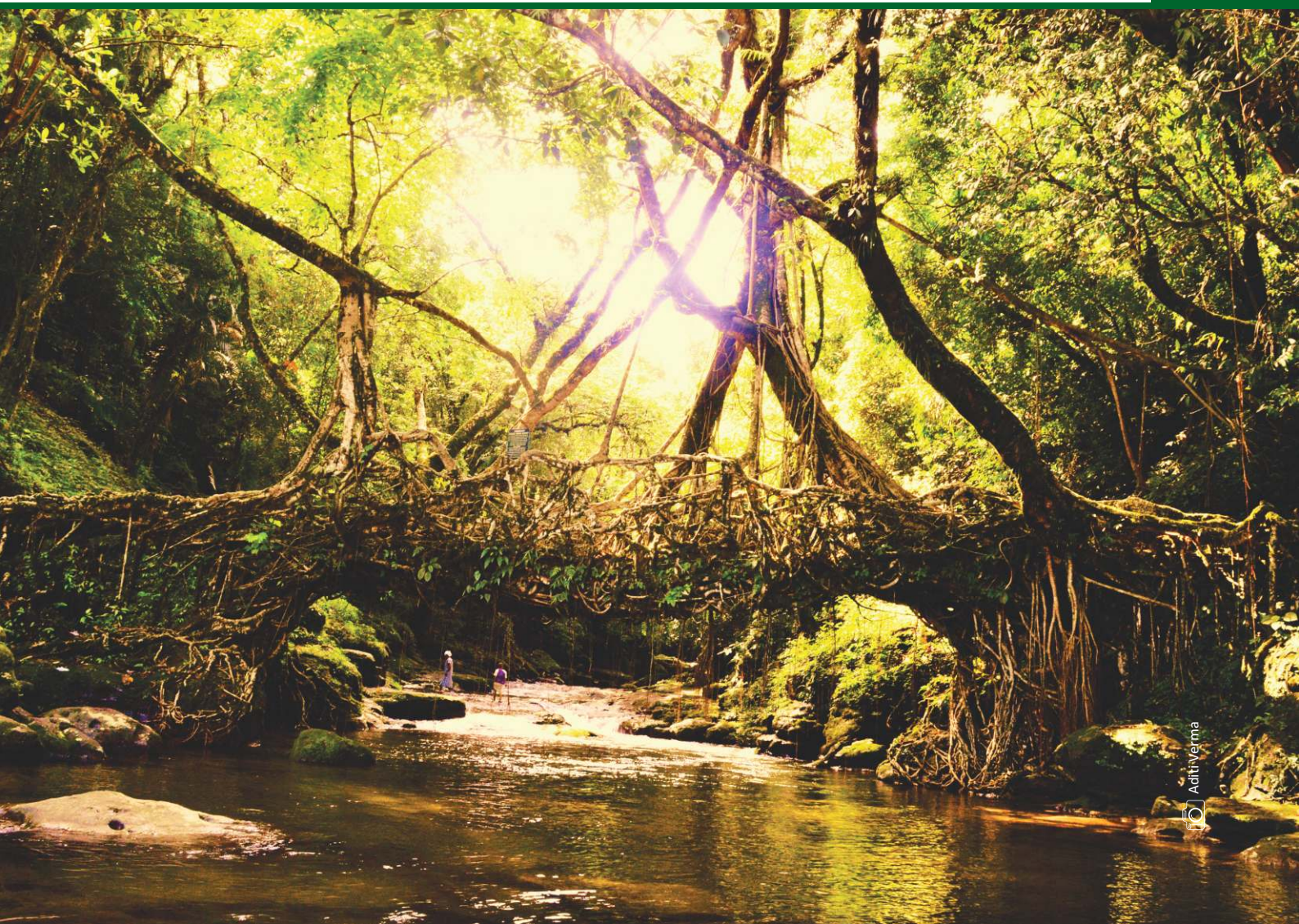
MEGHALAYA BIODIVERSITY STRATEGY AND ACTION PLAN

2011-2020
United Nations Decade on Biodiversity

Forest Department Meghalaya

MEGHALAYA BIODIVERSITY BOARD
SHILLONG

भारतीय वन्यजीव संस्थान
Wildlife Institute of India



Acknowledgements

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Human Resource Development
Mines and Minerals Department
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सत्यमेव जयते

MESSAGE

Meghalaya, which is part of the Indo- Burma Biodiversity Hotspot, harbours rich and diversified flora and fauna. Varied altitude, topography, status of soil and climatic conditions favour high species richness and support different types of forest.

I lowever, of late, the biodivcrsity of the State has become vulnerable to factors like forest degradation, mining, soil erosion, water pollution and urbanization. Raising awareness of the issue is a vital step in meeting our objectives with regard to halting biodiversity loss and protecting our ecosystems. If we could generate awareness among the key stakeholders, be it the farmers, the business sector or the wider public, our efforts towards securing biodiversity conservation will fructify better.

It gives me great pleasure, to learn that the Meghalaya Biodiversity Board is publishing "Meghalaya State Biodiversity Strategy and Action Plan (MBSAP) 2017-2030", containing action plan for improving and conserving the Biodiversity of Meghalaya.

I commend the efforts of the Meghalaya Biodiversity Board for their contribution towards preparation .of this document. I also thank Wildlife Institute of India for undertaking the project towards preparation of this important document, which is a statutory requirement for every State Biodiversity Board.

