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**Biodiversity Strategy and Action Plan (BSAP) of Sikkim
and the Resource Mobilisation Strategy for
implementing the BSAP with focus on
Khangchendzonga - Upper Teesta Valley**



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MoEFCC



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List of Abbreviations

ABS	Access and Benefit Sharing
ABT	Aichi Biodiversity Targets
ACA	Additional Central Assistance
ACF	Assistant Conservator of Forest
AF	Agro-forestry
AHLFVS	Department of Animal Husbandry Livestock Fisheries and Veterinary Services
ALPP	Action-learning Pilot Program
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AnGR	Animal Genetic Resources
ATMA	Agricultural Technology Management Agency
ATREE	Ashoka Trust for Research in Ecology and the Environment
AYUSH	Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy
BCM	Biodiversity Conservation and Management
BD	Biodiversity
BDA	Biological Diversity Act
BER	Biodiversity Expenditure Review
BFP	Biodiversity Finance Plan
BI	Birdlife International
BIOFIN	Biodiversity Finance Initiative
BMC	Biodiversity Management Committee
BNHS	Bombay Natural History Society
BSAP	Biodiversity Strategy and Action Plan
BSI	Botanical Survey of India
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CBD	Convention on Biological Diversity
CC	Climate Change
CCAFS	Climate Change, Agriculture and Food Security
CCF	Chief Conservator of Forests
CEA	Classification of Environmental Activities
CEPA	Classification of Environmental Protection Activities
CF	Conservator of Forests
CFB	Community Fodder Bank
CFC	Chlorofluorocarbon
CoP	Conference of Parties
CS	Central Sector Schemes
CS	Carbon Sequestration
CSIR-ARI	Council for Scientific and Industrial Research-Animal Research Institute
CSR	Corporate Social Responsibility

CSS	Centrally Sponsored Scheme
CZA	Central Zoo Authority
DARE	Department of Research and Education
DC	Deputy Commissioner
DCI	Department of Commerce and Industry, Sikkim
DESME	Department of Economics, Statistics, monitoring and Evaluation, Sikkim
DFE	Department of Forest and Environment
DFO	Divisional Forest Officer
DMF	District Mineral Foundation
DNA	Deoxyribonucleic acid
DoA	Department of Agriculture
DoAH&VS	Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services
DoCI	Department of Commerce and Industry, Sikkim
DoH	Department of Horticulture
DoT	Department of Technology
DSTC	Department of Science, Technology and Climate Change
DTCA	Department of Tourism and Civil Aviation
DUD	Department of Urban Development Sikkim
EAP	Externally Aided Projects
EARAS	Agency for Reporting Agricultural Statistics
EDC	Eco-Development Committee
EDF	Environment Damage Fund
EEA	European Environment Agency
EIA	Environmental Impact Assessment
ENVIS	Environment Information System
EOS	End of Season
FAO	Food and Agriculture Organization
FCA	Forest Conservation Act
FDA	Forest Development Agency
FIG	Farmer Interest Groups
FRA	Forest Rights Act
FSI	Forest Survey of India
GBPIHED	G.B. Pant National Institute of Himalayan Environment & Sustainable Development
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GISP	Global Invasive Species Programme
GIZ	Gesellschaft für Internationale Zusammenarbeit / German Agency for International Cooperation

GLOF	Glacial Lake Outburst Flood
GoI	Government of India
GPU	Gram Panchayat Unit
GSDP	Gross State Domestic Product
GST	Goods and Services Tax
HCFC	Hydro chlorofluorocarbon
HIMAP	Hindu Kush Himalayan Monitoring and Assessment Programme
HMNEH	Horticulture Mission for North East and Himalayan States
HP	Himachal Pradesh
HRDD	Human Resource Development Department
HWC	Human Wildlife Conflict
HZP	Himalayan Zoological Park
IAFCD	Irrigation and Flood Control Department
IAS	Invasive Alien Species
IBA	Important Bird Areas
ICAR	Indian Council of Agricultural Research
ICIMOD	The International Centre for Integrated Mountain Development
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDWG	Inter Departmental Working Group
IGFRI	Indian Grassland and Fodder Research Institute
IHCAP	Indian Himalayas Climate Adaptation Programme
IITM	Indian Institute of Technology Madras
ILCA	International Livestock Centre
INDC	Intended Nationally Determined Contribution
INM	Integrated Nutrient Management
IPP	Independent Power Producer
ISSG	Invasive Species Specialist Group
IUCN	International Union for Conservation of Nature
IWSM	Integrated Watershed Management
JFMC	Joint Forest Management Committee
JICA	Japan International Cooperation Agency
KBR	Khangchendzonga Biosphere Reserve
KCC	Khanchendzonga Conservation Committee
KNP	Khangchendzonga National Park
KVEDC	Kitam Village Ecotourism Development Committee
LADF	Local Area Development Fund
LHT	Local Health Tradition
LTDC	Lachen Tourism Development Committee
LTF	Local Trust Fund

MDF	Moderately Dense Forest
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoEE&CC	Ministry of Environment and Climate Change
NAEB	National Afforestation and Eco-Development Board
NAM	National Agriculture Market
NAP	National Afforestation Programme
NAPCC	National Action Plan on Climate Change
NBA	National Biodiversity Authority
NBAGR	National Bureau of Animal Genetic Resources
NBAP	National Biodiversity Action Plan
NBM	National Bamboo Mission
NBPGR	National Bureau of Plant Genetic Resources
NBT	National Biodiversity Targets
NDC	Nationally Determined Contributions
NEC	North Eastern Council
NEMiD	Northeast Microbial Database
NEP	National Environment Policy
NGO	Non-Government Organization
NMHS	National Mission on Himalayan Studies
NMPB	National Medicinal Plants Board
NMSA	National Mission on Sustainable Agriculture
NR5	India's Fifth National Report to the CBD
NRSC	National Remote Sensing Centre
NTFP	Non-timber forest products
ODA	Overseas Development Assistance
OECD	Organization for Economic Co-operation and Development
OFWM	On Farm Water Management
PA	Protected Areas
PBR	People's Biodiversity Register
PDD	Planning and Development Department Sikkim
PES	Payment for Ecosystem Services
PGPB	Plant Growth Promoting Bacteria
PLUS	Partnership for Land Use Science
PME	Priority Setting, Monitoring and Evaluation
PMKKKY	Pradhan Mantri Khanij Kshetra Kalyan Yojana
PMU	Project Management Unit
PMUY	Pradhan Mantri Ujjwala Yojana
PRI	Panchayati Raj Institutions
REDD+	Reducing Emissions from Deforestation and Forest Degradation

REMC	Research Evaluation and Monitoring Cell
RET	Rare, Endangered and Threatened
RKVY	Rashtriya Krishi Vikas Yojana
RMDD	Rural Management & Development Department
ROAM	Restoration Opportunities Assessment Methodology
RRC	River Rejuvenation Committee
SAMETI	State Agricultural Management and Extension Training Agency
SAPCC	State Action Plan on Climate Change
SBB	State Biodiversity Board
SBFP	Sikkim Biodiversity Conservation and Forest Management Project
SBSAP	State Biodiversity Strategy and Action Plan
SDG	Sustainable Development Goals
SDM	Sub-Divisional Magistrate
SECURE	Securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems
SERVE	Save the Environment and Regenerate Vital Employment
SFDA	State Forest Development Authority
SMPB	State Medicinal Plant Board
SMSP	Sub Mission for Seed and Planting material
SOS	Start of Season
SPCB	Sikkim Pollution Control Board
SSBB	Sikkim State Biodiversity Board
SSDMA	Sikkim State Disaster Management Authority
TK	Traditional Knowledge
TOF	Tree Outside Forest
UMMB	Urea Molasses Mineral Block
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organizations
USAID	United States Agency for International Development
VDF	Very Dense Forest
WII	Wildlife Institute of India
WP	Working Plan
WRI	World Resource Institute
WRRDD	Water Resource and River Development Department
WWF	World Wildlife Fund
ZSI	Zoological Survey of India

Preface

SECURE Himalaya (Securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems) is a GEF funded project being implemented by the Ministry of Environment, Forest and Climate Change, Government of India along with the UNDP, in the states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, and Sikkim. The project aims to support the Government of India to effectively promote sustainable land and forest management in alpine pastures and forests in high range Indian Himalayan ecosystems that secure sustainable livelihoods and community resilience and ensures conservation of globally significant biodiversity and threatened species.

The National Institute of Public Finance and Policy was commissioned to undertake this study as part of the SECURE Himalaya study by the United Nations Development Program, New Delhi at the behest of the Ministry of Environment and Forest & Climate Change, Government of India. The present report “Biodiversity Strategy and Action Plan (BSAP) of Sikkim and the Resource Mobilisation Strategy for implementing the BSAP with the focus on Khangchendzonga – Upper Teesta Valley” covers important issues around conservation of biodiversity in India on which the authors have done exhaustive research through desk based empirical and policy research, field visits and stakeholder consultations. The empirical analysis and investigations have enabled authors to make a number of policy recommendations which I am confident will be extremely useful to the central government and the government of Sikkim in their efforts to improve the status of biodiversity, natural resources and ecosystem services in the state and the identified landscapes.

This study was designed, managed and carried out by a team led by Professor Rita Pandey, Senior Fellow at NIPFP. Other key members of the team are Ms Priya and Anuja Malhotra. The views expressed in the report are that of the authors and the Governing Body of the institute are in no way responsible for them.

(Pinaki Chakraborty)
Director

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Authors

Chapter 1: Overview of International Conventions and Legislative and Policy Actions for Biodiversity Conservation in India

1.1 Background

India, a mega diverse country with only 2.4 percent of the world's land area, harbors 7-8 percent of all recorded species, including over 47,000 species of plants and 96,000 species of animals. Of the 34 global biodiversity hotspots, four are present in India, represented by the Himalaya, the Western Ghats, the North-east, and the Nicobar Islands.

India recognizes that besides human survival and well-being, millions of livelihoods in the country depend upon biodiversity and healthy ecosystems and the goods and services they provide. Therefore, protection, and conservation of biodiversity and ecosystems is of paramount importance in India.

However, the country's biodiversity faces a variety of threats — caused by various anthropogenic activities — ranging from land use changes in natural habitats to overexploitation of natural resources, proliferation of invasive species, and climate change. This calls for effective and urgent action to halt the loss of biodiversity in order to ensure that ecosystems are resilient and continue to provide essential services.

Threats to species and ecosystems are not unique to India but are prevalent in countries all over the world in different dimensions and shapes. It is this recognition that culminated into The Convention on Biological Diversity (CBD) — which was one of the three international Conventions of the Rio Earth Summit in 1992.

1.2 The Convention on Biological Diversity (CBD), Biological Diversity Act 2002 and National Biodiversity Action Plan (NBAP), 2008

The CBD is a multilateral treaty, entered into force on 29 December 1993. Its objective is to develop national strategies for the conservation and sustainable use of biological diversity. The 2050 Vision for Biodiversity was adopted as part of the Strategic Plan for Biodiversity 2011- 2020. The Strategic Plan for Biodiversity 2011 – 2020 consists of five strategic goals and twenty Aichi Biodiversity Targets.

India as a signatory party to the CBD, has proactively taken a range of legislative, policy, and institutional measures to fulfill its mandate and go beyond it in order to tackle the existing and emerging threats to biodiversity, ecosystems and the environment -- of which the following measures need to be emphasized:

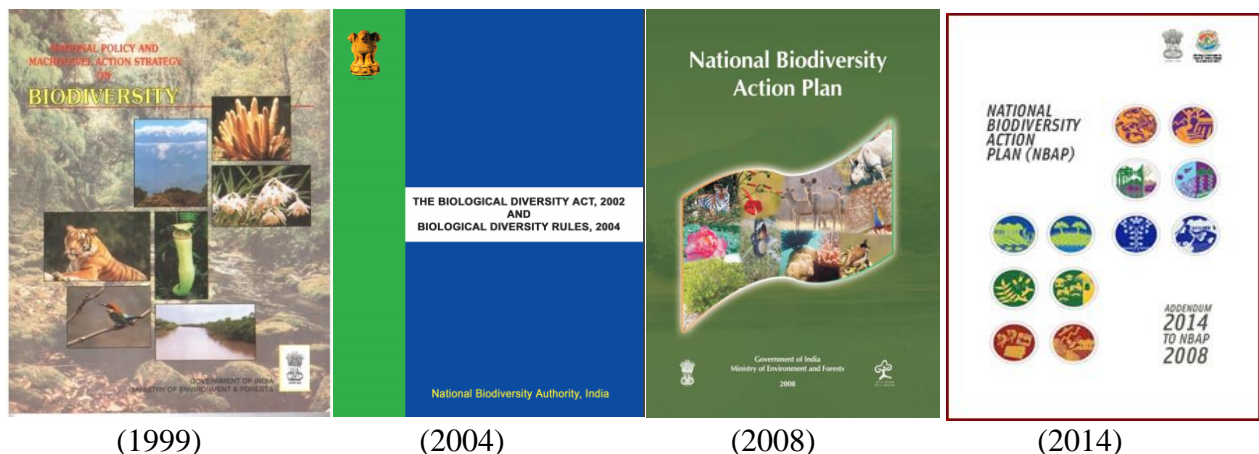
- i. India developed a 'National Policy and Macro level Action Strategy on Biodiversity' in the year 1999. Subsequent to this the National Environment Policy (NEP), 2006 which has been put in place mechanisms to mainstream environment -- including biodiversity -- in development planning processes.

- ii. India was one of the first countries to enact a comprehensive Biological Diversity Act in 2002 (BDA, 2002), to implement the provisions of the CBD. This is being implemented through a three-tier structure, National Biodiversity Authority (NBA) at the national level, State Biodiversity Boards (SBBs) at the provincial level, and Biodiversity Management Committees (BMCs) at the local level.
- iii. India's NBAP, 2008, was developed prior to the formal release of CBD Strategic Plan for Biodiversity 2011-2020 and associated Aichi Biodiversity Targets. The NBAP was formulated through a comprehensive inter-ministerial process and approved by the Government of India in 2008. Subsequently, as part of the preparation of India's Fifth National Report to the CBD (NR5) and updating of NBAP 2008, India developed 12 National Biodiversity Targets (NBTs) in harmony with the Aichi Targets (Addendum 2014 to NBAP, 2008).

Table 1.1: CBD Strategic Goals, Aichi Targets and India's NBTs

	Strategic Goal				
	A	B	C	D	E
CBD Strategic Goals	Address underlying causes of biodiversity loss by mainstreaming biodiversity across government and society	Reduce direct pressures on biodiversity and promote sustainable use	Improve the status of biodiversity by safeguarding ecosystems species and genetic diversity	Enhance the benefits to all from biodiversity and ecosystem services	Enhance implementation through participatory Planning, knowledge management and capacity building
NBTs	(1,2,10)	(3,4,5,6)	(6 & 7)	(3,8,9)	(10,11,12)
Aichi Targets	1,2,3&4	5,6,7,8,9 & 10	11,12 & 13	14,15 & 16	17,18,19 & 20

Figure 1.1: Legislative and Policy Actions for Biodiversity Conservation in India



1.3 Linkages of NBTs with Sustainable Development Goals (SDGs)

Under the 2030 Agenda, a series of 17 global Sustainable Development Goals (SDGs) have been agreed that are to be universally achieved. Although both NBTs and SDGs are not legally binding, governments are expected to establish national frameworks to achieve the goals and observe a reporting requirement. Biodiversity and ecosystems feature prominently in the 2030 agenda.

Almost all of the SDGs are relevant to biodiversity conservation although SDGs 13 (combating climate change) and 14 and 15 (marine and terrestrial biodiversity and ecosystems) have stronger biodiversity conservation linkages. Linkages between NBTs and SDGs are depicted in Table 1.2.

A coordinated implementation of SDGs and NBAP and state level BSAPs will provide a tremendous opportunity to mainstream biodiversity in key national and sub-national development policies thereby setting up a robust policy, institutional and financial environment in achieving these interdependent goals and targets.

Table 1.2: Linkage of NBTs with ABTs and SDGs

India's National Biodiversity Targets	Aichi Biodiversity Targets	SDGs
		
		
		
		
		

Source: India's 6th National Report to the CBD (2018).

1.4 Linkages and Synergies between NBTs and NDCs

In 2015, 196 countries came together to sign the historic Paris Agreement, guided by the United Nations Framework Convention on Climate Change (UNFCCC), in order to deal with global warming impacts. Countries were required to submit their Intended Nationally Determined Contribution (INDC) to the UNFCCC outlining their commitments to reduce greenhouse gas emissions and strengthen resilience to climate change.

India too signed the agreement and ratified through approval from the Union Cabinet on 2nd October 2016. Almost all of the NDCs committed and ratified by India (Box 1.1) are relevant to biodiversity conservation although NDCs 5, 6 and 7 have stronger biodiversity conservation linkages. Also, the National Action Plan on Climate Change (NAPCC) in India which is implemented through eight National Missions has strong focus on Biodiversity conservation.

Box 1.1: NDCs Committed and Ratified by India

1. To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
2. To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
3. To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.
4. To achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF).
5. **To create an additional carbon sink of 2.5 to 3 billion tons of CO₂ equivalent through additional forest and tree cover by 2030.**
6. **To better adapt to climate change by enhancing investments in development programs in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management**
7. **To mobilize domestic and new & additional fund from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.**
8. To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

1.5 Rationale for and Scope of Sikkim Biodiversity Strategy and Action Plan (SBSAP)

It has been increasingly recognized by both the CBD and its member countries that the Sub-national BSAPs are necessary for effective conservation and management of biodiversity as each state may have a different connect of biodiversity with human well-being as well as states' developmental priorities. Further, unique features of the state, land use patterns and practices, and institutional and policy arrangements for governance of biodiversity and natural resources may require a state specific BSAP.

Thus Sikkim BSAP (SBSAP) will ideally have elements of NBAP relevant for the state of Sikkim and strategies and action plans necessary to address the pressures and resulting decline and loss of biodiversity unique to the state.

In Sikkim its first BSAP was prepared in 2003. This report had at least three key achievements: (i) it carried out extensive mapping of biological diversity in the state, both wild and cultivated/domesticated, found in the different eco-regions of the state, based on available scientific studies and knowledge, (ii) a thorough grass-root consultative process was followed in the form of meetings and interactions with different stakeholders, and (iii) it outlined strategies and an action plan for biodiversity conservation.

In 2010, new guidelines for regional and National BSAPs were framed at the Nagoya (10th CoP) Summit. For achieving this, it was decided by the central Ministry of Environment and Climate Change (MoEF&CC) to prepare an addendum to India's NBSAP and various states (state biodiversity boards) were asked to prepare state BSAPs to include the concerns of various CBD CoP meetings, and to align the BSAP of the state according to the 2011-20 commitment of the country towards CBD. Thus, the need for a revision and updating of BSAP, 2003 was felt by the Government of Sikkim. In 2010, Sikkim launched a study for revising and updating the BSAP, 2003 under the Sikkim Biodiversity Conservation and Forest Management Project (SFBP), assisted by the Japan International Cooperation Agency.

Keeping in view the recent data, knowledge and experience, this study has been launched for refining and updating the BSAP under the GEF funded and UNDP managed SECURE Himalaya study in the state. The updated SBSAP will have the following new elements and components

- Identification of regulatory, institutional, and finance gaps in implementation of existing SBSAPs
- Periodic monitoring and evaluation framework
- Suggestions for mainstreaming and coordination with other flagship programs
- Resource mobilization strategy for implementation of SBSAP.

1.6 Key Objectives of the Study

1. To update the existing Biodiversity Strategy and Action Plan (BSAP) of Sikkim, based on current state priorities and in alignment with national and global priorities of biodiversity conservation and wildlife protection.
2. To develop a resource mobilization strategy for implementing BSAP in Sikkim.
3. Prepare process document for implementation of 1-2 financial solutions for conservation of snow leopard landscape; namely the Khangchendzonga Landscape located in North Sikkim district.

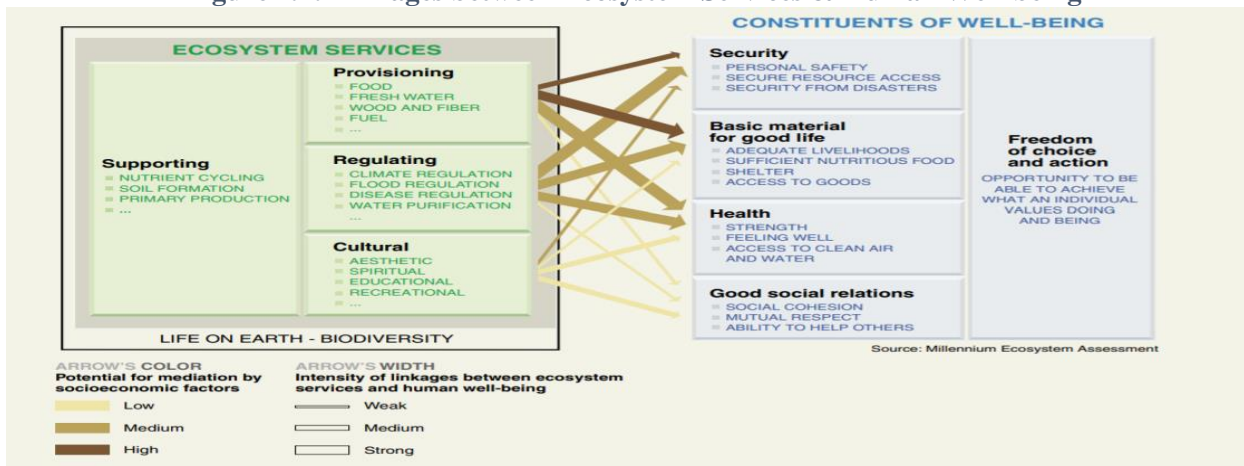
Chapter 2: Overview and Process Documentation

2.1 Vision and Guiding Principles

The vision of SBSAP is same as the CBD strategic vision -- “Living in harmony with nature” where “By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.”

- i. The SBSAP should address all three objectives of the Convention on Biodiversity (CBD) and the NBAP, namely:
 - Conservation of biodiversity
 - Sustainable use of the components of biodiversity
 - Fair and equitable sharing of the benefits deriving from the utilization of genetic resources.
- ii. SBSAP should recognize the contribution of biodiversity and ecosystem services for human well-being and poverty eradication, besides their valuable contribution to economic, social, and cultural development of people dependent on them. *Therefore, BSAP should seek to maintain this fundamental connect with biodiversity and ecosystems* (see Figure 2.1).
- iii. Only a participatory approach, where all stakeholders work together to support and conserve the wealth of biodiversity, can bring the desired success. In order to be effective, it is important that the SBSAP be jointly developed, adopted, and owned by the key stakeholders including those who may have stakes or rights with regard to biodiversity.
- iv. SBSAP should emphasize the need for biodiversity conservation to be a significant consideration in socio-economic development strategy of the state and *thus mainstreaming of biodiversity into sectoral and cross-sectoral decision-making at the policy and programmatic planning and budgeting level* especially in the context of achieving the SDGs and NDCs.
- v. The strategy *should suggest and construct appropriate coordination and reporting arrangements as well as monitoring and evaluation frameworks.*

Figure 2.1: Linkages between Ecosystem Services & Human Well-being*



Source: Millennium Ecosystem Assessment, 2005.¹

¹ Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

* It depicts the strength of linkages between categories of ecosystem services (supporting, provisioning, regulating, and cultural) and components of well-being (security, basic material for good life, health, good social relations, freedom of choice and action). In addition to the influence of ecosystem services on human well-being, it also shows how ecosystems are in turn affected by changes in human well-being.

2.2 Methodology and Process

In fulfilling the objectives of the study outlined in Chapter 1, and to encompass the vision and guiding principles of BSAP mentioned above, the following methodology and approaches have been adopted by the team.

2.2.1 Key Process Details

While detailed methodology for different components and themes of the study has been discussed in relevant chapters in the report, a snapshot of the process is given below:

1. *Review of existing SBSAPs and rapid assessment of the gaps in implementation*

Rapid assessment of BSAP, 2003, and Sikkim Biodiversity Action Plan, 2012 was undertaken with the following key objectives: Understanding the institutional, financial and programmatic arrangements put in place for implementation of the BSAPs and the barriers therein, and;

- The progress made so far with respect to achieving the listed actions/targets.
- Any gaps in coverage of issues, threats and practical solutions.

We have extensively consulted and elicited information through questionnaire and detailed one-on-one and group discussions with the Sikkim State Biodiversity Board (SSBB), relevant line departments, subject experts, research organizations, district and Panchayat level officials, civil society organizations and communities. We also compared the existing BSAP action plans with the programs and schemes implemented in the state for biodiversity conservation and preservation is assessing the status of implementation of the same.

2. *Linking existing BSAP with NBTs, NDCs and SDGs*

These linkages were mapped in order to identify the synergies and potential entry points for coordination and mainstreaming.

Box 2.1: Key Steps

1. Review of existing SBSAPs
2. Rapid assessment of gaps in SBSAPs
3. Review of key government policies and programs relevant for the study
4. Identification of key stakeholders (government, private, research, specialized institutions, communities)
5. Mapping linkages with SDGs and NDCs
6. Review of relevant literature
7. Field level one-on-one and group consultations with key stakeholders
8. Mapping budgetary fund flows for biodiversity
9. Mapping budgetary revenue receipts from biodiversity
10. Identifying resource mobilization strategy and finance solutions
10. Estimating gaps in funding
11. Resource mobilization strategies

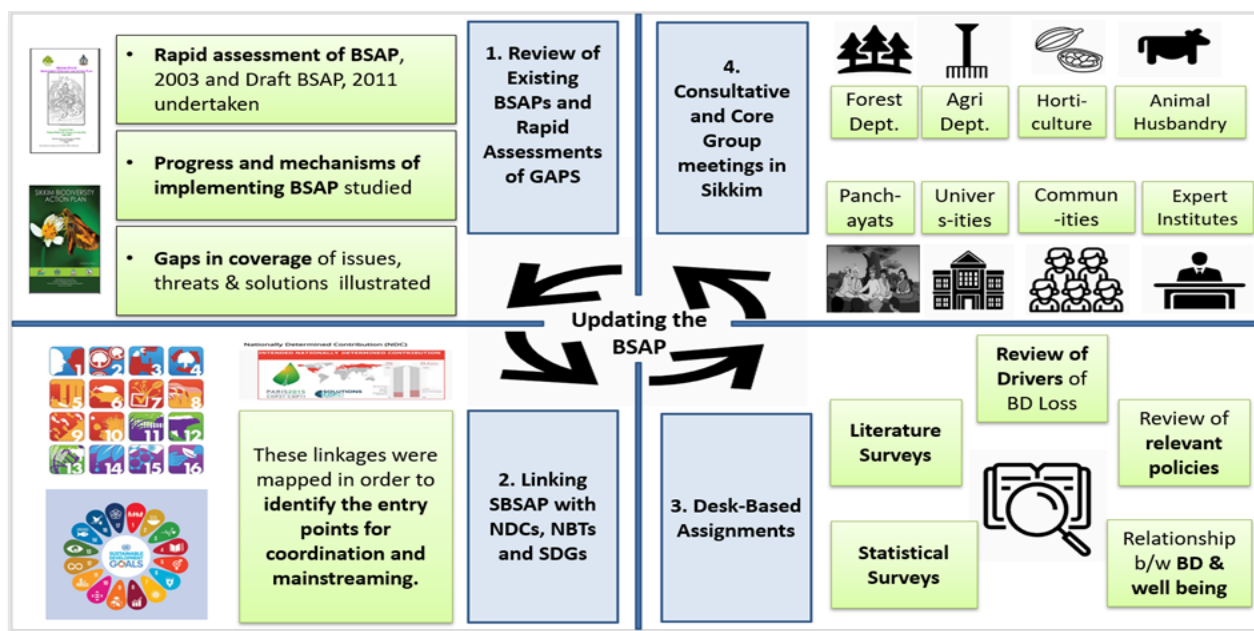
3. Desk-based assessments

We have also collected, compiled & reviewed state budgets of various years, annual reports, policies, peer-reviewed scientific publications and other literature relevant and important in this context. Desk assessments included the following:

- i. A review of the status and trends of biodiversity and biological resources in the state;
- ii. A review of the drivers of biodiversity loss. Both direct drivers (such as land use change, invasive species, over-exploitation of resources, pollution) and indirect drivers (such as changes in human population, livestock population, and climate change);
- iii. A review of the framework of biodiversity relevant laws, policies, programs, and expenditures in the state and an assessment of any gaps;
- iv. The relevant public institutions;
- v. Literature and statistical surveys, both primary and secondary, and field trips;
- vi. Consultative meetings with representatives of Forest Departments, State Biodiversity Board, key government departments relevant for conservation of biodiversity, institutions associated with implementation of BSAP, state level institutions, universities, district and village level institutions and officials, and other stakeholders to get insights into any policy, institutional, capacity or technical gaps in current BSAP due to changing development and other priorities of the state as well as any new challenges and threats to biodiversity;
- vii. Field trips for holding of public meetings;
- viii. Discussions with local experts and knowledgeable persons;
- ix. The status, sources and potential sources of biodiversity financing in the country;
- x. Gaps and unmet needs, and resource mobilization strategies.

A snapshot of the meetings held is given in Table 2.1. For details, see Annexure 1.

Figure 2.2: Key Process Followed in Updating the BSAP



Source: Authors' Construct

Table 2.1: A Snapshot of Consultative Workshops and Meetings in Sikkim

S. No.	Particulars	Date	Participation
1.	Roundtable Meeting organized by NIPFP in Gangtok	December 2018	Senior Forest Department Officials- CCF, CF (WL), CF, DFOs, ADA, Sikkim State Biodiversity Board Officials and SPO-SECURE Himalaya
2	1 st Review Meeting of the project (Gangtok)	January 2019	PCCF, CCF, CF(WL) Senior Forest Department Officials including Representatives from Agencies of SECURE study
3	Questionnaires sent to line departments via email, post and fax	Sent – April – May 2019 First round of follow-ups – May – July, 2019 Second round of follow-ups – August 2019	Department of Horticulture, Department of Agriculture, DFE, RMDD, Power Department, Tourism Department, Health and Family Welfare Department, Department of Water Resources, NEC
4	Workshop to share Draft BSAP report and findings of BER mapping (Gangtok)	August 2019	Senior Forest Department Officials, Department of Horticulture, Department of Agriculture, Department of Animal Husbandry WWF, ATREE, Sikkim University
5	20 one-to-one Consultations and meetings with Department Officials (Gangtok)	August 2019	Department of Forest and Environment, Department of Science, Technology and Climate Change (DST), Horticulture and Cash Crops Development Department, Department of Agriculture
6	Stakeholder Consultation Workshop in Landscape (Geyzing)	August 2019	Department of Agriculture, Department of Animal Husbandry, DFO, BMCs, EDCs, BAMOS NCS, KCC, GICIA
7	2 nd Review Meeting of the project (Gangtok)	February 2020	PCCF, CCF, CF(WL) Senior Forest Department Officials including Representatives from Technical Agencies of SECURE study
8	Consultative Meetings with Department Officials (North Sikkim- Mangan)	February 2020	DC North, Agriculture Department, Animal Husbandry and Veterinary Services Department and Horticulture Department.
9	4 consultations with local governance bodies and communities in the landscape (Lachen, Lachung, Mangan, Dzongu)	February 2020	JFMCss, BMCs, EDCs, GPU Members, Executive Members of Dzumsa
10	Consultative Meeting (Gangtok)	February 2020	Principal Secretary -cum- PCCF, Forest Department

11	Validation Workshop on NIPFP Study (Online)	December 2020	Chair, National Biodiversity Authority, CF (WL), SBB, Senior Forest Department Officials, DoAH, DoA, DoT, Retd PCRO, Scientific Experts, Academicians
12	Consultative Meeting with Khangchendzonga Conservation Committee (KCC), Yuksom, West Sikkim	January 2021	CEO, KCC, Project Manager, Community Mobilizer and other staff working on the field.
13	Focused Group Discussion (FDG) in Tshoka-Khyongtey ward of Yuksom Dubdi GPU, West Sikkim	January 2021	Panchayat members, EDC President, EDC members, JFMC members and community members.
14	Consultative Meeting with Local Governance Bodies and Community Members of Yambong- Singalila, and Chongri Cluster, Sindrabung	January 2021	EDC President, EDC Members, Panchayat, Himal Rakshaks, Community members

2.2.2 Consultations and Field Visits



Roundtable in Gangtok (*December 2018*)



Workshop to discuss draft BSAP-
Gangtok (*August 2019*)



Stakeholder Consultation
Workshop in Landscape, Geyzing
(*August 2019*)



Meeting with DC, North and senior
officials from line departments, Mangan
(*Feb 2020*)



Meeting local governance body-
Dzumsa in Lachen Valley (*Feb 2020*)



Meeting PRI executives, JFMC
members, BMC members in Dzongu
(*Feb 2020*)



Consultative Meeting with Khangchendzonga Conservation Committee (KCC), Yuksom, West Sikkim (*January 2021*)



Meeting in progress at KCC Office



Focused Group Discussion (FDG) in Tshoka- Khyongtey ward of Yuksom Dubdi GPU, West Sikkim (*January 2021*)



Meeting in progress at Panchyat Hall



Consultative Meeting with Local Governance Bodies and Community Members of Yambong-Singalila, and Chongri Cluster, Sindrabung (*January 2021*)



Meeting in progress in Sindrabung

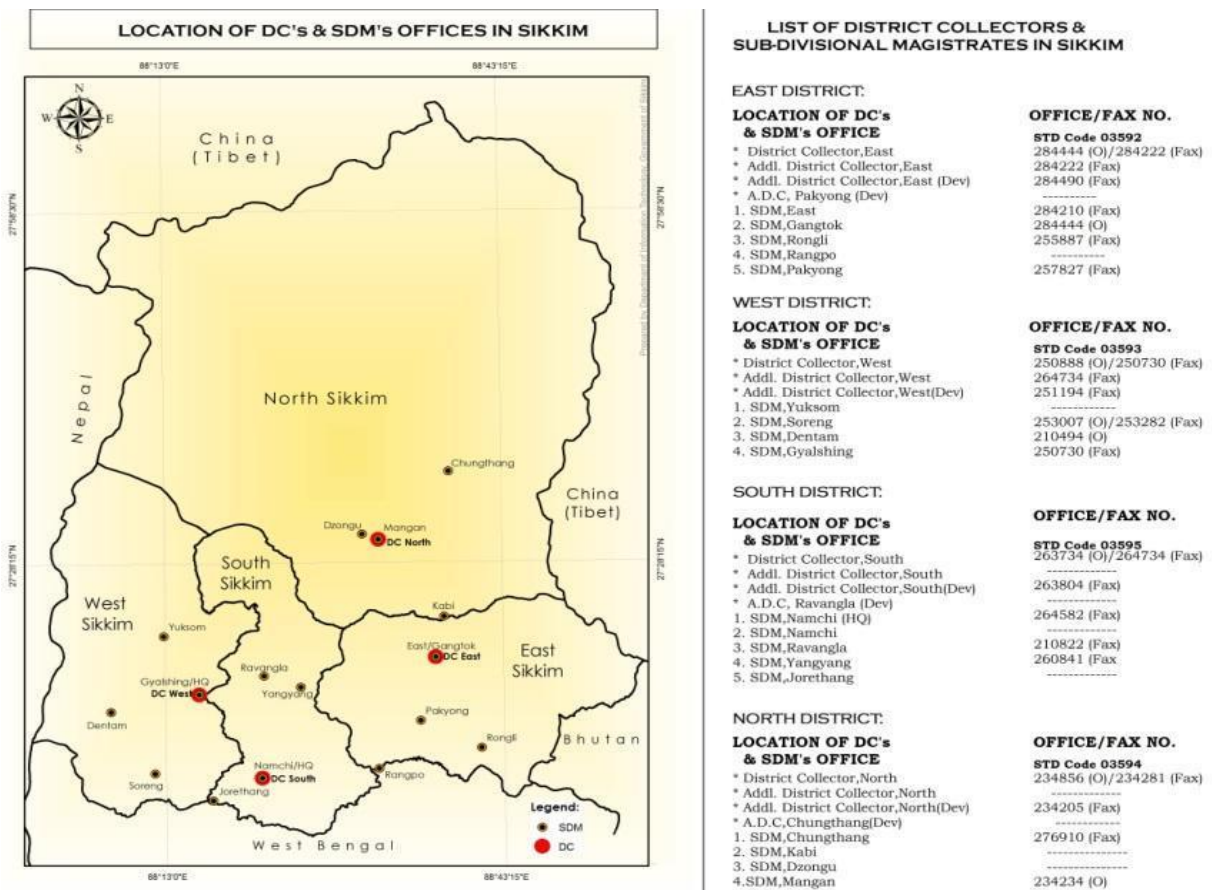
Chapter 3: State Profile, Drivers of Change and Gaps in Biodiversity Conservation

3.1 State Profile

3.1.1 General Profile and Physiological Features

Sikkim, covering an area of just 7,096 km², ranges approximately 112 Km. from North to South and 64 Km. from East to West. Sikkim is bordered by the Tibet Autonomous Region of China to the north and northeast, by Bhutan to the southeast, by the Indian state of West Bengal to the south, and by Nepal to the west. Figure 3.1 shows a map of Sikkim showing location and boundaries of 4 districts and district headquarters along with the Deputy Commissioner (DC) & Sub-Divisional Magistrate (SDM) offices.

Figure 3.1: Map of Sikkim showing Location & Boundaries



3.1.2 Physiological Features

Sikkim is a hilly state having varied elevations ranging from 300- 8598 mts above mean sea level consisting of lower hills, middle and higher hills, Alpine Zones and snow bound land; the highest elevation 8585 mts (Mt. Khangchendzonga). Two-third of its hilly regions are very high mountains perpetually covered with snow and are the sources of glaciers like Talung, Zemu, Lhonak etc.

1. *Total area and land use pattern**

Table 3.1 gives a summary of the land use pattern and area in Sikkim, for 2017. Notably, more than 75 percent of the reported area for land utilization is under the forest department.

Table 3.1: Land use Types in Sikkim: 2015^{*2}

Land Use Types	Area (in 000' ha)	Percentage (%)
Total geographic area	710	
Reporting area for land utilization	443	100
Forests	336	75.85
Not available for land cultivation	10	2.26
Under miscellaneous tree crops & groves	4	0.90
Culturable wasteland**	4	0.90
Fallow land ***	5	1.13
Current fallow****	7	1.58
Net area sown	77	17.38

Source: Land Use Statistics, Ministry of Agriculture (GOI, 2015).

2. *Rivers and lakes*

Teesta and Rangeet are the two important rivers of Sikkim. The state is the major catchment of river Teesta that originates from Tso Lhamo Lake. It is joined by Goma Chhu (river) from the North. Lachen chhu rises at Pauhunri and joins the Teesta River at Chungthang. The important tributaries of river Teesta are the Lachung Chhu, Longbo Chhu, Poke Chhu, Umran Chhu, Dik Chhu, Rangphap Chhu, Rongni Chhu and Rongpo Chhu. River Teesta flows from north to south.

River Rangeet, with its deep green and crystal-clear water, meets the forceful mountain stream Teesta at a point called Triveni between Teesta Bazar and Melli Bazar. Kayam chhu, Rongdung chhu, Relli chhu,

² *The latest figures of geographical area of the State/Union Territories are as provided by the Office of the Surveyor General of India. Reporting Area for Land Utilization Statistics: The Reporting area stands for the area for which data on land use classification are available.

** Culturable Wasteland includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other.

*** Fallow land is lands that are used for the purpose of cultivation but are kept out of cultivation for rejuvenating the nutrients.

**** Current fallow is fallow land which is fallow for a period of up to one year.

Rathang chhu Kalej khola, Rishi khola, Ramam khola are the important tributaries of river Rangeet. Besides, there are around 180 perennial lakes at different altitudes.

3. *Climate*

The climate of Sikkim is extremely varied largely due to variation in altitude. The Himalayas also act as barrier to the flow of cold winds from Central Asia, resulting in heavy snowfall on the mountain tops and higher elevations, and dry winter season at lower elevation. For most of the periods in a year, the climate is cold and humid as rainfall occurs in each month. The area experiences a heavy rainfall due to its proximity with the Bay of Bengal. The rainfall in North District is comparatively less than that of the other Districts. The general trend of decrease in temperature with increase in altitude holds good everywhere. The monsoon winds dominate the climate. There is seasonal reversal of winds almost throughout the state. The monsoon imposes the seasonal rhythm which is apparent in the activities of the people since most of them are agriculturists.

The following four seasons are prevalent on the basis of the monsoon circulation over the state:

1. The cold weather season - December to February
2. The spring weather season - March to May
3. The south-west monsoon - June to September
4. The period of retreating monsoon - October to November.

Thus, the climate and the seasons of Sikkim state are suitable for growing a variety of crops which include cereals and commercial crops. Paddy, maize, millets, pulses are the principal crops and large cardamom, potato, ginger, orange and other horticultural crops are the cash crops.

4. *Key vegetation, livelihood and agriculture*

To have a better understanding of the climate with respect of land use pattern, Table 3.2 presents the district-wise climatic types along with the key vegetation, livelihood and agriculture.

Table 3.2: Vegetation, Agriculture and Key Livelihoods by Agro-Climatic Zones*³

S. No	Climate/ Agro-climatic zone/Eco-region type	Altitude (mt.)	Districts/ Important areas	Vegetation	Agriculture	Economic base/ livelihood
1	Snow peak type Trans Himalaya** or Alpine	>4000*	North district	Herbs or medicinal herbs. Precipitation is mainly through snowfall.	Mostly rangeland use. Potato, cereal and other vegetables	Pastoral based economy, Yak herding <ul style="list-style-type: none"> Lachen, Thangu, Muguthang, and Lachung Valley: Handicrafts, horticulture Dzongu: Apiary, Nettle, Dairy
2	Densely forested hill type or Alpine	2701-4000	North and East districts	Dense vegetation: tall trees & variety of rhododendron & primula flowers.	Potato, cabbage & other vegetables	Tourism, agriculture, horticulture, Pastoral based economy, Yak herding
3	Very high hill type or temperate	1701-2701	North and East districts	This climate is suitable for growing potato	Barley, maize Apple, Plum, Large cardamom Cabbage, peas, radish	Traditional agriculture, tourism, horticulture, animal husbandry There is some Seasonal nomadism or Transhumance
4	High hill type or sub-tropical	1501-1700	North, West and East districts	This is essentially a large cardamom growing belt.	Maize, wheat paddy, millets, peas, potato oranges, vegetables	Traditional farming Horticulture Livestock
5	Mid hill type or sub-tropical	881-1500	West and South districts	This is essentially an orange belt most suited for cultivation of orange	Maize, wheat paddy, oilseeds, - pulses, large cardamom, ginger, plum, peach, pear and vegetables	Traditional farming Horticulture Livestock MFPs
6	Low hill type or tropical	300-880	West and South districts	Suitable for cultivation of sub-tropical fruits such as banana, guava, lemon and lime	Paddy cultivation. Maize, pulses, oilseeds, ginger and vegetables.	Horticulture Livestock Traditional farming systems

Source: Compiled by Authors from various sources

³ *Above 5000 mt., the rangelands have been traditionally used for sheep, yak, grazing. The transhumance (the action or practice of moving livestock from one grazing ground to another in a seasonal cycle, typically to lowlands in winter and highlands in summer) nature of living still exists in some parts.

** The Trans-Himalayan eco-region extend from 4500 mt. to 5500 mt. with characteristic cold desert vegetation exclusive restricted to the north of Sikkim. This eco-region has not yet been included in the protected area network of the state and is perhaps the most threatened as it contains mostly endangered species. Dominant among these are Kiang, Nayan, Tibetan Gazelle, Snow Leopard, Tibetan Wolf, Tibetan Snowcock, Lammergeier, Raven, Golden Eagle and Ruddy Shelduck. There are no permanent settlements. Human population consists of a small number of nomadic Tibetan graziers or 'Dokpas' (who herd yak, sheep and pasmina-type goats).

3.1.3 Biodiversity Profile including Threatened Ecosystems and Species

Unique ecology and ecosystems have attracted a large number of international and national naturalists, field biologists, botanists, ecologists and scientists in Sikkim. Significant contributions made by the Lepcha community of Sikkim in documenting the floral and faunal wealth of the finds special mention in the literature (Smith and Cave, 1911). During the past few decades Indian institutions and researchers have updated the information on various taxonomic groups such as rhododendrons, orchids and ferns and made significant new contributions on Birds and butterflies, distribution of various faunal groups, the ecology and management of alpine vegetation, habitat use and food selection by wild and domestic ungulates (large mammals with hooves) in Tso Lhamo plateau. Besides, the Department of Environment, Science & Technology, Government of Sikkim has undertaken and supported a number of initiatives for documentation of species, and detailed ecological studies on various aspects related to biodiversity and ecosystems conservation and management as part of preparation of SBSAP 2003 and 2011 Reports.

Sikkim is endowed with a wide variety of natural Flora and Fauna due to variation in altitude and good rainfall. Although Sikkim comprises only 0.2 percent of the land area in India, it is home to an astounding 26 percent of the biodiversity. The state is one of the 34 global biodiversity hotspots of the world (Myers et al. 2000; Mittermeier et al., 2004). Significant medicinal plant diversity is found in Sikkim, leading to vibrant Local Health Traditions (LHTs). Unique tribal knowledge rests with the communities of Lepchas, Limboo, Bhutia and Chhetri. The state exhibits great compression of eco-climatic zones owing to wide altitudinal gradient and fairly high degree of slopes. Perhaps no other Indian state would have such a contiguity of diverse habitat types from sub-tropical forests to dry alpine plain within a short distance of less than 100 km. Each eco-climatic zone is represented by its own distinct floral and faunal communities, some of which occupy more than one habitat and wider altitudinal range, especially a few migratory species. A large number of altitudinal migrants especially leaf-warblers reach tree line and adjacent alpine scrub to breed during summer and descend to foot-hills and further to peninsular India during winter. The foot-hill forests in the state harbour several floral and faunal elements, typical of eastern Himalaya. Notable among the floral assemblages are a variety of epiphytic orchids, aroids, wild banana, pandanus and bamboos, while prominent avifauna include Rufous-necked Hornbill (*Aceros nipalensis*), Great Indian Hornbill (*Buceros bicornis homrai*), Chestnut-breasted Partridge (*Arborophila mandellii*), Black-breasted Parrotbill (*Paradoxornis flavirostris*), Grey-crowned Prinia (*Prinia cinereocapilla*) and Ward's Trogon (*Harpactes wardi*). This region also exhibits a narrow range of Sal - Chir pine transition (GS Rawat and S Tambe, 2008).

Sikkim has exceptionally diverse orchids and it is also believed to be centre of origin for Cymbidium. Contiguous riverine habitats along sub-tropical and warm temperate belts surrounded by rich forests of Duars of North-west Bengal form congenial habitat for a variety of epiphytic as well as ground orchids. The deep valleys and lower hills retain considerable moisture throughout the year owing to summer as well as winter precipitation. The sub-tropical belt has a number of tall trees which form excellent host for epiphytes. This belt is also extremely rich in ground orchids represented by the species of Nervillia, Galeola, Tropidia, Anoectochilus, Goodyera and Zeuxine. Other notable species of orchids along foot-hills are snow orchid (*Diplomeris hirsuta*), Lady's slipper orchid (*Paphiopedilum venustum*) and Bamboo orchid (*Arundina graminifolia*) among others (GS Rawat and S Tambe, 2008).

A snapshot of Sikkim's rich biodiversity followed by the Threatened, Endangered and Rare* fauna and flora, in Tables 3.3 and 3.4.

Table 3.3: A Snapshot of Biodiversity in Sikkim (including snapshot of floral RET (Rare, Endangered, Threatened) Species)

Species	Number	Species	Number	Plant Group	Life Forms	Total Species	Total RET Species
Flowering plants	5,500 +	Primulas	30	Phanerogam	Herbs	3246	65
Orchids	557	Oaks	11		Shrubs	487	17
Rhododendrons	38	Medicinal Plants	1,681		Trees	702	11
Conifers	16	Mammals	144	Cryptogam	Palms	11	7
Bamboos	28	Birds	568		Cycads	1	1
Ferns and allies	362	Fishes	48	Ferns and Fern Allies	Ferns	468	29
Tree ferns	9	Butterflies	689		Lycopods	12	1
		Moths	7,000	Angiosperm	Orchids	523	34
					Rhododendrons	36	15

Source: Compiled by authors using ENVIS Sikkim and Sikkim Bioinformatics Data.

Table 3.4: A Snapshot of Critical, Threatened and Endangered Faunal Biodiversity in Sikkim⁴

Class	Category	Species
Mammals	Endangered	5 species (Dhole, Red Panda , Alpine Musk Deer, Himalayan Musk Deer, Black Musk Deer)
	Vulnerable	7species (Asiatic black bear, Snow Leopard, , Clouded Leopard, Binturong, Mandelli’s Mouse-eared Myotis, Common Leopard, Himalayan Serow)
	Near threatened	5 species (Eurasian otter, Asiatic golden cat, , Himalayan goral, , Tibetan gazelle, Marbled Cat)
Fish	Endangered	1 species (Golden Mahseer)
	Vulnerable	2 species (Common snow trout, Saddleback loach)
	Near threatened	3 species (Indian mottled eel, Gray’s stone loach, Pangusia labeo,)
Reptiles	Vulnerable	3 species (King Cobra, Burmese Python, Walnut Kukri Snake)
	Near threatened	1 species (Sikkimese Bent-toed Gecko)
Amphibian	Least Concern	1 species (Sikkim Snow Toad)
Insects	Near threatened	2 species (Kaiser-i-hind, Relict Himalayan Dragonfly)
Birds	Critical	3 species (Red-headed vulture, White-rumped vulture, Baer’s pochard)
	Vulnerable	10 species (Beautiful nuthatch, , Chestnut-breasted Partridge, Great Honbill Greater Spotted Eagle, Grey-crowned Prinia, Hodgson’s Bushchat, , Palla's Fish Eagle, Rufous-necked Hornbill, Slender Babbler, Wood Snipe)

⁴ * As per the IUCN Red List Categories and Criteria⁴, the classifications are defined as follows-

- Critical- considered to be facing an extremely high risk of extinction in the wild.
- Endangered - considered to be facing a very high risk of extinction in the wild.
- Vulnerable- considered to be facing a high risk of extinction in the wild.
- Near Threatened- A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critical, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- Least Concern- Widespread and abundant taxa are included in this category.

Class	Category	Species
	Near threatened	9 species (Black-necked crane, Blyth's Kingfisher, Cinereous Vulture, Firethroat, Giant Babax, Rusty-bellied Shortwing, Satyr Tragopan, Yellow-rumped Honeyguide)
Domesticated animals	Endangered	1 species (Yak,)

Source: Compiled by Authors using IUCN Red List.

*For a list of endangered, critical, vulnerable and nearly threatened fauna and flora in Sikkim respectively, along with their scientific names, see **Annexure 2**.

3.1.4 Administrative set up and Natural Resource Governance

Sikkim is a multi-ethnic and multi-lingual state. The state has 11 official languages: Nepali, Sikkimese, Lepcha, Tamang, Limbu, Newari, Rai, Gurung, Magar, Sunwar and English.

English is taught in schools and used in government documents. Sikkim's economy is largely dependent on agriculture and tourism, and as of 2017, the per capita GDP of Sikkim was the third largest among Indian states⁵. Sikkim is divided into four districts. Each district is further divided into smaller administrative units or subdivisions. Table 3.5 presents some important indicators for each district in Sikkim.

Table 3.5: District-wise Basic Indicators (2011 census)

S. No.	Districts and sub-divisions	Head-quarter	Area (Sq. km.)	Population	Literacy	Sex ratio/ 1000	Agriculture
1	North Sikkim	Mangan	4226	43,709	78.01	767	Cardamom, corn and paddy, potato, apple, and cabbage
2	West Sikkim	Geyzing	1166	1,36,435	77.39	942	Rice, maize, barley, cardamoms, oranges, potatoes
3	East Sikkim	Gangtok	954	2,83,583	83.85	873	Maize, rice, soybean, heat, finger millet, mustard, black gram, passion fruit, banana, mandarin
4	South Sikkim	Namchi	750	1,46,850	81.42	915	Emerged as "green belt"-peas, radish, cauliflower, cabbage, beans and ginger

Source: Compiled by Authors from various sources.

1. Soil

Survey conducted by ICAR National Bureau of Soil Survey and Land Use Planning has established eight sub-groups and fifteen soil series in Sikkim.⁶ Table 3.6 shows the types of soils in Sikkim; the soil series as well as sub-group.

⁵ Source: Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India.

