to latter's health and survival. Such indiscriminate use and resultant loss of biodiversity threatens the very survival of the planet itself. The Convention on Biological Diversity (CBD) which entered into force in December 1993, is an international agreement among the nations of the world to arrest and reverse this situation for the welfare and survival of the planet and its denizens, as well as for inter-generational equity. The Convention has three objectives, namely, conservation of biodiversity, sustainable use of the components of biodiversity,

and fair and equitable sharing of benefits arising out of the use of genetic resources.
The Convention is implemented through programmes/ strategic plans adopted by the Conference of Parties (CoP) to the CBD which are then incorporated in the National Biodiversity Action Plan (NBAP) by the Parties. Implementation is monitored by the CoP to the CBD through periodic national reports. Preparation of NBAP or equivalent documents and preparation of National Reports are two mandatory obligations of CBD as per Article 6 and Article 26 of the Convention, respectively. Six national reports have been submitted by the Parties so far. India submitted its Sixth National Report (NR 6) to the CBD on 29 December 2018. It is available at the link https://chm.cbd.int/database record?documentID=241351 The Report comprehensively covers the progress in implementation of India's NBAP. The present document is an endeavour to share the progress of the implementation of NBAP (referred to as National Biodiversity Strategy and Action Plan (NBSAP) in the online report in accordance with CBD nomenclature for such plans) with a wider audience of stakeholders in a reader friendly format.

1.1 Evolution of Biodiversity Action Plans in India

India became a Party to the CBD in 1993, and prepared its first NBAP entitled "National Policy and Macro Level Action Strategy on Biodiversity" in 1999, (referred to as Strategy, 1999 hereafter) to give effect to its commitments under the CBD. The Strategy, 1999 was prepared after extensive consultations with stakeholders at all levels. The consultative process generated nationwide awareness about the CBD and created aspirations for its effective implementation. Enactment of Biological Diversity Act, 2002 (referred to as BD Act hereafter), followed this exercise to create the required legislative support base for the implementation of the Convention. Section 36(3) of the Act obligates the Central Government to "as far as practicable wherever it deems appropriate, integrate the conservation, promotion and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies."
Thus, the Strategy, 1999 and the BD Act recognized and articulated the need to integrate biodiversity in sectoral and cross-sectoral programmes. It was therefore required that the cohesiveness between Strategy, 1999 and the sectoral policies, namely, the National Forest Policy (NFP), 1988, the National Conservation Strategy and Policy Statement on Environment and Development, 1992, the Policy Statement on Abatement of Pollution, 1992, the National Agricultural Policy (NAP), 2000, National Population Policy (NPP), 2000, and National Water Policy (NWP), 2002 was established. A similar demand of cohesiveness was created by the need to meet the other national and international commitments on the issues of environment including climate change and desertification. Taking note of all these, the Government brought out a comprehensive National Environment Policy (NEP) in 2006 which did not abrogate sector specific policies, but provided the much needed synergy and coherence for sustainable development in all the policies. It emphasized that sustainable development policy and action profile should be such that the poor and the vulnerable derive livelihoods and quality of life from the fact of conservation of biodiversity and not its deterioration, and called for the mainstreaming of biodiversity in planning and development in all sectors.

The Strategy, 1999 was revised and updated into NBAP, 2008 to bring the biodiversity agenda in alignment with the NEP, 2006. This second generation of NBAP was further updated with Addendum 2014 to NBAP, 2008 in order to integrate the Strategic Plan for Biodiversity 2011-20 (SPB 2011-20) in NBAP which was adopted by CoP 10, held at Nagoya in the Prefecture of Aichi in Japan. The SPB 2011-20 provides an overarching framework on biodiversity, not only for all biodiversity related conventions including CBD, but for the entire United Nations (UN) system and all partners engaged in management of biodiversity. The SPB 2011-20 includes 20 Aichi Biodiversity Targets (ABTs) covered under five strategic goals to be implemented during

2011-20. Parties to CBD were required to develop National Biodiversity Targets (NBTs) in line with these 20 global ABTs taking into account their national priorities and needs towards achieving the globally shared Biodiversity Vision 2050.

Biodiversity Vision 2050

"By 2050, biodiversity is valued, conserved, restored and widely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."
(CBD Decision X/2)

Accordingly, initiating the process in 2011, India developed 12 NBTs in consultation with stakeholders using SPB 2011-20 as the framework. All the 20 ABTs have been incepted in these 12 NBTs. Annexure 1 A and 1 B gives the text of NBTs and ABTs.

For overseeing and monitoring the implementation of these targets, agencies were identified on the basis of their mandate, domain areas and geographical coverage in the country. Indicators and monitoring framework were also developed for each NBT.

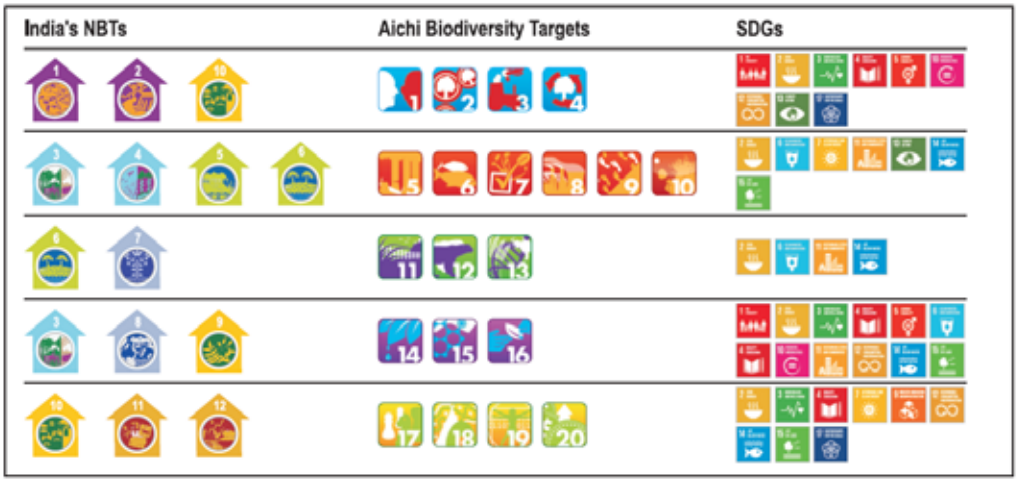
The "Addendum 2014 to NBAP 2008" contains the details of 12 NBTs with associated indicators and monitoring framework.

1.2 Linkage with Sustainable Development Goals (SDGs)

The UN General Assembly in its 70th meeting in 2015 adopted Resolution 70/1: "2030 Agenda" of Sustainable Development with 17 SDGs. These goals cover social and economic development issues including poverty, health, education, gender equality, water, sanitation, energy, urbanisation, environment and social justice. These have a strong resonance with ABTs which in turn have been integrated into NBTs. The twelve NBTs, their linkage with ABTs and the SDGs are shown in the Figure 1.1.

The implementation of the NBAP involves the Central Government, the state governments and institutions of governance in the States/ Union Territories (UTs) at the local level. These three tiers of governance implement the NBAP with the active involvement of all other stakeholders such as Non-Governmental Organisations (NGOs), Civil Society Organisations (CSOs), industry and business, technical and educational institutions, local and traditional communities.

Figure 1.1 Linkages of India's NBTs with ABTs and SDGs



1.3 Gender Mainstreaming

The CBD and its CoPs recognize the importance of gender mainstreaming in biodiversity conservation and implementation of the ABTs. Gender balance in governance institutions and other walks of life has been an integral objective of governance and development agenda in India. The Constitution (73rd Amendment) Act, 1992 and the Constitution (74th Amendment) Act, 1992 have mandated reservation of at least one third of the seats for women in institutions of local governance at all levels in the rural and urban areas respectively. Nearly all the states have voluntarily raised this percentage to fifty. The elections in various states take place at different points of time. Data relating to 2016 shows that nearly 1.4 million women occupied the seats of elected representatives in 2016 in rural local bodies. This ensures their representation and participation in governance at the local level and in the planning and implementation of policies and programmes. Effective engagement of women in implementation of NBAP has been promoted and secured through specific provisions in policies and programmes to ensure their role and engagement.

Gender budgeting (GB) is another means of ensuring gender mainstreaming. The GB process was started in India in 2001. After consultations at various levels and various initiatives by the Ministry of Finance from time to time, creation of gender cells in the central ministries was encouraged. Guidelines were issued to states in 2013 to provide a road map towards institutionalizing gender budgeting at the state level. States of Assam, Bihar, Chhattisgarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Nagaland, Odisha, Rajasthan, Tripura, Uttarakhand and Uttar Pradesh have adopted gender budgeting.

1.4 Role of Local Communities in NBAP Implementation

Governance and implementation systems also specifically provide for the representation and involvement of local communities by securing their mandatory representation in committees and government institutions at various levels. Their participation in implementation of government programmes at all levels is also secured. Specific schemes and interventions have been designed and implemented to secure their economic uplift and welfare. They make important contributions in conservation and sustainable use of biodiversity both as users and conservers. Local level institutions such as Joint Forest Management Committees (JFMCs) and Biodiversity Management Committees (BMCs) and a vast presence of CSOs and NGOs help ensure and consolidate their participation. Effective implementation of NBAP contributes to meeting India's commitments under other relevant international Conventions to which India is a Party.

Local community cleans the pond by removing Water Hyacinth, Odisha

1.5 Scheme of this Report

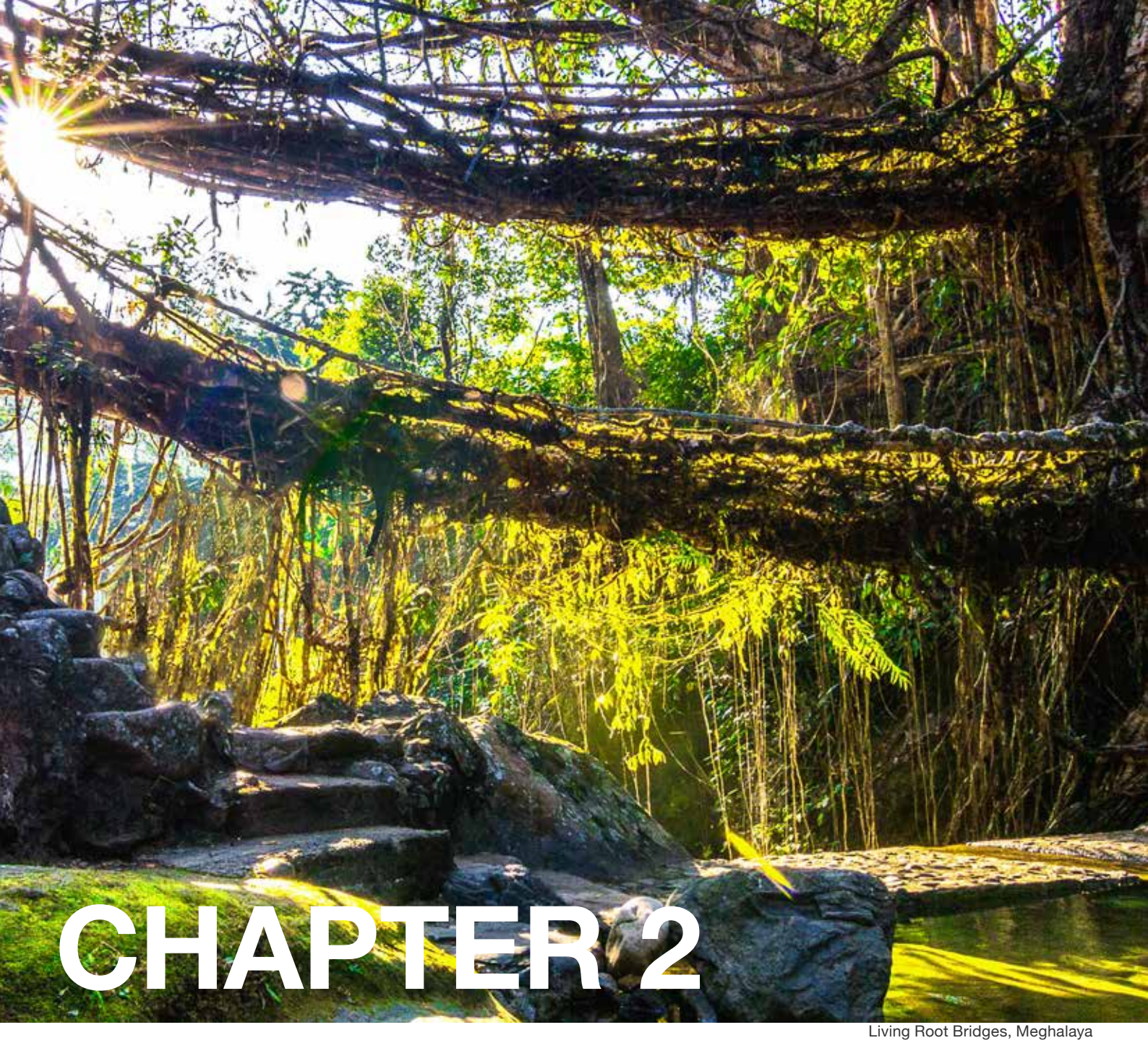
NR6 was prepared after nationwide consultations with all stakeholders at three levels of governance, along with examination and analysis of data from various sources. (See Annexure 2 for details of the process adopted for NR6). Though this report draws heavily on the NR 6 submitted to CBD in December 2018, it also includes information on some actions that have taken place after the submission of the Report in December 2018. The objectives under the 12 NBTs have been designed to cover various components and dimensions of biodiversity in an issue based manner. As a result, NBT 3 to NBT 8 each covers that dimension of the ecosystem which the NBT concerned addresses. For example, quite a few ecosystems are covered by NBT 3 in relation to reducing the rate of degradation and loss of natural habitats, and nearly the same ecosystems are covered under NBT 5 for pursuing the goal of sustainable management, and in NBT 7 for conservation of genetic diversity. Strategies and plans that deal with these ecosystems are made and implemented in a holistic manner and therefore are multi-outcome oriented in nature. Repetitive discussion of those strategies and plans becomes necessary if NBT-wise analysis of issues related to ecosystems covered under them is presented. In order to avoid such repetitive references, this Report has adopted a thematic approach by giving a comprehensive treatment to each ecosystem in separate chapters. For example, the chapter on Agriculture or Forest covers all the issues related to these ecosystems covered by different NBTs. The figure 1.2 demonstrates the point by identifying ecosystems against NBT 3, 5, 6 and 7.

Chapter 2 on Biodiversity Profile of India gives a bird's eye view of biodiversity scenario of the country. It helps the reader to appreciate the significance of the actions covered in subsequent chapters. Chapter 3 on Policy and Legislative Framework for the Implementation of NBAP informs the reader about the policy and legislative instruments that support and govern the actions. The rest of the chapters provide information on the subjects covered under NBTs.

India is a vast country. There is a growing consciousness about the value of biodiversity and the need for its conservation. People, institutions and organisations both in the government and outside the government take measures that protect, conserve and enhance biodiversity at various levels. Hearteningly, the entries received under India Biodiversity Awards (IBA) in successive years have established this fact. Since this document cannot possibly cover all the information regarding actions taken on biodiversity, it presents information about broad measures taken at the national level.

Indian Roller

Figure 1.2 Linkages of NBTs with ecosystems



CHAPTER 2

Living Root Bridges, Meghalaya

Biodiversity Profile of India

India is one of the recognized megadiverse countries of the world. Situated at the tri-junction of Afro-tropical, Indo-Malayan and Paleo-Arctic realm, India has a wide array of ecosystems and habitats. India has only 2.4 % of the geographical area of the world, but harbours nearly 8 % of the globally known floral and faunal species. It is an acknowledged centre of crop diversity and crop wild relatives.

Biodiversity encompasses all variety and variability of living organisms. It includes biodiversity within species, between species and diversity of ecosystems. The biodiversity profile of a country at any point of time is a reflection of the presence of this kind of diversity, the consequences of the way it has been utilized and how it has been conserved through legal or other measures.

The Biodiversity Profile of India presented in this chapter covers the cultural ethos and legal support for the conservation and use of biodiversity, ecosystems diversity, species and genetic diversity, status of threatened species, protection of natural habitats and species, and challenges to conservation of biodiversity.

2.1 Cultural Ethos and Legal Support for Conservation

People of India, including its nearly 4,635 ethnic communities spread all across the country have protected and maintained its rich cultural and spiritual heritage of living in harmony with nature over centuries. (https://ansi.gov.in/people-of-india/)

> Local and traditional communities still venerate nature and conserve biodiversity through traditional practices and institutional structures such as sacred groves.

The phenomenon of destruction of forests in the country started in early 19th century under the colonial rule to meet the timber and land needs for purposes such as ship-building, iron smelting and farming. The Forest Policy, 1894 sought to achieve custodial and timber driven management of forests to meet these needs disturbing the traditional relationship between people and forests.

The first post-independence National Forest Policy, 1952 recognised the economic role of forests but also advocated bringing 33% of the area of the country under forests/tree cover. This policy was replaced by NFP, 1988, which retained the objective of bringing one-third area of the country under forest/tree cover (FTC) but also effected a paradigm shift in forest management by including conservation as one of the goals along with the utilization of forests. National Working Plan Code, 2014 (NWPC) for sustainable management of forests and biological diversity in India has established a holistic concept of conservation of forests with due emphasis on conservation of biodiversity.

Another important development took place in the mid 1970s when the Directive Principles of State Policy and Fundamental Duties of the citizens of India were modified/ strengthened through Constitution (42nd Amendment) Act, 1976. As a result, Article 48 of the Constitution of India mandates that “the State shall endeavour to protect and improve the environment and to safeguard the forests and the wildlife of the country.” Article 51 A (g) makes it a “duty of every citizen to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.” Forests were placed under the concurrent jurisdiction of the Centre and the states in the same year.

The Environment (Protection) Act (EP Act) enacted in 1986 paved the way for legal interventions for protection of ecosystems including coastal, riverine and wetlands ecosystems. The Wildlife (Protection) Act, 1972, (WP Act), the Forest (Conservation) Act, 1980 (FC Act), the BD Act and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (referred to as Forest Rights Act, 2006 hereafter) further strengthen the legal base for conservation and sustainable utilization of biological diversity.

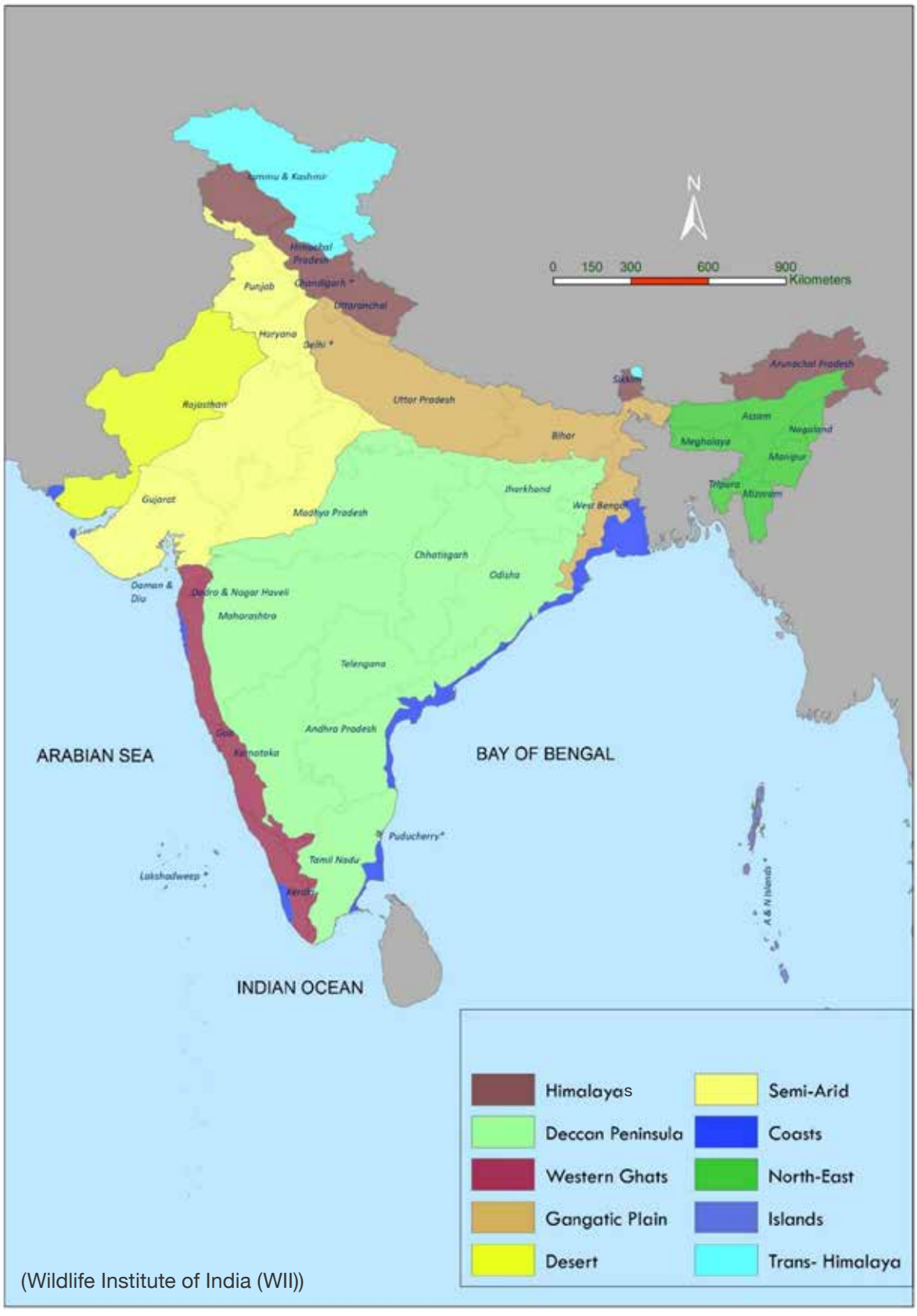
2.2 Ecosystem Diversity of India

India's unique topographical features endow it with a diversity of terrain and terrestrial and aquatic ecosystems that harbour rich biodiversity. Based on a study of the distinctive biogeographic characteristic features of the country from north to south and east to west, 10 Biogeographic Zones (BZs) have been identified (Rogers and Panwar, 1988). The study further identifies three subordinate levels in BZs namely, (i) the Biotic Province- a secondary unit within a zone, of particular communities separated by dispersal barriers or gradual change in environmental factors, e.g., North-west and West Himalaya on either side of the Sutlej River, (ii) the Land Region- a tertiary unit within a province, indicating different land forms, e.g., Aravalli Mountains and Malwa Plateau in Gujarat-Rajwara Province, and (iii) the Biome- an ecological unit such as swamp/wetland or temperate broad leaved forest in each zone. Figure 2.1 shows the distribution of the 10 BZs across India.

Over 1,00,690 species of fauna and over 47,800 species of flora have been documented in the 10 BZs of the country. This diversity is hosted by many types of terrestrial and aquatic systems namely forests, wetlands, grasslands, deserts, coastal, and marine ecosystems.

Brahma Kamal *(Saussurea obvallata)*

Figure 2.1 Biogeographic zones of India



(Wildlife Institute of India (WII))

2.3 Terrestrial Ecosystems

(i) Forests

Sixteen forest types have been identified in India (Champion and Seth, 1968). Of these, nearly 38.2 % constitute tropical dry deciduous forests and another 30.3 % are tropical moist deciduous forests (Singh and Singh, 2011). Figure 2.2 shows the distribution of these sixteen forest types in the country.

Forest Survey of India (FSI) prepares India State of Forest Report (ISFR) every two years based on a nationwide survey of forests and trees outside forest (TOF). The first ISFR was brought out in 1987. The ISFR 2017 is the 15th Report in the series. Each successive report provides state/district wise forest cover of the country in comparison to the previous assessment. They also provide the estimates of growing stock of forests and TOF, cover carbon stock and information about the state of the health and management of forests.

FSI does these assessments through wall to wall mapping of forests by using remote sensing technology which are then subjected to rigorous ground truthing. It uses "Good Practices Guidance" (GPG) methodology of Intergovernmental Panel on Climate Change (IPCC) for estimation of carbon stock.

Assessment of growing stock of forest/ trees is also part of the survey. It is estimated through forest inventory under which both qualitative and quantitative parameters are recorded to know overall health of growing forests.Forest Survey of India (FSI) prepares India State of Forest Report (ISFR) every two years based on a nationwide survey of forests and trees outside forest (TOF). The first ISFR was brought out in 1987. The ISFR 2017 is the 15th Report in the series. Each successive report provides state/district wise forest cover of the country in comparison to the previous assessment. They also provide the estimates of growing stock of forests and TOF, cover carbon stock and information about the state of the health and management of forests.

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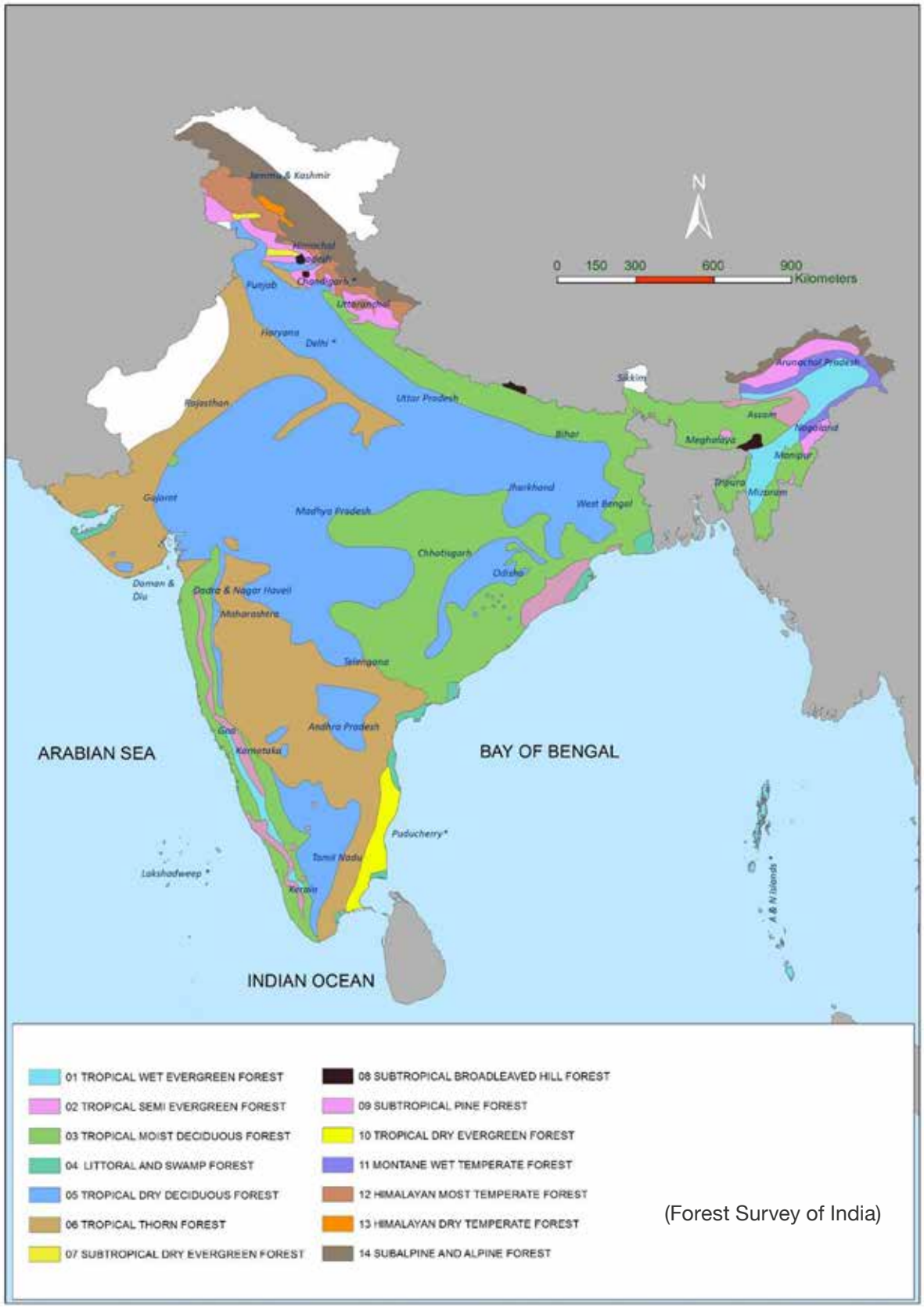
Assessment of growing stock of forest/ trees is also part of the survey. It is estimated through forest inventory under which both qualitative and quantitative parameters are recorded to know overall health of growing forests.

A view of virgin forests in Tawang, Arunachal Pradesh

Figure 2.2 Forest types of India



(Forest Survey of India)

Considering the large diversity in the forest types of the country, the country is stratified into 14 physiographic zones based on the similarities in physiography, vegetation, climate and soil type, to assess growing stock. Figure 2.3 shows these 14 physiographic zones.

ISFR (2017) has shown positive trends in relation to the increase in forest area, very dense forest, mangroves, carbon stock and growing stock of forests. Table 2.1 depicts these changes.

Table 2.1 Increase in forest area, very dense forest, mangroves, carbon stock and growing stock

Forests	2015	2017	Increase
Forest Area (in km^2)	7,01,495	7,08,273	6,778
Very Dense Forest (in km^2)	88,633	98,158	9,525
Mangroves (in km^2)	4,740	4,921	181
Growing Stock (in million cum)	5,768	5,821.990	53.990
Carbon Stock (in million tonnes)	7,044	7,083	39

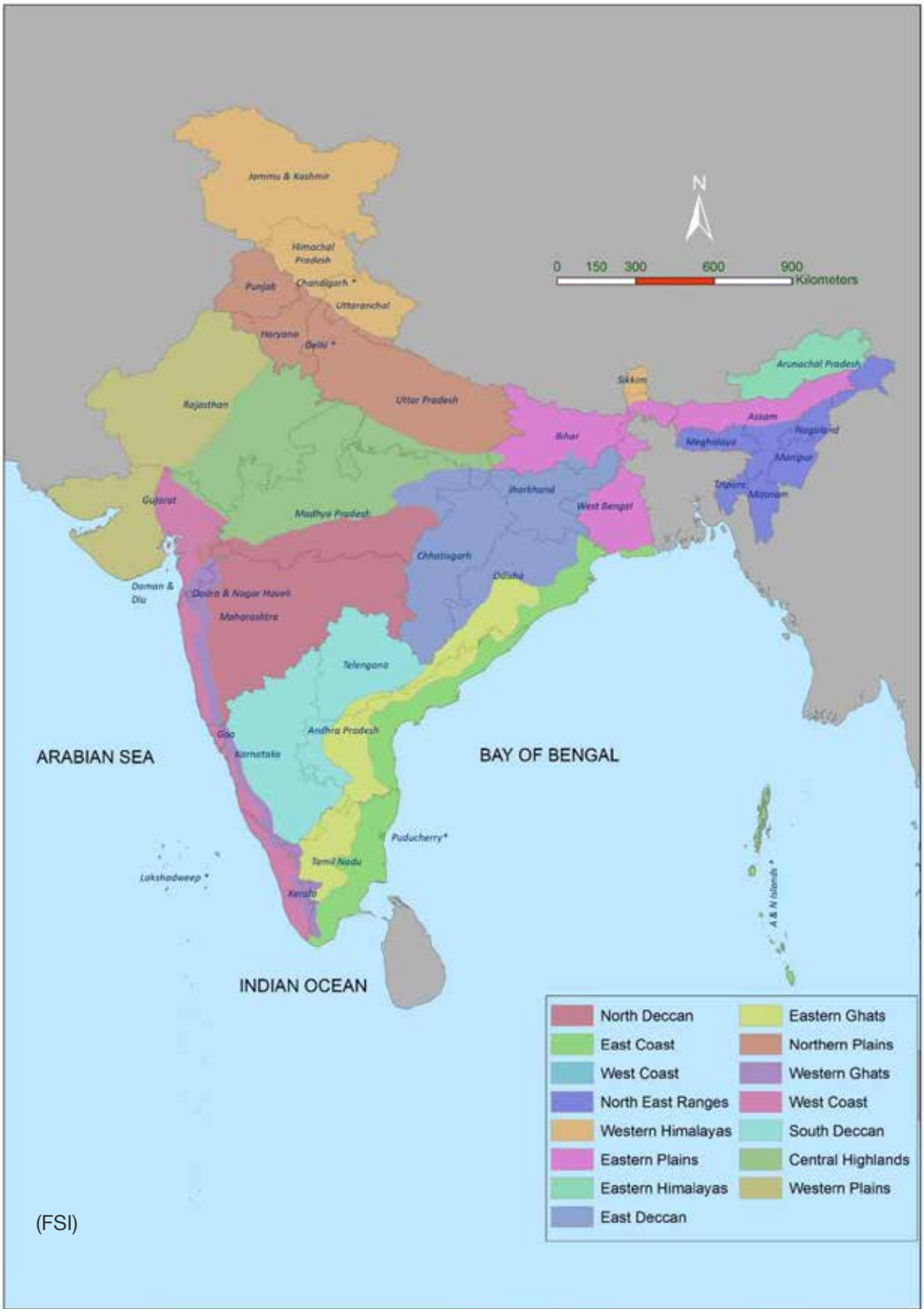
The current forest and tree cover stands at 23.39 % of geographical area of the country.

A male Blackbuck *(Antilope cervicapra)* in dry grasslands, Gujarat

(ii) Grasslands

Grasslands are spread across several BZs and exhibit a wide range of ecological characters. Besides playing the role of important wildlife habitats, they form the backbone of pastoral economy. Major types of grasslands in India can be identified as alpine moist meadows of the Greater Himalayas, alpine arid pastures or steppe formations of the trans Himalayas, hillside grasslands in the mid-elevation ranges of the Himalayas, 'Chaurs' of the Himalayan foothills, 'Terai' grasslands on the Gangetic and the Brahmaputra floodplains, 'Phumdis' or floating grasslands of Manipur, 'Banni' and 'Vidis' of Gujarat, savannas of western and peninsular India, plateau and valley grasslands in the Satpuras and Maikal hills, dry grasslands of the Andhra Pradesh and Tamil Nadu plains and 'Shola' grasslands of the Western Ghats (Ecology and Management of Grassland Habitats in India, ENVIS, 2016).

Figure 2.3 India's physiographic zones



Thar Desert, Rajasthan

(iii) Desert Ecosystems

Deserts in India have been classified into hot and cold deserts. Cold deserts cover Ladakh area in the Himalayan state of Jammu and Kashmir. Hot deserts are found in Andhra Pradesh, Gujarat, Haryana, Karnataka, Punjab, and Rajasthan. Gujarat, Haryana, Punjab and Rajasthan share the Thar Desert also known as The Great India Desert. Andhra Pradesh and Karnataka desert regions are rain shadow deserts of coastal range. These desert ecosystems host floral and faunal diversity distinctive to their terrain and climate.

The Indian part of Thar Desert hosts 6.4% endemic plant species, many of which are threatened. *Ceropegia bulbosa* is one such threatened species. Its ecological niche modelling (ENM) revealed its very few and sparse populations at three locations. Its plants were regenerated successfully from propagules under mist house conditions. Nearly 3,000 saplings could be produced in four years (DARE-ICAR Annual Report, 2016-17). The plants were reintroduced into natural habitats predicted by the ENM. Introduced plants showed excellent survival, growth, flowering and seed- set.

2.4 Mountain Ecosystems

(i) Himalayas

The major mountain ranges in India are the Himalayas and the Western Ghats. The Indian Himalayas stretch to about 3,000 km in length and vary between 220 and 300 km in width. These are spread over the states of Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and a part of Assam, eight districts of Uttar Pradesh, and one district namely, Darjeeling, of West Bengal. This complex mountain system consists of narrow and deep valleys, glaciers and fertile terrain, and can be divided into four distinct zones longitudinally: (i) the Shivalik (900 – 1,500 m), (ii) the Outer Himalaya (1,500 – 3,500 m), (iii) the Middle or Lesser Himalaya (3,600 – 4,600 m), and (iv) the Greater Himalaya (above 4,600 m).

Climatically, the region is delineated into five zones based on geographic and physiographic factors that affect climate. These climatic regions are named as the warm tropical, warm sub-tropical, cool temperate, alpine and arctic. Many local variations are also experienced in the climate due to variation in precipitation, temperature, wind patterns, humidity etc. The type and nature of

Bactrian camels *(Camelus bactrianus)* in Nubra valley, Ladakh

soils also varies vastly from deep alluvial to the thin and bare soils of the high mountains. Its richness and representativeness in biodiversity is determined by topography, altitude, precipitation, temperature, geological formations, soil conditions and resultant diversity of bioclimates. The region is rich in forest, horticulture, agriculture, floral and faunal species diversity. 30,377 species/subspecies of faunal diversity are found in the region which amounts to 30.16 % of Indian faunal diversity. (Chandra *et al.,* 2018)

(ii) Western Ghats

The Western Ghats run parallel to the Western Coast of Indian Peninsula for almost 1,600 km with a latitudinal range of more than 10 degrees. They extend from the mount of the river Tapti to the South of India. The mountain chain of the Western Ghats is older than Himalayan system and represents geomorphic features of immense importance with unique biophysical and ecological processes. The high montane forest ecosystems of their range influence the Indian monsoon weather pattern. Exceptionally high level of biological diversity and endemism characterise this area and it is recognized as one of the world's eight 'hottest hotspots' of biological diversity. The forests of the site include some of the best representatives of non-equatorial tropical evergreen forests of the world.

(iii) **Other Mountain Ranges**

Aravallis, the oldest mountain system in India runs across the states of Gujarat, Rajasthan, Haryana, and ends in Delhi, as what is known as Delhi Ridge. Eastern Ghats are a broken range of mountains along the eastern coast of India. They travel from North Odisha, through Andhra Pradesh to Tamil Nadu in the South touching parts of Karnataka and Wayanad district in Kerala. Seshachalam hills of the Eastern Ghats are known for the endemic and economically highly valuable species of red sanders. Vindhyas are another broken mountain range extending from Gujarat in the west to Varanasi in the east passing through Madhya Pradesh and Chhattisgarh. They form the southern boundary of the central highlands.

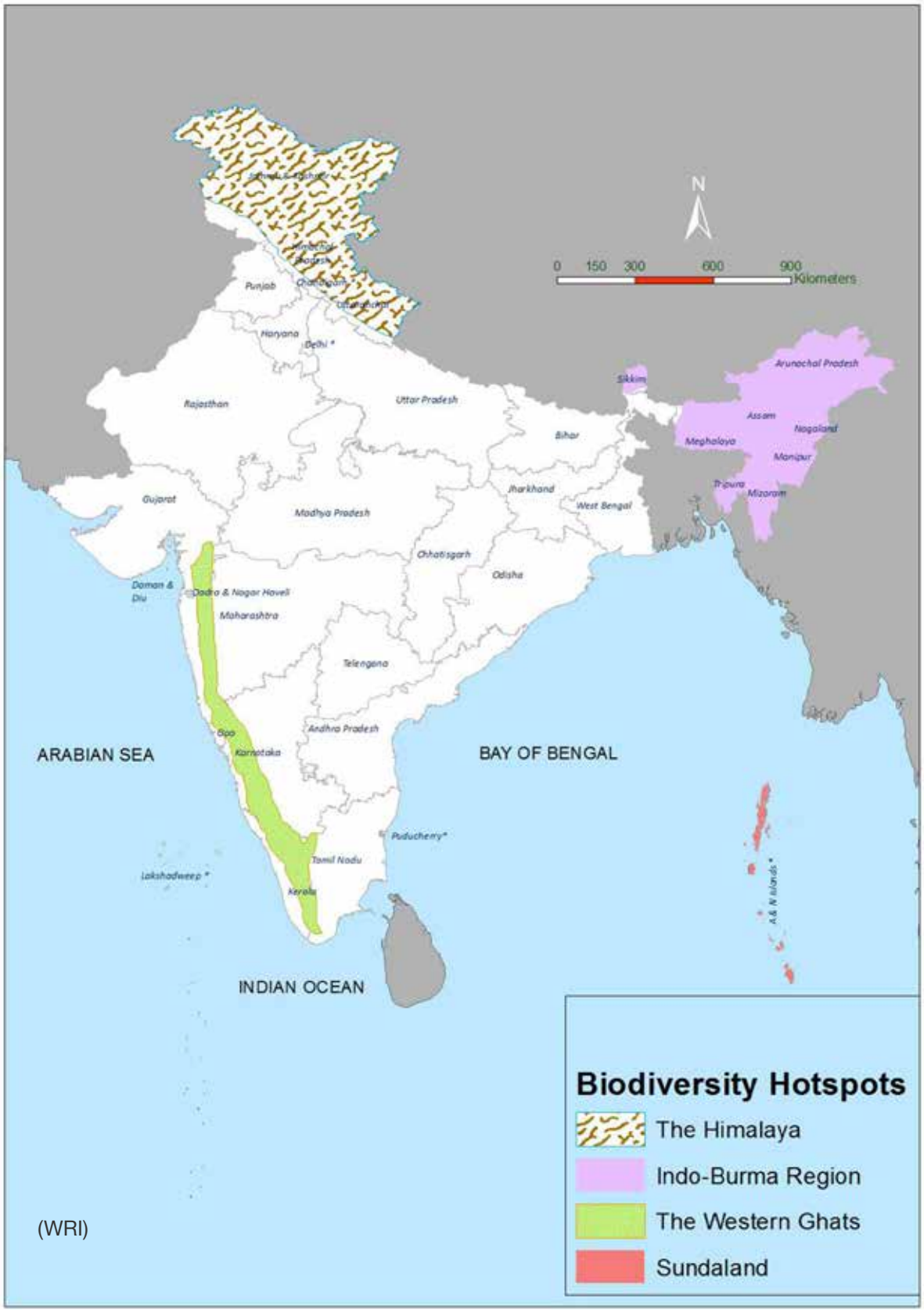
Global Biodiversity Hotspots in India

Four out of 35 global biodiversity hotspots of the world are represented in India viz. (i) the Western Ghats as part of the Western Ghats-Sri Lanka global hotspot, (ii) the Nicobar Islands as part of the Sundaland hotspot, (iii) parts of Assam and Meghalaya in the North-eastern region as part of Indo-Burma hotspot, and (iv) the Eastern Himalaya comprising North-eastern Himalayas of India, Bhutan and Nepal. Initiatives have been taken by government and non-government sectors for maintaining the integrity of these ecosystems. The Economics of Ecosystems and Biodiversity India Initiative (TEEB-TII) has involved local communities in enumeration of ecosystem services in valuation studies in the Western Ghats. The National Mission for Sustaining the Himalayan Ecosystems has undertaken studies and initiatives for conservation, rehabilitation and sustainable use of biodiversity in Himalayan hotspots. Local solutions for conservation and sustainable use of biological resources based on traditional knowledge (TK) are encouraged in hotspots areas.

2.5 Aquatic Ecosystems

The alluvial plains of River Ganga and Brahmaputra have extensive riverine aquatic ecosystem formations such as floodplains and oxbows known variously as *maun, beel, chaur, jheel and pat* locally. These sustain highly productive agriculture and fisheries, besides acting as natural flood defence for communities. In arid and semi-arid zones of the peninsular and western India, several water bodies have been constructed to support domestic water and irrigation needs. The arid zone spanning Rajasthan and Gujarat has vast saline flats, monsoon fed freshwater lakes as well as salt lakes such as Sambhar, Pachpadra, Deedwana and Lukransar. The Peninsular Deccan region abounds in man-made lakes

Figure 2.4 Global biodiversity hotspots of India



providing water for various human needs. Several of these such as Varthur, Rachenahalli and Amruthalli Lakes in Bangalore, and Kolleru in Andhra Pradesh also act as good habitats for waterbirds. The metropolitan area of Hyderabad and urban development area within Ahmedabad have strikingly high numbers of man-made lakes ranging over 400 and 600 in numbers, respectively. The narrow plains of the east and the west coasts are dotted with lagoons, backwaters, mangroves and salt lakes. High altitude lakes in the western and eastern Himalayas support breeding grounds and habitats for local biodiversity as well as important migratory bird species such as black necked cranes.