I wish all success in the implementation of this conservation plan over the coming years through a spirit of co-operation among farmers, State organisations and others who arc partners in the biodiversity conservation in the State as envisaged in this document. I take this opportunity to assure all cooperation of the State Government for the fund and other requirements for the purpose of implementation of this MBSAP.

(Lahkmen Rymbui)

MINISTER
Education, Forest & Environment and
Border Area Development,
Government of Meghalaya.

Date Shillong
the 16 January, 2019

सत्यमेव जयते

MESSAGE

It gives me immense satisfaction to know that Meghalaya Biodiversity Board (MBB) is publishing the "Meghalaya State Biodiversity Strategy andAction Plan (MBSAP)" for 2017 — 2030. It demonstrates Meghalaya's serious commitment to protect our biodiversity for the benefit of future generations through a series of targeted strategies and actions through fulfilling the mandate as spelt out in the Biological Diversity Act, 2002.

India is one of the mega — diverse countries in the world. The State of Meghalaya is rich in biodiversity, traditional knowledge and culture. The State is home to many rare, unique, endemic and endangered species. The day to day life and culture of the local people is intricately twined with biodiversity. The indigenous tribal communities of the State possess very rich traditional knowledge associated with biodiversity. Meghalaya thus, deserves special focus in the sphere of biodiversity conservation which needs to be achieved in a scientific manner by conceiving a plan document and overseeing its implementation.

The new MBSAP for 2017 — 2030 is developed along the lines of the 12 National Biodiversity Targets through extensive stakeholder
consultations and public outreach. Implementing the MBSAP will be a challenging task and calls for active involvement of all the stakeholders. People's participation will remain central to its successful implementation with active support of the State Biodiversity Board.

I congratulate all concerned who were involved in this task which has been supported by National Biodiversity Authority (NBA), Chennai and the Wildlife Institute of India, Dehradun for having played a key role in preparing this document with active guidance from the State Biodiversity Board.

I sincerely hope that in the coming years, the MBSAP will be successfully implemented for the conservation of the rich biodiversity of the State and the associated traditional knowledge for the benefit of future generations.

C P MARAK, IFS)
Principal Chief Conservator of Forests & HoFF
Meghalaya

1st April, 2019

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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

MESSAGE

In accordance with Article 26 of the Convention on Biological Diversity (CBD) member countries areobligated to prepare their national reports on the status of implementation of the convention. India as a party to the CBD prepared its National Biodiversity Strategy and Action Plan (NBSAP) at a macro level in 1999 for implementing convention. This document was further developed and updated through a comprehensive inter-ministerial process in 2008and thereafter with technical inputs from the Wildlife Institute of India it was further updated in 2013. India's NBSAP is broadly aligned with global AICHI targets. Meghalaya has been one of the first states in the country to come forward with its plan to formalize this at a state level.

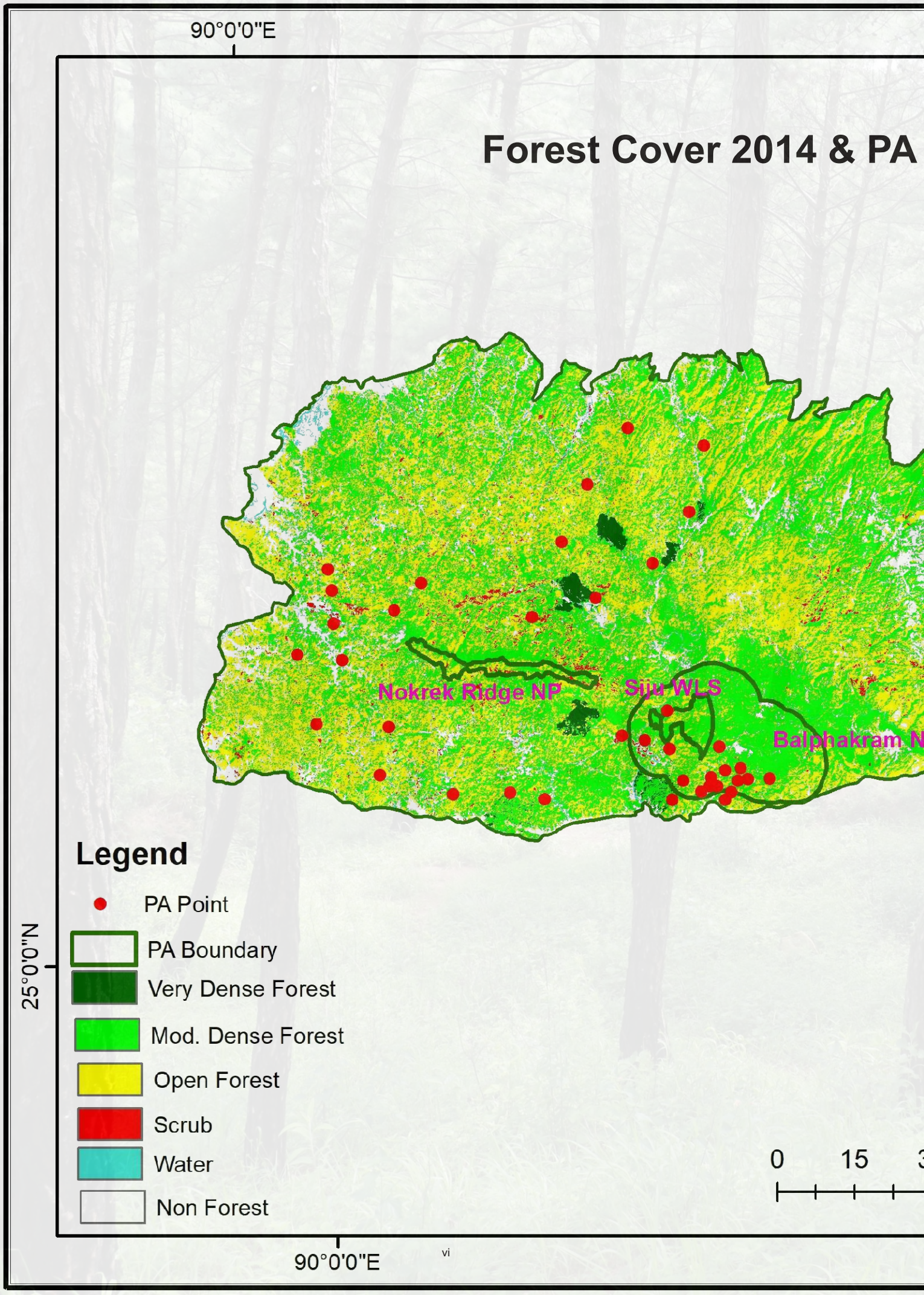
The Wildlife Institute of Indiahas provided its professional inputs for preparation of the Meghalaya State Biodiversity Strategy and Action Plan. We strongly believe that mainstreaming biodiversity, equitable sharing of resources and mitigating climate change are major challenges in the current scenario. The plan highlights the need for harmonization with climate change missions and other related missions for better inter-operability and effective natural resource conservation.