⁶ [http://www.sikenvis.nic.in/writereaddata/Soils%20of%20Sikkim%20-%20SIKKIMAGRISNET\(dot\)ORG.pdf](http://www.sikenvis.nic.in/writereaddata/Soils%20of%20Sikkim%20-%20SIKKIMAGRISNET(dot)ORG.pdf)

Table 3.6: Types of Soil in Sikkim

Soil Series	Soil Sub-Group	Characteristics
Markong, Hilley	Typic Haplumbrepts	Very deep moderately well-drained fine loamy soils with dark reddish brown to reddish brown.
Gompa	Lithic Haplumbrepts	Shallow excessively drained loamy skeletal soils with brown to dark brown colour.
Lingtse, Losep, Namthang	Typic Dystrochrepts	Very deep, moderately well-drained fine loamy soils with dark grayish brown to dark brown color.
Machong	Litic Dystrochrepts	Moderately deep moderately well-drained, grayish brown fine loamy soils.
Thekabong, Chatrikola, Padamchen	Umbric Dystrochrepts	Moderately deep, moderately well drained loamy skeletal soil with dark grayish brown in colour.
Putuli, Simkara, Nandugaon	Lithic Udorthents	Shallow excessively drained dark brown loamy skeletal soil having some rock particles scattered over the surface
Majitar	Aquic udifluents	Well-drained loamy soils with grayish brown to light gray colour.
Tariku	Ultic Hapludalfs	Very deep, moderately well-drained fine loamy soils with brown to dark colour developed on sand stones.

Source: Compiled by Authors using National Bureau of Soil Survey and Land Use Planning (ICAR).

2. *Forestry*

At present 75.85 percent of the total geographical area of the state -- with reserved forest, Khasmal forest, Goucharan forest, Alpine pasture and scrub and Perpetual snow cover of the state territory -- falls under the administrative control of the Forest and Environment Department. Recorded Forest Area (RFA) in the State is 5,841 sq km of which 5,452 sq km is Reserved Forest and 389 sq km is Protected Forest (State Forest Report, 2015). In Sikkim, during the period 1st January 2015 to 5th February 2019, a total of 24.30 hectares of forest land was diverted for non-forestry purposes under the Forest Conservation Act, 1980 (FSI, 2019). Sikkim is rich in forest resources, with 44.1 percent (3127 km²) of the state's area under the green cover. It has large areas under forests ranging from the Tropical to Temperate and Alpine zone (Table 3.7).

Forest in Sikkim contain a large number of herbs and shrubs of great medicinal value and variety of bamboo and has great potential for Non-Timber Forest Product (NTFP) which includes medicinal plants/herbs/orchid, sand, boulders, minerals etc. The growth in population has led to increased dependence on forests for fuel wood, fodder and timber, besides occupation of land for agriculture. According to Forest Survey of India (2019), the number of people dependent in Forest Fringe Villages on Forests in Sikkim has been the following-

- i. Fuel-wood (tonnes) – 82,134
- ii. Fodder (tonnes)- 4,39,756,
- iii. Bamboo (tonnes)- 66
- iv. Small Timber (cum)- 1,320

Table 3.7: Summary of Forest Statistics in Sikkim (FSI, 2019)

Forest Cover			District Wise Forest Cover in Sikkim		
Class	Area (in sq km)	% of GA	District	Total Forest Cover (sq. km)	Change since 2017 (%) * ⁷
Very Dense Forest	1,101	15.53	East District	2	-0.28
Moderately Dense Forest	1,552	21.88	North District	1,284	-0/95
Open Forest	688	9.7	South District	571.82	-0.18
Scrub	306	4.32	West District	1,166	-0.10
Total (excluding shrub)	3,342	47.11	Total	3,342	-1.51
Forest Types & Biodiversity: Percentage area under different forest types of Sikkim					
Forest Type		% of Forest Cover	Forest Type		% of Forest Cover*
East Himalayan Sal		1.85%	East Himalayan Sub-tropical wet hill		23.89%
East Himalayan Moist Mixed Deciduous		5.19%	Buk Oak		23.04%
East Himalayan Mixed Coniferous		5.90%	Montane Bamboo Brakes		0.19%
East Himalayan Sub-alpine birch/fir		24.01%	Birch/Rhododendron scrub		3.36%
Alpine Pastures		3.91%	Dwarf Rhododendron Scrub		0.30%
Dwarf Juniper Scrub		4.96%	Plantation/TOF		3.40%
Growing Stock in Sikkim (in m cum)					
Growing Stock in Recorded Forest Area			35.32		
Growing stock in TOF (Trees Outside Forest)			1.94		

Source: Compiled by Authors using FSI, 2019.⁸

2.1 Governance of forests: The Forest and Environment Department undertakes this huge task through its four divisions, which are further sub-divided into 22 ranges. The main aims and objectives of the department are the protection and management of forests, water bodies, alpine pastures and wild life. It also carries out afforestation activities, soil conservation, and research in medicinal plants. The table 3.8 presents a brief account of the governance of forests in Sikkim.

⁷ According to FSI (2019), the main reasons for the small loss in forest cover in the State are shifting cultivation practice on the community owned lands and mining activity in some parts of the State.

⁸ <https://fsi.nic.in/isfr19/vol2/isfr-2019-vol-ii-sikkim.pdf>

Table 3.8: Governance Structure of Department of Forest, and Environment, Sikkim

Boards	Focus area	Committees and Agencies	Focus area
State Land Use and Environment Board	Land-Use related planning	Joint Forest Management Committee / Eco-Development Committee (JFMC/EDC) (Village Level)	Preparation of micro plans, choice of species to be planted, suggesting physical and financial targets, propose entry point activities, fund creation and awareness programmes.
State Biodiversity Board	Biodiversity; bio-survey and bio-utilization of any biological resources	Forest Development Agency (FDA) (Division Level) BMCs	Supervising and monitoring JFMCs/EDCs in micro plan preparation and approval of micro plans, organise training and awareness generation programmes
State Medicinal Plants Board	Oversee projects/schemes related to medicinal plants	State Forest Development Agency (SFDA) (State Level)	Policy support, managing the Centrally Sponsored Schemes, guidance, monitoring, approval, evaluation
State Pollution Control Board	Pollution control	Research Evaluation and Monitoring Cell (REMC)	Evaluating and monitoring all research applications and proposals from different organizations, institutions, individuals within and outside Sikkim
State Wildlife Advisory Board	Wildlife management	Forest conservation act (FCA) cell	Deals with forest land diversion cases

Source: Compiled by Authors.

2.2 Major NTFP and Invasive Species: In Sikkim, there are two major NTFP species- the Calamus Flagellum (a shrub, with a relative abundance of 99.94%), and the Spandios Axillaris (a tree, with a relative abundance of 0.06%).

Major Invasive Species in the state are the following (FSI, 2019)

- i. *Glinsoga Parviflora*
- ii. *Parthenium Hysteropharus*
- iii. *Solanum Viarum*
- iv. *Lantana Camara*
- v. *Ageratum Conyzoides*

3. Khangchendzonga National Park

The Khangchendzonga National Park gets its name from the mountain Khangchendzonga, the third-highest peak in the world. The core area of the park covers an area of 1784 km square; while the total area (including core, buffer and transition zone) covers an area of 2931 km square. Numerous lakes and glaciers, including the 26 km long Zemu Glacier, dot these high altitudes. The property falls within the Himalaya global biodiversity hotspot and displays an unsurpassed range of sub-tropical to alpine ecosystems. Animals like musk deer, snow leopard, sloth bear, red panda; Himalayan black bear, Himalayan blue sheep, serow, Himalayan Tahr and many more make their home in this park. In 2016, The Khangchendzonga National Park (KNP), which comprises the core area of the KBR, was inscribed

as India's first “Mixed World Heritage Site”. It is the first and only Indian site to meet the mixed – both cultural and natural – heritage criteria (O Neill 2017).

4. *Himalayan Zoological Park and various Sanctuaries*

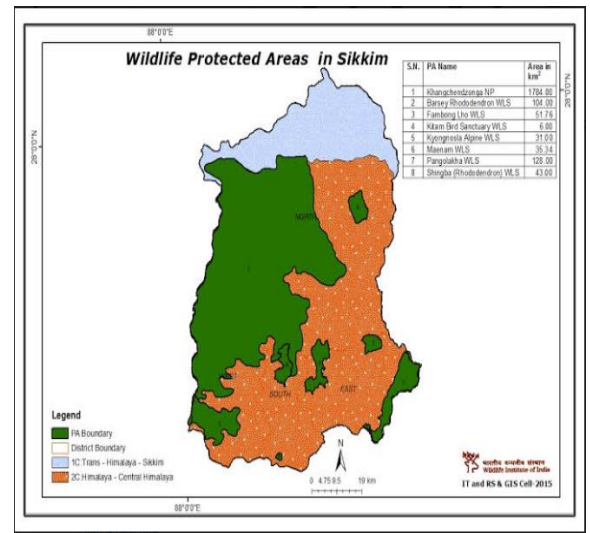
It is a prestigious project of the state government and covers an area of 230 hectares of forest land. The main objective of the park was to display and exhibit the breeding of rare and endangered species for conservation and propagation of the state’s rapidly dwindling wildlife. The park has also pioneered much lauded ex situ conservation breeding efforts for endangered species like the red panda. Besides the above park, the state department has the following sanctuaries (see Figure 3.2). Recently, the Slingsong Tinkitam Fairrieanum Conservation Reserve has been notified in South Sikkim, for the protection of orchid *Paphiopedilum fairrieanum*.

Table 3.9: Wildlife Sanctuaries in Sikkim

S. No	Name of Wildlife Sanctuary	Year	Total Area (km ²)
1	Barsey Rhododendron Wildlife Sanctuary	1998	104
2	Fambong Lho Wildlife Sanctuary	1984	51.76
3	Kitam (Bird) Wildlife Sanctuary	2005	6
4	Kyongnosla Alpine Wildlife Sanctuary	1977	31
5	Maenam Wildlife Sanctuary	1987	35.34
6	Pangolakha Wildlife Sanctuary	2002	128
7	Shingba (Rhododendron) Wildlife Sanctuary	1984	43

Source: Wildlife Institute of India.

Figure 3.2: Wildlife Protected Areas in



5. *Mines and geology*

The geological feature and topography of Sikkim are characterized by young mountainous terrain which are prone to natural calamities. The frequency of landslides and the cumulative effect on the socio-economic life of the state need no emphasis. Seismologically Sikkim lies in the Alpine-Himalayan mountain system, a major earthquake belt which has been responsible for many tremors. Sikkim is host to a large number of mineral deposits, base metals and high value natural crystals. Though large areas of the state are yet to be explored, occurrence of the following minerals has been reported. Table 3.10 presents the minerals in Sikkim, and their location, occurrence, quality and some additional remarks.

Table 3.10: Minerals and Metal Deposits in Sikkim

S. No.	Minerals	Location	Occurrence/ mining	Remarks
1	Quartzite	Parts of East, West and South Sikkim.	Occurrences	Found at Ranikhola- Mansari area of West Sikkim is quite extensive and further exploration is needed. Talctoo has been found in these quartzite bands in the same area
2	Dolomite limestone	Maniram Bhanjyang, Phalidary, Wok, Legship and Magalbaria of South and West districts.	Occurrence	
3	Coal	Reshi, Sikkip, Nandugaon and Namchi.	Occurrences	There are no coal fields as such in Sikkim
4	Marble	Chungthang, Lachung, Tsongo and Tolung.	Sizeable deposits of marble were found	The area being strategically and ecologically sensitive no exploration has been carried out.
5	Copper ores	Bhotang, Rorathang and Dikchu.	found and mined	
6	Graphite	over parts of West and North districts	Occurrences	The mining and exploration of graphite is difficult due to pinching, swelling and trusting.
7	Sillimanite minerals	parts of West district	reported	
8	Kyanite	Kabi and Phodong in North district.	found	
9	Garnet	North and East districts mainly in Kabi, Phodong and Lingdok, section on high-grade metamorphic rock	found	The crystal of Garnet has been found to be highly fractured and twisted due to tectonic movements.

Source: Compiled by Authors.

6. Thermal springs

There are eight well-known thermal springs in Sikkim like Reshi (Phurtsachu), Borong and Polok in South Sikkim and Yume Samdong, Yumthang, Zee, Tarum and Tolung in North Sikkim. The hot springs of Sikkim are locally called as Tatopani/Tsha-Chu. It is believed that these hot springs have medicinal properties and can help cure a number of medical conditions including arthritis, skin problems, and gastrointestinal and bowel associated problems.

7. Agriculture

Agriculture is the primary activity in Sikkim, more than 64 percent of the population is dependent on agriculture and it is practiced in approximately 15.36 percent of the total geographical area. Local agrobiodiversity features more than 126 landraces of cereals, including rice (77), maize (26), and millet (7); 18 cultivars of oilseeds; 34 cultivars of pulses/beans; 132 species of vegetables; 38 species of

spices/condiments; 33 landraces of tubers/roots; and 64 species of fruit. Sikkim’s traditional system of cultivation also supports more than 200 species of wild edibles, 119 species of multipurpose agroforestry trees, 52 crops with high social and cultural value, and 69 species of plants sacred to indigenous communities. It also has a diversity of land uses, with 15 to 20 field types, and specific land use categories. Similarly, there is a high diversity of domestic animals, with about 21 different local and indigenous breeds. (Sharma et al 2016).

However, the actual area available for agricultural purpose is declining due to diversion of cultivable land for non-agricultural purposes like establishment of industries, township expansion, construction of roads, hydel projects, buildings etc. (Sikkim Agriculture Department Annual Report 2005-06). Farming in Sikkim is characterized by small and fragmented holdings, limited irrigation, lack of farm mechanization, and low productivity. Besides, there are frequent occurrences of natural calamities like landslides, floods and earthquakes which adversely impact agriculture. This has also led to decline in certain crop varieties such as buckwheat (*Fagopyrum esculentum*), naked barley (*Hordeum himalayens*), adzuki bean (*Vigna angularis*), and horse gram (*Macrotyloma uniflorum*). Moreover, certain local varieties have become completely obsolete. These include Murli makkai of maize, Ramzira, Thaprey, Ramkalan, Birinpool, Dharmali, Dhorokey Jholungey, Ramkalan, Kalchhati, Kataka, Khaiya dhan, Mansare, and Sirkey-Marsee of rice, Harey sibi, Potherey sib, Jotharey, Jureli, Kali sibi, Harey Doode, Doode Haddey, Lam Rangey, Bharlangey, Kalo Mantulal, and Thakmanacy of rajmash, and Ghew Kera, Japadi and Kadali of banana. In view of these, emphasis should be on intensive agriculture and increasing the productivity of agricultural land, while conserving the local agriculture varieties of Sikkim.

Table 3.11 shows the land use statistics in Agriculture, along with the major crops of Sikkim.

Table 3.11: Land Use Statistics in Agriculture and Major Crops of Sikkim

Land Use Statistics in the Agriculture Sector		Major Crops	
Total Geographic Area	7,09,600	Cereals	Paddy, Wheat, Maize, Barley, Buckwheat, Finger Millet
Net Area Sown (Ha)	77,179.41 (10.87 %)	Pulses	Urad, Rajmash, Paheli Dal and others
Area under current fallow (Ha)	6,980.50 (0.98%)	Oilseeds	Mustard, Soyabean
		Fruits	Mandarin, Pear, Guava, and Kiwi
Culturable waste (Ha)	4,230.51 (0.59%)	Spices	Cardamom (highest production in India), Ginger, Turmeric, Chili, Coriander
Land not available for cultivation (Ha)	10,204.18 (1.43%)	Tuber Crops	Potato, Sweet Potato
		Flowers	Cymbidium orchids, rose, liliun, gladioli, anthurium, carnation, gerbera, alstroemeria, and zantedeschia
Fallow other than current fallow (Ha)	4,454.41 (0.62%)	Vegetables	Broccoli, Onion, Brinjal, Carrot, Iskus, Pumpkin, Radish, Tomato, Tree Tomato, Cabbage, Cauliflower.

Source- Compiled by Authors using the Handbook on Agriculture in Sikkim, 2014-15, and ENVIS Sikkim.

Governance of agriculture: The Food Security and Agriculture Development Department (DoA) governs the agriculture sector. Table 3.12 gives an account of its governance.

Table 3.12: Governance of Agriculture in Sikkim

Board/Federation/ Agency	Focus area	Board/Federation/ Agency	Focus area
Sikkim State Organic Board	Frame policy of organic farming in the state, prepare roadmap and work on implementation.	Agricultural Technology Management Agency (ATMA)	Capacity building and training, coordination and management of agriculture extension related work
Inter Departmental Working Group (IDWG)	It overlooks the activities of SAMETI and ATMA	State Agricultural Management and Extension Training Agency (SAMETI)	Capacity building and training at the state level
Agency for Reporting Agricultural Statistics (EARAS)	It is intended to cover all principal crops grown in different seasons in the year with a view to obtain reliable estimate of area, yield rate and production	Sikkim State Co-operative Supply and Marketing Federation Ltd.	Aims at development of certified organic production in a value chain mode to link growers with consumers and to support the development of entire value chain
Farmer Interest Groups (FIG)	Self-managed, independent group of farmers to address local issues	ATMA Management Committee	Since there are 4 ATMAs in the state, this committee manages and coordinates their activities

Source: Compiled by Authors.

8. Horticulture

More than 70 percent of the population is dependent on agriculture and allied activities in Sikkim. Horticulture has gradually become popular in the state with a phenomenal increase in area under horticulture crops, increase in both the production and productivity, along with many activities related to post-production and marketing. Moreover, off-season vegetables, floriculture and protected cultivation have recorded unprecedented growth in the State. The present status of horticulture in Sikkim has been illustrated in Table 3.13.

Table 3.13: Present Status of Horticulture in Sikkim

Sub-Sector	Present Status
Fruits	<ul style="list-style-type: none"> • Important fruits: Mandarin, pear, guava, kiwi • Revival of apple cultivation in Lachung and Lachen Valleys led to setback in traditional apple cultivation • Technological intervention checked citrus decline • Production of quality planting materials through high-tech facilities & nurseries • Crop diversification successful for banana and papaya as filler crops
Vegetables	<ul style="list-style-type: none"> • Vegetable cultivation has shifted from backyard kitchens to commercial activity • MSP has boosted vegetable cultivation along with 50% transport subsidy
Spices	<ul style="list-style-type: none"> • Ginger is an important cash crop • Re-plantation efforts to mitigate decline • Other spice crops are turmeric and cherry pepper
Flowers	<ul style="list-style-type: none"> • Recorded unprecedented growth in terms of area and production • Two joint venture units, one on cymbidium orchids and another on anthurium have been set up
Protected Cultivation	<ul style="list-style-type: none"> • Low-cost prototype greenhouses: 10,360 numbers of low-cost poly-houses and 850 tubular structures constructed
Bee-Keeping	<ul style="list-style-type: none"> • Interventions in the form of modern & scientific technology and inputs like bee boxes, bee colonies and equipment have brought about great transformation to the traditional bee keeping practices.

Source: Compiled by Authors using Sikkim Organic Mission Data.⁹

Governance of horticulture: The Horticulture and Cash Crops Development Department focuses on increasing horticulture activities in Sikkim, and operates through the underlined structure. Apart from the Secretariat and Directorate, there are Joint Directors and Additional Directors for various sub-divisions. It works mostly in Mission Mode and the following key areas are headed by Directors.

- HMNEH – Horticulture Mission for North East and Himalayan States
- NBM – National Bamboo Mission
- NAM – National Agriculture Market
- PME – Priority Setting, Monitoring and Evaluation
- OFWM – On Farm Water Management
- INM – Integrated Nutrient Management

9. *Livestock and animal husbandry*

Animal husbandry is the major source of supplementary income for rural households. Around 6-7 percent of the state's GDP is from livestock sector. Livestock population in Sikkim is widely distributed; in the high-altitude areas- yaks, sheep and goats (*chengra*) are predominate, whereas in the mid and low hills- siri cows, jersey, goats, poultry and pigs are reared. In almost all the areas, the exotic blood inheritance is increasing as there is introduction of genetically superior germplasm.

⁹ <https://www.sikkimorganicmission.gov.in/towards-organic-sikkim/horticulture-sector/>

Every five years, a livestock census is conducted in Sikkim since 1977. According to the 2007 census, the population of crossbred cattle was 91,289 (having an annual growth rate of 7.45%), indigenous cattle was 71,852 (having a negative growth rate of -2%), and poultry was 2,55,882 (having annual growth rate of 1.45%). Apart from these, other livestock includes buffalo, yak, sheep, goat and pig.

Sikkim has rich biodiversity in livestock. The local cattle breed is called *siri*, local goat varieties are *Singhari and Changra*, local sheep include *Banpala and Gharpala*, local yak is *Bho and Aho*, and local poultry is Desi fowl and naked neck.

Table 3.14: A Snapshot of Livestock Sector in Sikkim

Theme	Features (2003-2004)
Stock holding pattern	<ul style="list-style-type: none"> • More than 85% of the livestock are held by small, marginal farmers and landless labours • 90% of the backyard poultry is held by small farmer groups
Contribution of livestock to economy	<ul style="list-style-type: none"> • Contribution to GSDP- 7% • Employment in Livestock sector is at 4.5% growth rate, per annum • Milk is the second largest produce in agriculture • 70% of the main workforce is engaged with animal husbandry
Impact on rural income	<ul style="list-style-type: none"> • 14.32% of income is from milk • And 0.5-3.4% if from other livestock

Source: Compiled by Authors using Sikkim State livestock policy data.¹⁰

Governance of livestock: The Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services (DoAH&VS) is one of the important technical departments of the Government of Sikkim, which came into existence as a separate department in April 1975. Table 3.15 gives a brief presentation of the governance structure of the department.

Table 3.15: Brief of Governance Structure of DoAH&VS*

Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services	
Breeding cell	Artificial insemination (AI) of cows, Natural service to cattle, Cross breeding, Private Bull Calf Rearing Programme, Conservation of indigenous cattle breed, Livestock insurance, Training for AI
Feed and fodder cell	Mitigate the shortages of green fodder production during lean period
Extension and training cell	Close interaction with farmers and expose them to the latest scientific advancements.
Statistics cell	Support in the livestock census, use census data for planning, execution and monitoring of the various development programmes

Source: Compiled by Authors.

10. Fisheries

In general, fishing is a limited activity, and is performed by daily wage labour, farmers or servicemen as a secondary occupation for them. The dominant fish species in Sikkim are Asala, Katley, Buduna, Kabrey, Chirkay and Chepti, and many ornamental fish species. However, now a declining trend has

¹⁰ http://www.sikkim-ahvs.gov.in/policy_final_4.pdf

been noted in the fish germplasm. The average fish catch is low due to productivity decline and destruction of habitat due to overfishing/pollution.

Governance of fisheries: The establishment of Fisheries began as a wing in the late 1970s in the Forest and Environment Department. In 1995, the Fisheries Directorate was established and focus shifted from conventional policy to promotion and development of Fish Culture as an income generating activity in the rural areas. The Directorate of Fisheries under the administrative control of Secretary, Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services (DoAH&VS) has been working hard for sustainable development of Fisheries. The Fisheries Directorate oversees fisheries related activities such as Trout Culture, Carp Culture, Propagation of Mahseer, and Conservation of riverine fisheries and so on.

11. Medicinal and high-value biodiversity

The rich flora of Sikkim has a number of raw drugs that have been noted in Ayurvedic texts and people in Sikkim have been known to use about 420 plants for various diseases. However, out of these, very few have seen a commercial market. Notably, many species of Himalayan origin have revolutionized allopathic system of medicine, and the recognition is due.¹¹ Ethnic groups in Sikkim use medicinal plants for serious ailments like epilepsy, leprosy, paralysis, asthma, typhoid, diabetes, hemorrhages, during childbirth, cholera and many others. Some plants are also believed to “prolong life”. (Singh and Prasad, 2002)

The medicinal and high-value biodiversity is governed by the State Board on Medicinal Plants, under the Forest and Environment Department. The cultivation of the following species has been taken up by the farmers in their farmland under Contractual Farming under the State Medicinal Plants Board (SMPB) of Sikkim funded by the National Medicinal Plants Board (NMPB), Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry of Health and Family Welfare Department, Government of India.

High Altitude/ Sub-Alpine areas above 2500 Meter. - Aconitum heterophyllum (Atees), Aconitum ferox, palmatum (Bikh), Picrorhiza kurooa (Kutki), Nardostachys jatamansi (Jatamansi), Digitalis purpurea (Fox glove), Podophyllum hexandrum (Patch patey), Panax pseudoginseng (Ginseng), Rheum emodi (Padamchal), Selinum tenuifolium (Bhut kesh), Rhododendron anthopogon (Sunpati), Juniperus macropoda (Shukpa).

Middle and Lower Hills/Temperate and Sub-Tropical areas- Swertia chiraita (Chiraita), Acorus calamus (Bojho), Aloe barbadensis (Ghiu Kumari), Asparagus racemosus (Kurilo), Glorisa superba (langarey tarul), Piper longum (Pipla), Valeriana hard wickii (Nakali jatamansi), Solanum nigrum (Bokshikara), Ocimum sanctum (Tulsi), Terminalia belerica, T. chebula, Emblica officinalis (Triphala) and Azadiracta indica (Neem)¹²

For a full list of medicinal and aromatic plants found in Sikkim, see Annexure 3.

¹¹ http://www.sikkimforest.gov.in/medicine_main.htm

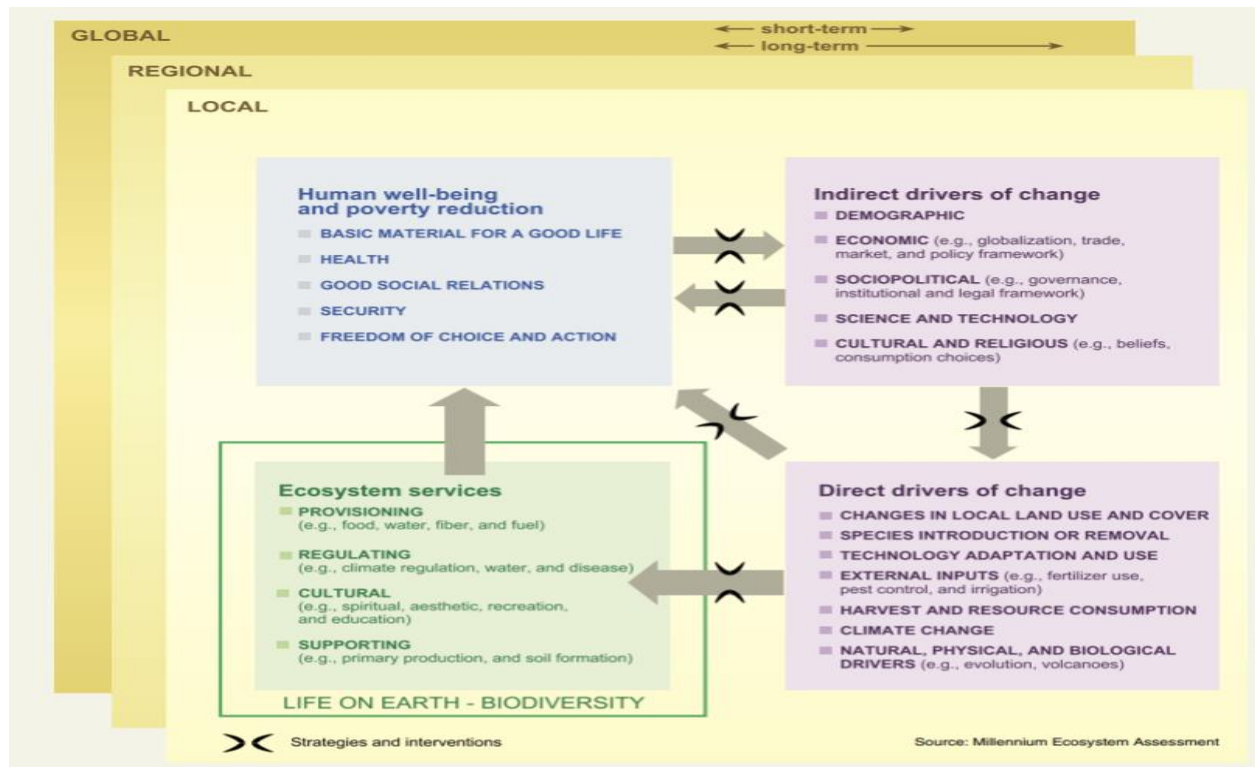
¹² http://www.ikkimforest.gov.in/medicine_main.htm

3.2 Drivers of Change: Key Factors Impacting Biodiversity

3.2.1 Millennium Ecosystem Assessment and Direct and Indirect Drivers of Change

Globally, some threats and drivers of change have been recognized as those which affect biodiversity, and subsequently human well-being. Millennium Ecosystem Assessment (2005)¹³ has developed a conceptual framework depicting relationship between interaction of Biodiversity, Ecosystem Services, Human Well-Being and Drivers of Change (Figure 3.3).

Figure 3.3: Conceptual Interaction between Biodiversity, Ecosystem Services, Human Well- being and Drivers of Change



Source: Millennium Ecosystem Assessment, 2005.

Below, threats have been classified into direct and indirect threats, based on their effect on biodiversity.

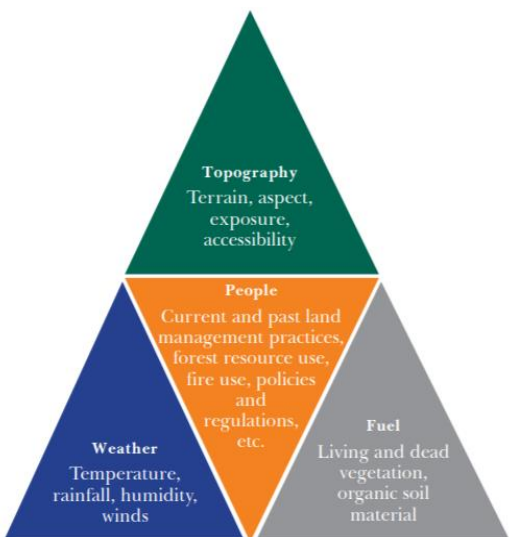
- **Direct threats include:** Forest Fires, Human-Wildlife Conflict (HWC), Invasive Alien Species (IAS), Climate change, loss of agro-biodiversity, poaching of wildlife, and illegal removal of NTFPs.
- **Indirect threats are:** Climate Change, unplanned and mass tourism, pollution and waste accumulation, loss of traditional knowledge.

¹³ <https://www.millenniumassessment.org/documents/document.356.aspx.pdf>

3.2.2 Direct Threats

1. Forest fires

Figure 3.4: Causes of Forest Fires – The Wildlife Triangle



Forest fires result from a combination of natural and social factors, shown in Figure 3.4. Uncontrolled forest fires constitute a threat to the forests in Sikkim. There has been a total of 547 forest fire cases in Sikkim in 2004-2014, causing damage to approximately 3,794 Hectares of forest land (Table 3.16). Majority of forest fires have been ground fires (a forest fire that burns the humus and usually does not appear at the surface) and have harmed various species like Champ, Panisaj, Kaijal, Lampatey, Arupatay, Teak, Sal, Simal, Angeri, Malingo, Junifer, Rhododendron, Salimbo, Gurash, Aughari Mouha, Shour, Salimbo and Ground Bushes.

Table 3.16: Cases of Forest Fires in Sikkim between 2004 - 2014

Year	Number of cases	Approximate area damage (in hectares)	Year	Number of cases	Approximate area damage (in hectares)
2004	9	60.5	2009	157	847.5
2005	31	225	2010	34	136.5
2006	56	474	2011	62	529.1
2007	18	64	2012	34	252
2008	46	346	2013	38	275.5
			2014		582.5

Source: Compiled by authors from Sikkim State Disaster Management Authority Database.¹⁴

¹⁴ <http://www.ssdma.nic.in/CMS/GetPdf?MenuContentID=88>

Table 3.17: Forest Fire: Threats, Drivers and Impact

Type of Threat	Drivers	Impact on environment and biodiversity
<ul style="list-style-type: none"> • 40% of forests in Sikkim are susceptible to forest fires during November to March. Peak fire season: March and April. (Sharma et al 2014) • The old growth forests of Sikkim are vulnerable due to high calorific value, aggressive middle-story vegetation and slow growing nature. • Spearman's Rank-Order Correlation Coefficient Index shows that the effects of cooler sea surface on forest fires is more on Sikkim. The index for Sikkim (-0.11) shows a strong negative relationship, in contrast to the All-India index (-.02) (Dogra et al 2018)¹⁵ 	<ul style="list-style-type: none"> • Erratic rainfall, extensive dry spells during winters, decrease in annual rainfall and early summers due to climate change (Sharma et al 2012) • Human activities such as bonfires during winter, use of traditional torch <i>rankoo</i> by trespassers or even lit cigarette butts thrown (Kaushik 2015) • Traditional grazing practices used to control the growth of shrubs naturally, but a ban on grazing leads to unchecked growth of shrubs which often can be a cause of forest fires in dry summer season. 	<ul style="list-style-type: none"> • With warming climate, forest fire is ascending upwards and impacting Sikkim's temperate oak and sub-alpine conifer forests. (Sharma et al 2012) • Forest fires lead to change in biomass stocks, alter hydrological cycle and have negative effects on marine systems. Smoke from fires can significantly reduce photosynthetic activities and is detrimental to the health of humans as well as animals. (Davies and Unam, 1999) • Forest fires also cause increased probability of burning in subsequent years as dead trees topple to the ground and increase fire-prone species. (Nasi et. al., 2002)

2. *Human-wildlife conflicts*

Human wildlife conflict (HWC) has been a long-standing problem in Sikkim, which is on the rise. HWCs have been prevalent throughout the state (Figure 3.5) and can be grouped into 4 categories - Attack on Humans, Livestock killing, Crop raiding, Wildlife straying in human-dominated areas (Bhutia, 2017).

¹⁵ The index calculated to determine if the number of active fire locations detected per state during peak fire season (January to June) has varied systematically with ENSO. In other words, the index can determine cooler sea surface temperatures are strongly correlated forest fires.

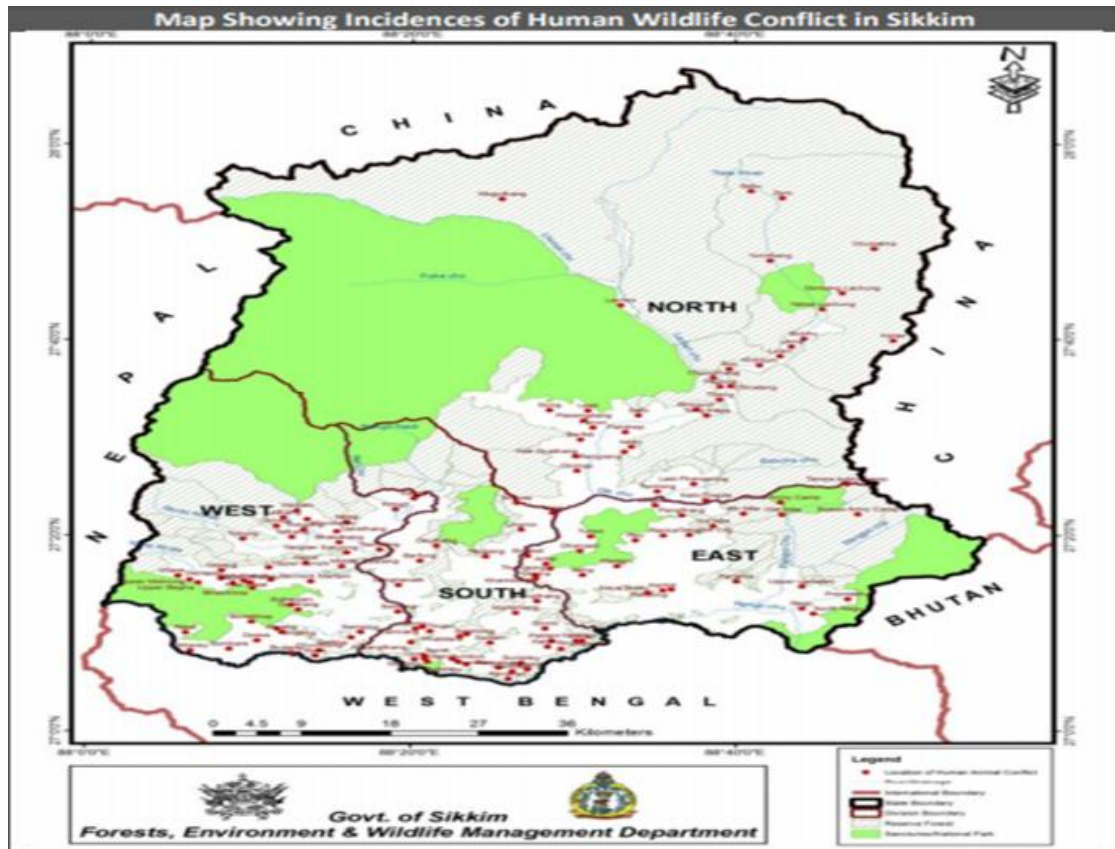
Table 3.18: Human Wildlife Conflict in Sikkim: Threats, Drivers and Impact

Type of threat	Drivers	Impact on environment and biodiversity, and economic losses
<ul style="list-style-type: none"> • High altitudes: conflicts due to yak, cows, wild dogs and Himalayan black bear, cattle lifting by snow leopard • Middle belts: Conflicts due to Himalayan Black Bear, wild pigs and macaques. • Lower belts: Wild pigs, peacocks, Feral dogs¹⁶ • Seasonality: Himalayan Black Bear attacks on crops/human are highest before winter and then spring season. Wild pig, peacock and monkey attacks are throughout the year. (Bhutia, 2017). • Most crop raids near Pangolakha Wildlife Sanctuary and Kitam Bird Sanctuary are caused by wild boar, Himalayan palm civet, monkey and porcupine. Their survey revealed that around 20 to 50% of the crop yield is lost due to damage by wildlife. USAID (2017) • A pilot study in Kitam (South Sikkim) has recorded that conflict affects all 290 households in Kitam-Manpur village council area. Farmers have claimed to have crop losses exceeding INR 10,000 per year. (Jamwal 2018) 	<ul style="list-style-type: none"> • The key drivers of HWC are overlap of resources amongst humans and wildlife and increase in wildlife population and increasing resource requirement, along with rising urbanization (Bhutia, 2017) • Ban on grazing is also a contributor as grazing created a symbiotic relationship between forests and cattle. Cowsheds on hilltops helped to keep forest land healthy as urine and cow dung flowed to forestland. Healthy forest land ensured availability of food for wildlife. (Jamwal, 2018) • Climate induced changes have impacted the habitat and food availability for wild animals. Climate Change has also led to a dramatic increase in direct encounter incidents. (Sikkim State of Environment Report, 2016) • The yak and urang pastoral systems have substantially affected the oak and fir forests in KNP; Red Panda has been severely affected due to disturbance from yak crossbreeds, herders, and the herders' dogs. This disturbs the ecological balance of the area leading to HWC. (Tambe and Rawat 2008) 	<ul style="list-style-type: none"> • In Talkhadka and lower Kitam area, the severity of the problem is such that farmers have abandoned agriculture practices due to continuous crop raids. (Ghose, 2017) This is causing severe loss of local vegetables due to abandonment of agriculture¹⁷ <p>Some estimates of economic losses due to HWC in Sikkim-</p> <ul style="list-style-type: none"> • Rai et al (2012) reported that almost 1890 kg potatoes were destroyed in 2010-11 on average per household by Wild Boar in the fringe villages of Barsey Rhododendron Sanctuary in Sikkim. • Villages around Barsey Rhododendron Sanctuary in West Sikkim lost up to 65% of their crops (maize, potato, beans, green peas, millets etc) due to HWC in 2013, as reported in Rai et al 2014. • Pradhan et al (2012) noted that near Kitam Bird Sanctuary, out of the total cultivated land, an average of 85.92% land was affected by HWC. <p>There is also diminished psychosocial well-being among affected communities, disruption of livelihoods and food insecurity; and when seeking compensation for damages, there are added transaction costs due to bureaucratic inadequacies and delays in receiving compensation. (Barua et al 2012).</p> <p>The transaction costs are more enhanced in Sikkim because the compensation mechanism has been considered inefficient, as well as inadequate. (USAID, 2017) .</p>

¹⁶ Information received through consultation meetings and workshops in Sikkim

¹⁷ Information received through consultation meetings and workshops in Sikkim

Figure 3.5: Incidences of Human-Wildlife Conflict in Sikkim Depicted on a Map: Red dots Indicate Human-Wildlife Conflict Areas (2016)



Source: ENVIS Sikkim Quarterly Newsletter 2016-17, Vol 9, Issue 3.

3. *Invasive Alien Species (IAS)*

Invasive Alien Species are considered among the major threats to global biodiversity as they affect the life cycle of native species and alter the habitat conditions negatively, affecting regeneration of many species. Following are the key concerns related to IAS in Sikkim.

- Detailed studies on the impacts of IAS are negligible in Sikkim, however it has been recognized that species like *Lantana camara*, *Rumex nepalensis*, *Eupatorium odoratum*, *Mikania sp.*, *Polygonum spp* and aquatic weeds have caused problem at many places inhibiting the regeneration and growth of indigenous species or choking water bodies. (Sikkim SBSAP, 2011)
- Whether IAS has been introduced intentionally for a particular purpose, or it has come in the state through trade has no clear answers. For instance, Arden plants were introduced in Sikkim for beautification purposes, now these alien species have disturbed the original vegetation. Exotic weeds like *Eupatorium* are reported to be seriously competing with *Artemisia* and spreading into the forest as well as urban areas. In fact, *Eupatorium* is locally called 'Banmara' or 'forest killer' in Nepali. Other exotic weeds now well established include *Ageratum houstonianum*, *Bidens biternata*, *Erigeron karvinskianus*, *Galinsoga parviflora*, *Erichthites valerianifolia* and *Calceolaria mexicana*. Some animal pests have also begun to manifest their influence in Sikkim.

An exotic snail for example, which may have come in along with the subsidized food grains is a major pest of food crops in many parts of the state

- There are various negative impacts due to IAS, which can be classified into Environmental, Economic, and Social impacts. These have been illustrated in the following Figure 3.6.

Figure 3.6: Negative Impacts of IAS

Environmental Impacts	Economic Impacts	Social Impacts
<ul style="list-style-type: none"> • Reduced biodiversity due to increased competition among species. • Decreased availability and quality of key natural resources • Water shortages • Pollution caused by overuse of chemicals to control infestations 	<ul style="list-style-type: none"> • Value and quality of land has degraded • Lower crop productivity • High cost of controlling pests, weeds, diseases etc • Livestock forced into Sub-optimal grazing lands due to competition 	<ul style="list-style-type: none"> • Food security impacts • Recreational and social opportunities limited • Risks to human and animal health • Increased social challenges

Source: Compiled from Centre for Agriculture and Bioscience International.¹⁸

4. *Climate Change*

In Sikkim, there has been a change in the weather parameters such as number of rainy days, rainfall, temperature, relative humidity; and these have impacted the ecology (Rahman et al 2012). The Climate Change Cell, Sikkim has identified the key areas for concern due to climate change; these are Water, Agriculture, Horticulture, Livestock, Forests, Wildlife, Tourism, Energy efficiency and Urban and Rural Habitats. These sectors are highly vulnerable to Climate Change. (Sikkim State Action Plan on Climate Change (SAPCC), 2014).

Climate change and forest fires have a vicious circle that is difficult to disrupt. Fires release carbon trapped in vegetation and soils, and as their severity increases, they begin to damage deeper layers of soil, releasing centuries-old ‘legacy carbon’. Moreover, when forests regrow after burning, they are smaller, younger and drier than before, and, in some ecosystems, their carbon storage capacity is reduced. This results in a net increase in carbon emissions, thereby worsening climate change. Climate change causes forest fires, which further worsens climate change (WWF, 2020).

¹⁸ <https://www.invasive-species.org/>

Table 3.19: Climate Change: Threats, Drivers and Impact

Type of threat	Drivers	Impact on ecology and environment
<ul style="list-style-type: none"> • Many birds, mammals, plants and insects are showing changes in their geographic distribution and have started moving North (onto higher ground), in response to these changes. Species like Snow Leopard are threatened as their southern limits gets pushed northward due to limited space availability and changing temperatures. • Moreover, there are changes in the composition of species found in some particular habitats. The conservation implication is that there is a mismatch in space (geographical shift) or time (phenology shift). • Maximum species of endemic and threatened birds are found in broad leaved tropical forests between 900-1800m above sea level and in temperate broad-leaved forests (1800m-2800m). Reduction in their habitats is being observed now, which is a combination of direct anthropogenic interference as well as the changing climate (Acharya et al 2010). 	<p>The East District is the most vulnerable to Climate Change, followed by the North and West Districts which are moderately vulnerable and followed by the Southern district which is least vulnerable. This has been analyzed in IHCAP (2018) where a Climate Vulnerability Assessment of 12 Indian States has shown that the following are the drivers of CC in Sikkim: low area under forests per 1,000 households, low percentage area covered by insurance and low percentage of farmers taking loans, as compared to the other 12 states. Since 88.9% of the population in Sikkim is residing in the rural areas, they are dependent on agriculture, horticulture, livestock and forest produce. This creates excessive pressure on these sectors which are already vulnerable due to climate change, thereby projecting further changes in climate in the future. (SAPCC 2014)</p>	<p>It is leading to an increase in HWC, because of its adverse effect on the production of biomass and fruits. (Bhattacharya et al 2012)</p> <p>Climate change is negatively affecting agro-biodiversity because of increased storms, droughts, disturbed hydrological cycle, increased pests and rainfall variation. Another negative effect of climate change is altered hydrological cycles, affecting habitat and resource availability. Aquatic habitats at risk due to long flow periods in rain fed stream, snow melting and summer floods.</p> <p>Climate change also impacts the fodder availability for livestock-both the quantity and quality</p> <p>Climate Change is contributing to increase in frequency of forest fires as the dry months have become drier and more susceptible to fires.</p> <p>Increased frequency and magnitude of forest disturbances creates openings vulnerable to colonization by invasive plants. (SAPCC 2014)</p>

5. *Loss of agro-biodiversity*

The erosion in agro-biodiversity in Sikkim is due to a number of factors such as degradation of natural forests, which sustained traditional agriculture, introduction of modern and uniform plant varieties in place of mixed farming system with traditional varieties, destruction of habitat and developmental activities, changing food habit and attitudes of the consumers from coarse grains and fine grains, the latter being considered more ease to produce and consume, large-scale migration for employment, causing some hills or fields to be abandoned or neglected, the inevitable supply of high yielding varieties seeds and other inputs at subsidized cost by the government, attraction to maximize profits through cash crop monocultures such as maize, paddy, and above all the lack of incentives for marketing of traditional crops. They key threats to Sikkim’s agro-biodiversity have been presented below (Table 3.20).

Table 3.20: Loss of Agro-biodiversity: Threats, Drivers and Impact

Type of threat	Drivers	Impact on ecology and environment
<p>Availability of local and cheaper alternatives to smallholder agriculture raises the opportunity costs of continued farm work, leading to a shift towards mixed livelihoods¹⁹. There is a lack of understanding among farmers about the significance of agro-biodiversity and its linkage to secure livelihood.</p>	<p>Two factors seem to be increasing the risk in agriculture livelihood- Human Wildlife Conflict (HWC) and Climate Change. Agriculture is seeing a reduction as other livelihood options are emerging (such as tourism), accompanied by fast-moving, multidimensional socio-economic changes (such as youth not willing to work on farms).</p>	<p>This is leading to irreversible loss in traditional varieties, as many crop varieties have become completely obsolete.</p>
<p>Soil Erosion and topsoil runoff Four erosion classes have been identified in Sikkim – slight erosion (1.1% of TGA²⁰), moderate erosion (17.4%), severe erosion (14.6%) and very severe erosion (6.1%) (Chapter 4, Sikkim State of Environment Report, 2007)²¹ Kusre et al (2018) measured erosion in East Sikkim using erodibility indices, such as clay ratio, dispersion ratio, modified clay ratio and critical level of organic matter; concluding that the district has high vulnerability to soil erosion.</p>	<p>The State is highly susceptible to acute soil erosion problems due to its undulating topography and high intensity of rainfall, which on an average is 2500mm per year. The various detrimental factors that put pressures on Sikkim’s land are agriculture, susceptibility to disasters, and urbanization and thus sustainable land management practices need to be adopted in order to protect environment of Sikkim. (Sikkim State of Environment Report, 2016)</p>	<p>Longer ecosystem recovery time, Increased risk of flooding, Increased risk of desertification, Negative impacts on aquatic ecosystems and species. Loss of topsoil and soil fertility, reduced native plant species When the soil has been very disturbed, weedy plant species often come in to colonize the disturbed soil, affecting local species (Greentumble, 2016)</p>
<p>Reduction in yields and farmers’ income Since the inception of organic farming, Sikkim has accelerated the process of certification, marketing and subsequent sustenance of organic enterprises. Despite this, farmers’ income has fallen due to reduced yields and certain shortfalls in execution. For instance, farmers claim that ginger used to sell for 1,500 per maund, now fetches less than 1,200 per maund. Moreover, data has shown that while the per hectare productivity of Sikkim mandarin has declined, there</p>	<p>The sales are lower and not fetching premium prices because of the following-</p> <ul style="list-style-type: none"> • Lack of awareness among consumers about organic produce. Consumers do not prefer organic produce because it appears to be smaller, or duller as compared to the other produce. There is lack of awareness about benefits of organic produce. (Doshi, 2017) • There has been a slight neglect in marketing the produce and thus farmers are unable to charge 	<p>Lower yields and agriculture incomes are leading to a shift to mixed livelihood and loss of local species.</p>

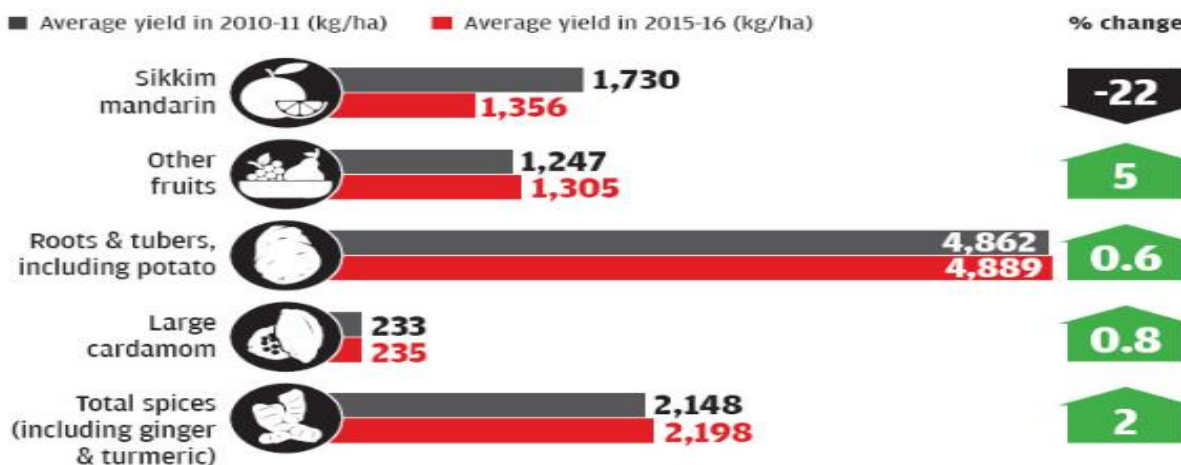
¹⁹ Seidler et al (2019)

²⁰ TGA- Total Geographic Area

²¹ <http://www.sikkimforest.gov.in/soer/Soils%20of%20Sikkim.pdf>

Type of threat	Drivers	Impact on ecology and environment
has been no substantial increase in other crops like cardamom, tubers, spices etc. (Figure 3.7) (Taneja 2017)	premium prices for the organic produce. (Taneja, 2017).	
<ul style="list-style-type: none"> Increased homogenization of agriculture <p>Conservation is focused on the commercially important species; many local/ traditional species are getting endangered because they do not give high economic returns. Due to exclusive focus on food security, crops like wheat, rice and pulses have been encouraged in Sikkim, thereby neglecting the traditional and local varieties</p>	<p>Most departmental interventions have focused on hybrid seeds, popularization of HYV, farm mechanization and exotic varieties due to higher productivity and margins. While it does address food security, it has led to an indiscriminate shift from traditional varieties, leading to the disappearance of local varieties.</p> <p>(Sikkim Agriculture Department Annual Report, 2014)</p>	<p>Increased homogenization in Agriculture is leading to a fall in the traditional varieties. As reported in Rahman and Karuppaiyan (2011), 45-55% area under traditional rice varieties has been replaced by other exotic and hybrid varieties.</p> <p>Availability of cheaper alternatives for food. Traditional crops like 'Phapar' (buckwheat) are not being grown due to availability of cheap alternatives like Maida and Atta from other states like West Bengal. (ICIMOD, 2016)</p>

Figure 3.7: Average Yields of various Crops in Sikkim: Comparison between 2010-11 and 2015-16



Source: Down to Earth (Taneja, 2017)

6. Poaching of wild animals and Illegal removal of NTFPs

Illegal wildlife trade and trafficking have been causing havoc globally and India has been deeply impacted by this new shift of paradigm because of the trafficking operations in China and South East

Asia. There are several trade routes operating in India that facilitate the successful trafficking; reported to be operating across Uttarakhand, Himachal Pradesh, Sikkim and into Tibet, and then China. (Basu, 2018). Despite a ban on wildlife trade and NTFP collection, illegal collection and poaching is a serious threat to the biodiversity of Sikkim.