(i) Wetland Ecosystems

Wetlands are highly productive ecosystems supporting a wide array of biodiversity providing products and services vital for human welfare. The National Wetland Atlas 2013 (ISRO, 2013) has mapped 15.26 million ha area under wetlands, which is roughly equal to 4.6% of India's land area. Of this, the share of inland wetlands is 69.22% and remaining 27.13% is coastal wetlands. The major inland wetland types are rivers/streams, reservoirs/barrages, tanks, lakes and ponds. Coastal wetlands include inter-tidal mudflats, mangroves, aquaculture ponds and lagoons. Nearly 60% of the wetlands fall within protected forests.

India is a Party to the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat - an international treaty for the conservation and sustainable use of wetlands. India has declared 27 wetlands as Ramsar Sites, Sunderbans in West Bengal was declared as Wetland of International importance in February 2019. The List of Ramsar Sites can be seen in Annexure 3.

(ii) Coastal and Marine Ecosystems

India's coastal and marine ecosystems encompass 7,517 km long coastline, 2.02 km^2 Exclusive Economic Zone (EEZ), island ecosystems, and a wide continental shelf. These ecosystems include estuaries, mangroves, coral reefs, lagoons, seaweed and seagrass meadows. These meadows serve as nursery grounds for a vast number of faunal communities. Altogether 20,444 species of faunal communities have been recorded from marine and coastal environments of India, which is 7% of global marine diversity. (Chandra *et al*., 2016)

Gurudongmar lake, Sikkim

(iii) Diversity of Marine Ecosystems

(1) Mangrove Ecosystems

They occur mostly in the inter-tidal region between mean sea level to the highest spring tide in the tropical and sub-tropical regions of the world. They provide a breeding and nursing ground for various marine and pelagic species, livelihoods for the coastal communities' dependent on collection of honey, tannins, wax and fishing. They protect coastal areas from storm surges and tsunamis. Their protective role has tbeen widely recognized especially after the tsunami of 2004. Mangroves are spread over an area of 4,921 km^2 in India which is nearly 3.3 % of the world's mangrove vegetation. Sundarbans in the West Bengal accounts for almost half of the total area under mangroves in India. About 4,580 faunal and 920 floral mangrove species have been recorded from India (Zoological Survey of India (ZSI), 2018).

(2) Seaweed Ecosystems

They are marine macro algae under three phyla or divisions, namely, Brown Algae, Red Algae, Green Algae. A total of 936 species of marine algae have been recorded from marine and coastal environments of India. (Central Marine Fisheries Research Institute (Manisseri *et al*., 2012)). These systems provide breeding strands for many marine organisms.

(3) Seagrass Ecosystems

A total of 14 species of seagrasses are reported in Indian waters. Seagrass meadows are found in eastern and western coasts, Lakshadweep islands and Andaman and Nicobar Islands. Seagrass meadows play a significant role in the processes and resources of near shore coastal ecosystems, contribute substantially to carbon sequestration and support a high diversity of fauna. The health of seagrass meadows is closely tied to that of mangroves and coral reef ecosystems as many fish migrate between these habitats for food and shelter (Central Marine Fisheries Research Institute (CMFRI), 2012).

(4) Coral Reef Ecosystems

Coral reefs are formed of colonies of tiny invertebrates called coral polyps. Corals reefs occupy less than 0.2% of the total area under oceans; but they support nearly 25% of all marine species. India has 5,790 km^2 of coral reefs. This is just 1% of world's coral reef area. About 25% of all reef forming shallow water corals are found in

Mangraove wall

these waters. Gulf of Kachchh in the North-West and the Gulf of Mannar in the South-East host these. Patches of reefs are also found off the Malvan Coast (Maharashtra), Netrani Island and Gaveshani Bank, off the Mangalore Coast (Karnataka). They contribute significantly to the livelihoods of coastal communities. In the Gulf of Kachchh alone, the net annual benefit of coral reef ecosystems has been estimated at USD 47 million (http://www.moef.nic.in/sites/default/files/mff/Coral-Reefs-Rainforests-of-the-Oceans.pdf).

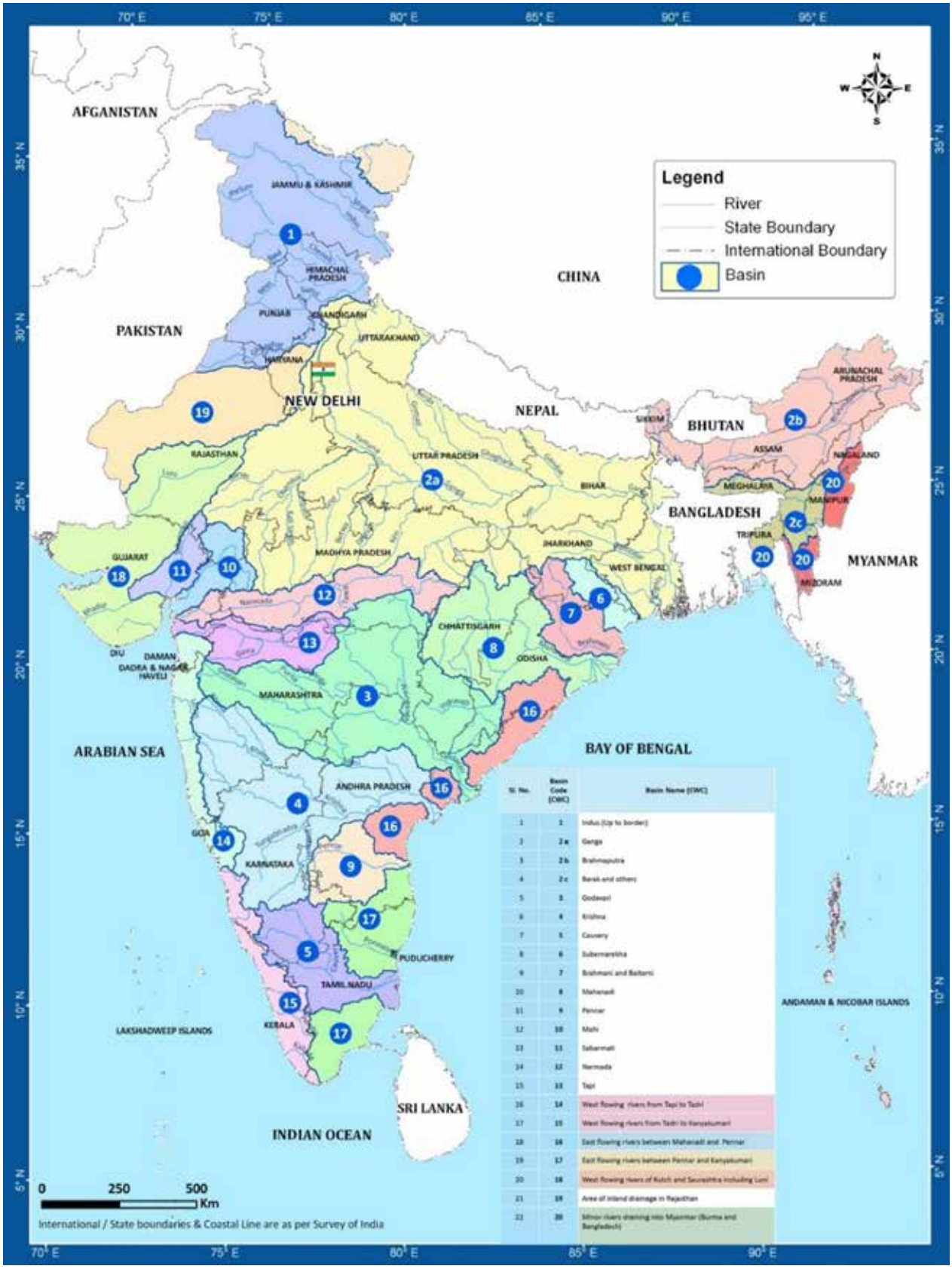
2.6 Riverine Ecosystems

The river systems of India can be classified into four groups viz. Himalayan rivers, Deccan rivers or Peninsular rivers, Coastal rivers and Rivers of the inland drainage basins. Himalayan rivers are perennial, fed by melting glaciers during summer and by rains during monsoon. The Gangetic basin is the largest river system in India, draining almost a quarter of the country. It travels a distance of 2,525 km from hills to the sea housing nearly 40% of India's population in its basin. The biodiversity hosted by river Ganga includes Gangetic Dolphin, the national aquatic animal. The rivers of the Indian peninsular plateau are mainly fed by rain. During summer, their flow is greatly reduced, and some of the tributaries even dry up, only to be revived in the monsoon. The Godavari basin in the peninsula is the largest in the country, spanning an area of almost one-tenth of the country. The rivers Narmada and Tapti flow almost parallel to each other but empty themselves in opposite directions. These two rivers make the valley rich in alluvial soil, teak forests cover much of the land. Coastal rivers flow down the peaks of the Western Ghats into the Arabian Sea in torrents during rains. Rivers in Rajasthan are mainly seasonal in character. These drain into the inland basins and salt lakes.

The 20 river basins/draining areas that these systems form within the country are shown in the Figure 2.5.

Narmada river, Bheraghat, Jabalpur

Figure 2.5 River basins of India



(Water Resource Information System (WRIS))
http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=Main_Page

2.7 Agrobiodiversity and Agroecosystems

Agrobiodiversity essentially includes the entire genetic diversity covering harvested crop varieties, livestock breeds, fish species, non-domesticated and wild plants and animals within field, forest and aquatic ecosystems. It includes soil microbiota, pollinators and other insects such as bees, butterflies, earthworms, greenflies as well as non-harvested species in the wider environment that support food production ecosystems. The genetic diversity has evolved through natural selection processes and the careful selection and development of genetic resources by farmers, herders and fishers over millennia (FAO, 2018).

India is recognised as one of the 12 Vavilovian centres of origin and diversification of cultivated plants of the world, known as the "Hindustan Centre of origin of crop plants". It is fourth globally in coarse warm-weather annual cereal production of short duration crops such as sorghum, pearl millet, maize, and finger millet in rainfed agro-climatic regions. It is the leading producer of millets in the world. It supports a variety of agroecosystems, and agrobiodiversity hotspots.

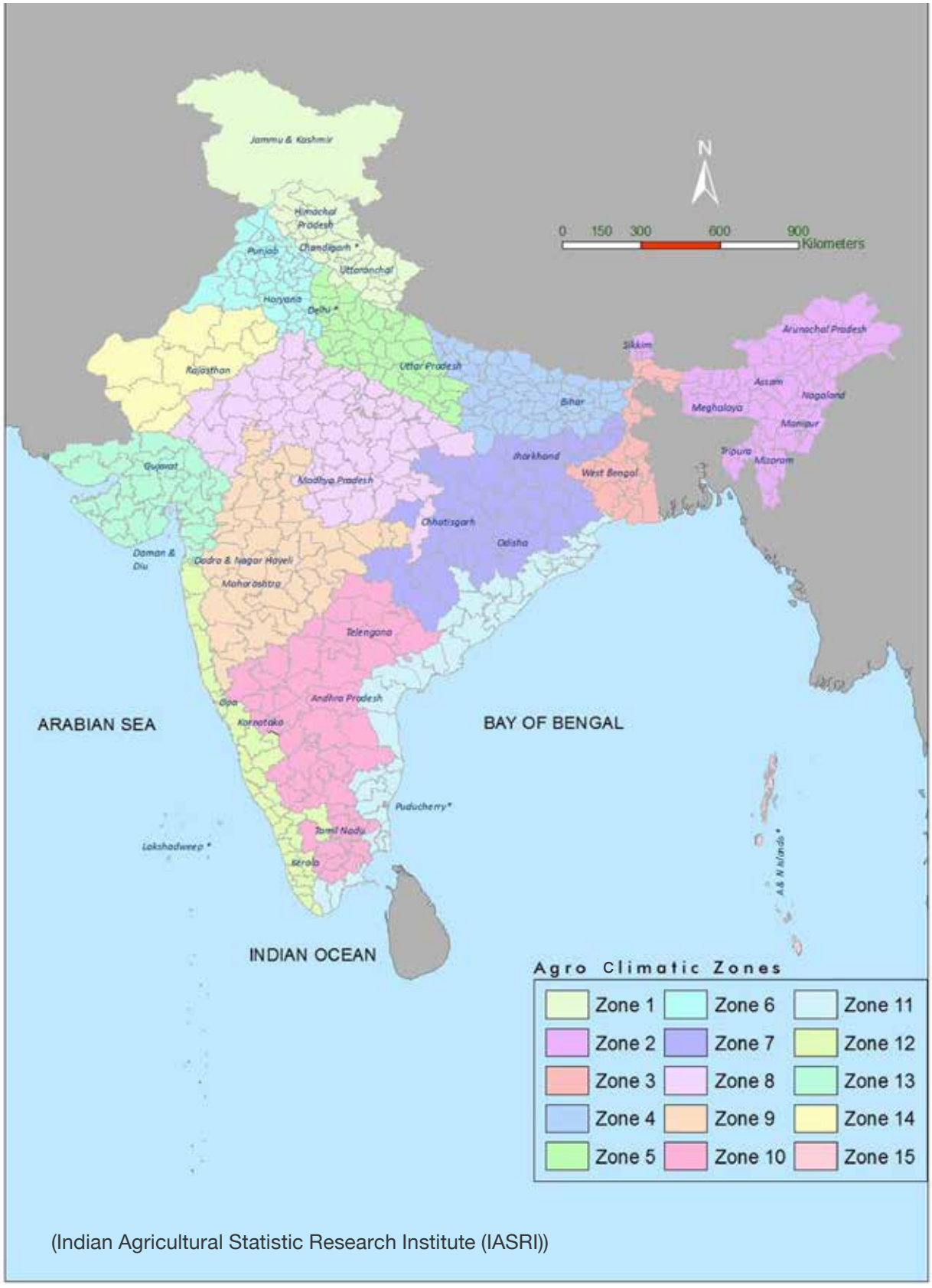
(i) Agroecosystems

Fifteen different agro-climatic zones have been identified that determine and influence the nature of agrobiodiversity in these zones. Different sets of farming practices have evolved over centuries in different agro- ecological areas suited to the specific local climatic, edaphic and landscape features. Figure 2.6 shows the 15 agro-climatic zones of India. The list of these zones can be seen in Annexure 4.

The agro-climatic zones create a rich array of landraces and traditional varieties of crops and other elements of agrobiodiversity. These landraces, traditional varieties and Crop Wild Relatives (CWRs) are important for sustainability of crops, particularly for adaptation and sustainability against the impacts of climate change.

A Pearl millet field

Figure 2.6 Agro-climatic zones of India.



(ii) Agrobiodiversity Hotspots

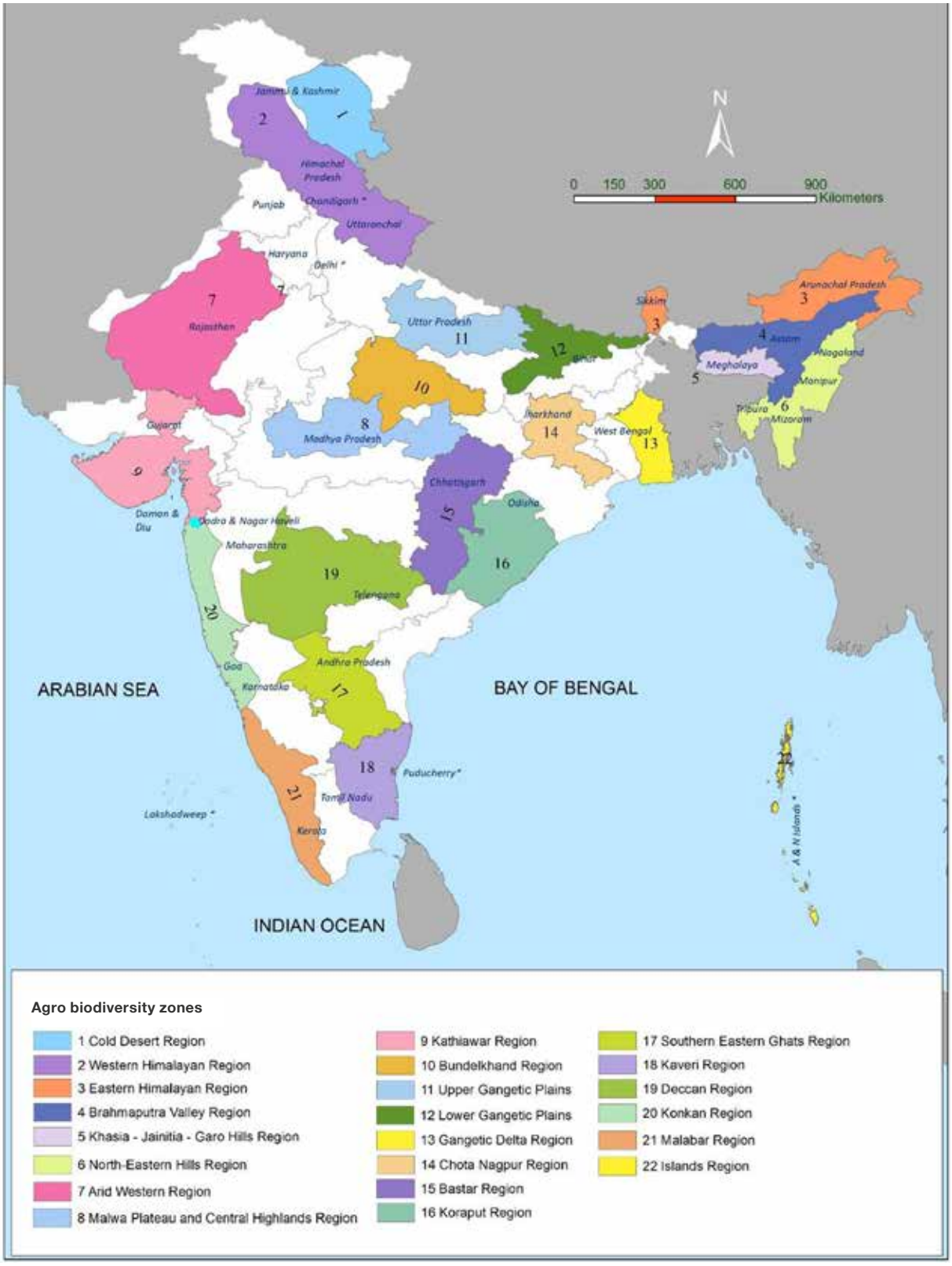
The Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA) has identified 22 agrobiodiversity hotspots in India based on the number of species, crop varieties, wild relatives of cultivated crop species, social relevance, ancientness of agriculture, number of species domesticated and the uniqueness of the agroecosystem. Figure 2.7 gives the distribution of these hotspots.

Citrus Gene Sanctuary

India set up its first gene sanctuary in the Garo Hills of Assam for wild relatives of citrus in 1980s. The distinct microclimate of the area having a combination of tropical and temperate seasons and heavy rainfall in the area offers an environment conducive to citrus plants. Rare varieties such as *Citrum acroptera* (Melanesian sour orange), *Citrus aurantifolia* (lemon) and *Citrus grandis* (pummelo) grow abundantly in the region. The sanctuary conserves these rare citrus species *in situ.*

Rural women planting rice in the field, Tamil Nadu

Figure 2.7 Agrobiodiversity hotspots



(Indian Agricultural Statistic Research Institute (IASRI))

2.8 Agriculturally Important Insects

Beneficial insects provide ecosystem services to agriculture such as pollination and the natural regulation of plant pests which are extremely important from a conservation and production perspective. These beneficial insects regulate the pest population of many harmful pest species, generate natural products, dispose waste and recycle nutrients. The National Bureau of Agricultural Insect Resources (NBAIR) maintains accessions of these. Table 2.2 shows the genetic diversity of agriculturally important insects held by NBAIR.

Table 2.2 Genetic diversity of agriculturally important Insects held by NBAIR

S. No.	Insect groups maintained or registered	Number of accession / holdings Indigenous	Exotic
I	Hosts / Pest Insects	25	
1	Predators	16	1
2	Parasitoids	56	17
3	Silkworms	357	157
4	Detrivores	1	
5	Total live insects germplasm holdings	630	
II	Total Museum Holdings	1,70,654	

(NBAIR)

Chanterelle mushroom *(Cantharellus cibarius)* | Source: Andreas Kunze

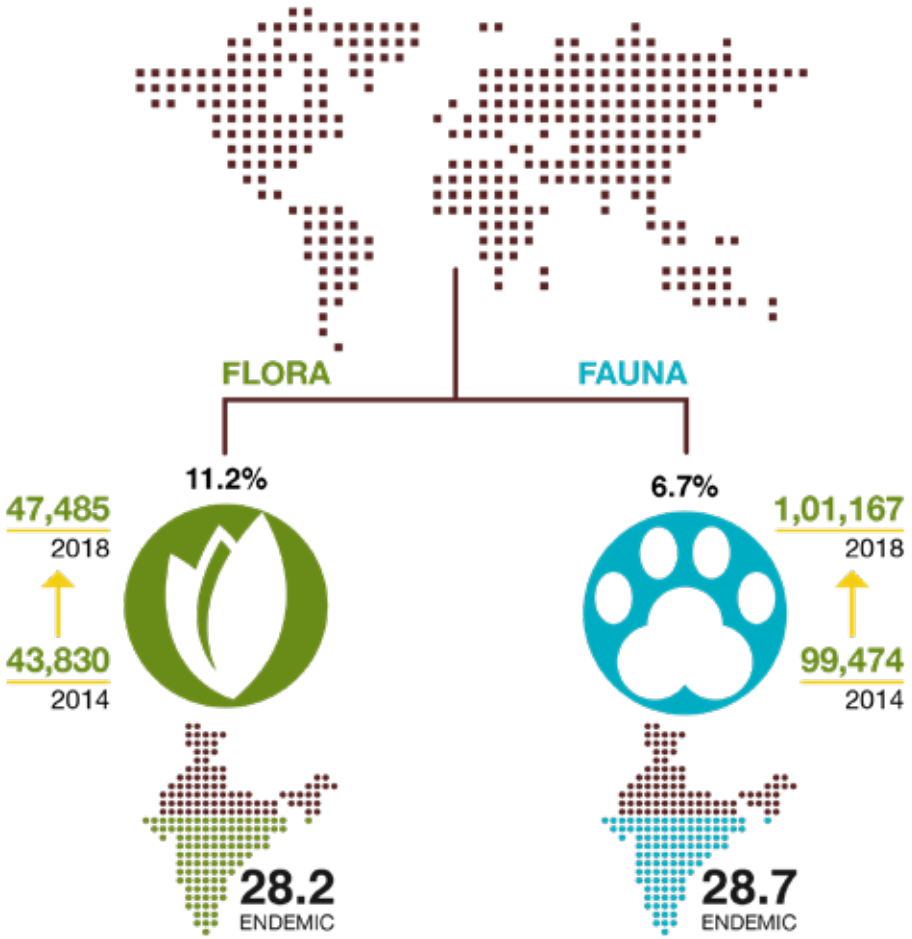
2.9 Microorganisms

Microorganisms are described as *'silent and unseen majority of life'* on the earth. Their genetic and metabolic diversity is enormous. They are associated with all ecosystem processes and maintain the functioning and homeostasis of the ecosystems. Globally, many microbial bioresource centres (mBRCs) /culture collections have been established which conserve microbes for finding solutions to problems associated with agriculture and other economic sectors essential to humankind. National Agriculturally Important Microbial Culture Collection (NAIMCC), a unit of National Bureau of Agriculturally Important Microorganisms (NBAIM) conserves microbial cultures from all over India including from the unique ecosystems such as hot and cold deserts and thermal springs. So far, 1,540 bacteria, 157 archaea, 260 fungi and 200 actinomycetes have been isolated after surveys. NAIMCC holds 6,350 agriculturally important microorganisms which include 2,319 bacteria, 3,804 fungi and 228 cyanobacteria from different agro ecological zones of India. (NAIMCC- http://nbaim.org.in/pages/services-culture-collectionnaimccculture-collectionnaimcc)

2.10 Diversity at Species level

As part of their mandate, Botanical Survey of India (BSI) and ZSI, the more than a century old premier organisation of the country, continuously undertake surveys to identify and describe new species. An increase of 3,655 in floral and 1,693 in faunal species has been registered in the last four years since the submission of India's fifth National Report. This is depicted in the figure 2.8.

Figure 2.8 Diversity at species level



(i) Floral Diversity

Angiosperms with 18,386 species i.e., a little over 37% of the identified floral species form the largest group in plant diversity. Fungi come next accounting for 31 % at 15,115 species. Table 2.3 shows recorded number of floral species, along with number of species endemic to India and approximate number of species considered threatened across major groups.

Table 2.3 Recorded floral species, their endemism and threat status

Group	Number of Species	Number of Endemic Species	Number of Threatened Species
Angiosperms Gymnosperms	18,386 81	4,303 12	1,242 7
Pteridophytes Bryophytes	1,293 2,754	66 629	414 80
Algae Fungi Lichens	7,396 15,222 2,528	1,924 4,100 520	Not known 580 Not known
Total	**47,807**	**11,554**	-

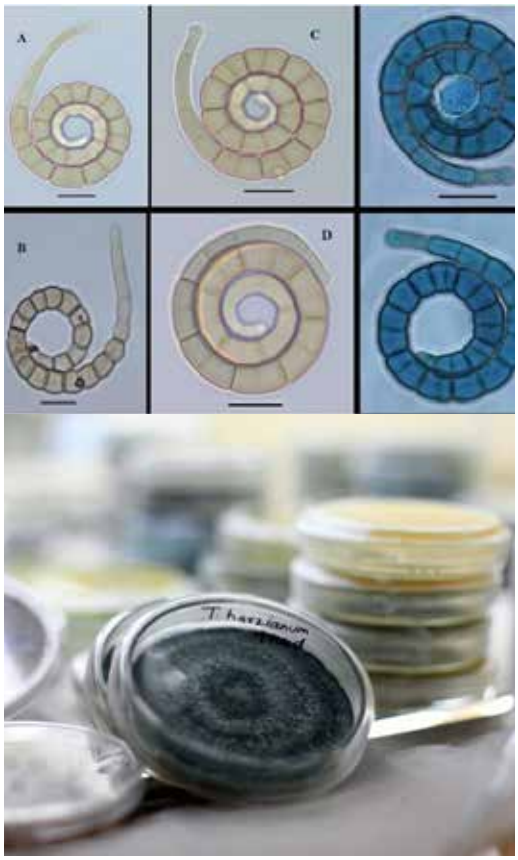
(BSI)

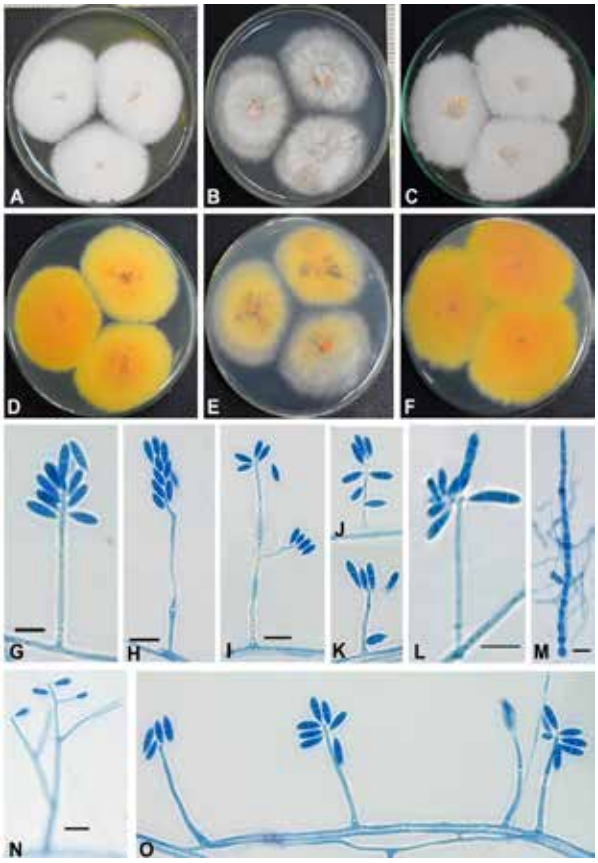
Ceropegia bulbosa

Richness of Fungi and Lichen Diversity in India

Lichens- Considered a good source of useful bioactive compounds and other activities useful for human benefits, lichens cover 8% or more of the earth's terrestrial area and are a significant component of biodiversity in many of the world's ecosystems. Agarkar Research Institute (ARI), Pune an autonomous grant-in-aid research institute of the Department of Science and Technology, houses a collection of about 30,000 dried herbarium samples of lichens belonging to more than 87 genera.

Fungi- About 350 host plants belonging to nearly 119 plant families have been screened so far out of identified angiosperm and gymnosperm species for identifying fungi. National Fungal Culture Collection of India (NFCCI) a national facility established in 2008 and an affiliate member of World Federation for Culture Collections (WFCC), holds nearly 5,000 fungal strains belonging t 18 genera collected from 29 states of India.





(ii) Faunal Species

Of the 1,01,167 species identified so far by ZSI, about 28,537 have been reported as endemic to the country comprising 28.2% of the known animal diversity of the country. Table 2.4 shows the known faunal species, their endemism and threat status. (ZSI, 2018)

Table 2.4 Recorded faunal species, their endemism and threat status

Group	Number of Species		Percentage Endemism	Threatened (No. of Species)
	Total	Endemism		
Protozoans	**3,525**	**640**	**18.2**	**-**
Invertebrates (including insects, spiders, ticks, mites, earthworms, crabs, molluscs, worms, sponges, marine invertebrates etc.)	**90,986**	**26,782**	**29.43**	**135**
Chordates, Cephalochordates, and Urochordates	**6,656**	**1,115**	**16.75**	**540**
Fishes	3,364	482	14.32	228
Amphibia	414	287	69.32	75
Reptilia	584	220	37.7	54
Birds	1,340	81	6.04	89
Mammals	427	45	10.53	94
Total	**1,01,167**	**28,537**	**28.2**	**675**

The Great Indian Bustard, Rajasthan

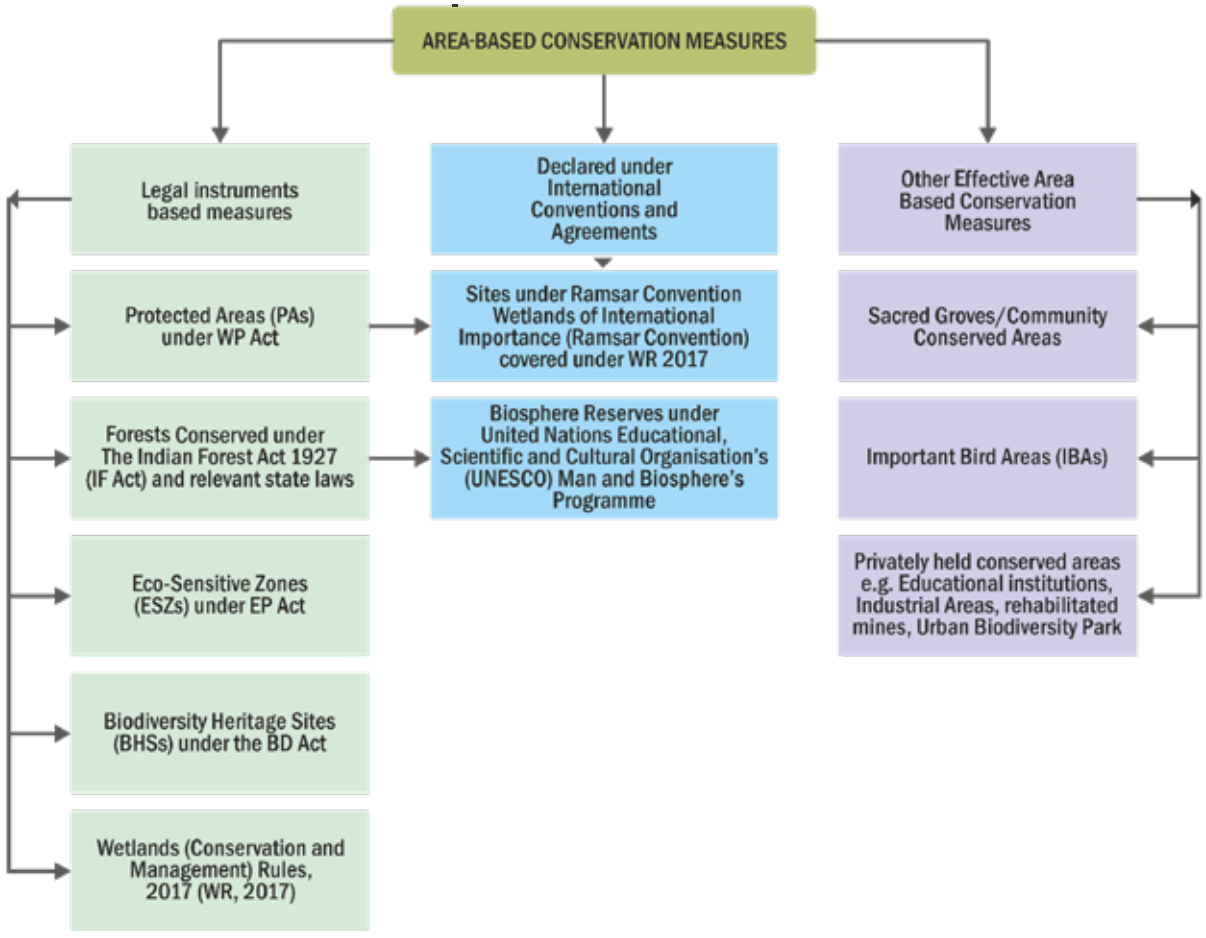
Status of Threatened Faunal Species

Total evaluated fauna as reported in India's Fifth National Report to the CBD (NR5) in 2014 was 4,681 species. Of these 646 were in threatened categories. Evaluated fauna in 2018 increased to 5,507. Of these, 675 species fall under threatened categories. The percentage of threatened species against evaluated species has come down from 13.8% in 2014 to 12.25% in 2018. Various conservation initiatives taken across the spectrum in India have shown a positive impact.

2.11 Area Based Conservation

Various area- based conservation measures have been shown in figure 2.9.
Total conservation areas add up to approximately 9 million km^2, i.e., 27 % of the geographical area of the country. Details of these areas have been included in chapter 7 on Forest Ecosystems and Sustainable Management of Forests.

Figure 2.9 Area-based conservation measures



2.12 Challenges

India has registered a drop in fertility rate from 2.6 in 2004 to 2.3 in 2014. It will, however, be sometime before the population of India stabilizes. Balancing the development and livelihood needs of the growing population and enhancing conservation of biodiversity is a serious challenge. Coherent and comprehensive policy, legislative and administrative measures have been institutionalized for biodiversity conservation and sustainable use of biodiversity. Implementation of these measures is often a challenge because of the multi-disciplinary nature of biodiversity. Historically, fragmentation and change in habitat use, over exploitation and technological change to meet the development needs have been the major drivers of change in biodiversity status. Climate change, invasive alien species and pollution have also emerged as the major threats now.

Effective and sustained measures are being taken through eight national missions, namely, National Action Plan on Climate Change (NAPCC) for adaptation to and mitigation of adverse climate change effects. Extension of education and awareness to people through various modes including use of public media has been extensively restored to achieve attitudinal shifts in people in favour of conservation of natural resources. Capacity building measures are being taken up on a regular basis to motivate and empower people to take conservation actions and adopt conservation friendly lifestyles. Effective enforcement of the FC Act, Notifications under the EP Act for regulation of activities in coastal zone areas, encouragement of organic agriculture and soil-health based application of inputs in agriculture, diversion of demands from forests and natural habitats to alternative sources have made substantial positive difference. But the challenges continue and need constant review and re-alignment of strategies to meet the emerging requirements. The ensuing chapters analyse the strategies and actions with the objective of mapping their impact and identifying areas of further consolidation and action, if any.

Blackbuck *(Antilope cervicapra)*

Cattle Egrets, Okhla Bird Sanctuary, Noida

Robin, Chintamani Kar Bird Sanctuary, Kolkata

Deer, Bandipur National Park, Karnataka

CHAPTER 3

Satellite view of Sunderbans

Policy and Legislative Framework for Implementation of NBAP

Implementation of NBAP

A comprehensive web of policies and laws has evolved in the country to address various aspects of nature conservation that NBAP seeks to achieve. The fundamental policy and legal support for its implementation is embedded in the Constitution of India which creates an abiding responsibility of the State and the people of India to take positive action for the protection and conservation of natural resources. The relevant provisions of the Constitution have already been noted in chapter 2. This chapter discusses the policy and legal instruments which contribute to the effective implementation of the NBAP in conformity with the mandate of the Constitution and international commitments of India under CBD and other biodiversity related environmental conventions. These include the Ramsar Convention on Wetlands, the Convention on the Conservation of Migratory Species of

Wild Animals (CMS), the Convention on the International Trade Endangered Species of Flora and Fauna (CITES), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), the International Plant Protection Convention (IPPC), United Nations Convention to Combat Desertification (UNCCD), and the United Nations Framework Convention on Climate Change (UNFCCC). Actions under NBAP also contribute to implementation of the Sustainable Development Goals (SDGs).

Policy Framework

The range of human actions and needs that impact biodiversity are varied and affect all ecosystems. Hence, nearly all sectoral policies of the government have a bearing on the conservation and sustainable use of natural resources, directly or indirectly. Annexure 5 gives the list of the sectoral policies that play important role in the implementation of NBAP. This section brings out the key elements of the four core policies, namely, NFP 1988, NEP 2006, National Agroforestry Policy, 2014, and National Policy on Marine Fisheries (NPMF), 2017, that directly relate to biodiversity and channelize conservation concerns into all other sectoral policies as well.

(1) NFP, 1988

Its goals include:

(i) To ensure environmental stability and maintain ecological balance.
(ii) To maintain atmospheric equilibrium vital for sustenance of all life forms – human, animal and plant.
(iii) To allow derivation of direct economic benefits but without disturbing the goals at (a) and (b) above to bring 33% of the geographical area of the country under FTC.

A new draft NFP is under consideration at present. It retains the core objectives of NFP, 1988 with, *inter alia*, greater emphasis on:

(i) conservation,
(ii) rehabilitation of degraded forests, and
(iii) greater involvement of local and traditional communities and women in conservation and management.

(2) NEP, 2006

It ensures coherence of purpose of conservation and enhancement of environment in all sectoral policies. It acknowledges and commits action on international environmental agreements to which India is a Party in conformity with India's commitments. Its goals include:

(i) Creating a consolidated and coherent guideline for all sectoral policies by outlining broad goals and parameters.
(ii) Ensuring integration of environmental concerns in all development planning and programmes.
(iii) Encouraging partnerships of different stakeholders such as public agencies, local communities, academic and scientific institutions, NGOs, and investment communities in securing environmental agenda.
(iv) Securing required synergy in all environment related issues and actions.

The broad goals and parameters of NEP, 2006 are integrated in sectoral policies. The specific elements pertaining to biodiversity in the NEP include:

(i) Creation of education and awareness for conservation and sustainable use of biodiversity with the involvement of people, particularly the traditional communities, the disadvantaged and the poor.
(ii) Integration of biodiversity values in all awareness building measures.
(iii) The adverse impact of environmental degradation on soil fertility, quantity and quality of water, air quality, forests, wildlife and fisheries is far more severe on the rural poor, tribals and women as it enhances and perpetuates poverty.
(iv) The most secure basis for conservation lies in ensuring that people dependent on

particular resources obtain better livelihoods from conservation than from degradation of the resources.
(v) Mutually beneficial multi-stakeholder partnerships between local communities, gender agencies, the academic and research community, investors and multilateral and bilateral development partners should become vehicles of enhancement of resources including technology and TK for conservation.
(vi) ESZs having environmental resources of incomparable values should be identified and conserved with adequate participation of the local communities.

(3) National Agroforestry Policy, 2014

The policy promotes tree plantation in complementarity with crops and livestock to:

(i) improve productivity, employment, incomes and livelihoods of rural households,
(ii) achieve efficient nutrient cycling and organic matter addition for sustainable agriculture,
(iii) expand vegetation cover,
(iv) increase FTC, and
(v) contribute to conserving natural resources and forests by meeting demand for timber, food, fuel, fodder and other agroforestry products.

(4) NPMF, 2017

The overarching goal of NPMF, 2017 is to ensure the health and ecological integrity of the marine living resources of India's EEZ for the benefit of present and future generations of the nation. Its goals include:

(i) Sustainable development of fisheries for socio-economic uplift of fishers.
(ii) Management of fisheries on the principle of subsidiarity and partnership and gender justice.
(iii) Harvesting and management based on precautionary approach to secure intergenerational equity.
(iv) Application of "Public trust doctrine in management while keeping fishers at the core".
(v) Mainstreaming biodiversity conservation in harvesting and production processes and management plans by adopting ecosystem approach to management.
(vi) Mainstreaming conservation of Ecologically and Biologically Significant Areas (EBSAs) and Vulnerable Marine Ecosystems (VMEs), protection of iconic and endangered and threatened species.
(vii) Review and periodic evaluation of the existing MPAs.
(viii) Harmonising conservation and tenurial rights of the traditional fishermen.
(ix) Blending TK with science on the principles of sound business and effective engagement.

The Policy recognizes that women constitute 66 % of workforce in post-harvest fisheries activities and includes sharp focus on their needs and development.

3.2 Legislative Framework

This section covers the enactments that directly deal with the elements and issues related to biodiversity.

(1) BD Act, 2002

The Act recognises India's richness in biological diversity and associated traditional and contemporary knowledge systems, acknowledges its commitment to implement the CBD and provides for "conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources and for matters connected therewith or incidental thereto."

The Act *inter alia* obligates the Central Government to:
(i) develop national strategies, plans and programmes for conservation and sustainable use,
(ii) institute measures to identify and monitor

areas rich in biological resources,

(iii) promote *in situ* and *ex situ* conservation of biological resources,

(iv) create incentives for research, training and public education to increase awareness about biodiversity, and

(v) integrate the conservation, promotion and sustainable use of biodiversity into relevant sectoral, cross sectoral plans, programmes and policies, "as far as practicable and wherever deemed appropriate."

The Act also includes specific provisions for:

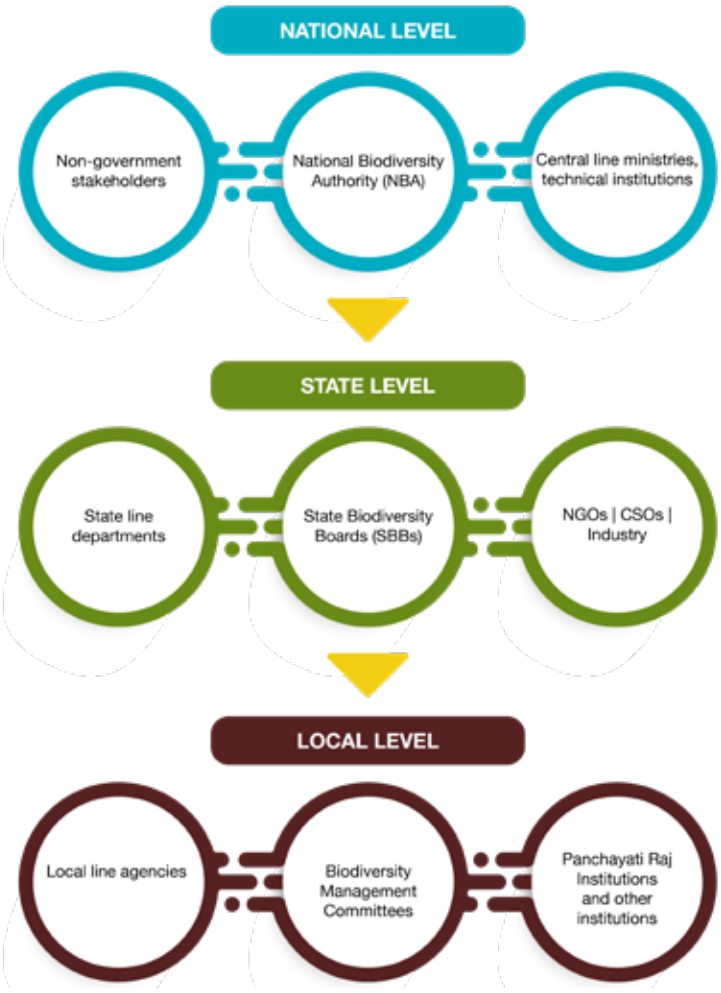
(i) notifying species which are on the verge of extinction, or likely to become extinct in near future as threatened species; rehabilitation of such species promoting Research and Development (R&D) and other necessary actions,

(ii) chronicling of knowledge related to biological resources at the local level with the object to respect, preserve and use such knowledge, and

(iii) conditionalities and modalities for seeking prior approvals for undertaking certain activities such as research, biosurvey and bioutilisation, and commercial utilisation, granting access to biological resources and associated knowledge for various purposes so as to ensure fair and equitable sharing of benefits from use of biological resources and associated knowledge.