The 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development were adopted by world leaders in September 2015. The SDGs universally apply to all countries and require mobilization of efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind. Governments have also been requested to develop their own national indicators to assist in monitoring progress made on the SDG goals and targets. The MBSAP has been aligned to guide planners in achieving these goals. I would urge the Government of Meghalaya to provide necessary resources for successful implementation of MBSAP.

(Dr. V. B. Mathur)
Director

2nd April, 2019

Dehradun


90°0'0"E
Forest Cover 2014 & PA
Nokrek Ridge NP
Siju WLS
Balphakram N
Legend
PA Point
PA Boundary
Very Dense Forest
Mod. Dense Forest
Open Forest
Scrub
Water
Non Forest
25°0'0"N
0
15
90°0'0"E


Network of Meghalaya
N
Nongkhyllem WLS
4
25°0'0"N
60 km
भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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Abbreviations

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ATREE	Ashoka Trust for Research in Ecology and the Environment
BCIL	Biotech Consortium of India, Limited.
BHSs	Biodiversity Heritage Sites
BNHS	Bombay Natural History Society
BSAP	Biodiversity Strategies and Action Plan
BSI	Botanical Survey of India
CAPs	Conservation Action Plan
CCA	Community Conserved Areas
CCRI	Climate Change Research Institute
CEENE	Centre for Environment Education North - East
CEPRD	Centre for Environment Protection Research and Development
CFI	Community Forestry International
CGPDTM	Controller General of Patents, Designs& Trade marks
CPCB	Central Pollution Control Board
CPREEC	C.P.R. Environmental Education Centre
CZA	Central Zoo Authority
DCs	Autonomous District Councils of Meghalaya
DIPR	Directorate of Information and Public Relations
DoB	Department of Biotechnology
DoE	Department of Education
DoNER	Department of North Eastern Region
DoS	Department of Space
FD	Forest and Environment Department
FRLHT	Foundation for Revitalization of Local Health Traditions
FSI	Forest Survey of India
GHADC	Garo Hills Autonomous District Council
GSI	Geological Survey of India
IBA	Important Bird Areas
ICAR	Indian Council for Agriculture Research
ICFRE	Indian Council of Forestry Research and Education
IEG	Institute of Economic Growth
IFAD	International Fund for Agricultural Development
IGIDR	Indra Gandhi Institute for Development Research
IGNOU	Indira Gandhi National Open University
IIFM	Indian Institute of Forest Management
IIMs	Indian Institute of Managements
IKS	Indigenous Knowledge System
IMD	Indian Meteorogical Department
IPR	Intellectual Property Rights
IUCN	International Union for Conservation of Nature and Natural Resources
IYCN	Indian Youth and Climate Change Network
JHADC	Jaintia Hills Autonomous District Council
KHADC	Khasi Hills Autonomous District Council
MAA	Meghalaya adventurers association
MBOSE	Meghalaya Board of Secondary Education
MBSAP	Meghalaya Biodiversity Strategy and Action Plan
MFD/FD	Meghalaya Forest Department
MMoHRD	Meghalaya Ministry of Human Resource Development
MNCs	Multinational Companies
MoEFCC	Ministry of Environment, Forest and Climate Change
MSEB	Meghalaya State Electricity Board
MBB	Meghalaya Biodiversity Board
NBA	National Biodiversity Authority
NBSAP	National Biodiversity Strategy and Action Plan
NBAGR	National Bureau of Animal Genetic Resources
NBFGR	National Bureau of Forest Genetic Resources
NBPGR	National Bureau of Plant Genetic Resources
NEBRC	North Eastern Biodiversity Research Cell
NEC	North Eastern Council
NEHU	North East Hill University
NESAC	North East Space Application Center
NGOs	Non- Governmental Organisations
NIF	National Innovation Foundation
NMPB	National Medical Plant Board