Table 3.21: Poaching of Wild Animals and Illegal collections of NTFPs: Threats, Drivers and Impact

Type of Threat	Drivers	Impact on ecology and environment
<p>Sikkim, sharing its border with three countries, has become the growing hub of illegal wildlife trade, and it might become the next hub of international illegal wildlife because Nathu La trade route is the shortest route to Tibet, and then China. (Indian Environment Portal, 2008).</p> <p>These poachers usually have international connections and work in powerful gangs. Two poachers were caught with a clouded leopard skin that they purchased for INR 7.5 Lakhs from West Bengal, which was brought there by Bhutanese poacher. The leopard was originally killed in Sikkim and was being sent to Nepal. (Uniindia, 2018)</p>	<p>The following are the major drivers of illegal wildlife trade and poaching</p> <ul style="list-style-type: none"> • Fast and quick cash- Illegally traded items fetch huge prices across borders encouraging poachers to look out for more money. • Diverse demand and usage- Right from being used in medicines to making a carpet and rug, the usage of the wildlife trade is so diverse that sometime it's hard to tackle it on such a big scale. (Ashwini, 2018). • Lack of proper implementation of guidelines related to illegal activities is also a driver (Pradhan, n.d.). 	<ul style="list-style-type: none"> • Poaching leads to 'defaunation' of an area which flows from the immediate impact of killing an existing animal, the medium term effect of reducing breeding numbers and hence the rate of reproduction, and the long term effects of thinning the gene pool and the symbiotic- and often irreversible – impact this has on overall biodiversity. (Noel, 2013) • Poaching also has several social and economic impacts. For instance, it affects tourism negatively if the key species are less in number. Also, these activities usually are carried out by powerful gangs who threaten/ exploit locals. (Estrada, 2019).
<p>Illegal collection of NTFPs</p> <p>There is ample anecdotal evidence of illegal collection of NTFPs from Sikkim's forest areas.²²</p> <ul style="list-style-type: none"> • Illegal extraction of herbs, incense and other medicinal plants from the KNP • Unsustainable and destructive collection of medicinal plants by grazers, BRO laborers, and others for commercial purposes has been reported in the Sub-Tropical Eco-region. 	<p>The locals are attracted to lose and quick cash in exchange of NTFPs. This has encouraged illegal activities.²⁴</p> <p>Most NTFPs are perishable and have short shelf-lives, and therefore selling those through formal mechanisms require storage facilities and training. The absence of these lead to inclination towards illegal channels.</p> <p>Legalization has not been a plausible solution yet because</p>	<p>There is unsustainable harvest of NTFPs in Sikkim. However, since there has been no proper study regarding it, the exact loss and baseline figures of which species are most threatened and vulnerable due to this threat is not available presently.</p>

²² Through consultations and meetings in Sikkim.

²⁴ Through consultations and meetings in Sikkim.

Type of Threat	Drivers	Impact on ecology and environment
(Plan for Conservation and Sustainable Utilization of Medicinal Plants, Sikkim, 2003) ²³	there is no stable market for NTFPs. Since the cultivation happens informally, scaling up has not been successful.	

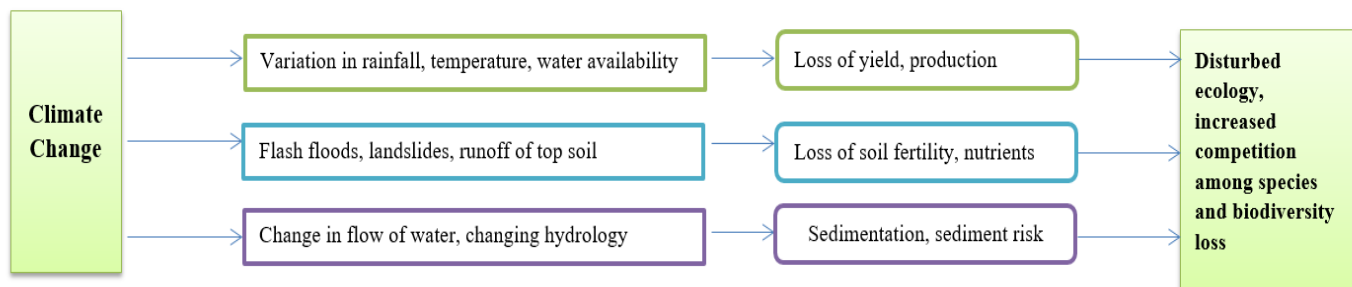
3.2.3 Indirect Threats

As conceptualized in the Millennium Ecosystem Report (2005), there are many indirect drivers that threaten the biodiversity of an area. The key indirect threats to biodiversity in Sikkim have been presented below.

1. Climate change

Climate change directly affects species by altering their physical environment (as mentioned earlier) and indirectly affects species by altering interspecific interactions such as predation and competition. The main concerns in Sikkim are illustrated below in Figure 3.8.²⁵

Figure 3.8: Indirect Effects of Climate Change on Biodiversity



Source: Compiled by Authors based on Sikkim Climate Change Action Plan 2015.

2. Unplanned and mass tourism

Rise in popularity of high-altitude mountain tourism has increased the influx of tourists in Sikkim and there has been an unprecedented growth of tourism in Sikkim. The number of tourists increased from 15,000 in 1985 to 14, 25,965 in 2017.²⁶ Given this trend, Sikkim is likely to achieve its target of having

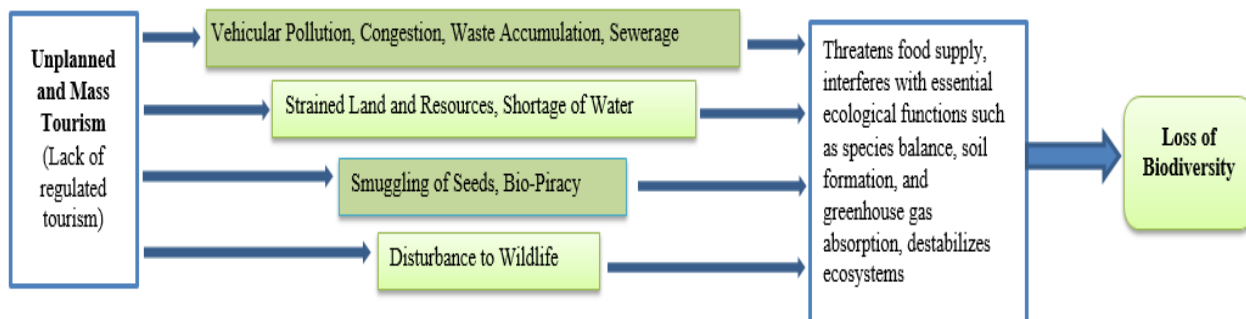
²³<http://www.sikkimforest.gov.in/docs/Plan%20for%20Medicinal%20Plants%20Conservation%20and%20Sustainable%20Utilization/FRLHT%20Final%20Report%202.5.pdf>

²⁵ Climate Change Action Plan Sikkim- 2015

²⁶ State Tourism Policy 2018- Government of Sikkim

20 lakh tourists visit Sikkim by 2020. As a consequence, mountain tourism has become an important source of income and means of economic development. However, this tourism influx is a threat to environmental conservation, due to fragility of its ecosystems as well as lack of adequate infrastructures. Moreover, dominance of conventional leisure- based tourism products over eco-tourism is a challenge for Sikkim that needs to be addressed. Key concerns for Sikkim have been illustrated below in Figure 3.9.

Figure 3.9: Indirect Effects of Mass Tourism on Biodiversity



Source: Generated by Authors using inputs from Mandal and Sengupta (2015), UNEP, UNWTO (2005), Sunlu (2003) and Sikkim State Tourism Policy 2018

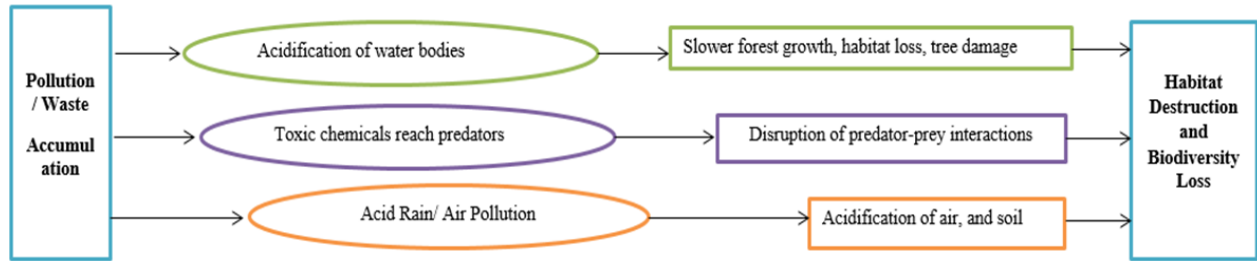
3. Pollution & waste management

Recent infrastructure development, urbanization, rapid tourism influx and other constructions have been causing waste management problems as well as air & water pollution. With an increase in these factors, along with urbanization, higher income, population and increasing vehicles in the state; pollution & waste management have become looming threats to Sikkim’s environment and biodiversity.²⁷ Sikkim generates less than 90 metric tonnes of waste per day; and half of it comes from Gangtok Municipal Corporation. To tackle the issue of waste management, Sikkim has introduced Sikkim State Policy and Strategy on Solid Waste Management, 2019 which has provisions for elevating the role of Bazar Inspectors to that of a Local Environment Manager. The manager shall not only be responsible for monitoring the health and sanitation of the bazaar (market) areas but also for general upkeep and safety of the natural environment of the Local Authority. The Local Environment Manager shall be empowered to integrate, monitor and regulate activities that would detriment the natural environment of the Local Authority.

Solid waste management is an increasing concern in the state, especially due to tourism. The most visible impact of tourism has been the accumulation of waste, especially in the high-altitude villages which have no means for proper disposal of the non-biodegradable waste. The effects of pollution and waste accumulation on biodiversity have been illustrated below (Figure 3.10).

²⁷[State of Environment Report, Sikkim, 2016.](http://sikenvis.nic.in/WriteReadData/Publication/State%20of%20Environment%20Report%20Sikkim%202016.pdf)
<http://sikenvis.nic.in/WriteReadData/Publication/State%20of%20Environment%20Report%20Sikkim%202016.pdf>

Figure 3.10: Indirect Effects of Pollution and Waste Accumulation on Biodiversity Loss



Source: Compiled by Authors using various sources.

4. Loss of traditional knowledge

Lack of systematic documentation of traditional knowledge in written form, reliance on oral traditions along with modernization and migration is leading to irrevocable loss of rich traditional knowledge in Sikkim. Traditional Knowledge is important as the Indian Systems of Medicines (Ayurveda, Siddha, Unani) depend on it for developing medicine and farmers and livestock keepers depend on it for food security and livelihood, and healthcare. Traditional Knowledge converts biodiversity into bio-resources and therefore loss of traditional knowledge is a threat to these bio resources. (Kannaiyan, 2007).

5. Degraded Land

In Sikkim, land degradation is a major environmental concern, Total degraded land of Sikkim constitutes 17.32 percent of the total geographical area (State of Environment Report, Sikkim 2016). While South Sikkim suffers from severe water erosion, East and West districts are affected both by water erosion and rocky waste. North District witnesses the maximum land degradation due to rocky wastes and glacial erosion since a significant portion of the land is under perpetual snow cover. There has been a significant increase in wastelands in the category of snow covered/glacial areas and land with open scrubs. With over a total of 23 wasteland classes, Sikkim has shown a decline of almost seven percent in wasteland area from 2005 to 2009 (Table 3.22).

The lack of mainstreaming of biodiversity conservation into the various developmental plans, which sometimes results in unplanned and detrimental anthropogenic activities, poses an additional indirect threat. For example, there is hardly any explicit concern for biodiversity in the usual district developmental plans, which also stems from the poor inter-agency sharing and coordination.

Table 3.22: Category-wise Distribution and Change in Wastelands (Area in Sq. Km)

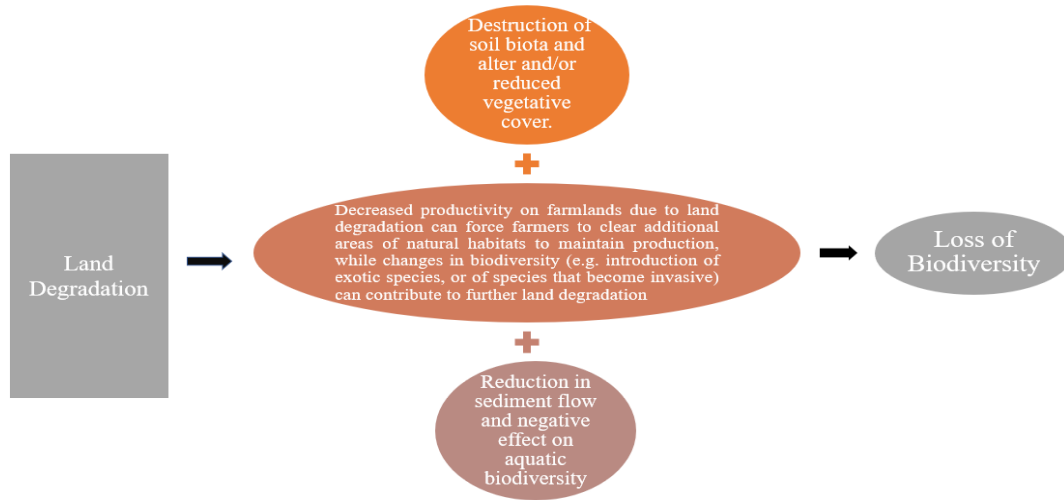
District and Year	Land with Open Scrub			Underutilized/Degraded forests (Scrub domain)			Barren Rocky/ Stony Waste			Snow Covered/Glacial Area		
	2005-06	2008-09	Change	2005-06	2008-09	Change	2005-06	2008-09	Change	2005-06	2008-09	Change
East	1.03	10.57	9.54	4.51	4.21	-0.30	111.67	104.15	-7.52	5.12	2.52	-2.60
North	2.54	7.43	4.89	24.45	24.93	0.48	351.15	145.17	-205.98	2474.07	2662.62	188.55
South	2.26	1.68	-0.58	15.05	14.95	-0.11	5.09	3.66	-1.43	29.19	29.54	0.35
West	0.53	0.55	0.02	16.94	17.10	0.16	111.99	109.24	-2.75	125.28	134.83	9.55
Total	6.37	20.23	13.87	60.96	61.18	0.23	579.90	362.22	-217.67	2633.66	2829.51	195.85

Source- State of Environment Report Sikkim 2016

In all, 46.12 percent of the total land area falls under the wasteland category. North Sikkim District recorded a maximum change of 188.55 sq. km. of its area under snow covered/glacial wastelands; while East Sikkim District recorded a negative change of -2.60 sq. km. Land with open scrub area is the minor wasteland category, accounting for an area of 20.23 sq. km. (2008-09). East Sikkim District recorded a maximum change of 9.54 sq. km. under the land with open scrub, while South Sikkim District recorded a negative change of 0.58 sq. km. in same category.

Anderson et. al. (2005) have illustrated how human activities involving land-use and land cover change along with land and water degradation causes loss of biodiversity. For instance, the effect of climate change on intensity and frequency of fires affecting land cover and thus land degradation, which can indirectly affect water bodies due to sediment flow. These linkages often manifest at one or more temporal and spatial scales with time lags, cumulative effects across a region, and thresholds adding to their complexity. The following Figure 3.11 illustrates how land degradation affects biodiversity.

Figure 3.8: Relationship between Land Degradation and Biodiversity



Source: Authors' Construct.

3.3 Gaps in Conservation and Management of Biodiversity

This section highlights the potential gaps in management and conservation of species and their habitats that need to be aligned with the current vision of the SBSAP, in accordance with National Biodiversity Targets as well as international conventions. The gaps in financial resources and policies that affect the biodiversity conservation have also been assessed. A rapid assessment of both the previous SBSAPs has been undertaken to understand the gaps comprehensively. This has been presented in Annexure 4. The key gaps in conservation and management of biodiversity have been highlighted below (Table 3.23). Further, mitigations for these gaps have been outlined in the subsequent chapter (Chapter 4).

Table 3.23: Key Gaps in Conservation and Management of Biodiversity

Theme	Gaps in previous SBSAPs and conservation and management of biodiversity
Coverage of previous SBSAPs	<p>The following gaps are identified</p> <ul style="list-style-type: none"> • Need for restoration of degraded land • Implementation of ABS mechanism • Focus on microbial biodiversity • Financial needs assessment for implementation of SBSAP • Assessment of how much is being spent on biodiversity conservation (BER) • Identification of innovative instruments to encourage conservation • Restrategising PA Management
Mainstreaming	<ul style="list-style-type: none"> • Lack of mapping of schemes that can be linked to the various action points in the SBSAP
Dedicated agency for coordination of Implementation of SBSAP	<p>Implementation of previous SBSAPs is fragmented as there is no single agency identified for coordinating the implementation of SBSAP and no systematic institutional mechanism for tracking the progress on action points and targets outlined. No clear finance plan for implementation of BSAP.</p>
Synergy and Coordination, Integrated Planning	<p>Multiple agencies are involved with overlapping functions with poor coordination:</p> <ul style="list-style-type: none"> • Eco-tourism projects are being conducted by both; the Eco-Tourism Directorate of the Forest and Environment Department and the Tourism Department with overlapping mandates. • Lack of convergence of BSAP with SAPCC • Biodiversity is multidisciplinary with agro-biodiversity, animal husbandry and horticulture etc. being key departments; but there is no formal mechanism for coordination and cooperation. • Lack of synergy between researchers and department.
Priority Issues for Sikkim	<p>Prioritization of actions on critical threats is lacking</p> <ul style="list-style-type: none"> • Human Wildlife Conflict • Forest Fires • Mass Tourism • Ex-Situ Conservation and Biotechnological tools lack focus. Gene banks and seed banks are largely missing • Fodder shortage in winter months
Capacity Building/ Strengthening of Institutions	<ul style="list-style-type: none"> • BMCs lack capacity both in terms of financial resources and manpower to expedite the preparation of PBRs and implementation of ABS. • Scope to strengthen the DFE for controlling wildlife crime
Information Gaps and Research needs	<ul style="list-style-type: none"> • Expedite ABS and PES mechanisms, and Economic Valuation of ecosystem services • Lack of monitoring, tracking and reporting mechanism for forest and genetic resources

Chapter 4: Biodiversity Strategy and Action Plan

4.1 Theme-Wise Recommendations and Action Plan

This chapter presents the strategy and action plans along with indicators, time frame and relevant institutions for conservation of biodiversity in the state of Sikkim (Table 4.2). Recommendations on key issues pertaining to the Kanchendzonga Upper Teesta Valley areas which constitute the landscape identified under the GOI-GEF-UNDP SECURE Himalaya project are presented in Table 4.1. The recommendations are grouped into the following categories.

1. Biodiversity Database
2. In-situ Conservation
3. Ex-situ Conservation
4. Agro-biodiversity
5. Animal Husbandry and Livestock
6. Impact of Climate Change
7. Tourism
8. Management of Invasive Species
9. Sustainable Utilization of Biodiversity Resources and Livelihood
10. Promotion of Awareness on Biodiversity Conservation
11. Policy, Legislation and Administrative Measures
12. Regional, National and International Coordination

Table 4.1: Specific Issues, Strategies and Recommendations for Kanchendzonga Landscape and Upper Teesta Valley in Sikkim

S.no.	Theme	Major Issues	Recommendations
1	Agriculture and Horticulture: Decline in quality and yield of crops such as oranges, large cardamom, beans, potatoes and complete loss of production of native apples	<ul style="list-style-type: none"> • <u>Policy Issues</u> Focus of schemes (of both the Centre and the State) is on promoting hybrid varieties, resulting in de-incentivizing the cultivation of native species. • <u>Declining yield</u> It is reported, that it is impossible to do vermi-compost due to cold weather in high-altitude areas. Since the packaged manure provided to farmers is not sufficient, farmers are forced to use yak dung and dried grass as manure, which is not as effective, and leads to decline in yields. <ul style="list-style-type: none"> i. Viral diseases, such as chirke (mosaic streak) and foorkey (bushy dwarf), are major threats to large cardamom ii. In case of Sikkim mandarin, decline in yield is prevalent due to virus and pathogens and nutritional stress. iii. Farmers who grew rice, maize, ginger, cardamom, pulses, and vegetables have reported decline in yield since they stopped using 	<ul style="list-style-type: none"> • <u>Policy Recommendations</u> GOI schemes should be tweaked for the Himalayan States to focus on support for native species of agriculture and horticulture crops. A plan to restore Lachen apples should be made. Restoration should be carried out with appropriate apple varieties in a scientific manner.²⁸ Department of agriculture and horticulture and SBB should play a role in this. Supporting the local communities of Hee-Gyanthang, Dzongu, for developing a community seed bank to store native species is essential. • <u>Technical and other support</u> <ol style="list-style-type: none"> Strengthening of extension services is necessary. Special focus on high-altitude areas is required to provide sufficient quantity of packaged organic manure which is in short supply To minimise the pathological causes of yield decline, it is imperative that bio-pesticides and herbicides be complemented with other preventive measures. However, additional research is required before it is widely adopted in the state. Adequate irrigation facilities should also be developed in the landscape. The following strategies may be considered. <ol style="list-style-type: none"> Promotion of rain water harvesting Promotion of solar energy and pumps Promotion of traditional irrigation systems • Government should provide support for promoting Climate Resilient Practices (CRA) that take a holistic approach into consideration. CRA includes smart practices, which are low cost, affordable and context specific. There are six major elements of CRA to improve farming: <ol style="list-style-type: none"> Weather-smart practices include alteration of planting time and the planting of recommended local varieties that are resilient to extreme weather conditions, assessment of rainfall requirements, snowfall and frostbite Soil/nutrient-smart practices include production and application of manures, compost production, green manure, inter-crops, weeding to maintain soil health/organic matter. Knowledge-smart practices, focus on strengthening linkages and making information available to value chain actors. Water-smart practices focusing on effective and efficient use of water at different stages of the value-chain Energy smart practices; focused particularly on harvesting/post-harvest management. Gender smart practices; focus on inclusive growth

²⁸ This plan can be made along the lines of Bhutan, which successfully restored cultivation of local varieties in a scientific and planned way.

S.no.	Theme	Major Issues	Recommendations
		chemicals. This has been attributed to issues like poor management, unavailability of good quality planting material and lack of irrigation facilities	
2	Need to review Grazing Ban	<p>In 2000, Sikkim banned its traditional pastoral practice in parts of the state due to ‘serious degradation’ of forests. This inevitably led to a loss of livelihoods and economic inequality between different groups. Further, recent studies show that there is a crucial role of traditional knowledge and experience of herders in the management of high alpine regions.</p> <p>A lot of debate currently exists about whether the ban has had positive outcomes or not.</p> <ul style="list-style-type: none"> • Since the grazing ban has been implemented, the sighting of wild animals in the national park has increased substantially. Illegal extraction of NTFPs has also reduced • However, grazing ban has impacted the local population as there is no specific place for grazing, causing hardships to community. 	<p>Based on this realization, in 2006, the Forest and Environment Department initiated the Himal Rakshak (HR) program, under which 21 individuals were recognized as “the honorary guardians of mountains” and were given stewardship of the alpine area. However, this may not be enough. Herders' conservation interventions based on traditional knowledge and experience should be given due attention and a more nuanced grazing policy should be put in place instead of a complete ban. Herders and HRs should complement each other and not confront. It is reported that HRs are often seen as those working against the interest of the community and traditional conservation practices as a result of which sometimes, they face social exclusion by communities</p> <p>Having a nuanced grazing policy should also include assignement of specific zones for grazing.</p>

S.no.	Theme	Major Issues	Recommendations
		<ul style="list-style-type: none"> Moreover, animals are left in the forest during off-season due to inadequate supply of fodder, causing pressure on the forests. 	
3	Livestock	<ul style="list-style-type: none"> Fodder shortage is a serious issue during the months of winter which adversely affects livestock and thus livelihood. It has reported to have caused death of 300 Himalayan Yaks in 2019 in Muguthang Valley as it is the most vulnerable region in the area for fodder crisis. The Department of AH&VS has estimated that for winters of 2019, there is a need for 84 MT of fodder for 933 Yaks in Muguthang for 60 days. To meet the demand of fodder in Muguthang and Gurudongmar, the Department needed to make provision to supply complete feed block and chelated mineral mixture fodder enough to last for 3 months (approximately 1,80,000 kg).²⁹ Other issues include ensuring quality treatment for livestock disease, enhancing the value chain and supply 	<ul style="list-style-type: none"> Revive degraded pasture lands on regular basis with native species (native trees, grass, legumes) used as fodder Prepare plans to grow species of grass, fodder trees and legumes which are high in protein & can be planted in high altitude regions of the state to feed livestock. Develop a Fodder Bank Model with technical help from local institutions to enhance quantity and quality of fodder. Community Fodder Bank, recommended as a Finance Solution should be implemented in Lachen\Lachung (See Chapter 8). Studies in other areas should be conducted to address the quantity and quality issues in fodder. Research on diseases among livestock should be strengthened. Conduct studies to identify diseases, causing agents as well as etiological agents of diseases including the impact of these diseases. There should also be Appropriate management and veterinary practices to reduce incidence of such diseases Document traditional knowledge in PBRs related to ethno veterinary plants to cure animal diseases

²⁹ W.P. (PIL) No. 08 of 2019 in RE: 300 Yaks Starve to Death in North Sikkim v. State of Sikkim

S.no.	Theme	Major Issues	Recommendations
		chain for livestock products, and their marketing.	
4	<p>Human-Wildlife Conflict Prevalent in cultivation of big cardamom, oranges and red chillies; caused by the Himalayan Black Bear, monkeys and wild boars</p> <p>As mentioned in chapter 3, HWC is responsible for severe economic losses in terms of crop damage and livestock deaths, as well as human casualties.</p>	<ul style="list-style-type: none"> Issues in Design and Implementation of Existing Policies Plantation of fruiting trees in forest areas has not been successful in mitigating the problem, probably due to inadequate scale of plantations. <p>It is perceived that amount of compensation does not cover the loss. Besides, there are issues of awareness about guidelines and procedures for filing compensation claims. Verification is a lengthy process (burden of proof lies on farmers who have to travel long distances carrying wildlife carcass to prove conflict took place) thus dis-incentivising filing of claims.</p> <p>Perceptions of impacts of HWC are variable between regions (North and West Sikkim), among villages, and also among households within individual villages. According to surveys conducted by ATREE under SECURE project:</p> <ol style="list-style-type: none"> in mid-elevation villages around the fringe villages of KNP, Bears and wild boar are reported to cause the most problem. 	<p>An Insurance scheme is recommended as a principal solution to HWC, along with supplementary measures like Solar Fencing, adequate plantation of fruiting plants in forest, periodic clearing of bushes in the forest to enable free movement of animals, and greater focus on sterilization of monkeys should be introduced.</p> <p>There is a need to review the present Compensation Policy until an effective insurance scheme is implemented. Delays and issues in providing proof etc. should be addressed by making appropriate changes.</p> <p>An integrated strategy which includes compensation along with direct incentives and support for preventative management measures, and awareness programs should be developed to address HWC.</p> <p>Further strategies and recommendations from the ATREE HWC assignment reports under SECURE Himalaya Project include:</p> <ol style="list-style-type: none"> research (to better understand the population dynamics of the problem species, especially inside protected areas); community-based trials and monitoring of combinations of mitigation strategies (multiple fencing types, fencing plus noise-makers, etc); intensive discussions between communities and Forest Department to reinvigorate efforts to develop an adequate insurance / compensation /ex gratia system that works for everyone.

S.no.	Theme	Major Issues	Recommendations
		<p>2. At the higher elevations in North Sikkim, feral dogs were often mentioned as the biggest HWC problem.</p> <p>3. Snow leopards and Tibetan wolves were mentioned in north Sikkim</p>	
5	Degraded forests	<ul style="list-style-type: none"> Afforestation currently happens reportedly through plantation of species of bamboo, banana and avocado. Experts and communities feel that the species such as silver fir, juniper and rhododendron that are ideal for high altitude areas are not available for plantations. Plant saplings brought from low lying areas do not have good survival rate in the harsh weather conditions of Lachen. 	<ul style="list-style-type: none"> For Afforestation programs a multi-stakeholder committee should examine the selection of species with species like silver fir, juniper, and rhododendron on the list. Similarly, site selection for afforestation should be guided by a multi-stakeholder group. Nursery should be developed in Chungthang which is near Lachen and Lachung. There should be identification of indicator species for monitoring health of forest areas
6	Restoration to realize Carbon Sequestration Potential and improve livelihood and	<p>The North District in Sikkim has the following unaddressed restoration needs³⁰</p> <ul style="list-style-type: none"> Potential for Forest Protection (Protection areas have forest cover with a 	<ul style="list-style-type: none"> <u>Forest Protection</u> These forests need to be protected against risks such as fire, land diversion and fragmentation through appropriate policy measures such as a clear land-use map to prevent fragmentation and impose guidelines for land diversion. <u>Wide-Scale Restoration</u>

³⁰ **Note:** Areas under the following land use categories were excluded from the restoration opportunities assessment: **areas under permanent ice and snow, sand dunes, scrub and wetlands**, water bodies, and swamp forests; Grasslands; National parks, sanctuaries, state reserves, and wildlife reserves; Areas under surface and groundwater irrigation; Urban and built-up areas; Croplands with more than 40 per cent tree canopy cover. For more details, please see the technical note available @ www.india.restorationatlas.org/methodology. The carbon sequestration potential is only for above-ground biomass. The carbon sequestration potential for mosaic restoration areas assumes a maximum tree cover of 20% in croplands. For more details, please see the technical note available @ www.india.restorationatlas.org/methodology.

S.no.	Theme	Major Issues	Recommendations
	ecosystem services	<p>density of more than 40 per cent.: 61302.60 hectares</p> <ul style="list-style-type: none"> • Potential for Wide Scale Restoration (Areas suitable for wide-scale restoration is those where near contiguous tracts of forest and tree cover can be established. The existing tree density in these areas is less than 40 % and the population density is less than 200 persons/ sq. km) has the highest potential in North Sikkim with a potential of 34,885.08 hectares. • Total potential for above-ground Carbon Sequestration in North Sikkim is 3.11 million tons of carbon. This untapped potential must be utilized (Restoration Opportunities Atlas, WRI, 2018). 	<p>Restoration must take place through afforestation, reforestation and ecological restoration. However, it must aim to improve both ecological integrity and local livelihoods. The following is important in this context.</p> <ul style="list-style-type: none"> • Engagement of local stakeholders in decision making as well as implementation. • Landscapes are restored and managed to provide for an agreed, balanced combination of ecosystem services and goods, and not just increased forest cover. • Continuous monitoring, learning, and adaptation are central to restoring a landscape.
7	Tourism	<ul style="list-style-type: none"> • Unregulated tourism creates pressure on the environment and resources, this issue is particularly serious in Lachen and Lachung valleys as these are popular tourist destinations. • Data on carrying capacity is poor and is not available in public domain to make an assessment of corrective measures. • There is untapped revenue potential in this sector. A detailed study should be commissioned to make an 	<ul style="list-style-type: none"> • Sensitization of hotel owners, drivers and guides is necessary about the ill-effects of unsustainable practices on fragile biodiversity. • Sustainable and nature-based tourism infrastructure and services should be promoted over traditional infrastructure (See next section). • Data on carrying capacity should guide the future development and regulation of tourism activities. • Additional revenue potential of tourism needs to be assessed and realised through branding of unique environment and biodiversity, including KNP. And developing leisure; wildlife safari; rich spiritual, heritage and wellness; and adventure tourism modules and circuits. Such modules and circuits models are also easy to control and ensure high quality. • In light of COVID-19, the important of ensuring long term income security is evident. Strategies must be developed in consultation with relevant departments to ensure a “high value-low impact” model. For the tourism industry to thrive in the future world, it is important to move towards a sustainable tourism model. • Khangchendzonga National Park (KNP), Sikkim has been inscribed as India’s first “Mixed World Heritage Site” on UNESCO World Heritage List, by fulfilling criteria under both natural and

S.no.	Theme	Major Issues	Recommendations
		<p>assessment of the same and the constraints therein.</p> <ul style="list-style-type: none"> Local jobs in tourism are not commensurate with the natural capital in the state. <p>COVID-19 Impact A rapid COVID-19 impact assessment carried out the by SPMU (SECURE Project) has illustrated that tourism was the hardest hit sector in terms of rural livelihood in Sikkim. Especially for places like Lachen/Lachung in North Sikkim and Dzongri-Goechala trek route in West Sikkim. This was because the lockdown co-incided with the major tourism and trekking season (Feb-May). Almost all respondents reported income loss and lack of relief from Government specifically due to tourism loss.</p>	<p>cultural heritage. The cultural significance of KNP along with its ecological richness must be marketed to attract high-value tourists for its uniqueness.</p> <ul style="list-style-type: none"> Promotion of homestays should be in sync with the original purpose of providing alternative livelihood, and reducing pressure on forests. The principle of “equal benefit sharing” should also be realised in practice.

Table 4.2: Recommendations, Action Points, Intervention Type, Indicators, Agencies, Time Frame

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
1. Biodiversity Database							
1.1 Integration of Data Management							
1.	<p>Integrate data collection, collation and management efforts to enable easy access to data for policy analysis & minimize duplication of efforts.</p> <p>Strengthen biodiversity database portal ENVIS Sikkim by making it more user-friendly and interactive.</p>	<p>Review ENVIS portal to identify additional software and staff needs.</p> <p>Proactively identify the relevant agencies, experts, & institutions working on BD issues and develop arrangements for sharing of reports, information, & data with them on a regular basis.</p>	<p>Data Collection and Research</p> <p>Management and Coordination</p>	<p>ENVIS Sikkim comes up as a comprehensive knowledge base and duplication of data is minimized.</p> <p>ENVIS is developed as an interactive database where arrangement for regular sharing of data with other institutions has been formed.</p>	ENVIS, DFE, SBB, MoEF&CC	S	This will also help in identifying further data needs and in keeping a record of data usage and thus tracking the usefulness of the portal; as well as in keeping a track of new research and researchers.
1.2 PBRs and BMCs and SBB							
2.	<p>Strengthen the financial and human resource capacity of SBB, and district and village level BMCs for effective enforcement of the Biological Diversity Act, 2002.</p> <p>Prepare and finalise PBRs as required in BDA, 2002.</p> <p>Organise necessary training and awareness for BMCs.</p>	<p>Develop a Capacity Development Strategy to drive meaningful change at local levels.</p> <p>Develop a time bound plan and dedicated fund to form and strengthen district and village level BMCs on priority.</p> <p>Form a dedicated 2-3-member group at SBB to coordinate this task with clear responsibility and accountability.</p> <p>Supplement TK in PBRs from other sources</p>	<p>Data Collection and Research</p> <p>Training and Awareness</p> <p>Management and Coordination</p>	<p>District & village level BMCs are formed.</p> <p>PBRs are used as key document in updating the list of endangered flora and fauna based on national, international criteria. PBRs are used in identifying appropriate strategies for conservation and propagation of identified species</p>	DFE, SBB, NBA, BMCs	S	Identification of appropriate in-situ conservation strategies; Ethno-biological knowledge documented by scholars in journals has identified that Sikkim has six ethnic communities and 1,128 species, which engage in bio-cultural relationships. Such studies have potential to be integrated into evidence-based policy.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
		Coherence between Range Officer and BMC members					
3.	Supplement PBRs with periodic scientific surveys to document and monitor key threatened, critical, vulnerable, rare and high market value species of flora and fauna. Train BMCs to consider seasonal variation and species availability along with the collection of specimen/photograph of species.	<p>Conduct Scientific surveys as a continuous process using latest technology and tools. This should appear as a separate budget line item on SBB budget.</p> <p>Depute BMC members on state sponsored scientific surveys for capacity building.</p> <p>Prepare a medium to long term plan for the number and type of surveys</p>	<p>Data Collection and Research</p> <p>Training and Awareness</p>	<p>Scientific survey along with PBRs used as a tool for designing policy interventions.</p> <p>A time bound plan for surveys prepared.</p> <p>Targeted species and ecosystems for restoration and other interventions identified.</p> <p>Proportion of local breeds classified as: at risk, not at risk or at unknown level of risk of extinction</p>	<p>DFE, SBB, NBA, ZSI, BSI, BCM, NMHS</p> <p>WWF, academic institutions and experts</p>	M	Scientific surveys are necessary in drawing up strategies to design suitable interventions not only for conservation and restoration activities but also for generating resources through ABS.
1.3 Microbial Biodiversity Database and emphasis on EIAs							
4.	<p>Study and document microbial diversity in terrestrial and aquatic ecosystems. Prepare A web-based databank of microbial biodiversity along the lines of the Northeast Microbial Database (NEMiD).</p> <p>Explore the use of this data for bio-prospecting.</p> <p>Assessment of impact on microbial biodiversity in</p>	<p>Develop database specifically for Sikkim and collect samples from unexplored territories such as agricultural fields, water bodies and very high altitudes.</p> <p>Identify the locations using geo-based plotting and characterize microbial diversity on the basis of their biochemical, morphological and molecular properties.</p>	Data Collection and Research	<p>Targeted microbes for conservation and propagation identified.</p> <p>Microbial data used for bio-prospecting contracts.</p> <p>Microbial studies applied in enzyme technology, cleaning up polluted areas and biofuel production.</p>	<p>DFE, SBB, ZSI, BSI, DSTC</p> <p>Collaborate with technical institutions, mountaineers, and local communities.</p>	S-M	Research shows that hot springs harbour microbial diversity.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	EIAs should be emphasized.						
2. In-situ Conservation							
2.1 Protected Areas							
1.	<p>Review PAs as a conservation strategy in light of recent scientific evidence suggesting re-strategizing of PAs in Sikkim.</p> <p>Re-strategizing should not result in increase in net area under PAs or significant impact on tenurial or access rights of communities on forest resources</p>	Effectiveness of a single large PA, with wide geographic area and altitude reach, instead of several smaller PAs would be a more prudent strategy to mitigate the effects of climate change and conserve plant diversity	Policy and Regulation	<p>A detailed report with proposed changes and its implications is prepared.</p> <p>A process of consultation with key stakeholders is set in motion to discuss the issues involved and outcomes of the proposed changes.</p>	DFE, SBB, ZSI, BSI, DSTC	M	People are more likely to conserve ecosystems for which they have either tenurial or access entitlements for their livelihoods. For long term sustainable conservation local stakeholders should be seen as allies.
2.2 Human Wildlife Conflict (HWC)							
2.	<p>Build comprehensive data on the nature and extent of conflict and address habitat and other pressures on prey species like Red Panda, wild goats.</p> <p>Suggested management strategies: Habitat improvement, Periodic clearing of shrubs in habitat to facilitate free movement and thus prevent straying of animals; Zoning for cattle grazing; compensation for loss of animals and crops due to wildlife; and solar fencing.</p>	<p>Conduct district-wise studies to establish complete protocol for the genetic identification of wild animals in conflict-prone areas to establish species, sex and individual identity of animals. More research to better understand the population dynamics of problem species has also been recommended by ATREE in their assignment under SECURE Project.</p> <p>Explore implementation of instruments like insurance for compensation</p>	<p>Data Management and Research</p> <p>Training and Awareness</p> <p>Management and Coordination</p> <p>Policy and Regulation</p>	<p>A Committee to look into Human-Wildlife Conflict resolution formed.</p> <p>Number of cases of conflict registered for death/morbidity, crop damage. Zoning for human activities notified.</p> <p>More socioeconomic research should be conducted to frame appropriate policies</p>	DFE, PRIs, JFMC, Local Governance bodies such as Dzumsa, EDCs,	S-M	<p>In the greater Himalayan areas, in last 6 decades sheep have been replaced by yaks (and their crossbreeds), which descend only up to the multi-layered temperate and sub-alpine forests during winter. These forests have been manipulated by the yak herders to increase the fodder availability.</p> <p>The yak and urang pastoral systems have substantially affected the oak and fir forests in KNP; Red Panda</p>

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>Implementation of Insurance scheme against loss of animals, human life, and crops.</p> <p>Sterilization of animals like monkeys and boar. The following provisions may be made for effective results</p> <ol style="list-style-type: none"> 1. Construction of Feed formulation cum Feed Store in Monkey Sterilization Centre 2. Construction of Isolation Unit for Monkey Sterilization Centre 3. Consider establishing 'Vanar Vatikas' (monkey shelter homes) with proper facilities for drinking water, shade resting, feeding and ranging 	<p>Support FRA beneficiaries to increase agricultural productivity, value addition and marketing for minor forest produce through convergence with schemes like Van Dhan Yojana and National Mission on Sustainable Agriculture and Soil and Water Conservation.</p> <p>Explore gainful alternate livelihood such as tourist guides, for herders and nomads.</p>		<p>Decrease in number of HWC incidents.</p> <p>Decrease in economic loss due to HWC</p>			<p>has been severely affected due to disturbance from yak crossbreeds, herders, and the herders' dogs. Red pandas have also been threatened in Sikkim due to trafficking</p> <p>Monkey shelter homes have been recommended in lieu of lessons from Himachal Pradesh, where it was observed that there was a change in behaviour of sterilized monkeys.</p> <p>Macaque Face Identification (MFID), an image based, non-invasive tool that relies on macaque facial recognition to identify individuals, and can be used to verify if monkeys have been sterilized</p>
2.3 Forest Fires							
3.	<p>Strengthen data on causes of forest fire to identify all risk factors.</p> <p>Incorporate Traditional Knowledge (especially with Lepcha tribe) in Forest Fire Management strategies.</p>	<p>Consider a relook at the useful elements of traditional grazing practices in controlling growth of shrubs.</p> <p>Herders' conservation interventions based on traditional knowledge and experience should be given due attention and a more nuanced</p>	<p>Data Management and Research</p> <p>Training and Awareness</p>	<p>Increase in number of local institutions like Panchayat and Dzumsa that adopt and implement local risk reduction strategies</p> <p>Incentives provided (like cooking gas).</p>	DFE, PRIs, JFMC, Local federation, EDCs	S This has to be an on-going effort	Lepcha tribe is reported to have good understanding of the nature and causes of disasters and have identified accurate and precise indicators to assist in predicting disasters.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>Explore the use of 'prescribed or cool burn' early dry season burning strategy to manage forest fires.</p> <p>Regulation, vigilance of trespassing, tourists and trekkers.</p> <p>Ban of inflammable materials during peak forest fire months.</p> <p>Develop an active prevention strategy on the basis of above recommendations</p>	<p>grazing policy should be put in place instead of a complete ban.</p> <p>Engage with communities through:</p> <ul style="list-style-type: none"> Controlled, ecologically compatible, early dry-season burning protocols to reduce the risk of serious fires. Delegate responsibility to the community with sufficient policy and legislative safeguards Technical support and training to enable communities in assuming a central role in fire management. Awareness campaigns for locals and tourists. Provision of cooking gas to reduce dependency on biomass-based stoves often used in open areas 	<p>Management and Coordination</p> <p>Policy and Regulation</p>	<p>Training conducted.</p> <p>Budget allocation to forest fire programs.</p> <p>Regulation of tourism activities.</p> <p>Awareness programs through audio and visual mediums.</p> <p>Awareness program in schools.</p>			<p>Provision of cooking gas is a strategy to reduce HWC and forest fires.</p> <p>Scientists have suggested a rethink of how India manages its fire, where fires are often managed by suppressing them. Instead, the idea of cool burn has been recommended, as intentional forest-fires can potentially reduce the risk of serious fires.</p> <p>This has been emphasised by scientists worldwide as they have called for prevention-based action rather than suppression-based action.</p>
2.4 Conservation of high-altitude wetlands							
4.	<p>Develop strategies for conservation of unique wetlands of Sikkim.</p> <p>Explore the potential of fund raising for wetland</p>	<p>Establish a database which has the following specific studies to address knowledge gaps-</p> <ul style="list-style-type: none"> Floral and faunal diversity in wetland ecosystems Bathymetric³¹ profile and water balance assessment 	<p>Data Management and Research</p> <p>Training and Awareness</p>	<p>Inter-departmental committee formed.</p> <p>Formal forum for engagement with communities is established to discuss</p>	<p>SSDMA, IAFCD, WRRDD, Wetland Authority, DFE, GBPIHED, BSI, DoT, National</p>	S-M	<p>NRSC (National Remote Sensing Centre) scientists recommend more GLOF studies, not just in Sikkim, but in the entire Indian Himalayan region.</p>

³¹ Bathymetry is the study of the "beds" or "floors" of water bodies, including the ocean, rivers, streams, and lakes. It is an essential component in understanding the dynamics of the marine environment, both in terms of sediment transport but also in the prediction of tides, currents and waves.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>conservation from eco-tourism.</p> <p>Set up an expert committee for:</p> <ul style="list-style-type: none"> Evaluating the early warning system for Glacial Lake Outburst Floods (GLOF) developed by CDAC and DST, and studying feasibility for replication in other areas in Sikkim. Outreach program for Dzumsas Signage upgradation <p>To address sedimentation in wetlands, consider planting Rhizomatous species such as Alocasia at the edge of the forest</p>	<ul style="list-style-type: none"> Trends in water regimes Ecosystem services and their valuation <p>Set up inter-departmental committee for identification and implementation of appropriate measures and strategies such as:</p> <ul style="list-style-type: none"> Designation of a wetland manager with clear roles and responsibility. Involving communities in identifying other suitable strategies in line with experiences of 'Pokhari Sanrakshan Samiti' in Tsomgo Lake. Dedicated budget for wetland programme. Capacity building programme for wetland manager and community. 	<p>Management and Coordination</p> <p>Policy and Regulation</p>	<p>management measures including alternate livelihood.</p> <p>GLOF studies commissioned.</p> <p>Plantation of Alocasia or other species along forest edges.</p> <p>Enhanced financial aid and capacity building for government departments and communities</p>	Wetland Committee		<p>India's first GLOF Early Warning System has been deployed by Centre for Development of Advanced Computing (CDAC) and DST, Sikkim. The early warning system has been deployed at Shakho Chho Glacial Lake, North Sikkim.</p> <p>Main issues to be addressed:</p> <ul style="list-style-type: none"> Catchment Area Treatment Biodiversity Conservation Water Management Community Participation. Alternate livelihood to reduce pressure on Wetlands Pollution abatement Sustainable fisheries development Education and awareness.
2.5 Restoration Needs and Potential							

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
5	Restoration needs of 0.21 MHa, should be realized in Sikkim: •Protection – 0.15 MHa •Wide-Scale Restoration- 0.06 MHa (WRI, 2018) Restoration of the 8 identified Eco-Sensitive Zones in and around PAs PA network: Khangchendzonga National Park; Kitam Bird Sanctuary; Kyongnosla Alpine Sanctuary; Shingba, & Barsey Rhododendron Sanctuaries; Maenam, Fambonglho, and Pangolakha Wildlife Sanctuaries.	Initiate a long-term restoration program for regeneration of degraded land and take steps to protect and regenerate several small-sized, fragmented forest patches in the lower belt. Explore the suitability of ROAM methodology developed by WRI ³² to conduct pilots for landscape restoration including interventions such as identification of degraded landscapes, plantation of native species, assisted natural regeneration, mixed plantations, and agri-horti-forestry.	Data Management and Research Policy and Regulation	Specific schemes included in the management plan Local community-based organizations consulted and made stakeholders Extent of dense forests jointly with forest cover should be used as an impact indicator.	DFE, Community based organization, MoEF&CC, NAEB.		Restoration can provide direct benefit of wage income; and livelihood can be generated by value chain development around key tree and other species A district wise distribution and classification by type of restoration (details in Chapter 8-Finance Solutions) shows that 46% of total restoration is required in North Sikkim. Similarly, 44% of the total CS opportunity in the state is in North Sikkim. This calls for a serious thinking and focused effort.
2.6 Wildlife Crime							
6	Prevent poaching and illegal trade of wild animals and plants by strengthening the DFE by providing them with adequate manpower, training, mobility and requisite equipment. Encourage Himal Rakshak model of community involvement in a number of	Develop close coordination mechanism with national and international security agencies by initiating dialogue between government agencies such as WCCB and international agencies like TRAFFIC and SAWEN Develop database on wildlife crime in consultation with local	Data Management and Research Training and Awareness Management and Coordination	Coordination mechanism among agencies established. Intelligence gathering mechanism put in place through community groups and individuals, herder community, Nomads.	DFE, Police, Himal Rakshak, BMCs, Local community groups, Security Agencies	S-M	More trans- border (national and international) cooperation and coordination among law enforcement agencies, as poaching often leads to export for personal and industrial use.