The Act creates a three tier architecture for its implementation at national, state and the local levels. This architecture coordinates the implementation of the NBAP in collaboration with line agencies and other non-government stakeholders. Figure 3.1 shows the three tier structure and links with the line ministries/ departments and other stakeholder groups.

Figure 3.1 Implementation architecture for biological diversity



(2) IF Act, 1927 (last amended in 2017)

Its provisions include:

(i) criteria and modalities for reserving and designating forests for conservation and legal protection,
(ii) management of forest produce, and
(iii) issues regarding transit of the forest produce and the fees and duties leviable on this produce.

Directorate General of Forests in the MoEFCC at the central level, state forest departments and their subordinate agencies at lower administrative levels implement the Act.

(3) WP Act, 1972 (last amended in 2006)

It empowers the State to declare areas of ecological, faunal, floral, geomorphological or zoological association or importance as protected areas, under four categories, namely, National Parks, Wildlife Sanctuaries, Community Reserves and Conservation Reserves.
The wildlife division in the Directorate General of Forests in MoEFCC at Central Government level, and state wildlife departments and their subordinate offices at field level in states implement this Act.

(4) FC Act, 1980

The Act governs matters relating to diversion of forest land for any non-forest purpose. The diversion of forest is made subject to:

(i) stringent scrutiny, and
(ii) recovery of net present value (NPV) and compensatory afforestation equal to the area diverted.

(5) EP Act, 1986

It covers all matters relating to the protection and importance of environment at a broad level and empowers the State to issue notifications to protect the environment whenever necessary. An example of this is the Coastal Regulation Zone Notification (CRZN) issued by Ministry of Environment and Forests, 2019 declaring coastal stretches as Coastal Regulation Zone (CRZ) to regulate industrial and other activities in CRZ towards ensuring conservation and protection of coastal areas, coastal ecosystems and the livelihoods of the coastal communities.

(6) WR, 2017

These Rules have succeeded the Wetland (Conservation and Management) Rules, 2010. WR, 2017 aim at conservation and wise use of wetlands making states responsible for conserving and sustainably managing wetlands recognizing the fact that land and water, the two major ecological constituents of wetland ecosystems are enlisted as State subjects as per the Constitution.

(7) The Plant Quarantine (Regulation of Import into India) Order, 2003 (PQO, 2003)

Notified under the Destructive Insects and Pests Act, 1914, it aims at preventing introduction of:

(i) exotic pests,
(ii) diseases, and
(iii) weeds likely to get introduced through import of agricultural commodities or plants/ materials into India.

It is implemented through 59 Plant Quarantine Stations (PQSs) located in various states.

(8) The Protection of Plant Varieties and Farmers' Rights Act, 2001 (PPVFR Act, 2001)

The Act has established an effective system for:

(i) protection of plant varieties,
(ii) recognition of varieties traditionally cultivated and evolved by farmers in their fields,
(iii) recognition of wild relatives or landraces of a variety about which the farmers possess the common knowledge, and
(iv) farmers' and plant breeders' rights including rights in respect of their contributions made at any time in conserving, improving and

making plant genetic resources available for the development of new plant varieties, and encouragement to development of new varieties of plants.

The PPVFRA set up under the Act ensures its implementation.

(9) The National Green Tribunal Act, 2010 (NGT Act, 2010)

The Act establishes a National Green Tribunal (NGT) inter alia for effective and expeditious disposal of cases relating to environmental protection, conservation of forests and other natural resources.

(10) The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (Forest Rights Act, 2006)

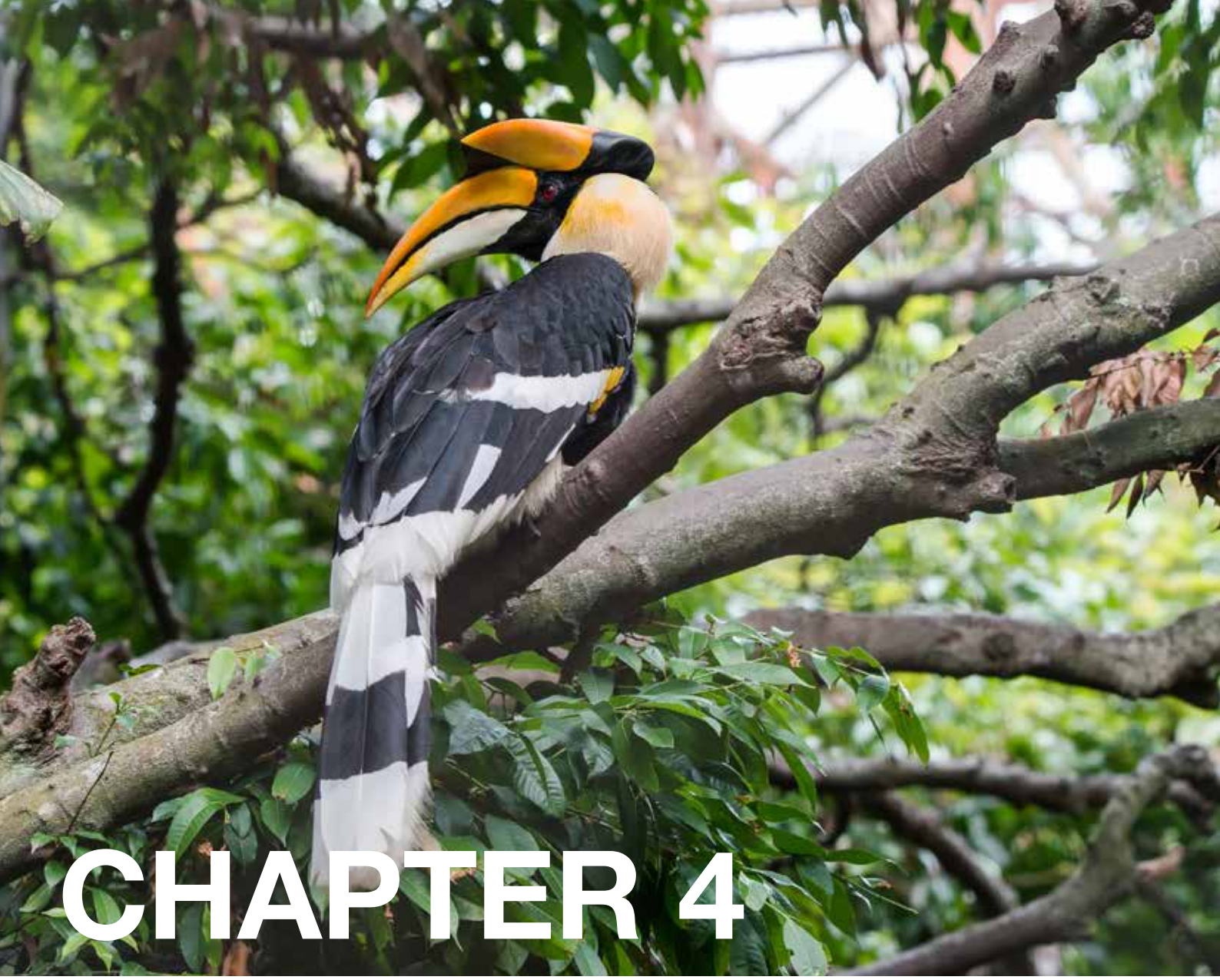
The Act recognizes and vests the forest rights and occupation in forest land in the forest-dwelling Scheduled Tribes and other traditional forest dwellers, who had been residing in such forests for generations but whose rights could not be recorded in the past.

The Act also seeks to balance these rights with the responsibilities for sustainable use, conservation of biodiversity and maintenance of ecological balance so that forests are conserved while ensuring the livelihood and food security of the forest dwelling Scheduled Tribes and other traditional forest dwellers.

Section 3(1) of the Act enumerates the types of rights that the Act recognizes. These include "Right of access to biodiversity and community right to intellectual property and TK related to biodiversity and cultural diversity".

Several other biodiversity relevant legislations that help in securing conservation and sustainable use of biodiversity include Mineral Conservation and Development Rules (MCDR) 2017, The Energy Conservation Act, 2001, Panchayats (Extension to the Scheduled Areas) Act, 1996 (PESA Act) The Patents Act, 1970 and the Mahatma Gandhi National Rural Employment Guarantee Act, 2005 (MGNREGA). See Annexure 6 for details.

A woman from Kamar tribe making bamboo baskets, Matal village, Chhattisgarh | Source: Shrikrishna Paranjpe



CHAPTER 4

The Great Hornbill

Participatory Plans and Implementation at Different Levels of Governance

NBAP, 2008 with its Addendum 2014 reflects the national agenda for biodiversity determined through a participatory process as noted in Chapter One. The process included identification of 176 action points as a guide for achieving the outcomes. Implementation of this agenda requires its integration and ownership at all levels of governance in the country. It requires effective and meaningful participation of stakeholders at all levels allowing flexibility for adaptation of strategies to local requirements and inclusion of additional strategies wherever the possibilities exist or emerge.

4.1 NBTs related to Participatory Plans and Implementation

NBT 10 aims at making NBAP operational at different levels of governance with an inclusionary and effective approach. Broadly,

three tiers of governance are identified in India, viz, Central Government including the national/ regional level autonomous and technical organizations under the Central Government; State Governments and UT administrations including autonomous organizations set up by them at the state level, and institutions of local governance in the states at local level. These three tiers have several other administrative units such as zonal level administrative agencies and district level administrative agencies as intermediaries.

4.2 Horizontal and Vertical Integration of NBAP at the Three Levels

Horizontal integration of NBAP in all the related line ministries at the Central Government level, including in the institutions under these ministries, developed organically through the process adopted for the preparation of NBAP, 2008 and Addendum 2014. However, most of the field action for implementation lies in the jurisdiction of states/UTs. States formulate their own state annual plans and longer-term plans for their social and economic development goals. State specific legislative and policy frameworks, broadly aligned with national policies and legislations, provide the basic template for these plans. NBAP integration in state plans was secured through the State Biodiversity Action Plans (SBAPs). These were prepared by the states following an extensive process of consultations with stakeholders. SBAPs thus, reflect state specific ground realities in the implementation of NBAP. They ensure an inclusive and decentralised approach to the governance and management of biodiversity. Participation of women and local communities in governance is integral to these SBAPs at the state as well as sub-state level.

Institutions that participate in implementation at the local level include institutions of local governance known as Panchayati Raj Institutions (PRIs), JFMCs, BMCs and Gram Sabhas in the areas falling under the purview of Forest Rights Act, 2006 and the PESA Act in their respective jurisdictions.

4.3 Inclusive Governance and Implementation in Operation

Government Policies are implemented through schemes and programmes which include specifically constituted missions and projects. The implementation basket of NBAP includes Central sector schemes which are either fully funded by the Central Government or Centrally sponsored schemes which are jointly funded by the Central and the state governments, and state plan schemes funded by the state governments, and local level initiative by institutions of local governance from own resources or grants received from the state governments and other sources. SBAPs provide an integrated platform for central and state schemes implementation. Typically, SBAPs include a review of sectoral policies and programmes that affect biodiversity to flag the areas of concern and challenges for implementation. Measures are identified to secure interaction and cohesion among these policies and their implementation. Roles and responsibilities of various levels of administrative machinery and the other stakeholders including women and local communities NGOs and others are identified and assigned.

The Central Government schemes are implemented on the ground by the state government agencies, including through the institutions of local governance. Most schemes having a direct connect with biodiversity or its components are implemented through a mission approach to achieve the desired results. Vertical integration of these missions is secured by collaborative mechanisms of the Central and the state governments. Vertical integration of the Green India Mission (GIM) and National Mission on Sustainable Agriculture (NMSA) is shown as an example.

GIM Implementation Mechanism

Objectives: Increased FTC, improvement in the quality of forest cover and ecosystem services including biodiversity, hydrological services and carbon sequestration

National Level
1. National Governing Council chaired by Minister MoEFCC
2. National Executive Council chaired by the Secretary MoEFCC and co-chaired by Directorate General of Forests
3. Mission Directorate headed by a Chief Executive Officer

State Level
1. State Level Forest Development General Body chaired by Chief Minister/ Environment Minister
2. State level executive committee chaired by the Principal Secretary, Forests

District Level
1. District Forest Development Agency chaired by Chairman Zila Parishad
2. District Level Steering Committee chaired by district collector with representation of Integrated Watershed Management Programme (IWMP), National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and GIM.

Village Level
1. Gram Sabha or the committees mandated by Gram Sabha
2. Cluster level committees, JFMCs

National Mission on Sustainable Agriculture (NMSA)

Objectives: Making agriculture more productive, sustainable, remunerative, climate resilient, optimizing water utilization through the motto 'more crop per drop'.

National Level
1. National Advisory Committee (NAC) Chaired by the Secretary (A&C)
2. Project Sanctioning Committee (PSC) chaired by the Mission Director, NMSA

State Level
1. State Level Committee (SLC) chaired by Agriculture Production Commissioner
2. State Standing Technical Committee (SSTC) headed by the official nominated by the State and membership of universities and technical experts

District Level
1. District Mission Committee (DMC) chaired by the collector or CEO

Zila Parishad
2. Representation of line departments, Growers' Association and Krishi

4.4 Jurisdiction and Role of PRIs, Gram Sabhas and BMCs

(i) The Constitution (73rd Amendment) Act, 1992 and the PESA Act provide for devolution of some subjects on PRIs and Gram Sabhas for local level administration and governance. Subjects related to natural resources management form an important part of these. Box 4.1 lists these subjects.

Box 4.1 Natural resources related subjects for devolution to PRI

- Agriculture, including agricultural extension
- Land improvement, implementation of land reforms, land consolidation and soil conservation
- Minor irrigation, water management and watershed development
- Animal husbandry, dairying and poultry
- Fisheries
- Social forestry and farm forestry
- Minor forest produce
- Drinking water
- Fuel and fodder
- Non-conventional energy sources
- Maintenance of community assets.

(ii) The mandate of BMCs includes

- Preparation of People's Biodiversity Registers (PBRs) with the participation of people to document comprehensive information on local biological resources and associated knowledge, including their medicinal and other uses; and
- conservation including identifying and recommending new conservation areas as BHSs. Their proactive approach has led to the protection of 941.44 km2 areas as BHSs.

(iii) JFMCs and similar subject matter specific committees participate in governance and implementation in their respective fields.

4.5 Mandatory Participation of Women and Marginalised Sections

Active participation space has been created for women, marginalised sections, local and traditional communities at all levels by mandating their representation in decision making bodies. To ensure effective inclusive governance, government has been investing in capacity building at all levels. Representation and participation of NGOs, academic and technical institutions is ensured in the committees at various levels.

The foregoing analysis makes it clear that biodiversity governance in India takes place through a complex network of people and institutions interfacing at multiple levels. Elected representatives, judiciary, ministries, departments, urban and rural institutions of local governance participate in devising and implementing laws, policies and programmes with the involvement and engagement of other stakeholders such as local communities, corporate and business sector, NGOs, academic and technical institutions.
Capacity building is undertaken at various levels; it needs to be expanded substantially given the diversity of the implementation machinery at various levels. Diversity of cultures, languages and state specific priorities create the need for substantial additional financial, technical and human resources. The succeeding chapters covering the thematic areas present the work done so far with the given resources.

Nubra valley, Ladakh

CHAPTER 5

Women volunteers clean out Water Hyacinth in Jeypore village, Odisha

Creating Communicaton, Education and Public Awareness for Biodiversity

Evolutionary history says that five mass extinction events took place over geological periods which influenced speciation and extinction rate on the earth. These were caused by natural disasters or phenomena of gradual change in earth's chemistry and physical topography. The number of species on the earth is the result of the equilibrium reached through these evolutionary processes of speciation and extinction. But now the extinction and erosion of species is taking place in the time scale of decades through human actions without giving the planet an opportunity of reaching the equilibrium.

People themselves are generally not aware of the rate of loss their actions cause and the consequences their own survival faces as a

result of extinction of species and degradation of habitats. Knowledge shapes people's perception about why and how biodiversity should be cared for, used wisely, conserved for sustainable use and inter-generational equity. A fundamental requirement of securing sustainable conservation of biodiversity requires that people are made aware of:

(i) the environmental, social, cultural, economic and intrinsic values essential for human wellbeing,
(ii) consequences of its loss, and
(iii) the responsibility that each person must share to arrest the loss and restore whatever is possible.

Creation of Communication, Education and Public Awareness (CEPA) is therefore the first requirement of any action to save biodiversity.

5.1 NBTs related to CEPA

NBT 1 covers CEPA with the aim of making a significant proportion of the country's population, especially the youth, aware of the importance and capable of taking decisions to conserve and sustainably use biodiversity. Elements of CEPA permeate all NBTs and SDGs.

5.2 Progress and Achievements

India's population is estimated to be 1.33 billion today. Biodiversity matters for each one of this population. While the aim is to reach the entire population through CEPA, specific priority has been assigned to reaching the following groups.

1. Youth and School Students

Youth constitute 35% of the population. School students and youth together add up to nearly 54 % of the total population. Their active engagement in gaining knowledge regarding conservation and participation in remedial activities contributes to immediate positive action, and it creates a foundation for long term sustainability of such biodiversity friendly attitudes and capabilities. Environmental Education (EE) and several other initiatives contribute to awareness and capacity building of this identified group.

- **EE** has been made compulsory in curricula at all levels of education throughout the country. Biodiversity conservation and sustainable use are an integral part of EE. To ensure quality in EE:

(i) Modules/courses for EE have been professionally designed by National Council of Educational Research and Training (NCERT) and University Grants Commission (UGC) in compliance with the order of the Supreme Court of India dated 06-12-1999 in Writ Petition no. 86199.
(ii) Pedagogical tools for transaction of EE have been professionally developed. See Box 5.1 for information on some pedagogical tools.
(iii) Capacity building of teachers and faculty members has been undertaken through various training programmes.

School children participating in plantation drive

Box 5.1 Some pedagogical tools for EE

Resource books, "Towards a Green School" (http://www.ncert.nic.in/departments/nie/dee/publications/pdf/towards%20A%20green%20school.pdf)

"The Environment Education Handbook: A Teacher's Resource" and other resource books at various levels guides school teachers. (http://ncert.nic.in/book_publishing/environ_edu/handbook/content.pdf)

Scheme of "Research Projects for Teachers" for University/College teachers includes environment as discipline. (https://www.ugc.ac.in/oldpdf/xiplanpdf/mrpxiplan.pdf)

Awareness camps for children

- **Other Major Initiatives for Students and Youth**
  Co-curricular programmes are funded by Central Ministries, Central Government, Departments, and state governments. MoEFCC supports Eco-clubs, National Nature Camps and Paryavaran Mitra Programmes.

(i) Eco-clubs Programme

Students are encouraged to constitute these clubs. These provide them with indoor and outdoor opportunities to learn, conserve, and spread the message to others. More than 1,00,000 eco-clubs with the membership of nearly 50,00,000 children have functioned over the years. States also fund eco-clubs in their respective jurisdictions. For details on MoEFCC Eco-club programme see (http://www.moef.nic.in/division/environmental-education-awareness-and-training-eeat).

Eco-club Members identify Genetic Diversity in Western Ghats A Global Biodiversity Hotspot

Nearly 10,000 members of 240 school eco-clubs and their teachers took part in a survey of 250 villages of 13 districts of Western Ghats region of Maharashtra and documented indigenous trees, associated local knowledge including the knowledge about their uses, seasonality and conservation history. Centre for Environment Education (CEE), Ahmedabad, a centre of excellence under the ENVIS of MoEFCC, organised this expedition. During this expedition, they identified 205 varieties of Mango, 24 varieties of Jamun, 18 varieties of Fanas or Jackfruit and 28 varieties of Karvand. Jackfruit (Artocarpus heterophyllus Lam.), Jamun/Jewish plum (Syzgium cumini. L. Skeels), and Custard Apple/Sweet Sop (Annona squamosal L.) form part of an ongoing research on nutritionally rich fruits and fruit trees by Bioversity International with its Indian partners to establish their nutritional value for people, particularly people in the vulnerable groups through tapping into horticulture diversity of the country. These pictures show children's pictorial depiction of the number of varieties they identified.

(ii) National Nature Camp Programme

Students undertake three- day field visits to PAs to get first-hand knowledge of the value of area-based conservation of species and habitats. Twenty camps of 50 students each are held with the financial assistance of Rs 20 lakhs per state/UT. Nearly, 1,16,000 students have already participated in these camps. (http://www.moef.nic.in/division/environmental-education-awareness-and-training-eeat)

(iii) Paryavaran Mitra (Friends of Nature)

The Programme creates a network of young leaders from schools across the country to make them enhance environmental sustainability. These leaders help create environmental citizenship qualities and positive changes in behaviour and actions at individual, school, family and community levels. Over 1,62,000 students have become Paryavaran Mitras. (http://www.moef.nic.in/division/centres-excellence)

(iv) Natural Resource Awareness Clubs programme (DNA Clubs)- Under a Department of Biotechnology (DBT) funded programme, school students visit institutions of excellence, undertake field excursions for first hand exposure to microbial, plant and animal resources, and carry out lab experiments. Mini-projects/ hands-on activities, lectures by invited eminent experts, audio visual shows, inter-and intra-school competitions on bio-resource based themes are part of the initiative. Nearly 1,00,000 students have participated in these clubs since the inception of the programme in 2007-08. (http://www.dbtindia.nic.in)

(v) Biotechnology Labs in Senior Secondary schools (BLiSS)
This programme in the North Eastern Region (NER) creates awareness about the use of biodiversity and biotechnology at the school level through well-equipped laboratories. (http://www.dbtindia.nic.in/dbts-bliss-program-for-teachers/)

(vi) Youth clubs for developmental activities including conservation of resources and greening the landscape under a programme of Ministry of Youth Affairs and Sports (MoYAS).

(vii) Engagement of children, youth and communities in undertaking campaigns to educate and train people in water management and water conservation under Swachh Bharat Abhiyan (SBA).

(viii) Specific training of the youth in environment, forest and wildlife sectors under the Green Skill Development Programme to enhance their employability under a programme of MoEFCC for which the BSI and ZSI have designed professionally sound curricula.

(ix) Mobile exhibitions such as the Science Express exhibition on diverse themes mounted on a railway train which has completed nine phases travelling across India. The Science Express ran as a 'Biodiversity Special' from 2012-2014 during India's presidency of the CBD-CoP.

(x) Science Express: 900,000 children have participated in this.

(xi) Mobile exhibitions by States such as Prakriti Bus by Uttar Pradesh government.

(xii) Involvement of youth and children in counting, identification, awareness generation and protection of birds through organisations specialised in ornithology and birdwatching such as Bombay Natural History Society (BNHS) and Sálim Ali Centre for Ornithology and Natural History (SACON). SACON has covered 242,371 persons in birdwatching.

(xiii) Vast network of botanic gardens maintained by BSI, Council of Scientific and Industrial Research (CSIR) institutions, universities, local-self-government bodies to provide opportunities of learning to visitors.

Children visiting Science Express

From Students' Trips to Saving Birds' Habitat
A Case study

Singanallur Lake in Coimbatore, Tamil Nadu was created in 7th Century AD to conserve the Noyyal river water for agriculture. Over centuries, it became an important habitat for birds and a transit destination of migratory birds. But with the expansion of urbanization, it had become a ground for dumping of all manner of wastes.

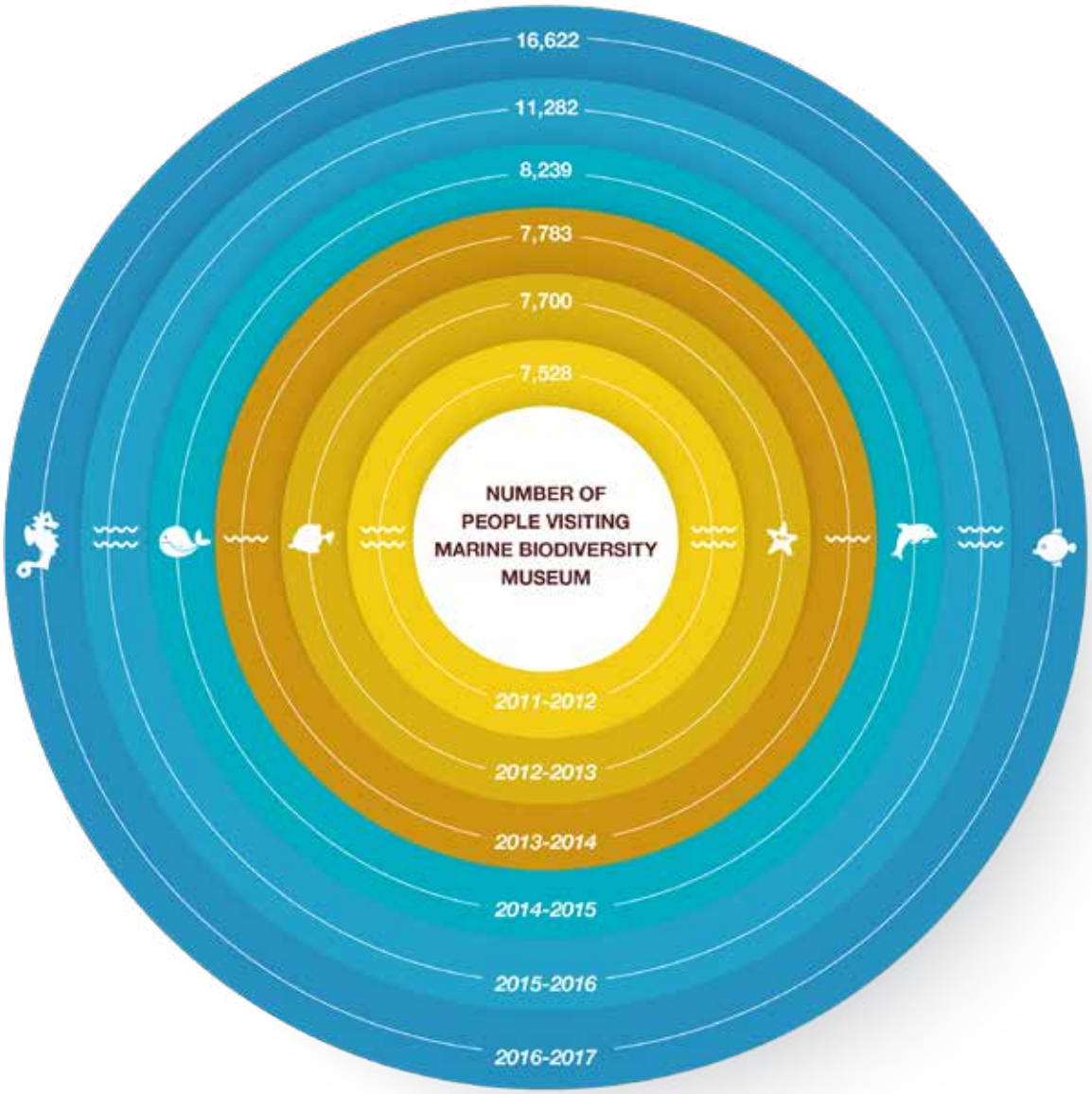
SACON has organised regular educational and bird watching trips of students and youth to the Singanallur Lake in recent years. The local yester year's students and youth in these trips have now restored the lake, identified more than 700 species of wild biodiversity which include 160 species of birds. The lake has been declared 'Urban Biodiversity Conservation Zone' in 2017 by the City Corporation. This restoration case has led to inclusion of wetlands conservation as the central agenda in the Smart City Programme of the city of Coimbatore.

(SACON)

Blue Pukeko at Coimbatore lake

Botanical / Zoological Galleries/ Natural History Museums are maintained for public viewing and education by BSI/ZSI/ CMFRI/National Museum of Natural History (NMNH). Large number of people of all ages including students visit these areas and institutions. The available data of the visit to parks show increasing trend with 2,936,985 to 4,030,069 visitors from the years 2011-12 to 2016-17 in the state of Tamil Nadu and increase from 1,144,116 to 1,657,815 visitors from the years 2009-2010 to 2016-17 in the state of Madhya Pradesh. The number of visitors to CMFRI Museum from 2011-12 to 2016-17 also shows an increasing trend signifying a positive trend towards understanding coastal and marine biodiversity.

Figure 5.1 Number of people visiting marine biodiversity museum



(CMFRI)

Mowgli Utsav in the State of Madhya Pradesh

Named after Mowgli, a fictional character of Rudyard Kipling's novel 'Jungle Book', this Utsav (festival) is organised annually by the State of Madhya Pradesh to sensitize school children to biodiversity related issues. The SBB organised the 2017 festival in the State in four National Parks- Kanha National Park, Madhav National Park, Bandhavgarh National Park and Satpura National Park and engaged children in activities such as nature trail, park safari, habitat search, quiz activity, painting competitions, message writing on banners, plays and other adventures. Nearly 300 students and over 100 teachers participated in the Utsav in 2017. Certificates and prizes are awarded to the winners of events in the Utsav every year. It proves as an effective means of reaching out to young minds to make them aware of the values of biodiversity and turn them into stakeholders in conservation.

Children celebrating Mowgli Utsav

(SBB, Madhya Pradesh)

2. Industry and Business

Economic and business decisions impact biodiversity substantively. Extension of CEPA to Industry and business to build a strong constituency for biodiversity conservation and sustainable use is of paramount importance. It has been done through various ways. They are a target for CEPA as well as facilitators for CEPA. They now participate in CEPA through funding support to NGOs and through their own corporate social responsibility (CSR) activities.

(i) An India Business and Biodiversity Initiative (IBBI) created in collaboration with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) anchored in Confederation of Indian Industry (CII) was facilitated by MoEFCC in 2014. Its purpose is to ensure mainstreaming of biodiversity and ecosystem services in the operations and supply chain of industry and business.

(ii) IBBI promotes awareness and green action to minimize adverse impact on the environment. Member companies sign a 10-point IBBI Declaration accepting their commitment towards positive action on biodiversity. It provides advisory services to companies on implementation of biodiversity regulations/policies, mainstreaming biodiversity conservation and ecosystem service management and monitoring.

3. Local Communities, Institutions of Local Governance

Awareness and capacity building of BMCs is done through workshops and issuance of guidelines from time to time and interaction between them and SBBs and NBA. Working of BMCs, as the core institutional set-up for biodiversity governance at local level, JFMCs as people's own management committees for forest, and the process of creating PBRs at local level create and extend awareness and capacity through open and transparent processes of decision making. They provide a continuing education and capacity building platform for current and future conservation and sustainable use actions at the occurrence level of biodiversity. The number of BMCs has reached over 1,44,000 by March 2019. The greater the awareness, the larger the number of BMCs as awareness encourages demand for constitution of BMCs for biodiversity governance.

4. Policy Makers and Government Functionaries

Their orientation leads to integration of NBAP in sectoral departments, planning and development programmes, technical and scientific institutions including universities in government and non-government sectors.

5. NGOs, CSOs, Individuals

These have generally been powerful contributors to extending CEPA in the society. Reaching them in turn through CEPA enhances their capacity, enables them to create required awareness in other sector specific NGOs/CSOs and also amongst general public and out-of-school children.

(i) For the identified target groups at 2 to 5 and people in general, the following initiatives have been undertaken so far. MoEFCC has created a comprehensive Environmental Information System (ENVIS) comprising a network of 69 ENVIS Hubs and Resource Partners (RPs) of which 29 deal with 'State of the Environment and Related Issues' are hosted by respective States/UTs, 40 RPs are hosted by governmental institutions/ NGOs/ institutes of professional excellence, with varied thematic mandates pertaining to environment, forests, climate change etc.

(ii) Nearly 300 national and regional level awareness programmes have been organised since 2014 by MoEFCC and NBA in collaboration with SBBs, NGOs, CSOs, for industry representatives, state officials, students, teachers, local communities, traditional healers and other stakeholders to extend CEPA.

(iii) Regular capacity building workshops and meetings with partners such as officials, Ayurvedic Drug Manufacturers' Association (ADMA), GIZ, Centre for Agriculture and Bioscience International (CABI) South Asia, Centre for Environmental Communication (CEC) and SBBs are conducted to raise awareness and create decision taking capacities amongst various participants.

(iv) Citizen Science Initiative is being implemented across the country through networks of NGOs. It enables participants to increase their scientific understanding, learn about environmental issues and contribute to research.

(v) Film/slide shows, lectures, tree plantations exhibitions, sit and draw/quiz competitions from time to time. Periodic festivals and events with the inclusion of biodiversity as one of the important thematic area are organised.

(vi) Participation in annually held Indian Science Congress by teams from NBA and SBBs is ensured to extend information on biodiversity issues and nuances of the BD Act, and Biological Diversity Rules, 2004 (BD Rules) to scientific community, academicians, teachers, youth and school children from across India.

(vii) Recognition of outstanding work, dissemination of best practices, to promote capacity and generate awareness.

(viii) Biennial India Biodiversity Awards instituted by MoEFCC in association with United Nations Development Programme (UNDP) during CoP 11 in 2012. These have now been institutionalised in the NBA. Till 2018, 47 awards have been given under different categories. The best practices identified under the Award are captured in the publication 'India Naturally!' Four editions have already been published.

(ix) E. K. Janaki Ammal National Award instituted in 1999 for outstanding contribution in the field of Plant Taxonomy, Animal Taxonomy and Microbial Taxonomy. Twenty- eight awards have been given till 2018.

Greater Adjutant

Women form Hargilla (Greater Adjutant) Army to Save the Bird

Fourteen self-help groups comprising five members each in villages of Dadara, Pacharia and Singimari villages of Assam, styled themselves as 70 women Hargilla army to defy and change the commonly held adversarial attitudes against Greater Adjutant Stork and save this IUCN red listed bird from disappearance from their villages, which used to be an important habitat of these birds.

It all started with the effective use of CEPA by a keen woman bird researcher determined to save the Greater Adjutant habitat in these villages. Once motivated, these women widened the support base for the Greater Adjutant by including children and other members of their households and neighbours. The persistent action of women secured the support of the district authorities in departments of administration, police, forest, health and the State Zoo Authority, each contributing to "Save the Greater Adjutant" goal in a coordinated manner. The case got IBA in 2016.

Significant outcomes include saving of all the Kadamba (Neolamarckia cadamba) trees which serve as Greater Adjutant Stork habitats, increase in nests from 28 in 2008 to 143 in 2015, establishment of rescue and rehabilitation system for injured birds in collaboration with Assam State Zoo, programmes for alternative livelihood options for the community under which 28 handlooms have been distributed among the 14 self-help groups. A Fashion and Textile Designing diploma course with a specially-designed Greater Adjutant stork introduced for women. Over 10,000 people were mobilised and sensitised for the conservation of the bird.

A street play organised by Women Hargilla Army

5.3 Trans-boundary Regional Level Initiatives and Contributions

India participates in the projects shown in Table 5.1 with other countries in the region.

India has contributed to the regional cooperation and capacity building by sharing its experience of various processes of implementing NBAP. Field visits were also organised for participants from the other countries to have a first-hand experience of the constitution and functioning of the BMCs and other related processes.

5.4 Challenges

India has 22 recognised state languages and many more dialects at the sub-regional level. Creating communication material which can easily reach the target groups is a challenge. This also comes in the way of mapping and disseminating best practices and good case studies. The area of invasive alien species requires more studies and communication material. Capacity also needs to be created in BMCs to progressively map best practices in their own jurisdiction and access these from wider areas and wherever needed include them as addendum to PBRs. Greater financial, technical and scientific resources are needed for creating communication packages in vernacular languages.

Table 5.1 Initiatives taken for awareness and capacity building

Initiative	Objective	Countries
ASEAN India Green Fund	Announced by India in 2007 at the 6th Association of Southeast Asian Nations (ASEAN) – India Summit for collaboration on Access and Benefit Sharing (ABS), City Biodiversity Index and Strategic Plan for Biodiversity. NBA, MoEFCC, MEA, ASEAN Centre for Biodiversity, ASEAN Secretariat are jointly implementing the initiative.	Indonesia, Singapore, Philippines, Malaysia, Brunei, Thailand, Cambodia, Lao PDR, Myanmar and Vietnam
Trans-boundary projects	Projects - Kailash Sacred Landscape Initiative (KSLDI) across borders of India, Nepal and China, Bay of Bengal Large Marine Ecosystem Project (BOBLME) involving 8 littoral states, promote biodiversity conservation through exchange of information with participating countries.	Nepal and China
Other Regional initiatives	Capacity building and experience sharing with SAARC, ASEAN and African countries.	Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan, Sri Lanka, Indonesia, Singapore, Philippines, Malaysia, Brunei, Thailand, Cambodia, Lao PDR, Myanmar, Vietnam and African countries

CHAPTER 6

Sandstone mountains, Leh

Integration of Biodiversity Values in Planning and Poverty Alleviation

These values lie in the ecosystem services that biodiversity provides. These services are essential for the survival of the planet, including for food production, secure living conditions and human health. Biodiversity has environmental, social, cultural, economic and intrinsic values. Biodiversity values have often not been accounted for in decision making because of externalities and the lack of understanding regarding their nature and the costs of losing them. One of the telling examples of the cost of losing biodiversity was demonstrated by lower agricultural yields, erosion, depleted water resources, and increased flooding in the areas surrounding the forest areas which had been denuded by industrial logging in Uttarakhand in the early 1970s. Industrial logging was also seen to be one of the main causes of the severe monsoon flood that killed 200 people in 1970. The Government eventually banned logging in

this area after protest from local people through Chipko Andolan. Similar examples exist in other parts of the country also.

Developmental, industrial and other economic activities use natural resources. Poverty alleviation programmes essentially aim at creation of opportunities for sustainable livelihoods for the vulnerable sections of the society including women, who heavily depend on primary sector activities, habitats and use of natural resources. Integration of values of biodiversity in planning and implementation of these programmes is necessary.

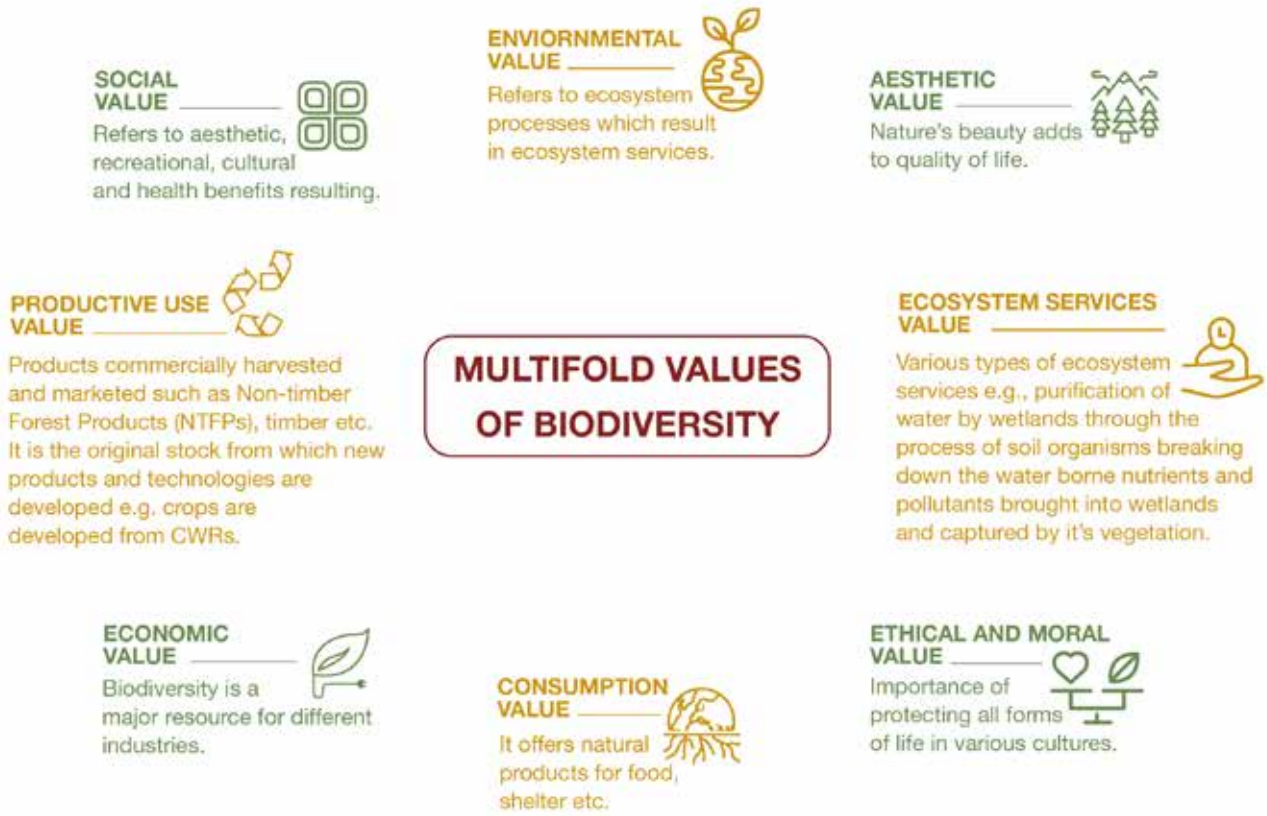
6.1 NBTs related to Integration of Values of Biodiversity

NBT 2 aims at integration of values of biodiversity in national and state planning processes and poverty alleviation programmes. It is relevant to all other NBTs.

6.2 Progress and Achievements

(i) Multifold Values of Biodiversity
Value of biodiversity is multifold. Expert opinions place it in the range of 6 to 8 types of values. These are depicted in Figure 6.1.

Figure 6.1 Multifold values of biodiversity



Neelakurinji, Western Ghats

(ii) These multifold values have been classified into four types of ecosystem services, namely, Provisioning Services, Regulating Services, Supporting Services and Cultural Services. The types of services mapped by the studies are shown in figure 6.2, 6.3 and 6.4.

Figure 6.2 Wetlands ecosystem services

PROVISIONING SERVICES	REGULATING SERVICES	SUPPORTING SERVICES	CULTURAL SERVICES
Food	Water Purification	Aquatic biodiversity and Habitat services	Aesthetic and Recreational Services
Water	Water Provisioning	Nutrient cycling	Spiritual
Raw materials			
Employment			

Figure 6.3 Forests ecosystem services

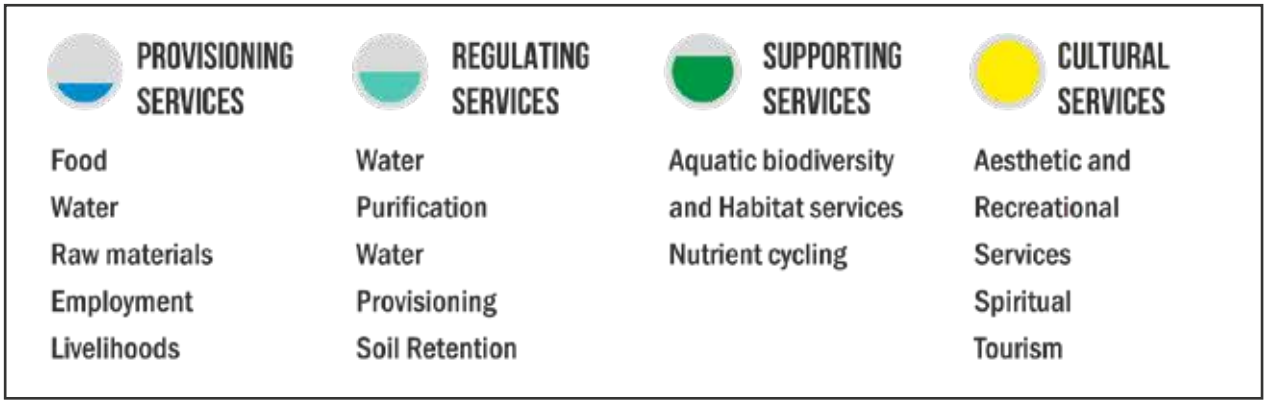
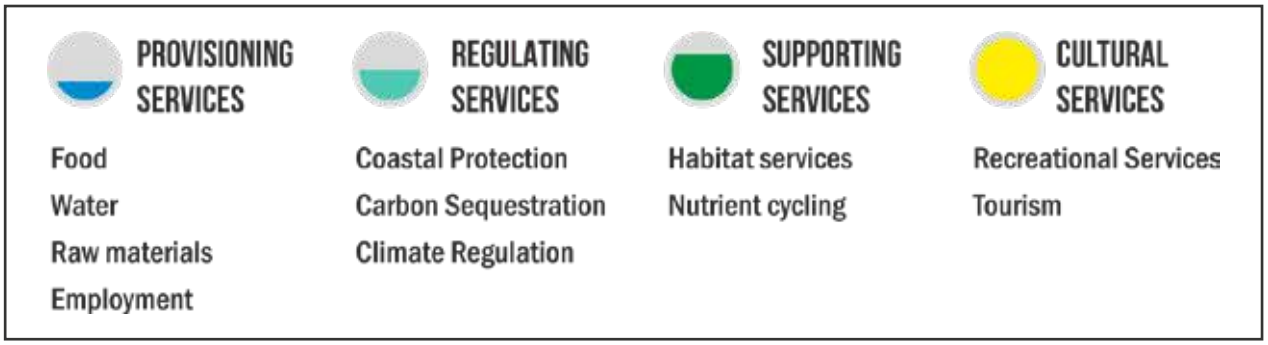


Figure 6.4 Coastal and marine ecosystem services



6.3 Issues and Strategies Identified for achieving this Objective

Integration of biodiversity values in all planning and programmes as envisaged under the NBT requires:

(i) creating reliable and convincing information about the essential services that biodiversity offers and the cost of losing these services; in other words the monetary value that can be assigned to these services;
(ii) creating an understanding of these values amongst the decision makers across the sectors and creating mechanisms for taking informed decisions that compensate for the loss of biodiversity; and
(iii) creating mechanisms for implementation of such decisions.