PID	Programme Implementation Department
PA	Protected Areas
SACON	Salim Ali Centre for Ornithology and Natural History
SAP	Strategy and Action Plan
SAYEN	South Asia Youth Environment Network
SPCB	State Pollution Control Board
SSC	State Steering Committee
TEEB	The Economics of Ecosystems and Biodiversity
TKDL	Traditional Knowledge Digital Library
UCIL	Uranium Council of India Ltd.
UNDP	United Nations Development Programme
WII	Wildlife Institute of India
WTI	Wildlife Trust of India
WWF	World Wide Fund for Nature
ZSI	Zoological Survey of India

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I Introduction

Ryan

01 Introduction

1.1 Background

India is a megadiverse country harboring nearly 7 - 8% of all recorded species including over 45,000 species of plants and 91,000 species of animals on only 2.4% of the world's land area. It has a long history of conservation, rich traditional knowledge and culture reflecting intimate association of its people with flora and fauna. However, rapid socio-economic transformation due to globalization and burgeoning human population has led to decline in biodiversity. As a party to the Convention on Biological Diversity (CBD), the Government of India (GoI) has taken several initiatives to arrest the loss and decline in biodiversity in the country. The Ministry of Environment and Forests, soon after ratification of CBD came up with a national policy dealing with broad based biodiversity conservation strategy (MoEF 1999). Subsequently, the MoEFCC commissioned a massive exercise to prepare national biodiversity strategy and action plan (NBSAP) during 2000 to 2004. Following India's adoption of the National Environment Policy (NEP) in 2006, the initial policy document (MoEF 1999) and NBSAP were updated and National Biodiversity Action Plan (NBSAP) was prepared in 2008. The NBAP was formulated through a comprehensive inter-ministerial process duly approved by the Government of India (GoI). During 2013-14, the GOI, through Ministry of Environment, Forest and Climate Change (MoEF&CC) undertook the process of updating the NBSAP so as to harmonise it with the Global Strategic Plan for Biodiversity 2010-2020 and the Aichi Biodiversity Targets. Using the Strategic Plan as a framework, India has now developed 12 National Biodiversity Targets (NBTs) and associated indicators and monitoring framework through extensive stakeholder consultations and public outreach (NBAP Addendum 2014). Currently, the MoEFCC is actively pursuing these targets. In order to meet the NBTs by 2020, it is mandatory that the action plans are implemented in a participatory manner at different levels of governance. In this context, various States and Union Territories are required to prepare their own State Biodiversity Action Plans (SBAPs) in alignment with the updated NBAP and implement the activities envisaged under these plans.

This chapter deals with biodiversity conservation initiatives around the world and within India including the state of Meghalaya, need for preparing a long term strategy and action plan in consonance with socio-cultural milieu of the state, scope of the plan and methodology adopted to prepare this plan.

1.2 An overview of biodiversity conservation initiatives worldwide

The term Biological Diversity, coined by Thomas Lovejoy (1980), refers to all the variety and variability among genes, species, communities and ecosystems and their functioning on earth. In 1985 Walter Rosen first referred to Biodiversity as a short form to Biological Diversity, which has become a more widely used term. According to the United Nations, biodiversity can be defined as *"The variety of life on Earth, it includes all organisms, species and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems"*. Biodiversity includes all form of variation from genetic level, i.e. variations among individuals to populations of a species, variation in species, and variation in communities of species, along with habitats they live in, that forms the corresponding ecosystems. A major role played by biodiversity is their services which provide innumerable benefits for not only survival and existence of humans, but for also sustenance of our varied tradition and culture.

Nineteenth century saw emergence of various conservation societies to protect species under threat from hunting, fur trade etc. In 20th century, the adverse effects of human exploitations on wild species came to light with the extinction of the last passenger pigeon and endangerment of the American Bison. The first popular article on environmental assessment and realization of the impact of humans on Lake Biodiversity loss was through writing of Rachel Carson. In her book "Silent Spring" (1962), she explained how indiscriminate use of pesticide is affecting biodiversity and ecosystems. Ever since these efforts were realized, world took international efforts for conserving biodiversity. There have been various organizations formed such as the International Union for Conservation of Nature (IUCN), the convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES), The Convention on Migratory Species (CMS), the World Heritage Convention (WHC), The International Treaty on Plant Genetic Resources, RAMSAR Convention, The Inter Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES) and finally the Convention on Biodiversity (CBD).