³² https://wri-india.org/sites/default/files/Sidhi%20Booklet%20a5_6%20july.pdf

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>activities from monitoring of high-altitude areas to reporting of deaths of important wildlife in their areas.</p> <p>Develop mechanism for convergence in schemes like MGNREGA for conservation efforts to address illegal trade of wild animals & plants.</p> <p>Organize awareness programs for farmers, herders, communities in uphill regions regarding the critically endangered status of species and need for their conservation</p>	<p>communities, local level institutions such as Dzumsa, PRI as well as forest guards, police and other line departments. A technical agency may be engaged to develop a format for such database.</p> <p>Develop a scheme for intelligence gathering using locals on illegal poaching and trade of animals and their derivatives. Dissemination centers should be created for mobilizing locals.</p> <p>Strengthen presence of Himal Rakshaks in the KNP fringe village areas. Communities and Himal Rakshaks (HRs) should complement each other as it is reported that HRs are often seen as those working against the interest of the community and traditional conservation practices as a result of which sometimes, they face social exclusion by communities.</p>	Policy and Regulation	Cases of illegal activities registered.			
2.7 Important Bird Areas							
7	Enhancing the Important Bird Areas (IBA) network in Sikkim by undertaking the following	Prepare a plan to develop the already identified 11 IBAs in Sikkim with the help of technical agencies like BirdLife International and other national expert agencies.	Data Management and Research Training and Awareness	Increase in presence of bird corridors in Sikkim Number of bird sanctuaries/ parks	BI, ZSI, DFE, DoT, BHNS	S-M	Collaboration with BirdLife International to conserve birds and their habitat; feed data into their system to assess Sikkim's position in comparison to the international standard.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<ul style="list-style-type: none"> Documenting avian diversity in Sikkim's IBAs. Establishing Local Conservation Groups which will monitor, manage and protect their IBAs Demonstrating the links between biodiversity conservation and sustainable livelihoods through community-centred projects at IBAs. 	<p>Studies to understand the status of IBAs based on pressure and response concepts.</p> <p>Based on this information conservation strategies should be identified.</p> <p>Explore the potential of fund raising as well as awareness building through eco-tourism in IBAs.</p>	<p>Management and Coordination</p> <p>Policy and Regulation</p>	<p>Development of Local Governance Groups to conserve IBAs</p> <p>Proportion of birds classified as being at risk, not at risk or at unknown level of risk of extinction</p>			<p>The database has classification of IBA status- Pressure (low-high) and the Response (low-high)</p> <p>The Bombay Natural History Society (BHNS) and Birdlife International have identified 467 IBAs in India, out of which 11 are in Sikkim.</p>
2.8 Biodiversity Monitoring							
8	Strengthen biodiversity monitoring system. Efforts of state can be complemented by NGO and community efforts. NGOs & communities should be trained and provided appropriate technical and financial support.	<p>Prepare a plan for periodic monitoring protocols;</p> <p>Prepare a plan for addressing critical issues around targeted (threatened, critical, endangered etc.) species.</p> <p>Protect and conserve the natural habitat of important medicinal plant wealth of Sikkim through establishment of Medicinal Plants Conservation and Development Areas (MPCDAs). The State Forest Department will play a vital role in establishing the MPCDAs, ensuring conservation of the Red Listed Medicinal Plants</p>	<p>Data Management and Research</p> <p>Training and Awareness</p> <p>Policy and Regulation</p>	Monitoring plans prepared and implemented	DFE, Ecclesiastical Department, SBB, BMCs, EDCs and NGOs like KCC	S&M	BD monitoring is an integral component of the entire range of activities of a conservation plan. Understanding of local socio-economic dynamics & practices is important in this context.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
		species along with associated flora. (Biswas 2017) ³³					
3. Ex-situ Conservation							
3.1 Conserving Genetic Diversity							
1.	Conserve genetic diversity of domesticated & wild animals & plants through: 1. Germ-plasm collection, freezing and storage facility 2. Establishment of breeding units for conservation of cattle species such as: Siri, Singhari, Changra & Banpala. 3. Similarly, germ-plasm centres for conserving plants such as Caterpillar Mushroom and Swertia Chirayta	Identify species for Ex-situ conservation and provide economic and technical support for conservation Germ-plasm collections need to be developed, for ex-situ conservation of Farm Animal Genetic Resources (AnGR) which includes all species, breeds and strains that are of economic, scientific and cultural interest to agriculture and livestock, now and in the future.	Data Management and Research Management and Coordination Policy and Regulation	Number of plant and animal genetic resources for food and agriculture secured in either medium- or long-term conservation facilities Gene-plasm conservation through gene-banks Germ-plasm collection	NMHS, DFE (NTFP, SBFP, SMPB) CZA, DoH, SBFP, NBA, ICAR, NBAGR, NBPGR DoA, SBB, NBA, ICAR, NBAGR, NBPGR, FAO	M-L	In ex-situ animal conservation, genetic material is stored in the form of frozen semen, embryos or nucleic acids - DNA, the molecules of inheritance. Low yields and some government policies (providing subsidies on hybrid varieties) contribute to the decline of indigenous species. Conserving the genetics is a viable alternative to conserve biodiversity. (Mendelsohn 2003)
3.2 Seed Banks							
2	Identify local agriculture and horticulture varieties for conservation Develop community seed banks for seed conservation and participatory plant breeding for seed development. Collaborate with organizations like	Setting up and maintaining a community seed bank 1. Identify villages & interested farmers. 2. Assess needs (species and quantity) through Focus Group Discussion 3. Provide necessary training in seed production and institution building.	Training and Awareness Management and Coordination Policy and Regulation	Number of community seed banks established Local seeds classified as being at risk, not at risk or at unknown level of risk of extinction	DoA, SBB, NBA, ICAR, NBPGR	S-M	The role of community seed banks is a key CC adaptation strategy. It can secure improved access & availability of diverse, locally adapted crops, and enhance indigenous knowledge and skills in plant management, seed selection, treatment,

³³ https://www.researchgate.net/publication/320284959_Medicinal_plants_conservation_and_development_areas_MPCDAs-An_initiative_towards_conservation_of_medicinal_plants

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	Navdanya which develop seed banks in various agro-climatic zones, & provide training to farmers.	4. Plan for renewal of diversity, focus on traditional and local varieties 5. Monitor to ensure quality seed production 6. Document the number of seed available for local use and supply.					storage, multiplication, and distribution (Vernooy et. al. 2017).
3.3 High- value species							
3	Encourage cultivation of wild high economic value plants with a focus on endangered Medicinal Plants such as: Ban Lahsun, Ginseng, Salam Panja, Kutki, Mahameda, Satuwa, Jatamansi	Since Government of Sikkim had issued a ban on extraction and trade of all medicinal plants, ex-situ cultivation should be carefully designed and closely supervised by the Biodiversity Board. Selling wild leafy vegetation (lattey Sag), which is already being done informally, should be supported with ex-situ cultivation and scaling it up.	Management and Coordination Policy and Regulation	Number of high-value plants under commercial cultivation	DFE, BMCs, FDAs, DoA	M	Branding using Sikkim's "Organic State" tag such vegetation will help to sell it in urban areas outside the state and to get farmers a fair price for their produce
3.4 Conservation facilities							
4	Zoos, herbal gardens, aquariums etc. besides building awareness towards native species, should be equipped to support scientific breeding programs. Aquariums and zoo should be made in tourist-friendly areas; for building awareness of people as well as raising revenue.	Identify suitable areas for these facilities and apart from linking them to tourism, also undertake breeding programs for endangered species. Gangtok Zoo's efforts to carry out breeding programs of red pandas and gorals may be enhanced by strengthening the manpower and resources at the zoo, along with exploring possibilities for other endangered species.	Policy and Regulation	Number of zoos, herbal gardens, aquariums	BSI, ZSI, DFE,	M-L	Build awareness towards native species. For instance, the Australian zoo has programs running for conservation of crocodiles, tigers, wombats, elephants and cheetah.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
3.5 Biotechnological Tools							
5	Use of biotechnological tools on a pilot basis for conservation of endangered species.	Use biotechnological tools like artificial insemination, embryo transfer and in vitro fertilization, Gamete and embryo micro-manipulation, sperm sexing, genome resource banking, semen banks, tissue graft banks, cloning should be explored with the help of relevant technical support.	Policy and Regulation	Experiments and scientific research	DFE, DoSTC, ATREE, ICAR	M-L	These ex-situ measures have also been suggested by ICAR. The focus is on biotechnological tools mentioned in column 2 as these have economic, scientific and technological potential.
4. Agro-biodiversity							
4.1 Identifying Sikkim's Agro-biodiversity							

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
1	<p>Building on existing agrobiodiversity database of Sikkim and registering the local agrobiodiversity under the Protection of Plant Varieties and Farmers Rights Act, 2001.</p> <p>Similarly, it is important to identify hotspots of Agrobiodiversity in Sikkim, and building action plans for certain threatened species.</p>	<p>Prioritize list of local varieties that need to be promoted for cultivation as adaptation measure in the context of climate change.</p> <p>Few varieties may be commercially exploited, but unique and local varieties should be conserved.</p> <p>Geographical Indication (GI) tagging of Agricultural products and foodstuff may be explored in the state.</p> <p>GI refers to a type of Intellectual Property (IP) protection where the quality, reputation, and other salient features of the commodity are linked to location of origin. The unique cultural aspects of rural communities associated with GI needs to be highlighted</p>	Data Management and Research	<p>Number of varieties registered and promoted</p> <p>Classification of agrobiodiversity species as being at risk, not at risk or at unknown level of risk of extinction</p>	DoA, SBB, NBA, ICAR, NBAGR, NBPGR, DST	S	<p>Classification may be:</p> <ol style="list-style-type: none"> 1. Threatened species 2. Ecologically Important species 3. Commercially useful. 4. Species with Cultural and heritage values. <p>Benefits of GI tagging:</p> <ol style="list-style-type: none"> 1. Overall economic prosperity of producers as GI tags enhance secondary economic activities in the region. 2. GI tags creates a positive image and reputation of the products 3. Increases Tourism as GI tags builds a global reputation for the products <p>Such certification is particularly important for the state of Sikkim to encash its 100% organic status.</p>
4.2 Organic Farming, low yield issues and Certification							
2	<p>Explore potential of PGS Certification³⁴ of not for export varieties.</p> <p>Identify local varieties such as avocado, orchids and</p>	State has a MoU with IFFCO to provide support for commercial production of turmeric, ginger, buckwheat and big cardamom.	Management and Coordination	<p>Sale of organic produce outside the state</p> <p>Reduced Cost of certification</p>	DoA, ICAR, DoCI, Organic Mission SBB, Local community	S-M	There is willingness among farmers to join a cluster farming scheme because of small size of individual holdings.

³⁴ PGS Certification facilitates farmers to certify their organic produce, label and market their products domestically. It is a scheme under the Paramparagat Krishi Vikas Yojana (PKVY)

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
3	incentivise farmers to cultivate it in cluster approach.	Learning from this should be used to bring more species under the cover.	Policy and Regulation	Setting up of Facilities for value added products from the local bio-resources using innovative technologies for livelihood.			State government through implementation of central schemes can give a further boost to organic status of state
	Provide post-harvest support, labelling and marketing support through available schemes in this context. Develop strategies to address declining crop yields in organic farming. Explore the use of Plant Growth Promoting Bacteria (PGPB) in enhancing crop productivity and nutrient content and suppressing the growth of pathogens.	Collaborate with International Board for Plant Genetic Resources which funds training of scientists and technicians in all aspects of genetic resources work. More research on non-chemical pesticides for pest management is needed. Conduct large-scale screening of PGPB for antibiotic resistance and long-term studies to see the effect of the introduction of bio-fertilizers on native soil microbial community	Data Management and Research	Availability of non-chemical pesticides such as bone meal, cottonseed meal, bat feces, fish emulsions. Research conducted on PGPB	MoA, ICAR, Sikkim Organic Mission	M	Sikkim has been recognized as a 100% Organic State. However, farmers are facing challenges due to lower yields and timely availability of organic pesticides. Development of beneficial plant-microbe interactions based on genomics, transcriptomics, proteomics and metabolomic data leads to optimized microbial inoculants for enhancing yield.
4.4 Soil Erosion							
4	A Plan should be made to address the issue of soil erosion and topsoil runoff. There should be convergence with the Sikkim State Disaster Management Plan which identifies erosion as a potential reason for disaster risk in the state.	Compute Erodibility indices for all areas, so that measures can be taken according to vulnerability. Pollarding (a method of pruning that keeps trees and shrubs smaller than they would naturally grow) may be a solution in reducing soil erosion and landslides.	Policy and Regulation	Study conducted for assessing soil erosion Development of Erodibility indices for Sikkim. Strategies to address soil erosion are put in place.	DoA, ICAR, DST National Bureau of Soil Survey and Land Use Planning (ICAR)	M	Erodibility indices should be computed for all areas, because they are useful for planning appropriate treatment measures in areas where soil erosion is serious.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>Include biological factors in soil erosion models.</p> <p>Better understanding of relationship between soil biodiversity and erosion is needed.</p> <p>Available data and technologies make both processes possible.</p>	<p>Another effective control method is combining trees and grass in strips on lands which are taken out of cultivation.</p>					
4.5 Payment for Ecosystem Services (PES)							
6	<p>Opportunities of PES must be identified. There should be an “Opportunities assessment” to develop a PES scheme</p> <p>PES can provide positive incentives (additional income or in-kind payments) for alternative land uses or particular agronomic practices at the farm level.</p>	<p>“Good Farming Practices” or GFPs such as drip irrigation instead of flood irrigation should be compensated using a PES mode.</p> <p>Funds should come from the irrigation department as the water tables will increase due to water savings at farmlands.</p> <p>Traditional practices should be supported.</p> <p>PES could be an effective way of persuading farmers to adopt ecologically sensitive practices and local variety of crops.</p>	Policy and Regulation	Opportunities Assessment to develop a PES scheme	SBB	M-L	<p>In Bolivia, a government-negotiated PES programme compensated 46 upstream farmers who agreed to protect forests. By maintaining trees and preventing hunting, the farmers enhanced the hydrological flows to downstream farmers during the dry season. In addition to the in-kind payment, the beneficiaries of hydrological services also paid upstream farmers a monetary compensation (Asquith and Wunder 2008)</p>
4.6 Agro-forestry							

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
7	<p>Promote agro-forestry (AF) on private lands given strong positive relationships between AF and land productivity.</p> <p>Combinations of trees, with crops and pasture utilizes resources (solar radiation, water, soil volume) more efficiently than in mono-cropping or trees.</p>	<p>Agroforestry should be promoted along with the following objectives:</p> <ol style="list-style-type: none"> 1. Provide habitat for species that can tolerate a certain level of disturbance; 2. Preserve germplasm of sensitive species; 3. Focus on conserving biodiversity through erosion control and water recharge. 	Policy and Regulation	<p>Policy for Agro-forestry</p> <p>Land use change towards agro-forestry</p>	MoA, ICAR, Sikkim Organic Mission	M-L	<p>Research has shown that agroforestry has helped promote biodiversity globally.</p> <p>Small, diversified agro-forestry systems may be a viable strategy for promoting both social and ecological functions. (Sistla et al 2016).</p>
4.7 Issues in Large Cardamom							
8	<p>Revive large-cardamom based farming through climate-smart innovations and practices for agricultural sustainability in Sikkim.</p> <p>Government support for promoting Climate Resilient Practices (CRA) is important. CRA includes smart practices, which are low cost, affordable and context specific. CRA includes:</p> <ul style="list-style-type: none"> • Alteration of planting time, and the planting of recommended local varieties that are resilient to extreme weather conditions, 	<p>Government intervention is necessary in the following</p> <ul style="list-style-type: none"> • To improve cardamom farming, the Agriculture department should make disease free and high- quality cardamom seedlings available for farmers • The department should come up with improved cardamom curing and drying technology to add value chain to cardamom. Using electricity and off-grid, through efficient utilisation of firewood were two improved curing and drying methods that 	Policy and regulation	<p>Indicators to measure yield such as the ratio of agricultural outputs to agricultural inputs</p> <p>Increase in area under large cardamom in Sikkim</p> <p>Availability of organic pesticides</p> <p>Increase in area under irrigation</p>	DoA, Spices Board India, ICIMOD, MoA, ICAR	M	<p>Till 2003-2004, Sikkim was regarded as the world's largest producer of large cardamom. Though it continues to be one of the leading producers of large cardamom in India, the title of the title of the world's leading producer now rests with neighbouring Himalayan country, Nepal. This is because of declining yield and fall in the area under large cardamom in Sikkim.</p> <p>The decline has been attributed to several factors, listed below</p> <ul style="list-style-type: none"> • Diseases and pests: Viral diseases, such as chirke (mosaic streak)

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>assessment of rainfall requirements, etc.</p> <ul style="list-style-type: none"> • Knowledge-smart practices, focus on strengthening linkages and making information available to value chain actors. • Water-smart practices highlight technologies that ensure water availability • Energy-smart practices for harvest/post-harvest management 	<p>were used in Bhutan. Such practices may be adapted in Sikkim, where feasible.</p> <ul style="list-style-type: none"> • Ensuring availability of organic pesticides and packaged natural fertilizers for improving yield of large cardamom. • Incorporating Sikkim's traditional practice of burning the stubble after harvesting large cardamom, to keep plantations disease-free 					<p>and foorkey (bushy dwarf), are major threats to the crop</p> <ul style="list-style-type: none"> • Old plantations, poor management, unavailability of good quality planting material and lack of irrigation facilities. • Climate Change leading to long dry spells and disease infestations
5. Animal Husbandry and Livestock							
5.1 Fodder Bank Model							
1	<p>Develop Fodder Banks to enhance quantity and quality of fodder where needed.</p> <p>This will reduce pressure on grazing lands, and dependence of people on forests; and support livelihood of communities.</p> <p>Commercialisation and branding of the fodder may also be explored after assessing feasibility of the same.</p>	<p>Identify areas where fodder bank is needed.</p> <p>Assessment of type and amount of fodder.</p> <p>Engage technical agency to set up a fodder bank</p> <p>Training of farmers.</p> <p>A fodder bank management model etc.</p>	<p>Policy and Regulation</p> <p>Training and Awareness</p> <p>Management and Coordination-</p>	<p>Development of Community Fodder Bank managed by communities.</p>	<p>DoAH&VS, DoA, Dzumsa Governing Body, PRI</p>	<p>M</p>	<p>See chapter 8</p>

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
5.2 Data collection and management							
2	Enumerate and categorize the endemic species of livestock, as the exercise has not yet been done by the department, except for Siri and Banpala.	Proactively document district-wise endemic species of livestock, and take appropriate steps to conserve endangered species such as Siri cattle.	Data Collection and Research	Enumeration of local varieties of livestock	DoAH&VS, DoA	M	
3	Strengthen data collection and research on diseases among livestock and conduct studies to identify the etiological agents of diseases	Document diseases as well as their agents in livestock across all districts in Sikkim.	Data Collection and Research	Documentation of research on diseases in livestock in Sikkim	DoAH&VS, DoA	M	
5.3 Issue of Yaks							
4	No census or other data available on population of indigenous Yak (pure breed). Develop a plan to collect such data & assess the extent of decline in yak population. Develop strategies to address the issue of decline in indigenous yaks in the state.	Facilitate artificial insemination using yak semen in the state, as has been successfully conducted in Himal Prakriti in Paton, Uttarakhand. However, a feasibility study in this context is important.	Policy and Regulation Management and Coordination	Increase in population of indigenous yaks	DoAh&VS	L	Population of yaks increased from 4,781 in 1997 to 6,220 in 2012 in Sikkim. However, there is no data on number of indigenous yaks. This was raised as a serious issue during our consultations with communities. There is a feeling that the number of indigenous yaks is falling.
6. Impact of Climate Change							
6.1 Inter-departmental planning for Climate Change							
1	Conduct vulnerability assessments at block and district level for sectoral mitigation and adaptation strategies such as:	Consult SAPCC, 2015 for guidance on specific areas and species which are more vulnerable to CC.	Policy and Regulation	Schemes such as Smriti Van, Harit Kranti Dashak, State Green Mission and Ten	DFE, SBB, DoA, SMPB, DSTC	M	Opportunities of reaping the benefits of REDD + in Sikkim has been emphasized considering the CS Potential for

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>agriculture tourism, horticulture and water.</p> <p>Develop mitigation and adaptation plan for vulnerable and high-risk ecosystems, geographical areas, crops, plants and animal species.</p> <p>Explore implementation of REDD+</p>	<p>Make appropriate changes in forestry management plans, plantation, watershed management, fodder, cropping system, etc.</p> <p>Set up Inter-departmental committee with members from DSTC, DoA, DoAH&VS, DoT for cooperation and coordination.</p> <p>Reorient programmes like Smriti Van, Harit Kranti Dashak, State Green Mission, and Ten Minutes to Earth to include species more adaptable to CC and favourable to CS.</p>	<p>Management and Coordination</p> <p>Data Collection and Research</p>	Minutes to Earth are reviewed and reoriented			<p>Sikkim, which is estimated between 6.94 to 7.02 mt. of additional above ground carbon through improvement of tree cover</p> <ul style="list-style-type: none"> •Protection – 4 MT •Widescale Restoration- 2.93 MT •Mosaic Restoration- 0.01-0.09 MT
6.2 Phenology monitoring units							
2	<p>Include phenology into predictive models integrating evolutionary history to identify species that are resilient or sensitive to future CC scenarios to understand how phenological mismatches can affect community dynamics, ecosystem services, and conservation over time.</p> <p>Establish permanent phenology monitoring units to have a continuous</p>	<p>This should be in a program mode such that continuous monitoring is undertaken.</p> <p>Vegetation phenology can be used as a sensitive barometer of terrestrial responses to short and long-term climate variability. Observational, modelling and remote sensing evidence suggests that vegetation phenology is changing in response to warming climates, principally through an earlier start of season (SOS) and later end of season (EOS).</p>	<p>Policy and Regulation</p> <p>Data Collection and Research</p>	Using plant phenology as an indicator for climate change permanent monitoring stations along different zones are established	DFE, SBB, DSTC	M-L	<p>The CC cell has generated database on exposure, sensitivity & adaptive capacity for CC at the district level.</p> <p>Phenology should be developed as the standard indicator for assessing impacts of CC in Sikkim. It is a multidisciplinary science covering biometeorology, ecology, and evolutionary biology. It can make a key contribution to</p>

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	monitoring source of climate change						conservation biology (Morellato et al 2016)
6.3 Identification and Classification of Vulnerable Areas and ecological impact assessments							
3	Proactively identify and list vulnerable areas, crops, plant and animal species, and fragile ecosystems for information and awareness of farmers, local communities, eco-tourism activities and other developmental works.	<p>Mapping of fragile areas due to CC and otherwise.</p> <p>Mapping of high-risk plant and animal species.</p> <p>Identify ‘no go’ zones in PAs and outside PAs.</p> <p>8 identified Eco-Sensitive Zones in and around PAs in Sikkim, namely- Khangchendzonga National Park; Kitam Bird Sanctuary; Kyongnosla Alpine Sanctuary; Shingba, & Barsey Rhododendron Sanctuaries; Maenam, Fambonglho, and Pangolakha Wildlife Sanctuaries.</p> <p>These may be further classified as per their resilience to climate change, and mitigation strategies may be developed accordingly.</p> <p>Identify ‘no go’ zones for economic activities including infrastructure development</p>	Data Collection and Research	<p>Areas mapped as per climate change vulnerability and notified</p> <p>‘No-go’ zones identified and notified</p>	DFE, SBB, BMCs, DSTC, IUCN, ICIMOD and HIMAP	M	IUCN has made repeated calls for identifying no-go zones in response to environmental threats. Areas can be classified according to their resilience as “least vulnerable” “most vulnerable”, and “no-go zones”.
4	Proactively conduct ecological impact assessments keeping in mind needs of infrastructure and tourism sectors.	Regularly conduct such assessments to identify vulnerable & favourable areas for economic activities.	Data Collection and Research Policy and Regulation	Development of a land use plan ecological impact assessments conducted	DFE, SMPB, DTCA, PDD	M-L	Considering that CC and biodiversity are interconnected in a cause-and-effect feedback loop, a negative effect in one

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	Identify CC and biodiversity issues early on: <ul style="list-style-type: none"> Historical data will provide a better idea of the rate of biodiversity loss as well as any extreme changes in climate Where available, use trends instead of data at one point in time, to reduce future uncertainty. 	Use this information in drawing up a land use plan for economic activities. This information should be used for inviting potential investors in eco-tourism, Agri production and processing, ex-situ cultivation of species used in pharma and wellness sectors.					factor creates a continual downward trend in both. While this downward trend can happen naturally, the influence of development projects can increase the speed at which this occurs.
7. Tourism							
7.1 Carrying Capacity and other studies							
1	Undertake studies of tourism Carrying Capacity in Sikkim in general and at specific high ecological value sites. Once these carrying capacity studies are conducted, the findings must be incorporated in the tourism policy, and suitable tourism strategies may be undertaken in the high ecological value sites.	Carrying Capacity study should be used as a basis to develop programs for tourism and eco-tourism.	Data Collection and Research	Study on Carrying Capacity incorporated in eco-tourism programmes and suitable strategies undertaken in the high ecological value sites	DoT, DFE	S-M	There was a record 14.25 lakh tourists in 2017. While it is good for government revenues and jobs, there are issues of ecological disturbance and problems related to Solid Waste Management There is a perception that tourism income has little multiplier effect on state income. There is little data to corroborate this assertion.
7.2 Regulated Tourism with focus on pristine environment, biodiversity and rich culture							
2	Promote high value low impact tourism that focuses on nature, wildlife and culture.	Lodging and boarding infrastructure should be built using local and eco-friendly material.	Policy and Regulation	Training of service providers and homestay operators	DoT, DFE		Development Alternatives, Delhi, has developed and demonstrated use of such technologies and materials

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>Convergence in Eco-Tourism Policy of the Forest and Environment Department and the Tourism Policy of the Department of Tourism such that they complement each other and not compete.</p> <p>Policy should have strong focus on showcasing pristine environment, wildlife biodiversity, wellness therapies, local culture, spiritual roots and food.</p> <p>Government support is required for the maintenance and beautification of trekking trails, especially near Yuksom.</p>	<p>Support local entrepreneurs under 'Atmanirbhar Bharat'</p> <p>Explore use of e-vehicles</p> <p>Undertake training and capacity building of local workforce under 'skill development program'.</p> <p>Develop Sikkim into a hub for specialized training for tourism in Himalayas, and well-ness and spiritual therapy for locals & for people from world over.</p>	<p>Management and Coordination</p>	<p>Dedicated fund for promoting village-tourism and heritage-tourism</p>			<p>in Uttarakhand and other places. Engage with them.</p> <p>Every year, almost 8 to 10 km of trail is destroyed by floods. Currently, these trails are maintained by the EDC with the help of local NGOs. Since the trails are narrow, horses sometimes slip and fall, leading to huge financial loss to the owner; ranging between INR 60 to 80 thousand.</p>
3	<p>Regulate tourism activities. Unregulated tourism puts more pressure on ecology than the tourist load.</p> <p>Develop strategies for round the year tourism by planning off-season events, and regulating peak-season numbers. Additional marketing is required about</p>	<p>Engage specialised agencies to help develop a strategy to regulate tourism. Well organised and regulated tourism plans will boost high value tourism.</p> <p>Potential Tourism products in Sikkim include</p> <ul style="list-style-type: none"> Nature tourism (forest areas, birding trails, wildlife trails - such as 	<p>Policy and Regulation</p> <p>Data Collection and Research</p>	<p>Study undertaken on seasonality of tourism.</p> <p>Policies to regulate tourism developed</p> <p>Number of tourism products mapped and documented</p>	DoT, DFE	M	<p>Tourism destinations, such as Sikkim, are experiencing serious seasonality issues, and the best way to address these issues is through counter-seasonal strategies (Šegota & Mihalič, 2018).</p> <p>The GREAT Green Deal Sustainable Certification Program (GGD) represents</p>

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>the services provided by locals in higher altitude.</p> <p>Seek Global Certification from organisations such as the Global Sustainable Tourism Council (GSTC). Being certified means that the state complies with the highest social and environmental standards on the market. Certification will provide credibility and enhance regulated tourism.</p>	<p>red panda or musk deer trails, waterfalls, lakes and wetlands, viewpoints)</p> <ul style="list-style-type: none"> • Adventure tourism (trekking, mountain biking) • Culture tourism (village walks, dance, music, handicrafts) <p>Engage reputed tourism companies to develop summer and winter circuits</p> <p>Incorporate standards such as the GGD standard, which has more than 400 indicators that provide hotel and tour operators a map that takes executives and entrepreneurs on a path to be more successful in their business while being responsible with employees and their families, the community, the cultural heritage and traditions including the environment</p>					a way of doing business while taking care of all stakeholders involved in the tourism operations
4	Conduct impact studies of activities like trail-use, trekking, off-road driving, fishing and camping; on ecological parameters such as soil degradation, solid waste, water and air	<p>This data should be used in taking corrective measures.</p> <p>For instance, trekker inflow could be periodically diverted towards less sensitive areas or more homogeneously</p>	<p>Policy and Regulation</p> <p>Data Collection and Research</p>	Impact assessment for each tourist activity in Sikkim	DoT, DFE	M	A study conducted in Ladakh, using GIS modelling has assessed the impact of various tourism activities like trail-use, trekking, off-road driving, camping, and dumping of

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	pollution, and habitat disturbances.	distributed among the different trails					waste on ecological systems.
5	Explore the PES model for tourism to conserve biodiversity. Opportunities of raising revenue must be identified. Conduct study for assessment of opportunities to develop a continuous stream of revenue for conservation.	Consider indicative ideas for such a model- Popular trekking trails, national parks etc. should have fee associated to the entrance. These can be in the form of Permit Fees, Congestion Fee, Green tax for people and vehicles. This must be earmarked for conservation.	Policy and Regulation Data Collection and Research	Programme for PES	DoT, DFE	L	National Parks with high biodiversity values are more attractive for visitors than parks with lower biodiversity values.
7.3 Promotion of allied sector of tourism							
6	Engage popular NGOs to promote handicrafts and handlooms as an allied sector. Tourism outreach should be enhanced through handicrafts souvenir Wood, bamboo, and wool are the potential raw materials that can be explored for handicrafts sector. Cooperation between department of Tourism and Rural development and small scale and micro enterprises is important.	A program combining traditional and modern designs and skills needs to be developed. Invite businesses who understand preferences of tourists and have innovative ideas and technical knowhow which can be blended into traditional designs and materials.	Training and Awareness Management and Coordination	Creation of SHGs Technological Interventions such as sewing machines provided Number of products developed	DFE, DoT	M	UNEP and WTO (2005) show that tourists spend around 40% of their budget in souvenir purchases and other craft products. For places such as Yuksam- Kyoungtey cluster, Maneybung cluster and Lachen cluster which already have regular tourist footfall, there is immense potential for developing this allied sector of tourism looking at handicrafts and souvenir.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
7.4 Minimise impacts of tourism							
7	<p>Sustainable Waste Management Solutions documented by WWF in a Livelihood strategy study under project SECURE Himalaya should be looked at.</p> <p>Establishment/improvement of Material Recovery Centres and provision of waste collection vehicles</p> <p>Identifying existing gaps and challenges and establishing community rules and regulations for improvement</p>	<p>Regular and consistent awareness programmes for the community and other stakeholders</p> <p>Mass awareness drives engaging communities, tourists and army authorities, conduct of regular clean-up drives and exhibitions, provision of garbage bags in tourist vehicles, printing of posters and putting up hoardings for waste management.</p>	Training and Awareness	<p>Awareness programmes conducted</p> <p>Development of Material Recovery Centers</p>	DFE, DoT	S	<p>The most visible impact of tourism has been the accumulation of waste, especially in the high-altitude villages which have no means for proper disposal of the non-biodegradable waste</p> <p>NGOs such as KCC have initiatives where a Zero Waste Trekking Trail in Yuksam is promoted.</p>
8. Sustainable utilization of biodiversity resources and Livelihood							
8.1 Promotion of bamboo							
1	<p>Under National Bamboo Mission promote management and use of bamboo and cane and other NTFPs.</p> <p>Grow industrial grade bamboo such as Bambusa bamboo and promote it as a construction material in schemes like National Housing Scheme and tourism infrastructure.</p>	<p>Technological interventions, support for marketing, packaging etc. will be required, along with facilitating an integrated value chain.</p> <p>Policy intervention to mandate use of bamboo in identified activities</p>	<p>Policy and Regulation</p> <p>Management and Coordination</p>	<p>Bamboo cover increased</p> <p>Mainstreaming these concerns in the functioning of Himal Rakshaks, EDCs, JFMCs, and other NGOs</p>	DFE, EDC, JFMC, Himal Rakshak, National Bamboo Mission	M	<p>Bamboo is integral part of livelihood as it is used for housing, infrastructure and containers and crafts.</p> <p>Important for Red Panda.</p> <p>It has a unique ability to repair damaged soils, and rehabilitate degraded soil.</p>
8.2 Promotion of Bee-Keeping							

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
2	<p>Promote bee keeping providing a boost to pollination and livelihood.</p> <p>Provide technical and material support to encourage greater participation from people.</p> <p>Engage specialised agencies for labelling, branding and marketing support.</p>	<p>Provide technical and material support such as scientific bee boxes, honey extractors, protective equipment, aggregation units.</p> <p>Draw lessons from 'Project SERVE' to replicate and scale up in other areas.</p> <p>Carry out branding and Marketing of Himalayan Honey from Sikkim. Scientific aggregation, processing and packaging of Himalayan Honey from Sikkim can be undertaken through the farmer's collectives and local, national and online marketing networks</p>	<p>Policy and Regulation</p> <p>Management and Coordination</p>	<p>Modern bee keeping boxes</p> <p>Rise in income of bee-keepers</p>	DFE, WWF, RMDD	M	<p>Explore Project SERVE - Save the Environment and Regenerate Vital Employment (WWF + government): Bee Keeping</p> <p>Local NGOs like KCC have tried to work on bee-keeping at their level, but have not seen much success due to lack of funds and external support. There is interest among community and potential to enhance bee-keeping efforts through external support.</p>
8.3 Improving the Dairy Farming Sector							
3	Improving Dairy Management Practice through scientific management to improve milk productivity, reduced cattle morbidity, and increase in income.	Upgradation of cowsheds to improve the health and hygiene of the cattle and improvement of breeds. Enabling access to finance for farmers to set up dairy entrepreneurship to enable this.	<p>Training and Awareness</p> <p>Policy and Regulation</p>	<p>Training on Improved Dairy Management Practices</p> <p>Number of upgraded cowsheds</p> <p>Number of farmers with financial access</p>	DoAH, Sikkim Milk Union, NABARD/Banks	M	The dairy sector has potential to be a major livelihood earner, but issues such as low productivity and low quality of milk, lack of market linkages, and limited financial linkages are some challenges.
9. Management of Invasive species							

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
1	Formulate state policy for control and management of invasive species.	Set up an interdisciplinary group to develop strategies to address the multiple issues involved.	Policy and Regulation	Interdisciplinary research on invasive species (presence and impacts)	DFE DTCA, DST, FSADD	M-L M S S	Collaboration with institutions such as Invasive Species Specialist Group (ISSG), Global Invasive Species Programme (GISP)
2	Set up a state level agency for Control of Invasive Species and preventing introduction of exotics.	Prepare reporting and monitoring protocols for new sightings of invasive species.	Management and Coordination	Plan for control and management of invasive species prepared and rolled out.			Sikkim has been successful in banning plastic and chemical produce and fertilizers.
3	Conduct research for a database on presence and type of impacts of invasive species.	Explore specific solutions for invasive species like 'Banmara' or 'forest killer' which has become a threat for native plants.	Training and Awareness	Training and awareness for local community.			Bio-terrorism is a challenge and the state should strengthen the monitoring and detection systems.
4	Establish procedures to ensure that invasive species do not enter the state through national and international borders.	Strengthen border monitoring mechanisms. Establish a quarantine cell in the state. Organise awareness and training of staff involved in border trade and tourism.	Data Collection and Research	Establishment of quarantine cell Training of staff at airports/borders.			
10. Promotion of Awareness on Biodiversity							
1	Develop orientation programs for relevant departments and institutions including Department of Finance to emphasize on the collective and specific role of each of the departments. Develop training modules for government and non-government agencies to strengthen their role in biodiversity conservation.	Focus on two aspects – learning best practices from other areas globally, and spreading awareness about Sikkim's achievements and programs through this mechanism. Prepare short films and documentaries on ecological wealth of Sikkim, on challenges faced by ecology in Sikkim Radio programs, Stories in print media	Training and Awareness	Survey conducted using Scientific indicator of environmental awareness. Documented best practices Policy exchange workshop	ENVIS, DFE	S	There has been considerable progress in terms of trainings and workshops, now it is desirable to target communities and move towards more innovative methods of awareness using electronic as well as print media.

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>Training and sensitisation of law enforcement staff and border trade and security staff.</p> <p>Develop a portal for documenting and sharing national and international best practices to relevant officials and stakeholders, using electronic and print media.</p>	<p>Comic strips- weekly columns in local newspapers, animation films</p>		<p>Ex-ante policy assessment</p>			
2	<p>Increase awareness of tourists, students and others in tourism and related vocations through audio visual media.</p>	<p>List of endangered and high-risk species along with their local names and pictures in print and digital media for wider circulation.</p> <p>Prepare short films and documentaries on ecological wealth of Sikkim, on challenges faced by ecology in Sikkim</p> <p>Installing attractive signages on biodiversity values as well as pamphlets and brochures as souvenirs at strategic locations in Sikkim</p> <p>For instance, KNP's unique identify of having cultural as well as ecological value may be displayed. This can be done through a dedicated branding exercise.</p>	<p>Training and Awareness</p>	<p>Short films, Radio programs, Stories, Documentaries</p>	<p>ENVIS, DFE</p>		<p>This may be included in the scope of work of ENVIS.</p>

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
11. Policy, Legislation and Administrative Measures							
11.1 ABS Mechanism							
3	<p>Focussed efforts are required to tap the full potential of ABS in the state.</p> <p>Explore and assess collaboration opportunities for Bio prospecting with research institutes and pharmaceutical companies to evaluate the commercial prospects of identified plants, insects, and microbial samples.</p>	<p>SBB and DFE should proactively take the following actions.</p> <p>Commission a study for assessment of the total potential of ABS in Sikkim.</p> <p>Commission a study for assessment of current use of natural resources which is liable for ABS and the key issues impacting ABS collection.</p> <p>Strengthen and empower SBB and BMCs, with training, and financial and human resources.</p> <p>A continuous dialogue with industrial users and traders on the importance and need for ABS for long term sustainability of resource and thus a win-win situation for all stakeholders.</p>	<p>Research studies</p> <p>Management and Coordination</p> <p>Data Collection and Research</p>	<p>Bio prospecting Contract developed</p>	<p>SBB, DFE, Sikkim Medicinal Plant Board</p>	<p>M-L</p>	<p>Bio prospecting is the systematic search for biochemical and genetic information in nature in order to develop commercially valuable products for pharmaceutical, other applications.</p> <p>Poor understanding of the Nagoya Protocol and ABS and the implications of protocol ratification are the barriers to implementation. (IUCN 2017) ³⁵</p>
11.2 Valuation of Biodiversity Resources							
1.	<p>Actively collaborate with central ministry MoSPI and develop expertise in the state.</p>	<p>Prepare a plan for a research program</p>	<p>Data Collection and Research</p>	<p>Natural Resource Accounting initiated</p>	<p>DESME, UN agencies, MoSPI</p>	<p>M</p>	

³⁵ <https://www.iucn.org/news/mexico-central-america-and-caribbean/201702/advances-bioprospecting-and-abs-legislation-caribbean>

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
2	Support studies of valuation of natural resources and ecosystems.	Commission studies for valuation of ecosystem services. Develop a platform for consolidating independent studies of valuation.	Data Collection and Research	Studies conducted. Results of studies inform policy making.	DFE, GBNIHED	S	As per NBA, economic valuation of bio-resources is important for ABS mechanism.
12. Regional, National and International Coordination							
1	Establish contact with multilateral, bilateral, and private impact investor funds for collaboration for financial and technical support for biodiversity conservation	Identify and prioritise areas where support is needed. Provide full support to donor agencies A technical capacity building component for departmental officers should be included. Action-learning and forming scalable plans.	Management and Coordination	Pilot programmes for biodiversity conservation	DFE, UN Bodies, other donor agencies	L	An Action-learning Pilot Program (ALPP) developed by U.S.-India Partnership for Land Use Science (Forest-PLUS) in Sikkim to mitigate Human-Wildlife Conflict has been useful.
2	Seek cooperation from specialised research institutions and universities in different aspects of biodiversity conservation including public finance, tourism, and innovative finance solutions.	Carry out systematic inventories, cataloguing and documentation of biodiversity in Sikkim, carrying capacity for tourism, innovative regulatory and economic instruments, and sources of finance in collaboration with research institutes and universities.	Management and Coordination Data Collection and Research	Technical Research Studies undertaken	DFE, National Mission on Himalayan Studies (NMHS), GB Pant Institute, Project team at NIPFP.	M	
3	Seek support from the National Biodiversity Mission under their programmes related to building an inventory of India's Biodiversity, mapping key ecosystem services, developing various conservation actions while maximising benefits to local people,	Initiate the work on developing a Biodiversity Park in West Sikkim, as recommended by the NBA. Biodiversity Park is an innovative approach for conservation, where native species are conserved. Biodiversity Parks are unique landscapes of wilderness where	Data Collection and Research Management and Coordination	Development of Biodiversity park in the state	NBA, MoEFCC, ATREE, TERI, IISc, NCF, Project team of this report	M-L	The Mission proposes a national effort that aims to transform biodiversity science by linking it to the peoples' economic prosperity. It further aims to help India realize the United Nation's Sustainable Development Goals by using India's rich biodiversity to create

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	<p>quantify the role of India's forests, and components under Biodiversity and Agriculture, and Biodiversity and Health Programmes.</p> <p>The Mission will focus on 117 aspirational districts in the country; and in Sikkim, West Sikkim has been identified as an aspirational district.</p>	<p>ecological assemblages of native species in the form of biological communities are recreated and maintained.</p> <p>West Sikkim is selected as a aspirational district. This district id also selected for a pilot under the National Biodiversity Mission of India.</p> <p>Planning in this direction would include, among others, identification of sites for the pilots, and products to be promoted; and strengthening of BMC both in terms of capacity and finances.</p>					<p>solutions for challenges in agriculture, health, and climate change.</p> <p>As part of the preparatory phase, the mission's programs will be implemented in two pilot districts - west Sikkim and Raichur in Karnataka. The Panchayat-level biodiversity management committees will create a "people's biodiversity register", which will document the flora, fauna and traditional knowledge of people about them. Before launching the full-fledged project, pilot will be carried out in these two districts. The objective of the pilot will be to test the interest and involvement of local communities. NBA will be the nodal agency of the mission.</p>
4.	<p>One District One Product (ODOP) is an initiative which is seen as a transformational step forward towards realizing the true potential of a district, fuel economic growth and generate employment and rural</p>	<p>All four districts of Sikkim have been listed in the scheme. An inter-ministerial group or an expert group with representatives of the relevant departments should be formed to finalise the products under the scheme.</p>	<p>Planning, Management and Coordination</p>				

S. No	Recommendations	Action points	Intervention Type	Indicators	Agencies	Time frame	Remarks
	entrepreneurship, taking us to the goal of AtmaNirbhar Bharat. ODOP initiative is operationally merged with 'Districts as Export Hub' initiative being implemented by DGFT, Department of Commerce, with Department for Promotion of Industry and Internal Trade (DPIIT) as a major stakeholder.						
5.	The work on Post 2020 framework is in progress at the CBD. Once the new framework and targets are developed and notified, there will be a need to align the SBSAP of Sikkim with the new biodiversity framework.	A plan along with a budget should be made ready for necessary revision in this SBSAP Report.	Planning, Management and Coordination				

Chapter 5: Biodiversity Expenditure Review

5.1 Introduction

Biodiversity Expenditure Review (BER) is a standard tool used to map the sources and amount of funds flow towards biodiversity and ecosystem conservation and protection. It is a useful instrument in assessing the alignment of an economy's concerns and priorities in respect of biodiversity loss with its expenditure on conservation of biodiversity³⁶. In this report the purpose of BER is to map and estimate the current expenditure on biodiversity through various schemes and programmes of the central government, state government, and district plans. The BER is, in turn, used to estimate the additional funding required for implementing the proposed SBSAP in Sikkim.

Biodiversity expenditure can be direct (restoration, tree planting and other conservation and protection activities) or indirect (training, awareness building of stakeholders, research, measuring and mapping of biodiversity etc.). Similarly, expenditure on biodiversity can be to achieve one or more goals of CBD or achieve one or more NBTs, or both. Therefore, it is important to have a framework (Table 5.1) for the analysis of BER results which would help in examining which aspects of biodiversity conservation have been addressed adequately through budgetary expenditure and where gaps remain.

Table 5.1: Framework Used in Analysis of BER

	Strategic Goal A	Strategic Goal B	Strategic Goal C	Strategic Goal D		Strategic Goal E
CBD Strategic Goal	Address underlying causes of biodiversity loss by mainstreaming biodiversity across	Reduce direct pressures on biodiversity and promote sustainable use	Improve the status of biodiversity by safeguarding ecosystems species and genetic diversity	Enhance the benefits to all from biodiversity and ecosystem services		Enhance implementation through participatory Planning, knowledge management and Capacity building
NBTs	NBTs (1,2,10)	NBTs (3,4,5, 6)	NBTs (6 & 7)	NBTs (3,8, 9)		NBTs (10,11, 12)
Aichi Targets	1,2,3&4	5,6,7,8,9 & 10	11,12 & 13	14,15 & 16		17,18,19 & 20
BIOFIN Taxonomy	Biodiversity Mainstreaming	Sustainable use of Resources except Prevention & Control of invasive species	Protection Strategies include Aichi Target 9 and NBT 4	Restoration strategies	ABS (Aichi Target 16 & NBT 9)	Implementation Strategies

³⁶ In this report the term biodiversity conservation has been used as a generic term although in our analysis it corresponds to CBD definition in this context.

	Strategic Goal A	Strategic Goal B	Strategic Goal C	Strategic Goal D	Strategic Goal E	
		(Aichi Target 9 & NBT4)				
Impact on Biodiversity	Indirect	Indirect In most cases except Aichi Target 9 & NBT4	Direct	Direct In most cases except when it is a very small component	Direct	Indirect Direct only when implemented by MOEF&CC; There can be some deviations

5.2 Mapping Public Expenditure for Biodiversity in Sikkim

The BER in Sikkim considers budgetary flows of funds during the period 2011-12 to 2016-17 comprising:

- i. **Central government funds** in the form of Centrally Sponsored Schemes (CSS), Central Sector Schemes (CS), and Additional Central Assistance (ACA). Some of these schemes could be fully funded by the Centre while others would require the State government to contribute its share. For Sikkim, funds for all CSS are contributed in the ratio 90:10, where the Centre contributes 90 percent and the State's share is 10 percent.
- ii. **Consolidated fund of the State** funds a number of state schemes.
- iii. **Union Finance Commission of India:** The Thirteenth Finance Commission (which covered a period of April 2010 to March 2015) provided a forest grant of Rs. 5000 crores to the states based on the criteria of standing forest (stock) in each state.
- iv. **External Aid:** In Sikkim, two Externally Aided Projects (EAPs) were identified to be related to biodiversity.
 - a. **Sikkim Biodiversity Conservation and Forest Management Project** – Implemented by Department of Forest, and Environment assisted by Japan International Cooperation Agency (JICA). The project finances the scheme for Promotion of Sustainable Forest Management.
 - b. **South Asian Tourism Infrastructure Development Project** – Implemented by Department of Tourism and Civil Aviation assisted by Asian Development Bank. From this project, the following components are related to biodiversity: (i) Development of nature-based sites forming part of the Great Himalayan Trail in West Sikkim district, (ii) Transformation of Sikkim into a sub-regional centre of learning; and strengthening and development of existing Indian Himalayan Centre for Adventure and Eco-tourism at Chemchey in South Sikkim.

Using the Budget documents of Government of Sikkim and the specific guidelines of schemes, which were obtained from various sources, we reviewed the entire list of schemes and identified schemes which have activities/components directly or indirectly relevant for biodiversity conservation. For each scheme, budget codes for the major head, sub-major head, and minor head along with the scheme code have been recorded for easy tracking of the scheme as well as sectoral and department-wise analysis of expenditure. For the identified schemes data on actual expenditure was collated for further analysis.

Box 5.1: District Level Funds

Article 243ZD of the Constitution of India provides for establishment of District Planning Committee for consolidation of plans prepared by Panchayats and Municipalities in the district. The committee also prepares a draft development plan for the district as a whole.³⁷

The development plans are financed from resources from different sources such as: a) Central Schemes (CSS, CS or ACA) or programmes like MGNREGA (for employment generation); b) State funds released for financing state schemes which are directed to districts; c) revenue raised by districts through own sources. In Sikkim, district level funds have not been considered separately, due to the following two reasons:

- Some schemes are being implemented directly by the state government department located in Gangtok and are not routed through the department located in the district. Therefore, the district officials do not have the details and data for such schemes.
- The departments located in the district get their allocation in kind and not in monetary terms, therefore, they cannot give details of the amount allocated and the actual expenditure incurred within a scheme. For example: The Agriculture department located in Mangan makes an assessment of the seeds and other inputs required and conveys it to the headquarters. The district only prepares the beneficiary list. Supplies are sent to the district by the state government department. Therefore, they do not have the data on monetary value of support to the district under different schemes.

5.3 Methodology for Determining Expenditure Attributable to Biodiversity Conservation in Sikkim

Having collected the data pertaining to funds released for various biodiversity relevant schemes, the next step is to determine the proportion of expenditure under each of the identified schemes. This involves the following steps:

- i. The relevance or significance of the identified schemes with respect to their impact on biodiversity is not same; and may vary significantly. Some schemes may have a direct bearing on biodiversity while others may impact it indirectly. Conceptualization of schemes' relevance (in terms of impact on biodiversity conservation) in this study is guided by the Rio markers, OECD³⁸ methodology and a study of BER³⁹ conducted for Maharashtra by the authors of this report³⁹ as part of BIOFIN project.
- ii. We approach the biodiversity attribution issue by defining 'tiers' of relevance into direct (where 'primary' purpose of the scheme/activity is biodiversity conservation) and indirect (when conservation of biodiversity is not primary but a 'significant' objective)⁴⁰. While expenditure on schemes/activities classified as 'direct' is conceptualized to be fully attributed to biodiversity, a system for attribution (coefficients/ proportion of expenditure attributable to biodiversity conservation) of expenditure of schemes/activities under the tier 'indirect' has been developed (Table 5.2). The tier 'Indirect' comprises activities that are relevant for biodiversity but not as a primary purpose. A range of activities can be listed in this tier e.g., promotion of

³⁷ http://www.nrddp.org/DPC/District_Planning_Committee_Jharkhand.pdf

³⁸ https://www.oecd.org/dac/environment-development/Revised%20climate%20marker%20handbook_FINAL.pdf

³⁹ Pandey et al (2020); available at: https://www.nipfp.org.in/media/medialibrary/2020/07/WP_311_2020.pdf

⁴⁰ This is consistent with the approach used in existing methodologies.

organic farming, sustainable fisheries, data management, pollution control, watershed management (Table 5.1). Further, contribution of all these activities to biodiversity is not the same. To reflect their varied levels of contribution the ‘indirect’ tier has been classified into: indirect high; indirect medium; and indirect low (see Table 5.2). For schemes having Indirect-High relevance we have considered that the percentage of expenditure attributable for biodiversity would range between 50-75 percent with a midpoint of 62.5 percent. Similarly, for schemes having Indirect-Medium and Indirect-Low relevance we have considered biodiversity attributable expenditure to be 37.5 percent and 12.5 percent (which are mid points of their respective ranges) of their expenditures respectively.

While expenditure on schemes/activities classified as ‘direct’ is conceptualized to be fully attributed to biodiversity, a system for attribution (coefficients/ proportion of expenditure attributable to biodiversity conservation) of expenditure of schemes/activities under the tier ‘indirect’ has been developed (Table 5.2).

Table 5.2: Determining Attribution for Biodiversity Expenditures

Biodiversity Relevance	Broad Thematic Areas	Expenditure Attributable to Biodiversity Conservation
Direct (Range: 90 – 100%)	Where primary purpose of the scheme is biodiversity conservation. Example: Wildlife conservation, Afforestation and Regeneration of forest, Research on ecology.	95 percent
Indirect Very High (Range: 75 – 90%)	Where conservation of biodiversity is a significant objective. Ex. Promotion of organic farming, Ecosystem restoration - River conservation/ rejuvenation, conservation of wetlands (lakes, ponds, tanks, etc.), preventing pollution of water bodies by treating sewage, etc.	82.5 percent
Indirect High (Range: 50 – 75%)	Where the emphasis is on strengthening the grass root level institutions (considering role of Panchayats in BMCs, etc)	62.5 percent
Indirect Medium (Range 25-50%)	Where biodiversity is not the main but significant biodiversity relevant outcomes are expected. Ex. Sustainable Agriculture, Integrated Watershed Development, Programs of animal husbandry, fisheries and poultry which include promoting on-farm diversity	37.5 percent
Indirect Low (Range: 5 – 25%)	Example: River management including flood management and erosion control, Developing water resources information system	15 percent
Indirect Marginal (Range: 0 – 5%)	Example: renewable energy, general awareness and training, climate mitigation activities	2.5 percent

Apart from classifying schemes into Direct and Indirect Biodiversity relevance, the identified schemes are also classified into six CBD themes using the framework developed by us in Table 5.1. These six themes are: (i) Sectoral Mainstreaming, (ii) Natural Resource Uses, (iii) Biodiversity Protection, (iv) Biodiversity Restoration, (v) Access and Benefit Sharing, and (vi) Enhancing Implementation. This framework can be used to align thematic classification with NBAP targets, Aichi targets and CBD goals for tracking which aspects are being adequately provided for and where more focus may be required.

5.4 Analysis of Results

A snap shot of biodiversity attributable expenditure during 2011-12 to 2016-17 in the state of Sikkim is presented in Table 5.3 and Figure 5.1. It would be seen from the table that the number of biodiversity related schemes have been increasing steadily over the period of the study, from 75 in 2011-12 to 98 in 2016-17. Total expenditure attributable to biodiversity also shows an impressive increase ranging from Rs. 79.58 crore in 2011-12 to Rs. 202.05 crore in 2016-17.

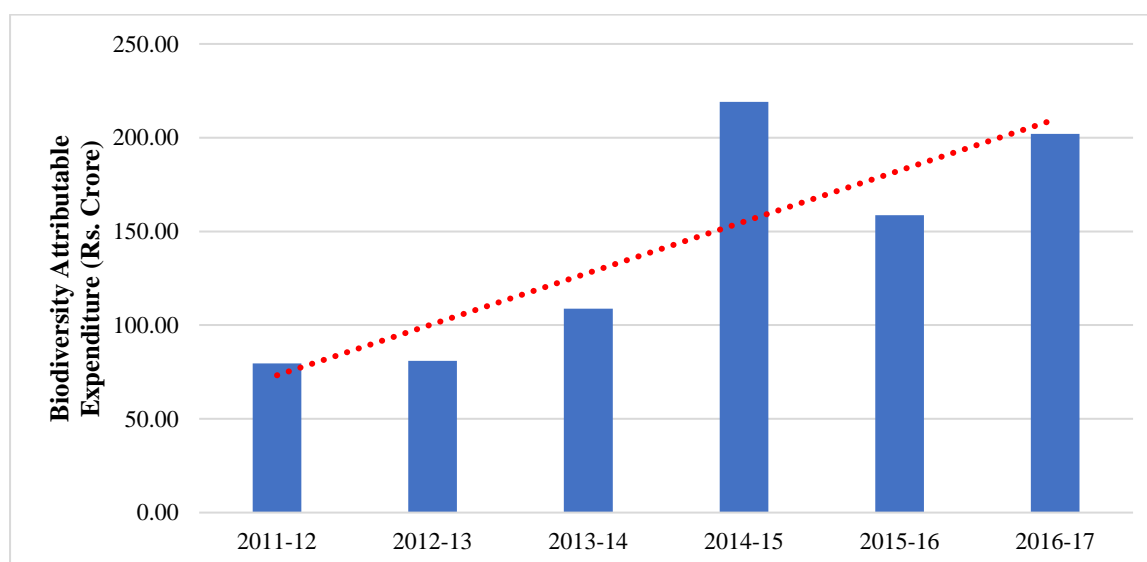
The share of biodiversity attributable expenditure in the total expenditure of the State registered a rising trend (from 2.02 percent in 2011-12 to 4.23 percent in 2016-17) which is encouraging. Biodiversity expenditure as percent of GSDP has been steady ranging between 0.66 to little over 1 percent in 2016-17 which compares well with the state of Maharashtra and Himachal Pradesh.

Table 5.3: Biodiversity Related Schemes in Sikkim (Summary)

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
No. of Biodiversity Relevant Schemes	75	86	95	98	100	98
Biodiversity Attributable Expenditure (Rs. Crores)	79.58	80.91	108.85	219.09	158.60	202.05
Attributable Expenditure as % of Total Expenditure of the State	2.02	2.06	2.44	4.54	3.52	4.23
Biodiversity Attributable Expenditure as % of GSDP of the State	0.71	0.66	0.79	1.42	0.88	1.01

Source: Author's Calculation.

Figure 5.1: Total Biodiversity Attributable Expenditure



The schemes related to biodiversity have been classified according to the BIOFIN thematic classification corresponding to CBD strategic goals (see Table 5.4).

Most of the biodiversity relevant schemes are for Protection (ranging from 32 in 2011-12 to 38 in 2016-17) and Natural Resource Use (ranging from 20 in 2011-12 to 30 in 2016-17). The schemes for Protection have the highest share in expenditure attributable to biodiversity over the years, ranging from Rs. 45.84 crore in 2011-12 to Rs. 120.65 crore in 2016-17. There is a sudden rise in expenditure in 2014-15 when the expenditure reaches Rs. 139.77 crore due to a sudden rise in the transfer to Sikkim ecology fund and expenditure from it. The schemes for sustainable use of natural resources show a steady increase in expenditure ranging from Rs. 15.67 crore in 2011-12 to Rs. 57.57 crore in 2016-17.