Hence, strategies to achieve this objective have focussed on the following:

(i) Promotion of studies for identification of services provided by various ecosystems and assignment of monetary and other values to them;
(ii) Review of the legal and policy instruments to secure the integration of values in decision making; and
(iii) Ensuring integration in poverty alleviation programmes.

6.4 Valuation Studies

(i) Over 150 valuation studies have been undertaken starting from 1980s to 2017. Of these, 34 cover wetlands, 68 forests, 19

coastal, marine and mangrove ecosystems and 25, other ecosystems. A large number of these studies have been promoted by the government or by bilateral or multilateral institutions.

(ii) Assigning monetary value to the services through these studies serves an important purpose because in the absence of such an assessment, the cost of losing biodiversity is neither understood nor properly factored into decision making.

(iii) The scope of these studies varies. While some studies have restricted themselves to a chosen category of services or value such as intrinsic value, cultural value and spiritual value or regulating services, a large number of them have valued all the four categories of ecosystem services that biodiversity offers.

(iv) One of the studies, namely, "The Economics of Ecosystems and Biodiversity – India Initiative (TEEB-TII)" implemented by MoEFCC with support from GIZ, aimed at making values of biodiversity and ecosystem services explicit for integrating them into developmental planning. Fourteen studies under this covered
   (1) forests,
   (2) inland wetlands, and
   (3) coastal and marine ecosystems.

These were carried out by (i) Universities, (ii) research institutions, and (iii) NGOs. Local people participated in these by providing their knowledge and services. Availability of robust geospatial and bio-physical data underpins

A view of virgin forests, Peren, Nagaland

these studies in the enumeration of ecosystem services. These studies are now available at http://indo-germanbiodiversity.com/

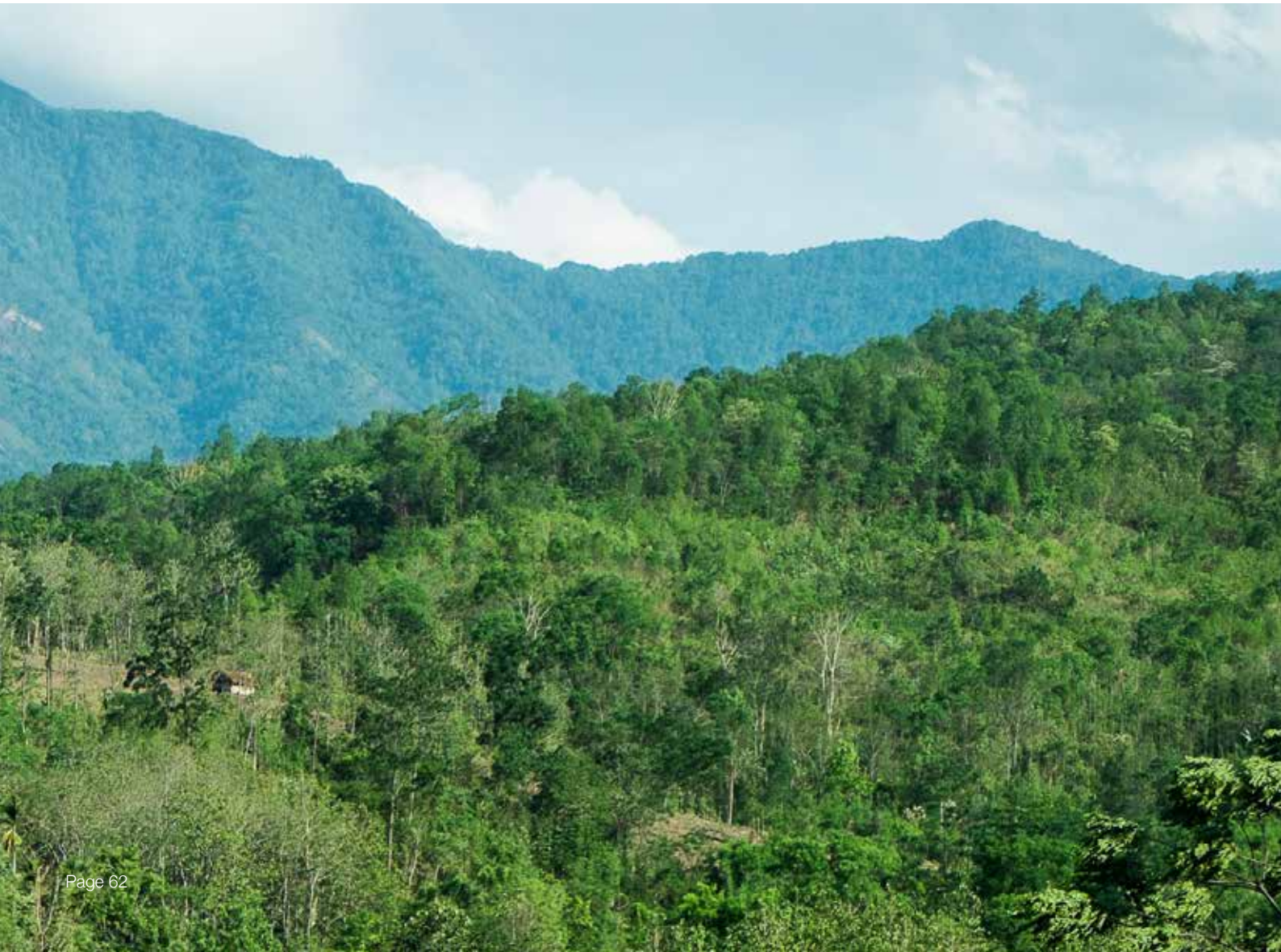
(v) These field-based case studies in each of the three ecosystems give policy relevant evidence of the relationship of ecosystem values to human wellbeing. The studies *inter alia* suggest:

(1) Strong linkages between degradation of ecosystem services and poverty;
(2) Support of tiger reserves to a wide range of economic sectors including responses to climate change crises, support to local economies and sustainable development;
(3) Value of wetlands in providing a wide range of ecosystem services spanning provisioning, regulating, supporting and cultural services; and
(4) Cost of losing them.

(vi) Sectoral Ministries, industry, and businesses are helped by the valuation studies in incorporating values including monetary values in decision making appropriately.

6.5 Integration of Biodiversity Values in Decision Making

(i) FC Act and the mandatory assessment of biodiversity as part of Environmental Impact Assessment (EIA) of the projects mandated by the Environment Impact Assessment Notification, 2006 are the two effective instruments to secure integration of biodiversity value in decision making



(ii) Rules and Guidelines issued under FC Act mandate:
• Realisation of NPV of the forests allowed to be diverted for any other purpose; and (http://forestsclearance.nic.in/writereaddata/Frequently%20Asked%20Questions.pdf)
• Compensatory afforestation on land equal to the forest area diverted.

(iii) A web based Geographic Information System (GIS), operational since 2014, developed and maintained by FSI has been created as an online Decision Support System (DSS). It uses 15 spatial layers and helps in informed and unbiased decisions on diversion of forest land based on qualitative and administrative characteristics of forests. Monetary values given by the studies help in determining the amounts of NPV and cost of compensatory afforestation.

6.6 Outcomes

(i) Compensatory Afforestation Fund Management and Planning Authority (CAMPA) and Guidelines on State CAMPA promote afforestation and regeneration activities to compensate for forest land diverted to non-forest purposes through the fund generated by realisation of NPV and funds for compensatory afforestation. An amount of Rs 66,298.58 crores has been collected through this fund. INR 14,560.63 crores has been released for various works (MoEFCC, 2018).

(ii) Valuation studies have created consciousness about the value and costs of conservation. The 14th Finance Commission (FC) awarded a study "High Conservation Value Forests (HCVF)" which was conducted by the Indian Institute of Forest Management (IIFM). Value of conservation of natural resources found a resonance in the devolution formula of the divisible pool of taxes between Centre and

Panthera tigris

States determined by the FC. It assigned a weightage of 7.5% to forest cover in the devolution formula. A strong direct policy connect was seen between enumeration and valuation of ecosystem services and government policy and programmes.

(iii) Potential impact of proposed projects on ecosystems through EIA is assessed by technical experts including the experts from BSI and ZSI for industries and businesses notified under the EP Act. For a brief account of the process adopted see note below.

(iv) At the initial stage in EIA, the project proponent has to submit information in environmental appraisal questionnaire along with other documents. The format of the questionnaire provides a definite scope for seeking information on several parameters that address biodiversity issues related to developments in different sectors. Based on the nature of the information elicited through the questionnaires, the importance and value of biodiversity components is evaluated by MoEFCC to flag any relevant issues. EIA reports are then examined for their comprehensiveness in terms of coverage of the issues flagged by MoEFCC. These reports also help in evaluating the conservation status of species in the project area in terms of rarity, threat, endangerment, restricted distribution or endemism; and in flagging biodiversity values for consideration at the time of initial scrutiny. Valuation studies help in ascertaining different types of ecosystem services affected by these and advising recovery of those through compensatory measures.

6.7 Integration of Biodiversity Values in Poverty Alleviation Strategies

(i) MGNREGA is the major poverty alleviation programme in the country which covers 2,264 blocks of the country with an integrated natural resource management perspective. Guidelines of MGNREGA have emphasized planning and implementation of works that enhance ecosystem services and biodiversity. MGNREGA Guidelines 2018 identify 260 combinations of permissible works which contribute to restoration and upgradation of biodiversity. Of these, 181 relate to natural resource management, 84 of which are related to water conservation and augmentation.

(ii) Integrated Watershed Management Programme (IWMP)

This is another programme for alleviating poverty by improving the local assets and infrastructure services which secure protection and enhancement of ecosystem services and biodiversity. The work under MGNREGA in conjunction with 8,214 projects under the watershed development programme also contributes to alleviating landscapes/ seascapes and adding value to ecosystem services.

6.8 Giving further fillip to Integration of Biodiversity Values in Decision Making

Manuals to facilitate conduct of valuation studies

'Guidance Manual for the Valuation of Regulating Services', 2010 and 'Valuation of Ecosystem Services from Tiger and Snow Leopard Landscapes: A manual on economic valuation approaches for practitioners', 2017 have been developed by IIFM as tools to facilitate conduct of valuation studies. These are designed to build capacity of the concerned stakeholders and provide assistance in communicating the results to concerned decision makers.

Developing easy to understand user manuals for local level agencies such as PRIs and BMCs to integrate values of biodiversity in decision making would establish the practice in all levels of decision making. To realize and capture the full potential, it is important to build technical capacity and generate awareness at each level so that site specific services also get reflected in local level decision making. The broad range of services brought out by the studies conducted so far may get further enriched by the inclusion of specific ground level services that may be of immense value to the local people.

CHAPTER 7

Nilgiri Tahr in Eravikulam National Park, Kerala

Forest Ecosystems and Sustainable Management of Forests

Forests are considered as the biggest repository of terrestrial biodiversity on the earth. They are a major source of oxygen for the planet after phytoplankton. They act as the lungs of the earth by absorbing carbon dioxide and releasing oxygen; they provide the natural habitats for floral and faunal biodiversity. The rich biodiversity of detritivores that forests host add nutrients into the soil, while various animals such as bees, birds, butterflies, moths, monkeys and bats act as pollen and seed spreading agents. Forests create conditions conducive to onset of rains, check soil erosion, control floods, enable soil water percolation and work as pollution control agents through phytoremediation by soaking up a wide variety of toxins, sequestering or degrading them. Their contribution in arresting and mitigating climate change is vital. In addition, they provide human beings with life sustaining

goods and services such as timber, fuel, honey, water and shelter. Valuation studies discussed in chapter 6 have mapped a range of 25 ecosystem services from diverse forests.
Degradation of forests affects the entire population adversely. But the local and traditional communities, women and the poor, which are dependent on land and natural resources for nutrition and livelihoods, suffer the most when the ecosystem services that forests offer are impaired. Nature's endowment of 16 types of forests and biodiversity hotspots to India needs to be restored wherever under degradation, and maintained in sound health for current and future generations.

7.1 NBTs Related to Forests

NBTs 3, 5 and 6 aim at reduction of the rate of degradation of forests, enable sustainable management of forests, and promote area based conservation of forest ecosystems respectively. Several other NBTs, and SDGs also include elements of forest conservation and sustainable management. Table 7.1 gives the coverage of forests under NBTs and SDGs that cover various aspects of forest conservation and management which NBAP seeks to achieve.

Table 7.1 Coverage of forests under NBTs and SDGs

NBTs		SDGs	
NBT 3	Strategies for reducing rate of degradation, fragmentation and loss of forests reduced.	SDG 2	Maintaining the genetic diversity of CWRs
NBT 5	Sustainable Management of Forestry.	SDG 12.2	Sustainable management and efficient use of forests.
NBT 6	Ecologically representative areas, of particular importance for species, biodiversity and ecosystem services conserved effectively and equitably, and integrated into the wider landscapes and seascapes.	SDG 15.2	Deforestation halted, degraded forests restored and afforestation and reforestation globally increased substantially.
NBT 7	Genetic diversity of wild relatives of cultivated plants. Other socio-economically culturally valuable species, maintained, minimizing genetic erosion.		

7.2 Governance and Management of Forests

MoEFCC provides the overall leadership to the sector at the national level through the Directorate General of Forests which is supported by subject specific technical and administrative divisions and units. States / UT Administrations govern and manage the sector in their respective jurisdictions through their forest departments. Several national level technical and scientific provide requisite support to MOEFCC in accordance with their mandates on various aspects of forest development and management:

(i) **Directorate of Forest Education, Dehradun** has the mandate to ensure standards, quality and effectiveness of forest officers and personnel in the country.

(ii) **FSI, Dehradun** conducts biennial survey and assessment of forests in the country, prepares ISFRs which provide a comprehensive time series data base for various aspects of forests and biodiversity and helps monitor the health and status of forests, contributes to evolution of policies and programmes in the sector.

(iii) **Indian Council of Forestry Research and Education (ICFRE), Dehradun** has the mandate of forestry education and research, transfer of research and technologies to states/ UT Administrations and other resource agencies for long-term ecological stability, sustainable development and economic security through conservation and scientific management of forest ecosystems.

(iv) **Indira Gandhi National Forest Academy (IGNFA), Dehradun** imparts knowledge and skills to professional foresters to develop their competence to manage forests and wildlife on a sustainable basis in tune with the policies of the government.

(v) **IIFM, Bhopal** runs regular courses in forestry education, and has the mandate of research, training and consultancy in forest, environment, natural resource management and allied sectors.

(vi) **Indian Plywood Industries Research & Training Institute (IPIRTI), Bangalore** is mandated to organise research, training and certification related to forest products utilisation for plywood industry, trade and allied sectors.

Coniferous forest in Himachal Pradesh

(vii) **WII, Dehradun** nurtures research, development and application of wildlife science in conservation, conducts training for government and non-government personnel, plays advisory role on matters of conservation and management of wildlife resources.

Forests are dynamic ecosystems and their scientific and sustainable management requires a multi-disciplinary approach. While MoEFCC and forest departments of state are directly mandated to manage forests, the role and contribution of user departments and other sectors responsible for various programmes such as poverty alleviation programmes is equally important in securing forest conservation to attain landscape/seascape approach to conservation.

7.3 Features of Current Management System

A brief account of the major policy shifts in the management, use and conservation of forests since independence has been covered in chapter 2. Chapter 3 has covered the policy and legislative instruments relating to forest governance. The point to be noted here is that these policies and legal instruments have progressively been changed to incorporate experiential learnings in forest management. The management regime that has evolved and is practiced now, as a result, includes the following features:

(i) Shift of emphasis from production forestry to conservation forestry. Now, nearly 65% of the wood supply is met through non-forest sources (National Agroforestry Policy, 2014).

(ii) Inclusion of parameters such as status of growing stock, NTFPs, carbon sequestering, and other ecosystem services to assess and maintain the integrity of forests which create a holistic approach to forest management.

(iii) Inclusion of focus on conserving ecological assemblages of species in addition to charismatic species.

(iv) Shift from control oriented governance to inclusive and participatory governance.

(v) Inclusion of rights and responsibilities of the local communities and forest dwellers along with use of their knowledge in conservation and sustainable use.

(vi) Emphasis on understanding and resolution of issues of conflicts with the participation of local communities.

7.4 Progress and Achievements

1. Rehabilitation of Degraded Areas

Approximately 41% area of the total forest cover was estimated to be in various stages of degradation (Joshi and Singh, 2003). Multifarious causes contributed to this degradation. Programmes and strategies have been implemented at the government and non-government level to restore the health of forests. Joint Forest Management (JFM) was introduced as a participatory co-management system on the philosophy of “care and share” in 1990 as a follow up of NFP 1988. It was further strengthened in 2000. It is operated through Joint Forest Management Committees (JFMCs) which are democratically constituted committees of the local communities including women and the forest officials of the area (Joint Forest Management: A Handbook, MoEF). Strategies in operation to restore these forests are discussed hereafter.

2. National Afforestation Programme (NAP)

NAP started in 2000 for ecological restoration of degraded forest areas with peoples’ participation through JFMCs at the village level, Forest Development Agency (FDA) at the forest division level, and State Forest Development Agency (SFDA) at State level is the umbrella programme for rehabilitation of degraded forests. Assisted Natural Regeneration (ANR) is the dominant

strategy of NAP as well as the externally aided forestry projects under implementation in 11 states.

More than 1,18,213 JFMCs involving around 20 million people are managing over 25 million ha of forest area. Such co-management promises to convert low-productivity and poorly stocked forests into rich forests which in turn increase carbon stocks. JFM covers approximately 29.8% of the total forest area of the country (REDD+ Strategy India, 2018). (REDD+ Strategy India, 2018)

About 1.69 million ha has been covered through ANR over the decade 2000-10 through 42,535 JFMCs under 800 Forest Development Agencies (FDAs). (MoEF, 2011)

3. Restoration of Difficult Areas through Eco Task Forces (ETFs)

ETFs serve twin objectives: (i) ecological restoration in difficult areas, and (ii) meaningful employment to ex-servicemen. ETFs composed of servicemen are created for greening difficult areas such as mined out and severely degraded areas. Stone dams, soil and moisture conservation works are part of the restoration measure in these areas to ensure sustainability. Six ETF battalions have undertaken successful eco-restoration of some highly degraded difficult sites in the states of Uttarakhand, Rajasthan, J&K and Assam. About 1,664 ha of difficult areas have been restored through plantation by ETFs by 2017-18.

4. Reclamation of Abandoned Areas

These include all abandoned areas, in particular mined out areas with the aim of eventually restoring the original flora to the extent possible.

(i) 115.70 million Saplings have been planted over 57,996 ha of mined out areas. Their survival rate is assessed at 68.38 %. (Annual Report 2017-18, Ministry of Mines)

(ii) Rehabilitation of 110 abandoned mines covering 1,363 ha has been achieved during 2017-18. (Annual Report 2017-18, Ministry of Mines)

Joint Forest Management Committee at work

Ecological restoration of limestone mined out area of Puranapani, Odisha

This is a limestone mined out area spread over approximately 250 acres. Deep pits, absence of soil layer and complete barrenness were its features when Centre for Environment Management of Degraded Ecosystem (CEMDE), University of Delhi in collaboration with DBT, Government of India and Steel Authority of India Limited took it up for restoration. Scientists engaged local people, particularly women, through self-help groups to collect native grasses and tree saplings from surrounding forests, giving them remuneration for this work. These saplings were raised in the nurseries and then planted in the mined-out areas using cutting edge biotechnology. Today a three storeyed tropical moist deciduous forest with 150 native tree species has come up in the area. The top canopy has reached a height of 90 feet; the secondary storey has canopy reaching to 60 feet height, the third storey has height of 40 feet and fourth storey is 20 feet tall. This restored rain forest is only 12-year-old. The 200 acres mine void has been transformed into a biologically productive aquatic ecosystem. The restored forest system and the wetland ecosystem provide livelihoods to local communities in addition to providing other ecosystem services. (CEMDE)

Before

After

5. Enhancing Forest and Tree Cover

GIM, one of the eight Missions under NAPCC, launched in 2014 is mandated to protect, restore and enhance forest cover and respond to climate change. It takes a holistic view of greening and focuses on multiple ecosystem services, especially biodiversity, water, biomass, preserving mangroves, wetlands and critical habitats along with carbon sequestration as a co-benefit.

GIM has met India's commitment under Bonn Challenge initiative by covering

- 9,810,944.2 ha under afforestation,
- 9,264,976 ha by government sector,
- 352,677.9 ha by NGOs, and
- 193,290 ha by private companies.

All the states have prepared comprehensive action plans to meet India's commitment of expanding tree cover with multi-objects including climate change issues, REDD+ Strategy published by MoEFCC (National REDD+ Strategy India, 2018) gives a detailed treatment to this. (http://www.moef.nic.in/ccd-sapcc)

6. Area Based Conservation of Natural Habitats

NBT6 which implements ABT 11 by determining area based conservation target keeping in view the country's national priorities aims at bringing over 20% of the geographical area of the country comprising terrestrial inland water, coastal and marine zones, areas important for species, biodiversity and ecosystem services under area based conservation. India has already achieved its target and contributes significantly in achieving the global target (Achievement of Aichi Biodiversity Targets 11 and 16, 2018).

Protected Areas under IF Act, State Forest Acts and WP Act.

- Total forest area protected under these Acts amounts to 7,67,419 km^2 which adds upto 23.39% of the total geographical area of the country.
- PAs under WP Act are classified into four categories, namely, National Parks, Sanctuaries, Community Reserves and Conservation Reserves according to the nature of protection and purpose they serve.

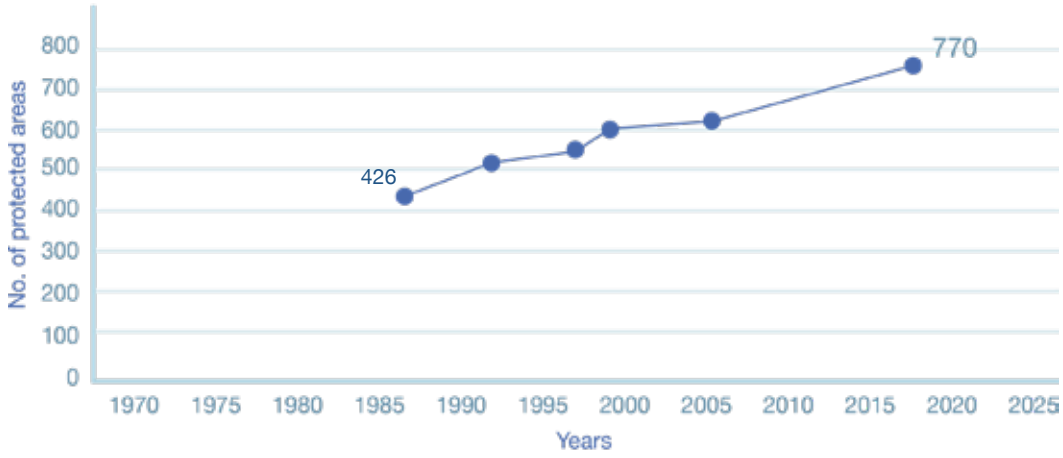
Periyar Wildlife Sanctuary, Kerala

Distinction between Community Reserves and Conservation Reserves under WP Act

The difference between the Community reserves and Conservation reserves is that the former comprise community or private land and the latter comprise government land.

- The PAs have increased from 690 covering 16,685 km^2 reported in 2014 to 770 covering 1,62,098.57 km^2 in 2017. These include 25 marine protected areas amounting to 6,200 km^2 in peninsular India and 106 Important Coastal and Marine Areas (ICMBAs) covering 1,569.63 km^2 in the islands. The parks and sanctuaries include 43 tiger reserves and 32 elephant reserves.

Figure 7.1 Progress in number of PAs under WP Act



7. Area Based Conservation through Other Measures

(i) BHSs under BD Act, 2002

Areas important from the point of biodiversity richness and conservation are identified and proposed by BMCs and local communities for declaration as BHSs. 12 BHSs covering 941.44 km^2 area have been notified so far. Table 7.2 shows the details of two of such BHSs.

Breathing roots of Keora trees, Sunderbans

Table 7.2 Details of Hogrekan and Ambargudda BHSs

Name of BHS	District, Taluk	Agro-climatic Zone	Type of Eco system	Details of Biodiversity importance and area of coverage	Name of BMC responsible for BHS
Hogrekan	Chikmagaluru, Kadur	Hilly zone (Western Ghats belt)	Terrestrial	The site comprising 2,508.06 acres area is a link with Bababudangiri and Kemmangundi, adjoining Bhadra Wildlife sanctuary and Yemedoddi tiger reserve, has unique Shola and grassland vegetation of dry deciduous forests with a number of unique floral species and medicinal plants. The area was under the threat of encroachment and illicit removals, prone to forest fire eyed by some for mining.	Balliganoor BMC
Ambargudda	Shivamogga, Sagara	Hilly Zone (Western Ghats belt)	Terrestrial	This 3,857.17 acres is revenue land located between Sharavathi Wildlife Sanctuary, Someshwara Wildlife Sanctuary and Kudremukh National Park. It is rich in forest density, harbors a wide range of biological diversity with evergreen, semi-evergreen and shola forests, and faunal species of tiger, panther, bison, bear, sambar, deer, Giant Squirrel, wild pig, lion tailed macaque and variety of insects, birds, ants of special genera, amphibians etc.	Shankanna Shanuboga BMC

(ii) ESZs under EP Act

Ecologically sensitive zones are notified to delineate areas at the cusp of PAs and human habitations as 'no-go' areas for some type of activities that may be injurious to the maintenance of the integrity of the natural habitats. They provide a protective buffer zone to PAs. 283 PAs have got additional protection through ESZ area of 30,349.63 km^2.

Figure 7.2 Ramsar Sites in India

(National Heritage Division (NHD), Indian National Trust for Art and Cultural Heritage (INTACH))

(iii) WR, 2017

As already noted in the section on Aquatic Ecosystems in Chapter 2, twenty seven wetlands declared as Ramsar Sites cover an area of over 12,119 km^2. Figure 7.2 shows the map of 27 Ramsar Sites. Area under the category of protected wetlands is likely to increase after the implementation of WR 2017 gets firmly established on the ground and information is collected from the states on the wetlands protected and conserved.

Other Effective Area Based Conservation

CBD defines Other Effective Area Based Measures (OECMs) as "a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic and other locally relevant values."

The following conservation areas among others fall under this category.

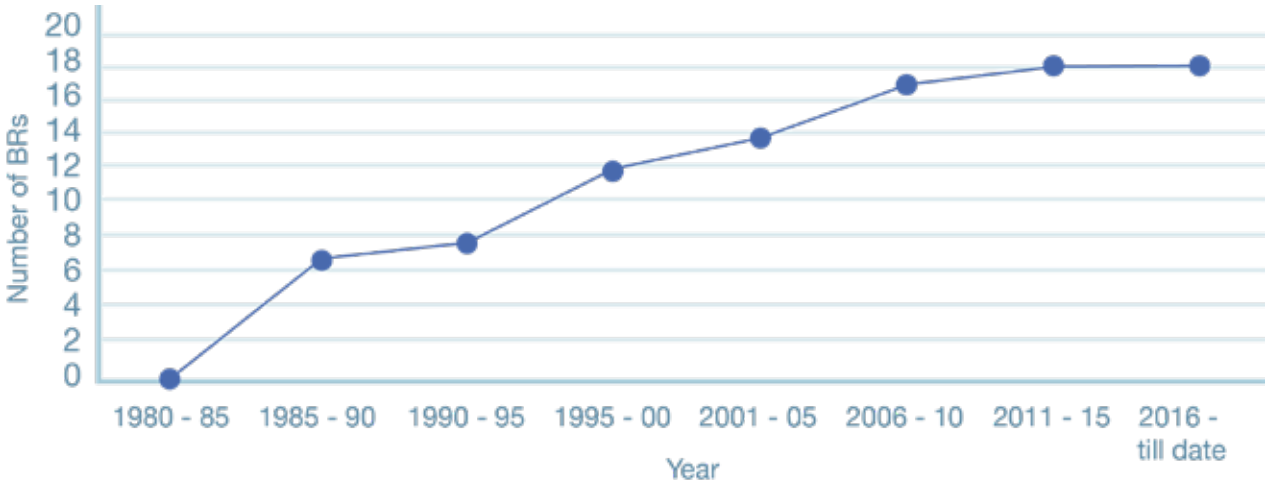
(iv) Biosphere Reserves (BRs)

Biosphere reserves are sites established under UNESCO's Man and the Biosphere (MAB) Programme with the purpose to promote sustainable development based on local community efforts and sound science. BRs conserve all forms of life in situ along with their support system in totality and serve as a referral system for monitoring and evaluating changes in natural ecosystems. Declaration of BRs has seen a steady increase from 8 in late 1990 to 18 by 2018. Year wise progress in declaration of these conservation areas since 1980 to 2018 as shown in figure 7.3 demonstrates that the number has increased by more than 100% since the CBD entered into force.

(v) Sacred Groves/ Community Conserved Areas

Sacred groves are conserved by communities for cultural, religious and livelihood-related purposes through customary practices. These

Figure 7.3 Progress in number of BRs from 1980 to 2018



customary practices signify area/ species/ faith-based traditional ethos. Known by different names in different parts of the country, these often harbour unique and endemic biodiversity. Over 7,000 sacred groves preserved through generations, most of them in pristine form have been documented. The actual number is estimated by experts to be 0.1 million to 0.15 million.

OECMs is a new concept and information regarding conservation areas under OECMs require to be scientifically gathered. In India's context, these could include sacred groves, cantonment forests, green belts around industrial areas, urban biodiversity parks and so on. These are likely to contribute to ecological representativeness, connectivity and inclusionary governance in area based conservation.

India's terrestrial conservation area adds up to 9,27,521.50 km^2. This is nearly 28 % of total geographical area of the country which is substantially above 17% mentioned in ABT. With 17.74 % of the world population and only 2.4 % of its area, this is a significant contribution to the global target of 17%. (Achievement of ABT 11 and 16- Success stories from India, 2018)

Asiatic Lion, Gir National Park, Gujarat

7.5 Establishment of Equity in Forest Governance and Management

Basic attributes of governance with equity include collaboration between all stakeholders, recognition of the roles and responsibilities of local communities, traditional forest dwellers, women and the other vulnerable groups in conservation and sustainable use of resources in a manner that the biodiversity inheritance of the future generations is also not compromised. This equity is secured through:

(i) Co-management for rehabilitation of degraded forests through JFMCs and involvement of Gram Sabhas in management of forests under the Forest Rights Act, 2006, and management of biological resources through BMCs at local level.

(ii) Planning and implementation of forest regeneration and redevelopment activities jointly by state forest departments and local communities wherein the communities get a substantial share in forest produce in return.

(iii) Wildlife Action Plan (WAP), 2017-2031 specifically adopts the approach of equity and inclusionary management and governance of protected areas in participation with the fringe traditional and local communities.

(iv) Eco-development programmes to provide fringe communities with the alternative sources of employment and reduce their dependency on drawls from PAs to meet their day-to-day and livelihood needs. Capacity building and alternative employment generation interventions are a part of these programmes.

7.6 Ensuring Effectiveness of Management Measures

Forest surveys and publication of ISFR every two years establishes a strong, effective and regular system of monitoring. Management Effectiveness Evaluation (MEE) of PAs has been made a regular institutionalised feature for assessing protected areas management. Three cycles of MEE of PAs and Tiger Reserves have shown the following scores of effectiveness:

Table 7.3 MEE of PAs and Tiger Reserves

Year of MEE of PAs	Number of Tiger Reserves Included	MEE Mean Score		Global Mean Score
		PAs	TRs	
2006	28	60.80%	69%	56%
2010	39			
2014	43			

The fourth cycle of MEE is under implementation. The mean score percentages are indicative of enhancement of ecological services status of forest ecosystems.

7.7 Ensuring Ecological Representativeness in Conserved/Protected Areas

Legally protected areas cover all the ten BZs. Together with areas under OECMs, substantive ecological representativeness can be presumed. However, this is an area which requires:

(i) Building up a clear understanding about the ecological representativeness characteristics; and

(ii) Scientifically organised decentralised assessment.

7.8 Landscape/Seascape Approach

Landscape/seascape approach recognises that a large part of biodiversity exists outside PAs and hence relationship between these needs to be appreciated. Combining natural resource management with environmental and livelihoods considerations with the participation of multi-stakeholders is the crux of this approach. Strategies and actions already in place that contribute to achievement of this approach include:

(i) Management of forests and fringe areas through JFMCs, gram sabhas under the Forest Rights Act, 2006, promotion of agroforestry with the participation of KVKs, farmers, individuals.

(ii) Mechanisms such as ESZs around PAs, application of CZMP in coastal areas which regulate activities and promote actions conducive to wider conservation approach.

(iii) Creation of livelihood opportunities along with enhancement of natural resources through MGNREGA and Integrated Wasteland Development Programme (IWDP) and similar other programmes.

(iv) Engagement of the NGOs and CSOs in conservation, creation of environment friendly alternatives for production such as artificial reefs, and creation of mudflats to increase mangroves and enhance livelihoods.

(v) Encouragement of OECMs.

The role of BMCs in identifying areas to be notified as BHSs has emerged as a significant contributor to creating a wider vision of protected areas and connectivity. Table 7.2 that captures the details of two such BHSs indicates movement in this direction.
It is noted that a number of strategies and actions are contributing to securing landscape/seascape approach to conservation. But they are viewed in a disparate manner at present. There is a need to create a holistic vision of these actions and strategies and to create safe corridors between PAs through this coordinated approach.

7.9 Rehabilitation, Restoration and Conservation of Threatened Species

Threatened species are categorized as such based upon the degree of threat to their survival. Remedial strategies are adopted for their rehabilitation, restoration and conservation based on these threat assessments. These strategies include:

(i) Restriction on trade in threatened species in conformity with India's commitments under CITES.

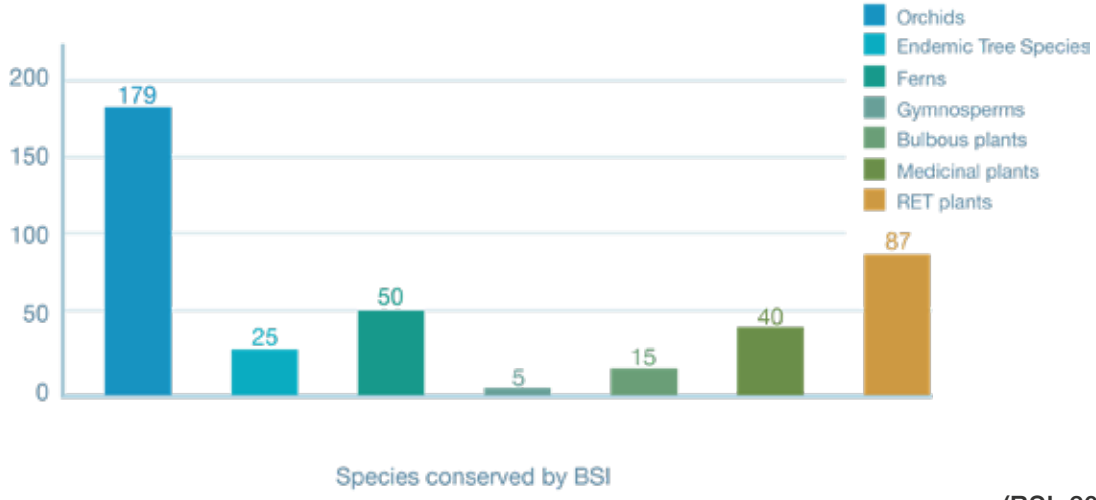
(ii) Wildlife Crime Control Bureau, a statutory multi-disciplinary body established by the Government of India under the MoEFCC, to combat organised wildlife crime in the country.

(iii) Declaration of species/habitats specific protected areas under WP Act and restoration and management of these through WAP, R&D projects sponsored by the government.

(iv) Notification of species under section 38 of the BD Act to regulate their extraction and promote R&D for rehabilitation. One hundred fifty nine (159) plant and one hundred and seventy five (175) animal species have been notified so far. SBBs are responsible for promoting R&D, regulation and rehabilitation measures for these in coordination with line departments and other stakeholders in the states.

(v) Conservation measures by BSI prioritizing species which are either threatened or are important from the point of the sensitive habitats they need and the pressures they face. Figure 7. 4 shows species conserved by BSI.

Figure 7.4 Species conserved by BSI



(BSI, 2018)

R&D and Pathbreaking Initiative by DBT for Threatened Plants

DBT's pan India project 'Preventing Extinction and Improving the Conservation Status of Threatened Plants through application of Biotechnological Tools' has demonstrated that ecological niche modelling (ENM) can be an economical and effective tool to guide surveys. It helps in overcoming the constraints regarding the availability of primary data on the distribution and population of species and problems in the correct categorisation of threatened species. Action to assess and rehabilitate 156 threatened floral species in different ecosystems had been taken under the project. The project led to the discovery and characterization of 38 new populations of threatened species.

Transformation from Hunting Ground to Safe Haven - Amur Falcon Case

Amur Falcons which make a round trip of 20,000 km every year from south-east Russia and northern China to southern Africa through India arrive in large numbers in Nagaland and a few other places in the north-east India. Tens of thousands of Amur Falcons roost in Pangti in Nagaland. They used to be harvested for sale and consumption by the local people.

A comprehensive campaign to protect the Amur Falcons was launched in 2013 in the area. The campaign revolved around nature education, creation of Amur Falcon Eco-clubs, patrolling and enforcement, and scientific study of the birds.

The Village Council imposed a ban on their hunting. The erstwhile hunters now protect Amur Falcons for the entire span of Amur Falcon visit. The protection squad gets a honorarium from the State Government and Wildlife Trust of India (WTI). Employment opportunities opened by the Tourism Department in the form of tourist guides and home-stay providers enhance livelihood of local communities. This safe haven for birds now has earned the epithet of Amur Falcon capital of the world.

Amur Falcons

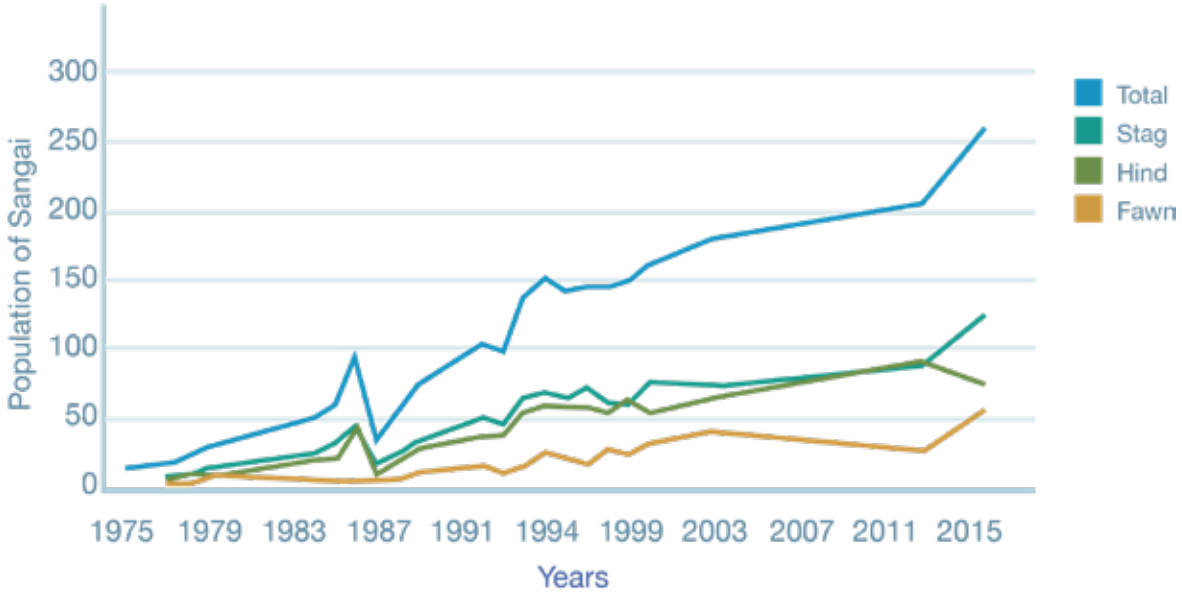
7.10 Species restoration after Forest and Water Body Restoration

(i) Sustainable population of tiger and elephants have been restored with increase in the number of tigers from 1,827 in 1972 to 2,226 in 2014, and number of elephants from 12,000 in 1970s to 27,000 in 2015.

(ii) Edible Nest Swiftlet and Lion populations are showing an increasing trend.

(iii) Manipur Brow Antlered Deer (Sangai) population in Loktak Lake shows anincreasing trend (Figure 7.5).

Figure 7.5 Population of Manipur Brow Antlered Deer (Sangai) in Loktak lake



(Wetland International)

(iv) *In situ* and *ex situ* programmes to conserve the Edible Nest Swiftlets in Andaman and Nicobar Islands have resulted in significant growth in the population of the Swiftlet.

(v) Population of lions in Gujarat has shown an increase from 177 in 1978 to 523 in 2015.

(vi) The number of one horned Rhinoceros had increased to over 2,900 in 2015.

(vii) Greater Adjutant Stork and its habitat has been conserved with the help of local community in Dadara, Pacharia and Singimari villages in Assam through community effort.

(viii) Nearly 1,050 m^2 of area of degraded coral reef belonging to family of *Acroporidae* has been restored in Gulf of Kachchh, Gujarat.

(ix) Black Necked Crane: World Wildlife Fund (WWF) India in collaboration with the Department of Wildlife Protection, Government of Jammu and Kashmir, has been working towards conservation of high-altitude wetlands, with black necked crane *Grus nigricollis* as a priority species in Ladakh.

(x) Survey of PAs, forests and core areas of BRs is likely to reveal more floral and faunal species whose populations would have been restored/have increased.

7.11 Sustainable Management of Forests

Sustainable management of forests as a production sector has been predicated first through suitable changes in forest management regimes and secondly, by creating alternative sources to meet forest dependant demands to reduce pressure on forests.

- **Revision on NWPC**

Management of forests is done according to working plans. The parameters of preparing these working plan plans changed when the Central Government prescribed NWPC 2004 in accordance with NFP, 1988 for scientific management of forests. . NWPC 2004 was replaced by NWPC 2014 to direct the focus of management to environmental stability, biodiversity monitoring and management, restoration of ecological balance of the disturbed areas, protective functions of the forest resources and other socio-economic benefits based on NTFPs. This is now the source document for forest management planning in India. Chapter VI 'Survey & Assessment of Forest Resources' of the NWPC provides for:

(i) maintenance, conservation and enhancement of biodiversity,
(ii) maintenance and enhancement of forest resource productivity,
(iii) optimization of forest resource utilization, and
(iv) maintenance and enhancement of social, economic, cultural and spiritual benefits.

- **Implementation of FC Act, 1980**

(i) The average annual rate of diversion of forest land for non-forest use has reduced from 1.65 lakh ha per annum during the 25-year period from 1951-1975 to about 35,000 ha per annum since the enforcement of the FC Act.