The World Charter for Nature adopted by the UN General Assembly in 1982, states that, *"Every form of life is unique, warranting respect regardless of its worth to man, and, to accord other organisms such recognition, man must be guided by a moral code of action and Man can alter nature and exhaust natural resources by his action or its consequences and therefore, must fully recognize the urgency of maintaining the stability and quality of nature and of conserving natural resources"*. Giving value to

nature and organisms has been recognized as a moral duty of humans and the ability of humans to modify or deplete natural resources, also makes them responsible for consequences thereof thus sustainable use and natural resource". Conservation has been stressed by this charter. However, these wordings in the U.N charter do not impose any laws on people for reducing anthropogenic effects on nature and for conservation of sustainability of natural resources. In 1991 organisations has like the UNEP, IUCN and WWF recognized that *"Biological diversity also provides us with economic benefits and adds greatly to the quality of our lives".*

The UN General Assembly also recognized that we can obtain lasting benefit from biodiversity and ecosystem services by maintaining them and these benefits are jeopardized by excessive exploitation and destruction of habitats. It recognized that we exploit biodiversity directly for a variety of resources and natural products. In response to alarming rate of species loss and changing environment, the UNEP formed an adhoc Working Group of Experts committee on Biological Diversity in November 1988 to explore the need for an international convention on biological diversity. On recommendation of this committee in May 1989, an adhoc working group of Technical and Legal Experts was established to prepare an international legal instrument for the conservation and sustainable use of biological diversity. This working group developed into an Intergovernmental Negotiating Committee by 1991. In May 1992, this text was agreed and adopted at the Nairobi Conference as Convention on Biological Diversity (CBD). Furthermore, in June 1992, when more than hundred heads of states met at the Earth Summit in Rio de Janeiro to debate and ratify protocols on the global environment, biodiversity had attained the status of a household word. This was signed by 168 countries in June 4, 1993 and on 29th December 1993 the Convention finally came into force. The first session of the convention, Conference of the Parties (COP I), was held in Bahamas in 1994.

1.3 History of Indian Conservation Movements

In India, there has been a tradition of wildlife conservation since time immemorial. The *Chipko* movement has left a strong impact on Indian environment and conservation movement. In 1730 AD, 363 *bishnois* sacrificed their lives to protect *Khejri* trees, sacred to their traditions, against an order of the king through a non-violent movement by hugging the trees. This movement was an inspiration for another *Chipko* movement for protection of the age long livelihoods and community areas by people of Garwhal Himalayas under the leadership of Shri Chandi Prakash Bhatt and Shri Sunder Lal Bahuguna. In April 1973, villagers of Mondal, Gopeshwar through peaceful demonstration prevented contract tree felling in their village, this movement spread to the adjoining villages motivating people and thus totally stopping the tree felling in Garhwal Himalaya.

In Uttara Kannada district, which was once a highly forested area (81% in 1950s), state Government declared it as a "backward district". The "development" process that followed resulted in setting up of numerous paper and pulp industries, building of dams and plantation of *Eucalyptus* that ultimately shrank the forest of district to just 25%, evicted people from dam area and drastically reduced water table in the district. Inspired by the *Chipko* movement, Yuvak Mandali led by Panduranga Hegde, launched a similar movement where men, women and children of Salkani village hugged the trees in Kalase forest to protect them from felling by the forest contractors. This standoff continued for 38 days, in September 1983, finally the government was forced to cancel the felling order. This was referred to as *Appiko* movement (Appiko = hugging in Kannada). The movement spread to four hill districts of Karnataka and brought to light the people' struggle against commercial forestry by forcing the government to amend the forest policy, ban clear-felling, withdraw concessions to logging companies and moratorium on felling of green trees. This movement resulted in enhanced awareness of people towards conservation of forest and nature as well as recognising the rights of the people.

'Narmada Bachao Andolan' was another environmental movement in the states of Madhya Pradesh and Maharashtra against construction of numerous dams and displacement of thousands of villagers without any prior information. Medha Patkar initiated this movement with the help of many groups like Arch-Vahini (Action Research in Community Health and Development) and Narmada Asargrastha Samiti (Committee for people affected by the Narmada Dam), Madhya Pradesh-based Narmada Ghati Nav Nirman Samiti (Committee for a New Life in the Narmada Valley) and Maharashtra-Based Narmada Dharangrastha Samiti (Committee for Narmada Dam-Affected People) in 1989. Soon many environmentalists, scientists, academicians and social workers joined the cause and supported the movement. This led to increased scrutiny of all the lapses in the project, review of environmental impacts and withdrawal of funding from the World Bank.

In 1995, T.N. Godavarman Thirumulpad filed a writ petition with the Supreme Court of India to protect the Nilgiris forest land from deforestation by illegal timber operations. The Supreme Court expanded the Godavarman case from a matter of ceasing illegal operations in one forest into a reformation of the entire country's forest policy. In its first order on the Godavarman case, the Court suspended tree felling the country (Rosencranz et al. 2007)

1.4 Traditional ways of biodiversity conservation in Meghalaya

In Meghalaya, various traditional rituals and religious activities have a prominent role in conservation of nature. Many villages have dedicated part of the forest as sacred grooves, where extraction of any kind of forest produce is forbidden. The traditional agricultural system of *jhum* cultivation has also maintained the forest cover of the region. Even though *jhum* cultivation involves slash and burn of forest patches, this does not result in large-scale deforestation. The communities clear a small portion of village land for cultivation for few years and thereafter they leave this land to recover, and in subsequent years, they clear a new area for cultivation. In recent years however, the declining *jhum* cycles have caused concern with increasing fragmentation of forest in community areas (Ranjan & Upadhyay 1999). In comparison to permanent conversion of land for rice, fruits and other cash crops, *jhum* cultivation allows maintenance of high forest cover in the state with forest patches in various stages of recovery. Many species such as hoolock gibbon and the Asian elephant find place in tribal folkore and mythology. Communities living close to such forests have a very high tolerance for such species (Tiwari *et al.* 2010). Among the Garo community Hoolock gibbons are revered as protectors of their land, thus any harm to these apes is forbidden. Elephant related conflicts in *jhum* areas and paddy fields also find empathy among the villagers.