A study by the WRI in 2019 puts forest and landscape restoration potential in Sikkim at 0.21 MHa. However, the number of schemes focusing on restoration and the expenditure incurred within them is low indicating a lower focus on restoration.

Table 5.4: BIOFIN Thematic Classification wise Analysis of Biodiversity Relevant Schemes (Rs. Crore)

Type of Expenditure (BIOFIN Classification)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Enhancing Implementation	0.12 (3)	0.11 (4)	0.10 (4)	1.26 (4)	2.96 (4)	1.66 (4)
Natural Resource Use	15.67 (20)	17.44 (25)	13.19 (28)	42.61 (29)	78.93 (30)	57.57 (30)
Protection	45.84 (32)	50.29 (34)	81.41 (35)	139.77 (36)	56.58 (37)	120.65 (38)
Restoration	3.18 (7)	3.19 (9)	3.17 (9)	22.81 (9)	8.48 (6)	5.07 (6)
Sectoral Mainstreaming	5.21 (13)	4.70 (15)	2.05 (19)	3.14 (21)	6.46 (23)	11.53 (20)
Total	79.58 (75)	80.91 (86)	108.85 (95)	219.09 (98)	158.60 (100)	202.05 (98)

Source: Author's Calculation.

Note: Figures in brackets are number of schemes.

Figure 5.2 shows the key departments incurring expenditure on biodiversity. As expected, Department of Forest and Environment incurs the highest expenditure on biodiversity (ranging from Rs. 51.53 crore in 2011-12 to Rs. 111.93 crore in 2016-17, followed by Department of Rural Development and Management (ranging from Rs. 0.02 crore in 2011-12 to Rs. 30.15 crore in 2016-17) and Department of Horticulture and Cash Crop Development (ranging from Rs. 15.85 crore in 2014-15 to Rs. 15.08 crore in 2016-17). The sudden rise in 2014-15 in the expenditure of Rural Management and Development is due to increase in expenditure under MGNREGA.

Figure 5.2: Expenditure Attributable to Biodiversity by Key Departments

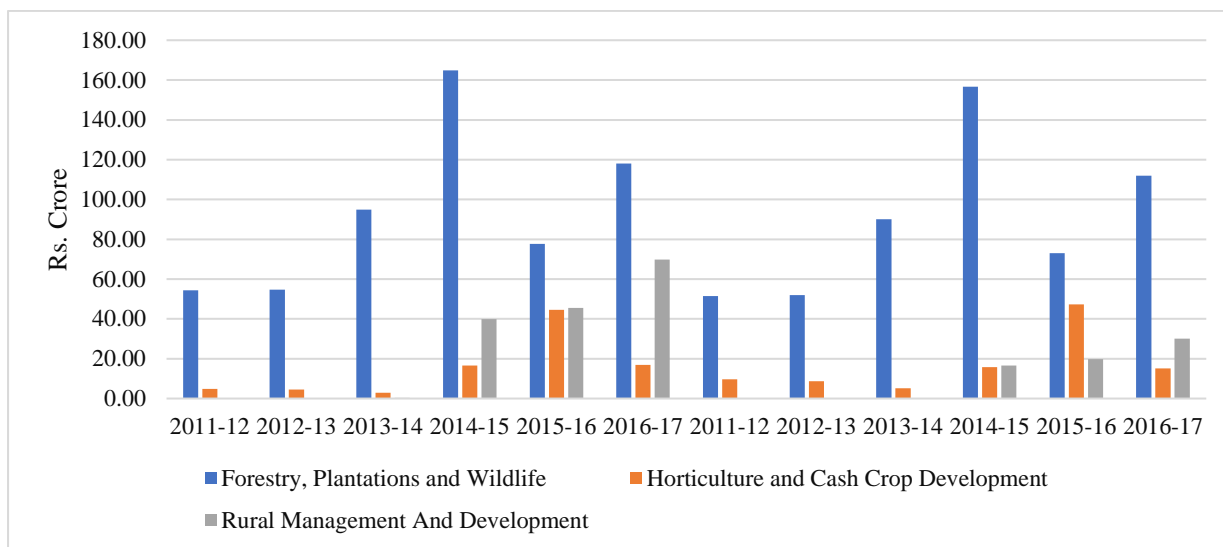


Table 5.5 shows the department wise expenditure classified as per the themes of BIOFIN.

Table 5.5: Department-wise Biodiversity Attributable Expenditure (Rs. Crore)

	Department	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Enhancing Implementation	Food Security and Agriculture Development		0.00	0.00	1.12	2.79	1.53
	Forestry, Plantations and Wildlife	0.06	0.06	0.04	0.06	0.11	0.07
	Water Resources and River Development	0.06	0.05	0.06	0.08	0.06	0.06
Natural Resource Use	Animal Husbandry, Livestock, Fisheries and Veterinary Services				0.00	0.00	0.06
	Commerce and Industries	3.17	3.81	3.83	3.83	5.61	5.49
	Energy and Power	0.13	0.12	0.14	0.08	0.09	0.09
	Food Security and Agriculture Development	1.61	2.07	1.17	3.76	1.62	4.27
	Forestry, Plantations and Wildlife	1.65	1.65	1.62	2.39	5.45	3.06
	Horticulture and Cash Crop Development	7.33	7.11	5.23	15.85	47.34	15.08
	Rural Management and Development	0.00	0.00	0.00	16.61	18.15	28.62
	Water Resources and River Development	1.79	2.68	1.20	0.10	0.68	0.91
	Protection	Animal husbandry, Livestock, Fisheries and Veterinary Services	0.76	0.61	0.55	2.33	0.62

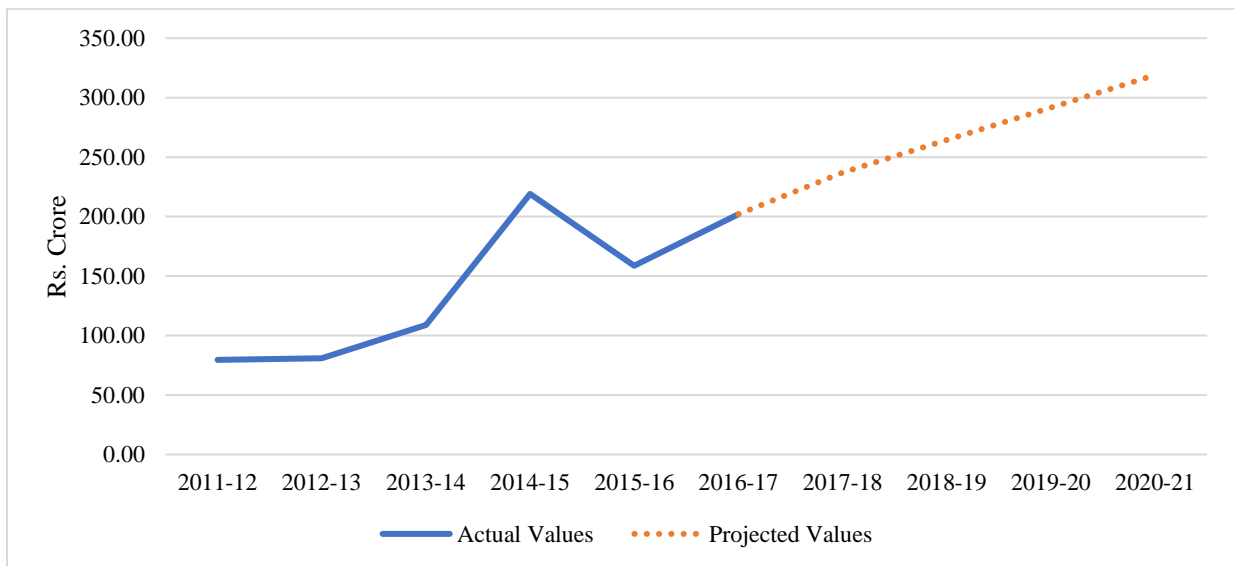
	Department	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
	Development Planning, Economic Reforms and North Eastern Council Affairs				0.00	0.00	14.84
	Food Security and Agriculture Development	1.58	1.03	1.11	1.34	1.08	1.06
	Forestry, Plantations and Wildlife	37.26	41.89	75.86	134.71	53.85	98.16
	Horticulture and Cash Crop Development	2.32	1.63	0.00			
	Tourism and Civil Aviation	0.00	0.00	0.00	0.08	0.13	0.00
	Water Resources and River Development	3.91	5.13	3.89	1.32	0.91	1.04
	Water Security and Public Health Management					0.00	4.95
Resto- ration	Forestry, Plantations and Wildlife	12.57	8.30	12.10	18.72	13.67	10.64
	Tourism and Civil Aviation	0.18	0.07	0.00	13.59		
Sectoral Mainstreaming	Animal husbandry, Livestock, Fisheries and Veterinary Services	0.25	0.31	0.31	0.31	0.29	1.04
	Energy and Power	0.01	0.00	0.00	0.00	0.00	0.09
	Forestry, Plantations and Wildlife		0.00	0.53	0.71	0.00	0.00
	Health Care, Human Services and Family Welfare		0.00	0.00	0.00	0.93	7.04
	Rural Management and Development	0.02	0.03	0.03	0.04	1.69	1.53
	Tourism and Civil Aviation	4.93	4.36	1.19	2.07	2.49	0.53
	Urban Development & Housing				0.00	1.06	1.31

Source: Authors' Calculation.

5.5 Projections

Using the principle of Least Square Methods which assumes a linear trend we project the attributable expenditure for biodiversity in Sikkim. We have actual data on expenditures for six years from 2011-12 to 2016-17. The projections or the forecast is made for the next 4 years starting from 2017-18 till 2020-21. (Figure 5.3).

Figure 5.3: Projections of Biodiversity Attributable Expenditure



5.6 Conclusion

In Sikkim, the number of schemes addressing biodiversity conservation, whether directly or indirectly, have shown a steady increase over the study period. Similarly, the expenditure attributable to biodiversity has shown an impressive increase from Rs. 79.58 in Rs. 2011-12 crore to Rs. 202.05 crore in 2016-17.

The share of biodiversity attributable expenditure in total expenditure of the State registered a rising trend (from 2.02 % in 2011-12 to 4.23 % in 2016-17) which is encouraging. Biodiversity expenditure as percent of GSDP has been steady ranging between 0.66 in 2011-12 to little over 1 percent in 2016-17 which compares well with the state of Maharashtra and Himachal Pradesh.

Throughout the study period, Department of Forest and Environment has spent the highest amount of funds for biodiversity followed by Department of Rural Management and Development. Maximum expenditure is related to Protection followed by expenditure related to Natural Resource Use. There is a need to increase focus on restoration given that its potential is 0.21 Mha. Restoration can contribute to help realize carbon sequestration potential which is 6.94 MT besides improving ecosystem services and livelihood opportunities.

Chapter 6: Mapping Revenue from Biodiversity in Sikkim

6.1 Introduction

It is important to capture revenue from biodiversity to examine and understand the fiscal value that biodiversity and ecosystem services provide to the national and state governments. However, mapping and analysis of full potential of revenue from biodiversity or even current revenue from biodiversity is an under researched subject in the literature. There is an increasing recognition that it is important to identify and map the revenue to the governments from biodiversity for at least the following reasons:

- i. Well-designed fiscal and other economic instruments are important instrument for governments to shape relative prices of goods and services and address the problems with property rights.
- ii. An analysis of the type of instruments used to raise revenue can help assess the appropriateness and under-utilized potential of some of these instruments in conservation of biodiversity.
- iii. Identifying and supporting revenue streams from biodiversity-positive actions that could generate increased private sector investment
- iv. Explore the feasibility of using these revenues for creating a fund dedicated to biodiversity management and conservation.

In this chapter, we have mapped the revenue from biodiversity in Sikkim. This involved the following steps:

- i. Identify economic sectors within the state having positive and negative impacts on biodiversity.
- ii. Identify revenue generated from biodiversity within these sectors by referring to relevant Acts, Rules, Notifications and Reports.

6.2 Guidance from Literature

Two prime sources of guidance for this exercise are reports of UNEP for identification of revenue from biodiversity and OECD dataset on environment related tax revenues.

6.2.1 Economic Instruments in Biodiversity-related Multilateral Environmental Agreements, 2004 (UNEP)

This report recognizes the role of economic instruments, and states that if economic instruments are well designed and used within the right policy framework these can promote the conservation and sustainable use of biological diversity. Following is the summary of economic instruments identified in the report that can be used to protect biodiversity (Table 6.1). In addition, these economic instruments also generate revenue from biodiversity.

Table 6.1: Economic Instruments for Biodiversity Conservation and Addressing Specific Externalities

Economic Instrument	Description
Property Rights	Established or strengthened to reinforce private incentives for conservation, and to underpin other market-based conservation tools.
Market Creation and Enhancement	Used to strengthen the role of the market in guiding the allocation and use of resources, and providing economic incentives for conservation. Includes establishment of: <ul style="list-style-type: none"> • Carbon sequestration offsets, • Tradable development rights, • Tradable quota systems, • Eco-labelling and environmental certification, • Bioprospecting
Charges	Used to align private and social incentives, promote environmentally sound behavior, and raise funds for conservation efforts. <ul style="list-style-type: none"> • Entrance fees for protected areas, • Payments for water services, and • Schemes to internalize the costs of pesticide or fertilizer use
Fiscal Instruments	Used to discourage unsustainable production and consumption practices and raise public revenues. Examples: <ul style="list-style-type: none"> • Differential land use taxation • Deforestation taxes⁴¹ • Tax exemptions or tax deductions • Removal or mitigation of perverse fiscal policies relevant to biodiversity protection⁴²
Liability Systems	Used to modify behavior by increasing the likely costs associated with non-compliance with environmental rules. Examples: <ul style="list-style-type: none"> • Environmental fines • Environmental performance bonds
Environmental Funds	While not per se economic instruments, can be used to complement such instruments by financing conservation activities.

Source: Based on UNEP, 2004.

6.2.2 OECD dataset on environmental related tax revenues

Taxes related to environment⁴³ are an important instrument for governments to shape relative prices of environmental goods and services. In OECD data set⁴⁴, sources and instruments of revenue are identified by economic sectors.

⁴¹ Apply a high(er) tax rate to certain logging activities thus providing a disincentive for activities that cause deforestation. They usually are unit payments applied to each hectare or cubic metre of wood extracted. They can be partially refunded if the logging enterprises engage in reforestation within a certain time period.

⁴² It involves the reform of a range of measures such as subsidies in the agricultural sector, the fisheries sector or other natural resource sectors, and import taxes related to technology transfer relevant to biodiversity protection.

⁴³ The characteristics of such taxes included in the database (e.g. revenue, tax base, tax rates, exemptions, etc.) are used to construct the environmentally related tax revenue with a breakdown by environmental domain.

⁴⁴The OECD maintains a database of Instruments used for environmental policy, originally developed in co-operation with the European Environment Agency (EEA). The database contains detailed qualitative and quantitative information on environmentally related taxes, fees and charges, tradable permits, deposit-refund systems, environmentally motivated subsidies and voluntary approaches used for environmental policy. www.oecd.org/env/policies/database. https://stats.oecd.org/Index.aspx?DataSetCode=env_envpolicy

Table 6.2: Sectoral Categorization of Environmentally related Tax Revenues in OECD Dataset

Sectors	Revenue source/Instruments
Energy	<ul style="list-style-type: none"> • Energy products (Fossil Fuels, Electricity) • Transportation fuels (Petrol, Diesel) • All CO₂ related taxes
Motor Vehicles and Transport ⁴⁵	<ul style="list-style-type: none"> • One-off import or sales taxes on transport equipment • Recurrent taxes on ownership • Registration or road use of motor vehicles • Other transport-related taxes.
Other environment related tax	Environment related taxes not included elsewhere, e.g. <ul style="list-style-type: none"> • hunting and fishing taxes, • SOx and NOx emission taxes.
Water and wastewater ⁴⁶	Taxes on: <ul style="list-style-type: none"> • Water extraction • Piped water • Discharge of wastewater • Other water-related taxes.
Mining and Quarrying	<ul style="list-style-type: none"> • Mining royalties • Excavation taxes (e.g., sand and gravel).
Waste Management	Taxes on: <ul style="list-style-type: none"> • Final disposal of solid waste • On packaging (e.g., plastic bags), and • Other waste-related taxes (e.g., batteries, tires).
Ozone – depleting substances	Taxes on specific substances, such as <ul style="list-style-type: none"> • Chlorofluorocarbons (CFCs) • Carbon tetrachloride, • Hydro chlorofluorocarbon (HCFCs) • Other Ozone-depleting substances.

Source: OECD Dataset.

6.3 Framework and Methodology

Economic sectors and biodiversity are usually evaluated separately from each other, even though they are linked in significant ways. This is because these links are often invisible. However, some economic sectors rely, and impose several unquantified externalities⁴⁷ on biodiversity. Profitability in some sectors (tourism, forestry and wildlife, fisheries) directly depend upon healthy ecosystems and biodiversity. Whereas, other sectors, like mining and hydropower, have a direct impact on biodiversity through their process of production. Sources of revenue in these sectors have been analyzed and those related to biodiversity have been identified⁴⁸.

⁴⁵Excludes excise taxes on automotive fuels.

⁴⁶Fees and charges related to water supply are not included.

⁴⁷ An externality is said to arise when (i) the actions of one economic agent in society impose costs or benefits on other agent(s) in society, and (ii) these costs or benefits are not fully compensated for and thus do not factor into that agent's decision-making. Without intervention in the free market to internalize externalities, positive externality benefits are chronically under-supplied and negative externality costs are over-supplied

⁴⁸ For mapping the revenue, the acts, rules, official notification and departmental reports were referred to.

Table 6.3: Sectors Related to Biodiversity

Sector	Relation to Biodiversity
Tourism	Sikkim is increasingly becoming a prime attraction for nature-based tourism. Therefore, maintaining a healthy eco-system and conserving biodiversity is of importance to maintain viability of the tourism ventures. However, due to high influx of the tourism, there is a threat to the fragile ecosystem of the State which leads to loss of biodiversity.
Forestry and Wildlife	Forests of the State are haven of floral and faunal diversity. But in certain areas unregulated activities have put pressure on some species.
Fisheries	This sector is dependent on diversity among fish species. However, over-exploitation due to unchecked fishing activities may lead to some of the fish species being threatened. There are scientific evidences that, on the time scale of decades, over-fishing can change genetic, species, and ecosystem diversity from levels that have been achieved over millions of years through natural selection. ⁴⁹
Mining	Mining does not rely on biodiversity for inputs in the process of production. But site preparation for mining operations is a destructive process which changes abiotic and biotic conditions, sometimes causing decline in rare and threatened species and ecosystems.
Hydropower	Although hydropower does not depend on biodiversity for inputs in process of production, setting up a hydropower plant leads to submergence, deforestation, loss of flora/fauna, and soil erosion. Local natural water sources get disturbed and often dry up as a result of the tunneling activity for hydro projects (Sharma and Rana 2014).

Source: Authors' Construct.

6.4 Revenue Receipts: Sectoral Analysis

6.4.1 Tourism

It is one of the primary sources of revenue for the state. The state collects revenue from the sector through implementation of various economic instruments (Table 6.4). Table 6.5 shows the budgetary receipts from the sectors.

Table 6.4: Economic Instruments Levied in Tourism Sector Related to Biodiversity

<p>Fees:</p> <ul style="list-style-type: none"> • Maintenance fee for expedition and trekking routes • Registration of Tourist Trade and Homestays • Environmental fees 	<p>Penalty:</p> <ul style="list-style-type: none"> • Sikkim Registration of Tourist Trade Act, 1998 • Penalty levied by local bodies
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⁴⁹ Boehlert GW (1996), "Biodiversity and the Sustainability of Marine Fisheries", Oceanography, Vol. 9, No. 1. Available at: https://tos.org/oceanography/assets/docs/9-1_boehlert.pdf

Table 6.5: Revenue Earned from Tourism (Rs. Crore)

Budget Code	Budget Head	2011	2012	2013	2014	2015	2016
1452	Tourism	1.84	2.13	2.65	2.64	3.96	5.42
105	Rent and Catering Receipts	0.61	1.08	0.85	0.94	2.00	2.26
800	Other Receipts	1.22	1.05	1.80	1.70	1.97	3.15

Source: State Budget, Various Years.

6.4.2 Forests and wildlife

The State keeps a check on human activities in the forest through a number of economic instruments in form of royalty, import fees and entry fees. These economic instruments, in addition to serving as tools for encouraging environmentally friendly behavior, also generate revenues for the State. The revenue thus generated should also be attributed to the biodiversity present in the forest, and a part of this should be provided towards conservation of biodiversity. Table 6.6 shows the economic instruments levied on the forest products in the State.

Table 6.6: Economic Instruments Levied on Forest Products

Economic Instrument	Purpose	Levied On
Royalty	It is levied on use of a natural resource. It is an important means of discovering resource price.	<ul style="list-style-type: none"> • Timber • Poles • Miscellaneous Forest Produce⁵⁰ • Bamboo • Firewood and Fodder • Medicinal Plants • Sand, Stone, etc. Royalty earned from mining operations on Forest land
Import Fees	Regulate the movement of forest produce into the State from outside. In Sikkim, it is levied in addition to the transit permit.	<ul style="list-style-type: none"> • Poles (less than 2' girth of any species) • Bamboo • Charcoal • Firewood • Sand • Stone • Stone Chips • Quartz Stone • New Furniture • Chirata • Coal • All Sawn Timber
Transit Permit⁵¹	Regulate the movement of forest produce within the	Forest Produce includes: bark, charcoal, firewood, myrabolence, natural varnish, resin, shellac, logs, trees and leaves, plants that are not

⁵⁰ On plants and part of plants like dhup, rhododendron, seed of sal, all types of mushroom.

⁵¹ Sikkim Transit of Timber and Other Forest Produce Rules, 1999

Economic Instrument	Purpose	Levied On
(Issued after levying fees equal to the commercial rate of royalty for the timber or forest Produce as notified in the Schedule of rates currently in force)	State, into the State from outside and from the State to the outside areas. Keeps a track of the movement of the forest produce and checks illegal activities like smuggling.	trees ⁵² , flowers and fruits, wild animals and skins, tusks, horns, bones, silk, cocoons, honey and wax, and all other parts or produce of animals, peat, dolomite, graphite, rock, surface soil, sand, stones, slates, and other minerals including laterite, mineral oils, and all other products of mines and quarries, and such other produce that the Government may, by notification, declare to be forest Produce.
Entry Fees	It is levied to recover the cost of providing recreational services. Motivating EDCs to dedicate more of their time in managing the PAs.	<ul style="list-style-type: none"> • National Parks • Wildlife Sanctuaries • Zoos Local Trust Fund (LTF) created from collected entry fee of PAs; 70 percent of which will go to Eco-Development Committees (EDCs) and 30 percent will be retained by the DFE for the management of the PAs ⁵³ .
Environmental Fees ⁵⁴	Levied to keep check on activities that might cause damage to environment	<ul style="list-style-type: none"> • Royalty on mountain expeditions • Royalty on alpine expedition • Royalty on trekking
Net Present Value and Charge for Compensatory Afforestation	Addressing loss of biodiversity and ecosystem due to commercial or developmental activities	On user agency meaning any person, organization or company or department of the Central Government or State Government making a request for diversion or de-notification of forest land for non-forest purpose or using forest land for non-forest purpose in accordance with the provisions contained in the Compensatory Afforestation Fund Act, 2016.
Charges in addition to charge for Compensatory Afforestation ⁵⁵	Recover the payment towards cutting, felling, logging and transportation of project affected trees and forest produce from User Agency	Charges are collected for the following heads: <ul style="list-style-type: none"> • Extraction and Transportation of Timber from Felling Site to Forest Department • Extraction and Transportation of Firewood from Felling Site to Forest Department • Extraction and Transportation of Bally/Poles from Felling site to Forest Department

⁵² For the purpose of issuance of Transit Permit, the Sikkim Transit of Timber and other Forest Produce Rules, 1999 defines 'plants not being trees' as including agave, creeper, dioscores, dephne, edgeworthis, ferns, grass, licopodium, lichens, mushroom, moss and reeds, bamboo, nettle, polygonum, thysanolaena, and all categories of medicinal herbs and shrubs, any agricultural crops, bulbs, rhizomes, tubers and all parts of produce of such plants

⁵³ Report on One Day Cross Sectoral Policy and Integration Workshop on Biodiversity Conservation: Common Goals, Shared Responsibilities, Multiple Policies, 16 June, 2016, UNEP-GEF-MoEF&CC-ABS Project; Available at: <http://sbsikkim.nic.in/pdf/publications/Reports/June2016-Report-Cross-sectoral-Policy.pdf>

⁵⁴ Levied in form of royalty vide notification no. 114/Home/2010 dated October 10, 2010. Available at: <http://sikkimtourism.gov.in/Webforms/General/ActsRulesNotifications/ActRulesNotificationFiles/Trek%20Guidelines.pdf>

⁵⁵ Notification No. 844/799/FCA/FEWMD, dated 23/2/2009; Available at <http://www.sikkimforest.gov.in/docs/Forestry/Schedule%20of%20Rates%202009-%20FCA.pdf>

Economic Instrument	Purpose	Levied On
		<ul style="list-style-type: none"> Rehabilitation, translocation of existing medicinal plants and economically important saplings and herbs/shrubs and replanting as per the direction.
Fines and Penalties	<ul style="list-style-type: none"> Induce behavioural change Keep a check on activities harmful to environment 	On contravention of the provisions of the Regulations being implemented in the State. Also implemented by the local authorities (dzumsa has revenue collection powers and can impose taxes and fines).
Environment Cess (Levied under Sikkim Ecology Fund and Environmental Cess Act, 2005)	Protection of environment and ecosystems	<ol style="list-style-type: none"> Anyone who brings non-biodegradable materials (as specified in Schedule II of the Act) from outside the State for commercial or consumption purposes, at 1% on the sale price from the date of commencement of this Act. Every hotel, resort, lodge or motel operating within the State, at 5% on its annual turnover (The State government may exempt the hotels, resorts, lodges, and motels below a particular turnover). On entry of certain vehicles in the State (Types of vehicles and rates may be specified by State by notification). On any such other item having impact on environment directly or indirectly (Rates may be prescribed by the State by notification).

Source: Compiled by Authors from various sources.

The following Table 6.7 shows the revenue that the State earns from the forestry and wildlife. Over the years, the revenue from this sector has been increasing steadily.

Table 6.7: Revenue Earned from Forestry and Wildlife (Rs. Crore)

Budget Code	Budget Head	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
0406	Forestry and Wild Life	12.53	12.28	14.27	11.45	12.79	16.02
01	Forestry	12.08	11.98	13.95	11.12	12.44	15.86
101	Sale of Timber and Other Forest Produce	3.56	1.43	1.14	1.37	1.72	2.11
01	Receipt from Utilization Circle	0.43	0.49	0.45	1.37	1.72	0.25
02	Receipt from Territorial Circle	3.12	0.94	0.69	0	0	1.86
800	Other Receipts	8.53	10.55	12.81	9.75	10.72	13.75
01	Receipt under Forest Conservation Act-1980	0	0.01	0	0.02	0	0
02	Receipt from Sericulture Activities	0	0.05	0.06	0.05	0.03	0.01
03	Royalties from Forest Produces	7.44	9.60	11.12	9.09	8.64	8.22
04	Other Misc. Receipts	1.08	0.89	1.63	0.58	2.05	5.52

Budget Code	Budget Head	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
02	Environmental Forestry and Wild Life	0.24	0.30	0.32	0.33	0.34	0.16
111	Zoological Park	0.08	0.06	0.07	0.14	0.17	0.00
01	Receipts from Himalayan Zoological Park	0.08	0.06	0.07	0.13	0.17	0.00
02	Receipts from Zoological Park	0	0	0	0.01	0	0
03	Receipts from Wildlife Sanctuaries	0	0	0	0	0	0
112	Public Gardens	0.09	0.02	0.07	0.05	0.02	0.10
01	Receipts from Epica Garden, Saramsa	0.07	0.01	0.07	0.05	0.02	0.09
02	Receipts from Rongnichu Water Garden	0.02	0.00	0.01	0.00	0.00	0.01
800	Other Receipts	0.07	0.22	0.17	0.14	0.15	0.06
01	Receipts from Wildlife Sanctuaries	0.07	0.22	0.17	0.14	0.15	0.06
02	Fees and Fines from Territorial Circle	0	0	0	0	0	0

Source: State Budget, Various Years.

Apart from above-mentioned revenues, the Environment Cess collection under Sikkim Ecology Fund and Environment Cess Act, 2005 is quite significant and is showing a steadily increasing trend over the period of the study (see Table 6.8).

Over the years, the fund has collected a significant amount (Table 6.8). One reason for collection of such significant amount is that it does not lapse at the end of the financial year. These amounts are important source of funds for environmental restoration and biodiversity conservation.

Table 6.8: Collections of Environment Cess and Receipts of Sikkim Ecology Fund (Rs. Crores)

Year	Collection of Environment Cess	Amount in Sikkim Ecology Fund
2011	22.13	9.5
2012	29.35	20
2013	48.83	30
2014	37.83	84.14
2015	37.27	30.09
2016	49.09	51.34

Source: State Budget, Various Years.

Receipts from CAMPA is also an important source of fund that is to be utilized for the purposes of regeneration, development, maintenance and protection of forests and wildlife. The Compensatory Afforestation Fund and Compensatory Afforestation Fund Management and Planning Authority (CAMPA) was established in 2001 after an order of Hon'ble Supreme Court of India to induce the states to utilise the money collected towards compensatory afforestation. In 2006, the Adhoc CAMPA was established to manage the Compensatory Afforestation Fund. Every year, funds were released to all the states and UTs to carry out activities related to compensatory afforestation. Table 6.9 shows

the yearly receipts of Sikkim from Adhoc CAMPA and the expenditure incurred. In 2018, CAF rules were notified and with approval of the Supreme Court on 28 Jan 2019, an amount of Rs.54,685 Crore from Adhoc CAMPA has been brought under the control of Government of India. So far funds to the tune of Rs.47,436 crore have been transferred to 27 states/UTs and Sikkim has received total fund of Rs. 392.36 crore.⁵⁶

Table 6.9: Year-wise Receipts from CAMPA (Rs. Lakh)

Year	Opening Balance	Receipt from CAMPA	Interest Accrued	Total Receipts	Funds Utilized	Closing Balance
2011-12	84.66	904	19.88	1008.54	1007.56	0.98
2012-13	0.98	875.23	20.54	896.75	545.30	351.45
2013-14	351.45	950	31.95	1333.40	939.97	393.43
2014-15	393.43	1370	0	1763.43	999380	763.63
2015-16	763.63	1149.55	0	19	546.61	1366.57
2016-17	1366.57	900	0		586.41	1680.16

Source: Annual Administrative Report, 2016-17, Department of Forest and Environment.

A. *ABS as potential source of revenue from biodiversity*

Sikkim is a treasure house of biodiversity and traditional knowledge associated to it. Enormous amount of bio resources in the State are either conserved in the PA networks, reserved forests or are cultivated under diverse agro-forestry systems: Alder-cardamom-based agroforestry, mix tree-cardamom agroforestry, mandarin mix- tree based agroforestry. Some resources also exist in the alpine, greater Himalayan and Trans-Himalayan landscapes: these areas are also supported by nomadic pastoralism and agro- pastoralism.

There are a large number of plant species that have high economic value and high market demand due to their medicinal importance. There has been a limited research on the chemical composition of these plants. Therefore, the only source of information is the traditional knowledge of the local community members. These communities are still using these indigenous species for health and nutrition purposes.

The implementation of Biological Diversity Act, 2002 and increasing awareness of ABS has created opportunities for local communities for ABS arrangements with bio-prospecting industries. This arrangement will be put in place with the help of Biodiversity Management Committee (BMCs). The formation of BMCs is in process in the State. Out of 185 total BMCs to be formed in the State, 45 have been formed. 4 PBRs have been prepared to document local species and traditional knowledge associated with them. The State is making slow progress in ABS; it has received two applications for ABS on Seabuckthorn (*Hippophae salicifolia*) and Caterpillar fungus (*ophiocordyceps sinensis*).

Sharma (2017) has identified some potential bio resources for ABS which can be evaluated for their medicinal or therapeutic value, or for their dye/fiber yielding properties which can be developed as marketable products (Table 6.10).

⁵⁶ <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1583452>

Table 6.10: Potential Bio Resources of Sikkim

Name (Scientific, Common)	Market Price	Geographical Location	Traditional Uses
Ophiocordyceps sinensis (Yartsa Gunbu)	Rs 250 – 300 per piece Rs 15,00,000 – 20,00,000 per kg	Lachen valley (Green Lake, Muguthang, Thangu Valley, Lashar Valley), Lachung Valley (Dombang Valley, Yumeysamdong Valley, Katao Area), Dzongu Valley (Tholung pass, Kishong Area, Singho Lake Area)	Improves physical performance, reproductive functions, cardiovascular and circulatory functions, respiratory system, kidney and renal system and hepatic system, arrest the growth of cancer cells
Hippophae salicifolia (Seabuckthorn, Achuk)	NE (Not Evaluated)	Riverside, torrential sides and vertical hills and slopes, mostly on the south-east region of Lachen and Lachung Valley	Beneficial in cancer cure, cardiovascular risk reduction, skin diseases and gastrointestinal ulcer and liver protection.
Rhus chinensis (Bhakmilo)	Fruit decoction of this plant is sold at Rs. 1000 per litres	Elevation range of 300 to 2000 m	Preventive and therapeutic effects on different ailments (such as diarrhoea, dysentery, rectal and intestinal cancer, diabetes mellitus, sepsis, oral disease and inflammation)
Docynia indica (Mel)	Rs. 1000 per kg	Elevation range of 1300 to 2000 m	Helpful in dysentery, diarrhoea, and gastric problems
Rhododendron arboreum (Lali –Gurans)	Fruit juice sold at Rs 250 per litre	-	Cure pneumonia, cough, menstrual disorders, dysentery
Asparagus racemosus (Kurilo)	Dried root sold at Rs 600 per kg	-	Improving loss of monopoly, leucorrhoea, asthma, irregular menstruation, piles, pneumonia, epilepsy, gastritis, diarrhoea, gonorrhoea, gout, cardiac weakness and diabetes
Rubia manjith, R. cordifolia (Majito)	Dry matter Rs 60 – 100 per kg	Widely available in the State all along the roadside, shrubberies, wasteland	Treats snake bite, dysentery, leprosy, skin diseases, scorpion bites, menstrual disorder
Terminalia chebula (Harro)	Rs. 70 – 150 per kg	At elevation of 1500 m throughout Sikkim	Used as tonic and also to cure eye, heart and bladder diseases

Name (Scientific, Common)	Market Price	Geographical Location	Traditional Uses
Swertia Chirayata (Chirayito)	Rs 500 per kg	-	Treats asthma, cold, aough, ulcer, asthma, inflammation, piles and skin diseases
Phyllanthus emblica (Rukh amala)	Rs 50 per kg	-	Cure cough, diarrhoea, and dysentery, burning sensation of heat and urinary discharge, liver complaints and eye trouble
Acorus calamus (Bojho)	Rs 200 – 400 per kg	Elevation of 100 – 1800 m in all districts of Sikkim	Treatment of epilepsy and other mental ailments, chronic diarrhoea, colic pain, cold, cough, malaria, skin diseases and asthma. Paste applied as ointment on wounds in cattle, also administered in indigestion
Berginia ciliata (Pakhanbed)	Rs 400 – 700 per kg	Elevation range of 1200 to 3400 m	Used as analgesic and in piles, heart diseases. Juice used to treat wounds, boils and diarrhoea. Root paste treats dysentery, cuts and burns, ulcer and tuberculosis.
Amomum subulatum (Large Cardamom, Alainchi)	Capsule Rs 1200 – 1800 per kg	-	Treats cough, asthma, gastritis, muscle pain, skin diseases, congestion of liver
Artemesia indica (Titey-pati)	NE	-	Treatment of wounds, bronchitis, ulcers, and tuberculosis
Edgeworthia gardneri (Argeli)	NE	Elevation range of 1000 – 2500 m	Used against food poisoning, and eye disorder
Daphne bhoolua (Lokto/Kagatey)	NE	Elevation range of 1600 – 4000 m	Traditionally used for preparing handmade paper
Girardina diversifolia (Bhangrey-sishnu)	NE	Open forests and moist riverside habitats between 1200 to 3000 m	Nettle fiber is processed, spun and woven traditionally to produce durable jackets, porter's head bands or straps, ropes, mats, fishnets, large grain-sacks, mats, bags, and blankets. It is also used for food, fodder and to treat constipation and blood pressure.
Nephrolepis cordifolia (Pani Amala)	Tubers Rs 100 per kg	Found in many climatic conditions of tropical and subtropical region	Warm juice is taken against cold, cough, fever and indigestion
Tetradium fraxinifolium (Khanakpa)	Rs 300 – 600 per kg	Subtropical to temperate agro-climatic zones (1000 – 2500 m)	Used in gastritis, hepatic disorder, dysentery, indigestion, skin disease, abdominal pain, cough and cold
Juniperus spp. (Bhaurungpati Dhup)	Rs 300 – 600 per kg	Juniperus squamata is found between 3700 to 4100 m on warmer slopes	Treats headaches, blood pressure, cough, and cold

Name (Scientific, Common)	Market Price	Geographical Location	Traditional Uses
		Juniperus indica is found between 4000 to 4400 m in the inner dry valleys ascends upto 4800 m	
Cryptomeria japonica (Dhuppi)	NE	-	Used in traditional medicines for a variety of problems like liver ailments, antitussive and antiulcer activities. Also used to cure tumour, eczema, and gonorrhoea
Mahonia napaulensis (Chutro, Kesar)	NE	Elevation range between 1200 – 2900 m	Treat dysentery, diarrhoea, and urinary disorder
Polygala arillata (Marcha Jhar)	NE	-	Used in preparation of starter culture of marcha (yeast cake) which is used to make Jaarnd, Rakshi, Chyang
Acotines	Aconitum ferox: Rs 10,000 per kg Aconitum heterophyllum: Rs 10,000 per kg	-	Aconitum bisma: treats asthma, cough, bronchitis, diabetes Aconitum ferox: antidiabetic, antiseptic, antipyretic, diuretic. Tuber paste used to treat cough, asthma, bronchitis, sore throat, gastric problems, fever, leprosy, food poisoning Aconitum heterophyllum: use as digestic, stomach tonic. Paste of tubers is taken against acute dysentery, bodyache, stomach disorders, fever, hysteria, throat infection, cough, piles.
Narodostachys jatamansi (Jatamansi)	Rs 800 – 900 per kg	Grows in steep moist, rocky and undisturbed grassy slopes between 3500 – 5000 m	Treatment of epilepsy, hysteria, convulsions, heart palpitation, intestinal colic and antiarrhythmic activities, hysteria, irregular menstruation, epilepsy, cholera, cough and jaundice
Neopicrorhiza scrophulariiflora (Kutki)		Elevation range between 3600 – 4800 m. Commonly found in Thangu Valley, Chopta Valley, Khangchendzonga National Park, Kyongnosla Alpine Sanctuary, Barsey Rhododendron	Treats high blood pressure, fever, stomach ache, bile and other intestinal pains, cold, constipation, bronchial asthma, psoriasis and liver infection.

Name (Scientific, Common)	Market Price	Geographical Location	Traditional Uses
		Santuary, Kupup and Gnathang	
Panax spp. (Ginseng, Mangan)	Panax pseudo-ginseng subsp himalaicus is sold at Rs 22000 per kg	Three species Panax sikkimensis, panax bipinnatifidus and Panax sokpayensis is found in Sikkim at the elevation range of 1700 to 3000 m.	Used to treat asthma, diabetes, gastritis, high blood pressure. It is also used to increase immunity. It also improves thinking, concentration, memory, physical stamina. It is also used to improve condition of patients of Alzheimer, depression, anxiety, and fights against particular infections in a lung disease called cystic fibrosis.
Paris polyphylla (Satuwa)	Rs 4000 – 8000 per kg	Grows in moist areas under canopy of forests in full shade or partial shade between 2400 – 3300 m in temperate forests.	Have anti-tumour, anti-leishmanial, anti-tyrosinase, haemostatic, anti-fungal, anti-bacterial, spermicidal activities and immune stimulating properties
Taxas wallichiana (Thingre Salla)	NE	Elevation range between 2300 – 3400 m in the temperate and sub-alpine forest.	Used in respiratory problems, cancer and bronchitis. It also has antifungal, antiviral, anticonvulsant, analgesic, antipyretic and tumour growth inhibitory activity.
Lantana camara (kanika kande, Banmara)	NE	Grows in areas receiving 3000 mm of rainfall per year	Leaf extract is useful as biocides and weedicides. Used in traditional medicines for treatment of cancers, chicken pox, measles, asthma, ulcers, swellings, eczema, tumours, high blood pressure, bilious fevers, catarrhal infections, tetanus, rheumatism, malaria
Piper longum (Pipla)	Rs 1500 per kg	-	Used for diseases of the respiratory tract (cough, bronchitis, asthma); as sedative (in insomnia and epilepsy); as cholagogue (in obstruction of bile duct and bladder), as emmenagogue, as digestive, appetizer and carminative (in indigestion); as general tonic and haematonic (in anaemia, chronic fevers and for improving intellect).

Source: Sharma (2017).

6.4.3 Fisheries

Nature has endowed Sikkim with distinct advantage of abandoned water bodies and varied aquatic life. During 1970s, the establishment of Fisheries in the State as a wing of the Forest Department was a milestone in realizing the high potential of Fisheries in the State. The State earns revenue from this sector mainly in the form of fees, fines and sale of fish and fish seeds (Table 6.11).

Table 6.11: Economic Instruments Related to Biodiversity levied in Fisheries Sector

License Fees	Fines/Penalty	Sale of Fish, Fish Seeds
Keep a check on the number of people indulged in fishing	Induce behavioural change	Recover the cost of production
This keeps a check on the pressure put on the marine resources of the state.	It keeps a check on activities harmful to the marine resources of the State.	Livelihood support to fishermen

Source: Compiled by Authors from various sources.

It is tricky to map revenues from fisheries as attributable to biodiversity because the prime objective of any economic or regulatory instrument implemented in this sector is enhancing livelihood of fishermen. However, following revenues have been identified from the state budget which are relevant for biodiversity conservation (Table 6.12).

Table 6.12: Revenue Earned from Fisheries (Rs. Thousands)

Budget Code	Budget Head	2011	2012	2013	2014	2015	2016
0405	Fisheries	465	262	733	1100	265	412
102	Licence Fees, fines, etc.	115	211	242	258	214	205
103	Sale of Fish, Fish Seeds etc.	12	51	456	626	27	24
800	Other Receipts	338	0	35	216	24	183

Source: State Budget, Various Years

6.4.4 Mining

Although Sikkim is rich in minerals like quartzite, talc, dolomite and limestone; due to difficult terrain, large part of the State is unexplored. However, after having worked in rugged mountain terrain for over a decade and half on various aspects of geology and geo-tectonics, the State Department of Mines, Minerals & Geology has obtained enough experiences and understanding of specific mountain conditions and their imperatives in implementing appropriate interventions /responses. Thus, it will not be surprising if the State witnesses rising mining activities in near future. While contributing to the economic well-being of the State, increasing mining activities will increase the threats to biodiversity in the State. According to Sonter, Ali and Watson (2018), mining has direct and indirect impacts on biodiversity.

To counter these losses, a share of revenue earned in this sector should be provided towards restoration and conservation of biodiversity. Table 6.13 shows the economic instruments by which revenue is raised in mining sector in Sikkim.

Table 6.13: Economic Instruments related to Biodiversity in the Mining Sectors

Economic Instruments	Purpose
Royalty	The mining lease confers upon the lessee the right to extract minerals from the land and to appropriate them for his own use or benefit. For this, the lessee is required to pay a certain amount in respect of the minerals extracted proportionate to the quantity so extracted. ⁵⁷
Fees	Charged for providing mining permit, mining lease.
Dead Rent	Charged to ensure a flow of income to the lessor in case the mine is not being operated on and therefore, no royalty is being paid.
Surface Rent	In a mining lease, a lessee has to pay the lessor the rent for the area leased. This rent is called Surface Rent .
Penalty	On contravention of the provisions of the Sikkim Minor Mineral Concession Rules, 2016.
District Mineral Foundation	Established to counter adverse impacts of mining on environment and livelihood of local people.

Source: Compiled by Authors from various sources.

Rates of royalty, dead rent and surface rent are specified in the Sikkim Minor Mineral Concession Rules, 2016.

One major step taken to counter the loss of livelihood and environment is the setting up of District Mineral Foundation (DMF). In June 2015, the Mines and Minerals (Development and Regulation) Act, 1957 was amended to introduce a new section, i.e., Section 9(B), which provides for the establishment of *District Mineral Foundation* in any district affected by mining related operations, the object of which shall be to work for the interest and benefit of people and areas affected by mining. This fund can be utilized for addressing specific biodiversity concerns due to the mining projects.

Box 6.1: District Mineral Foundation

The District Mineral Foundation is funded by statutory contributions from holders of mining lease, in the following manner:

For Major minerals (as prescribed by Central Government):

- i. 10% of the royalty paid in terms of the Second Schedule to the MMDR Act, 1957 in respect of the mining leases or, as the case may be, prospecting licence-cum-mining lease granted on or after 12th January, 2015; and
- ii. 30% of the royalty paid in terms of the Second Schedule to the said Act in respect of mining leases granted before 12th January 2015.

For Minor Minerals (as prescribed by the State Government):

- i. Ordinary Soil/brick earth/Shale – Re. 1/-per tonne of the mineral dispatch
- ii. All other mineral material – Rs. 10/- per tonne of the Dispatch

The DMF will implement Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) for implementation of development projects in the areas affected by mining. PMKKKY guidelines prescribes that at least 60% of fund shall be utilised for high priority areas:

- i. Drinking water supply
- ii. Environment preservation and pollution control measures
- iii. Health care
- iv. Education

⁵⁷ D.K. Trivedi And Sons And Ors. Etc. ... vs State Of Gujarat And Ors. Etc. Etc on 5 March, 1986.

- v. Welfare of women and children
- vi. Welfare of aged and disabled people
- vii. Skill development
- viii. Sanitation

40% of funds shall be utilised for other priority areas:

- i. Physical Infrastructure
- ii. Irrigation
- iii. Energy and Watershed Development
- iv. Any other measure for enhancing environment quality in mining districts

Out of the permissible works that can be undertaken using the funds of DMF, 3 are related to biodiversity (Environment preservation, Sanitation, and Energy & Watershed Development).

The information about the amount collected under the DMF in the State is not available in the public domain.

Following revenues (in Table 6.14) have been identified from the state budget which are relevant for biodiversity conservation.

Table 6.14: Revenues Earned from Mining (Rs. Thousands)

Budget Code	Budget Head	2011	2012	2013	2014	2015	2016
0853	Non-Ferrous Mining and Metallurgical Industries	1638	1788	1462	3113	1427	1320
800	Other Receipts	1638	1788	1462	3113	1427	1320

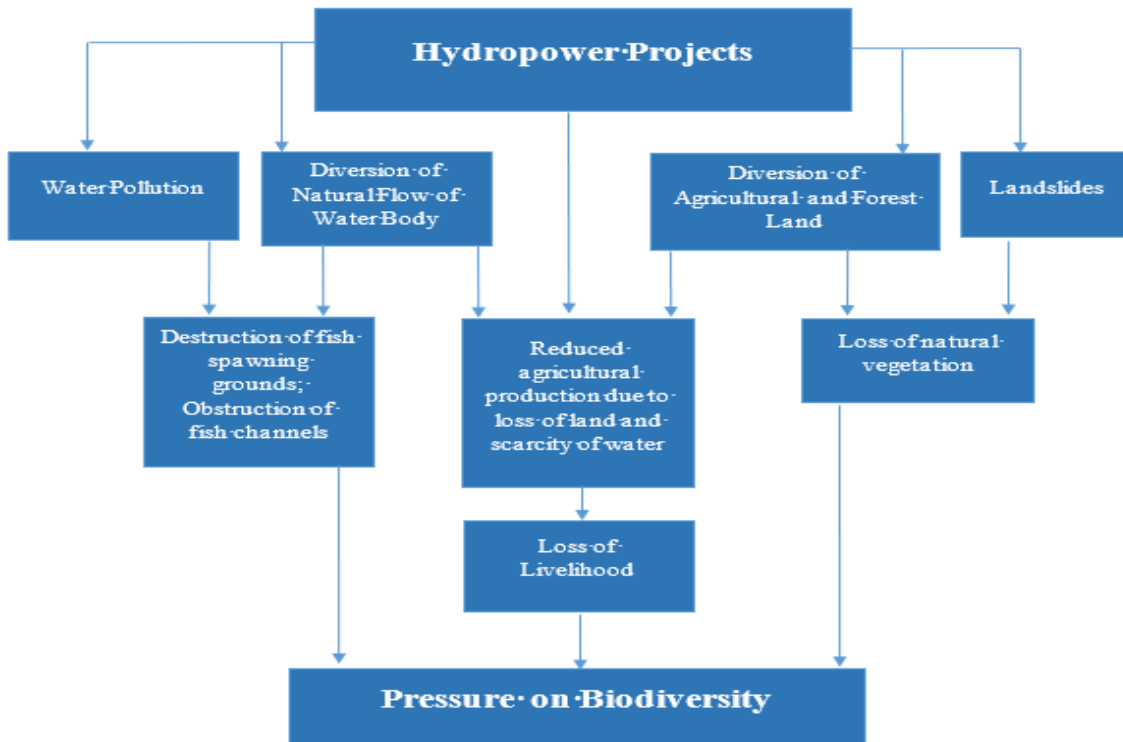
Source: State Budget, Various Years.

6.4.5 Hydropower

Although hydropower is clean energy, the construction of hydropower plants impact livelihood, environment and biodiversity in different ways⁵⁸ is well documented (Figure 6.1).

⁵⁸ Biodiversity and Development of the Hydropower Sector: Lessons from the Vietnamese experience, Policy Brief, ICEM; Available at: <http://icem.com.au/documents/biodiversity/bioHPdevt/Volume%20III%20Biodiversity%20and%20development%20of%20hydropower-policy%20brief.pdf>

Figure 6.1: Impact of Hydropower Projects on Biodiversity



Source: Compiled by Authors

However, the State has the potential to earn large revenues through hydropower projects. According to the ‘Terms for Development’ of the State government for development of hydropower project under private sector for project above 25 MW, the Independent Power Producers (IPP) will provide the State royalty at the rate of 12 percent of net energy for first 15 years. After 15 years of operation, a royalty of 15 percent of net energy will be made available to the Government of Sikkim free of charge by developer.

Box 6.2: Local Area Development Fund⁵⁹

Local Area Fund Development (LADF) has been set up as per provision 10.1 (h) of National Hydro Power Policy 2008.

“An additional 1 percent free power from the project would be provided and earmarked for a Local Area Development Fund, aimed at providing a regular stream of revenue for income generation and welfare schemes, creation of additional infrastructure and common facilities, etc., on a sustained and continued basis over the life of the project. It is recommended that the host state governments would also provide a matching 1 percent from their share of 12 percent free power towards this corpus. This fund could be operated by a standing committee headed by an officer of the State Government, not lower than a district magistrate to be designated by the State Government, male and female representatives of the Project Affected People and the project head nominated by the developer. This fund would be available in the form of an annuity over the entire life of the project.

The objective of establishing the fund is to carry out local development activities so as to ensure visible additional benefit to local communities in the project area.

The Fund would receive revenue from sale of 1 percent additional free power by the project developer and matching share of the State Government from sale of 12 percent free power allocated by the project developer.

The funds of LADF would be kept in a joint account in any scheduled bank. The interest earned on LADF will be a part of LADF.

Source: Draft Guidelines for Management of Local Area Development Fund.

The following Table 6.15 shows the revenue earned from power sector.

Table 6.15: Revenue Earned from Power (Rs. Crore)

Budget Code	Budget Head	2011	2012	2013	2014	2015	2016
0801	Power	79.70	82.90	98.93	113.56	147.68	170.04
01	Hydel Generation	79.68	82.88	98.93	113.56	147.68	170.04
800	Other Receipts	79.68	82.88	98.93	113.56	147.68	170.04
01	Sale of Power	78.67	82.23	98.93	113.56	147.67	169.75
02	Other Receipts	1.01	0.65	0.00	0.00	0.00	0.29

Source: State Budget, Various Years.

6.5 Way Forward

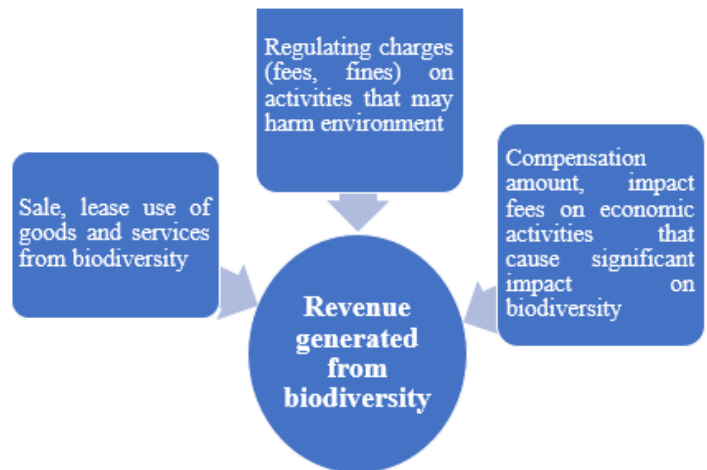
In this chapter, potential revenue sources have been identified; which can be divided into the following categories:

⁵⁹ Draft Guidelines for management of Local Area Development Fund, ministry of Power, dated 23rd October, 2013

http://sjvn.nic.in/writereaddata/Portal/Images/3_DRAFTGUIDELINE_ON_MANAGEMENT_OF_LADF2013.pdf

- i. When revenue is generated from sale, lease, access, use, etc. of goods and services provided by biodiversity.
- ii. When income is generated from implementing policies which regulate economic activities (that impact biodiversity) and encourage sustainable practices such as fee, fines, permits in case of fisheries, tourism, etc.
- iii. When a compensation amount, impact fee etc. are levied on economic activities which cause significant adverse impact on biodiversity sometimes leading to complete destruction and loss.