(ii) By establishment of measures of compensatory afforestation, realisation of NPV has taken place. As noted in chapter 6, a CAMPA fund of Rs 66,298.58 crores has been generated by MoEFCC. WAP, JFM, Eco-development projects, and similar various initiatives ensure amelioratory actions to avoid net reduction in forests.

Tamini Ghat, Maharashtra

- **Major Initiatives for Reducing Pressures on Forests**

Major initiatives taken to reduce pressures on forests by creating alternative avenues of satisfying demands include the following:

(i) **Pradhan Mantri Ujjwala Yojana** provides free LPG connections and subsidised refills of gas cylinders as a cooking fuel to families below poverty line as an alternative to fuelwood collected from forests. Over 5 crore families have already been covered under the programme.

(ii) Nearly 110 Medicinal Plants Conservation and Development Areas (MPCDAs) covering 23,969.6 ha spread across the country have been created. Encouragement to large scale cultivation of 50 widely used species meets nearly 40% of the medicinal plant demand on volume basis.

(iii) Rehabilitation of non-forest, wasteland/ rangeland/grassland/non-arable land through Feed and Fodder scheme. The share of feed and forage from non-forest lands increased to 2,641.95 ha by December 2017 reducing the share of forest land used for this purpose to 540 ha.

(iv) Promotion to agroforestry as one of the viable means to meet the target of increasing FTC to 33 % and greening the rural employment and rural development by substituting agroforestry trees for tree produce based economic opportunities. About 65% of the country's timber requirement is met from agroforestry. (Agroforestry Policy, 2014) (MoEFCC, 2018) http://envfor.nic.in/sites/default/files/EXPERT%20COMMITTEE%20REPORT%20ON%20TOF%2018112018_0.pdf

(v) Employment generation under MGNREGA and Eco-development projects helps sustainable management by releasing livelihoods pressure on forests.

CHAPTER 8

A woman farmer working in the wheat field

Agrobiodiversity, Land and Sustainabile Management of Agriculture

Agriculture is the biggest land user and the biggest employer in India. It occupies 140.1 million ha of the total area of 328.7 million ha of the country. Nearly 55 % of the population, particularly the vulnerable and disadvantaged groups of society, rely on agriculture and allied activities for their livelihood. Small and marginal farmers cultivate about 86.21% of the total land holdings comprising merely 47.34% of the total agricultural land (Agriculture Census 2015-16). The economic viability of agriculture, social and economic equity for farmers, food and nutritional security for all, ensuring quantity and quality food at affordable prices are some of the major development goals of the country.

The current national endeavour is to increase farmers' incomes to twice the current level by

2022-23. Conservation and sustainable use of agrobiodiversity which includes the genetic diversity of cultivated plants and their wild relatives is an integral aspect of this objective. Increase in the productivity, profitability and stability of farming systems is pursued simultaneous with:

(i) protection and improvement of land, water and biodiversity by creating economic stake in conservation; and
(ii) augmentation of bio-security of crops, farm animals, fish and forest trees;
(iii) mainstreaming human and gender dimensions of agriculture with attention to rural livelihoods including opportunities of non-farm employment; and
(iv) conservation of biodiversity essential for sustainability of agriculture.

8.1 NBTs related to Agrobiodiversity and Sustainable Agriculture

NBTs 3,4,5, and 7 by aiming at reduction of degradation of land, control and management of invasive species, sustainable management of agriculture, and conservation of genetic diversity respectively address this sector. NBT 11 supports the sector by recognising the role of TK in conservation and sustainable agriculture. Figure 8.1 gives the coverage of agriculture under NBTs and SDGs that cover various aspects of agrobiodiversity conservation and management which NBAP seeks to achieve.
Agriculture being the biggest land user, a section captioned 'Land' has also been included in this chapter.

Table 8.1 Coverage of agriculture under NBTs and SDGs

NBTs		SDGs	
NBT 3	Reduce rate of degradation, fragmentation and loss of agriculture	SDG 1	Exposure and vulnerability to climate-related extreme events reduced
NBT 4	Management and control of invasive alien species	SDG 2.3	Agricultural productivity and incomes doubled
NBT 5	Agriculture managed sustainably	SDG 2.4	Sustainable and resilient agriculture
NBT 7	Crop and genetic diversity protected and maintained		
NBT 11	Traditional knowledge respected, widely used.		

The critical areas identified for action under NBAP to achieve these include:

(i) Management of land degradation;
(ii) Enhancement and conservation of agrobiodiversity; and
(iii) Sustainable management of agriculture.

8.2 Progress and Achievements

Management of Land Degradation

(i) Tracking the status of land

National Natural Resource Management System (NNRMS) under MoEFCC works towards mapping of land status through a combination of remote sensing technology and the conventional data tracking system to assist in policies for management and development of natural resources. Desertification and Land Degradation Atlas of India (2016) is the latest available atlas of land resources through this exercise. It captures the status and trends in land degradation over the time frame 2003-05 and 2011-13. The comparison of the two sets of data on vulnerability and risk assessment is used for prioritizing action to arrest and reverse degradation. The Atlas showed a see-saw trend in land degradation. It showed that:

(i) 1.95 million ha area was reclaimed;
(ii) 0.44 million ha moved from higher severity to low severity during the reference period of 2003-05 to 2011-13;
(iii) 3.63 million ha area of productive land became degraded; and
(iv) 0.74 million ha area moved from 'low' to 'high' severity.

Water erosion, vegetation, degradation and wind erosion were identified as the most significant causes abetting land degradation. (Desertification and Land Degradation Atlas, 2016).

(ii) Tracking the status of agricultural land

Status of agricultural land is tracked by the National Bureau of Soil Survey and Land Use Planning (NBSSLUP) under Indian Council of Agricultural Research (ICAR). It undertakes survey and identification of factors of land degradation with the objective of supporting strategies to find appropriate solutions for them. Its comparative survey of Changes in Various Factors and Status of Land Degradation over 2008-09 to 2010-11 reveals that:

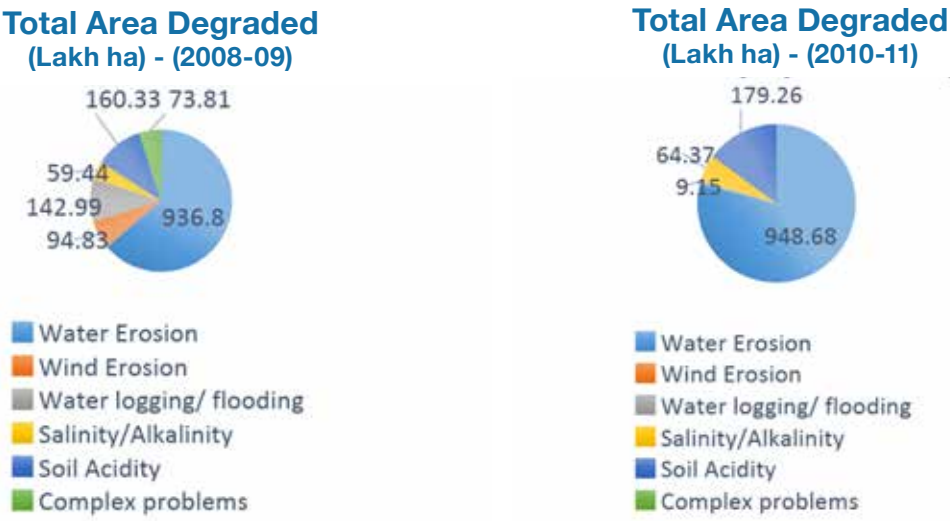
(i) total degraded area has declined by 18 % over the period from 1,468 to 1,204 lakh ha; and
(ii) degradation due to soil acidity, salinity/ alkalinity and water erosion has increased by 12, 8 and 1% respectively.

Figure 8.1 shows the comparative status of total degraded area from 2008-09 to 2010-11.

ICAR promotes R&D to recommend good practices and find solutions to problems of soil and land degradation in agriculture sector. Under its work:

(i) Land form maps, soil survey and soil maps of 1.73 million ha have been prepared.
(ii) State specific trends and contributing causes in land degradation are analysed to develop and recommend appropriate technologies and agricultural practices to control arrest and reverse such degradation.

Figure 8.1 Comparative status of total degraded area from 2008-09 to 2010-11



Box 8.1 Reclamation of Sodic Soils

About 6.73 ha soils (2.1% of the geographical area) are salt affected in the country. Out of these, 2.8 million ha are sodic and mainly occur in the Indo-Gangetic plains (IGP). A large proportion of these soils are cultivated by small farmers. 'Farmers participatory sodic soil reclamation programme this implemented by ICAR-Central Soil Salinity Research Institute, Karnal in Santaraha village in Hardoi district of Uttar Pradesh.

Reclamation process was started in April 2011 according to a scientifically developed reclamation protocol. After three years of implementation of reclamation, all uncultivated lands have been put under cultivation. The yield loss in rice and wheat crops over the normal soil has reduced drastically. Table 8.2 gives the comparison of the average yield over the three years each immediately prior to (2009-12) and post-reclamation (2011-14).

Table 8.2 Average yield (t ha^{-1}) of rice and wheat pre and post reclamation in the selected area

Crops						
	Year	Normal	Slightly Sodic	Mederately Sodic	Sodic	Severely Sodic
Rice	Pre-reclamation period (2009-12)	4.87	2.95	1.22	0	0
	Pre-reclamation period (2009-12)	5.21	4.99	4.64	4.42	3.04
Wheat	Pre-reclamation period (2009-12)	3.65	2.82	1.42	0	0
	Post-reclamation period (2011-14)	3.77	3.36	2.96	2.48	1.85

(iii) Programmes under Ministry of Agriculture and Farmers' Welfare (MoA&FW) for solutions to land degradation

The programmes of MoA&FW which contribute to arresting and reversing land degradation include Resource Conservation Technologies, reclamation of problem soil, rainfed area development, organic village/cluster and Participatory Guarantee System (PGS) organic certification, Soil Health Management (SHM) and soil health cards, rainwater conservation and secondary storage structures under Pradhan Mantri Krishi Sinchai Yojana (PMKSY), promotion of agroforestry, portable soil testing kit, soil resource data bank creation, conservation and management of agroforestry on bunds/ wastelands.

Watershed development projects numbering 8,214 covering 39.07 million ha in 28 states are being implemented under PMKSY to encourage ridge area treatment, drainage line treatment, afforestation, soil and moisture conservation, rain water harvesting, horticulture, pasture development, etc. Over 5,06,000 water harvesting structures have been created/rejuvenated since 2014-15. Additional area of 10,27,837 ha has been brought under protective irrigation up to 2017-18. The number of farmers benefitted is 19,41,017 during 2017-18. Tree cover expansion through GIM and NAP on degraded forests helps land rehabilitation and landscape amelioration. 14.3 million ha of land improved through NRM interventions in MGNREGA during 2015-18.

8.3 Enhancement and Conservation of Agrobiodiversity

1. Plant Genetic Diversity

(i) Plant genetic resources include:

- Modern cultivars
- Breeding lines and genetic stocks
- Landraces and farmers' varieties
- Obsolete cultivars
- Wild relatives
- Weedy races
- Potential domesticated/ other wild species
- Biotechnological cell lines.

Conserving plant genetic resources is important on account of the vital role they play in providing and supporting:

- Agricultural crops and varieties
- Raw materials for crop improvement such as through genes for plant resistance and tolerance in biotic and abiotic pressure
- Diversification of cropping and farming systems
- Adaptation to climate change
- Food, nutritional and environmental security.

The 1st International Agrobiodiversity Congress in Delhi

The Indian Society of Plant Genetic Resources (ISPGR), an autonomous multidisciplinary scientific body constituted by the scientists in the field of plant genetic resources of NBPGR and Bioversity International (BI) in partnership with ICAR, PPVFRA, Trust for Advancement of Agriculture Science (TAAS), National Academy of Agricultural Sciences (NAAS) and Global Crop Diversity Trust (GCDT) organised the first International Agrobiodiversity Congress (IAC) on 6th – 9th November, 2016. The Congress provided a platform for all stakeholders engaged in genetic

resource conservation and management to come together for conservation, rational and effective use of agrobiodiversity for food, nutrition and environmental security. Nearly 900 participants from 60 countries attended this Congress. The Congress adopted the Delhi Declaration on Agrobiodiversity Management which recommended a 12-point agenda for Action. It can be seen at (http://ispgr.nbpgr.ernet.in/download/Presentations_Brainstorming/08_RC_Agrawal%20_PPVFRA_%20Delhi_Declaration_28_Aug_2017.pdf).

(ii) Governance and Management of Agrobiodiversity

Six Bureaux under the ICAR system are mandated to work on the identification, conservation of genetic resources and R&D thereon with respect to the subjects for the components of agrobiodiversity allocated to them. These are:

- National Bureau of Agriculturally Important Microorganism (NBAIIM)
- National Bureau of Agricultural Insect Resources (NBAIR)
- National Bureau of Plant Genetic Resources (NBPGR)
- National Bureau of Fish Genetic Resources (NBFGR)
- National Bureau of Animal Genetic Resources (NBAGR)
- National Bureau of Soil Survey and Land Use planning (NBSS&LUP).

(iii) Role of NBPGR

NBPGR is the lead organisation of the country for identification, conservation and R&D of PGRs. It works in collaboration with the network of ICAR research centres and universities. Major achievements in PGR conservation include the following:

(iv) Survey, Collection and Conservation of CWRs

- NBPGR conducts explorations throughout the country to identify and manage collection and conservation of plant genetic resources including CWRs scientifically. It has prioritised 168 Agri-horticultural crop species for CWR mapping. Narrow endemics and threatened CWRs have been assigned high weightage in prioritisation. The criteria for prioritisation include:

  • economic importance of crops per se,
  • level of closeness of CWR to crops,
  • CWRs possessing traits of breeders' interest/need,
  • Endemism, and
  • Extent of distribution and threat to survival of CWR.

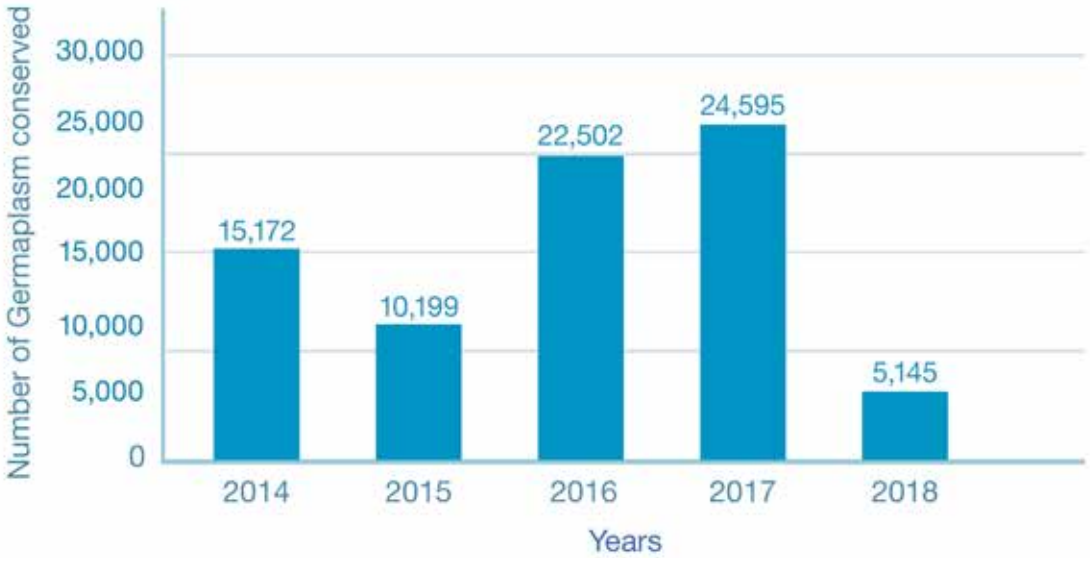
- Prioritised species include 41 taxa from the vulnerable ecosystem of coastal off-shore area with Gossypium stocksii, Lablab purpureus (semi-wild), Sesamum prostratum, Cajanus scarabaeoides, Porteresia coarctata, Solanum arundo, Vignaluteola and V. marina as the most important prioritized species. As noted in Biodiversity Profile of India, so far 817 taxa belonging to 730 species, including wild/weedy form(s) or populations of 142 crop species have been identified through explorations.

CWRs of more than 20 accessions of seeded endemic species of banana (Musa spp.) from North-eastern region, and Andaman & Nicobar Islands have been collected. Protocols for their conservation are under development.

(v) Plant Germplasm Accessions in *ex situ* collections maintained by NBPGR

The National Gene Bank for plant germplasm conservation has collected 4, 36,779 plant germplasm accessions by the end of 2018. Figure 8.2 shows the progress in such collections since 2014 when the last national report for CBD was presented.

Figure 8.2 Status of germplasm of major crops conserved at national gene banks



(NBPGR)

A woman carrying local produce

(vi) National Herbarium of Cultivated Plants (NHCP), New Delhi at ICAR-NBPGR:

- holds collections of cultivated taxa, wild/ weedy relatives of crop taxa of both native and exotic origin; keeps seed and carpological samples of PGRs as complementary collections. It has preserved over 500 taxa of CWRs as herbarium specimens with digital images.
- has preserved Important taxa belonging to wild Vigna from north-western Himalaya; wild *Allium* from high altitude areas of western and eastern Himalaya; wild *Triticeae* from cold arid tracts of western Himalaya; and some neglected groups: less-known domesticated species and taxa of potential/ commercial value.

(vii) Conservation of Indigenous Crop Varieties (ICVs) in Agrobiodiversity Hotspots

Cultivation, propagation and conservation of ICVs, landraces, traditional varieties and their wild relatives by farmers is encouraged and promoted through extension, exploration and Annual Award Schemes. These Award Schemes operated under the aegis of PPVFRA are:

- **Plant Genome Saviour Community Awards and Plant Genome Saviour Farmer Reward and Recognition:**

These recognise and reward farmers and communities of farmers, tribal and rural communities for improvement and preservation of genetic resources of economic plants and their wild relatives. So far, awards have been conferred upon 10 farming communities and 13 farmers, and 31 farmers have been recognized for their contributions in conserving traditional varieties.

The material of the awarded cases is selected, preserved and used as donors of genes in varieties registerable under the PPVFR Act.

Details and case studies related to awards are available at http://plantauthority.gov.in/pdf/E_Annual%20report%2016-17.pdf. See case study, Sec II, Other relevant information.
The IBA also recognise restoration and conservation of plant and animal breeds and species. IBA to Pithorabad BMC was given for rehabilitation of traditional crop varieties and disseminating best practices in such conservation in the country.

Terrace farms, Kashmir valley

Rehabilitation of Agrobiodiversity - Pithorabad BMC gets IBA

Pithorabad BMC was constituted in 2013. Soon after its constitution it took stock of the ongoing rapid loss of indigenous varieties in the area and decided to restore and rehabilitate them. It campaigned to create awareness about the ongoing loss, compiled an exhaustive PBR with the participation of local people, took note of the lost heritage of biodiversity in this exercise, and discussed the importance of the lost varieties in the emerging issues of local climatic conditions and climate change. Thus informed, the local community resolved to take immediate action and not allow any more such losses.
Today effectively all 110 threatened indigenous varieties of paddy of the area have been saved through in situ conservation. A seed bank with capacity of keeping seeds viable for 4 years has been set up, and 86 traditional varieties are under the process of registration under PPVFR Act, 2001. With sharpened awareness about conservation, 150 medicinal plants, herbs and tuber species have also been conserved.

(viii) Role of Botanical Gardens

- 350 Botanic Gardens located in various parts of the country serve as referral model centers for *ex situ* conservation of endemic and threatened plants, in different phyto-geographic region.
- 20 Lead Botanic Gardens located in different phyto-geographic zones conserve and create awareness about plant diversity and facilitate rehabilitation of threatened plants.
- 11 Botanic Gardens attached with Regional Centres of BSI do *ex situ* conservation and education.
- More than 2, 00,000 living plant accession belonging to 15,000-16,000 plant species are housed in these Botanic Gardens.

'Seeds for Needs' Initiative

Bioversity International's 'Seeds for Needs' Initiative aims at broadening the crop genetic base by integrating horticulture crops to reduce farmers' excessive dependence on cereals, increase their livelihood and nutritional security. Study of the Nutritional profiling of indigenous minor and under-utilized horticulture crops is a part of the initiative.

2. Genetic Diversity of Indigenous Animal Breeds

Role of NBAGR

Indigenous breeds are robust, resilient and suited to the climate and environment of the country. Studies suggest that they perform better in the face of the challenge of climate change. NBAGR is the lead agency for identification, promotion and conservation of domesticated and indigenous animal genetic resources. It works in collaboration with universities and other technical institutions in this field. Major initiatives and achievements in this field include the following:

(i) Registration of Indigenous Breeds

NBAGR has established a registration system of indigenous breeds /populations/strains of domesticated animals and their wild relatives. It has so far registered 169 indigenous breeds of livestock and poultry till 2018. These include: cattle- 41, buffalo -13, goat - 28, sheep -42, horses & ponies-7, camel-9, pig-7, chicken–18, 1 each for donkey, yak, duck and geese. Of the 25 species of indigenous livestock and poultry were registered during 2014-2018, 5 each of goat and pig, four cattle, 3 each of sheep and chicken and 1 each of horse, camel, yak, geese and duck.

(ii) Cryopreservation of Germplasm in National Animal Gene Banks

• Over 1, 51,228 frozen semen doses from 340 breeding males for ex situ conservation have been conserved.
• Somatic Cell Banking achieved for indigenous varieties of Manipuri and Marwari Horse, Kachchhi and Double Humped Camel to preserve genetic resources for genomic, post-genomic and somatic cell cloning research.

(iii) Measures Instituted to Encourage Indigenous Breeds

Rashtriya Gokul Mission: Launched in 2014, the Mission works on development and conservation of indigenous breeds, selective breeding in the breeding tract and genetic upgradation of nondescript bovine population. The Mission works through:

- **National Mission on Bovine Productivity**: Two of its five components directly serve conservation of genetic diversity through 'E Pashu Haat Portal', by linking farmers and breeders of indigenous breeds and through **Establishment of National Bovine Genomic Centre for Indigenous Breeds (NBGC-IB),** for enhancing milk production and productivity through genomic selection among indigenous breeds.

- **National Programme for Bovine Breeding** by establishing **two National Kamdhenu Breeding Centres**, one each in North and South of the country for conservation of Indigenous Bovine Breeds (41 cattle and 13 buffaloes). These will act as repositories of germplasm of indigenous breeds certified germplasm for supply to farmers.

(iv) Breed Conservation Award for conserving and maintaining the registered breeds of livestock and poultry. Annually four awards are given. Awards to Farmers are called "Gopal Ratna" and to Breeders Societies are called "Kamadhenu". 22 Gopal Ratna awards and 21 Kamdhenu awards have been given till 2017-18.

IBA categories also include awards for outstanding work in rehabilitation and conservation of indigenous breeds.

Mustard field, Uttarakhand

Vechur Cow

Vechur Cow, a small statured indigenous breed of Kerala, is heat and humidity resistant, and needs no sophisticated management. Grass in the compound and byproducts of agriculture are its feed, its urine and cow manure have the potential to replace chemical inputs with organic farming or "zero budget natural farming". The breed was on the verge of extinction by 1980s as a result of cross breeding program with exotic bulls like Brown Swiss, Jersey and Holstein Friesian started in the 1960s. In 1989, Dr. Sossama Iype, Kerala Agriculture University, led a scientifically organised programme for saving the cow with eight cows collected from the field after wide scouting and search. Today, it is a well-accepted breed registered under NBAGR. Vechur cow owners are spread across different economic strata in the state of Kerala.
('India, Naturally!', 2016)

Vechur Cow

8.4 Sustainable Management of Agriculture

Millions of farmers spread across the length and breadth of the country take decisions about agriculture as a private enterprise. Government plays a crucial role in this decision making by creating a suitable legislative, policy and economic environment, and implementing policies and programmes that create capacities and facilities for informed decision making leading to sustainable management of agriculture.

1. Policy Support

Policies in the agriculture sector to secure sustainable management are anchored on the pillars of:

(i) Soil Health Management;
(ii) Irrigation Expansion and Management with 'Per Drop More Crop' motto;
(iii) R & D in Bio-fortification, health foods and climate resilience;
(iv) Integrated Nutrient Management;
(v) Integrated Pest Management;
(vi) Encouragement to organic farming;
(vii) Protection of farmer's rights with respect to their contribution made at any time in conserving, improving and making available plant genetic resources;
(viii) Conservation of germplasm;
(ix) Economic viability; and
(x) Plant protection and plant quarantine.

Four National Missions, namely, NMSA, 2014, National Mission of Agricultural Extension and Technology (NMAET), 2014, National Mission on Oilseeds and Oil Palm (NMOOP), 2014, Mission for Integrated Development of Horticulture (MIDH), 2014, supported by R&D through ICAR and National Innovations on Climate Resilient Agriculture (NICRA) implement various aspects of agriculture in mission mode in this vastly diverse sector. These missions are supported in their work by State Level Standing Technical Committees and Technical Support Groups. States have their own directorates and departments of agriculture with well-defined implementation agencies at the district and sub-district level.

2. R&D Support by ICAR

ICAR provides R&D support for finding solutions for known and emerging issues in sustainable agriculture. It has a network of 4 Deemed Universities, 64 Institutions, 15 National Research Centres, 6 National Bureaux, 13 Directorates and Project Directorates located in various parts of the country which help find locale-specific ecologically sustainable solutions to problems and issues.

3. Important Initiatives for Sustainable Management of Agriculture

(i) National Initiative on Climate Resilient Agriculture (NICRA)

it is an ICAR Initiative to promote climate resilient agriculture technologies to deal with impacts of climate change. Its priorities focus on:

- Development and application of improved production and risk management technologies;
- Developing and demonstrating site specific packages for farmers; and
- Enhancing research and application capacity of scientific and stakeholder community to upscale the research outputs through KVKs and NMSA.

(ii) NICRA's Important Achievements so far include successful introduction of:

- Several climate resilient crop varieties, animal breeds and natural resource management technologies in 151 villages spread across the country.

- Country-wide studies to understand the impact of temperature on flowering behaviour in mango.

- Nation-wide pest surveillance and real time incident monitoring system for all target

crops, identifying weather parameters for pest warning models.

- A pilot project of agro-advisory services in one district.
- Technologies including for on-farm water harvesting ponds, supplemental irrigation, early maturing drought tolerant varieties, submergence tolerant paddy varieties in flood prone districts, improved drainage in water logged areas, recharging techniques for tube wells, site specific nutrient management and management of sodic soils, mulching, and use of zero-till drills by farmers in NICRA villages.
- Nearly 50,000 farmers have been covered by more than 100 training programmes to create awareness on climate change and adaptation and mitigating strategies.

The Project has led to:

- Creation of state-of-the-art infrastructure for long term strategic research and modelling future climate impacts on agriculture and livestock.
- Specific projects for fragile areas such as arid zones, hill and mountain ecosystems, climate impact on pollinators.
- Development of coping strategies through water saving technologies and expansion of technology demonstration and dissemination to 100 vulnerable districts.

(iii) Support and Incentives for Natural/ Organic Agriculture through:

- **Paramparagat Krishi Vikas Yojana** (PKMY) 2015, to promote certified organic cultivation in 2 lakh ha covering 10,000 clusters.
- **Participatory Guarantee System** (PGS) for organic farming certification by farmers through a decentralised system (https://pgsindia-ncof.gov.in/). Since 2015, 83,866 PGS certificates have been generated covering an area of 2,12,553.73 ha.

Figure 8.3 shows rise in certificates since 2015.

Figure 8.3 Rise in PGS certificates since 2015

(PGS, MoA&FW)

Tea Garden, Sikkim

- Timely advisories and quality inputs to farmers on organic farming relating issues through 675 KVKs spread across the country.
- Special Measures for North Eastern States through Mission Organic Value Chain Development for North Eastern Region (MOVCDNER) to develop certified organic production by linking growers with consumers, One hundred Farmers Producer Companies (FPCs) composed of 2,500 Farmers Interest Groups (FIGs) were created covering 50,000 ha area, in which 50,000 farmers participated.
- Sikkim has become a fully organic agriculture state.

(iv) Encouragement to Natural Inputs

- Fertiliser Control Order (FCO), 1985 was amended to incorporate biofertlizers to encourage use of quality biofertilizers.
- Specifications of non-edible de-oiled cake/ castor oil cake fertilizers have been notified under FCO schedules to ensure availability of standard quality to farmers.
- Different grades of fertilizers have been notified under FCO, 1985 to suit the soil specific needs. Effective implementation of the FCO ensures need based supply of fertilizers to farmers. Share of organic manure which was 2294.15 million tonnes in 2013-14 has reached 2547.87 million tonnes in 2015-16.

Adoption of Natural Inputs

Impact of initiatives and farmers' decisions

• In 2016-17 alone, 820.31 lakh quality planting material and bio-fertilizers (5,509q), vermicompost, mineral mixture etc., and 3.39 lakh quality seeds, were produced at KVKs and supplied to farmers.
• 2,406 FIGs, 82 FPCs and 44,604 farmers have been formed during 2014-15. They cover an area of 45,863 ha.
• Area under organic farming increased from 1.2 to 1.49 million ha in the years 2014 to 2015.
• Land under organic farming in India has shown third highest increase in the world between 2014 and 2015.
• 7,983 PGS local groups comprising 2,76,865 farmer members covering an

area of 2,12,553.73 ha participated in PGS certification by June 2018.
(DARE-ICAR, 2016-17)

(v) Efficient Use of Water (EUW)

PMKSY, an inter-sectoral programme is being implemented by the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD & GR) for Accelerated Irrigation Benefit Programme (AIBP), MoA&FW for On-farm Water management and Department of Land Resources (DLR) for Integrated Watershed Management Programme with the motto "Per Drop More Crop" to:

- achieve convergence of investments in irrigation at the field level,
- expand cultivable area under assured irrigation,
- promote sustainable use and water conservation practices,
- ensure water use efficiency at farm level through precision /micro irrigation, and
- reach scientifically assessed irrigation potential of the country at 140 million ha.

(vi) Promotion of Green Energy in Agriculture

ICAR promotes development of clean and renewable energy technologies. Some examples of technologies developed so far are:

- Solar Powered Knapsack Sprayer with 3 nozzles;
- Solar-Powered Onion Curing Chamber;

Community based Solar Lift Irrigation Systems in Saharia Tribals, Dangpura Village in Madhya Pradesh

Dangpura village under Chetikhera panchayat of Vijaypur tehsil has 62 Saharia tribal families. Its total population is 415. The village has 28.8 ha area of which 26 ha is cultivated. Land holdings are marginal and land is undulating. The average annual rainfall is 750 mm, the climate is extreme with minimum and maximum temperatures at 2° C and 49° C respectively. Collection and selling of NTFPs and rain-fed agriculture are the sources of livelihoods with average monthly household income varying between Rs. 1,500 to 2,000.

A small stop dam was constructed on Kuwari Rivulet by the district administration some time ago which became defunct due to poor water storage and unavailability of water lifting system at the advice of ICAR and All India Coordinated Research Project (AICRP) on Irrigation Water Management, Morena, and ICAR and Indian Institute of Water Management, Bhubaneshwar.

The height of stop dam was increased by 1.5 meters and a community based solar water lift system was installed under Tribal Sub-Plan. Now, the system generates 10000 watts electricity through 40 solar panels enough for a water pumping of 10 hp capacity and can pump about 50,000 litres/hour. Irrigation pipeline in 26 ha and drip and sprinkler irrigation in about 4.0 ha was created. The net income from agricultural crops has increased to Rs. 32,440/year/household with improved cropping intensity and productivity from Rs. 6,165/year/household before this intervention. The operation and maintenance is done by a registered group of tribal water user farmers funded through a revolving fund bank created by contributions of the members.

- Indirect Solar-Biomass Hybrid System for drying of spices; and
- An agri-voltaic system in which electricity generation, crop production, rainwater harvesting can be done on a single land unit. Such a system of 105 KW capacity has already been established at Central Arid Zone Research Institute (CAZRI), Jodhpur.

(vii) Kisan Urja Suraksha evam Utthan Mahabhiyan (KUSUM)

A MNRE capital subsidy scheme promotes replacement of diesel pump sets with solar pump sets. 1.1 Lakh solar pumps were installed during 2014-17. (https://kusum.online/kusum-yojana-2018/)

(viii) Soil Health Management (SHM)

SHM is an important part of the mandate of NMSA. SHM system makes real time advice available to farmers for inputs and other matters based on the soil health of individual farms which is included in the SHM cards. During the period 2015-18, a total of 150,939,538 Soil Health Cards have been distributed to farmers on various parameters. These include:

- Farm-based information on soil nutrient status;
- Appropriate nutrient dosage recommended for improving soil health and fertility;
- Real time advice on location and crop specific sustainable soil health management through residue management; and
- Organic farming practices by creating and linking soil fertility maps with macro-micro nutrient management and land use based on land type given in soil health card.

Infrastructure for soil testing has been enhanced by:

(1) Setting up additional Soil Testing Laboratories (STLs); 1,414 labs were set up with analysing capacity of 19.5 million samples per annum.

(2) Strengthening existing infrastructure.

- 161 STLs strengthened
- 3,140 mini STLs approved
- 10 FQCL strengthened and 1 FQCL set up.

RAD programme under Rashtriya Krishi Vikas Yojana (RKVY) promotes Integrated Farming Systems (IFS) by integrating horticulture, livestock, fishery, agroforestry, value addition along with crops/cropping system.

(ix) Advisory Support, Extension and Capacity Building Services

All the schemes of the sector have a component of extension, education and awareness building for farmers and field officials. It is augmented by dedicated Krishi Darshan channel on TV and through mobile apps.

• 25 million farmers registered on Soil Health Card portal
• Around 18,370 million SMSs have been sent through Mkisan since inception in 2013
• 6, 22,931 of Kisan suvidha app, 36,047 of Pusa Krishi and 43,140 of Agrimarket apps have been downloaded.

A farmer-driven and farmer-accountable Agricultural Technology Management Agency (ATMA) at the district level and a platform of Farmer Friend (FF) of experienced and progressive farmers provide advisory services to farmers at the village level. KVKs play a critical role of taking technology from labs to fields. These initiatives make for an interactive system of learning.

Krishi Vigyan Kendras (KVKs)

KVKs are agricultural extension arm of the ICAR at district level acting as a bridge between ICAR and farmers in disseminating state of the art technologies, knowledge and new developments in agriculture to farmers with a multi-disciplinary approach. They provide the following types of support services to villages:

- Farm advisory services
- Training programmes for different categories of people
- Training programmes for extension functionaries
- Front line demonstrations
- On-farm testing of technologies.

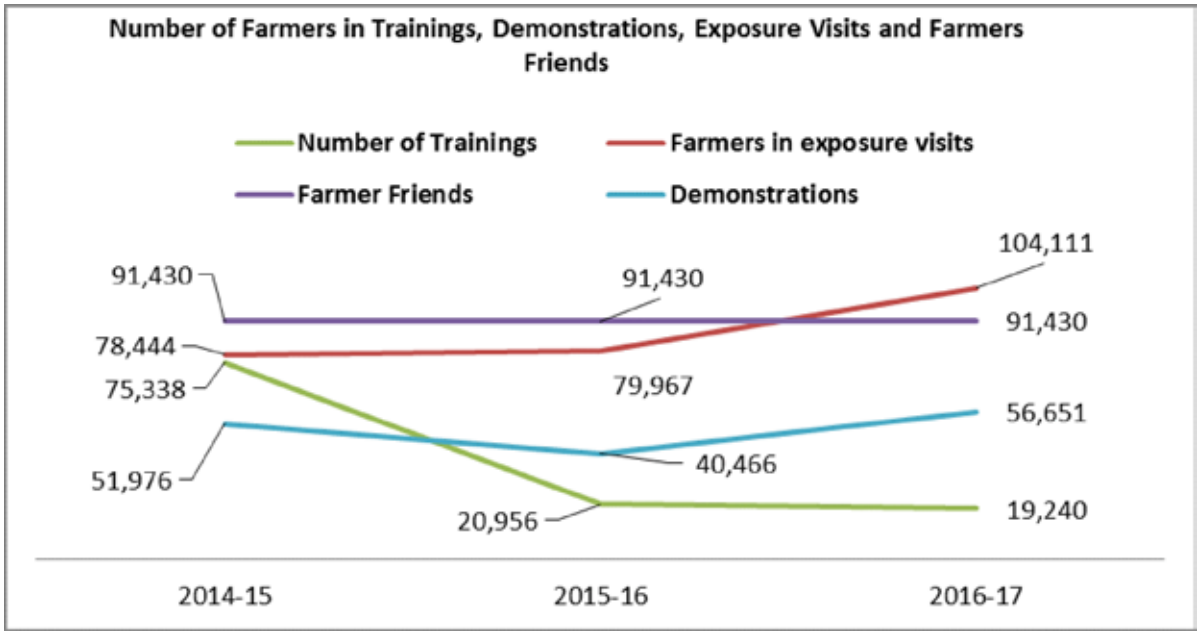
They mostly function under the administrative control of the State Agricultural University of the state concerned. Over 675 KVKs are functional in the country at present. (https://kvk.icar.gov.in/)

(x) My Village My Pride (Mera Gaon Mera Gaurav)

Started in 2014 is an initiative to provide doorstep technical services to farmers by making scientists/officers adopt villages and provide information to farmers on technical and other related aspects in regulated time-frame through personal visits. This takes science to the doorstep of farmers. Figure 8.4 shows number of trainings, demonstrations, exposure visits held and Farmer Friend created.

Agronomist with farmer at cotton field

Figure 8.4 Number of trainings, demonstrations, exposure visits held and farmers friends created



(Annual Reports DAC; ICAR)

Women working in the field, Chhattisgarh | Source: Shrikrishna Paranjpe

8.5 Women in Agriculture

Specific provisions for involvement of women have been included in all aspects and schemes of agriculture. **National Gender Resource Centre in Agriculture (NGRCA)**, New Delhi, acts as the focal point for addressing gender dimension to agriculture policies and programmes, renders advisory services to States and UTs to mainstream gender in agriculture development. ICAR- Central Institute for Women in Agriculture, Bhubaneswar, undertakes research on gender issues in agriculture and allied fields to promote mainstreaming of gender for economic and technical empowerment of women farmers.

8.6 Integrated Pest Management, Plant protection, Quarantine, Control of Invasive Species and Ecological Equilibrium

(i) Protection from invasive species:
Sub-Mission on Plant Protection and Plant Quarantine (SMPP) ensures protection against introduction of any invasive alien species, pathogens, pests. There are 59 PQS in India at present. (http://ppqs.gov.in/contactus/plant-quarantine-stations-pqs)

(ii) Integrated Pest Management

The emphasis is on shift towards Biocontrol Measures to Reduce and Rationalise Use of Chemical Pesticides through thirty-five Central Integrated Pest Management Centres (CIPMCs) located across the country to:

(i) carry out pest/disease monitoring, conservation, production and release of bio-control agents, and
(ii) reach out to farmers through Farmers Field Schools (FFSs) to guide them tailor IPM practices to suit their individual needs.

An area of 273.69 lakh ha has been brought under pest monitoring and IPM Packages developed for 87 crops. These can be seen and accessed at http://ppqs.gov.in/ipm-packages.

Farmer working in rice field, Nalbari, Assam

The cumulative impact of IPM measures can be summed up in Table 8.3.

Table 8.3 Impact of IPM measures

S.No.	Impact of IPM measures
1	Increased crop yielding rice and cotton from 6.72 - 40.14% in rice and 22.7 - 26.63% in cotton in IPM fields compared to non-IPM fields.
2	Reduced use of chemical pesticide sprays by 50-100% in rice and 29.96 to 50.5% in cotton.
3	Increased use of bio-pesticides/neem-based pesticides from 123 million tonnes during 1994-95 to 63540 million tonnes during 2016-17.
4	Reduced consumption of chemical pesticide from 75,033 million tonnes (Tech. grade) during 1990-91 to 54121 million tonnes (Tech. Grade) during 2015-16.

(IPM at Glance, Directorate of Plant Protection, Quarantine & Storage)

CHAPTER 9

Mahseer in southern India

Sustainable Management of Fisheries

Approximately 14.5 million people depend on fisheries for livelihood in India. It is the second largest fish producing and also the second largest aquaculture country in the world. With the paradigm shift from marine dominated fisheries to inland fisheries as a policy of the government, marine fisheries account for 31.9% and inland fisheries 69.1% of India's fish production. Marine fisheries activities are spread across the entire coastline, and 2.02 million km^2 of EEZ including 0.5 million km^2 of continental shelf. Nearly 3,937 fishing villages are situated along the coastline. Out of nearly 4 million marine fisher folk, 0.99 million are active fishers.

Considering the important contribution of fisheries in securing food and nutrition and

creating livelihoods, government has adopted a comprehensive approach to develop the sector with an aim at achieving 'Blue Revolution'. Elements of FAO's 'Blue Growth Initiative' and targets of SDGs are encompassed in the 'Blue Revolution'.

9.1 National Fisheries Action Plan (NFAP)-2020

The NFAP- 2020 aims at achieving an annual growth rate of about 8% on a sustainable basis to reach a production level of 150 lakh tonnes by 2019-20. The share of Inland Fisheries is expected to be nearly 109 lakh tonnes. Sustainable management of such a vast production sector is important.

The NFAP-2020 inter alia focusses on:

(i) development of technologies and studies to support sustainable inland and coastal and marine fisheries;
(ii) concerted strategies for conservation of fish genetic resources;

Fisherman at the coast

(iii) creation of scientific database; and
(iv) ensuring people's, including women and vulnerable groups', role and participation in development and management.

9.2 NBTs Related to Fisheries

NBT 5 aims at sustainable management of fisheries as a production sector. Several other NBTs include aspects of sustainable management of fisheries. Table 9.1 gives the coverage of fisheries under NBTs and SDGs that cover various aspects of fisheries conservation and management which NBAP seeks to achieve.

Table 9.1 Coverage of fisheries under NBTs and SDGs

NBTs	SDGs
NBT 4 — Strategies to manage invasive alien species and pathways developed	SDG 14 — Small scale artisanal fishers are provided access to marine resources and markets
NBT 5 — Measures for sustainable management of fisheries adopted	SDG 14b — Effective harvesting regulate and overfishing checked
NBT 11 — Traditional Knowledge is respected and used widely	

9.3 Governance and Management of Fisheries

The National Fisheries Development Board under the Department of Animal Husbandry and Dairying, MoA&FW provides overall leadership and policy direction for improving the functioning of the sector. The objective of conservation and scientific sustainable harvesting of natural aquatic resources conservation along with fish stocks and sustainable management is pursued with the support of subject matter specific scientific and technical organisations which assist the Board in its work. These technical organisations include:

1. Central Institute of Fisheries Technology (CIFT): Regularly develops and updates craft, gear and fishing methods for marine, inland and aquaculture fisheries with emphasis on resource conservation and sustainability besides increase in productivity.

2. Fishery Survey of India undertakes:

(i) Survey of Demersal, Pelagic and other resources and assess their stock,
(ii) Experimental fishing using species-specific fishing gears to establish sustainable fisheries practices, which are popularized among fisherman in accordance with Code of Conduct for Responsible fisheries (CCRF), and
(iii) Collection of baseline data on biodiversity of fin fishes, crustaceans and cephalopods resources in Indian EEZ to guide sustainable fisheries.

3. CMFRI: Helps maritime states in designing guidelines and practices to ensure sustainable production and management for commercially important fish stocks.

4. Central Institute of Brackish Water Aquaculture: R&D support for brackish water aquaculture. (HQ-Chennai, est. 1987)

5. Directorate of Coldwater Fisheries Research: Research on cold water fisheries and aquaculture. (HQ-Uttarakhand, est. 1987)

6. Central Inland Fisheries Research: Inland fishery resources management and conservation. (HQ- Assam, est. 1959)

7. Central Institute of Fisheries Education: Post graduate fisheries education, training and research (HQ- Mumbai, est. 1961)
States have their own administrative infrastructure of fisheries' departments. Besides Indian National Centre for Ocean Informatics Services (INCOIS), National Institute of Ocean Technology (NIOT) and Centre for Marine Living Resources and Ecology (CMLRE) provide requisite support for policies and practices in the fisheries sector.