1.5 The Need of Meghalaya Biodiversity Strategy and Action Plan

In accordance to the NBSAP, various regional BSAPs are also required to achieve various CBD objectives. Meghalaya prepared its first BSAP in 2004. This chapter was started in December 2000, when the State Steering Committee (SSC) was formed and the first meeting was held on 9th December 2000. Subsequently, the members of SSC and other experts extensively toured the villages of East Khasi Hills, West Khasi Hills, Jaintia Hills, Ri-Bhoi, East Garo Hills, West Garo Hills and South Garo Hills, during January - December 2001 with a view to make local contacts, find resource persons and local administrative heads for the NBSAP purposes. The Meghalaya BSAP was finalized in 2004 and was submitted to the NBA.

In 2010, new guidelines for regional and National BSAPs were framed at the Nagoya 10th COP summit. For achieving this, an addendum was prepared for NBSAP and various states (state biodiversity boards) were asked to prepare regional state BSAPs. To redraft a BSAP with 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, the Wildlife Institute of India was entrusted the task of rewriting and refining the Meghalaya BSAP (MBSAP). The consultative meetings with stakeholders were organized on 24th November 2015 and 13th December 2016 at Sylvan House at Shillong. Nearly 50 delegates attended it from various government departments, NGOs and public institutions. During the workshop the delegates were informed of the development in respect to the preparation of the MBSAP, their expert opinion was also sought for various aspects of MBSAP preparation.

Box 1.1 Aichi Biodiversity Targets

The tenth meeting of the Conference of the Parties, held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011-2020 period.

The 20 Aichi targets were identified to meet the five strategic goals for biodiversity conservation:

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

- By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.
- By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.
- By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.
- By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

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

- By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
- By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.
- By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.
- By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.
- By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.
- By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

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

- By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.
- By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.
- By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

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

- By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
- By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.
- By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

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

- By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.
- By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.
- By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.
- By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

1.6 Mainstreaming Biodiversity in Meghalaya

The economic survival of various production sectors, and of the people depending on those sectors for their livelihoods, is intricately connected to the conservation and sustainable use of biodiversity. The word “mainstreaming” can be used synonymously with "inclusion". Mainstreaming means integrating or including actions related to conservation and sustainable use of biodiversity in strategies relating to production sectors, such as agriculture, fisheries, forestry, tourism and mining. Mainstreaming might also refer to including biodiversity considerations in poverty reduction plans and national sustainable development plans. By mainstreaming biodiversity into sectoral strategies, plans and programmes, we recognize the crucial role that biodiversity has for human well-being. Through mainstreaming, biodiversity concerns will be internalized into the way economic sectors, development models, policies and programmes operate. Integrating biodiversity concerns into the way sectors operate can have immediate benefits in improving environmental quality and productivity, and can also serve as a long-term safeguard for sustainable development. Ideally, biodiversity policy should not be seen as independent of sectoral policies, but rather sectoral policies should be seen as an instrument to implement national biodiversity goals. These goals differ from one country to another. Mainstreaming of biodiversity into sectors can include strategies to reduce the negative impacts that the sector has on biodiversity. In agricultural strategies, it might involve minimizing the use and optimizing the application of chemical fertilizers and pesticides so as to reduce negative impacts on groundwater, surrounding habitats and wildlife. Mainstreaming might also include strategies through which activities in production sectors not only prevent negative impacts on biodiversity, but might actually benefit biodiversity. For example, small-scale farming or aquaculture activities, when undertaken in a sustainable manner, might actually provide local relief to the pressure on commonly harvested wild species. Positive biodiversity impacts might also be optimized through promoting poor peoples’ access to and benefits derived from the use of biological resources (e.g. community-based forest management or joint forest management, promotion of traditional multi-species and multi-variety agricultural practices, securing access to medicinal resources for local use, strengthening traditional cultural practices governing the use of wild resources,clarifying disputes over land tenure, etc. (CBD 2007)

1.7 Scope of the Meghalaya State Biodiversity Strategy and Action Plan

The MBSAP attempts to involve multiple stakeholder, experts, organizations, entities and agencies. It suggests opportunities, threats, strengths and weaknesses of state controlled and community owned areas of Meghalaya. The MBSAP includes government declared protected areas, conservation reserves, community conserved areas and sacred groves.

The MBSAP has been prepared in consultation with all the state government departments concerned with biodiversity, agriculture, animal husbandry and environment. It also involves District Councils, Non-Governmental organizations, educational institutions and public sector organizations working in the field of biological sciences concerned with ecology, biodiversity and environment in the state.

The MBSAP caters to the need of all the stakeholders of the state including village communities adjoining forests and CCAs. It would include institutions involved with local people, a number of local NGOs and stakeholders from across the state.

1.8 Objectives of the MBSAP

According to the recent COP meetings for CBD, the scope and objectives of BSAP has been redefined. The focus of the MBSAP has been to document the status of biodiversity in the state by providing a direction through strategies and actions for addressing various threats to biodiversity in the state.