Figure 6.2: Categories of Revenue Generated from Biodiversity



Source: Authors' Construct

The identified sectoral revenue ranges from 0.29 percent of GSDP to 0.47 percent of GSDP⁶⁰ during the study period which is about 30-50 per cent of the biodiversity attributable expenditure (Chapter 5). Given the enormous natural wealth of Sikkim there appears a significant untapped potential. In this context the following is recommended.

1. **Effective Implementation of ABS:** Companies and other economic entities utilizing bio-resources of the State should be persuaded to share the benefits accrued with the State. Sikkim Biodiversity Board in collaboration with The Mountain Institute, Gangtok has released a report on tradable bio resources of Sikkim. This report identified all the tradable resources of the State that have the potential for ABS. The resources identified in the report should be considered for development of a robust ABS mechanism.
2. **CAMPA Fund and Sikkim Ecology Fund** are promising sources of revenue. There is a need to integrate biodiversity in utilisation of these funds, especially for restoration and afforestation activities. A specific amount should be earmarked for biodiversity conservation, specifically for restoration of endangered and threatened species.
3. **Restore the Sikkim Ecology Fund and Environment Cess Act, 2005:** With the introduction of GST, the Sikkim Ecology Fund and Environment Cess Act, 2005 was repealed. In other words, the environment cess, which was an important source of revenue related to biodiversity (See Table 6.8), is no longer being collected. While discussions on greening of GST framework are in progress, there is need to restore the Environment Cess Act.
4. **Utilisation of District Mineral Foundation Fund:** Although, the mining activities are limited in the State, the mining operations take place nonetheless. The share of DMF meant for environment should be allocated to the Sikkim Ecology Fund for biodiversity conservation.
5. **Increasing Involvement of Dzumsa:** Dzumsa should be encouraged to participate in conservation of biodiversity like regulating environmentally harmful activities, implementing

⁶⁰ Author's calculation, data taken from state budget for various years.

economic instruments within their powers and mandate for encouraging behavioural changes within the community.

The Lachen Tourism Development Committee (LTDC) banned packaged water inside Lachen and imposed a fine of Rs. 5000 on violators (Santyan Bera, 2015). This was done only after the dzumsa agreed to the ban. This has opened up a potential source of revenue as well as has contributed to conservation of biodiversity as the lakes, streams and drainage channels are no longer choked by plastic packaging left behind in the area by the tourists.

- 6. Environmental Fees:** Although Sikkim has implemented entry fees for protected areas, environmental fees for entering ecologically fragile areas which are outside the boundary of protected areas is implemented only in Nathula. Other hill states, like Himachal Pradesh have such environmental fees for major tourist areas (Bir Billing, Manali, Shimla). Sikkim should consider implementation of such levies.

Chapter 7: Financial Needs Assessment Based on Quantitative Targets

7.1 Financial Needs Assessment

The implementation of BSAP whether at the national level or at the state level requires funds. An assessment of the quantum of funds required has been termed as Financial Need Assessment (FNA) in the conceptual framework developed by the global level BIOFIN initiative. The methodology adopted for the purpose of FNA in this report, is inspired by the BIOFIN initiative. This methodology requires detailed data on baselines of various parameters of biodiversity and ecosystems etc. and quantitate BSAP targets.

However, BIOFIN initiative recognizes that appropriate tweaking of suggested FNA methodology will be necessary owing to huge variations across countries on account of:

- (a) Planning & design of how BSAP is translated into implementable programs and schemes;
- (b) The number and type of agencies involved in implementation;
- (c) Whether or not there is a dedicated fund for the purpose;
- (d) Budgeting-processes;
- (e) The status and reliability of baseline data; and
- (f) Governance systems.

In India both NBSAP and SBSAPs are implemented through various programs and schemes of central and state governments implemented by various specialized departments and institutions of both the centre and the state. Notwithstanding limitations of this arrangement a key advantage of this system is that it enables sectoral mainstreaming of biodiversity – one of the key strategic goals of CBD.

The FNA in this report estimates the finances required to implement SBSAP in alignment with existing schemes and programs. In other words, it pertains to only those action points which are not covered in existing programs and schemes being implemented for biodiversity conservation or have not been provided adequate funds (See Chapter 5, and Table 7.1 below).

The quantitative targets for various action points recommended in SBSAP have been derived from various sources: development vision statements for the state and of various departments of the central and state governments, and targets of existing schemes, policies, programs and mission statements of different government departments of Sikkim. This is because these policies, schemes, programs and action plans have been approved after much deliberation at the highest levels in the government. Financial projections for the quantitative targets were made by using government approved costs and approved norms for per unit costs.

The action points identified from the SBSAP of Sikkim (Chapter 4) form the basis of the assessment. These action points are spread across 14 thematic areas: Biodiversity Database, In-situ Conservation, Ex-situ Conservation, Agrobiodiversity, Animal Husbandry and Livestock, Impact of Climate Change, Tourism, Management of Invasive Species, Impact of Pollution, Sustainable Utilization of Biodiversity Resources, Valuation of Biodiversity Resources, Promotion of Awareness on Biodiversity Conservation, Policy, Legislation and Administrative Measures, and Regional, National and International Coordination.

Table 7.1: Financial Needs Assessment

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
1. Biodiversity Database Management					
1.1 PBRs and BMCs					
1.	Necessary training and awareness for BMCs should be organized on the various themes identified in SBSAP	49 BMCs ⁶¹ .		No additional fund required	The funds will be released by NBA after the SBB provides a statement of expenditure or a utilisation certificate.
2.	Preparation of PBRs in all BMCs	45 PBR 15 PBRs have been formed and 4 PBRs have been approved. 30 BMCs now need to make their PBRs.			The State will have to bear the cost of digitisation of PBRs, as has been done in Kerala. ⁶² For this, the State can host the digitised data on ENVIS Portal or the website of SBB. For the process of digitisation, the SBB needs to float a tender and based on the quotation received make a decision on how much should be spent for this purpose.
2. In-situ Conservation					
2.1 Human Wildlife Conflict					
1.	Habitat improvements with species which prey animals and fruiting trees	Annual Target – 12,000 ha in 2020-21 ⁶³ (Long term target of 61302.60 ha ⁶⁴ to be met over 5 years)	<ul style="list-style-type: none"> ➤ CAPMA ➤ National Afforestation Programme 	Annual Cost = Rs. 15 crores	Restoration Potential in North District 61,302.60 ha. ⁶⁵ (Assumed that this Target will be met over 5 years)

⁶¹ http://sbbsikkim.nic.in/pdf/publications/Reports/singhik_28_07_2014.pdf

⁶² Kerala SBB Annual Report 2018-19

⁶³ Target and cost taken from HP. As HP is a Himalayan state, the cost and targets there can be taken as proxy for Sikkim.

⁶⁴ WRI report, 2018

⁶⁵ WRI report, 2018

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
2.	Periodic clearing of shrubs in habitat to facilitate free movement of and prevent straying of animals	Yearly target = 2500 ha for very dense and 2500 ha for moderately dense forest. ⁶⁶	➤ MGNREGA	Total Annual cost for VDF and MDF = Rs. 4.72 crore	Very Dense Forest area – 1,101.96 sq. km (110196 ha); Moderately Dense Forest area: 1552.31 sq. km (155231 ha) (Long term target) ⁶⁷
3.	Sterilization of animals like monkeys and Boar	Set up four sterilization units in the State, one in each district		Cost of setting up 4 units = Rs. 3.87 crore	HP has set up 8 units at a cost of Rs. 7.74 crore.
2.2 Restoration Potential					
1.	Initiate a long-term restoration program for the degraded oak and conifer forests	Annual Target = 12,000 ha ⁶⁸	➤ CAMPA ➤ NAP ➤ State Green Missions	Annual cost = Rs. 15 crores (to be incurred for nine years).	Restoration Potential in North District 61,302.60 ha. ⁶⁹ (Assumed that this Target will be met over 5 years)
2.3 Poaching and Illegal Trade in Wild Animals and Plants					
1.	Strengthen the DFE by providing them with adequate manpower, training, mobility and requisite equipment		➤ Integrated Development of Wildlife Habitat ➤ Externally Aided Projects like SBFP-JICA	No additional funding needed. To be imparted as part of regular training.	
2.	Develop a scheme for intelligence gathering using locals on illegal poaching and trade of animals and their derivatives. Local dissemination centers should be created for mobilizing locals	Train three existing clusters of 15 Himal Rakshaks in each cluster for setting up information dissemination centers	➤ Criminal Tracking Network and Systems ⁷⁰	Annual cost Rs. 15,000	HP Training Manual ⁷¹ specifies training for 50 participants for 3 days In addition to the mentioned scheme, the State can seek support

⁶⁶ The annual target has been taken from HP State budget, 2020-21 because HP is a Himalayan State like Sikkim.

⁶⁷ Periodic cleaning comes under thinning practice for forestry where the standard thinning cycle is 10 years, as outlined in Forest Manual (Volume- IV), Himachal Pradesh

⁶⁸ The annual target has been taken from HP State budget, 2020-21 because HP is a Himalayan State like Sikkim.

⁶⁹ WRI report, 2018

⁷⁰ Through correspondence with the office of DGP-HP, it became clear that even the crime related to wildlife under the Wild Life Protection Act, 1972, and Indian Forest Act, 1927 respectively are being registered under the CCTNS CAS. This information has been used to make the recommendation of the mentioned scheme.

⁷¹ HP Training Manual Agriculture, accessible at: <http://www.hpagriculture.com/Trg.%20Man.%20&%20Trg.%20PI.%202013-2014.pdf>

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
					from international agencies like TRAFFIC, SAWEN, and WCCB.
2.4 Forest Fire					
1.	Provision of cooking gas to reduce dependency on biomass-based stoves often used in open areas	Target: 5973 beneficiaries ⁷²	Pradhan Mantri Ujjwala Yojana	@highest cost norm = Rs. 1.86 crore per annum	Cost taken from Modalities for implementation- Pradhan Mantri Ujjwala Yojana (PMUY) ⁷³
2.	Awareness about consequences of forest fires among both locals and tourists	Publicity in electronic media – 20 Nos. Awareness camps – 40 Nos. Publicity in print media – 75 nos.	Integrated Forest Management Scheme CSS-IDWH CAMPA EAP	Annual Cost = Rs. 10.75 lakh	The funds can be mobilised from the scheme mentioned.
3. Ex-Situ Conservation					
3.1 Conserving Genetic Diversity					
1.	Establish seed banks for seed conservation and participatory plant breeding for seed development, germplasm collection, freezing and storage	One	➤ Establishment and Maintenance of Seed Bank ⁷⁴	Rs. 69,61,760 per annum	Cost has been taken from National Mission for Himalayan Studies (Implemented by MOEF&CC) ⁷⁵
3.2 Seed Banks					
1.	Set up a community seed bank	Target: 12 Community Seed banks to be set up	➤ Sub mission for seed and planting material (SMSP) under NMSA ➤ Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds (CSS Scheme)	@ highest Cost for 12 Community Banks = Rs. 6.82 crore per year	For construction of seed banks, the lowest expenditure occurred in Sikkim is Rs.16.87 lakh in Malbassey and highest is Rs. 56.86 lakh in Majhitar. (Annual Progress Report, 2012-13, Agriculture department, Sikkim)

⁷² 8,747 recorded beneficiaries on record. Till 2018, 2774 connections were released. Therefore the target comes out to be 5973 beneficiaries

⁷³ http://petroleum.nic.in/sites/default/files/P_17018_1_2016_Lpg%28Pt%29_PMUY.pdf

⁷⁴ http://seednet.gov.in/PDFFILES/Guidelines%20for%20seed%20bank_Revised_.pdf

⁷⁵ http://nmhs.org.in/MG_02_2018_19.php

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
2.	High Tech Nursery should be developed in Chungthang to support species like silver fir, juniper, and rhododendron.	One Nursery in Chungthang	Green India Mission and State Green Missions	Rs. 10 lakh per nursery	Funds may be mobilised from the scheme mentioned
4. Animal Husbandry and Livestock					
1.	Develop a Fodder Bank	One fodder bank in an area of 6 ha to be set in SECURE Landscape	<ul style="list-style-type: none"> ➤ Rain fed Area Development Component of NMSA (CSS, Ministry of Agriculture) ➤ Sub mission on Fodder and Feed Development under National Livestock Mission 	Total Cost = Rs. 9 lakhs Rs. 6 lakhs for establishment and Rs. 3 lakhs for unforeseen and unexpected expenditure	Cost taken from Operational Guidelines- National Livestock Mission ⁷⁶ Fodder shortage has reported to have caused death of 300 Himalayan Yaks in 2019 in Muguthang Valley as it is the most vulnerable region in the area for fodder crisis. The Department of AH&VS has estimated that for winters of 2019, there is a need for 84 MT of fodder for 933 Yaks in Muguthang for 60 days. To meet the demand of fodder in Muguthang and Gurudongmar, the Department needed to make provision to supply complete feed block and chelated mineral mixture fodder enough to last for 3 months (approximately 1,80,000 kg). ⁷⁷
2.	Facilitate artificial insemination using yak semen in the state, as has been	Introduce One farm	➤ Yak Development Programme	@highest cost norm = Rs. 91,000 ⁷⁸	

⁷⁶ <http://dahd.nic.in/sites/default/files/REVISED%20GUIDELINES%20OF%20NLM%2027.04.16.pdf>, page 71

⁷⁷ W.P. (PIL) No. 08 of 2019 in RE: 300 Yaks Starve to Death in North Sikkim v. State of Sikkim

⁷⁸ <http://www.agriclinics.net/artificialinsemination.htm>

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
	successfully conducted in Himal Prakriti in Paton, Uttarakhand.				
5. Sustainable Utilisation of Biodiversity Resources					
1.	Technological interventions, processing units and support for marketing, packaging etc. for bamboo	Set 1 bamboo bazaar and Training of farmers that are already cultivating bamboo or are willing to take up bamboo.	➤ National Bamboo Mission	Budget allocated by centre is Rs. 5.51 crore as its 90% share for National Bamboo Mission. State needs to contribute approximately Rs. 60 lakhs as its 10% share	Technological intervention through training of farmers – Rs 1000/per day. ⁷⁹ Bamboo Bazaars – Rs. 48 Lakh/unit
2.	Train communities for scientific bee management and technological interventions and training of community	Total batches of 25 individuals each to be trained = 176 ⁸⁰	➤ Mission for Integrated Development of Horticulture ➤ Green Skill Development Programme	State needs to raise = Rs. 8.80 crore	Cost taken from Cost norms of National Beekeeping and Honey Mission ⁸¹
6. Management of Invasive Species					
1.	Prepare plan for planting or regenerating native species	Target = 3000 ha ⁸²	➤ CAMPA ➤ National Afforestation Programme	Total Cost = Rs. 4.55 crore ⁸³	According to FSI 2019 ⁸⁴ , the area infested with IAS in Sikkim is a total of 3000 ha.
2.	Capacity building particularly at field level to control spread of invasive species.	Himal Rakshaks – almost 45 ⁸⁵ Forest Guards - 309	➤ CSS-IDWH ➤	Rs. 15,000 per year	HP Training Manual ⁸⁶ specifies training for 50 participants for 3 days

⁷⁹ <https://vikaspedia.in/agriculture/policies-and-schemes/crops-related/krishi-unnati-yojana/mission-for-integrated-development-of-horticulture/national-bamboo-mission>

⁸⁰ According to the Operational guidelines of national beekeeping and honey mission, the duration of training in bee keeping will be 7 days for and the limit on candidates in one training session is 25 individuals. The target can be set at training 25 individuals at each GPU level. Total GPU in Sikkim – 176

⁸¹ <https://nbb.gov.in/Archive/Cost%20Norms%20MM%20-%20I.pdf>

⁸² <http://sikenvis.nic.in/WriteReadData/UserFiles/file/2019%20FSI%20SIKKIM.pdf>

⁸³ Cost norms have been taken from the HP CAMPA Cost Norms for Rehabilitation of forest areas infested with Invasive Alien Species.

⁸⁴ <http://sikenvis.nic.in/WriteReadData/UserFiles/file/2019%20FSI%20SIKKIM.pdf>

⁸⁵ <https://www.livemint.com/news/india/meet-sikkim-s-warriors-for-sustainable-tourism-11577812665484.html>

⁸⁶ HP Training Manual Agriculture, accessible at: <http://www.hpagriculture.com/Trg.%20Man.%20&%20Trg.%20PI.%202013-2014.pdf>

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
					Training of forest guards to be a part of regular training. Funds can also be drawn from the Externally Aided Projects like SBFP-JICA.
3.	Establish a quarantine cell in the state to check the introduction of invasive species within the State.	One quarantine facility to be established.	➤ Strengthening & Modernization of Plant Quarantine Facilities	Funding Required = Rs. 66.25 lakh	Cost norms for the scheme “Strengthening & Modernization of Plant Quarantine Facilities” ⁸⁷
7. Tourism					
1.	Sensitization of hotel owners, drivers and guides is necessary about the ill-effects of unplanned tourism and fragile biodiversity	Target for sensitization ⁸⁸ : <ul style="list-style-type: none"> • Hotel owners: 1021 • Drivers: (646 + 6445)⁸⁹ = 7091 • Guides: 66 Since sensitization is a regular exercise, needed to be undertaken each year, the total yearly target = 3544 ⁹⁰	<ul style="list-style-type: none"> ➤ EAP: South Asia Tourism Infrastructure Project ➤ Tourism Department (Following Sikkim Tourism Policy 2018) 	Total annual cost for sensitisation = Rs. 10,63,200	HP Training Manual ⁹¹ specifies training for 50 participants for 3 days For this purpose, the state can also engage NGOs like ATREE, and WWF.
2.	Popular trekking trails should have fee associated to the entrance.	12 trek trails, mentioned on the		No additional fund required	Permits can be issued at the same offices where permits are issued for going to North Sikkim.

⁸⁷ <http://diragrikmr.nic.in/assets/files/Plant%20Quarantine%20Facilities%20in%20India.pdf>

⁸⁸ Sikkim State Tourism Policy 2018, Available at: http://sikkimtourism.gov.in/Webforms/General/pdf/Sikkim_Tourism_Policy_10.pdf

⁸⁹ Assuming one driver per registered cab.

⁹⁰ Target has been taken from HP, another Himalayan State.

⁹¹ HP Training Manual Agriculture, accessible at: <http://www.hpagriculture.com/Trg.%20Man.%20&%20Trg.%20PI.%202013-2014.pdf>

S. No.	Action Point	Targets	Scheme	Funding Gaps (Per annum)	Remarks
		website of the tourism department. ⁹²			
8. Promotion of Awareness on Biodiversity					
1.	Prepare short films and documentaries on ecological wealth of Sikkim and on challenges faced by ecology of Sikkim	One documentary on the lines of the documentary produced in Karnataka.	Externally Aided Projects: SBFP-JICA CSS-IDWH CAMPA	Annual Cost = Rs. 50 Lakh	In Karnataka, Rs. 20 million was total budget to prepare a documentary ⁹³ over four years
2.	Radio programs, Stories in print media Comic strips- weekly columns in local newspapers, animation films	Publicity in Print media – 75 numbers Publicity in electronic media – 20 numbers	Externally Aided Projects CSS-IDWH CAMPA	Annual Cost = Rs. 6.75 lakh	Cost taken from Annual administration report 2016-17 of Sikkim Forest and Environment Department ⁹⁴
9. Policy, Legislation and Administrative Measures					
1.	Presence of Himal Rakshaks needs to be encouraged in the KNP fringe village areas.	One cluster to be formed in KNP on the lines based on the three clusters of Yambong, Yuksam, Uttarey. Currently one cluster on average has 15 members. Thus, target is to form one cluster of KNP with 15 members.		Rs. 5,000	HP Training Manual ⁹⁵ specifies training for 50 participants for 3 days
Total Additional Funds Required				Rs. 63.57 crore per year	

⁹² <http://www.sikkimtourism.gov.in/Webforms/General/AdventureSports/Trekking.aspx>

⁹³ <https://thewire.in/environment/film-puts-karnatakas-biodiversity-on-the-global-map>

⁹⁴ <http://sikenvis.nic.in/WriteReadData/UserFiles/file/Annual%20Administrative%20Report%202016-17.pdf>

⁹⁵ HP Training Manual Agriculture, accessible at: <http://www.hpagriculture.com/Trg.%20Man.%20&%20Trg.%20PI.%202013-2014.pdf>

7.2 Mobilizing Conservation Finance

We suggest a combination of the following 4 different strategies for mobilisation of additional funds.

7.2.1 Leverage existing sources like MNREGA, CAMPA, and Agriculture and horticulture sector schemes

There is a need to focus on mobilising resources through CAMPA, and other well-funded Sectoral schemes such as the MGNREGA, Parampragat Krishi Vikas Yojana, Rashtriya Krishi Vikas Yojana, National Agroforestry Program, KUSUM, and National Mission on Sustainable Agriculture -- for implementation of relevant SBSAP action points covered under these schemes and programs. This will require the relevant departments to pro-actively identify, plan, and prioritise their activities accordingly so that the allocations made to their respective departments are fully and efficiently utilised in a systematic manner. In other words, the departments will need to augment their execution and thus absorption capacity.

Analysis in Chapter 5 clearly brings out that the key interventions required for conservation of biodiversity such as: conservation of endangered species, afforestation, management of protected areas, conservation of ecosystems like wetlands, river rejuvenation; budgetary finance is the primary sources of funding in India. The BER analysis shows that in Sikkim, biodiversity relevant expenditure has increased from Rs. 79.58 crore in 2011-12 to Rs. 202.05 crore in 2016-17 and has been projected to increase to Rs. 319 crores in 2020-21. The detailed analysis shows that while some aspects of conservation have received the required policy and programmatic focus along with adequate funding, in some areas increase in both the policy focus and funding is necessary. For instance, while a significant share (over 60-65%) of the total biodiversity attributable expenditure is being spent on ‘protection’ of biodiversity in the state; expenditure on restoration has been low (2.5-4.54%) especially when compared with restoration needs in the state. This calls for a greater policy focus and additional funding on restoration. Similarly, additional funding will be required in other key areas such as management of HWC, livelihood support, adequate compensation of farmers as an incentive for wild biodiversity conservation, training and awareness etc. (Table 7.1).

Table 7.2: Economic Instruments Levied Across Economic Sectors in Sikkim

Sector	Economic Instruments
Tourism	Fees: <ul style="list-style-type: none"> • Maintenance fee for expedition and trekking routes • Registration of Tourist Trade and Homestays • Environmental Fees Penalty: <ul style="list-style-type: none"> • Sikkim Registration of tourist Trade Act, 1998 • Levied by local bodies
Forestry and Wildlife	<ul style="list-style-type: none"> • Royalty • Import Fees • Transit Permit • Entry Fees to Pas • Environmental Fees • CAMPA fund • Fines and Penalties

Table 7.3: Economic sectors for Mainstreaming Biodiversity

Sector	Economic Instruments
Mining	<ul style="list-style-type: none"> • Royalty • Permit fees • Surface Rent • Penalties • District Mineral Foundation
Hydropower	<ul style="list-style-type: none"> • Royalty • Sale of power • Local Area Development Fund

7.2.2 Augment Ecology fund, Local Trust Fund through rationalising user charges, environment tax/cess, CSR.

PA: The funding support to PAs is often limited with the exception of tiger reserves, leading to a resource crunch in the other PAs.⁹⁶ The Government of Sikkim has already developed a ‘Local Trust Fund’ for each PA in the state which is serviced by the entry fee of PAs —70 percent of the proceeds go to EDCs and 30 percent are retained by the DFE for the management of the PAs. The state government should consider revising and rationalizing the entry fee commensurate with the demand for the PA and the pristine nature and services it offers. The state should also consider and levy a conservation cess on tourism activities in 4-5 sq. km. area around PAs for augmenting the receipts of Local Trust Fund.

The example of a nature-tourism based pilot project carried out by USAID (2017) in some villages around Kitam Bird Sanctuary in Sikkim is useful. The project worked with the local communities and developed a Kitam Village Ecotourism Development Committee (KVEDC) for generation of revenue through various nature-based activities like bird-watching, butterfly watching and trekking. The pilot project is reported to have been successful with potential for scaling up and replication in other parts of Sikkim. A part of the revenue is used for providing compensation to victims of HWC.

CSR: The potential of CSR expenditure on biodiversity is estimated at Rs. 718.44 crore (Pandey et al, 2019) for India. The same study shows that in India currently 2.64 percent of total CSR is being spent on biodiversity. The reasons for low CSR investment towards biodiversity are twofold— biodiversity is a complex multidisciplinary subject and that the projects in this sector are of long gestation and often with intangible results and benefits. In order to overcome this, at least partially, there is a need for SBB to develop a pipeline of projects in priority areas of biodiversity in Sikkim. SBB should develop collaboration with the India Business and Biodiversity Initiative (IBBI) for guidance and technical help.

7.2.3 Restore Environment Cess Act and levy a charge on identified sectors:

- (i) GST has subsumed a number of indirect taxes and cess at Central and State levels. In Sikkim, with the introduction of GST, Environment Cess Act, 2005 was repealed. In other words, the environment cess, which was an important source of revenue (with annual collections ranging from 38 crore in 2015 to 49 crores in 2015-16), is no longer being collected. While discussions on greening of GST framework are in progress, there is need

⁹⁶ Biodiversity Finance Plan, 2019

to restore the Environment Cess Act. It is important to mention here that GST has a provision for exemptions, for instance the Coal Cess Act has been provided exemption and therefore the Coal Cess is still being collected.

- (ii) Mining and Hydro power operations inflict negative stress on biodiversity. A number of charges are levied on these two sectors which go the general budget or collected in a special fund. For instance, in the case of Mining sector besides royalty and other levies, there is a 'District Mineral Fund'. Similarly, from Hydro power sector besides the royalty and other charges there is a 'Local Area Development Fund'. We propose, that 50 percent of the annual accruals in these funds be charged as 'biodiversity cess' and be transferred to the 'Ecology Fund' of Sikkim.
- (iii) Tourism department, and tourism activities by Forest department, and private sector tourism activities benefit from the presence and enhancement of biodiversity. We propose that a 'biodiversity cess' at 5 to 8 percent on revenues from the tourism activities (irrespective of the department involved) be charged and be transferred to the 'Ecology Fund' of Sikkim.

7.2.4 Focussed Efforts for Realising the Full Potential of ABS

ABS is a highly underutilised tool in Sikkim. SBB should prepare a detailed action plan on ABS with the help of policy and planning support from technical agencies.

The ABS provisions of the Convention on Biological Diversity (CBD) are designed to ensure that the physical access to genetic resources is facilitated and that the benefits obtained from their use are shared equitably with the providers. In some cases, this also includes valuable traditional knowledge associated with genetic resources that comes from indigenous and local communities.

ABS is an important tool for raising conservation funds at the same time ensuring its equitable distribution. It is based on the principle that the proceeds from commercialization of biological resources should contribute to conservation of the resources that are monetized, and for bridging the gap between users and providers/conservers of biological resources. Of all the funds accrued by the NBA from ABS, five per cent is to be used by the NBA; of which 50 percent is to be passed on to the concerned SBB for administrative charges⁹⁷. The remaining ninety five percent of ABS amounts are to be disbursed to the concerned BMC(s) and/ or benefit claimers⁹⁸. If the benefit claimers are not identified, the funds accrued are to be used to support conservation and sustainable use of biological resources and to promote livelihoods of the local people from where the biological resources are accessed. Similarly, when the SBB grants the approvals directly under the ABS Guidelines, it can retain 5 percent of ABS fees towards administrative charges and the remaining 95 percent is to be passed on to the relevant BMC or to the benefit claimers directly⁹⁹.

7.2.5 Carbon Credits

Carbon credits create a market for reducing greenhouse emissions by giving a monetary value to the cost of polluting the air. The mechanism of carbon credit trading was formalised in Kyoto Protocol, which is an international agreement among more than 170 countries. Under the Protocol, all the developed countries are assigned a quota or cap for greenhouse gases known as '**Assigned amounts**'. The countries that are not able to use up their quota are allowed to sell it to the country who has outrun

⁹⁷ Regulation 15 (1) (a) of the ABS Guidelines, 2014

⁹⁸ Regulation 15 (1) (b) of the ABS Guidelines, 2014

⁹⁹ Regulation 15 (1) Proviso of the ABS Guidelines, 2014

its quota of emissions, thus rewarding the country that has reduced its emissions and thus, has unused quota left (UNFCCC, 2008). In India, there are precedents where civic bodies or PSUs have generated revenue using carbon credits. The most recent example is that of Indore Municipal Corporation, which has generated a revenue of Rs. 50 lakhs by trading 1.70 million tonne of CO₂ under Verified Carbon Standard (VCS) Programme of UNFCCC. The civic body had registered three of its projects – a 600 tonnes-a-day compost plant, a bio methanation plant of 35 35 Tons Per Day (TPD) capacity and a 1.5 MW solar plant under the Verified Carbon Standard Programme. These projects reduced carbon emissions by over 1.70 lakh tonnes (PTI, 2020). In past, Delhi Metro Rail Corporation (DMRC) has benefitted from sale of carbon credits. In fact, Delhi Metro is the world's first railway network to earn carbon credits from UNFCCC. In 2011, the United Nations body administering the clean development mechanism under the Kyoto Protocol had certified that Delhi Metro has reduced emissions which earned DMRC carbon credits. The sale of these carbon credits has fetched DMRC a revenue of Rs. 2.41 crore (PTI, 2011).

The Kyoto Protocol focuses on soil conservation by identifying the sequestration of carbon in soil as a global environmental benefit that is eligible for payments under the carbon credit mechanism (Dumanski, J., 2004). NITI Aayog, in its virtual high-level round-table on 'Agroecology and Regenerative Agriculture' stressed that India can have access to carbon credits worth USD 50-60 billion if it propagates natural farming and agroecology.

Taking lessons from these experiences, Sikkim can explore the option of registering its environment friendly programmes and initiatives under VCS and generating revenue through the carbon credits earned. Following are some recommended programme that can be considered:

- Sikkim Organic Mission
- Restoration of degraded landscape
- Initiative to address the issue of invasive species
- Explore the feasibility of introducing electric vehicles for public transport; like electric cars for taxis, or electric buses (as has been done in Himachal Pradesh).

7.3 Other Sources

7.3.1 Payment for Ecosystem Services (PES)

The basic idea behind PES is that those who provide ecosystem services – like any service – should be paid for doing so. The 'business-like' conditional payment form is what differs PES from traditional conservation mechanisms and therefore provides an opportunity to put a price on previously un-priced ecosystem services like climate regulation, water quality regulation and the provision of habitat for wildlife and, in doing so, brings them into the wider economy. International donors, impact investment funds, private donors are potential funders of PES programs.

However, absence of data and symmetric information and difficulty in monitoring the effectiveness of PES schemes are issues that need to be addressed before a PES Scheme is implemented successfully. As mentioned in Chapter 4, a PES Opportunity Assessment is necessary to guide decision making and implement such a scheme. For the implementation of PES-Biodiversity scheme and to guarantee its

sustainability, Picharillo and Ranieri (2019)¹⁰⁰ have identified important elements to prioritise; listed below

1. Ecological elements of the landscape must prioritise the following:
 - Areas with highest richness of species, and with the highest number of threatened, vulnerable and rare species
 - Areas with flagship species as well as endemic species
 - Areas with species having commercial and economic value
 - Areas which are required for persistence and survival of these species
 - Areas which have fragments of vegetation with high degree of naturalness
 - To achieve highest environmental benefits, biodiversity conservation should be integrated with one or more ecosystem services such as water and carbon, and obtain local and global beneficiaries to pay for it
2. Socioeconomic and governance elements
 - Areas with the lowest land opportunity cost (Payment must be greater than the income obtained from the best land use alternative, to ensure sustainability of scheme)
 - Areas with clear land tenure rights because poorly clarified property rights make it difficult to legalize payment contracts
 - Consider transaction costs such as costs of negotiating, administrating, monitoring, executing to design an effective scheme where benefits outweigh the costs
 - Prioritise the areas where there are empowered social organisations, and more political and institutional capacity
 - Involve locals who have the highest stake in conservation

PES is an example of a market-based mechanism which has a potential to link up geographically disparate providers and beneficiaries as some ecosystem may be generated at one place, and benefits may be felt at considerable distances from their point of origin (flood control benefits associated with plantation may be felt by downstream communities a significant distance away).

¹⁰⁰ https://www.scielo.br/scielo.php?pid=S1414-753X2019000100321&script=sci_arttext&tlng=en

Chapter 8: Financial Solutions for SECURE Landscape

One of the key objectives of this study is to prepare process documents for 1-2 replicable and scalable financial solutions to be implemented in Khangchendzonga Landscape in Sikkim. After conducting extensive field visits, consultations with relevant authorities, experts and communities; two solutions have been identified in consultation with and under approval of the forest and wildlife department of the state. These are ‘Community Fodder Bank’, and ‘Restoration of Degraded Land’.

Both these solutions can be characterised as financial solutions as well as the core conservation and protection solutions. For each of these financial and conservation solutions the following aspects have been covered:

- i. The context and need assessment
- ii. Data and technical requirements
- iii. Estimates of financial implications or costs involved
- iv. Management and governance mechanisms and structures
- v. Best practices (global, local) and lessons.

8.1 Community Fodder Bank

8.1.1 The Context and Need Assessment

ICAR’s Indian Grassland and Fodder Research Institute (IGFRI) in its vision document¹ for 2050 noted that there is a pressing need to meet the demand of green fodder in India, and also enhance their productivity using good quality fodder (Table 8.1).

In North Sikkim, shortage of green and dry fodder exists mainly due to harsh winter and poor connectivity from other parts of

the state during this time, besides there are quality and nutrition issues. To address the shortage of fodder, the Department of Animal Husbandry and Veterinary Services (DoAH&VS) has undertaken various steps such as establishing fodder cultivation farms (Box 8.1)¹⁰¹ across the state and establishing hay storage farms in North Sikkim (Table 8.2). However, the shortage of fodder still persists. For instance, for winter of 2019, the estimated need in Muguthang was 84 MT of fodder for 933 Yaks for 60 days. The hay storage facility at Muguthang can store only 36 MT of fodder. In Gurudongmar region the fodder need is estimated at 1,80,000 kg for 3 months which does not even

Table 8.1: Feed and Fodder Deficit in India (MT)

Fodder Type	Particulars	Year		
		2015	2020	2025
Dry	Requirement	491	530	550
	Availability	387	408	433
	Deficit (%)	21	23	21
Green	Requirement	840	880	1000
	Availability	619	596	600
	Deficit (%)	26	32	40
Concentrates	Requirement	87	96	105
	Availability	58	61	65
	Deficit (%)	34	36	38

Source: Standing Committee on Agriculture (2016-17)

¹⁰¹ In which nutritionally high quality, succulent and high yielding exotic fodder such as hybrid Napier para grass cow-pea, guinea grass etc. are produced. From these farms the department has been continuously distributing seedlings, saplings and cutting to the farmers for fodder development in their own fields Apart from these farms, various types of fodder plants are being cultivated in the veterinary institutes of the State for the purpose of distribution of planting material to the farmers.

have a storage facility. Similarly, in other parts also fodder is reported to be in short supply. Therefore, during our field consultations, the idea of having a fodder bank has been received with huge interest from all concerned – the state’s Forest and Environment Department, AH&VS Department, PMU UNDP as well as local governance bodies and communities.

Table 8.2: Fodder Storage in North Sikkim

Infrastructure	Location	Jurisdiction
Hay storage	Rabum	Lachen Dzumsa
Hay storage	Dengna, CL	Lachen Dzumsa
Hay storage	Temchi	Lachen Dzumsa
Hay storage	Samdong, CL	Lachen Dzumsa
Yak Shelter	Talam, CL	Lachen Dzumsa
Yak Shelter	Byamzey, CL	Lachen Dzumsa
Hay storage	Thangu, CL	Lachen Dzumsa
Hay storage	Muguthang, CL	Lachen Dzumsa
Yak Shelter	Namdosa	Lachung Dzumsa
Hay storage	Leema, CL	Lachung Dzumsa

Note: CL is community Land.

Source: W.P. (PIL) No. 08 of 2019 in RE: 300 Yaks Starve to Death in North Sikkim v. State of Sikkim.

Box 8.1: Fodder Farms in Sikkim

- Karfectar (Jorethang, South Sikkim)
- Nandugaon (Jorethang, South Sikkim)
- Mangalbarey (Jorethang, South Sikkim)
- Dodak (Soreng, West Sikkim)
- Upper sombaria (Soreng, West Sikkim)
- Chujachen (Rongli, East Sikkim)
- Rorathang (Pakyong, East Sikkim)

What is a Community Fodder Bank?

A Community Fodder Bank (CFB) is formed when a group of farmers come together, to raise multiple fodder crops consisting of trees, grasses and legumes (largely in wastelands), to meet the following objectives:

- i. To meet fodder requirements, especially during peak winter.
- ii. To increase the productivity of livestock with nutrition through quality feed.
- iii. To reduce pressure on forests and replenishing arable lands that has lost fertility.
- iv. A CFB also serves as a channel to restore “lost” varieties of fodder plants.

8.1.2 Lessons from Best Practices

Based on an extensive review of national and global experience of CFBs, the key lessons that should be actively considered in establishing a CFB are enumerated in Table 8.3. While a number of important lessons emerge from this review, two lessons stand out. One, partnership and active involvement of communities in planning and design is the key for an accurate representation of important physical and technical aspects of CFB; and two, empowerment of communities through rigorous training and initial financial support is necessary for smooth functioning of CFB.

Table 8.3: Global Lessons and Local Experiences for CFBs

S. No.	Place	Project details and governance structure	Experiences and Lessons
1.	Maikhanda village, Uttarakhand State, India	Initiation: GBIHID Governance: Governed by GBIHID but managed by <i>Mahila Mandal Dals</i> (MMDs), with support from the Panchayat. Project intends to give the entire management to the MMDs.	Fodder Banks can relieve women from drudgery in collecting fodder from distant forests, by empowering local women’s governance bodies. Active involvement of local community-based governance systems is necessary in winning the community’s trust and cooperation. Continuous engagement through training and capacity building programs helped in winning full support.
2	Ratadia, Taluka Mandvi, Kutch (India)	Initiation: <i>Yuvak Mandal</i> of Mota Village Governance: Yuvuk Mandal, later registered as <i>Ratadiya Gram Vikas Mandal</i> .	The Yuvuk Mandal through street plays, dramas etc. in surrounding villages; and voluntary contributions. Eventually government subsidies were provided. It sustains through government subsidies, sale of surplus fodder, other cultivated crops. In drought years, the <i>Mandal</i> feeds 40 and 150 mounds of dry and green fodder, respectively, to 350 cattle.
3	Vellore, Tamil Nadu (India)	Joint Venture: Of Departments of AH, RD and PRI, and Tamil Nadu Veterinary and Animal Sciences University. Plantation of fodder grass with support under MGNREGA.	Fodder bank is supported by subsidies for five years, before the project is handed over to the PRI. In these 5 years, PRI will be empowered through training.
Global Projects			
1	Nigeria, West Africa	Initiation: International Livestock Centre (ILCA), Nigeria Governance: ILCA managed the costs and governance, but agro-pastoralists were routinely consulted for governance and decision making	The focus of the project was on a “low-input supplementary feed innovation”. Legume fodder banks were developed to improve the nutrition of the cattle. Searches for other productive, disease-tolerant and competitive legume species were undertaken to maximise productivity of livestock.
2	Uganda	Initiation: National Livestock Resources Research Institute under The National Agricultural Research Organization (NARO), Uganda Governance: The NARO and government ministry; with participation from farmers and livestock owners.	Focus has been on partnership building between farmers, policy makers, service providers and institutions for maximum impact and giving greater strength to scale up the fodder bank innovations Intensive training was provided by the extension staff and the researchers on demonstration plots.
3	Ghana	Initiative: CGIAR’s Research Program on Climate Change & Agriculture and Food Security (CCAFS) in collaboration with the ICRISAT and The Council for Scientific	This project is implemented with the ambition to improve fodder availability and nutritional quality for ruminants during dry periods in the Ghana Climate-Smart Villages. The aim was to establish a multi-species fodder bank with farmers to demonstrate efficacy for climate-smart

S. No.	Place	Project details and governance structure	Experiences and Lessons
		and Industrial Research-Animal Research Institute (CSIR-ARI) Governance: Same bodies as above	livestock production (the process that increases productivity, and enhances resilience (adaptation), reduces/removes greenhouse gases (mitigation)). To produce climate-smart livestock, it is important to improve the diet of the livestock so that animals produce more proteins with less feed and lower emissions.

Source: Compiled by Authors¹⁰²

8.1.3 Technical Requirements

The technical requirements of establishing a CFB can be divided into a Pre-Establishment Process, and a Post-Establishment Process (Venugopalan et al, 2016). These have been illustrated below.

A. Pre-establishment process

a. Site Selection: All available open lands around a farmer's homestead including crop borders, sloped or stony pieces of land, and bottomlands that are not suited for normal crop production can be brought into use. Common property resources (CPRs), including wasteland, grazing lands, uncultivated lands. **In Lachen, the Executive Members of Dzumsas were confident that there is no problem of land availability, and upon approval from Pipon, land can be allocated for CFB.** This land will be slightly low lying, where snowfall is not as harsh, yet close enough for access. Areas near **Chungtham** have been suggested by the Dzumsas.

b. Bunding: To retain rainwater (unexpected rains) in the soil, at least 30 cm high bunds are needed. On light soils, grasses should be planted on bunds to make them stable. On sloppy lands, bunds are formed along the contour or across the slope.

c. Planting Material: A mixture of tree, grass and legume fodder species of both annual and perennial nature suitable for rainfed condition is highly preferable to meet the nutritional demand of livestock and ensure supply of fodder throughout the year. Fodder crops with the following characters are ideal for this purpose: establish easily; grow quick; out-compete weeds; produce high-quality fodder; remain productive under repeated harvest; withstand dry season with limited water sources; survive on poor soils.

These plants should be chosen with the help of scientific institutions as well as traditional communities. For instance, Krishi Vigyan Kendra in West Sikkim introduced Azolla, at Sindrang and Naku-Chumpong Village in 2017 as a nutrient supplement for Milch cow. **Azolla was termed as a**

Box 8.2: Important Fodder Species in Sikkim

- Bhalu Buki (Kobresia Duthiei)
- Kesari Buki (Kobresia Nepalensis)
- Sun Buki (Kobresia Capillifolia)
- Rani Buki (Festuca Vallesiac)
- Suire Buki (Juncus sp.)
- Ganer (Heracleum sp.)
- Kenjo (Rheum nobile)
- Harkat (Carex Nivalis)
- Shyamphul (Pleurospermum sp.)

Source: Consultation Meetings in SECURE Landscape

¹⁰² Dhyani, Maikhuri & Dhyani (2013); Girdher (2010); PTI (2015); Saleem and Kaufmann (1995); Blog (Changemakers.com); <https://ccafs.cgiar.org/index.php/research/projects/multispecies-fodder-bank-climate-smart-option-improved-livestock-nutrition>

“wonder herb” for improvement in health of animals, as well as the increase in milk yield¹⁰³. Such species must be chosen for the CFB.

d. Spacing: Choice of spacing depends on the soil and fodder components chosen. Total biomass yields per area increase at higher densities. Wider spacing are generally used when both fodder and small diameter wood, for fuel or poles, are desired. Closer spacing maximizes fodder production, but may make access for harvest or grazing difficult. Spacing of 1x1 meter is common for many species. Fodder production and accessibility can be improved by using double rows of fodder trees at wider spacing. Rows are established about 50 cm apart with 1-1.5 meters between double rows. Once the fodder bank is well established, grass should be allowed to grow in the area between double rows. Competition between bank trees and grass will not be as severe as during the establishment period. Tree roots will feed from deep in the soil, grass from near the surface. Their difference in height will also decrease competition for sunlight. This two-tiered system produces more fodder per area than either plant type alone. The grass grown in the inter-row area should be an excellent fodder species.

B. Post establishment process

a. Weed Management: Their initial growth is often slow. In general, perennial fodders take about six months to establishment, sustain it and compete with weeds. Proper care should be taken to keep the fodder bank weed free. Weeds should be controlled from the very beginning through use of pre-emergence herbicides, clean and pure seeds and inter cultivation practices. Weed menaces reduce with the establishment of perennial fodder component.

b. Fertilization: Fodder are long-term crops that must be properly maintained to continue high productivity. Nitrogen, phosphorus and potassium are important nutrients. Application for these and other nutrients should be determined locally. Availability and costs of fertilizers may restrict their use. The nitrogen requirement may be self-provided if the species used are nitrogen-fixing.

c. Irrigation: Most of the fodder crops require enough soil moisture to establish. Efficient and low-cost system like rains gun is a good option. Experience of CRIDA-KVK in Tamil Nadu showed that rain-gun system in fodder crops is cost effective with higher water productivity.

d. Harvesting: Actual age at first harvest depends on environmental conditions and bank growth. In case of perennials, it takes about 12 months for establishment. However, if it is an annual crop it can be harvested within 3-4 months.

e. Methods of feeding livestock

- **Grazing:** Fodder banks can be directly grazed by livestock. However, it can cause permanent damage to plant and fodder waste from trampling. The key to direct grazing is subdivision of the fodder bank into paddocks. Livestock should be restricted to one paddock until the available fodder resource is fully utilized. Animals should then be moved to the next paddock.
- **Cut and carry approach:** Most fodder banks are managed through a cut-and-carry system in which the fodder is harvested and then 'carried' to the livestock. A cut-and-carry system decreases fodder waste from animal damage and the necessity to monitor animals. However, labour inputs may be greater than with direct grazing systems.

¹⁰³ <https://www.manage.gov.in/cfa/successstories/cattle.pdf>

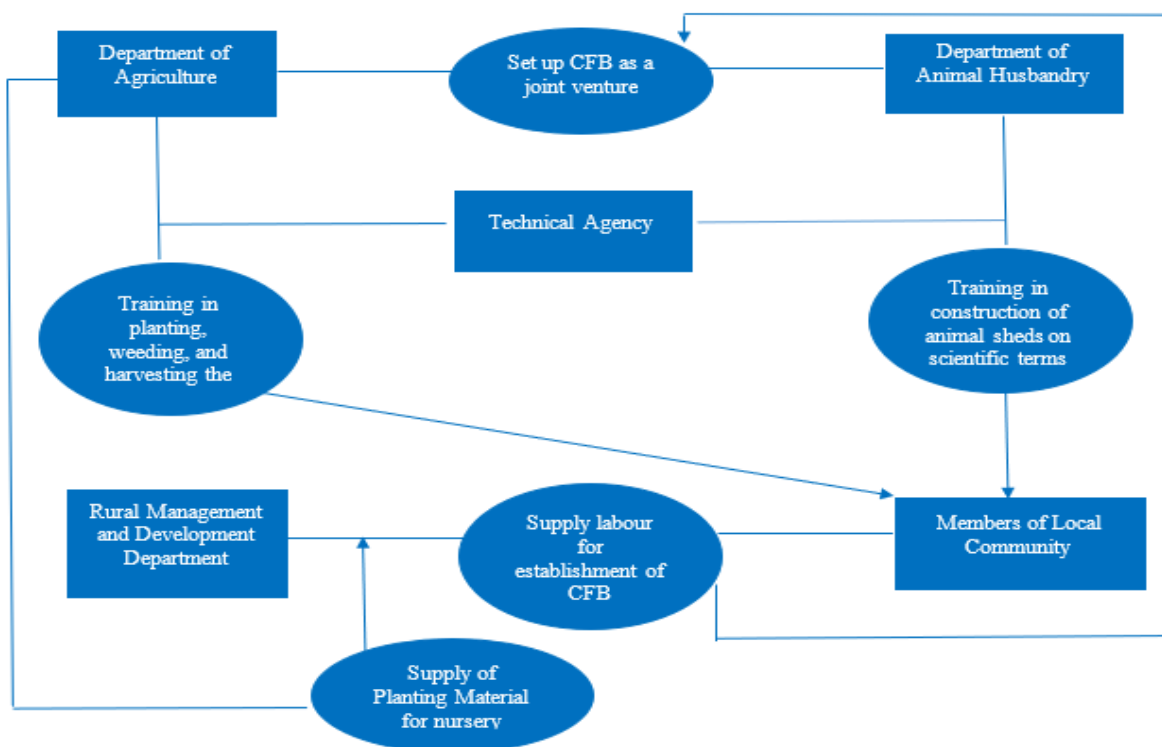
Important management factors to consider for a cut-and-carry system are cutting height, cutting frequency, and dry season management. These factors are all influenced by precipitation, temperature, soils, species, plant spacing.

f. Cutting frequency: The most common cutting frequencies are 6-18 weeks. Generally, longer cutting frequencies, 12-18 weeks, generate more total biomass but increase the proportion of small wood production. Shorter cutting frequencies, 6-12 weeks, favor fodder yields and fodder quality. Younger foliage tends to have a higher nutritive value and palatability. However, repeated cutting after short frequencies decreases longevity.

8.1.4 Proposed Model for Community Fodder Bank

The following model is proposed for establishing a CFB in Sikkim.

Figure 8.1: Proposed Model for CFB



Source: Authors' Construct

A. Technical agencies for training

According to the guidelines for implementation of National Livestock Mission, under the sub mission of fodder and feed development, the following agencies are eligible to impart training to farmers, researchers, academicians and officials on production, conservation, and efficient utilization of feed and fodder:

Department of Animal Husbandry Dairying & Fisheries, Agriculture Department, Krishi Vigyan Kendras, ICAR, Institutions and Research & Development Organizations, Agriculture and Veterinary Universities. Based on this, the following technical agencies are relevant:

- i. GB Pant National Institute of Himalayan Studies & Sustainable Development

- ii. National Mission on Himalayan Studies (ATREE)
- iii. ATREE Regional Office- Eastern Himalayas
- iv. Sikkim University
- v. ICAR: Sikkim Centre.

B. Facilitator

Department of Forest and Environment and SECURE project Unit will act as the facilitator by bringing all the players of the model to the table of negotiation and finalizing of the contracts among them.

C. Other Stakeholders

In addition to the stakeholders mentioned in Figure 8.1, following stakeholders may be consulted from time to time for establishing and functioning of the CFB:

- i. Department of Forest and Environment (For establishment of nursery)
- ii. Dzumsa governing body/ Panchayat

During our consultations in the landscape (Lachen, Lachung, and Mangan in North district and Yuksom, Sindrabung Cluster in West district), there was a huge support and excitement for the establishment of Community Fodder Bank. The communities will be willing and interested to support the project.

8.1.5 Capacity building framework for the Community Fodder Bank

For the success of the project, the various departments have to undertake and execute some functions. The following Table 8.4 shows the responsibilities of the different departments and the skill set required to execute those responsibilities.¹⁰⁴

Table 8.4: Responsibilities, Actions and Skill Required for Community Fodder Bank

Department	Desired Function of the Department	Activities	Skill Sets Required at the Department
Department of Forest and Environment and SECURE project unit, UNDP	Planning, Thought, Leadership and Strategizing	Coordination with all stakeholders for maintaining desired direction	Strong coordination and persuasive skills with strong sector expertise to command respect.
Department of Agriculture		Establishing itself as a nodal agency leading the effort for success of the project	Experience of dealing with multiple stakeholder agencies and coordinating for excellence
Department of Agriculture	Advisory to all stakeholders Departments/Agencies on formulation of policy, project and schemes for fodder production	Technical Assistance in formulation of projects, schemes and policy	Experience of providing technical assistance and backstopping support for formulation of projects, schemes and policy

¹⁰⁴ Adapted from Final Report on Developing a Capacity Development Framework for Strengthening State Medicinal Plant Board in Uttarakhand by IDCG, 2012; Available at: http://smpbuk.org/document/capacity_dev.pdf

Department	Desired Function of the Department	Activities	Skill Sets Required at the Department
Department of Agriculture, and Department of Animal Husbandry and Veterinary Services	Documentation of knowledge in fodder production and making it available in public domain	Documentation of best practices	Very good Knowledge Management & Documentation experience and maintain digital knowledge repository for dissemination and knowledge building in the sector
		Documentation of case studies	
Department of Rural Management and Development (Block Development Officer)	Building capacities of grass root level stakeholders	Identification of the cultivators to work in the fodder bank by coordinating with local bodies like Dzumsa.	Coordination with stakeholders, with strong experience in livelihood domain, training and community mobilisation experience. Strong experience in Communication, Knowledge Management and Knowledge sharing
Department of Agriculture Technical Agency		Facilitating training of cultivators on right techniques for cultivation, post-harvest management	
Department of Agriculture, Technical agency		Training to cultivators for soil and water management	
Department of Agriculture, and Technical Agency		Facilitating course material and course curriculum development for training of cultivators	
Department of Animal Husbandry, and Technical Agency		Training for construction of animal houses and sheds on scientific lines provided with cost-effective feeding and watering systems and proper ventilation using locally available materials	
Department of Agriculture	Monitoring and Evaluation	Monitoring the implementation of the project at the earlier stages, before it is handed over to the community	Strong experience with M&E frameworks, methods and approaches (including quantitative, qualitative and participatory) in community-based natural resource management projects

Source: Authors' Construct

In addition, the members of the community need to be trained so that they acquire skills and knowledge base to ensure proper functioning of the community fodder bank. Thus, the training programme should focus on inculcating following skills and knowledge base within the members of the community (Box 8.3). Table 8.5 shows the teaching aids that may be used during the training sessions to impart the training to the community members.