9.4 Progress and Achievements

1. CMFRI issues annual advisories about the distribution and abundance of fishes and shellfishes off the Indian coast based on its GIS-based resource mapping. It has developed a "Handbook on Application of GIS as a Decision Support Tool in Marine Fisheries" for the benefit of the stakeholders. CMFRI has:

- Created a digitized database of 8,82,263 fisher households of 4,057 coastal villages. It contains statistical portraits of marine fisher-folk residing in the marine fishing villages of all the 9 maritime states and 2 UTs of India, details of fishing crafts and fishing gears from 50 fishing harbours and 1,281 fish landing centres.
- Developed an installation art entitled "Fish Cemetery" covering an area of 2,500 sqft with a height of 13 ft at south beach, Fort Kochi in collaboration with Kochi shipping to create awareness about the threats caused by marine litter to marine ecosystem. The fish cemetery is a warning against dumping of plastics into water resources and the sea.
- Regularly undertaken skill enhancement and capacity building of fisher youth including women. For example, a two-month training programme for 35 educated unemployed young fisherwomen (funded by the Society for Assistance to Fisherwomen (SAF)) was organised in 2018.
- Promoted formation of National Marine Fisheries Management Council (NMFMC) for co-management for fishermen participation, local stewardship, and shared decision-making in the management. Fishers are empowered to become active members of the fisheries management team, balancing rights and responsibilities, and working in partnership with government.
- Undertaken bio-inventorying and biodiversity valuation of marine organisms in selected marine ecosystems.
- Steered restoration and sustainable management of fish resources under stress.

Establishing Sustainable Clam Fishing in Ashtamudi Lake

Situated in the Kollam district, Ashtamudi Lake is the second largest lake estuary of Kerala. Spread over an area of nearly 6,140 ha, it remains connected to Arabian Sea throughout the year. Kallada river empties into it and is the main source of its fresh water. About 173 ha area near the bar mouth is clam fishing area.

Introduction of processing expanded the market of these clams for export to countries like Vietnam, Thailand and Malaysia. The result was intensification of fisheries. The catch rose to the peak of 10,000 tonnes of 1991. But then, declined to 5000 tonnes in 1993, mainly because of unregulated fishing. This created a demand from fishermen for action against indiscriminate fishing, particularly organised mechanical dredging, especially during spawning seasons.

Spawning of clams commences by December and lasts till February. Clam beds have abundant young clams from January to March. Based on its studies on the fishery and biology of short-neck clam of Ashtamudi Lake undertaken since the late nineteen seventies, CMFRI in association with local fisheries introduced the following regulations:

- A closed season from October to January,
- Mesh size restrictions for nets used in fishing,
- A minimum export size of 1400 clam meats per kg, and
- Mechanical Clam fishing methods prohibited.

Clam fishery has since sustained landings of around 10,000 tonnes per year in the last decade, with relatively stable CPUE over the same period. The Ashtamudi estuary short-necked clam fishery has been certified Marine Stewardship Council (MSC) standards compliant since 5th November 2014. Its Certificate Code is F-ACO-0055. Receipt of MSC has constantly encouraged streamlining of practices. For example:

- Minimum Legal Size (MLS) of 20mm shell length was introduced in July 2015 on the basis of the stock and the catch size composition.
- Opening area for fishery for 2016 season was delayed until 1 March at the request of the fishermen, to allow time for the clams to grow in the early part of the year.
- Fishery is now open for five rather than six days per week. Weekend closure was introduced in response to the change in stock distribution and decline in biomass observed during 2015.

In response to the southward movement of stock distribution, a new management area was established during the 2015 fishing season. This has remained in place during 2016 and 2017.

2. Mobile App Advisory: m@krishi, for information on potential fishing zone through mobile phones has reduced scouting time for fishing by around 50%, fuel consumption, and increased profit to the tune of 25-35%.

3. All aquaculture units above 40 ha have been made subject to EIA under Guidelines for **Sustainable Development and Management of Brackish Water Aquaculture** (1995). Shrimp culture units of 40 ha or more must incorporate EMP for local watercourses, groundwater,

drinking water sources, agricultural activity, soil and salinization, waste water treatment and green belt development.

4. Standards have been specified by Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) for releasing effluents into the water bodies. Namami Gange (NG) and NRCP help sustainable fisheries by cleaning the water ways and lakes. **Policy guidance on light fishing** prohibits use or installation or operation of surface or submerged artificial lights/LED lights, fish lights attractors or any other light equipment with or without generator on mechanized fishing vessel or motorised fishing crafts in Indian EEZ beyond territorial waters.

5. Co-Management practices and Self-Regulatory Fishing Ban Seasons in fisheries are increasingly being promoted. Initiatives are taken by fishing communities reflecting the results of their own experiences and CEPA initiatives. **Closed Season** has been imposed either in the breeding and spawning season or in the recruitment season to allow generation of larvae/juveniles enough time to grow, very often such closed season demanded and enforced by fishermen themselves. Table 9.2 gives details of closed season for mechanised sector.

Table 9.2 Closed season for mechanised sector

State	Months	Days
Gujarat	June - August	45
Maharashtra	June - August	45
Goa	June - August	60
Karnataka	June - August	45
Kerela	June - August	45
Tamil Nadu	April - May	45
Andhra Pradesh	April - May	45
Odisha	April - May	45
West Bengal	April - May	45

Creation of best practices for sustainable harvesting of fisheries is being encouraged through specific initiatives such as mainstreaming coastal and marine biodiversity conservation into production sectors in the East Godavari river, estuarine ecosystem in Andhra Pradesh under Egree Project, mainstreaming coastal and marine biodiversity conservation into production sectors in Sindhudurg coast etc.

Case Study : Mainstreaming coastal and marine biodiversity conservation into production sectors in Sindhdurg coast

In the fishing district of Sindhudurg in the state of Maharashtra, the lives of thousands of people are inextricably linked with the sea for sustenance and livelihood. A pilot project co-funded by GEF, Ministry of Environment, Forest and Climate Change and UNDP (2012-2017) was taken up in Sindhudurg maintaining the livelihood-ecosystem balance with the aim of mainstreaming biodiversity conservation in production sectors.

Outcomes of the project include:

(i) 100 % adoption of CIFT developed by-catch removing square mesh nets by fishers.
(ii) Mangrove eco-tourism through Self-Help Group of women.

Sindhudurg was declared a 'tourism district' in 1997. The recorded number of visitors to the Sindhudurg fort grew from 1,00,000 to 7,00,000 between 2006 and 2010. Tourists are attracted by the many cultural sites (notably the forts), the beautiful beaches, the cruises, the backwaters and snorkelling/diving. (https://www.gefieo.org/sites/default/files/ieo/evaluations/files/programmatic-approaches-2016-vol2.pdf)

(iii) On pilot basis, mud crab-farming model on private lands by fisher women and men for which 28.5 acres of land in 15 villages has been used and 149 beneficiaries trained.
(iv) Oyster and mussel (bivalve) farming as alternative livelihood option for fishing communities.
(v) System of Rice Intensification (SRI) comprising set of practices for plant, soil, water and nutrient management to revive native species of rice that fetches higher price than the hybrid varieties.
(vi) Cleaning of the seabed of debris such as ghost nets and marine waste through the newly trained scuba divers including women divers.
(vii) Effective behavioural change making people not to dump litter or waste in the sea.

An expedition of living marine resources in Angria Bank has identified 160 species including 153 coral species, 18 fish species, 9 seaweed species and 9 echinoderms.

The State Government of Maharashtra has established Mangrove and Coastal and Marine Biodiversity Conservation Foundation for long term sustainability and for expanding the project approach to the rest of the coastal areas in the state.

6. Preparation of Coastal PBRs is being undertaken. Kerala and Goa have already done it.

7. Local initiatives for managing marine debris and micro plastics are being encouraged.

8. **MLS** of 58 commercial species adopted by the state of Kerala for commercial species in consultation with CMFRI. Consultations with other coastal states are encouraged.

9. **Wider participation in ensuring sustainable fisheries** is being promoted. As an experiment, **a responsible Luxury Initiative** has been taken up by CMFRI –WWF and ITC Hotels chain. They together developed a menu input to enable luxury of responsible choices for its guests. An advisory on about 100 species based on hotel procurement data has been put on the menu.

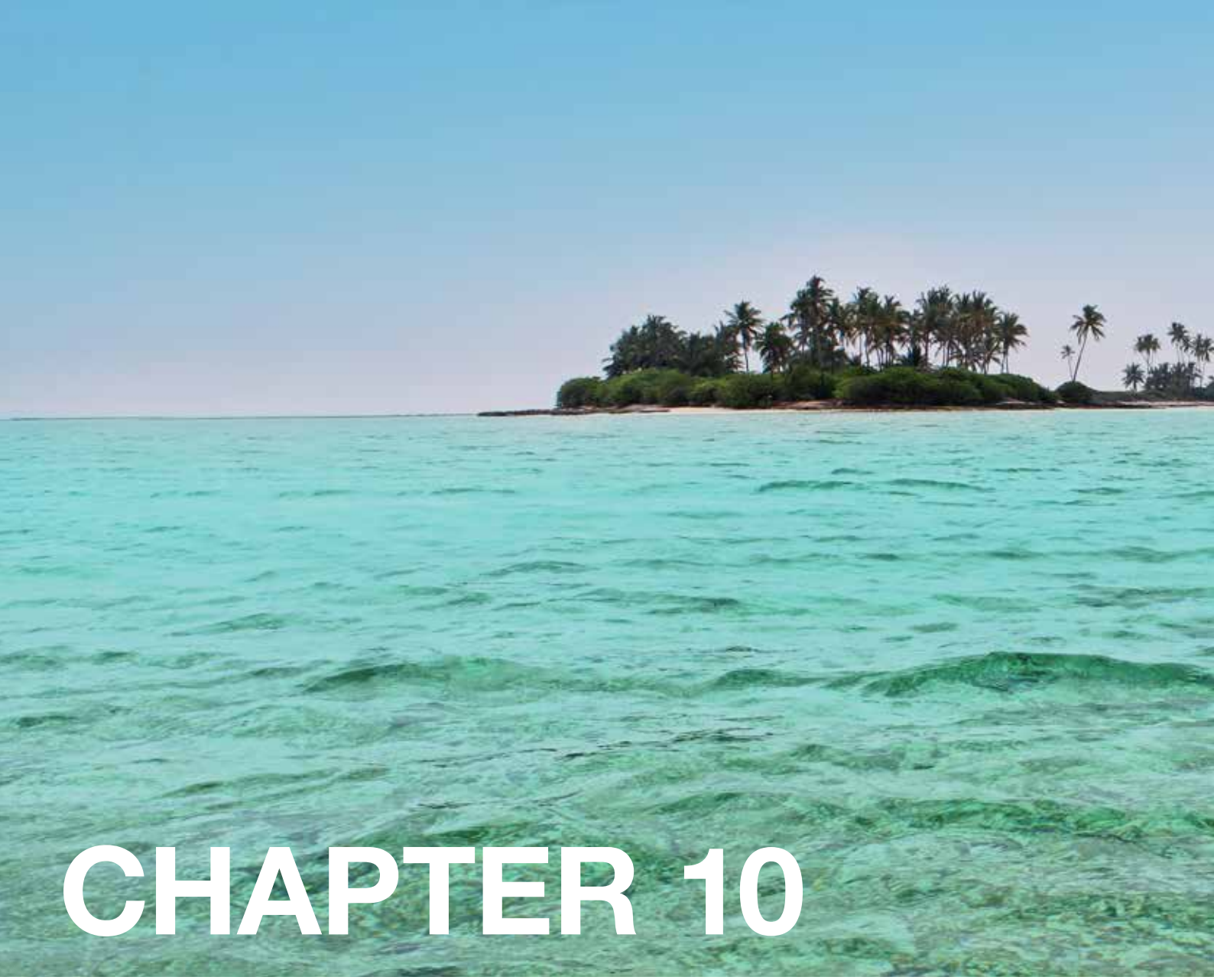
10. **MSC Certificate**: MSC, an independent non-profit council, sets certification standards for sustainable fishing, and issues certificates. MSC standards are assessed by a team of experts who are independent of both the fishery and the MSC.

11. **Logo Scheme for Export**: A logo is granted by Marine Product Export Development Authority (MPEDA) as mark of quality to be affixed on seafood products exported from India by the registered seafood processors who meet the prescribed criteria.

12 .Conservation of indigenous fish genetic resources

- NBFGR has the mandate to undertake activities regarding R&D and conservation of fish germplasm. The available data shows that 2,936 native fishes reported from India include 936 freshwater fishes, 113 brackish water and 1,887 marine species belonging to 44 orders, 252 families and 1,069 genera. (http://www.nbfgr.res.in/images/Publication/annual-reports/pdf/Annual%20Report%202015-16.pdf)

- 59 fish lines are being cryopreserved and maintained at National Repository of Fish Cell Line (NRFC) for distribution. (http://mail.nbfgr.res.in/nrfc/cellline.php)



CHAPTER 10

Kalpeni Island in Lakshadweep

Coastal and Marine Ecosystem

Oceans and seas cover nearly 71% of the earth's surface making coastal and marine environments the largest ecosystems on the planet. They support diverse aquatic life estimated to be somewhere between 500,000 and 10 million species. (https://www.cbd.int/undb/media/factsheets/undb-factsheet-marine-en.pdf)

Marine species offer humans a valuable source of protein and help in controlling global climate change. India's coastline extends to 7,517 km, which is approximately 0.25% of the world's coastline. Nearly 1.1% of the global population lives in India's coastal areas. About 560 million people live in coastal states and UTs of which approximately 250 million people live within 50 km of the coast. The marine fishermen

population of the country is estimated at 3.5 million, this includes 0.9 million active fishermen. (http://iomenvis.nic.in/index2.aspx?slid=758&sublinkid=119&langid=1&mid=1)

Like all other ecosystems, coastal and marine ecosystems face threats from natural and anthropogenic events and influences.

1. Natural Threats: Cyclones, earthquakes and tsunamis are natural catastrophic events affecting coastal areas which lead to destruction of marine biodiversity; sea level rise affects coastal areas and coastal ecosystems.

2. Anthropogenic Threats: These include threats from land based activities such as untreated wastes from municipal, agricultural and industrial sources, thermal effluents from power plants, brine discharge from desalination plants as well as physical impacts due to land use change, dredging, destructive fishing practices, and unregulated tourism. Climate change related global warming affects sea surface temperature and the distribution of marine biota and causes bleaching of coral reefs while ocean acidification can impact shellfish as well as corals.

India has three mega cities namely Mumbai, Chennai and Kolkata, with many small, medium and major ports and industries around its 7,517 km coastline. Major industries like fertilizer, petrol, agrochemicals and chemicals are located along the coasts. Industrial and municipal wastes, continuous movement of marine vessels in the major ports, wastes of aquaculture and agriculture farms unleash severe harmful impacts on the coastal water quality and the biodiversity.

10.1 NBTs related to Coastal and Marine Ecosystems

NBT 3 and NBT 6 aim at reducing degradation of natural habitats in coastal and marine ecosystems and delineating conservation areas to protect diversity and integrity of these systems respectively. Several other NBTs and SDGs also include elements of coastal and marine conservation and sustainable management. Figure 10.1 gives the coverage of coastal and marine ecosystems under NBTs and SDGs that address various aspects of coastal and marine conservation and management which NBAP seeks to achieve.

Table 10.1 Coverage of coastal and marine ecosystems under NBTs and SDGs

NBTs	SDGs
NBT 3 — Strategies for the rate of degradation, fragmentation and loss of coastal and marine ecosystems finalized	SDG 14 — Coastal and marine ecosystems sustainably managed and protected
NBT 5 — Coastal and marine fisheries managed sustainably	
NBT 6 — Coastal and marine ecosystems areas conserved	

10.2 Governance and Management of Coastal and Marine Ecosystems

- MoEFCC has the overall mandate of prevention and abatement of pollution, conservation of natural resources and protection of the environment. Maritime states have their own enactments for protection of coastal and marine ecosystem and use of their resource sustainably.

- The mandate of the Ministry of Earth Sciences (MoES) includes science and technology for exploration and exploitation of ocean resources (living and non-living). National Centre for Earth Science Studies (NCESS), NIOT Chennai, INCOIS Hyderabad, National Centre for Coastal Research (NCCR), CMLRE Kochi under the Ocean Science & Technology sector under this Ministry undertake activities related to various aspects of the coastal and marine ecosystems as per their mandate.

In addition to these, the other organisations are:

(i) **National Institute of Oceanography (NIO**, HQ- Goa, established 1966) is a technical organisation under the CSIR. It undertakes scientific research and studies of special oceanographic features of the Northern Indian Ocean.

(ii) **National Centre for Sustainable Coastal Management** (NCSCM, HQ-Chennai, established 2011) is a research arm of the MoEFCC for Coastal area management. The Centre has mapped 34,000 km^2 of Ecologically Sensitive Areas along the country's coastline and 76,000 km of High Tide Line (HTL). These form the foundation for preparation of the Coastal Zone Management Plans (CZMP) for all coastal states and Union Territories. The country's hazard line has been demarcated jointly by Survey of India and NCSCM.

Integrated Coastal Zone Management Project

The objective of this World Bank funded Integrated Coastal Zone Management (ICZM) Project is to assist Government of India in building national capacity for implementation of comprehensive coastal management approach in the country, and piloting the integrated coastal zone management approach. The project is being implemented by Society of Integrated Coastal Zone Management (SICOM) of the MoEFCC, in three states viz., Gujarat, Orissa and West Bengal in Phase I. The ICZM Plan and its implementation will be undertaken for the remaining coastal states and UTs (including islands) in Phase II of the ICZM Project.

(iii) **National Centre for Coastal Research (NCCR**, HQ- Chennai), formerly called Integrated Coastal and Marine Area Management – Project Directorate (ICMAM-PD), an attached office of MoES apply scientific tools and techniques in inter alia addressing problems like erosion and ecosystem changes.

10.3 Progress and Achievements

1. Main Achievements of Scientific Management of Coastal and Marine Ecosystem

(i) CRZNs under the EP Act are the main legal instruments to regulate activities in the coastal areas including through CZMP. They regulate onshore development activities to protect coastal environments.

(ii) NEP 2006 makes the use of CRZNs and CZMP plans more holistic to:

- ensure protection to the coastal ecological systems,
- reduce vulnerability of some coastal areas to extreme natural events and potential sea level rise, and
- ensure periodic review of CZMP plans to take account of changes in coastal and marine environmental conditions on account of economic and other activities.

(iii) The specific legislative measures include:

- The **Coastal Aquaculture Authority Act**, 2005 established the Coastal Aquaculture Authority for regulating the activities of coastal aquaculture in coastal areas.
- The **Water Pollution Act**, 1974 regulates the disposal of wastes from various sources.

(iv) Capacity building and creation of specialized manpower for mathematical models is undertaken at leading institutions such as Centre for Earth Sciences Studies, Trivandrum, National Institute of Technology Karnataka, Andhra University, Vishakhapatnam. (Refer to https://www.ncess.gov.in/ for further details.)

(v) As already noted in chapter 7 on Forest Ecosystems and Sustainable Management of Forests, 25 marine PAs have been declared under the WP Act. These cover an area of 6,200 km^2 in peninsular India and 106 ICMBAs as PAs covering 1,569.63 km^2 in the islands. WII has further identified 10,773 km^2 for integrated management as ICMBAs with the participation of local communities.

2. Mangroves and their Conservation

Many coastal area communities depend on mangroves for the goods and services for their day-to-day existence. These include:

(i) Mangrove wood as good construction material and fuel wood. It is resistant to rot and insects.
(ii) Medicinal plants
(iii) Mangrove leaves as animal fodder.

The area under mangroves has increased from 4,627.63 km^2 in 2013 to 4,921km^2 in 2017. India's contribution to global mangroves has increased to 3.33% from 2.69% noted in NR5 . Natural rejuvenation in old areas and plantations in new areas have led to increase of 293.27 km^2. (http://fsi.nic.in/isfr2017/isfr-mangrove-cover-2017.pdf)

Mangrove vegetation at sea coast in Andaman and Nicobar

3. Coral Reefs

Coral reefs have multifaceted value for humans. These include:

(i) Fisheries: One km^2 of a healthy coral reef can yield an average of 15 tonnes of fish and other seafood per year.

(ii) Ornamental and Aquarium Fish: Harvesting of corals, fishes and other species for the aquarium is a major form of trade. Molluscs, marine turtles, sea horses, starfsh and sea urchins are collected for making curios and souvenirs in coastal areas.

(iii) Medicines and Medical Research: Many coral reef species have been traditionally used in medicine. Chemicals found in coral reef species are the basis of many modern drugs.

(iv) Tourism and Cultural services: Their captivating beauty and the vibrant diversity of life forms they host makes them a popular excursion site for snorkelling enthusiasts, scuba divers, recreational fishermen and tourists.

(v) Prevent Coastal Erosion: By absorbing high wave energy, coral reefs protect coast lines from erosion.

(vi) Act as physical barrier against extreme weather events like storms, tidal surges, strong ocean currents and winds, and protect human lives and livelihoods. Oceans

Clown fish flitting around the Sea Anemone, Havelock Island, Andaman

absorb 525 billion tons of carbon dioxide, some of which corals use to produce calcium carbonate.

4. Threats to Corals

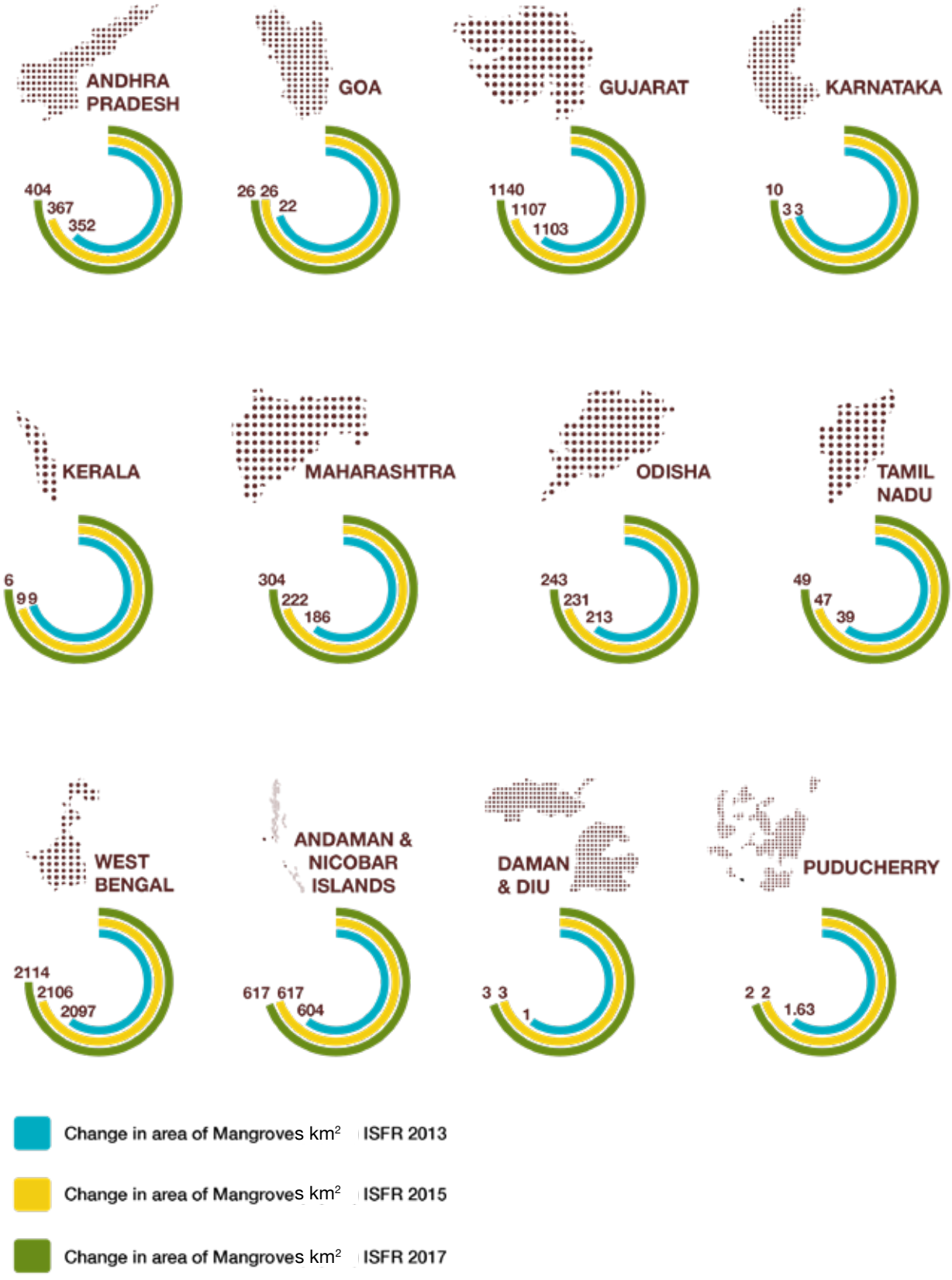
Sediments from construction, mining, pollution from agricultural and industrial activities in the coastal zones and unregulated tourist influx make sea water turbid and polluted which cuts off sunlight to coral reefs resulting in their destruction. Warming of ocean waters leading to coral bleaching and sea level rise due to climate change are other threats.

(i) EP Act prohibits the
- use of corals and sands from the beaches and coastal water for construction and other purposes, and
- collection and destruction of corals along with dredging and underwater blasting in and around coral formations (CRZN, 2011, 2019).

(ii) The Gulf of Mannar and Great Nicobar declared as BRs, the Gulf of Kachchh (Gujarat), Mahatma Gandhi Marine National Park (Andamans) and Rani Jhansi Marine National Park (Andamans) declared as Marine National Parks, provide protection for coral reefs.

(iii) Nearly 1,050 m^2 of area of degraded coral reef belonging to family Acroporidae has been restored in Gulf of Kachchh , Gujarat.

Figure 10.2 Change in Mangrove Cover according to ISFR 2017



(iv) As very sensitive ecosystems highly susceptible to impact of climate change and widely used for satisfying various human needs, coastal and marine ecosystems require dedicated attention and action. Various initiatives launched by the government and institutional infrastructure created for R&D and other facets of management of these ecosystems seek to answer these needs and require to be accelerated and expanded. CEPA activities have to include concerted focus on creating nationwide awareness on these ecosystems.

Alerts on coral bleaching by Indian National Centre for Ocean Information Services (INCOIS)

INCOIS provides bi-weekly alerts on coral bleaching based on satellite-based imageries. These alerts, which are disseminated through the web, contain information on the hotpots, degree of heating weeks and the variation of SST anomalies. Eighteen such warnings were issued to indicate the stress on the corals in the Gulf of Mannar during 2016-17.

Gulf of Mannar, Tamil Nadu

CHAPTER 11

Aerial view of Loktak lake, Manipur

Wetlands and Riverine Ecosystems

The chapter 'Biodiversity Profile' gives the extent of wetlands and riverine ecosystems of India. Ecosystem services of significant value to mankind that wetlands provide has come out emphatically from the valuation studies discussed in Chapter 6. Wetlands support a large variety of plant and animal species adapted to fluctuating water levels and provide habitats for water fowl, including migratory birds from other parts of the world. Riverine ecosystems provide multiple essential benefits and services including purification of water, fish production, transformation of organic matter and other materials, nutrient cycling and flood control. Rapidly expanding human population, large scale changes in land use/land cover, urban expansion projects, discharge of industrial effluents, sewage, household wastes and sedimentation, and improper use of watersheds all pose a severe challenge to the conservation of wetlands. Rivers face multiple challenges.

These include changes in water quantity and quality, habitat modification, over-exploitation of resources, climate change, pollution, and invasive species. These ecosystems are in close proximity to human settlements, are often treated as an ultimate sink for the sewage and industrial wastewater that emanate from human activities.

11.1 NBTs Related to Wetlands and Riverine Ecosystems

NBT 3 specifically covers aquatic ecosystems with the objective of reducing the rate of degradation, fragmentation and loss of these ecosystems. Several other NBTs and SDGs also include elements of wetlands and riverine conservation and sustainable management. Table 11.1 gives the coverage of wetlands and riverine ecosystems under NBTs and SDGs that cover various aspects of wetland and riverine conservation and management which NBAP seeks to achieve.

Table 11.1 Coverage of wetlands and riverine ecosystem under NBTs and SDGs

NBTs	SDGs
NBT 3 — Strategies for the rate of degradation, fragmentation and loss of wetlands and riverine ecosystems finalized	SDG 14 — Wetlands and riverine sustainably managed and protected
NBT 6 — Wetlands and riverine ecosystem areas are conserved	

Deer in water at Kaziranga National Park, Assam

11.2 Progress and Achievements

1. Wetlands

(i) Creating Base Data

Wetlands have traditionally been an integral part of the rural and urban landscape in India. The first survey to collect the basic information about wetlands was carried out in 1972. Thereafter, a Directory of Wetlands in India was brought out by MoEFCC in 1990, then known as Ministry of Environment and Forest (MoEF). National Wetland Atlas 2013 (Murthy *et al*., 2013), details of which have been given in chapter 2 is the current inventory of the Wetlands in India, prepared through the use of satellite remote sensing technology.

(ii) National Plan for Conservation of Aquatic Ecosystems (NPCA) 2013

It is a broad national initiative under which integrated management plans of wetlands are funded on the sharing pattern of:

- 70:30 in respect of all states except North Eastern states
- 90:10 in respect of North Eastern states.

(iii) Implementation of WR, 2017

Wetlands falling within the PAs have been conserved by virtue of being part of these areas. Implementation of the WR, 2017 has improved conservation of wetlands outside PAs. States have initiated action for their management and conservation. Examples include the following:

- The state of Uttar Pradesh has notified all wetlands exceeding an area of 2.24 ha falling outside the protected forest area under the WR, 2017. (www.sacup.org)
- State Governments are increasingly providing allocations for wetlands development in their budgets, e.g., Odisha has allocated approximately Rs. 70 million per year in their annual budget.
- States are leveraging funds from programmes such as MGNREGA, IWDP for amelioration and conservation of wetlands. For example, Uttar Pradesh has undertaken restoration in Sitapur and Lakhimpur Kheri districts through leveraging funds from MGNREGA.

(iv) National Level Initiatives

- Integrated Management Plans (IMPs) for 115 wetlands and 65 lakes have been taken up under NPCA. IMP Funds have already been released for 83 wetlands and 65 lakes for this.
- Management plans of seven Ramsar sites have been updated to IMPs covering an area of 0.30 million ha .
- MoEFCC organises capacity development workshops in collaboration with expert agencies for States and UTs to promote Integrated Management of Wetlands (IMW).
- Wetland restoration has been made a part of implementation of Smart Cities project.
- Non-government sector has been encouraged to play an important role in CEPA activities and conservation of aquatic ecosystems including through conservation and creating network of bird watchers. WWF, BNHS, Nature Conservation Foundation (NCF) and SACON are some such organisations.

Salim Ali Centre for Ornithology and Natural History (SACON), a centre of excellence

Creating partnerships with non-government sector for improvement and protection of the important bird areas and bird habitats has been a consistent policy of MoEFCC. Creation of SACON was one example of a concrete step towards this. SACON was established as a Centre of Excellence in 1990 under the Societies Registration Act as a partnership of BNHS and MoEFCC to assist, institute, conduct and promote scientific research in ornithology, species, habitats and ecosystems with and within which avifauna coexist, and

to develop scientific solutions to species, habitats and landscape conservation problems. Wetlands, thus, form the basic work area of this organization.

- Private sector participation is encouraged. In a model initiative, IUCN, Tata Chemicals and Wetlands International South Asia (WISA) developed a management plan for Chandrabhaga Wetlands, a coastal wetland in Jamnagar, Gujarat though CSR.
- Wetlands have been included in training curricula of Indian Institute of Corporate Affairs, an autonomous institute under Ministry of Corporate Affairs (MCA) for courses on research, education and advocacy on corporate regulation governance and running sustainable businesses under CSR.

Cumulative impact of all the actions has been positive in conservation of wetlands. Several sites under implementation of restoration plans have shown positive impacts on their ecological status. For example, open water surface area and the forest cover within the direct catchment increased in Loktak Lake and salinity gradient underpinning rich fisheries and ecological processes was maintained in Chilika Lake.

Asian Waterbird Census (AWC) under Citizen-Science programme through a jointly coordinated survey by BNHS and Wetlands International in India identified 313 AWC sites in 2015. Chilika Lake in India reported the maximum number of water bird species with 8,00,000 birds in this census.

Loktak lake, Manipur

Loktak Lake

Loktak lake, the largest freshwater lake in Northeast India, at a distance of 53 km from Imphal in the Manipur river basin is known for its circular floating swamps, called phumdis in the local language.
The Keibul Lamjao National Park located at the south western part of the lake is a habitat of brow-antlered deer, Sangai, which is also the state animal of Manipur. Its hooves are adapted to walk on the phumdis. Phumdi is a collection of heterogeneous mass of vegetation, soil, and organic matter at various stages of decomposition floating on the lake as miniature islands. The lake is home to 233 species of aquatic plants, more than 100 species of birds, and 425 species of animals, including the Indian Python and Sambhar. Livelihood of 0.3 million people living in and around the wetlands depend on it. (https://www.thebetterindia.com/38244/loktak-lake-manipur-floating-national-park/)
The lake became degraded after construction of six barrages on the river and other anthropogenic influences and sedimentation, leading to even excessive Phumdi creation, threatening the very ecosystem. A Loktak Development Authority (LDA) was established in 1986, and the lake was declared a Ramsar site in 1990. Sustainable Development and Water Resources Management of Lake (SDWRML) jointly formulated by WISA and LDA in 1997 was implemented with financial support from India-Canada Environment Facility. Ministry of Development of North Eastern Region (MDoNER) provided funds for Atlas of Loktak Lake 2004 and subsequent project actions under Manipur Lake Protection Act 2006. The comprehensive scientific treatment and management of the project has ameliorated the condition of the lake. (http://www.moef.nic.in/sites/default/files/nlcp/PLenary/PL-8%20Gojendro%20Singh.pdf)

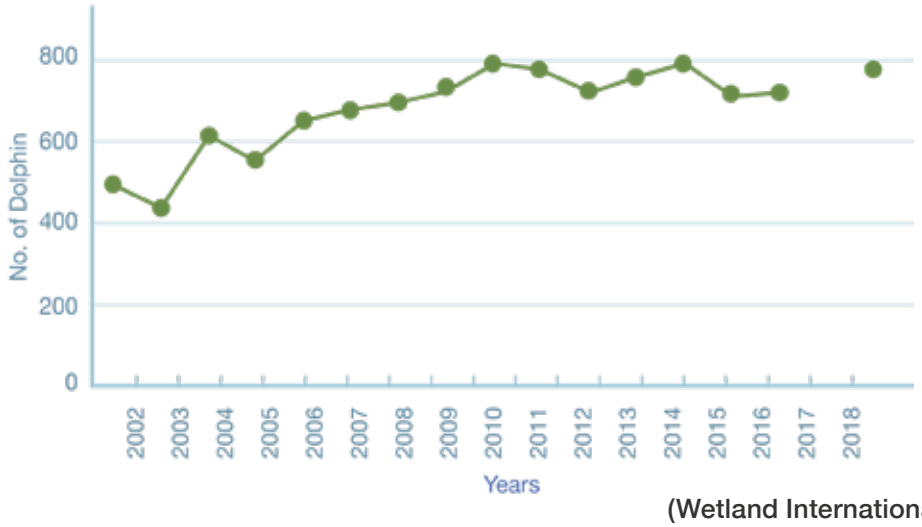
Chilika lake, Odisha

Restoration of the Integrity of the Chilika Lake, a Ramsar site

Chilika lake, the largest natural brackish water lagoon in Asia has constant interaction of marine and terrestrial features and as such supports the assemblage of fresh, brackish and marine water ecosystems. It is a prominent biodiversity hotspot along the Indian east coast in Odisha, and home to rare Irrawaddy dolphin and several other species.
It was designated as a Ramsar site in 1981, and then included in Montreux records (wetlands under threat) in 1993 owing to the continuous degradation of the lake on account of various factors
Chilika Development Authority (CDA), set up by the Odisha government in 1991 sought scientific and technical assistance and advice from organisations such as NIO , Central Water and Power Research Station (CWPRS) established strategic partnerships with international organisations, national organisations, state government organisations, NGOs, research institutions and community organisations, received funding support including from MoEFCC for restoration plans of this unique wetland. The comprehensive action gave positive results and the lake was removed from Montreux record with effect from November 2003.
Chilika lake's biodiversity and ecosystem services have been restored as indicated:

(i) Salinity gradient within the lagoon has been re-established.
(ii) The Irrawaddy Dolphin population has increased from 89 to 158 individuals between 2003 and 2014, along with increase in habitat use, improved breeding and dispersal, and decline in mortality rates. Figure 11.1 shows number of Irrawaddy Dolphin in Chilika lake over the years.
(iii) Sea grass meadows have expanded from 20 km^2 in 2000 to 80 km^2 in 2014.
(iv) Improvement of Chilika habitat, in particular, the increase in dolphins, has led to a resurgence of wetland eco-tourism.
(v) Annual number of tourists visiting the wetland during 2000–2014 averaged 0.3 million – an increase of over 60 % as compared to arrivals during 1994 –1999.
(vi) Livelihood base of 2,00,000 fishers and 4,00,000 farmers has been improved.
(vii) Based on the positive changes in ecological character, Chilika was delisted from Montreux Record and the intervention recognized with the Ramsar Wetland Conservation Award.

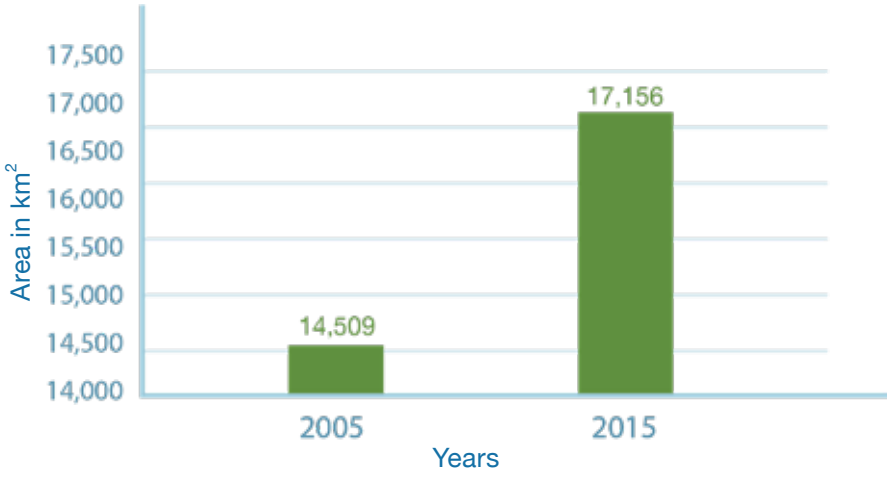
Figure 11.1 Number of Irrawaddy Dolphin in Chilika lake over the years



(Wetland International)

Leveraging of MGNREGA, IWDP and other government schemes, and effective participation of forests has led to increase in water bodies within forests. The area covered by these increased by 2,647 km^2 over the decade 2005-15. Figure 11.2 shows the decadal change in water bodies within forests.

Figure 11.2 Decadal change in water bodies within forests



2. Riverine Ecosystem

(i) The first major step at river conservation dates back to the year 1985 when Ganga Action Plan (GAP-I) was started. The objective of the Plan was abatement of pollution and improvement of the water quality of the river Ganga. GAP-I was expanded in 1993 as GAP Phase II to include two major tributaries of Ganga namely, Yamuna and Gomti rivers. GAP-II was further expanded to National River Conservation Plan (NRCP) in 1995 to include all the major rivers of the country.

These measures largely focussed on:

- protecting rivers from pollution,
- degradation of water quality, and
- incentives for control of pollution to industries, establishment of common effluent treatments plants for small scale industries and adoption of "Eco-mark" for the eco-friendly products formed important components of these measures.

Ganga river, Rishikesh

The Ganga river basin is the most densely populated basin in the world and gets heavily polluted by fertilizers, pesticides, industrial chemicals, and domestic effluents.

(ii) Ecological Status of Rivers

Gangetic river dolphin, Platanista gangetica gangetica, is one of the three obligatory freshwater dolphins in the world and is distributed in the Ganges-Brahmaputra-Meghna and Sangu-Karnaphuli river systems in India, Nepal, and Bangladesh. It is endangered as per 1996 IUCN list. The species was included in Appendix I of the CITES and Appendix II of the CMS. Gangetic dolphin was declared the national aquatic animal of India in 2009. A Dolphin Conservation Project was sponsored by the Ganga Project Directorate, MoEFCC.

(iii) Namami Gange (NG), a National Mission for Clean Ganga- a flagship programme of the Government of India for effective abatement of pollution, conservation and rejuvenation of river Ganga was started in 2014. The Ganga is the third largest river of India housing about 40% of India's population in its basin. Municipal sewage from urban centres, effluents from industries and polluting waste from several other non-point sources get discharged into the river through its 2,525 km journey from the hills to the sea. With an outlay of Rs. 20,370 million over a period of 2014-15 and involving several Ministries, NG aims at Ganga rejuvenation by consolidating the previous GAP Phase-I launched in 1987 and GAP Phase- II. The programme is implemented by National Ganga River Basin Authority (NGRBA) under MoWR, RD & GR with the involvement of other stakeholder departments, state governments of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal and the people. The work includes restoring the ecosystem of river Ganga by preparation and implementation of conservation plans, regular water quality monitoring and checking of wastewater generated from different sources. Figure 11.3 shows the components of NG.

Figure 11.3 Components of NG

(iv) Specific biodiversity relevant components of NG

- While all the components are biodiversity-relevant, the components river front development, biodiversity, and afforestation directly relate to the conservation and enhancement of biodiversity and ecosystems.

The actions regarding these include:

- River Surface Cleaning: River Surface cleaning for collection of floating solid waste from the surface of the Ghats and River and its disposal are afoot and pushed into service at 11 locations.
- Biodiversity Conservation: Several biodiversity conservation projects initiated include Biodiversity Conservation and Ganga Rejuvenation, Fish and Fishery Conservation in Ganga River, Ganges River Dolphin Conservation Education Programme. Five biodiversity centres at Dehradun, Narora, Allahabad, Varanasi and Barrackpore has been developed for restoration of identified priority species.

Legal Protection Measures for Gangetic Dolphin

Declared National Aquatic Animal on 5 October 2009, Gangetic Dolphin has been included in:

• Schedule I of the Indian WP Act,
• Appendix I of the CITES,
• Appendix II of the CMS, and
• categorized as Endangered in the IUCN Red List of threatened animals.

Purple Moorhen, Surajpur Wetlands, Uttar Pradesh

- Afforestation: Forestry interventions for Ganga through WII, Central Inland Fisheries Research Institute and CEE have been initiated. Forestry interventions for Ganga have been executed as per the Detailed Project Report prepared by FRI, Dehradun for a period of five years (2016-21) at project cost of Rs. 2,300 crores. Work has been commenced in seven districts of Uttarakhand for medicinal plants. (https://www.nmcg.nic.in/NamamiGanga.aspx)

All other components contribute to biodiversity and ecosystem services by remedial action against pollution from various sources and creating people's awareness.

(i) CPCB is mandated with the responsibility of undertaking continuous Real Time Water Quality Monitoring (RTWQM) of River Ganga at 36 locations. (http://cpcb.nic.in/uploads/healthreports/Biological-Water-Quality-Assessment-2018.pdf)

(ii) Guidelines for pesticides and heavy metals in drinking water stipulated by Bureau of Indian Standards (BIS) and World Health Organisation (WHO) are used by CPCB for the assessment of human health aspects.

(iii) A two-phase monitoring of water quality of river Ganga during 2014- 2016 in the states of Bihar, Jharkhand, Uttarakhand, Uttar Pradesh and West Bengal was undertaken based on biological indicators to assess different levels of pollution.

(iv) WWF organises the Ganga Mahotsav every year since 1997 as part of the Wildlife Week celebrations. Nearly 15,000 school children and villagers from the surrounding areas participate in various events on the day. (https://www.wwfindia.org/?4900/Conserving-the-Ganges-River-Dolphin)

(v) A River Watch Programme has been initiated to identify hotspots and develop management plans with the help of the Forest Department and create awareness in target areas.

(vi) A conservation action plan 2010-20 funded by MoEFCC is now under implementation. Education and awareness building is one of the components of the project. CEE, Northern Regional Cell (CEE North) is implementing this component with the support from NG Mission and NGRBA.