The redefined objectives of the MBSAP are:

- **i)** To assess the present status of biodiversity, identify threads and initiate conservation action
- **ii)** To identify gaps in the policy framework of various departments of the State
- **iii)** To project the common person’s perception and participation in biodiversity conservation
- **iv)** To suggest implementable strategies and action plans for immediate and future action relating to biodiversity and its conservation
- **v)** To document cultural and traditional practices that support biodiversity conservation
- **vi)** To map department/agencies that have a bearing on biodiversity conservation in the state
- **vii)** To redefine the NBT monitoring framework in the context of Meghalaya and identifying organizations or institutions for monitoring and reporting
- **viii)** To prioritise of activities as per the targets of NBTs
- **ix)** To prepare strategies and action plans based on the 12 NBTs
- **x)** To prepare the mitigation strategies for the identified threats
- **xi)** To prepare implementation plan for the action points/action plan with various stakeholders and mapping of various government departments, NGOs, autonomous councils and various public and private section institutions

1.9 Contents of the MBSAP Document

The Biodiversity Strategy and Action Plan for the state of Meghalaya is organised into eight chapters. The first Chapter provides an introduction to the BSAP process and its relevance to the state of Meghalaya. Chapter 2 is profile of the state, which is based on the extensive data compiled from the state government and other sources. Information on current status of biodiversity in Meghalaya is covered in Chapter 3; it also contains relevant information on slash and burn cultivation, community conserved areas like sacred groves, ethnobiology of the indigenous people of the state etc.

Meghalaya shares its land tenure system and agricultural system with the other North Eastern states. The predominant form of agriculture is slash and burn cultivation *(jhum)*. Over the years *jhum* cultivation has also changed leading to distorted *jhum* practices, which in turn has drastically altered the forest landscape of the state and is among the major reason for forest fragmentation and forest loss. With large deposits of coal, limestone etc. Meghalaya also faces relentless unscientific extractions. Chapter 4 provides an overview of such threats to biological diversity. The issues related to gaps in information, management and planning for biodiversity protection and conservation across Protected Areas, Community forests, sacred groves, agricultural lands etc. in the state are dealt in Chapter 5.

Chapter 6 is the crux of the MBSAP for policy and decision makers, as it lists the Vision, Mission and strategy and action plan for the state along with a composite table which outlines the actions and indicators of biodiversity monitoring for the state. Chapter 7 outlines the implementation mechanism and responsible implementation agencies, and coordinating agencies. This is followed by conclusion and acknowledgement in Chapter 8. The Bibliography and appendices are provided at the end.

1.10 Methodology

The methodology and approaches adopted for the preparation of the MBSAP were as follows:

i) Desktop review of literature and collation of both primary and secondary data on biophysical, socio-economic, cultural and other themes including biodiversity, natural resource management, agriculture, current policies and practices from archives and online resources.

ii) Field trips and surveys to collect primary and secondary information. A number of field trips were undertaken in the state to collect reports and information from various offices regarding ongoing programmes and policies. Information on biodiversity and cultural traditions was also collected from NGOs working in Meghalaya.

iii) Consultative and Core Group meetings were held with representatives of Forest Departments, state institutions, universities, colleges, district councils and other stakeholders regarding possible strategies and action plans. In addition two stakeholder consultative meetings' were organized in which more than 50 organizations, District Council nominees, Biodiversity Monitoring Committees and members of the traditional institutions also participated.

iv) Discussions with local experts and knowledgeable individuals, Local experts and knowledgeable individuals were identified and discussions were held with them regarding the strategies, action plans, monitoring plan and other stakeholders who could be made possible partners in implementation of the plan.

v) Listing and prioritizing the Meghalaya Biodiversity Targets (MBTs) and harmonizing with the National **Biodiversity Targets (NBTs) and Aichi Targets -** These were further matched with Aichi Biodiversity Targets. It is noteworthy that the intent and content of MBTs are similar to NBT, except the chapter on coastal and marine environment which is absent in Meghalaya. We prioritized the NBTs for actions according to the unique needs and profile of the state. Hence, NBT numbers may not necessarily corresponds to the MBTs.

vi) Synchronization with various international conventions and treaties - Seven major international conventions and treaties *viz*., Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Flora and Fauna, Convention on Migratory Species, International Treaty on Plant Genetic Resources, Convention on Wetlands, World Heritage Convention, and International Plant Protection Convention were taken into consideration for matching their linkages with MBSAP.

vii) Synchronization with Sustainable Development Goals - The SDGs recognize that ending poverty must go hand-in-hand with strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection. Linkages between the 17 SDGs were mapped for NBTs on basis of their goals and objectives. A detailed analysis of SDG synchronization with MBTs is presented in Chapter 7.

viii) Synchronization with eight-climate change missions - India has launched eight climate change missions to address threats of climate change to biodiversity, natural resource production and livelihood of communities. National Action Plan for Climate Change (NAPCC) with its eight National Missions advices directional shift in the developmental pathway *via* the enhancement of the current and planned programmes for climate change mitigation and adaptation. The eight National Mission are -National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystems, National Mission for Green India, National Mission for Sustainable Agriculture, National Mission on Strategic Knowledge for Climate Change. For climate change mitigation and coordination,Meghalaya State Council for Climate Change and Sustainable Development (MSCCCSD) was constituted with the chief minister of the state as chairperson. MSCCCSD is a project management agency supported by experts to formulate the implementation guidelines in each sector and work with departments and agencies to develop the baseline, emission inventory, and have consultation across departments and networks.