Box 8.3: Skills and Knowledge Base that needs to be inculcated within the Community Members for CFB

<p>Skills:</p> <ol style="list-style-type: none"> 1. Plan forage supply for scarcity periods 2. Prepare land for sowing or planting/ Sow/ plant/ weed/ apply herbicides and pesticides/ cut or harvest forages at the right growth stage 3. Make hay and silage and Urea Molasses Mineral Block 4. Treat crop residue with urea to improve nutritional value
<p>Knowledge:</p> <ol style="list-style-type: none"> 1. Explain various forage production strategies 2. Explain principles of plant growth 3. Explain the difference between grasses and legumes 4. Explain the difference between annual and perennial species 5. Explain the use of inoculants in legumes 6. Explain how to grow most common forage species 7. Explain how to make hay and silage 8. Explain how to treat crop residues with urea 9. Explain how to make UMMB (Urea Molasses Mineral Block)

Source: compiled by authors from literature¹⁰⁵

Table 8.5: Teaching Aids for Imparting Training

Training to be given on	Teaching Aids	Department Undertaking training
Techniques of planting fodder crops; Forage production strategies on small farm holders including preparation of land for planting of fodder	Training Manual Presentation Video Aids Field Demonstration Exposure visits	Department of Agriculture
Calculation of forage requirements during the year and scarcity periods	Training Manual Presentation	Department of Agriculture
Factors influencing the growth of fodder crops	Training Manual Presentation Video Aids	Department of Agriculture
Use of fertilizers and manure/compost; Maintaining the soil fertility	Training Manual Presentation Video Aids Field Demonstration	Department of Agriculture
Weed management	Training Manual Presentation Video Aids Field Demonstration	Department of Agriculture
Sustainable harvesting of fodder	Training Manual Presentation Video Aids Field Demonstration Exposure Visits	Department of Agriculture

¹⁰⁵ Dhyani et al (2012), and Forage Production and Management: Training Package for Extension Management, 2017 by SNV Ethiopia; Available at: https://snv.org/cms/sites/default/files/explore/download/eth_fomap.pdf

Training to be given on	Teaching Aids	Department Undertaking training
Conservation and preservation of forage including hay making	Training Manual Presentation Video Aids Field Demonstration	Department of Agriculture
Treatment of crop residue with urea	Training Manual Presentation Video Aids Field Demonstration	Department of Agriculture
Making of UMMB, make recipe/ weigh out quantities/ mixing of ingredients/ prepare moulds/ make blocks/ put them in place for drying	Training Manual Presentation Video Aids Field Demonstration	Department of Agriculture
Construction of animal houses and sheds on scientific lines provided with cost-effective feeding and watering systems and proper ventilation using locally available materials	Training Manual Presentation Video Aids Practical Demonstration	Department of AH & VS

8.1.6 Management and Regulation of Community Fodder Bank

As the name suggests, a Community Fodder Bank is managed by the community which is empowered by the government. Moreover, from the literature survey, it can be noted that a successful CFB requires community engagement at all levels. This includes governance as well as decision-making process. Following a literature study and conversations with experts as well as communities, the following are the key steps identified for management of a CFB:

- i. Typically, the CFB will be managed by a Committee consisting of 8-12 people, with at least 2 people from the Panchayat
- ii. All community members will register their names, and number of cattle with the committee
- iii. The CFB Committee will prepare a budget and put up the proposal to the Dzumsa body, or Panchayat
- iv. On approval, a CFB account with one Dzumsa or Panchayat member and 2 CFB Committee members as signatories will be opened
- v. On receiving funding, the committee will form sub-committees for cultivation of fodder, storage of fodder and procurement of material
- vi. After selecting type and quality of fodder, the CFB member will decide price and procurement of material

8.1.7 Budget for construction of Community Fodder Bank

The following components of cost for a CFB have been identified. These have been classified as fixed, and variable costs, and an estimate¹⁰⁶ of the cost per hectare has been given.

¹⁰⁶ Estimates generated from the guidelines of National Livestock Mission, Annexure C-I(A)-
<http://dahd.nic.in/sites/default/files/REVISED%20GUIDELINES%20OF%20NLM%2027.04.16.pdf>

Fixed Costs	Variable Costs
<ul style="list-style-type: none"> Fencing (demarcation of boundary)- Rs. 7500/ha Land development- Rs. 10,000/ha Farm Shed- Rs. 15000/ha Creating irrigation facility like well, pump or rainwater harvesting tank- Rs. 37500/ha Purchase of equipment – Rs. 5000/ha 	<ul style="list-style-type: none"> Labour Cost (hired or contributory)- Rs. 2000 Seeds, fertilizer/ manure, insecticides – Rs. 4000/ha Electricity charges – Rs. 3000/ha Cultivation charges – Rs. 10,000/ha Maintenance of Store- Rs. 3000/ha Miscellaneous Expenses- Rs. 3000/ha

Source: Guidelines of National Livestock Mission.

The total works out to Rs. 1 Lakh/ha. This is an estimated figure. One fodder bank has been proposed in North Sikkim. For establishing one fodder bank, an area of 6 ha is needed along with an area of 250 sq. m to set up a nursery where a poly house and a net house will be constructed to sow the seeds and germinate them by providing appropriate environment. The cost of fodder bank works out to Rs. 6 lakhs. Since the landscape is a remote area with high infrastructure costs, we propose that a separate budget Rs. 3 lakhs be kept for unforeseen events and unexpected occurring. **The total cost of the project will work out to Rs. 9 lakhs.**

8.1.8 Sources of Public Finance

Major sources of finance for establishment of CFB are discussed below:

- Fodder and Feed Development:** This programme is being implemented by Department of Animal Husbandry. This programme has two important components: National Livestock Management Programme and Pasture Development. Fodder Development Programme is the sub-component of Pasture Development. The following Table 8.6 gives a detail of the allocation and actual expenditure incurred within this programme.

Table 8.6: Expenditure and Allocation of Fodder and Feed Development Programme (Rs. Lakh)

Budget Code	Budget Head	Actual 2018-19	BE 2019-20	BE 2020-21
08.00.85	Sub-mission on Fodder and Feed Development (Under NLM)	-	14.40	14.40
73	Pasture Development	22.86	0.79	35.87
73.44.92	Fodder Development Programme	-	-	35.00
00.107	Fodder and Feed Development	22.86	15.19	50.27

Source: State Budget, 2020-21

It is important to note that the actual expenditure of Rs. 22.86 crore in 2018-19 was incurred against an allocation of Rs. 1.63 crore. Thus, in the programme there is a scope of planning and incorporating demand for grants for financing the establishment of a CFB in the state.

2. **Rainfed Area Development Programme:** This is a component of National Mission on Sustainable Agriculture. It adopts an area-based approach for development and conservation of natural resources along with farming systems, and has provisions for creation of common property resources like fodder banks. The status of allocation and expenditure within this programme is in Table 8.7.

Table 8.7: Expenditure and Allocation of Rainfed Area Development Programme (Rs. Crore)

Budget Code	Budget Head	Actual 2018-19	BE 2019-20	BE 2020-21
03.00.81	Rainfed Area Development (Central Share)	3.19	2.72	2.50
03.00.89	Rainfed Area Development (State Share)	0.18	0.25	0.15

Source: State Budget, 2020-21

3. Other Source: Other important sources of budgetary finance are programmes like National Livestock Mission, Rashtriya Krishi Vikas Yojana and MGNREGA. The National Livestock Mission has a component “Conservation of Fodder through post-harvest technologies” which has a provision of establishment of fodder banks at Panchayat/Block/Primary Milk Cooperative level. RKVY has a component “Accelerated Fodder Development Programme”. This component is focused upon increasing the access and availability of fodder along with increasing its quality. The Centre has allocated an amount of Rs. 3700 crores to RKVY during the financial year 2020-21. For meeting the requirement and expenses of labour for the purpose of construction, land preparation, irrigation and harvesting MGNREGA is primary source of finance. For 2020-21, the Centre has allocated a sum of Rs. 61,500 to MGNREGA.

8.2 Landscape Restoration of Degraded Landscape

8.2.1 Background

Land degradation and desertification (LDD) are increasing with alarming effects across the world affecting millions of people. In India, nearly 960 lakh hectares of land has been degraded presently, constituting 29.32 percent of the country’s Total Geographical Area (TGA). Land degradation has assumed national importance in the country because of its overwhelming impact on the economy and well-being of citizens (Kumar 2019)¹⁰⁷.

¹⁰⁷ <https://www.financialexpress.com/opinion/restoring-indias-degraded-land/1702382/>

Protecting forest land from degradation, deforestation and deterioration involves tree-based landscape restoration, which includes integrating trees in mixed land uses such as forests and cultivated areas, and is globally recognized as effective strategies for combating climate change. The Government of India has committed to a landscape approach to restoration under various international agreements and national targets; the Bonn Challenge (21 million hectares by 2030); Nationally Determined Contribution (NDC) of additional cumulative carbon sink of 2.5-3 Gt CO₂ by 2030 under the Paris climate agreement; targets under the Sustainable Development Goals (SDGs); and the National Mission for Green India (10 million hectares of restored forests and enhanced tree cover). Official estimates by the MoEF&CC have suggested that achieving the NDC goal requires not only protecting and improving existing forest cover but extending tree cover in 25 to 30 million hectares of mixed land uses, including agriculture (Chaturvedi et al 2018).

Box 8.4: Forest Landscape Restoration Principles

- Focus on restoring and enhancing ecological resilience & functionality.
- Plan and allow for benefits to community.
- Identify a set of interventions in partnership with stakeholders.
- Traditional knowledge and experience in natural resource management should be integrated and not used as an add-on to agreed interventions.
- Adapt and prioritize interventions to local conditions.
- Avoid conversion of natural ecosystems (Complement, and not undermine, ecosystem conservation efforts).

This requires identification of degraded land and its restoration using the most suitable interventions which will regain ecological integrity and enhance human well-being (Lamb and Gilmour, 2003). When implemented at scale, landscape restoration can conserve biodiversity, improve surface water storage, sequester carbon, enhance rural livelihoods and spur rural economy; Thus, paving a way for achieving the climate and social development goals.

8.2.2 Assessing the Restoration Need in Sikkim

In Sikkim 11.10 percent area is estimated to be under desertification/land degradation (ISRO, 2016) during 2011-13 (Table 8.8). The most significant process of degradation/land degradation in the state is Vegetation Degradation (over 90 percent at 10.47% area) in 2011-13. Figure 8.2 illustrates the desertification/land degradation status map of Sikkim in 2011-13¹⁰⁸.

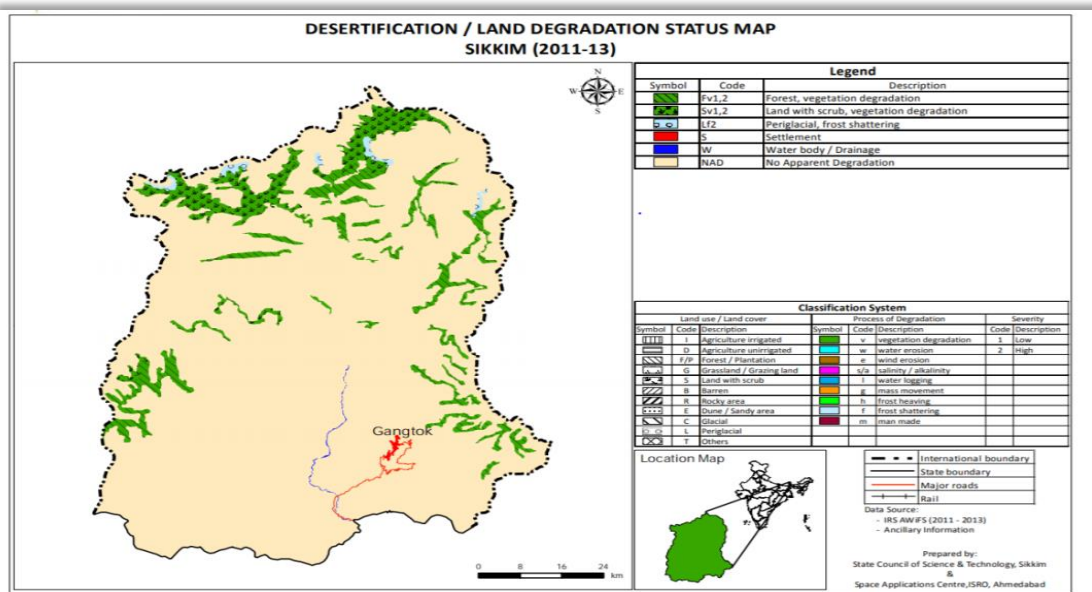
Table 8.8: Desertification/Land Degradation Classes in Sikkim (2011-13)

S. No.	Desertification/Land Degradation Classes		2011-2013	
	Code	Description (Land Cover/Process/Severity)	Area (ha)	% area of state
1	Fv1	Forest, vegetation degradation, low	14816	2.09
2	Fv2	Forest, vegetation degradation, high	25842	3.64
3	Sv1	Land with scrub, vegetation degradation, Low	19409	2.74
4	Sv2	Land with scrub, vegetation degradation, High	14251	2.01
5	Lf2	Periglacial, frost shattering, High	3730	0.53
6	S	Settlement	700	0.10
Total Area Under Desertification/Land Degradation			78749	11.10

Source: Desertification and Land Degradation Atlas of India, 2016.

¹⁰⁸ https://www.sac.gov.in/SACSITE/Desertification_Atlas_2016_SAC_ISRO.pdf

Figure 8.2: Desertification/Land Degradation Status Map of Sikkim (2011-13)



Source: Desertification and Land Degradation Atlas of India, 2016.

8.2.3 Land Restoration in Sikkim Landscape

In consultation with the Forest and wildlife department of Sikkim, UNDP, district level officials, local level institutions, NGOs, as well as local communities, a landscape restoration is suggested as a potential finance and conservation solution which will not only help in regaining ecological integrity but also create livelihood opportunities for local communities in the landscape. In our consultation meetings (see Annexure 1), local communities as well as line departments expressed their concern about degradation of land and threats revolving around native tree species, vegetables, fruits, grass as well as medicinal plants; and reiterated the need for restoration. Based on extensive review of literature, various key components of the restoration planning and process are enumerated in (Figure 8.3).

i. Spatial Analysis of Restoration Potential in Sikkim

A recent study (WRI, 2018) which has estimated restoration potential as well as carbon sequestration (CS) potential in India shows that Sikkim has a restoration potential of 0.21 mha and a CS potential of 6.94 MT. A district wise distribution and classification by type of restoration (Table 8.9) shows that 46 percent of total restoration is required in North Sikkim. Similarly, 44 percent of the total CS opportunity in the state is in North Sikkim. This calls for a serious thinking and focused effort.

Figure 8.3: Components of Landscape Restoration



Source: Authors' Construct based on WRI, 2018.

Table 8.9: District wise Restoration and Carbon Sequestration Potential in Sikkim

S. No	District	Potential for FP (ha)	Potential for WSR (ha)	Potential for MR (ha)	Total Potential for FP&LR	District share in Restoration %	Potential for above-ground CS (MT)	District share in CS %
		1	2	3	1+2+3			
1	East	28162.44	9414.72	706.68	38283.84	18	1.25	18
2	North	61302.60	34885.08	203.76	96391.44	46	3.11	44
3	South	26364.24	7215.84	1775.16	35355.24	16	1.23	17
4	West	30198.24	7610.04	1495.08	39303.36	20	1.36	21
	Total	146027.52	59125.68	4180.68	209333.88	100	6.94	100

Source: WRI (2018).

Notes: CS is carbon sequestration; WSR is wide-scale restoration; MR is Mosaic restoration; FP is forest protection.

Key





Forest Protection:	Protection areas have forest cover with a density of more than 40 percent. These forests need to be protected against risks such as fire, land diversion and fragmentation.
Wide-scale Restoration:	Areas suitable for wide-scale restoration are those where near contiguous tracts of forest and tree cover can be established. The existing tree density in these areas is less than 40 percent and the population density is less than 200 persons per sq. km.
Mosaic Restoration:	Mosaic restoration is the integration of trees in a patchwork of different land uses including rain-fed cultivated areas. These areas have tree cover density of less than 40 percent and population density of less than 400 persons per sq.km.

Note- Areas under the following land use categories were excluded from the restoration opportunities assessment: areas under permanent ice and snow, sand dunes, scrub and wetlands, water bodies, and swamp forests; Grasslands; National parks, sanctuaries, state reserves, and wildlife reserves; Areas under surface and groundwater irrigation; Urban and built-up areas; Croplands with more than 40 percent tree canopy cover. The carbon sequestration potential is only for above-ground biomass. The carbon sequestration potential for mosaic restoration areas assumes a maximum tree cover of 20 percent in croplands.

ii. Possible Interventions for Restoration

As mentioned in Table 8.8, the highest restoration potential in Sikkim is for Forest Protection, followed by Wide- Scale Restoration and Mosaic Restoration. It is necessary to identify suitable interventions for restoration in North Sikkim landscape based upon variables such as land ownership, land use pattern, tree cover density, slope and proximity to river bank. A framework for general categories of restoration for landscapes has been illustrated in Table 8.10.

Table 8.10: Interventions for Tapping Restoration Potential

Forest Land (Suitable for wide-scale restoration)	A. Plantation of native species	This includes planting of native tree species on forest land to improve biodiversity conservation as well as other purposes such as fuel wood, timber, fruit production
	B. Assisted natural regeneration 	This is helpful for sites which are highly degraded and requires fencing off an area to allow for regeneration naturally. This will also require minimizing anthropogenic pressure such as grazing and fuel wood extraction. If required, additional enrichment planting is done.
Agricultural Land (Suitable for mosaic restoration)	C. Agri-horti-forestry 	This is a practice of mixing fruit trees and forest trees on agricultural land
	D. Trees on boundaries 	The intervention is helpful to prevent soil nutrient run-off and requires planting trees on boundaries
Protective land and buffers	E. Watershed protection and erosion control 	The intervention helps in establishing and enhancing forests on a steep sloping land, along water courses

Source: Authors construct based on GPFLR, 2018; IUCN and WRI, 2014; WRI and IUCN, 2018.

iii. Identification of Species

The selection of tree species is required based upon preferences of communities as well as availability and suitability of planting material in the landscape. Preferences vary from place to place as well as across gender. *For instance, a case study in Madhya Pradesh (WRI, 2018) highlights that men*

preferred cash crops or commercial trees whereas women preferred trees which fulfill requirement of fodder and fuel wood.

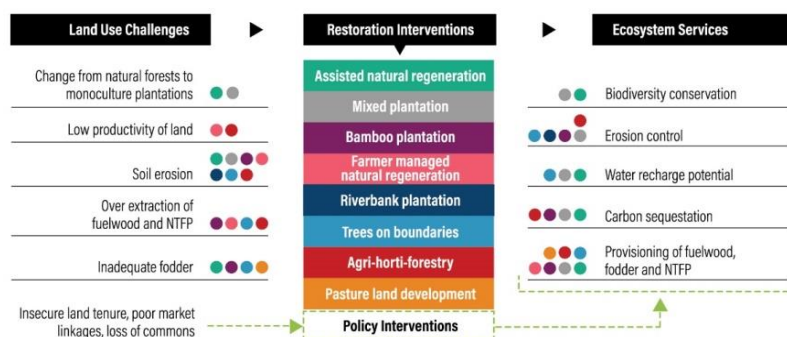
During the field visits in North Sikkim, we were informed that in the absence of a nursery in the area planting material is brought from low lying areas which poor survival rate. The following suggestions are important to consider in this context:

- For Afforestation programs, a multi-stakeholder committee should examine the selection of species with species like **silver fir, juniper, and rhododendron** (native species preferred by local communities of Lachen and Lachung Valley). Similarly, site selection for afforestation should be guided by a multi-stakeholder group involving the communities.
- A nursery should be developed in places like Chungthang which has ideal climatic conditions to support the mentioned species, and is in close proximity to Lachen and Lachung.
- There should be identification of indicator species for monitoring health of forest areas and success of restoration

iv. Providing Critical Ecosystem Services to Communities

Achieving Sikkim’s restoration potential can provide provisioning and regulatory ecosystem services and direct benefits to communities’ through food security, strengthened energy security, biodiversity conservation, and soil and moisture conservation. At the sub-district level, a specific intervention will cater to the local demand and requirement of the community and this will differ from one sub-district to the other (Figure 8.4).

Figure 8.4: Land use Challenges, Restoration Interventions and Ecosystem Services



Source: WRI, 2018; & Authors’ Field survey

The figure lists the possible land-use challenges in an area, all of them have been identified as threats to Sikkim’s biodiversity and forests in this report (Chapters 3&4). Homogeneity in agriculture has led to loss of agro-biodiversity, and hence plantation of native species will help in biodiversity conservation. Low productivity of land and soil erosion can be

addressed through restoration interventions. Similarly, unsustainable extraction of NTFPs and inadequate fodder may be addressed through pasture land development and agri-horti forestry. Besides there will be gain due increase in CS.

v. Livelihood

Achieving Sikkim’s restoration potential will provide direct benefits to communities through food security (agri-horti forestry), strengthened energy security (provisioning of fuel wood) and soil and moisture conservation (Figure 8.4). However, a livelihood assessment is necessary to identify value chains to support livelihood of local communities. Such an assessment includes identifying potential value chains and benefits that would flow to the communities. Value chain of key native species will be developed at pre-production, production and processing stages. Therefore, by promoting

micro-enterprises as well as small farmer producer companies, employment opportunities will be generated.

vi. Institutions and Networks

Restoration requires synergistic and collaborative efforts between various government departments as well as existing programs to help overcome the barrier of poor market linkages for products and missing infrastructure for value addition. It is important to focus on key actors and build strong networks for implementation of restoration as a potential finance solution for the landscape. The key actors required to form a committee for restoration are have been listed in Table 8.11.

Table 8.11: Key Actors, Responsibilities and Actions required for Tapping Restoration Potential of Sikkim

Agency/Department	Desired Functions	Responsibility / Activities
UNDP	Planning, Thought, Leadership and Strategizing	Coordination with all stakeholders for maintaining desired direction
DFE		Establishing itself as the nodal agency
DORM&D	Building capacities of grass root level stakeholders	Identification of labour in coordination with local governance institutions
DFE	Lead Agency	Identification of land, & native species, ensuring good supply of planting stock, training and capacity building.
DFE, and a Technical Agency	Monitoring and Evaluation	M&E frameworks, methods and approaches (including quantitative, qualitative and participatory)
Research Organizations	Technical Support	Preparation of training manuals, field demonstrations, and training.

Source: Authors' Construct.

vii. Enabling Conditions

Many enabling conditions which are necessary for the success of landscape restoration are in place in Sikkim. Policies, programs and schemes already exist in forestry, agriculture, and rural development sectors as well as at community level.

Figure 8.5: Enabling Conditions for Tapping Restoration Potential in Sikkim



Source: Authors' construct.

afforestation activities to increase the green cover

in the country are being implemented in Sikkim.

- At the level of state, there are various initiatives and program such as the State Green Mission, Smritivan program, 10 minutes to earth program, and the National Green Corps. The Department of Forest and Environment undertakes afforestation activities under these programs throughout the state and plant native species of bamboo, banana and avocado.
- During consultations in North Sikkim, communities' sense of responsibilities toward their environment was evident. In Hee-Gyanthang, Dzongu (North Sikkim), the members of community plant 10 saplings and take care of them as a compensating for cutting down 1 tree. Similar practice is prevalent in Lachen. The members of community in Lachen have also expressed their demand of having a nursery of silver fir, juniper, and rhododendron so that they can easily access the saplings for the purpose of afforestation and restoration activities.

viii. Financial Mechanisms

I. Cost Estimation Analysis

In a cost estimation analysis, it has been observed that cost largely depends upon the restoration intervention as well as the plants chosen. Since cost norms for Sikkim are not available in public domain, the cost of raising plantation of Himachal Pradesh has been used as a proxy for this purpose (Table 8.12). Since both are Indian Himalayan states, the proxy is suitable.

- As mentioned before, at the international level, India has committed to create an additional carbon sink of 2.2 to 3 billion tons of CO₂ equivalent through additional forest and tree cover by 2030. The restoration of degraded landscape in Sikkim will contribute towards meeting this target.

At the national level, Green India Mission, and Sub-mission on Agro-forestry under National Mission on Sustainable Agriculture which promotes

Table 8.12: Cost Norms (per hectare), for Raising Normal Plantations (new) and Maintenance of old Plantations for the Year 2020-21

Components	Description	Cost (Rs. per hectare)
Afforestation (for plants/hectare)	The includes: Survey, Demarcation and Fencing The cost of survey and demarcation and stone wall fence Planting This includes cost of digging of pits, filling of pits, carriage of plants, and planting of plants	112500
	1 st year Maintenance	40300
	2 nd year Maintenance	26000
	3 rd year Maintenance	15300
	4 th and 5 th year Maintenance	7400
Enrichment (for plants/hectare)	This includes cost of both survey and planting, as mentioned above	103100
	1 st year Maintenance	29300
	2 nd year Maintenance	19100
	3 rd year Maintenance	11200
	4 th and 5 th year Maintenance	5400

Source: Forest and Wildlife Department, Himachal Pradesh

Similarly, the cost of developing a High-Tech Nursery s in Chungthang to support species like silver fir, juniper, and rhododendron has been estimated. It is estimated that the cost of developing one such nursery is INR 10 lakh for producing at least 10 lakh plants per annum (Section 8.1). The cost norms have been adopted from operational the guidelines of National Afforestation and Eco Development Board¹⁰⁹.

II. Budgetary Sources of Finance

The following table (Table 8.13) shows the budgetary sources from which financial resources can be mobilized for restoration activities in the state.

Table 8.13: Budgetary Sources for Restoration (Rs. Crore)

Major Head	Name of the schemes	2018-19 Actuals	Allocation 2020-21 All India
Forest Conservation, Development and Regeneration	National Afforestation Programme* (expenditure within the State)	9.30	
Social and Farm Forestry	Social Forestry	3.66	
Social and Farm Forestry	Farm Forestry	1.15	
Social and Farm Forestry	Plantation Schemes**	0.32	
Environmental Research and Ecological Regeneration	Research and Ecological Regeneration	6.71	
Central Scheme	MGNREGA ¹¹⁰		61,500

¹⁰⁹ <http://naeb.nic.in/gasva.htm>

¹¹⁰ <https://economictimes.indiatimes.com/news/economy/policy/budget-2020-mgnrega-funds-down-by-13-marginal-dip-in-other-rural-development-schemes/articleshow/73847723.cms>

Major Head	Name of the schemes	2018-19 Actuals	Allocation 2020-21 All India
Central Scheme	National Mission for Green India ¹¹¹		311
Central Scheme	National Afforestation Programme ¹¹²		246

Source: State budget, various years.

Note: * Includes expenditure on Green India Mission and Forest Development Agency.

** Includes expenditure on Greening of Ecologically Fragile Areas and Regeneration of Conifer Forest Area.

In addition to sources in table above, CAMPA funds are also an important source of finance for restoration. In 2019, Sikkim received total fund of Rs. 392.36 crore from CAMPA¹¹³.

III. Other Potential Sources of Finance

Other potential sources are international donors for PES, Impact investors, Green Climate Fund, Green Bonds.

¹¹¹ <https://economictimes.indiatimes.com/news/economy/policy/budget-2020-environment-ministry-gets-rs-3100-crore-in-2020-21/articleshow/73848344.cms>

¹¹² <https://economictimes.indiatimes.com/news/economy/policy/budget-2020-environment-ministry-gets-rs-3100-crore-in-2020-21/articleshow/73848344.cms>

¹¹³ <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1583452>

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Annexure 1

Table A1.1: List of Participants in Consultation Workshop in Gangtok on 29th August, 2019

S. No.	Name of the Participants	Organization/Department	Designation
1.	Shri B.P. Pradhan	Department of Forest, and Environment, Sikkim	Chief Conservator of Forest (T/HQ) and Wildlife
2.	Shri B.S. Siktel	Department of Forest, and Environment, Sikkim	Chief Conservator of Forest (Social Forestry, Silviculture & Working plan)
3.	Shri D.C. Nepal	Department of Forest, and Environment, Sikkim	CF (Working Plan & Silviculture/ Social Forestry/ Wildlife)
4.	Ms. Bhumika Rai	Department of Forest, and Environment, Sikkim	DFO (SBB)
5.	Shri N.K. Gurung	Department of Horticulture	Director
6.	Ms. Sarala Khaling	ATREE – NE RO	Regional Director
7.	Shri Tilak	Department of Horticulture	Additional Director
8.	Shri K. Birla Singh	Department of Zoology, Sikkim University	Assistant Professor
9.	Shri Partha Sarathi Ghose	WWF India	Assistant Landscape Coordinator
10.	Shri Arundeeep Singh	WWF India	Project Officer
11.	Dr. Thinlay N. Bhutia	Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services	Programme Coordinator cum Joint Director
12.	Dr. D. Manjunatha	Department of Forest, and Environment, Sikkim	Conservator of Forests (Working Plan/Silviculture/ Research), Member Secretary, Sikkim Biodiversity Board
13.	Shri K.G. Lachungpa	Department of Forest, and Environment, Sikkim	A.C.F

Table A1.2: List of Meetings with the Officials of Forest and Line Department

S. No.	Official	Designation	Department
26th August 2019			
1.	Shri. M. L. Srivastava, IFS	Pr. Secretary -cum- PCCF	Department of Forest, and Environment, Sikkim
2.	Dr. D. Manjunatha, IFS	Conservator of Forests (Working Plan/Silviculture/Research), Member Secretary, Sikkim Biodiversity Board	Department of Forest, and Environment, Sikkim
3.	Mr. Sunil Kumar	DFO, Headquarter and Technical Assistant to PCCF	Department of Forest, and Environment, Sikkim
4.	Ms. Bhumika Rai	DFO (Sikkim Biodiversity Board)	Department of Forest, and Environment, Sikkim
5.	Dr. Bharat Pradhan	Scientific, Technical Associate, Sikkim Biodiversity Board	Department of Forest, and Environment, Sikkim
6.	Shri. Karma Legshey D	Additional Project Director, Sikkim Biodiversity Conservation and Forest Management Project	Department of Forest, and Environment, Sikkim

S. No.	Official	Designation	Department
7.	Shri M. Ravi Kumar	DFO (Working Plan)	Department of Forest, and Environment, Sikkim
27 August 2019			
8.	Shri B. P. Pradhan	Chief Conservator of Forest (T/HQ) and Wildlife	Department of Forest, and Environment, Sikkim
9.	Shri Y.P. Gurung	CCF Addl. Charge for CAMPA	Department of Forest, and Environment, Sikkim
10.	Shri Udai Gurung	CF (Territorial) and Addl. Charge as Director, Ecotourism Directorate	Department of Forest, and Environment, Sikkim
11.	Shri S.K. Thatal	Director-cum-CEO, SMPB/NTFP and Addl. Charge of Sericulture	Department of Forest, and Environment, Sikkim
12.	Shri. Blen Tshering Targain	Joint Director, FCA, 1980 cell and State CAMPA	Department of Forest, and Environment, Sikkim
13.	Ms. Yangcheng Bhutia	DFO(NTFP/SMPB) South/East	Department of Forest, and Environment, Sikkim
14.	Shri D.G. Shreshtha	Additional Director (RS)	Department of Science, Technology and Climate Change
15.	Shri R.K. Sharma	Scientist, Sikkim State Council of Science and Technology	Department of Science, Technology and Climate Change
28th August, 2019			
16.	Shri. Deo Kumar Bhandari	Secretary	Horticulture and Cash Crops Development Department
17.	Shri. Suman Sharma	Director (Agriculture)	Department of Agriculture
18.	Shri. P. L. Basnett	Joint Director (Horticulture)	Horticulture and Cash Crops Development Department
Local Consultations in North Sikkim (8-12th February 2020)			
1	GPU Hee-Gyanthang	Panchayat and JFMC members of the GPU and Forest Guard, Yangden	Department of Forest, and Environment, and Local governance bodies
2	GPU Lingtham	Panchayat President of the GPU	Local Governance Bodies
3	Executive Members of Dzumsas, Lachen	Members of Dzumsa Governing Body, Lachen	Local Governance Body
4	Executive Members of Dzumsas, Lachung	Pipon, Lachung and JFMC President	Local governance Body
5	DC, North Officials of Line Departments	DC, North Joint Director and Director	Department of Forest, and Environment, AH&VS Department, Agricultural Department
Local Consultations in West Sikkim (26-28th January 2021)			
1	Khangchendzonga Conservation Committee (KCC)	CEO, Program Manager, Community Mobilizer, Field level staff	NGO
2	Focused Group Discussion (FDG) in Tshoka-Khyongtey ward of Yuksom Dubdi GPU, West Sikkim	Panchayat members, EDC President, EDC members, JFMC members and community members.	Local Governance Body, Community

S. No.	Official	Designation	Department
3	Consultative Meeting with Local Governance Bodies and Community Members of Yambong- Singalila, and Chongri Cluster, Sindrabung	EDC President, EDC Members, Himal Rakshaks, Ex-EDC Members, Community Members	Local Governance Body, Community, Himal Rakshak

Annexure 2

**Table A2.1: List of Threatened Wild Animals in Sikkim
(as per the IUCN red list version 2014.3)**

Common Name	Scientific Names	IUCN status	Common Name	Scientific Names	IUCN status
Class: Mammals			Class: Fish		
Dhole	<i>Cuon alpinus</i>	EN	Golden mahseer	<i>Tor putitora</i>	EN
Snow Leopard	<i>Panthera uncia</i>	EN	Common snow trout	<i>Schizothorax richardsonii</i>	VU
Alpine musk deer	<i>Moschus chrysogaster</i>	EN	Indian mottled eel	<i>Anguilla bengalensis</i>	NT
Himalayan musk deer	<i>Moschus leucogaster</i>	EN	Goonch	<i>Bagarius bagarius</i>	NT
Black musk deer	<i>Moschus fuscus</i>	EN	Gray's stone loach	<i>Balitora brucei</i>	NT
Asiatic black bear	<i>Ursus thibetanus</i>	VU	Pangusia labeo	<i>Labeo pangusia</i>	NT
Red panda	<i>Ailurus fulgens</i>	VU	Saddleback loach	<i>Schistura devdevi</i>	NT
Marbled Cat	<i>Pardofelis marmorata</i>	VU	Class: Reptiles		
Clouded leopard	<i>Neofelis nebulosa</i>	VU	King Cobra	<i>Ophiophagus hannah</i>	VU
Binturong	<i>Arctictis binturong</i>	VU	Burmese Python	<i>Python bivittatus</i>	VU
Eurasian otter	<i>Lutra lutra</i>	NT	Walnut Kukri Snake	<i>Oligodon juglandifer</i>	VU
Asiatic golden cat	<i>Catopuma temminckii</i>	NT	Sikkimese Bent-toed Gecko	Sikkimese Bent-toed Gecko	NT
Pallas's Cat	<i>Otocolobus manul</i>	NT	Class: Amphibians		
Common leopard	<i>Panthera pardus</i>	NT	Sikkim Snow Toad	<i>Scutiger sikkimensis</i>	LC
Himalayan goral	<i>Naemorhedus goral</i>	NT	Class: Butterfly		
Himalayan serow	<i>Capricornis thar</i>	NT	Kaiser-i-hind	<i>Teinopalpus imperialis</i>	NT
Tibetan Argali	<i>Ovis ammon</i>	NT	Class: Dragonfly		
Tibetan gazelle	<i>Procapra picticaudata</i>	NT	Relict Himalayan Dragonfly	<i>Epiophlebia laidlawi</i>	NT
Large Indian civet	<i>Viverra zibetha</i>	NT			
Class: Birds			Domesticated Animals		
Himalayan Tahr	<i>Hemitragus jemlahicus</i>	NT	Siri Cattle	<i>Bos indicus</i>	EN
Red-headed vulture	<i>Sarcogyps calvus</i>	CR	Yak	<i>Bos grunniens</i>	EN
White-rumped vulture	<i>Gyps bengalensis</i>	CR	Banpala Sheep, Tibetan Highland Sheep	<i>Ovis aries</i>	EN
Baer's pochard	<i>Aythya baeri</i>	CR	Tibetan Mastiff	<i>Canis lupus familiaris</i>	EN
Beautiful nuthatch	<i>Sitta formosa</i>	VU			
Black-necked crane	<i>Grus nigricollis</i>	VU			
Chestnut-breasted Partridge	<i>Arborophila mandellii</i>	VU			
Greater Spotted Eagle	<i>Aquila clanga</i>	VU			
Grey-crowned Prinia	<i>Prinia cinereocapilla</i>	VU			
Hodgson's Bushchat	<i>Saxicola insignis</i>	VU			
Lesser Kestrel	<i>Falco naumanni</i>	VU			
Palla's Fish Eagle	<i>Haliaeetus leucoryphus</i>	VU			
Rufous-necked Hornbill	<i>Aceros nipalensis</i>	VU			
Slender-billed Babbler	<i>Turdoides longirostris</i>	VU			
Wood Snipe	<i>Gallinago nemoricola</i>	VU			
Blyth's Kingfisher	<i>Alcedo hercules</i>	NT			
Cinereous Vulture	<i>Aegypius monachus</i>	NT			

Common Name	Scientific Names	IUCN status	Common Name	Scientific Names	IUCN status
Firethroat	<i>Luscinia pectardens</i>	NT			
Giant Babax	<i>Babax waddelli</i>	NT			
Great Hornbill	<i>Buceros bicornis</i>	NT			
Rufous-throated Wrenbabbler	<i>Spelaeornis caudatus</i>	NT			
Rusty-bellied Shortwing	<i>Brachypteryx hyperythra</i>	NT			
Satyr Tragopan	<i>Tragopan satyra</i>	NT			
Ward's Trogon	<i>Harpactes wardii</i>	NT			
Yellow-rumped Honeyguide	<i>Indicator xanthonotus</i>	NT			

Notes: CR: Critical, EN: Endangered, VU: Vulnerable, NT: Near threatened, and LC: Least Concern.

Table A2.2: Rare, Threatened and Endangered Flora of Sikkim

Plant Species	Status	Plant Species	Status
<i>Acer sikkimense</i>	Endangered	<i>Cypripedium himalaicum</i>	Rare
<i>Acer osmastoni</i>	Endangered	<i>Dendrobium praecinctum</i>	Very rare.
<i>Acer stachyophyllum</i>	Rare	<i>Didiciea cunninghami</i>	Endangered
<i>Aconitum ferox</i>	Vulnerable	<i>Diglyphosa macrophylla</i>	
<i>Acronema pseudotenera</i>	Rare	<i>Diplazium heterophlebium</i>	At risk of endangerment
<i>Actinidia callosa</i>	Indetermined	<i>Diplomeris hirsuta</i>	Vulnerable
<i>Aleuritopteris argentea</i>	Very Rare	<i>Dryopteris alpestris</i>	Very rare.
<i>Angelica nubigena</i>	Indetermined	<i>Dryopteris angustifrons</i>	Very rare.
<i>Aphyllorchis parviflora</i>	Rare	<i>Dryopteris assamensis</i>	Very rare.
<i>Arenaria thangoensis</i>	Vulnerable	<i>Dryopteris costalisora</i>	Very rare.
<i>Asplenium delavayi</i>	Very Rare	<i>Dryopteris nobilis</i>	Very rare.
<i>Asplenium pellucidum</i>	Very Rare	<i>Juncus sikkimensis</i>	Rare
<i>Athyrium repens</i>	Very Rare	<i>Lactuca cooperi</i>	Endangered
<i>Athyrium roseum</i>	Very Rare	<i>Lagerstroemia minuticarpa</i>	Rare
<i>Begonia rubella</i>	Rare	<i>Licuala peltata</i>	Rare
<i>Begonia satrapis</i>	Rare	<i>Livistona jenkinsiana</i>	Endangered
<i>Biermannia bimaculata</i>	Rare	<i>Lloydia himalensis</i>	Rare
<i>Boehmeria rugulosa</i>	Rare	<i>Loxogramme grammitoides</i>	Very rare.
<i>Bulleyia yunnanensis</i>	Rare	<i>Lycopodium annotinum</i>	At risk
<i>Calamus inermis</i>	Endangered	<i>Malaxis saprophyllum</i>	Very rare.
<i>Calanthe alpina</i>	Rare	<i>Matteuccia orientalis</i>	Very rare.
<i>Calanthe manni</i>	Rare	<i>Nardostachys grandiflora</i>	Vulnerable
<i>Calanthe trulliformis</i>	Rare	<i>Oberonia micranthus</i>	Very rare
<i>Calanthe whiteana</i>		<i>Oreopteris elwesi</i>	Rare
<i>Calanthe chloroleuca</i>	Very Rare	<i>Panax pseudo-ginseng</i>	Vulnerable
<i>Carex kingiana</i>	Indetermined	<i>Phoenix rupicola</i>	Rare
<i>Ceropegia hookeri</i>	Endangered	<i>Phymatopteris nigrovenia</i>	Very rare
<i>Ceropegia lucida</i>	Endangered or possibly extinct in India	<i>Phymatopteris tibetana</i>	Very rare
<i>Cinnamomum glanduliferum</i>	Rare	<i>Pimpinella tongloensis</i>	Endangered, if not extinct already
<i>Cissus spectabilis</i>	Endemic + rare	<i>Pimpinella wallichii</i>	Endangered
<i>Codonopsis affinis</i>	Rare	<i>Polystichum glaciale</i>	Very rare
<i>Coelogyne treutleri</i>	Possibly extinct	<i>Pteridrys cnemidaria</i>	Very rare
<i>Cotonester simonsi</i>	Indetermined	<i>Pteris barbigera</i>	Very rare
<i>Cyathea andersoni</i>	At risk of endangerment	<i>Pyrrosia boothi</i>	Very rare
<i>Cyathea brunoniana</i>	At risk of endangerment	<i>Selliguea tricuspis</i>	Indeterminate
<i>Cyathea chinensis</i>	At risk of endangerment	<i>Sphaeropteris brunoniana</i>	
<i>Cyathea contaminans</i>	At risk of endangerment	<i>Taeniophyllum retro-apiculatum</i>	Very rare. Few details exist.
<i>Cycas pectinata</i>	Vulnerable	<i>Taeniophyllum crepidiforme</i>	Very rare. Few details exist.
<i>Cymbidium eburneum</i>	Vulnerable	<i>Trichomanes parvifolium</i>	Very rare
<i>Cymbidium hookerianum</i>	Vulnerable	<i>Woodsia cycloloba</i>	Very rare
<i>Cymbidium whiteae</i>	Endangered	<i>Zeuxine pulchra</i>	Endangered, Extinct possibly
<i>Cypripedium elegans</i>	Rare		

Annexure 3

Table A3.1 Details of Medicinal and Aromatic Plants Found in Sikkim¹¹⁴

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
1	<i>Abies wabbiana</i>	Gobre salla	Temperate & subalpine 5200-13800 ft	Tree	Leaves & Gum Tonic, Tuberculosis. Internal hemorrhage
2	<i>Abrus precatorius</i>	Lalgeri	Lower hills 900-4000ft	Climbing shrub	Fruits/roots Tonsil & Pneumonia
3	<i>Acorus calamus</i>	Bojho	Middle hill 3000-6000ft.	Herbaceous plants	Root/Rhizome Vermifuge, fever antispasmodic, Insect repellent
4	<i>Aconitum heterophyllum</i>	Bikh, Atish	Sub-alpine to Alpine 8000-13000 ft.	An erect Herb	Roots, Anti-fertility agent, tonic, stomachic, anti-periodic, hysteria, piles, throat diseases
5	<i>Aegle marmelos</i>	Bael	Lower Hill Forest up to 2000 ft.	Thorny small & medium tree	Fruits & roots
6	<i>Asparagus racemosus</i>	Kurilo	Tropical/ sub-tropical / Lower/ middle hill forests	Woody climber under shrub	Tuberous root Diabetes, jaundice, urinary disorder
7	<i>Aconitum ferox</i>	Bikh, Bish,	Temperate / Alpine 10000-14000 ft.	Perennial Herb	Tuberous roots Cough, asthma, leprosy, fever snakebite, skin diseases
8	<i>Astilbe rivularis</i>	Buriokahti	Temperate 5000-9000 ft.	Herb	Leaves/ roots/ Rhizome, Diarrhea, dysentery, blood purifier
9	<i>Adatoda vasica</i>	Asuru	Lower hill forest.	Bark, root leaf, flower	It is good insecticide, leaves & root expectorant & antispasmodic. It is used as remedy for asthma, cough, fever, gonorrhoea leprosy, Phthisis.
10	<i>Azadirachta indica</i>	Nimpat	Common throughout, India	Roots, bark, leaves, flower, fruits, seed & gum juice	As an anti-septic, treatment of small fox, as tooth brush, prophylactic for mouth & teeth, used as febrifuge.
11	<i>Aesandra butyraceae</i>	Chewri	Middle hill forest	Fruits	Used in rheumatism
12	<i>Allium wallichii</i>	Ban Lasun	Subalpine region	Leaves	Seasoning spices
13	<i>Aloe barbadensis</i>	Ghiukumari	Lower hill forest	Plant leaf root, leaves and flower	Used on burns, purgative, efficacious in treatment of leucoderma.
14	<i>Alstonia scholaris</i>	Chatiwan	Foot hill & lower hill	Bark, latex and flower	Bark as tonic, in fever, skin disease in treatment of leucoderma.
15	<i>Amomum subulatum</i>	Elaichi	Cultivated	Seed	Stomachic, heart and liver tonic
16	<i>Artemisia vulgaris</i>	Titaypati	2000 to 5000 ft.	Leaf extract	Leaf extract used on cuts and bruises to stop bleeding mostly in nose bleeding. Supposed to possess detergent effect & used as cleansing agent.
17	<i>Aconogonum molle</i>	Thotne	Lower hill forest	Young Shoots	The plants is used as an astringent and eaten relished in

¹¹⁴ http://www.sikkimforest.gov.in/medicine_main.htm

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
					the hills as vegetable and pickle. It has similar flavour as their of the Himalayas rubarb.
18	<i>Berginia ciliata</i>	Pakhanbed -	Temperate to sub-alpine 5000-13000 ft.	Herb	Root & rhizome Tonic, fever, boils, astringent
19	<i>Bauhinia vahlii</i>	Verla	Lower hill forest	Seeds bark leaves	Seeds used as tonic, aphrodisiac, leaves demulcent, bark is useful in skin disease, diarrhea
20	<i>Bauhinia variegata</i>	Koirala	Middle hill forest	Flower / fruits	Flower juice is taken to cure dysentery, diarrhea & stomach pain. The flower buds are taken for skin disease & ulcer. Fruits are used for blood purification.
21	<i>Bauhinia purpurea</i>	Tanki	Lower Hill Forest	Large flower Roots, Bark	The astringent bark is used to control diarrhoea. The flower are laxative and root is carminative The bark root and flowers are also useful as maturant for boils and ebcesses. Used against animal bite
22	<i>Bagonia picta</i>	Magar Kanhce	Upto 7000 ft. in Sikkim	Succulent stalks	Extracts from stalks used for venereal disease.
23	<i>Berberis aristata</i>	Chutro		Root, Bark	Used in jaundice, malaria, fever & diarrhea. It is also used externally to cure eye disease.
24	<i>Betula utilis</i>	Bhojpatra	Upper hill forest	Bark	Used to heal up the wounds.
25	<i>Bischofia javanica</i>	Kainjal	Middle hill forest	Leaves & bark	Leaves contain Vit. 'C', Bark contains tannin
26	<i>Bombax ceiba</i>	Simal	Middle hill forest	Root	Used for curing diarrhea & dysentery
27	<i>Buddleja asiatica</i>	Bhinsenpatee	Upto 4000 ft	Leaves, flower & stem.	Used in skin complaints & as abortificant.
28	<i>Callicarpa arborea</i>	Guahelo	Lower hill forest	Bark & root	The bark juice is given to treat fever. The root is chewed in cases of boils on the gums.
29	<i>Callicarpa macrophylla</i>	Sumali	Common in Darjeeling & tarai	Bark	Used in rheumatism gonorrhoea
30	<i>Calotropis gigantea</i>	Ankh	Lower hill forest	Latex	Latex used in sprain & swelling.
31	<i>Carica papaya</i>	Mewa	Lower hill forest	Leaf	The digestive enzyme papain is extracted from the milky sap.
32	<i>Cassia fistula</i>	Raj briksha	Below 11000 ft.	Fruits, leaves	The fruits are used for asthma, diabetes, and eczema. Leaves used for treating skin diseases.
33	<i>Cassia sp.</i>	Methizar	Lower hill forest	Leaf & root	The leaf powder is given to relieve indigestion & stomach pain. The root paste is used for ringworm.
34	<i>Centella asiatica</i>	Gora taprey	Upper hill forest	Leaf	Leaves are used for asthma and skin disease, Urinary discharges and improving memory.
35	<i>Cinchona officinalis</i>	Sinchona	Middle hill forest	Bark	Quinine is extracted as remedy for malaria.

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
36	<i>Cinnamomum tamala</i>	Sinkauli	Tropical & sub-tropical Himalaya upto 3000 to 5000 ft.	Bark & leaves	Leaves are stimulant used in rheumatism, in colic & diarrhea. Bark is given in gonorrhoea.
37	<i>Citrus indica</i>	Chaksi	Middle hill	Fruits	Stomach problems.
38	<i>Clematis buchmaniana</i>	Pinaasey lahara	Lower hill forest	Root	Used to cure sinusitis.
39	<i>Clerodendron infertunatumr</i>	Chitu	Lower hill forest	Bark /leaves	Leaves are of anthelmintic, fresh juice of the leaves is tonic and febrifuge.
40	<i>Cordyceps sinensis</i>	Yarcha gombuk	Alpine	Whole plant	Rejuvenates liver, heart & cheeks again process & built up immune system.
41	<i>Costus speciosus</i>	Bet laure	Tropical to temperate	Root	Useful in fever, bronchitis, anemia, rheumatism and diabetic.
42	<i>Calendula officinalis</i>	Calendula	Lower Hill	Flower, Leaves.	It is antiseptic and antifungal, contains hormones and vitamin A. It is diaphoretic, stimulant, antispasmodic and small pox. It is also used in healing wounds, ulcers, burns.
43	<i>Catharanthus roseus</i>	Sadabahar	Lower Hill	Plant	Anti cancer, antitumour, leaves are diuretic.
44	<i>Chenopodium album</i>	Bethu Saag	Middle and Lower Hill	Plant	It improves appetite, laxative, diuretic, eye diseases, throat troubles, piles, blood heart and spleen diseases. It is used as a pot herb in piles.
45	<i>Citrus medica proper</i>	Bimbira	Lower Hill	Fruits and rind	Fruits are used in the treatment of indigestion and typhoid and dysentery.
46	<i>Dolichus uniflorus</i>	Gahat	2500 ft.	Seeds	Cure Measels, Chicken pox, tumors, asthma.
47	<i>Dioscorea bulbifera</i>	Gittha	4000 ft.	Tuber	Aphrodisiac, stomachic, improves appetite.
48	<i>Dichroa febrifuga</i>	Basak	Middle hill at 6000 ft.	Small tree	Roots & Leaves Fever, malaria
49	<i>Daphne cannabina</i>	Kagatey	Upper hill forest	Bark & root	The bark decoction is given to treat fever. The roots are used for intestinal troubles.
50	<i>Desmodium sp.</i>	Sakhino jhar	Himalaya forest upto 2000 ft.	Bark & flower	Decoction of bark used for hemorrhage, diarrhea poisoning & eye disease, flower used in biliousness.
51	<i>Dichroa febrifuga</i>	Vasak	Middle hill forest	Leaf & root	The decoction of leaves is taken for fever. The root is given as a tonic.
52	<i>Digitalis purpurea</i>	Fox glove	Middle hill forest	Leaves	Heart tonic & cardiac stimulant.
53	<i>Dillenia indica</i>	Ramphal	Lower hill forest	Barks & leaves	Fruit juice with sugar works as cooling beverage in fever and cough mixture: bark, leaf for diarrhea & dysentery.
54	<i>Dioscorea deltoidea</i>	Kukurtarul	Lower hill forest	Barks & tuber	Roots-tuber are edible & also used for washing clothes, to kill lice & fish. Used in contraceptive pills.