The state government of Bihar has funded dolphin census which was conducted by ZSI, WTI and Tilka Manjhi University, Bhagalapur between November 18 and December 10, 2018. The extensive survey lasting for 23 days, traced 700 dolphins in the 300 km stretch of the Ganga from Mokama to Manihari, 300 dolphins in another 300 stretch from Buxar to Mokama, 100 in the Gandak river and 50 in the Ghaghara river. (https://www.downtoearth.org.in/news/wildlife-biodiversity/thriving-gangetic-dolphin-presence-in-bihar-reveals-census-63285)

Considerable action is being taken for ensuring the integrity and conservation of wetlands and riverine ecosystems. Nevertheless, there is a need to create and deepen collective consciousness about the immense value of conserving these ecosystems for the sustainability of human settlements and their welfare.

CHAPTER 12

Achatina fulica

Management of Invasive Alien Species

Invasive Alien Species (IAS) are species whose introduction and/or spread outside their natural past or present distribution threatens biological diversity. IAS occur in all taxonomic groups, including animals, plants, fungi and microorganisms, and can affect all types of ecosystems.

(CBD)

Species compete to survive in the habitats they inhabit. Alien species introduced in the non-native habitats are described as invasive if they outcompete the native species in survival. In other words, alien species that get naturalized in the new habitats without destroying native natural flora and fauna are not invasive. Analysis of the IUCN Red Listed cases of threats to species shows IAS as the second most common threat in the case of species that have gone completely extinct, particularly with regard to extinction of amphibians, reptiles and mammals. It is apprehended that, if not checked, biodiversity loss through IAS may soon surpass the loss through habitat destruction and fragmentation.

An invasive plant alters the habitat. It draws in nutrients and moisture, outcompetes native species and paves the way for further invasions by microorganisms, pests and pathogens. Proliferation of these IAS threatens native biodiversity, subverts natural plant succession, changes structure and composition of communities, and impairs ecosystem services severely.

IAS introduced deliberately or accidentally in Indian ecosystems are a serious threat to the survival of natural habitats and species across the country. Repeated sampling of forests in the four consecutive cycles over 12 years under India's National Assessment of Tigers, Co-predators, Prey and their Habitat, to survey and monitor invasive plants suggests that >90% of sampled forests were invaded by some high concern invasive species.

Some example of the commonly found faunal and floral alien species are given below.

Faunal Species

- **African apple snail** *(Achatina fulica)*: The most invasive among all invasive alien faunal species in India, this mollusc was first reported in the Andaman & Nicobar Islands. It is now found across the country and threatening the habitat of several native species.
- **Papaya Mealy Bug** *(Paracoccus marginatus)*: Native of Mexico and Central America, it infests and destroys huge crops of papaya in Assam, West Bengal and Tamil Nadu.
- **Cotton Mealy Bug** *(Phenacoccus solenopsis)*: Native to North America, it has severely affected cotton crops in the Deccan.
- **Amazon sailfin catfish** *(Pterygoplichthys pardalis):* It is responsible for destroying the fish population in the wetlands of Kolkata.

Floral Species

Prospis julflora: Vilayti Kikar *(Prosopis juliflora)*

- Causes degradation to the native flora.
- Depletes soil nutrition.
- Grows well in arid conditions and has the ability to tolerate salinity.
- Thick canopy of the tree suppresses growth and regeneration of other tree species lowering the species richness of the area.
- Thorny branches make it difficult for foraging by livestock.
- Strong seed dispersal mechanism.
- Impacts native plant growth by preventing sunlight and releasing chemicals.

Parthenium hysterophorus- colloquially known as Congress grass, is believed to have been introduced into India and Australia from North America. It has emerged as the seventh most devastating weed in Africa, Asia, and Australia responsible for severe human and animal health issues, such as dermatitis, asthma and bronchitis, agricultural losses, besides being a big problem for biodiversity.

Lantana camara introduced in India, its diverse and broad geographic distribution is a reflection of its wide ecological tolerance. It occurs in diverse habitats and on a variety of soil types. Lantana grows as impenetrable thickets that can suppress the growth of native species. Lantana threatens natural habitats and native flora and fauna (FAO).

Water hyacinth *(Eichhornia crassipes)* with its massive proliferation minimises availability of open water surface. Large scale invasion prevents entry of sunlight and significantly alters air-water interface and adversely affects the productivity of the ecosystem.

12.1 NBTs Related to IAS

NBT4 aims at identification of pathways of IAS, management and control of prioritized IAS.

12.2 Progress and Achievements

(i) Identification of Pathways of IAS

Pathways in the past have included deliberate introduction of species including as ornamental plants. Lantana is an example of deliberate introduction as an ornamental species. Increase in the movement of people and goods around the world in the modern times has substantially increased opportunities for the introduction of species outside of their natural range. Common pathways for such introduction

Pterygoplichthys pardalis

include cases such as escape of fish from farms and horticulture, in ship ballast water and the spread through man-made corridors such as canals.

(ii) Identification of IAS

After detailed intensive and extensive consultations with experts on pathways and identification of IAS, NBA has prepared an agreed list of 168 invasive aliens in India. Table 12.1 shows the ecosystem wise distribution of so identified species.

Prioritisation of species for management and control is under process in NBA, and once completed it is expected to lead to a well-directed comprehensive plan of action for their management and control.

Table 12.1 IAS of India

S.No.	Ecosystems	Number of IAS
1	Terrestial Plants	54
2	Aquatic Ecosystem	56
3	Agriculture Ecosystem	44
4	Island Ecosystem	14
Total		168

(NBA)

(iii) Strategies and Measures Currently in Place

- NWPC for Sustainable Management of Forest and Biodiversity in India includes management of invasive species for maintenance and enhancement of forest health and vitality as part of the working plans for forest management.
- National Assessment of Tigers: Invasive plants monitoring has been made an integral part of the assessment of Co-predators, Prey and their Habitat which is done every fourth year since 2006. Forest staff and trained biologists sample all the forest patches in the tiger ranges of the country and record presence of all invasive plants.
- PQO, 2003: SMPP takes action to prevent introduction of exotic pests, diseases and weeds likely to get introduced through import of agricultural commodities or plant material into India under Plant Quarantine (Regulation of Import into India). This also fulfils India's obligation under the IPCC.
- Plants, Fruits & Seeds (Regulation of Import in India) Order 1989 (PFS Order 1989): regulates the import of plants, fruits or seeds in India.
- Destructive Insects and Pests Act, 1914 (DIP Act) and Amendments aims at preventing introduction of any insects, fungus or other pest which is or may be destructive to crops and transport from one state to another in India.
- Intensification of Forest Management Scheme (IFMS) was started in 2009 includes control and eradication of forest invasive species as a component.
- Studies are being carried out by Tropical Forest Research Institute (TFRI), Jabalpur, and others to establish workable models for control/eradication of IAS. Management of Lantana camara adopting one or the other of the models mentioned is being practised. Strategies tested and advocated by these studies include:

  (i) ecological restoration by allowing selected indigenous plant species with potential to outcompete invasive species to flourish,
  (ii) mechanical control in combination with crop-competition method, and
  (iii) cut-root-stock method combined with introduction of native legumes and grasses.

Identification and treatment of IAS has been made an essential part of management of protected areas and wetlands.

Management through Cut Root-Stock Method

Lantana introduced into India as a garden ornamental and or a biohedge plant in early 19th century, has now virtually invaded all the tropical and subtropical regions of India. Attempts to control Lantana by physical, chemical and biological methods do not succeed in controlling or eradicating it. CEMDE has experimented with a strategy that involves (i) its removal by cut rootstock method, (ii) weeding of saplings from beneath the trees used by generalist birds for perching and causing dispersal of seeds, and (iii) ecological restoration of weed-freed landscapes, preferably to the grassland, or forest communities to prevent reinvasion of the same species or secondary invasion by another alien species. The strategy has been implemented successfully in demonstration plots of 2–5 ha at the Corbett Tiger Reserve (Uttarakhand), Kalesar National Park (Haryana) and Satpura Tiger Reserve (Madhya Pradesh). This strategy is said to be cost effective, simple and easy to adopt, and effective in controlling Lantana without using chemicals and exotic biological control agents with minimum disturbance of soil.

(C. R. Babu *et al*, 2009)

12.3 Scientific and Technical Needs

Pervasiveness of IAS across areas and their tendency to resurge after patchy treatments necessitates implementation of strategies that create lasting effect. Sharing of best practices from across the globe, scientific and technical cooperation, contiguous transboundary cooperation and additional earmarked funding are required to successfully control and manage IAS. Also, a nationally coordinated system of invasive species management needs to be established which brings together domain experts such as botanists, foresters, wildlife biologists, researchers, engineers, ecologists, hydrologists, and communication experts to make areas and species-specific strategies taking a long-range management perspective of IAS.

Lantana camara

CHAPTER 13

Living Root Bridges, Meghalaya

Traditional Knowledge and Biodiversity

Traditional Knowledge (TK) in the context of biodiversity refers to the know-how, skills and practices evolved and adopted by local and traditional communities over centuries regarding maintenance and use of natural resources. The range of this knowledge is vast. It covers medicinal and other properties of plants and animals, the manner of using them for healthcare and other essential needs, insights into the intrinsic value of biodiversity for environmental and human purposes and manner of conservation and sustainable use of the elements of biodiversity. Its ethical norms help regulate human interactions with the natural environment and secure intergenerational equity. It can be environmental, medicinal, or knowledge associated with agriculture, food and health and genetic resources (Annex to WIPO, The

Protection of Traditional Knowledge: Revised Objectives and Principles, 2007). Quite a bit of this knowledge is now in wider public domain also.

India has a vast heritage of written and oral knowledge coming down from generations. This knowledge covers identification and uses of natural resources for human, animal and planet welfare. Indian systems of health and medicines which include Ayurveda, Siddha, Unani and Sowrigpa systems are rooted in texts written in ancient Indian languages. Day-to-day health and healing practices based on locally available natural resources evolved by communities remain in the form of oral folklore. In addition, this rich store of knowledge covers nearly all other aspects of day-to-day existence of the communities such as food, agriculture, pest control, ethics based cultural activities and protocols for conservation and wise use of natural resources.

This treasure of knowledge is essentially dynamic and continues to evolve and respond to the emerging needs and shared experience of a community, helps advancements in modern science. Its judicious and wider use enlarges its application for human welfare and conservation, helps advancement in modern science, and its application for human welfare and conservation.

Living Root Bridges - Testimony to TK's Role in Conservation Based Infrastructure

Dense tropical rainforest, heavy monsoon rains, typical geography of mountains, deep gorges and far flung villages define the terrain of global biodiversity hotspot represented in the states of Assam and Meghalaya. The local tribal societies in the area developed an eco-friendly 'Living Root Bridge' (LRB) technology since centuries to establish communication and connectivity across villages. LRBs are natural suspension bridges made up by training the aerial / prop root of *Ficus elastica.* The local tribal communities have contemporized and kept live even today the beautiful eco-friendly answer to the problem of connectivity through ages of evolution. The village community of Mawkyrnot, Pynursula, and East Khasi Hills is constructing the longest and highest LRB since 2010 at present.

13.1 NBTs related to TK

The CBD and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (referred to as Nagoya Protocol hereafter), obligate that this knowledge is conserved, its wider use encouraged for conservation and sustainable use, including for modern science but subject to sharing of benefits with creators and holders of knowledge in a fair and equitable manner. NBT 11 seeks to ensure this. By virtue of the multidimensional and dynamic nature and value of the TK, this NBT contributes to the entire NBAP by creating a positive sentiment for conservation and sustainable use of GRs amongst conservers and local communities.

Living Root Bridges, Meghalaya

13.2 Progress and Achievements

1. Conservation and Protection of Oral TK

Oral and undocumented TK faces the threat of loss and extinction as urbanization, modern education, modern systems of health care and medicine, new technologies and lifestyles make inroads in local areas and communities. Following measures have been taken as safeguard against this.

(i) Section 41 (1) of the BD Act makes BMCs responsible for chronicling of knowledge relating to biological diversity and its uses in their areas of jurisdiction. BD Rules provide for creation of PBRs to implement section 41 (1) of the BD Act.

(ii) Proforma have been carefully designed by an expert group for BMCs to document TK comprehensively.

(iii) Taxonomic surveys by BSI and ZSI, technical organisations under the Ministry of AYUSH and NGOs document TK practices ideas and innovations.

The Measures for identifying and documenting TK have created a vast but dispersed library of TK as is evident from the following:

- Nearly, 6,800 PBRs have been prepared by BMCs so far.
- **The National Innovation Foundation India (NIF) 2010**, an autonomous organisation under the Department of Science and Technology, Government of India is engaged in documenting and promoting grassroots knowledge, innovations, value addition and protection including through IPRs of the traditional and local knowledge documented by it and its field organizations. Honey Bee Network associated with **NIF** has documented more than 1,00,000 ideas, innovations and TK practices.
- NIF has so far validated 168 technologies and products. It has

supported entrepreneurs in filing for 63 patents.
- Traditional healers have validated about fifty nine human health related herbal claims during the year 2015-16 in collaboration with Indian Council of Medical Research (ICMR).
- Nearly 1,100 folk claims have been collected by various organisations.
- Taxonomic surveys conducted by BSI have mapped 8,000 medicinal plants.
- About 16,155 folk claims for treating diseases and conditions including other economic uses have been recorded and published.

2. Conservation and Wider use of Coded Knowledge

A Traditional Knowledge Digital Library (TKDL) has been created by transcribing ancient texts. It was a pioneer initiative of India to prevent misappropriation of India's traditional medicinal knowledge. The Ministry of AYUSH in collaboration with CSIR got ancient texts of Ayurveda, Unani, Siddha and Yoga systems transcribed into modern languages. This has overcome the language and format barrier by scientifically converting and structuring available contents of ancient texts of Indian systems of medicine into five international languages namely English, Japanese, French, German and Spanish. (http://tkdl.res.in)

Table 13.1 Current status of transcription of the traditional medicine formulation in the TKDL

Discipline	No. of books used for transcription	Transcribed Formulations
Ayurveda	75	97,337
Unani	10	1,75,150
Siddha	50	23,016
Yoga	15	1,680
Total	**150**	**2,97,183**

Traditional fishing technique practiced in Sindhudurg, Westren Ghats

MOEFCC and Department of Industrial Policy and Promotion (DIPP) are engaged in exploring ways to include documented oral TK as in TKDL.

3. Protection of TK against its Unfair Use including through IPRs

Provisions have been incorporated in relevant laws to check unauthorised use of TK for commercial or IPR purposes. These include:

(i) **The BD Act** makes access to TK and filling of applications for IPRs for products/ inventions that use TK subject to approval by competent authorities.

(ii) Section 3(k) of **Forest Rights Act** recognises that that forest dwelling Scheduled Tribes and other traditional forest dwellers have the right to intellectual property on TK related to biodiversity and cultural diversity included in the act.

(iii) **The Patents Act**, 1970 disallows TK as invention under section 2(1) (j). Section 3 (p) provides that an invention which in effect, is TK or which is an aggregation or duplication of known properties of traditionally known component or components is not patentable.

(iv) **Guidelines for processing Patent Applications relating to TK and Biological Material 2012** help Patent examiners in analysing what constitutes novelty and inventive step in TK related inventions.

(v) **International Access Agreements** have been signed with United States Patent and Trademark Office, European Patent Office, Canada Patent Office, Germany Patent Office, Japan Patent Office, United Kingdom Patent Office, Australia Patent Office, Malaysia Patent Office, Chile Patent Office and Indian Patent Office to allow TKDL's use by them in patent application examination.

Pre-grant opposition showing prior art evidences from TKDL are submitted on a regular basis. TKDL has so far succeeded in preventing the grant of 220 wrong patents, and facilitating scrutiny for such prevention at International Patent Offices (IPOs).

(vi) NBA has the power under the BD Act to oppose grant of patents anywhere which has either used TK unauthorizedly or seek patent on what is already a part of TK. NBA files third party observation against grant of such patents. It has filed over 50 such third party observations in Patent Offices of US, Canada and Europe.

4. Fair and Equitable Sharing of Benefits for TK

NBA and SBBs are responsible to ensure that access to TK for any use is approved subject to fair and equitable sharing of benefits with the creators and conservers of TK.

5. Advancement and Wider Use of TK

With the formation and capacity building of BMCs and establishment of PBRs at the local level, revival of traditional knowhow and practices for conservation has been witnessed. BMCs have also engaged themselves in rehabilitation of threatened flora and fauna including recovery and cultivation of landraces and traditional varieties.

Use of TK is being promoted to find viable solutions for rehabilitation of species and degraded habitats with the active participation, and often own initiatives of local communities. Value of traditional practices in securing integrated management of water, forests and land is increasingly being noted and used. Various types of resource management practices have been mapped by studies which contribute to local diversity.

Simple local technology and an ethic that exhorts "capture rain where it rains" have given rise to 1.5 million traditional village tanks, ponds and earthen embankments that harvest substantial rainwater in 6,60,000 villages in India (Pandey, 2001a), and encourage growth of vegetation in commons and agroecosystems. For instance, 15 types of resource management practices have been mapped that result in biodiversity conservation and contribute to landscape heterogeneity in arid ecosystems of Rajasthan. Even traditional rainwater harvesting systems promote landscape heterogeneity through augmented growth of trees and other vegetation which in turn supports variety of fauna.

Interactions and integration of local and formal knowledge create valuable tree species diversity on farms and agroecosystems. Context specific TK and local institutional mechanisms it employs form a rich resource that offer scope for harmonizing TK with the current science.

13.3 Steps for Consolidation and Further Action

The number of entries of oral TK achieved through various streams of documentation is huge. Many more may get documented once PBRs are completed in the entire country, and scouting of TK and innovations through efforts of NIF surveys yield more information. Integration of these in TKDL would be a challenging exercise owing to the possibility of some information coming out to be commonly shared across communities and locations firstly, and multiplicity of languages and dialects used in recording the TK, secondly. Human, technological and financial resources needed for this could be substantial.

A woman from Baiga tribe using indigenous tools for fishing, Madhya Pradesh | Source: Shrikrishna Paranjpe

CHAPTER 14

Traditional practice of storing seeds

Access and Benefit Sharing

CBD introduced a new paradigm in the utilization of biological resources by obligating the user parties to ensure fair and equitable sharing of benefits arising from the use of biological resources and associated TK with the provider parties. The Nagoya Protocol, which entered into force in 2014, created an internationally accepted framework for implementation of access and benefit sharing (ABS). Nagoya Protocol created legal certainty and transparency for providers and users of GR and TK in achieving ABS through obligations for transboundary compliance of national laws. Nagoya Protocol obligates Parties to take measures for ABS in accordance with their national laws and policies. ABS Clearing-House Mechanism (ABS-CHM) has been created at the Secretariat of the Convention under the Nagoya Protocol. It helps provider and user Parties by

hosting validated information which in turn helps parties in enhancing legal certainty, clarity and transparency on procedures for implementation of ABS, and facilitating access to resources legally from provider Parties.

Parties are obligated to designate smooth and effective implementation of the National Focal Point, Competent National Authority, National Publishing Authority, and National Authorised User for ABS-CHM for smooth and effective implementation of the Protocol. Article 6 paragraph 3 (e) of the Protocol provides for issuance of permit or its equivalent on grant of access and publishing it on ABS-CHM. Parties publish the information of such grant permit and ABS Clearing-House automatically generates an Internationally Recognized Certificate of Compliance (IRCC). The Protocol obligates Parties to designate one or more Checkpoints to enhance transparency about the utilisation of GRs. The information collected or received by Checkpoints is then published on the ABS Clearing-House in a format called a Checkpoint communiqué (CPC). These measures are expected to help ensure ABS.

14.1 NBTs Related to ABS

NBT 9 aims at ensuring that by 2015 access to genetic resources and equitable sharing of benefits arising from their utilization is implemented as per the Nagoya Protocol consistent with the national legislation.

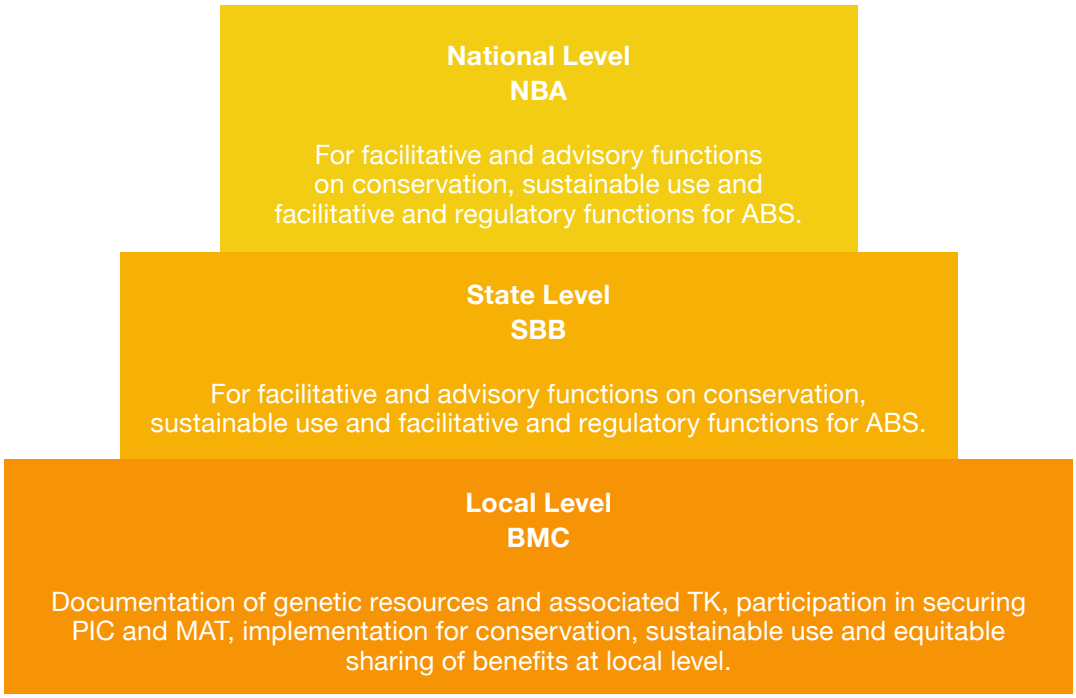
14.2 Governance and Management of ABS

BD Act, the BD Rules and the Guidelines on Access to Biological Resources and Associated Knowledge and Benefits Sharing Regulations, 2014 (Guidelines, 2014) include specific provisions to create administrative infrastructure and prescribe procedural details for operationalising ABS. These laws identify the purposes for which access is regulated to secure ABS, permissible exemptions for certain uses from the purview of ABS.

14.3 Institutional Infrastructure for Implementation

BD Act created a comprehensive institutional architecture covering all the three levels of governance identified in chapter 4 for establishment of ABS. Figure 14.1 shows the implementation architecture for ABS.

Figure 14.1 Implementation architecture for ABS



India has designated the following on ABS-CHM:

National Focal Point- MoEFCC
Competent National Authority- NBA
National Publishing Authority- MoEFCC
National Authorized User for ABS Clearing-House-NBA

The NBT 9 was achieved by 2014. For further details refer to the publication 'Implementation of Nagoya Protocol on Access and Benefit Sharing- India's experiences'.

14.4 Progress and Achievements

Section 3(2) and sections 4, 6 and 7 of the BD Act defines persons and purposes for which prior approval of the competent authorities is needed before accessing the biological resources and associated knowledge. Table 14.1 shows matters in respect of which prior approval of NBA and SBBs as the case may be, is required for access to biological resources and associated knowledge.
BD Act and Guidelines, 2014 together provide for the following exemptions from the purview of access.

Table 14.1 Access for which Prior Approval Required

Activities	Authority of Persons u/s 3 (2) **	Authority of Persons u/s 7 *
Research (S. 3)	NBA	NA
Bio-survey and Bio-utilization (S. 3)	NBA	SBB
Commercial utilization of resources (S. 3)	NBA	SBB
Prior approval before seeking Intellectual Property Rights (S. 6)	NBA	NBA
Transfer of research results (S. 4)	NBA	NBA
Third party transfer of already accessed bioresources/ knowledge (S.20)	NBA	NA

** Persons u/s 3 (2) are the following;
i) a person who is not a citizen of India;
ii) a citizen of India, who is a non-resident as defined in clause (30) of section 2 of the Income-tax Act, 1962;
iii) a body corporate, association or organization:
(a) not incorporated or registered in India; or
(b) incorporated or registered in India under any law or the time being in force which has any non-Indian participation in its share capital or management.

*Persons u/s 7 are citizen of India, or a body corporate, association or organisations registered in India.

(i) The local people and communities of the area, including growers and cultivators of biodiversity, and vaids and hakims, who have been practicing indigenous medicine from the provisions of Section 7. (Section 7)

(ii) Publication of research papers or dissemination of knowledge in any seminar or workshop, if such publication is as per the guidelines issued by the Central Government. (Section 4)

(iii) All collaborative research projects that conform to the policy guidelines issued by the Central Government in this behalf, and transfer or exchange of biological resources or information relating thereto between institutions, including Government sponsored institutions of India, and such institutions in other countries. (Section 5)

(iv) Persons making an application for grant of any right under any law relating to protection of plant varieties enacted by Parliament. (Section 6 (3))

(v) Any items including biological resources notified by the Central Government as normally traded as commodities (NTACs) when traded as commodities. Currently the list covers 421 items. (Section 40)

(vi) Crops notified from Annex-I crops of the ITPGRFA by the Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, Government of India, from time to time from the purview of Sections 3 and 4 of the Act, 2002. (Section 40)

(vii) Human genetic material. (Section 2(c))

(viii) Access to value added products. (Section 2(c) and 2(p)) read together)

Progress in approvals by NBA under ABS

(i) Approvals for filing IPRs

- Four hundred and seventy-six (476) applications stand approved from 2006-7 to 2017-18. See Figure 14.2 for year-wise applications approved.

(ii) Approvals for third party transfer for accession of biological resources and associated TK

- Twenty nine (29) applications stand approved from 2006 to 2017-18. See Figure 14.2 for year- wise applications approved.

(iii) Approvals for transferring the results of research to foreign nations, companies, NRIs for commercial purpose

- Seventeen (17) applications stand approved from 2006-07 to 2017-18. See Figure 14.2 for year-wise applications approved.

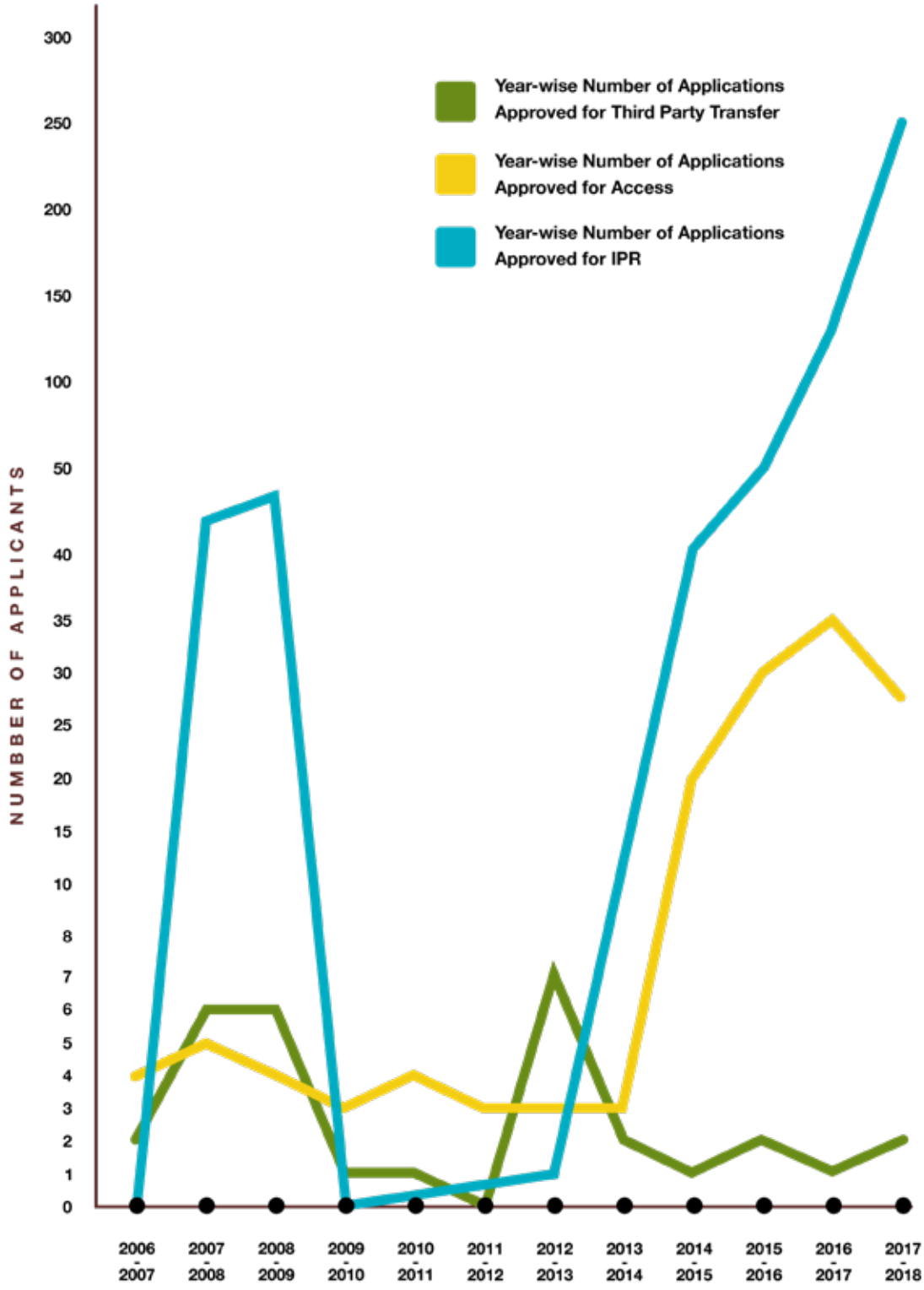
(iv) Approvals for bio-resources and associated TK for commercial utilization

- One hundred and thirty-five (135) applications approved from 2006-07 to 2017-18. See Figure 14.2 for year-wise applications received, cleared and approved.

The process of simplification of procedure is still progressively being carried out by NBA. It is currently engaged in making prior approvals for non-commercial research simpler and prompt and designing standard operating procedures (SOPs) for various sectors covered under the purview of ABS.

ABS is included as a category of awards under IBA. Four awards have been given so far.

Figure 14.2 Year-wise applications approved

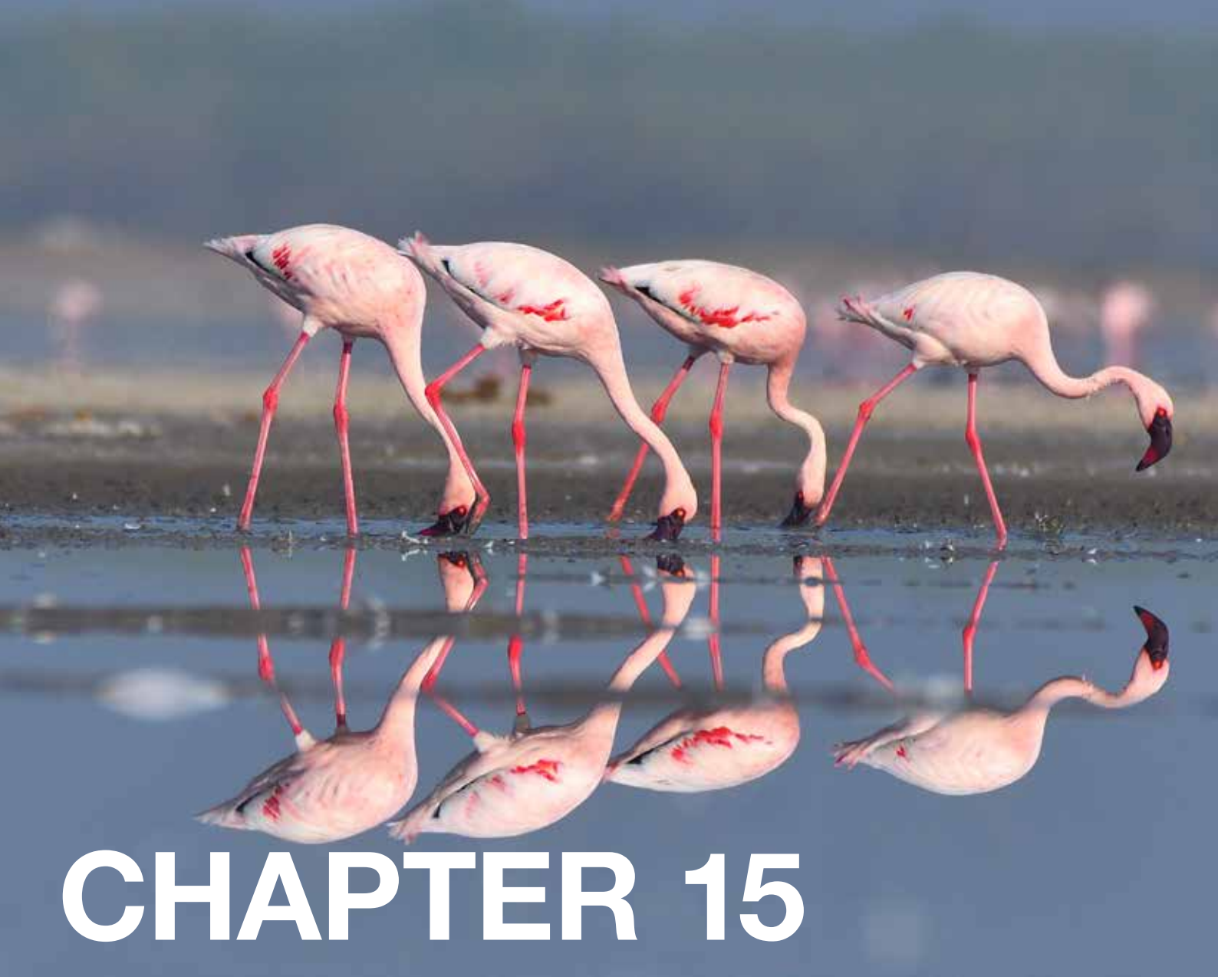


(NBA)

ABS Agreement by Raipassa BMC

It is an example of a successfully concluded ABS agreement for sale of Broom Grass *(Thysanolaena maxima)* by Raipassa BMC in a remote tribal village of North Eastern state of Assam. The ABS agreement between the BMC and the commercial user was signed after detailed discussions with the owners of the resources, which were mainly JFMC members, and commercial users to ensure sustainable harvesting and continued availability of resources. BMC was assisted by Tripura Minor Forest Producers Traders Union and Legal Advisory group (LAG) to frame the agreement, which provides for share of 5% of sale proceeds for JFMCs, 2% for proceeds BMC and Local Biodiversity Fund and 1 % for SBB. The enforcement of agreement is monitored by Tripura Biodiversity Board, Forest Department and Committees under Indo-German Development Corporation Project. Only environmentally and commercially viable extraction of limited quantities of resources is allowed to ensure sustainability. BMC and Village Council ensure that villagers continue to plant Broom Grass.

A woman healer



CHAPTER 15

Lesser Flamingos feeding in Little Rann of Kutch, Gujarat

Safeguarding Ecosystems Vital for Human Well-Being

Valuation studies discussed in chapter 6 have shown that all ecosystems render invaluable services for human well-being. But some ecosystems services, particularly the ones that provide food, fiber, freshwater, pollination of crops, livelihoods, protection from natural disasters and contribute to human health are especially important. Paradoxically, by virtue of being so they are under great pressure. Local communities particularly the poor and vulnerable sections of the society and women depend on these services for their day-to-day living. Their direct dependence is often perceived to be a major contributor to degradation, but the fact is that human actions that cause degradation are neither restricted by temporal and spatial boundaries nor are they always the result of the dependence of local communities on these.

Degradation of environmental and natural resources impacts these vulnerable groups the most. Rampant urbanization, technological and industrial developments, proliferation of environment-unfriendly economic activities such as inappropriate mining, appropriation of wetlands for construction etc., are indeed the main reasons that damage the sustainability of such ecosystem services.

The responsibility for taking actions and creating conditions to ensure that ecosystems are restored and remain healthy lies as much on spatially and temporally distant people as on the ones living in the proximity. Urbanization, technological applications, industrial and economic activities and development sectors need to account for the unintended or intended adverse impact of their actions on natural habitats. Otherwise, local communities, women and vulnerable sections only would continue to suffer and would be driven to exploit natural resources unsustainably.

15.1 NBTs Related to Safeguarding Ecosystem Services

NBT 8 articulates the need to enumerate and safeguard ecosystem services with this perspective and broadly covers the core of all NBTs and SDGs.

15.2 Progress and Achievements

Enumeration of the ecosystem services has been an integral part of the evaluation studies. These provide a good way forward for the local level governance institutions, NGOs and communities to assess and enumerate services that their locale specific ecosystems and biodiversity assets provide. TEEB TII has particularly aimed at creating awareness and understanding of these services among local institutions and people through their active involvement in assessment and enumeration.

Safeguarding of ecosystem services vital fort human well-being requires a multi-dimensional approach. This approach has to inter alia include intellectual capacity building of people to understand, appreciate and contribute to conservation of biodiversity, a regulatory regime that encourages conservation and penalizes destruction, and economic development path that creates sustainable means of livelihoods for all, particularly the poor and the vulnerable including women. The entire spectrum of basic elements of Human Development Index (HDI) such as access to education, health, water, energy, connectivity, urban green environment and sustainable means of livelihoods for all, particularly the poor and the vulnerable including women, is needed for this.

1. Education

It is the foundation for overall growth and employability of human beings and empowers them to make informed choices about the use of natural resources and lifestyles. The major actions in this regard include:

(i) Compulsory education for all children in the age of six to fourteen years under The Right of Children to Free and Compulsory Education Act, 2009.

(ii) Inclusion of environment education from early childhood to graduation level.

(iii) Promotion of women related studies as part of curricula at different levels of education, and elimination of sex stereotyping in vocational and professional courses as implementation of National Education Policy, 1986.

(iv) Inclusion of parents from disadvantaged groups and at least 50% women members in School Management Committees responsible for developing school plans and monitoring utilization of government grants.

(v) Support services for girls to enable their attendance in schools.

(vi) Educational development of vulnerable groups through equalization of education of

Schedule Castes/ Schedule Tribes with the rest of the population.

(vii) Encouragement to women's participation in non-traditional occupations.

2. Access to Health and Potable Water Services

Health is a basic need for surviving productively. Human health ultimately depends on ecosystem services and their products such as potable water and clean air. Biodiversity can have significant human health impacts if ecosystem services cannot meet the demand. Lack of access to health and safe drinking water services impacts adversely on the very sources of biodiversity that provide basic ecosystem services for these.
Main initiatives for securing access to health and safe drinking water services are described below.

3. National Health Mission (NHM) focuses on health related infrastructure and services for all through:

(i) **National Rural Health Mission (NRHM)** and **National Urban Health Mission (NUHM**) in rural and urban areas for universal access to equitable, affordable and quality health care services.

(ii) **Special Programme to focus on women** for catering to reproductive-maternal, new born, child and adolescent health, health issues due to gender-based violence through Janani Shishu Suraksha Karyakaram (JSSK), Rashtriya Kishor Swasthya Karyakram, and Rashtriya Bal Swasthya Karyakram.

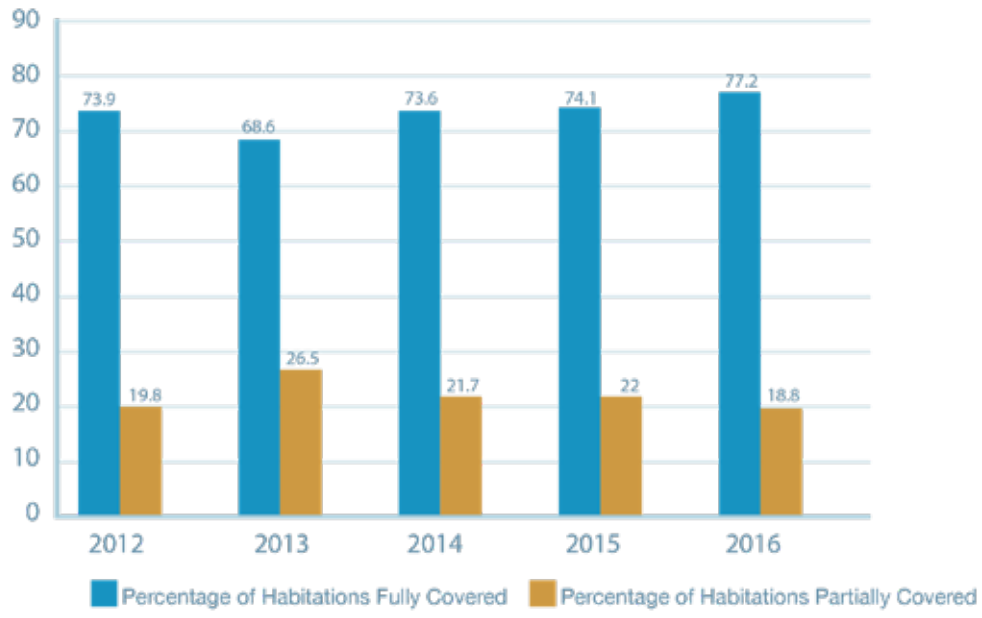
(iii) **Health insurance through Ayushman Bharat – National Health Protection Mission (AB-NHPM)**: This covers over 100 million poor and vulnerable families (approximately 500 million beneficiaries) providing coverage for secondary and tertiary care hospitalization.

(iv) **Mid-Day Meal Programme** and **Integrated Child Development Services** (ICDS) for supplementary nutrition, immunization and pre-school education to children.

4. Access to Safe Drinking Water

National Rural Drinking Water Programme (NRDWP), since 2009 aims to provide adequate and safe drinking water to rural population

Figure 15.1 Percentage of population covered under NRWDP from 2012 to 2016



(Annual Report 2017-18, Ministry of Drinking Water and Sanitation)

with focus on sustainability of water availability in terms of potability, adequacy, convenience, affordability and equity in rural areas.
Marked improvement in percentage of rural population with access to safe drinking water has been achieved over the years. Figure 15.1 shows the increase in habitations covered under NRWDP from 2012 to 2016.

5. Access to Electricity

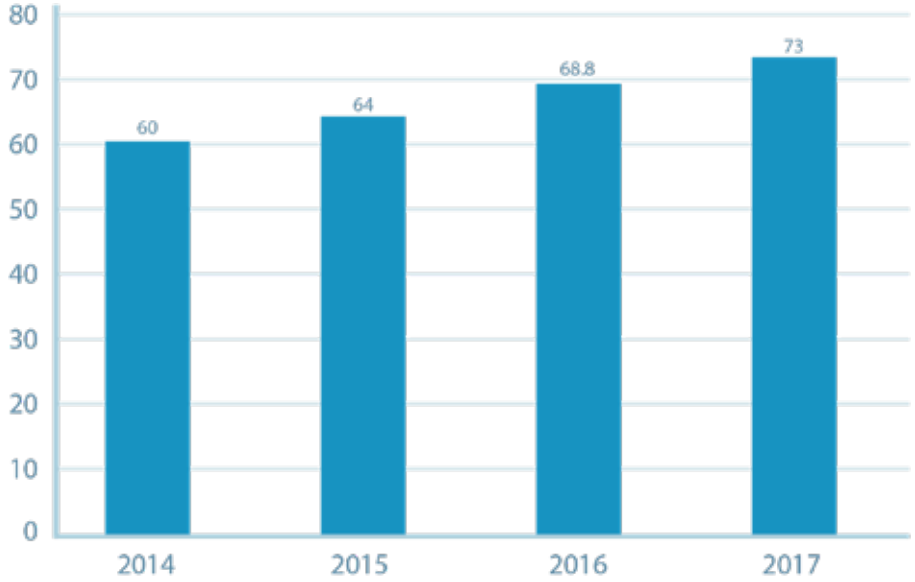
Access to electricity makes direct contribution to safeguarding ecosystem services by reducing dependence on other polluting sources of lighting such as kerosene. The Central Government launched Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) in 2017 for achieving universal household electrification by March 2019 which has helped in reaching electricity to all. Simultaneous emphasis has been laid on increasing the share of green energy. **National Solar Mission** set up as one of the eight missions under NAPCC promotes development and use of solar energy for power generation and other uses with the ultimate objective of making solar energy competitive with fossil-based energy options.