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
55	<i>Dioscorea alata</i>	Ghartarul	Lower Hill Forest	Tuber	It is used in fever, leaves in rash and itch and plants in constipation. The tubers are anthelmintic useful in leprosy, piles, gonorrhoea.
56	<i>Drymaria cordata</i>	Abhijal	Upto 5000 ft.	Whole plant	Above ground parts-steamed and smelled during sinus trouble. Plant paste for fever, cold and cough also used for dog bites, headache.
57	<i>Eleoarpus spaericus</i>	Rudraksh	Upto 4000 ft	Fruit	Used in Vata and Kapha disease of head, epileptic fits.
58	<i>Evodia fraxinifolia</i>	Khanakpa	Upto 7000 ft.	Fruit	Antipyretic, treatment of typhoid.
59	<i>Entada scandens</i>	Pangra	Middle hill forest	Seeds	Emetic, astringent.
60	<i>Ephedra gerardiana</i>	Somlata	Lower hill forest	Whole plant	Plant raises blood pressure & used to relieve asthma high fever.
61	<i>Equisetum debile</i>	Kurkure Jhar	Throughout hills	Aerial part	Clotting agent used in wound, nose bleeding & bleeding of urinary tract.
62	<i>Eupatorium odoratum</i>	Kalijhar	Lower hill forest	Leaves & tender bud	Extract from leaves used in cuts and wounds.
63	<i>Eupatorium cannabinum</i>	Banmara	Lower hill forest	Leaves & stem	Leaf and stem extract used on cut & bruises to stop bleeding & infection.
64	<i>Euphorbia royleana</i>	Siwri	Lower hill forest	Latex	The latex is used to cure cuts & stop bleeding; It is also used to relieve earache, cough & asthma.
65	<i>Emblica officinalis Gaertn</i> <i>Phyllanthus emblica Linn.</i>	Amla	Tropical/ sub-tropical Lower Hill Upto 4000ft.	Small Tree	Fruits, leaves, flowers, roots, bark seeds Multiuse
66	<i>Edgeworthia gardeneri</i>	Argaily	4000-7000 ft	Shrub	A fish poison, stem bark is used in paper manufacture.
67	<i>Eucalyptus globosa</i>	Tarpin	Lower Hill	Leaves	Yield a strong pungent essential oil, valued in medicine as an antiseptic, febrifuge and anthelmintic.
68	<i>Fapophyrum esculentum</i>	Mithey Phapur	Upto 6000 ft.	Grains	Used in diet in colic, diarrhea
69	<i>Fagopyrum dibotrys</i>	Ban phapar	5000 – 11000 ft.	Fruit & Grains	Diet in colic, used in lungs infection and pulmonary abscess.
70	<i>Ferula narther</i>	Hing	Rocky location	Gum	Used in asthma, cough, hysteria & epilepsy.
71	<i>Ficus semicordata</i>	Khasrey Khaneu	Lower hill	Latex & bark	Latex, bark applied on boils to check infection.
72	<i>Fraxinus floribunda</i>	Lakuri	Middle hill	Bark	Bark-boiled & applied for gout.
73	<i>Foeniculum vulger</i>	Sounp	Lower and Middle Hills.	Leaves, tender shoots, fruit	It is used as flavouring agent of foods, curries and salad. Seeds are good in digestion, removes stomach pain regulates

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
					menstruation, improves appetite, breast milk production.
74	<i>Garuga pinnata</i>	Dubdabey	Lower hill forest	Bark, root	The bark juice is applied to treat dislocated bones & to heal wounds. Root bark is used for curing skin disease.
75	<i>Gloriosa superba</i>	Langarey Tarul	Sub-Tropical Lower hill up to 3500 ft.	Herbaceous & glabrous climber	Tubers, roots flowers Chronic ulcers, leprosy, piles, abdominal pains
76	<i>Glycyrrhiza glabra</i> Linn.	Jethimadhu	Sub- Himalayan tract (Cultivated)	Erect & tall perennial plant	Roots Cough, fever, dysentery, chronic Hepatitis
77	<i>Glyeine soja</i>	vhatmas	6000 ft	Erect herb	Astringent property, a nutritional diet, rich in vitamins and minerals
78	<i>Hippophae salicifolia</i>	Achuk	Temperate 5000-10,000 ft.	Shrub	Fruits/bark Lung dieases, skin Eruptions. Irritations
79	<i>Heracleum wallichii</i>	Chimphing	8000-13000 ft.	Small shrub	Roots Tonic , aphrodisiac
80	<i>Orchis latifolia</i> -	Panchamlay	Alpine 8000-12000 ft.	Erect herb a terrestrial orchid	Tubers Tonic, diarrhea, dysentery, chronic fever
81	<i>Holarrhena antidysenterica</i>	Anley khirrn	Lower hill forest	Bark	Orally administered in amoebic dysentery.
82	<i>Hymenodictylon sp.</i>	Latikaran	Lower hill forest	Bark	Orally used for treating haemorrhoids (Piles).
83	<i>Hypericum patilum</i>	Urila	3 to 7000 ft.	Seed	Seeds are aromatic & stimulant.
84	<i>Jatropha curcas</i>	Kaden, Hathi-kane	Lower hill forest	Juice	The Viscid juice stops bleeding of wounds. Also applied to treat burns, scabies, eczema & ringworm.
85	<i>Juglans regia</i>	Okhar	Upper hill forest upto 5000ft.	Fruit & oil	Oil is used for headache. Bark is used for dye & acts as an detergent.
86	<i>Kaempferia roturela</i>	Bhui Champa	Below 5000	Tuber	Bone settlers
87	<i>Leea macrophylla</i>	Bulyettra	Lower hill forest in Darjeeling & Sikkim.	Roots, leaves & seeds	Tuber for ringworm & guinea worm, leaves paste floor stopping bleeding.
88	<i>Linderaa neesiana</i>	Siltimbur	Temperate Himalayas, Nepal & Sikkim.	Bark & fruits	It is aromatic, carminative.
89	<i>Litsea citrata</i>	Siltimur	Upper hill forest	Fruits Plants	Dried fruit used for stomach trouble.
90	<i>Lycopodium clavatum</i>	Naagbeli	Middle hill/upper hill to 6000 ft.	Creeping plant	Plants & Spores Rheumatism, pulmonary disorder, chronic kidney
91	<i>Lycopodium clavatum</i>	Nagbeli	Upper hill forest	Roots & leaves	Used in treating rheumatism.
92	<i>Mentha viridis</i>	Pudina	4000-8000 temperate Himalayas	Roots	Leaves given in fever & bronchitis; oil is used for rheumatism.
93	<i>Moringa oleifera</i>	Sajana	Lower Hills	Root, bark and fruits	Root is tonic, used in piles urinary discharge and asthma, bark is useful in heart complaints eye diseases.

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94	<i>Melia azederach</i>	Bakaina	Lower hill Forest	Entire plant	Root is astringent, removes biliousness, pain in heart, useful in vomiting, leucoderma.
95	<i>Marsdenia roylei</i>	Baahuni Lahara	Lower hill forest upto 5000ft. in Sikkim & Darjeeling.	Entire plant	It has a cooling & alternative effect in gonorrhoea.
96	<i>Melia azadirach</i>	Bakaina	Lower hill forest	Roots	Root is astringent, removes biliousness, pain in heart, use full in vomiting, leucoderma.
97	<i>Mentha viridis</i>	Nageswari	4000 to 8000 trmperate Himalayas.	Root	Leaves given in fever & bronchitis; oil is used for rheumatism.
98	<i>Mesua ferrea</i>	Nageeswari	Lower hill forest	Bark	Orally administered in various skin diseases (mostly poxes) & in menstrual disorder
99	<i>Mimosa pudica</i>	Lajjawanti	Lower hill forest	Leaf & leaves	The leaf & root paste is used in case of piles & diseases of kidney. The root is used in treating asthma, fever, cough, dysentery, vaginal & uterine complaint.
100	<i>Moringa oleifera</i>	Sajana	Lower hill forest	Root, bark & fruits	Root is tonic, used in piles, urinary discharge & asthma, bark is useful in heart complaints, eye diseases.
101	<i>Myrica esculenta</i>	Katusi	Middle hill forest	Bark	Used against fever. The paste of the bark is applied on the chest to get relief from cough & bronchitis.
102	<i>Marsdenia roylei</i>	Baahuni Lahara	Lower hill forest upto 5000ft. in Sikkim & Darjeeling.	Entire plant	It has a cooling & alternative effect in gonorrhoea.
103	<i>Melia azadirach</i>	Bakaina	Lower hill forest	Roots	Root is astringent, removes biliousness, pain in heart, useful in vomiting, leucoderma.
104	<i>Mentha viridis</i>	Nageswari	4000 to 8000 trmperate Himalayas.	Root	Leaves given in fever & bronchitis; oil is used for rheumatism.
105	<i>Mesua ferrea</i>	Nageeswari	Lower hill forest	Bark	Orally administered in various skin diseases (mostly poxes) & in menstrual disorder
106	<i>Mimosa pudica</i>	Lajjawanti	Lower hill forest	Leaf & leaves	The leaf & root paste is used in case of piles & diseases of kidney. The root is used in treating Asthama, fever, cough, dysentery, vaginal & uterine complaint.
107	<i>Moringa oleifera</i>	Sajana	Lower hill forest	Root, bark & fruits	Root is tonic, used in piles, urinary discharge & asthma, bark is useful in heart complaints, eye diseases.
108	<i>Myrica esculenta</i>	Katusi	Middle hill forest	Bark	Used against fever. The paste of the bark is applied on the chest to get relief from cough & bronchitis.
109	<i>Nyctanthus arbortistiis</i>	Parijat	Lower hill forest	Leaves, bark	Leaves are boiled & the decanted water is taken to

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					control malaria fever. Bark paste is used for dislocated bones, flower are offered to god & goddesses.
110	<i>Nardostachys jatamansi</i> DC.	Jatamansi,	11000-17000 ft.	Perennial herb	Whole plant & root stock Skin diseases, leprosy, ulcers, cough
111	<i>Ocimum sanctum</i>	Tulasi	Lower hill forest	Leaf/root	The leaf juice is applied to cure scabies & other cutaneous diseases. Infusion of leaves is given as a remedy for gastric trouble, flu, colds & bronchial infection. Root for fever
112	<i>Oxalis corniculata</i>	Chariamilo	Lower hill forest	Whole plant, root	Leaf juice is eaten to cure dysentery & fever, anemia, and for appetite, digestion.
113	<i>Oroxylum indicum</i>	Totola	Lower hill upto 2500 ft.	Small weak tree	Bark, root bark, fruits for fever, bronchitis, dysentery, asthma
114	<i>Podophyllum hexandrum</i>	Bankankari, Panchpatey	9000-14000ft.	An annual shrub	Whole plant, roots, fruits Torpid fever, diarrhea, mental disorder, plague
115	<i>Physalis minima</i>	Jangali phokphokey	Below 5000 ft.	Fruits	Used as tonic, diuretic, laxative and useful in inflammations
116	<i>Phytolacca acinosa</i>	Jaringo	Middle hill forest	Leaves	Fresh juice applied on cuts & wounds to stop bleeding & infection
117	<i>Panax pseudoginseng</i>	Mangan	Above 8000ft.	Roots	The root is taken to reduce fever, indigestion & vomiting: also used as tonic.
118	<i>Phyllanthus emblica</i>	Amla	Lower hill forest	Fruits	Dried food for burning sensation of heat & urinary discharge, liver complaint & eye trouble.
119	<i>Picrorhiza kurooa</i>	Kutki	Above 7000 ft.	Roots	Used as laxative, brain, tonic, emetic; goods in paralysis
120	<i>Piper longum</i>	Pipla	Lower hill forest	Fruits	Dried unripe fruits alternative tonic; ripe fruits, aromatic, stomachic carminative
121	<i>Potentilla fulgens</i>	Bajradanta	Lower hill forest	Plants /roots	The plant juice is taken to treat stomach trouble, cough & cold. The root powder is considered to cure toothache & pyorrhea.
122	<i>Pteri biaurita</i>	Thado unew	Middle hill forest	Stem	Mashed stem applied on cuts & wounds to stop bleeding & infection
123	<i>Polygonum viviparum</i>	Ratnaula	Middle hill forest	Root	Root juice boiled with water is given in case of fever, recommended for jaundice & stomach trouble.
124	<i>Punica granatum</i>	Darim	Above 7000 ft.	Fruits	Unripe fruit is useful in vomiting, fever, heart diseases, sore throat, diarrhoea and dysentery.
125	<i>Rubia manjita</i>	Majhito	Upper hill forest	Stem roots	Root-tonic, alternative astringent, stem used in scorpion bite, plant used as dye.
126	<i>Rubus ellipticus</i>	Aeiselu	Middle hill forest	Root, fruits	Root & young shoots for colic pain. Root paste is applied to

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
					treat wounds. Fruit juice is used to cure fever and cough.
127	<i>Rumex nepallensis</i>	Halhaley	Lower hill forest	Root	Root dried or fresh extract used orally in hepatitis, loss of hair, also plant used as dyes.
128	<i>Rhus semialata</i>	Bhakimlo	Lower hill forest	Fruits	Fruits dried-extract used in diarrhea, swellings and wounds.
129	<i>Ricinus communis</i>	Rairi	Upto 3000 ft.	Leaves roots	Leaf juice is used to cure headache, boils & dysentery. Paste of young leaves used to cure jaundice. Roots for skin diseases.
130	<i>Rheum australe</i>	Padamchal	Above 6000ft.	Rhizome	Dried rhizome & roots used as astringent, tonic stomachic. The petals as pickles.
131	<i>Rubia cordifolia</i>	Majito	Middle & upper hill 4000-7000ft	Perennial herbaceous climber	Root & Fruit Anti- dysenteric, uterian pains, voice, complexion
132	<i>Rhododendron Anthopogon</i>	-Sunpati	Alpine 11000-16000ft.	Dwarf evergreen shrub	Whole plant except root, incense, snuff to induce sneezing
133	<i>Rhododendron arboreum</i>	Laligurans	Temperate & upper hill 4000-10,000 ft.	Medium size evergreen tree	Flowers, young leaves, dysentery, diarrhea, headache
134	<i>Rauwalfia serpentina</i>	Sargandha	Lower Hill Forest up to 2000 ft.	Shrub	Roots, high blood pressure Snake bite, insomnia,
135	<i>Rubia cordifolia</i>	Majito	Middle & upper hill 4000-7000ft	Perennial herbaceous climber	Root & Fruit Anti- dysenteric, uterian pains, voice, complexion
136	<i>Selinum tenuifolium</i>	Bhut Kesh	6000-13000 ft	Leaves & Fruits	Leaves, aromatic, carminative, fruit used in skin diseases, scabies.
137	<i>Sapindus mukrosssi</i>	Ritha	Lower hill forest	Fruits	The juice of fruit is used to cure burnt part of the body. The fruit is also used for epilepsy.
138	<i>Swertia chiraita</i>	Chiraita	Upper Hill / Temperate 5000-10,000ft	Annual. Perennial herb	Whole plant Tonic, leucoderma, skin diseases, chronic fever.
139	<i>Smilax zeylanica</i>	Kukur Dainey	Tropical Upto 6000 ft.	Thorny climber	Used in Urinary complaints and dysentery Roots are taken as tonic
140	<i>Saussurea costus</i>	N - Kapisful, Kuth	8000 – 13000 ft.	Perennial herb	Bronchitis, vomiting, epilepsy, Headache, hysteria
141	<i>Solanum nigrum</i>	Kalobehi,	Worldwide	Shrub Weed	Fruits, roots, leaves Leucoderma, dysentery, vomiting, asthma, bronchitis, fever, urinary discharge
142	<i>Stephania glabra</i>	Taubarkey	Lower hill forest	Root bulb	Powder used in diabetes, tuberculosis, asthma, fever.
143	<i>Taxus baccata</i>	Dhengresalla	6000-11000 ft.	Medium tree	Leaves extracts used in breast cancer
144	<i>Tamaarindus indica</i>	Titari	Lower hill forest	Bark/fruits	A decoction of bark is given in cases of paralysis, ulcers & inflammations; fruit used for cough blood disorders.

Sl. No.	Botanical Name	Local Name	Distribution	Types	Part used & Uses
145	<i>Taxus baccata</i>	Dhengre salla	Above 8000ft.	Leaf/bark	Leaf extracts used in breast cancer.
146	<i>Terminalia ballerica</i>	Barra	Lower hill forest	Fruits Bark	It is useful in dealing with bronchitis, asthma & respiratory trouble. Bark used for anemia and leucoderma.
147	<i>Terminalia chebula</i>	Harra	Lower hill forest	Fruits	Used as tonic; to cure eye diseases, heart & bladder diseases.
148	<i>Thysanolaena maxima</i>	Amliso	Upto 6000 ft.	Roots	Roots, dried or fresh, paste applied to cheek boils.
149	<i>Toona ciliata</i>	Tooni	Lower hill forest	Bark flower	Bark is astringent, febrifuge. The flower is given in menstrual disorder.
150	<i>Trichosanthus bracteata</i>	Indreyani	Middle hill forest	Fruits roots	Fruits cures asthma, roots used in lung diseases of cattle
151	<i>Tupistra nutan</i>	Nakima	Upto 6000 ft.	Flower	Appetizer and Diabetic
152	<i>Tinospora cordifolia</i>	Garjo	6000 ft.	Stamp, Root	Diabetic
153	<i>Uritca dioca</i>	Sisnu	Lower hill forest	Whole plant	Roots dried or fresh paste applied on minor fractures. The tender shoot/leaves taken as vegetables.
154	<i>Viscum articulatum</i>	Harchur	Lower & Upper hill 1000-6000 ft.	Herb	Whole plant Ulcers, epilepsy, muscular pains, injuries, fracture
155	<i>Valeriana jatamansi</i>	Nakali Jatamansi	Middle hills	Herb	Root is given in case of hysteria, epilepsy and neurosis. It is Carminative and stimulant.
156	<i>Woodfordia fruticosa</i>	Dhayeroo	Lower hill forest	Flower, bark	Dried flower for piles, liver complaints Bark for gastric trouble.
157	<i>Zanthoxylum allatum</i>	Bokey timbur	Lower hill forest	Fruits	Fruit carminative, stomachic, seeds used to cure dyspepsia & cholera.
158	<i>Zingiber officinale</i>	Aduwa	Cultivated	Rhizome	Its laxative, aphrodisiac, carminative useful in heart diseases, throat & asthma.
159	<i>Zizyphus sp.</i>	Bayer	Below 1000ft.	Bark fruit	Bark as tonic. The ripe fruits to cure thirst and in blood diseases.
160	<i>Zenthoxylum acanthopodium</i>	Bokey timbur	Below 7000 ft	Fruit	Food poisoning

All the Medicinal and Aromatic plants (Maps) listed above are having high efficacy and have medicinal values which have been widely used by the different Indian System of Medicines like Ayurveda, Homeopathy, Unani, Siddha, Amchi, and Allopathy. Some of the species are also used for Cosmetic, Nutraceuticals, Food products, Beverages etc. and have tremendous demands from pharmaceuticals and many other Herbal Based Industries.

Annexure 4

Table A4.1: Rapid Assessment of SBSAP 2011

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
A. Biodiversity Database							
a) Establish a state biodiversity information system with facilities for easy storage, retrieval and distribution in an interactive manner.	DFE (SBFP, WP)	GBPIHED (Sikkim)	S	ENVIS Sikkim documents the biodiversity species; Flora (heritage trees, lichen diversity, mushrooms, flowering plants, alpine vegetation, orchid diversity, tree species) and fauna (amphibians, butterflies, fish, moths, rare and endangered fauna)	Some data not usable for analysis because of format (PDF) Scattered data and often does not specify the reference year Not fully interactive	What is the reference year for the lists of threatened, endangered and endemic species listed on ENVIS Sikkim database? Does ENVIS Sikkim have provision to incorporate databases from PBRs? Is there any mechanism to collate data of different entities, or if the entire species list is from ENVIS's independent studies?	Other experts, scholars and relevant institutions should be identified to develop reciprocal arrangements for data and information sharing.
b) Conduct biodiversity surveys and prepare inventories utilizing services of local institutions, particularly in unexplored tracts, including an assessment of quantum availability of economically important and threatened plant in natural habitats, and providing GPS	DFE (SBFP, WP, SBB),	GBPIHED (Sikkim), BSI, ZSI, Sikkim University, etc.	M	Not clear if any plan has been developed for periodic data collection. Work on People's Biodiversity Registers (PBRs) has started. 15 PBRs have been formed and 4 PBRs have been approved (Lingi Sokpay BMC, South Sikkim; Hee-	No other information is available in public domain. Biodiversity Management Committees (BMCs) are responsible for preparation of PBRs.	Why have BMCs been unable to formulate PBRs? What are the constraints? (funding, accountability, management or any other issues) What is the status of the 4 PBRs listed on	Projects supported by multilateral and bilateral co-operation such as UNDP, World Bank. Other experts, scholars and relevant institutions should be identified to develop reciprocal arrangements for data and information sharing.

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
coordinates for all sampling areas.				Gyathang BMC, North Sikkim; Kitam Manpur BMC, South Sikkim; and West Pendam BMC, East Sikkim).		the website? Are they finalized? What is the status of BMCs? Do regular meetings take place or does it require more funds/ push/incentivization?	
c) Conduct regular surveys to monitor changes in targeted species of wild and cultivated, domesticated plants and animals using the latest technologies and tools.	DFE (WP, SBB)	Dept. of Agriculture, A.H., Fishery, GBPIHED (Sikkim), BSI	L	ENVIS Sikkim, "Biodiversity of Sikkim", book published in 2011 by Information and Public Relations Department, Government of Sikkim.	Not clear if any plan has been developed for periodic data collection. No information about regular surveys on Public Domain	19 Working Circles have been prescribed in Chapter 25 in the scripting of a working plan. These include Oak restoration working circle, Wetland working circle, applied forestry research working circle, Khasmal forest working circle among others. What is the status of these working circles?	
d) Update the list of endangered flora and fauna based on national, international criteria.	DFE (WL, SBB)	DFE (T,NTFP), Horticulture Department, GBPIHED (Sikkim), BSI	S		Reference year of lists of endangered species are not mentioned Book published in 2011, needs updation	How often are the lists updated?	
e) Assess populations and monitor species which are declining and plan how these species should be recovered.	DFE	DFE (T, WL, SBFP, DREE), GBPIHED (Sikkim), BSI, ZSI,	L	ENVIS Database identifies threatened /declining species	Reference Year of the database is missing Mechanisms of recovering species	Is the greening mission in Sikkim oriented towards replanting threatened species?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
		universities, etc.			have not been given specifically given. No indicator to check which species are recovered (if any)		
f) Develop a database on traditional knowledge.	SBB, BMCs	DFE, Tribal Welfare Dept., GBPIHED (Sikkim)	M	Studies promoted by DFE Documentation to some extent by Sikkim biodiversity conservation board (Indigenous lifestyles and biodiversity conservation issues in Sikkim)	No single database for traditional knowledge (TK)	What has been the progress in involving locals to document TK? Which agency has been working on it?	
g) Study and document microbial diversity, including both beneficial and harmful microbes in terrestrial and aquatic ecosystems.	DFE, Health Department Agriculture Department	ICAR, Animal Husbandry (Fisheries and Livestock), Sikkim Govt. College, Sikkim University	M	North East Biodiversity Database setup by a group of researchers from the North-Eastern Hill University	No database for Sikkim specifically Database needs more work according to researchers	Which agency is responsible for documenting microbial diversity (if any)? Has there been any provision to apply microbial diversity research in other areas such as enzyme technology or biofuel production?	Importance of microbial diversity has been emphasized in literature. There is research that shows that hot springs harbor microbial diversity. Their results can be applied in enzyme technology, cleaning up polluted areas and biofuel production.
h) Build the capacity of law enforcing officials for recognizing rare and threatened species of plants and animals and provide necessary reference materials.	DFE	WII, BSI, ZSI, etc., law enforcement agencies, GBPIHED (Sikkim)	S	Trainings and workshops regularly conducted by Forest Department.		Do these trainings give specific knowledge sharing for recognizing rare and threatened species? Is training imparted for dealing with loss to threatened species?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
B. In-situ biodiversity conservation							
a) Explore the scope for further expansion of the PA network with stakeholders, identifying, prioritizing biodiversity rich areas, e.g. Dombang Gymnosperm Reserve	DFE (WL)	GBPIHED (Sikkim) (BCM), BSI	M	Expansion recommended in previous BSAP has not taken place. No clarity on progress of this action point.	No clarity on progress of this action point	What is the strategy for PAs in Sikkim? Is there any plan for increasing the area or any other strategy to make the PAs more effective?	According to researchers, PA networks in Sikkim need re-strategizing.
b) Strengthen biodiversity monitoring systems in the PA network and reserve forests.	DFE (WL, T)	GBPIHED (Sikkim) (BCM), BSI, WII, FSI	M	REMC (Research Evaluation and Monitoring Cell) has been constituted in 2016 in the DFE mainly for evaluating and monitoring all research and to ensure that the benefits of the research reach the Forest and Wildlife Managers.	REMC activities not reported on public domain	Have the research works sponsored by REMC been included in policy-making? Is there any agency responsible for inter-departmental knowledge sharing? Has REMC developed any indicator for monitoring progress?	
c) Strengthen the capability of the DFE to coordinate biodiversity monitoring systems in the PA network and reserve forests.	DFE (WP, WL, Training cell)	GBPIHED (Sikkim) (BCM), BSI, WII, FSI, ZSI	M	REMC has been constituted for monitoring efforts.	No clarity about indicators which may have been developed for carrying out monitoring	Same questions as above	
d) Evaluate the experience of ongoing programs to address human animal conflict and identify effective approaches to strengthen programs to prevent human-animal conflict.	DFE (WL)	NGOs, WII,	S	ENVIS 2016-17 newsletters reported human-wildlife conflicts with a focus on region-wise incidences.	Forest Department's population estimation to know the status of wildlife in the state is not available. Status of solar fencing, training and	What is the population of wildlife in these areas? Are the reports of 'overpopulation' of wildlife in certain areas	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
					tranquilizing animals has not been reported	acknowledged by the DFE data?	
e) Initiate well-planned eco-development programmes in the fringes of PAs to improve the livelihood of dependent community.	DFE (FDA)	RMDD, Agriculture, AHLF&VS, Tourism, TDCs, NGOs.	M	The Red Panda Project (DFE): Training and workshops involving both the community & the forest department	Project report unavailable in public domain, so progress is not clear	What has been the progress of the project?	
f) Establish and notify permanent preservation plots for monitoring biodiversity along different altitudinal zones and in different habitats.	DFE (WP, DREE)	DFE (WP, DREE)	GBPI HED (Sikkim)	No permanent preservation plots established.	No plan for establishing permanent plots identified	Is there any progress in this area?	
g) Develop a mechanism to identify and conserve sacred groves and other religious landscapes, e.g. Devithan around springs.	DFE, Ecclesiastical Dept.	GBPIHED (Sikkim), BSI, RMDD	M	Project in collaboration with Kabi Endeavours, a local NGO: Looking at conservation of the sacred groves and promoting it as an area for tourists	State level progress not clear	Which sacred groves have been successfully revived, if any? What is the status of the Sikkim sacred groves projects? Has there been community mobilization?	
h) Conduct research on different aspects of species biology and ecosystem function in PAs and reserve forests.	DFE (DREE), GBPIHED (Sikkim)	Universities, WII	M	The state incurs expenditure on Research and Ecological Regeneration.	Expenditure has been noted in the budget but progress not clear	Have local universities been involved, as per the recommendation in 2011 BSAP?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
i) Promote reintroduction and recovery of threatened plant and animal species.	DFE (HZP, P&G, GBPIHED (Sikkim) (BCM)	Dept. Agriculture, Dept. of AH	L	The Red Panda Project (DFE) Sikkim Forestry and Environment Mission 2015 Flagship Greening Programmes like state green mission, ten minutes to earth, smritivan, creation and management of propagation nursery	Monitoring framework is lacking	Are there any mechanisms to monitor the saplings? Is the orientation of these programmes towards threatened species provisioned yet?	
j) Strengthen the capability of DFE and other agencies to prevent poaching and illegal trade of wild animals, plants and their parts.	DFE (T, WL)	Police, NGOs, FDA,	L	Collaborations and projects to stop illegal trade	Despite efforts, poaching exists because of shortage of frontline staff, and wildlife personnel does not have 'status' at par with police, do not have weapons or equipment to effectively combat illicit trade	Does the department acknowledge such shortage? What are the reasons for it? Have there been efforts for community mobilization, as suggested by BSAP 2011?	
k) Identify habitat for key wildlife species outside of PAs and encourage conservation outside the PA network on government and private property	DFE (WL)	Dept. of Public Relation, Media, GBPIHED (Sikkim)	M	Progress on this recommendation is not clear	Progress on this recommendation is not clear	Have the key wildlife species been identified?	
l) Strengthen forest fire-fighting program.	DFE (T, WL)	NGOs, FDA	L	Sikkim State Disaster Management Authorities runs programs for managing forest-fires	Ban on gothwalas without necessarily providing alternate livelihood measures	What are the measures taken during peak months? Is a complete ban on trespassing during	The reasons of forest fires may be intentional (management of grasslands, ward off animals, bonfires by herders). illegal timber mafias)

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
						peak months a viable option? What has been the progress in rehabilitating the gothwalas?	or may be accidental (through traditional torches carried by trespassers, sparks in electric transformers, cigarette butts) Data on causes of forest fires needs to be strengthened.
m) Conduct surveys of economically-important native bio-resources	DFE (SBB, NTFP), GBPIHED (Sikkim)	BSI	M	PBRs have a provision for economically-important native bio-resources	Native bio-resources have not been included so far	Has there been a plan to include native bio-resources to reiterate their importance?	
n) Develop strategies for conservation of unique wetlands and potential Ramsar sites with the support of local communities and other stakeholders.	DFE (Land Use & Env., SBFP)	RMDD, PSS, BNHS, WWF, Tourism Dept.	S	Wetland Conservation Programme: identification of some wetlands from the state of Sikkim for conservation Celebration of "World Wetland Day" by ENVIS Sikkim through awareness programmes for schools, communities With the involvement of the DFE, a community-based organization (Pokhri Sanrakshan Samiti) has been formed with the residents of the lake area to look into the conservation of Tsomgo Lake	Heavy sediment loads have been recorded in wetlands like Khecheopalri. This has happened because of land use change during the past four decades causing heavy deterioration. Increase in GLOFS (Glacial Lake Outburst Floods)- Due to climate change, sudden break of a moraine dam may generate the discharge of large volumes of water and debris causing disastrous floods downstream	What is the status of Pokhri Sanrakshan Samiti in terms of activities, initiatives, funding and training? Is there collaboration/knowledge sharing between Sikkim State Disaster Management Authority (SSDMA), Irrigation and Flood Control Department and Water Resources and River Development Department; to mitigate the water related problems post natural disaster. (considering that	There was a policy decision to form a Himalayan Institute of Disaster Management and Climate Change in Pakyong (announced by the CM). But no updates about is available

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
						earthquakes could trigger GLOF)	
o) Identify and recognize large and old trees and declare as heritage trees (for Hornbills, Flying Squirrels, Fruit bats, etc.).	DFE (T, WL)	DST, HRDD, IITM	S	DFE formulated the "Sikkim Forest (Preservation, Protection and Declaration) of Heritage Tree Rules, 2016" wherein the criteria for declaring a tree as heritage tree has been given, along with restrictions in dealing with heritage trees. For instance, these cannot be felled or damaged	Identification has been successful, no further gaps		
p) Link major butterfly habitats through strategic corridor development by planting indigenous larval and nectar food plants (native) through the involvement of various stakeholders	DFE (WL)	Nurseries, tourist entrepreneurs, FDAs	M	Small wood brown butterfly discovered in Sikkim after 120 years by researchers in Department of Zoology of the Sikkim University in Gangtok, Sikkim.	Butterfly corridors have not been progressed	Is there any plan to make strategic butterfly corridors?	
q) Develop approach to conserve identified Important Bird Areas (IBA)	DFE (WL)	NGOs, FDAs	S	Compiling of information by DEWFM on birds, and 11 important IBAs have been selected for conservation. Database on threatened birds, IBAs, migratory birds			

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
r) Complete proposal for inscription of KBR, KNP as World Heritage site	DFE (WL, SBFP), GBPIHED (WL, SBFP), GBPIHED (Sikkim)		M	KNP inscribed as UNESCO's WORLD HERITAGE SITE in 2016 and Grant for maintenance of World Heritage Site (UNESCO)			Recommendation fully addressed no gaps.
C. Ex-situ Conservation							
a) Develop and standardize the propagation and mass multiplication protocols for the rare, endangered and endemic plant species	DFE (SBFP, NTFP, SMPB), GBPIHED (Sikkim)	Horticulture Department	L	Initiated the standardization of mass multiplication protocol of rare orchid species in Sikkim Himalayas in 2018. (National Mission on Himalayan Studies)	Status unknown	What is the status of the deliverables required as per the grants given by NMHS? Is it possible to use those deliverables for other projects? (upon signing in/registering)	
b) Develop and standardize the conservation breeding protocols for the rare, endangered and endemic faunal species and dovetail it with a reintroduction programme.	DFE (HZP)	CZA	M	Khangchendzonga Landscape Programme: Red Panda Project, Wildlife Trade Control	Final report unavailable	When will the final reports of these projects be available?	
c) Implement programs to conserve the genetic diversity of native land races of cultivated plants, domesticated animals and their wild relatives	Dept. of Agriculture, AHLF&VS	SBB, BMCs	L	Lack of gene banks in the state.	Lack of gene banks in the state, as well as community centers is a constraint in ex-situ genetic resource collection and conservation in Sikkim.	What is the constraint because of which there is a serious lack of seed-banks in Sikkim? Is there any plan to overcome these constraints?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
d) Identify the seed viability and develop storage technologies for targeted species.	GBPIHED (Sikkim)	DFE, Dept. of Agriculture, and scientific Institutions	M	Progress unclear	Storage technologies and seed banks lacking in Sikkim.	Have there been studies to encourage threatened/endangered species in the prospective seed banks?	Link to national gene bank
e) Encourage propagation and cultivation of wild economic plants.	DFE (Parks and Gardens)	GBPIHED (Sikkim), FDAs, BMCs, Agriculture Dept.	M	Plantation Schemes (Components: i. Medicinal Plants ii. Regeneration of Conifer Forest Area iii. Greening of Ecologically Fragile Area)	Updates/progress not available on the mentioned schemes. However, there has been independent research that there is socio-economic gain from the sale of wild plants.	What has been the progress of planting conifers and medicinal plants in Sikkim?	
f) Create new botanical gardens and parks with sections for different communities, focusing on native species.	DFE (Parks and Gardens)	DFE (NTFP, T, WL, FCA), SPCB, SBFP, GBPIHED (Sikkim), BSI, Ayurveda)	M	Only two Botanical gardens in Sikkim- Rhododendron Arboretum, Gangtok and Jawaharlal Nehru Botanic Garden, Rumtek	Not clear progress on developing new ex situ facilities like botanical gardens.	Are there plans to create more botanical gardens in Sikkim?	
g) Improve labeling in existing and new gardens, ex-situ conservation- arboretums, herbal gardens, etc.	DFE (Parks and Gardens)	DFE (NTFP, T, WL, FCA), SBFP, GBPIHED (Sikkim) BSI, Ayurveda)	M	Labelling progress not clear	Labelling progress not clear	Has there been any agency responsible to improve labelling in ex-situ gardens? Is it possible to include local names in such labelling?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
h) Develop new ex-situ conservation facilities, e.g. butterfly park, bird park, etc.	DFE (SBFP, WL, HZP)		M	Sikkim Forestry and Environment Mission 2015 does address it: Biodiversity conservation through enhancement of planning, monitoring and implementing biodiversity management.	No butterfly parks	The chief Minister declared in 2017 that the 2-hectare bird park in west Sikkim (Sidkeong Tuluk bird park) will be extended to 18 hectares. What is the status of that? Are there any other bird parks/butterfly parks that will be built?	
a) Register local varieties under the Farmers Rights Act.	Agriculture Dept., AHLFVS, SBB	NBAGR, NBPGR, ICAR, DARE, NBA	M	Local varieties not identified and registered.	Not registered yet.	Is there any agency looking into the registering of local varieties?	Link to different gene banks, clonal preservation centers and collections with different universities and research institutes
D. Agro-Biodiversity							
b) Ensure direct access to market for organically farmed local crop varieties though appropriate certification to fetch more remunerative price to the farmer.	Agriculture Department	DST, funding agencies. NABARD	M	Mission Organic Value Chain Development (for north eastern region) (MOVCS) The scheme aims at development of certified organic production in a value chain mode to link growers with consumers and to support the development of entire value chain. Under this initiative, value chains for organic farming are being created. "Sikkim Organic" will be the brand.	Certification has not been converted into sales as high as the potential goes. Consumers are not preferring organic produce because it is "smaller, or duller" as compared to the other produce. Consumers might not have been aptly communicated about the benefits of organic produce. Marketing may be strengthened	Is there any plan or scheme to educated prospective consumers about organic produce to increase the sale? Is there any mechanism to charge a premium price on organic produce, to increase farmer income?	CSE study has shown that farmers have reduced incomes due to organic farming.

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
c) Preserve local germ-plasm of field and horticultural crops by screening germ-plasm for desirable characters	Agriculture Dept., AHLFVS, SBB	NBAGR, NBPGR, ICAR, DARE, NBA	L	Local germ-plasm centers lacking in Sikkim	Lack of a comprehensive plan for assessment and preservation of germ plasm in Sikkim. This should also have specifically dedicated fund	Are their plans for germ-plasm collection centers? Is there any collaboration between Horticulture Department and Science Technology Department?	
d) Identify hotspots of agro- biodiversity and cropping systems and promote on- farm conservation through training programs and use of appropriate incentives.	Agriculture Dept., AHLFVS, SBB	NBAGR, NBPGR, ICAR, DARE, NBA	M	Hotspots of agro-biodiversity in Sikkim not identified	Hotspots of agro-biodiversity in Sikkim not identified	Are hot-spots of biodiversity being identified in Sikkim?	
E. Impact of climate change							
a) Identify the vulnerability of different sectors of the state, such as forest, agriculture, livestock, and microbial diversity and Himalayan ecosystem towards climatic change.	DST	DFE, Dept. of Agriculture, RMDD, Animal Resources	L	Climate Change Action Plan developed, Vulnerability assessment of climate change conducted by IISC, adaptation techniques recommended	REDD + has not been explored	Are there any programs to sensitize and prepare the communities towards climate-change?	Included in 2015 State Climate Change Action Plan
b) Identify priority habitats for species and ecosystems which are at risk due to climate change through appropriate ecological criteria.	GBPIHED (Sikkim) (BCM), BSI	DFE, Sikkim University	S	Sikkim State Action Plan on Climate Change is currently being updated by the Department of Science, Technology and Climate Change	Areas not mapped as per climate change vulnerability and notified		
c) Use plant phenology as an indicator of climate change and establish	DFE (WP), GBPIHED (Sikkim)		L	Indicator not developed	Phenology, as an indicator has been used in several independent	Is there any plan to establish permanent phenology centers for	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
permanent phenology monitoring stations along different altitude zones.					research works, but it should be acknowledged as the standard indicator for assessing climate change in Sikkim.	continuous monitoring?	
d) Undertake other multidisciplinary research for developing appropriate technology for monitoring changes on biodiversity and assess the adaptive mechanisms for biodiversity components.	Universities and Research Centers and Research Centers	DFE, DST, GBPIHED (Sikkim), WII	M	Research conducted by joint initiative of Shakti foundation, IORA ecological solutions and Sikkim Climate Inventory and Monitoring System	Adaptive mechanisms need to be strengthened	What has been the progress of linking these studies to forming appropriate changes in forestry management plans, watershed management, fodder, cropping system, plantations etc.	
e) Develop adaptive management approaches for relevant activities like change in forestry management and watershed management for soil and moisture conservation and enhance green cover.	DFE (T, Land Use & E, WL), RMDD	Dept. of Agriculture, Animal Resources, DST, ICFRE	M	Projects like Smriti Van, Harit Kranti Dashak, State Green mission and ten minutes to earth are addressing the issue of greening Sikkim	Monitoring not clear Indicator not developed to check their sustenance	Have opportunities of reaping the benefits of REDD + been recognized in these programmes? Is there a plan to encourage saplings of those plants which are better for carbon sequestration?	
F. State Development Activities and Biodiversity Conservation							
a) Involve local agencies in impact assessments (EIA) of development projects in order to limit the impact on surrounding biodiversity and habitats.	DFE (T, WL, SBFP, Land Use & Env.) State Pollution Control Board	CWC; GBPIHED, (Sikkim), BSI, GSI	L	Local agencies involvement is not clear	Local agencies involvement is not clear	Have local agencies been involved?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
b) Enforce the guidelines so that all EIAs of major developmental projects should be properly authenticated with herbarium specimens and other records from project area. All RET species falling in those area should be properly documented.	DFE (T, WL, SBFP, Land Use & Env), State Pollution Control Board	CWC; GBPIHED (Sikkim), BSI, GSI, DST	L	Progress not clear	Progress not clear	Progress not clear	Guidelines from MoEFCC
c) Monitor the preparation and implementation of Environmental Management Plans (EMPs). Prepare rehabilitation plan in case of displacement of local people due to any project considering their social, cultural, economic and other livelihood needs.	DFE (T, WL, SBFP, Land Use & Env.) State Pollution Control Board	DFE (T, WL, SBFP, Land Use & Env.), CWC; GBPIHED (Sikkim), BSI, GSI, DST, Revenue Department	L	Rehabilitation has been done through job offers or cash transfers to the affected communities due to any development projects.	Rehabilitation process need more work. There were protests when the development prospects in their sacred land was being done through Teesta hydro power projects. There has been a movement against the hydropower projects in Sikkim.	What are the challenges in rehabilitation faced by the government?	Guidelines from MoEF, Govt of India
d) Build capacity of the department to carry out mid-term assessment	DFE		L	Progress not clear	Progress not clear	Have there been any mid-term assessments in Sikkim?	
e) Avoid the development projects affecting wetlands and other biodiversity rich area.	DFE (FCA, T, WL)	Development agencies, Tourism Dept. & other Line Deptts.		Progress not clear	Progress not clear	Are there any development projects which were resituated due to prospective environmental degradation?	
G. Impact of pollution							

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
a) Conduct research to study the impacts of different types of pollution on biodiversity and develop prevention measures.	DFE (SPCB), Fisheries Dept.	Research institutions and universities		Research conducted and available on ENVIS Sikkim, with data on air quality (weekly), solid waste, water quality and soil.	Data on measures to manage pollution is not available	What are the measures being taken to manage pollution due to development activities in Sikkim?	
b) Manage industrial effluents so that neither terrestrial nor aquatic biological resources are adversely affected.	DFE (SPCB)	Industries, PCB	L	River Rejuvenation Committee constituted in 2019 which identified 4 polluted river stretches of Sikkim and formulated an action plan for their rejuvenation	Lack of proper waste disposal facilities has led to contamination of land due to leachates leaking into the ground, thereby polluting land and ground water resources.	What is the progress on waste disposal facility, which has been acknowledged in State of Environment Report 2016? Which agency is responsible for implementation of this river rejuvenation program?	
c) Promote the use of organic manures, bio-fertilizers, bio-insecticides or biological control and discourage excessive use of chemical fertilizers and biocides.	Agriculture Department	NGOs	L	Organic Mission, Paramparagat Krishi Vikas Yojana	Organic mission mandated ban on chemical fertilizers, but that has led to lower yield for crops.	What are the programmes to compensate farmers facing lower yield due to their organic produce?	
H. Biodiversity conservation with use of technological interventions							
a) Use of conventional and biotechnological tools on a pilot basis for conserving endangered species.	GBPIHED (Sikkim), DFE (SBFP)	Sikkim University	M	Progress not clear	Progress not clear	Have any biotechnological tools like artificial insemination, vitro fertilization, Gamete and embryo micro-manipulation, sperm sexing, genome resource banking,	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
						semen been run on pilot basis?	
b) Encourage value added production from the local bio-resources using innovative technologies as a tool for sustainable use of biodiversity for livelihood.	RMDD	Agriculture Department, Animal Husbandry, DST, Dept. of Small Cottage Industries, Tribal Welfare, DFE	M	Progress not clear	Progress not clear	Has agro-business been encouraged in Sikkim? Are there any facilities to process raw agriculture produce before selling?	
c) Identify and document ethno-biological knowledge, including the safety and efficacy of traditional medicinal practices.	GBPIHED (Sikkim), DFE (NTFP)	DFE (T, SBFP), Ayurveda, BSI	S	Ethno-biological knowledge documented by scholars in journals and identified that Sikkim has six ethnic communities and 1128 species, which engage in biocultural relationships.	The research is a stand-alone study which has potential to be integrated into evidence-based policy through its conclusions.	Are there any efforts being made to collate ethno-biological knowledge in Sikkim?	
d) Identify alternate income generating activities to divert the people from livelihoods which negatively impact biodiversity, e.g. grazing, harvesting bioresources, etc.	RMDD, DFE	DFE (T, WL, SBFP), Tourism Department, NGOs	M	Promotion of Eco-tourism, Geo-Tourism and Village Tourism	Anecdotal evidence suggests that locals not able to reap benefits of tourism. Locals are doing the lower paid jobs, while the bigger home-stays and hotels are owned by outsiders.	Is the state trying to involve locals as there is an influx in tourism?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
e) Promote the management of bamboos and canes and other NTFPs, sustainably with the participation of local communities and other stakeholders and make a data base.	Agriculture Dept., DFE (NTFP)	Industries Dept., RMDD, DHH, Tourism	M	Horticulture Department is the nodal department of National Bamboo Mission in Sikkim	Status not known	What has been the progress of: <ul style="list-style-type: none"> • Management of NTFPs • Participation of locals • Database 	
f) Promote agro-forestry on private lands.	Agriculture Dept./DFE	RMDD	M	Limited agro-forestry	Limited infrastructure facilities, sloping terrain, inaccessibility to most agricultural zone, depletion of natural resources from forests, water scarcity during lean period and heavy rainfall during monsoon, and erosion	Is there any plan to promote agro-forestry?	
g) Promote bee keeping for improving pollination and providing livelihood to local communities.	RMDD, Khadi & Gramodyog	DFE, Dept. of Agriculture, Industries and Tribal Welfare, GBPIHED (Sikkim)	M	Project SERVE - Save the Environment and Regenerate Vital Employment (WWF + government): Bee Keeping	Progress not known	What has been the progress of project SERVE? Any other schemes or programmes that have worked for bee-keepers?	
h) Document, disseminate and promote best practices of traditional use of bio-resources through proper study on traditional methods of utilization.	RMDD, DFE (SBFP)	Dept. of Tribal Welfare, Agriculture Dept, Ayurveda Dept, GBPIHED (Sikkim)	M	Point addressed earlier			

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
i) Promote <i>ex-situ</i> cultivation of high value trade taxa, including medicinal plants to support livelihood of communities and ensure that wild stock is not depleted.	GBPIHED (Sikkim), DFE	DFE (T, Wildlife, NTFP), RMDD, Ayurveda, Agriculture Dept.	M	i. National Mission on Ayush including Mission on Medicinal Plants ii. Plantation Scheme (Medicinal Plant)	Progress not known	What has been the progress on Medicinal Plants?	
j) Extend traditional sustainable land use practices which have been validated through research.	Agriculture Dept.	RMDD, DFE (social forestry)	M	No progress documented	Traditional users are communities, synergy between research and their livelihood is missing.	What is the mechanism to bring research findings to traditional sustainable lands?	
I. Management of invasive species							
a) Conduct research on ecological assessment of invasive species and related habitat changes and maintain a database.	GBPIHED (Sikkim), DFE (T, WL, SBFP)	BSI, Agriculture Dept., NCBS, IBSD.	L	Currently this is being done in a scheme mode by sectoral stakeholders such as DFE and DoA.	Invasive species are worked upon by sectoral stakeholders, such as agriculture department and forest department; the synergy is missing.	Have the recommendations given in SSAPCC been utilized in any policy or programme?	
b) Strengthen measures to contain and manage any spread of invasive species. Develop inter-sectoral approach for the same.	DFE (T, WL)	Fishery, Agriculture, Animal Husbandry	L	Progress report missing	Specific solutions missing Inter-departmental mechanism missing Plan for regenerating native species missing	Which agency is working on invasive species?	
c) Develop system for early warning on new sightings of invasive species in the state.	DFE (T, WL)/ Agriculture	Fishery, Agriculture, RMDD, GBPIHED (Sikkim)	M	Progress report missing	Planning is needed for early detection to control them Reporting of infestations of spread of new weeds missing	What is the plan to develop early warning signs for invasive species?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
					Naturalized weeds to be monitored		
d) Support capacity building particularly at field level to control spread of invasive species.	DFE (T, WL)	Agriculture, Fishery Dept., Animal Husbandry Dept.	S	Field level capacity building not clear	Field level capacity building not clear	Has there been capacity building for field level stakeholders for invasive species? Do forest department trainings include capacity building for invasive species?	
e) Support restoration of area affected by invasive species, including occupied butterfly habitat, by planting or regeneration native species.	DFE	Agriculture Fishery Dept., BSI, other developmental agencies, GBPIHED (Sikkim)	M	Plantation Schemes (Regeneration of Conifer Forest Area)	No data available	What has been the status of: <ul style="list-style-type: none"> Restoring Eco-Sensitive Zones Carbon sequestration potential for restoration 	
f) Establish procedures to ensure that invasive species do not enter Sikkim through international borders of three neighboring countries. Establish a quarantine cell in the state.	DFE (SBB), Agriculture Dept.	Fishery Dept.	L	Quarantine cell not formed	Capacity building for border officials (even at civilian airports), for the issue of invasive species is not clear.	What is the plan for formation of quarantine cell? Are border officials being trained and sensitized for invasive species?	
g) Help retard climate change both globally and locally and develop ways to minimize or eliminate	DFE	State Pollution Control Board (SPCB)		Climate change action plan does address the issue of invasive species	But no responsible agency has been identified		

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
such activities which enhances climate change.							
J. Valuation of Biodiversity Resources							
a) Develop a system of natural resource accounting for Sikkim reflecting both ecological and economic values of biodiversity, using UN guidelines, wherever necessary.	GBPIHED (Sikkim) DFE (WP)	DST and related organizations	M	Natural Resource Accounting system does not exist	Natural Resource Accounting system not yet explored	Is there any plan to form a natural resource accounting system in Sikkim?	
b) Support studies to validate the valuation process	DFE (SBFP)	DFE with support of GBPIHED (Sikkim) and related organizations and experts in Sikkim	M		Valuation studies lacking	Has any funding or financing been made for such studies?	
K. Promotion of Awareness on Biodiversity							
a) Provide training to government and non-government agencies to strengthen their role in biodiversity conservation.	DFE, (trainers will be identified)	GBPIHED (Sikkim), BSI DIET, AATI, RMDD, SIRD, etc.	M	<ul style="list-style-type: none"> National Green Corps-Sikkim: All Sikkim government schools eligible for aid to launch Eco-Clubs: Introduction of Environmental Education in Schools, Chief Minister's Green School Rolling Trophy and State Green Schools Awards, Awareness among school students through environmental quizzes, Green Schools Programmes, Green 	No indicator to check and monitor the impact of these awareness programmes	Is there any monitoring for which awareness techniques or mechanisms are most useful?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
				Teachers' Training Programmes			
b) Make available literature based on research and documents on best practices to relevant functionaries and stakeholders, also using electronic media.	DFE (Extension wing, SBFP)	RMDD, NGOs, GBPIHED (Sikkim), IPR	S	Scheme - Research and Ecological Regeneration	Progress not clear	What has been the progress?	
L. Policy, legislation and administrative measures							
a) Strengthen the capacity of state and local institutions for effective enforcement of the Biological Diversity Act, including ensuring TK and ABS mechanisms.	DFE (SBB)	State Biodiversity Board, Home (Police)	M	Point covered earlier			
b) Review the policies and laws for conservation and management of sacred landscapes, grasslands and other areas of importance for biodiversity conservation.	DFEMW (T, WL, SSB)	GBPIHED (Sikkim), BSI, DST, Ecclesiastical and Cultural Deptts, etc.	M	Ban on collection of medicinal plants from forest areas for commercial use (Heritage Tree Rules, 2016) Ban on Burning of Agricultural Waste: The State Government in 2015 has imposed prohibition on the burning of agricultural waste, leaves, litter, paper wastes and garbage within the State of Sikkim	Progress not known	What has been the impact of these bans? Is there good implementation/enforcement at ground level?	

Recommended Actions (As per BSAP 2011)	Lead agency	Partner agencies	Time frame	Progress so far (schemes/ program, others)	Gaps	Questions	Remarks
c) Prepare Peoples Biodiversity Registers and strengthen mechanisms with the support of technical institutions. JFMCs, EDCs and PSSs.	DFE (SSB, BMC, ENVIS)	State Biodiversity Board	S	Point covered earlier			
d) Include the evaluation of biodiversity as an integral part of any development project, and ensure that the design of the project includes measures to minimize any loss of biodiversity and is vetted by experts.	DFE (FCA, T, WL)	Line Departments, GBPIHED (Sikkim), BSI	L	Progress not clear	Progress not clear	Which development projects have included evaluation of biodiversity as a parameter? Which agency is responsible for expert vetting?	