The Energy Conservation (EC) Act, 2001 promotes efficient use of energy and conservation and National Mission for Enhanced Energy Efficiency (NMEEE), one of the eight missions under NAPCC promotes market for energy efficiency.
Actions taken to encourage energy conservation and shift to green energy can be seen at Annexure 7.

6. Access to Connectivity

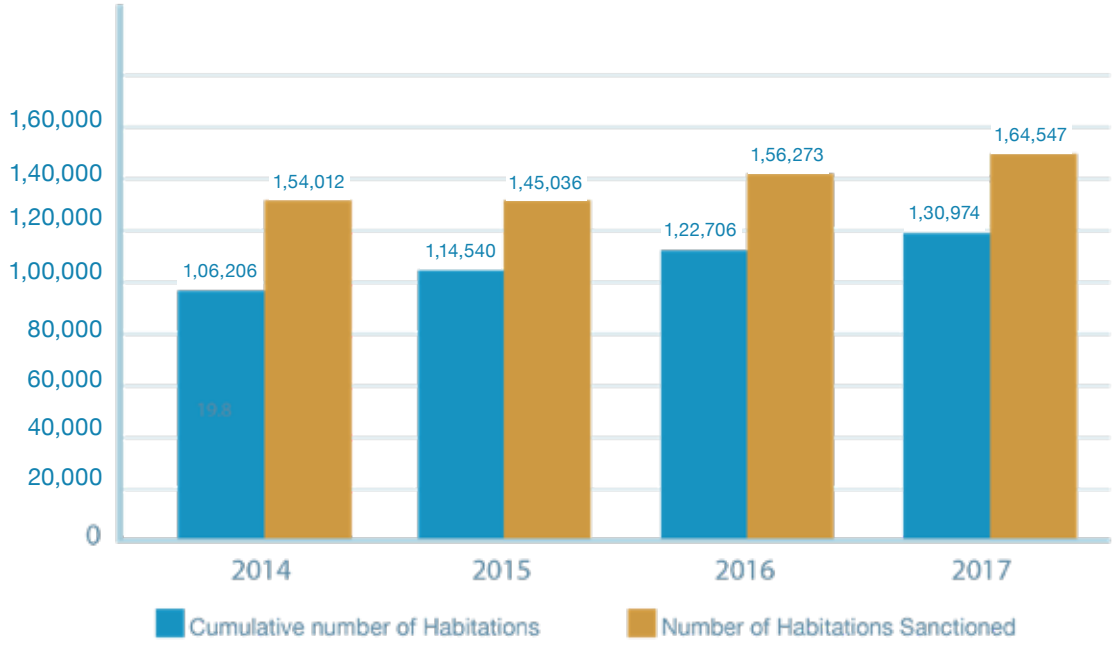
To connect all habitations in India with all-weather roads has been a consistent objective of Pradhan Mantri Gram Sadak Yojana (PMGSY) launched in 2000. Special relaxation has been made in population norms for eligibility of road connectivity for villages of Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Uttarakhand, desert areas, tribal areas and 88 selected tribal and backward districts and special problem areas. A special feature of the projects under the programmes is that women are engaged from PRIs and SHGs to prepare detailed project reports for these roads. It aims to reach even very difficult and far flung areas.
Figure 15.2 shows increasing trend of year-wise percentage of habitations connected by rural roads built and upgraded under PMGSY. Figure 15.3 shows the progress in number of households connected by rural roads under the PMGSY scheme.

Figure 15.2 Year-wise progressive percentage of habitations connected under PMGSY



(Annual Report 2014-15 to 2017-18, Ministry of Rural Development MoRD)

Figure 15.3 Year-wise Habitations Sanctioned and Cumulative Figure of Habitations Connected under PMGSY



(Annual Report 2014-15 to 2017-18, Ministry of Rural Development MoRD)

A group of tribal women, Bastar, Chhattisgarh

7. Employment Generation for Rural Poor, Vulnerable Groups including Women

MGNREGA provides livelihoods resource base for the poor, vulnerable, local communities and women. MGNREGA mandates that women from Scheduled Castes/Scheduled Tribes and Other Backward Classes (OBC) category must constitute at least one third of the beneficiaries under the scheme.

Deendayal Antyodaya Yojana -National Rural Livelihoods Mission (DAY-NRLM) promotes diversified and gainful self-employment and skilled wage employment, social mobilization and sustainable community institutions such as SHGs, which are composed of 5 to 10 women each from poor households. SHGs facilitate discussion on issues of poverty and deprivation, undertake saving and inter-lending, access bank credit and technical support to improve livelihoods and quality of life.

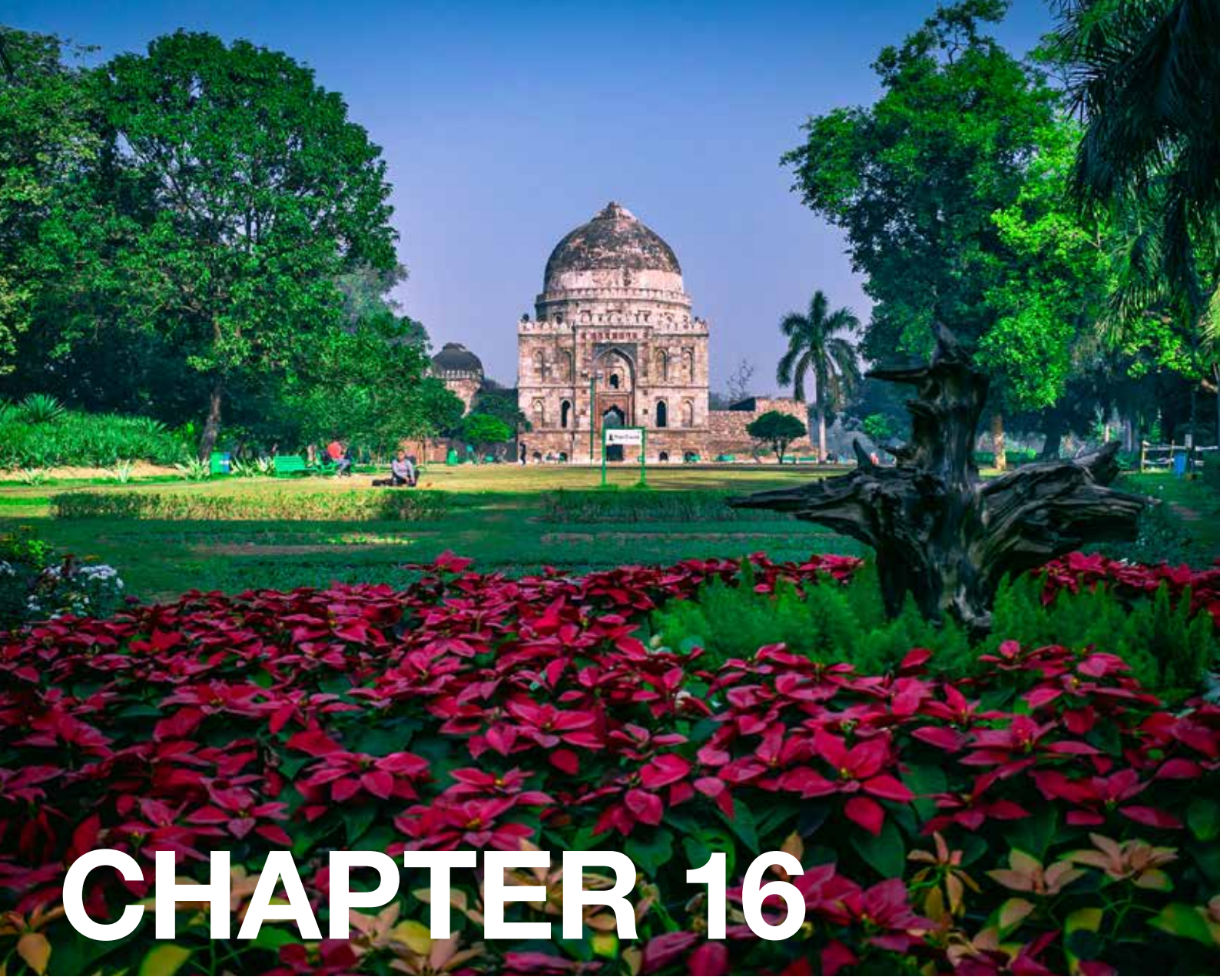
Green Skill Development Programme enhances employability of youth in green jobs as already noted in chapter 5.

MGNREGA

- In the year 2017-18, 1,794.4 million people benefited from MGNREGA of which 53.93% were women.
- Nearly 14.3 million ha of land improved through NRM interventions.

Self Help Groups

- Under DAY-NRLM scheme, 38.7 lakh SHGs of which 34.4 lakh are women SHGs have been formed covering 457 lakh households in 583 districts.



CHAPTER 16

The Lodhi Gardens, Delhi

Urban Biodiversity

Development and economic processes in the urban areas require land for various purposes. These include residential, industrial, commercial and social purposes such as schools, hospitals. All these entail changing land use from forest, agriculture or grasslands to support urbanisation. Most consequences of changing land use through urbanisation can be grouped into two main categories; one, decrease in natural and agricultural land, and two, increase in impermeable hard surfaces of built-up areas. Multiple effects of hard surface areas are quite serious. For example, rain water cannot infiltrate soil causing run-off which may lead to floods. Further, water cycle is adversely affected, and exchange of energy with atmosphere is impaired creating urban heat islands.

Though there is no specific NBT on urban biodiversity, but there is a specific action point

on urban biodiversity in NBAP. Biodiversity and ecosystems represented in urban settings need to be protected for the sustainability of cities and integrity of ecosystems not constituting part of cities spatially. Urban land–use planning and regulation are therefore a paramount need and play a fundamental role in conserving ecosystems and creating green belts. Such planning should ideally involve multiple stakeholders such as the local municipality, architects, academic institutions, and other land user sectors, to build a futuristic image for green spaces and working towards it in a phased and sustained manner.

Promoting natural vegetation in the city needs to be a part of it. Such vegetation strengthens resistance to floods and droughts, and promotes healthier biological processes such as pollination. It needs minimal maintenance cost. Many native species self-propagate and live several years, requiring little human attendance or input of water and fertilizers. Assembly of diverse plant species improves soil health, absorbs precipitation and improves filtration. Wetlands clean up water contaminated with industrial pollutants and sewage, provide other essential ecosystem services while trees strip the air of pollutants. Since the process of urbanisation cannot be arrested, the challenge is to build the native biodiversity within the urban landscape to maintain an optimum level of ecosystem services.

While states, institutions of governance and people take initiatives at the state and local level, major initiatives of the Central Government towards securing green spaces, wetlands and biodiversity conservation are given below.

(i) **Atal Mission for Rejuvenation and Urban Transformation** (AMRUT) set up in 2015 builds upon the experience of the previous mission to provide basic civic amenities like water supply, sewerage, urban transport and parks so as to improve the quality of life for all, especially the poor and the disadvantaged. It includes energy (street light) audit as one of the parameters of cities. AMRUT provides incentives for green buildings by offering rebates in property tax or building permission and development charges covered under the scheme.

(ii) **Smart City Mission 2015** includes objectives of preserving and developing open spaces- parks, playgrounds, and recreational spaces, in order to enhance the quality of life of citizens, reduce the urban heat effects and generally promote eco-balance. Sixty cities have been selected under the Mission covering a total of 9,152 km^2 of urban area.

(iii) **Nagar Van Udyan Yojana** was launched by MoEFCC in 2015 to develop at least one city forest in 200 cities having Municipal Corporation / Class I status.

(iv) **Indian Green Building Council (IGBC)** is a part of CII for developing new green building rating programmes, certification services and green buildings training programmes.

(v) Amending building bye-laws for making solar roof tops is mandatory in new constructions or for higher Floor Area Ratio.

(vi) Mandatory share of 10% renewable energy under Smart Cities Project.

Smart cities project includes focus on creating walkable localities which in turn reduce congestion, air pollution and resource depletion, boost local economy, promote interactions and ensure security.

Delhi Development Authority (DDA), Delhi city's planning and development agency has notified six biodiversity parks in and around Delhi based on a concept developed by CEMDE, University of Delhi, a Centre of Excellence of MoEFCC, to rescue, rehabilitate and restore degraded areas in and around cities to bring back the natural heritage.

Two out of the six parks, namely, the Yamuna Biodiversity Park and Aravalli Biodiversity Park have become fully functional nature reserves of Delhi. The other four are under development.

Yamuna Biodiversity Park

Once the lifeline of civilisations and cities that thrived on its banks, the river Yamuna now has inadequate water flow and heavy load due to pollution. It has a stretch of nearly 48 km with a river bed of 97 km^2 in the National Capital Territory of Delhi. The rescue and restoration of the lost native biodiversity and riverine ecosystem was launched through Yamuna Biodiversity Park. The park covers two different areas comprising native floodplains of the river in phase I and active floodplains in phase II. Phase I comprises 157 acres near village Wazirabad on which the work started around 2002. Native grass and plant species were planted. Phase II of the park covers an area of 300 acres and consists of a mosaic of wetlands, grasslands and floodplain forests. With the restoration of the wetlands and plantation of native species along with proper landscaping of diversity of resident and migratory birds such as Grey Herons, Painted Storks, Spoonbills, Open-billed Storks, Red-crested Pochards, Wagtails and Sandpipers, the park now hosts a wide range of ecosystems indigenous to the Yamuna river basin and supports more than 1,500 plant and animal species.

Spread across 456 acres of land near Wazirabad village, Yamuna Biodiversity park is located on the flat of alluvial plans of the river Yamuna. The park is a biologically rich landscape of grassland communities, a wide variety of fruit yielding species of plants and a rich repository of medicinal herbs. The park also nurtures native flora and fauna that existed 100 years ago and then became extinct locally.

Aravalli Biodiversity Park

The Aravallis are among the oldest mountain ranges having evolved about 1,500 million years ago, and extend from Gujarat through Rajasthan to Haryana and Delhi. The spurs of the Aravallis are popularly known as the Delhi Ridge in Delhi, which is divided into the Northern, Central, South Central and Southern Ridge. Extensive mining of mica, sandstone, china clay, badarpur and gravel over several decades had left the dense forest supporting a wide range of ecosystems such as tropical moist forests, scrubs and grasslands, of south central Ridge, barren and degraded with wide deep pits and denuded hillocks. The Supreme Court issued an order in 1996 that prohibited DDA from allowing any construction activity on 560 acres of the land.
The Aravalli Biodiversity Park, has brought the unique natural heritage of Delhi back in this area. DDA got the park developed by a dedicated team of scientists from Delhi University under leadership of Professor C.R. Babu at CEMDE.
Stretching across 692 acres of scenic landscape, Aravalli Biodiversity Park is located on South Central Ridge near the posh Vasant Vihar colony of South Delhi. The park provides a picture perfect landscape and biodiversity for protection of the natural Aravalli ecology. To further enrich the ecology, the depression area has been converted into orchidarium, and Fernarium for educational interests. It has specialized parks such as Butterfly Park, Sacred Groves, Medicinal and Herbal Garden.
From a barren piece of land in 2004 to a lush-green sanctuary hosting birds, mammals, reptiles, rare ayurvedic plants, butterflies and other insects, the Aravalli Biodiversity Park is an ecological transformation of the degraded land, which holds a torch to other similarly degraded areas.

Biodiversity restored in and services rendered by these two parks are of immense value. Together they harbour some 3,000 species native to Yamuna river basin and Aravalli Mountains, the two major landforms that support life in Delhi. Nearly 3,000 species live in 45-50 communities and include 1,500 plant species, 250 bird species, 50 species of dragonflies, 115 species of butterflies, 25 species of reptiles, 20 species of fish, 20 species of mammals including herbivores, primary and secondary carnivores and some 2,000 invertebrate fauna. The Yamuna Biodiversity Park is now one of the finest wetlands in the country that attracts thousands of migratory birds.

Amelioration of the urban environment through wise use of wetlands and creation and maintenance of urban green spaces contribute to improvement of ecological status of various ecosystems and complements landscape and seascape approach to conservation.

CHAPTER 17

Spiti valley, Himachal Pradesh

Financial, Technical and Human Resources

Effective implementation of NBAP is dependent upon adequate availability of financial, technical and human resources. The multidisciplinary nature of NBAP makes the exercise of identifying these resources a challenge. Chapter 4 on 'Participatory Plans and Implementation at different levels of Governance' brings out the range and variety of sectors, departments and levels at which the NBAP is implemented. Financing this implementation of the plan is a joint responsibility of various Central Ministries, State Governments and the civil society at large.

Globally also, the complexity of identifying the actual and potential resources for the NBAPs has been recognized. Consequently, a Biodiversity Finance Initiative (BIOFIN) was conceived of in 2012 which is being piloted in 31 countries including India. The core objective of the

BIOFIN is to find financial solutions based on a deeper study of the drivers of biodiversity loss to create positive results for biodiversity and society. MoEFCC is the implementing agency for developing the methodology for BIOFIN India. The focus of the work in India so far has been on developing suitable and workable methodology for identifying current sources of finance at various levels, quantifying the gaps at national and state levels and finally suggesting the ways of mobilizing additional resources based on the deeper understanding of biodiversity loss and priorities. NBT 12 deals with the subject in NBAP.

Even before India became a part of BIOFIN project, it had been undertaking assessment of funding for biodiversity conservation since the year 2010-11 using the concept of core, net non-core and net peripheral funding at the Central Government level and funding by the State Governments. The core refers to direct and immediate biodiversity impact schemes of MoEFCC, net non-core refers to other MoEFCC schemes that have an indirect biodiversity impact and net peripheral refers to biodiversity relevant schemes of Ministries/Departments other than MoEFCC. These concepts of net non-core and net peripheral flows were worked out on the basis of multiplicative factors.

Using a similar methodology, the MoEFCC undertook an assessment of funding for biodiversity conservation in India during the year 2013-14 also that included expanded datasets based on peripheral funding related to 77 schemes of 23 Ministries/ Departments of the GoI and used a 'multiplier' to estimate the peripheral funding. It was estimated that the core (under the MoEFCC's biodiversity related programmes), non-core (under MoEFCC's other schemes), and peripheral funding along with outlays of the States amounted to Rs. 9,204.45 (USD 1482.68 million) for 2013-14. This was also included in India's NR 5 and as part of updating of NBAP, 2008 to prepare Addendum, 2014.

After India joined BIOFIN in 2015, it continued the assessment work using the BIOFIN methodology to measure the direct and attributable expenditures on biodiversity, assess gaps and financial needs, and identify suitable finance solutions. The first set of the Biodiversity Expenditure Review (BER) exercise of the 12th Five Year Plan Period (2012-13 to 2016-17) has estimated the average annual attributable biodiversity expenditure to the tune of Rs 20,031.51 crores (USD 2,861.64 million) through an assessment of 116 biodiversity relevant public schemes of 25 ministries. This is depicted in table 17.1.

Table 17.1 Biodiversity expenditure review for the period 2012-13 to 2016-17 (annual average expenditures at Central Government level)

No. of Ministries	No. of Departments	No. of Schemes	Average of Total Expenditure	Average of Biodiversity Attributable Expenditure
25	29	116	Rs 1,07,962.18 crores USD 15423.17 Million	Rs 20,031.51 crores USD 2861.64 Million
				Conversion rate 1 USD = Rs 70

Assessing and computing biodiversity attributable expenditures of all the states was a challenge. To begin with, projecting the national level assessments through extrapolation across all states based on their Gross State Domestic Product (GSDP) estimates were made which yielded an average annual expenditure of Rs 22, 900 crores by states. An exercise to assess biodiversity expenditures under CSR was also undertaken which yielded an estimate of an allocation of Rs. 500 crores per annum. The Official Development Assistance for the Externally aided projects (EAP), Other Official flows and Other Flows such as to NGOs and civil society, were also estimated. Based on this entire exercise, India's domestic biodiversity expenditure covering the period of 2012-13 to 2016-17 was worked out which is shown in the table 17.2.

Table 17.2 India's domestic biodiversity expenditure over the period of 2012-13 to 2016-17

India's Domestic Biodiversity Expenditure (BIOFIN estimates) (Rs in crores)									
Financial Year	Central Government		State Governments and UTs		CSR		Expenditure under EAP (grants and loans)		Grand Total
	Total Expenditure	Attributable Expenditure #	Real	Nominal #	Potential CSR	Biodiversity Share#	Nominal	Real#	Rs in crores
2012 - 13	89,220.74	15,195.08	28,647.76	30,920.78	-	-	1,392.45	812.32	46,928.18
2013 - 14	92,479.82	15,707.10	28,160.12	32,274.81	15,245.38	452.79	1,642.30	896.11	49,330.81
2014 - 15	92,632.33	16,148.31	21,298.36	25,223.72	16,411.94	487.43	1,652.46	875.13	42,734.59
2015 - 16	1,28,890.68	25,390.48	23,726.04	28,681.01	17,783.62	528.17	1,756.01	859.33	55,458.99
2016 - 17	1,36,587.32	27,716.56	27,040.37	30,142.26	18,342.55	544.77	1,831.20	844.50	59,248.09

Values counted for Grand Total

The detailed assessments done in consultation with technical experts show that the annual average financial need for implementing the NBAP is to the tune of Rs 1,15,567 crores, i.e., nearly 16.57 billion USD (2017-18 to 2021-22).

Annual average gap in available public resources for implementing the NBAP is estimated to be Rs 45,849 crores, i.e., nearly 6.5 billion USD for the period 2017-18 to 2021-22. (1 USD= 70 Rs).

Table 17.3 Total finance needs assessed and gap in resources

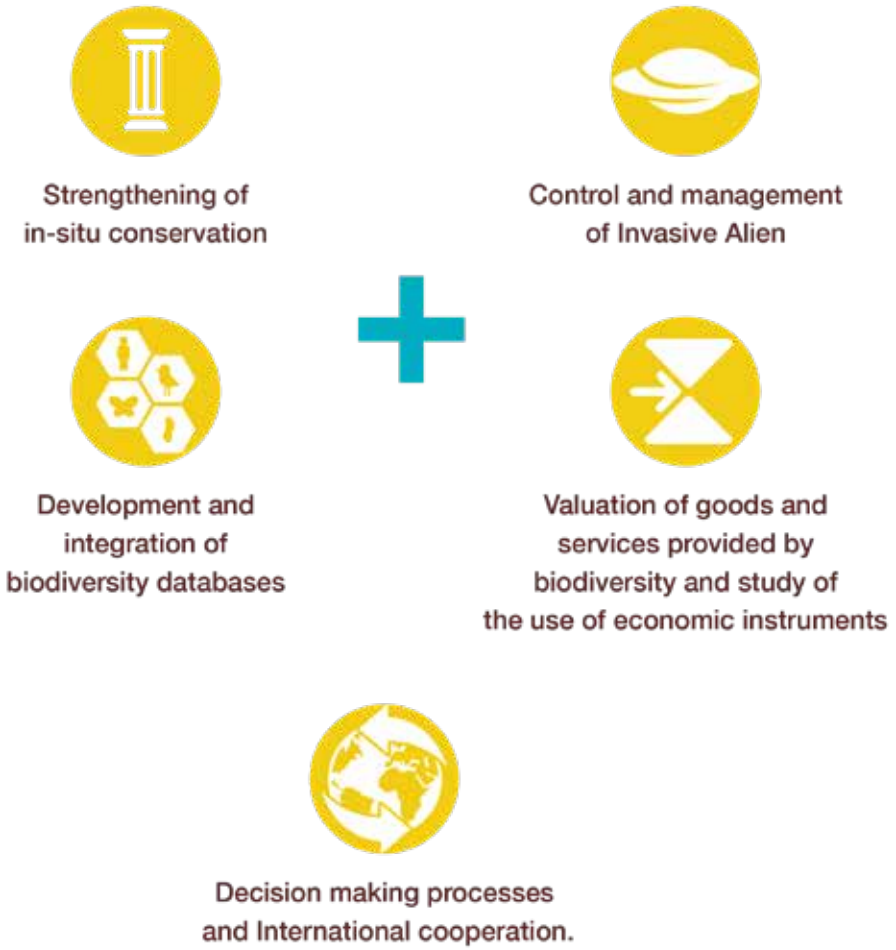
Projected Central govt. expenditure	Projected State govt. expenditure	Projected Total Public Finance	Total Financial Needs Assessed	Gap in Resources
Rs. 39,241.03 crores	Rs.30,880.2 crores	Rs.70,121 crores	Rs.1,15,970 crores	Rs.45,849 crores

A Biodiversity Finance Plan (BFP) has been prepared under BIOFIN India based on detailed national and state level assessments and wide ranging public and private sector stakeholders consultations. The BFP seeks to bridge the gap in financial resources through a blend of existing and innovative finance solutions. These include:

(i) Mainstreaming biodiversity in public finance
(ii) Corporate Social Responsibility
(iii) Access and Benefit Sharing
(iv) Augmenting the public finance
(v) Ecological Fiscal Transfers. (https://www.biodiversityfinance.net/india)

Based on the Financial Needs Assessment (FNA) and BER exercise under the project, priority areas requiring enhancement of financial resources have been identified. These are depicted in Figure 17.1.

Figure 17.1 Priority areas requiring enhancement of financial resources



Variety of legumes

Human and Technical Resources

While states have SBAPs, the human and technological resources required for integration and monitoring of biodiversity related actions in sectoral plans and programmes have been completely inadequate to the task. Programme and Institutional Review study under BIOFIN included review of these capacities at national and sub-national levels. Several one-to-one consultations were held with key stakeholders and reinforced by surveys to assess the institutional capacities (including human, technical and financial capacities etc.) of 29 SBBs (institutions mandated for biodiversity governance at the subnational level in 29 states). This exercise has revealed a pressing need for augmenting these resources. Much more intense work of review at state levels to identify the needs which can be met with a combination of realignment of existing resources and allocation of new resources is needed. Even for this exercise, capacity building is required which itself calls for additional allocation of resources.

In the meantime, following actions have been taken to augment the resources for implementation of NBAP and SBAPs.

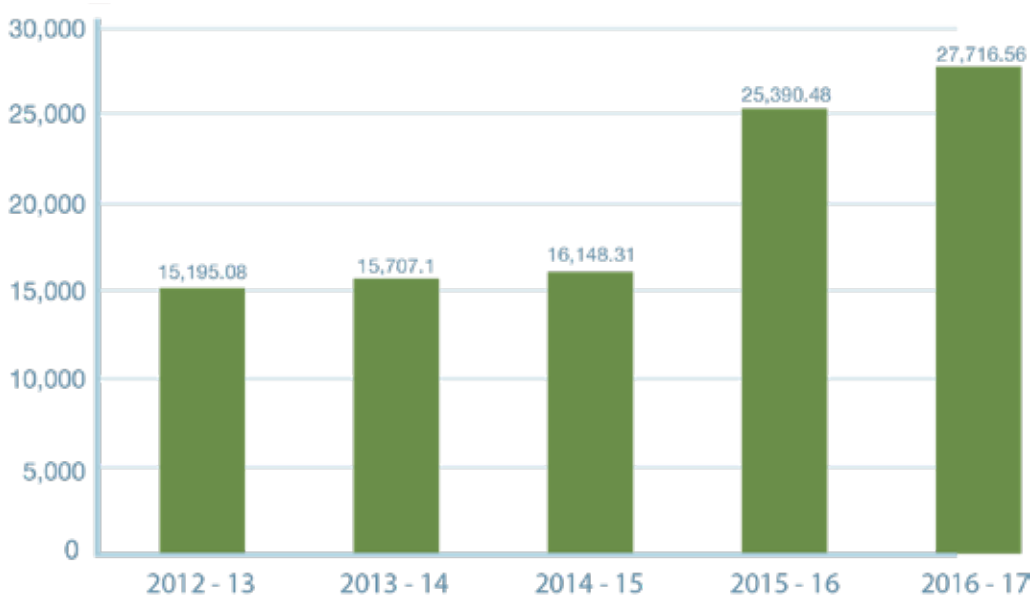
(i) Several state and national level consultations and training programmes have been held for government functionaries and other stakeholders from time to time for mainstreaming of biodiversity and for identifying current levels of funding along with possible sources of additional funding.

(ii) Technical and technological capacities and resources are being harnessed to strengthen scientific planning for conservation and use of elements of biodiversity.

(iii) Central ministries and states have been encouraged to create special cells for monitoring and tracking biodiversity related actions and expenditures.

(iv) Application of geo-spatial technologies has been encouraged to monitor the status of ecosystems and also to provide requisite alerts and guidance for timely actions to save biodiversity, e.g., bi-weekly alerts on coral bleaching based on satellite imageries are issued by INCOIS.

Figure 17.2 Biodiversity attributable expenditure (Rs in crores)



(v) Over the years, budget allocation has been increased in the centre and the states. Analysis of year-wise attributable biodiversity expenditure over five years from 2012-13 to 2016-17 shows a significant increase of 82.40% in 2016-17 over the figure in 2012-13. See figure. 17.2.

State budgets are important players in funding of biodiversity related actions. A methodology has been standardised through consultative process involving different sectoral departments and experts for integrating identification and allocation of financial resource plans in SBSAPs.

Capacity building workshop conducted by EGREE foundation, Andhra Pradesh | Source: Sri Kolari

ANNEXURE 1 A.

National Biodiversity Targets

	**NBT 1**	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.
	**NBT 2**	By 2020, values of biodiversity are integrated in national and state planning processes, development programmes and poverty alleviation strategies.
	**NBT 3**	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.
	**NBT 4**	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.
	**NBT 5**	By 2020, measures are adopted for sustainable management of agriculture, forestry and fisheries.

	**NBT 6**	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.
	**NBT 7**	By 2020, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socioeconomically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.
	**NBT 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.
	**NBT 9**	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.
	**NBT 10**	By 2020, an effective, participatory and updated national biodiversity action plan is made operational at different levels of governance.

	**NBT 11**	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.
	**NBT 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.

ANNEXURE 1 B.

Aichi Biodiversity Targets

Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society		
	**Target 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.
	**Target 2**	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.
	**Target 3**	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.
	**Target 4**	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.
Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use		
	**Target 5**	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.
	**Target 6**	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.
	**Target 7**	By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.
	**Target 8**	By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

	**Target 9**	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.
	**Target 10**	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
Strategic Goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity		
	**Target 11**	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.
	**Target 12**	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.
	**Target 13**	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.
Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services		
	**Target 14**	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.
	**Target 15**	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.
	**Target 16**	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.
Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building		
	**Target 17**	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.

	**Target 18**	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
	**Target 19**	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.
	**Target 20**	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.

Annexure 2.

Process Adopted for Preparation of NR6 (referred to in chapter 1)

The Ministry of Environment, Forest and Climate Change (MoEFCC) as the nodal ministry for the implementation of CBD in India initiated action for preparation of NR6 in early 2017 in association with the National Biodiversity Authority (NBA) and support from Global Environment Facility (GEF) through United Nations Development Programme (UNDP). The process began with extensive consultations with the multiple stakeholders at national and state levels. The stakeholders included representatives of the Central Government, state governments, State Biodiversity Boards (SBBs), other relevant government organisations, academia, civil society organisations, industry and business, domain experts, individuals and groups of people. A brochure comprising information on India's National Biodiversity Action Plan (NBAP), National Biodiversity Targets (NBTs) and their linkages with Aichi Biodiversity Targets and Sustainable Development Goals spelling out the requirements of national reporting was prepared and widely circulated to provide background information to seek relevant inputs from stakeholders. The brochure initially prepared in English was translated into eight different Indian languages to reach the largest possible number of stakeholders. A dedicated web-portal for receiving inputs online for NR6 (www.nationalreport6.in) further facilitated wider outreach to stakeholders. Six Regional Consultations covering all States were organised between July-September 2017. In addition, a few NBT-specific consultations were hosted by national level technical institutions for receiving focused inputs on specific thematic areas.

These regional consultations were followed by State level consultations organized by SBBs involving all stakeholders to get state specific data and information. A specialized team was engaged under a senior consultant to draft the National Report analysing all the information generated through these activities. The members of the team participated in these regional and state level consultations. The team also conducted personal interviews with domain experts, held group discussions with experts, industry and other users to get their perspectives and data.

A video on 'Preparation of India's NR 6: Process and Status' was presented during the 'Workshop on the preparation of the Sixth National Report' in Montreal on December 9, 2017, by way of sharing of experience. The video can be viewed at the link: http://www.nationalreport6.in/.

`A 'Zero Draft' of NR6 was prepared by the specialised team based on the information collected from various stakeholders, and other relevant sources such as official websites, annual reports of the ministries, departments and state governments, published case studies and all other available relevant information. The 'Zero Draft' was shared with all the central ministries, departments, organizations and the divisions of MoEFCC for review, endorsement and suggestions. A 'National Consultation' was organized on 17 July 2018 by the MoEFCC. Representatives of 23 Central Ministries, NITI Ayog, and national level technical lead agencies such as Botanical Survey of India (BSI), Zoological Survey of India (ZSI), Wildlife Institute of India (WII), Indian Council of Forestry Research and Education (ICFRE), National Council for Educational Research and Training (NCERT), National Bureau of Plant Genetic Resources (NBPGR), Central Pollution Control Board (CPCB) attended the National Consultation. The zero draft was revised by incorporating comments/inputs received during the National Consultation and the revised first draft was circulated to a group of experts for their comments/inputs. Simultaneously first draft was examined internally in MoEFCC and NBA. After a series of meetings of the core group, the first draft was finalised. While all the five previous National Reports to CBD were prepared with involvement of stakeholders, consultations for preparation of NR6 have been the most extensive and elaborate so far.

Annexure 3.

List of India's Ramsar Sites (referred to in chapter 2)

S.No.	Name of Site	Date of Notification	State	Area (in ha)
1.	Ashtamudi Wetland	19/08/2002	Kerala	61,400 ha
2.	Bhitarkanika Mangroves	19/08/2002	Odisha	65,000 ha
3.	Bhoj Wetland	19/08/2002	Madhya Pradesh	3,201 ha
4.	Chandertal Wetland	08/11/2005	Himachal Pradesh	49 ha
5.	Chilika Lake	01/10/1981	Odisha	116,500 ha
6.	Deepor Beel	19/08/2002	Assam	4,000 ha
7.	East Calcutta Wetlands	19/08/2002	West Bengal	12,500 ha
8.	Harike Lake	23/03/1990	Punjab	4,100 ha
9.	Hokera Wetland	08/11/2005	Jammu & Kashmir	1,375 ha
10.	Kanjli	22/01/2002	Punjab	183 ha
11.	Keoladeo National Park	01/10/1981	Rajasthan	2,873 ha
12.	Kolleru Lake	19/08/2002	Andhra Pradesh	90,100 ha
13.	Loktak Lake	23/03/1990	Manipur	26,600 ha
14.	Nalsarovar	24/09/2012	Gujarat	12,000 ha
15.	Point Calimere Wildlife & Bird Sanctuary	19/08/2002	Tamil Nadu	38,500 ha
16.	Pong Dam Lake	19/08/2002	Himachal Pradesh	15,662 ha
17.	Renuka Wetland	08/11/2005	Himachal Pradesh	20 ha
18.	Ropar	22/01/2002	Punjab	1,365 ha
19.	Rudrasagar Lake	08/11/2005	Tripura	240 ha
20.	Sambhar Lake	23/03/1990	Rajasthan	24,000 ha
21.	Sasthamkotta Lake	19/08/2002	Kerala	373 ha
22.	Sundarban Wetland	30/01/2019	West Bengal	423,000 ha
23.	Surinsar-Mansar Lakes	08/11/2005	Jammu & Kashmir	350 ha
24.	Tsomoriri	19/08/2002	Jammu & Kashmir	12,000 ha
25.	Upper Ganga River	08/11/2005	Uttar Pradesh	26,590 ha
26.	Vembanad-Kol Wetland	19/08/2002	Kerala	151,250 ha
27.	Wular Lake	23/03/1990	Jammu & Kashmir	18,900 ha

Annexure 4.

Agro-climatic Zones/Regions of India (referred to in chapter 2)

S. No.	Agro Climatic Zones / Regions	States Represented
1	Western Himalayan Region	Himachal Pradesh, Jammu & Kashmir, Uttarakhand
2	Eastern Himalayan Region	Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, West Bengal
3	Lower Gangetic Plain Region	West Bengal
4	Middle Gangetic Plain Region	Uttar Pradesh, Bihar
5	Upper Gangetic Plain Region	Uttar Pradesh
6	Trans Gangetic Plain Region	Chandigarh, Delhi, Haryana, Punjab, Rajasthan
7	Eastern Plateau and Hills Region	Chattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, West Bengal
8	Central Plateau and Hills Region	Madhya Pradesh, Rajashthan, Uttar Pradesh
9	Western Plateau and Hills Region	Madhya Pradesh, Maharashtra
10	Southern Plateau and Hills Region	Andhra Pradesh, Karnataka, Tamil Nadu
11	East Coast Plains and Hills Region	Andhra Pradesh, Orissa, Puducherry, Tamil Nadu
12	West Coast Plains and Hills Region	Goa, Karnataka, Kerela, Maharashtra, Tamil Nadu
13	Gujarat Plains and Hills Region	Gujarat, Dadra & Nagar Haveli, Daman & Diu
14	Western Dry Region	Rajasthan
15	Island Region	Andaman & Nicobar Islands, Lakshdweep

Annexure 5.

List of the Sectoral Policies that Play Important Role in the Implementation of NBAP (referred to in chapter 3)

1. National Youth Policy, 2014 calls for engagement of youth in various nation and character building initiatives including augmentation of greenery and protection of environment.

2. National Policy on Education, 1986 inter alia mandates inclusion of environmental education and promotion of women related studies as part of curricula at different levels of education, provisoin of support services for girls to enable their attendance in schools, promotion of educational development of vulnerable groups and equalization of education of Scheduled Castes/Scheduled Tribes with the rest of the population.

3. National Policy for Farmers, 2007 calls for a holistic development of farm sector and increase in farmers' incomes inter alia through protection and improvement of land, water, bio-diversity and genetic resources essential for sustained increase in the productivity. It also aims at strengthening the bio-security of crops, farm animals, fish and forest trees, and mainstreaming the human and gender dimension in all farming related policies and programmes.

4. National Tariff Policy, 2016 mandates purchase of 8 % solar energy by Solar Energy Research Centre's (SERCs) and procurement of 100 % power produced from all Waste-to-Energy plants, provides incentive for shift from non-renewable to renewable sources of energy which include generation-based incentives (GBIs), and other measures. The ultimate policy objective is to make solar energy compete with fossil-based energy options.

5. National Biotechnology development Strategy, 2015-2020 inter alia calls for setting up of national knowledge repositories for promotion of research and development from indigenous efforts and sources and creation of new biotech products, a strong infrastructure for R&D in mission mode (http://www.dbtindia.nic.in/national-biotechnology-development-strategy-2015-2020-announced-2/).

6. Green Highways (Plantation, Transplantation, Beautification& Maintenance) Policy, 2015 aims at promoting greening of Highway corridors with the participation of the community, farmers, private sector, NGOs, and government institutions. With a strong monitoring of the actions so taken through the use of Indian Space Research Organization ISRO's Bhuvan and GPS Aided GEO Augmented Navigation (GAGAN) satellite systems.

7. National Intellectual Property Right Policy, 2016 emphasizes on documenting oral traditional knowledge (TK) and maintaining its integrity and that of traditional lifestyles. It also aims at supporting TK's expansion through R&D under 'Creative India, Innovative India.

8. National Water Policy 2012 calls for treating water as economic good with the vision of optimal sustainable development, maintenance of quality and efficient use of water resources to match with the growing demands of the country (http://mowr.gov.in/about-us/functions)

9. National Population Policy, 2000-is to address the issues of reproductive health with the medium-term objective is to bring the Total Fertility Rate (TFR) to replacement levels and through vigorous long-term objective of the Policy is to achieve a stable population by 2045, at a level consistent with the requirements of sustainable economic growth, social development, and environmental protection. (https://mohfw.gov.in/sites/default/files/26953755641410949469%20%281%29.pdf)

Annexure 6.

List of Other Biodiversity Relevant Legislations (referred to in chapter 3)

The Constitution (73rd Amendment) Act, 1992 and Constitution (74th Amendment) Act, 1992: The former mandates creation of a three tier system of democratically elected Panchayati Raj Institutions (PRIs) for decentralized governance in the rural areas and the latter mandates Constitution of municipal bodies in urban areas.

Panchayats (Extension to the Schedule Area) Act, 1996 (PESA): The Act extends the decentralised grovernance through panchayati raj institutions in the areas covered under the Fifth schedule areas of the Constitution. It empowers tribals in these areas by ensuring better control over the utilisation of public resources. PESA promotes conservation of cultural heritage through respect of traditions, customs and cultural identity of tribal population. https://pesadarpan.gov.in/en

The Maritime Zones of India (Regulation and Fishing by Foreign vessels) Act, 1981 provides for regulation of fishing by foreign vessels and matters connected therewith.

Order SO 729 (E) (1995) of Export (Quality Control and Inspection) Rules, 1964 under **The Export (Quality Control and Inspection) Act, 1963** ensures quality control of fresh, frozen and processed fish and fishery products.

The Right of Children to Free and Compulsory Education Act, 2009 provides for free and compulsory elementary education to all children of the age of six to fourteen years, mandates inclusion of parents from disadvantaged groups and at least 50% women members in School Management Committees responsible for developing school plans and monitoring utilization of government grants.

The Energy Conservation Act (EC), 2001 provides for efficient use of energy and its conservation and for matters connected therewith or incidental thereto.

The Patents Act, 1970 as amended from time disallows grant of patent on "an invention which in effect, is traditional knowledge or which is an aggregation or duplication of known properties of traditionally known component or components."
Section 2 (1) (j) **Definitions and interpretation**: "invention" means a new product or process involving an inventive step and capable of industrial application;
(ja) "inventive step" means a feature of an invention that involves technical advance as compared to the existing knowledge or having economic significance or both and that makes the invention not obvious to a person skilled in the art;
Section 3 (p) - **What are not inventions**: an invention which in effect, is traditional knowledge or which is an aggregation or duplication of known properties of traditionally known component or components.

Mahatma Gandhi National Rural Employment Guarantee Act, 2006 (MNREGA) provides livelihood resource base for the poor, vulnerable, local communities and women. It mandates that women from Scheduled Castes/Scheduled Tribes and Other Backward Classes (OBC) category must constitute at least one third of the beneficiaries under the scheme.

Mineral Conservation and Development Rules, 1988 (MCDR) (as amended from time to time) Mining plan and provisions for restoration, reclamation and rehabilitation of lands affected by mining operations have been made compulsory under Rule 31 to 41. Every holder of prospecting license or mining lease has to undertake phased restoration, reclamation and rehabilitation of lands affected by prospecting or mining operations and complete this work before the conclusion of such operations and the abandonment of prospecting or mine.

Annexure 7.

Measures that Encourage Energy Conservation and Shift to Green Energy (referred to in chapter 15)

• **Energy Conservation Building Code (ECBC) 2017** prescribes norms and standards for building design, including envelope, lighting, heating and air-conditioning. Minimum energy standard for new commercial buildings has been given.

• **Guidelines for Energy Efficient Multi-storey Residential Buildings** issued in 2014.

• **Indian Green Building Council (IGBC)**, a part of the Confederation of Indian Industry (CII) for developing new green building rating programmes, certification services and green buildings training programmes.

• **National Tariff Policy 2016,** mandates purchase of 8% solar energy by State Electricity Regulatory Commissions (SERCs) and procurement of 100% power produced from all Waste-to-Energy plants. Incentives for shift from non-renewable to renewable sources of energy include Generation-Based Incentives (GBIs), capital and interest subsidies, viability gap funding, concessional finance, fiscal incentives etc. The ultimate policy objective is to make solar energy compete with fossil-based energy options. Measures include:

• Setting up of exclusive solar parks and giving infrastructure status to solar projects.

• Development of power transmission network through Green Energy Corridor project.

• National Offshore Wind Energy Policy.

• Waiving Inter State Transmission System charges and losses for interstate solar and wind power sale from projects commissioned by March 2019.

• Identification of large government complexes/ buildings for rooftop project.

• Amending building bye-laws for making solar roof tops mandatory in new construction or for higher Floor Area Ratio.

• Mandatory share of 10% renewable energy under Smart Cities project.

• Measures for Integrated Power Development Scheme (IPDS) to encourage distribution companies and to make net-metering compulsory.

• Raising funds including through Green Climate Fund to achieve the target.

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