ix) Synchronization with other national and state missions - The Action Plan of MBSAP has also taken inputs from various state and national missions and tries to incorporate the objectives that link with biodiversity, education, awareness, cleanliness, and pollution control as outlined under respective missions such as Swatch Bharat Mission and Sarva Shiksha Abhiyan.

x) Implementation plan and mechanism for financing biodiversity conservation - As per the new CBD guidelines, a comprehensive plan for implementation of MBSAP has been prepared for achieving the biodiversity targets. This plan lists the synergies between various government departments and opportunities that exist in policy interventions, institutional roles, and financial and human resource mobilization. Similarly, patterns of financial allocation for activities related to biodiversity conservation by various departments during last 5 years have been studied separately. This analysis allows better planning and negotiation for financing of activities during the period of plan implementation. This mechanism (BioFin) is a useful financial planning tool accepted internationally

II Meghalaya - A Profile

Arup Malakar

02 Meghalaya - A Profile

2.1 Introduction

The modern history of Meghalaya dates back to 1700 A.D. when the Garo, Khasi and Jaintia hills were ruled by separate kings and chiefdoms (Playfair 1929, Barooah 1970, Chowdhury 1996). The expanding British Empire in India annexed these hills during 1835 to 1872. In 1935, Meghalaya became part of erstwhile Assam, with territorial autonomy. Till 1970, Meghalaya was part of undivided Assam, with Shillong as its capital. In 1971, Meghalaya was conferred autonomy through the North-Eastern Areas (Reorganization) Act, 1971. On January 21, 1972, Meghalaya was created by combining the hill regions of Garo, Khasi and Jaintia to form a separate state, housing a Legislative Assembly of its own.

The three geographical sub-regions of Meghalaya, viz., Khasi, Garo and Jaintia hills are among the wettest regions of the world, with clouds persisting in various areas nearly throughout the year (*in Sanskrit, Meghalaya = abode of the clouds*). The topography and climate support a rich diversity of forests, orchids, angiosperms and faunal diversity. Also, it is considered as one of the goldmine for taxonomists from different disciplines, which is evident from the regular new species discoveries, particularly in orchids, butterflies and amphibians etc.

The state comprises 11 districts, namely South Garo Hills, South West Garo Hills, West Garo Hills, East Garo Hills, North Garo Hills, West Khasi Hills, East Khasi Hills, South Khasi Hills, Ri-Bhoi, West Jaintia Hills and East Jaintia Hills lying between 25°47" - 26°10" N and 89°45" - 92°45" E and covers 22,429 km^2 area. It is bounded on the north by Goalpara, Kamrup, Karbi Anglong and Nagaon districts, east by Cachar and North Cachar Hills districts of Assam and west and on the south by Rangpur division and Mymensingh divisions of Bangladesh (Figure 2.1). The altitude ranges from 50 - 1950 m (Talukdar *et al.* 2004). The highest peak is Shillong Peak. The state has population of about 29.67 lakhs with a density of 132 persons km^{-2}. The sex ratio is 989 females: 1000 males and the total literacy rate is 74.43%; male -75.59% and female -72.89 %; urban - 90.79% and rural - 69.92 % (Census of India, 2011).

2.2 Historical Background

The Indian subcontinent is a major corridor for migration of people to East Asia (Cavalli-Sforza *et al.* 1994, Jin and Su 2000, Thangaraj *et al.* 2005, Macaulay *et al.* 2005). Having a unique position geographically, north eastern India has a lone connecting link between Indian subcontinent and East Asia, as an important passage for migration. Thus, many migrating lineages also settled here and this region has populations belonging to Indo-European, Tibeto-Burman and Austro-Asiatic lineages (Reddy *et al.* 2007). The history of settlement in north eastern India is quite unique with multiple waves of immigration of various indigenous communities (Reddy *et al.* 2007; Kumar & Reddy 2003, Cordaux *et al.* 2004). The indigenous communities of the Khasi, Jaintia and Garo are of Paleo-Mongoloid descent, and were one of the earliest waves of the East Asian settlers in Meghalaya.

Among the Khasi Jaintia group, the Jaintia or Synteng *(Pnar)* are the older branch of the indigenous community (Gurdon 1907) and have a fairly long traditional historical accounts of the kingdom and dynasties. The Garo, belong to the Bodo group of the *Tibeto-Burman* family, while the Khasis and the Jaintias belong to the *Mon-Khmer* family of Austric affiliation (Ali & Das 2003). The Garo, Khasi and Jaintia languages have many local variations and spoken in different dialects. English was adopted as the script for these languages. In the earliest Indian literature there are references of Indo-Mongoloid communities of Kiratas. '*Bhagavata* purana' composed by Sankardeva around 1500 A.D. is the first mythological Indo Aryan literature first to mention 'Khasi' (Playfair 1975, Sen 1985).

During early 1700, the Khasi were known to trade at the Pandua border of Sylhet for silk, cotton, iron, wax, honey and ivory in exchange for rice, salt, dry fish and entire supplies of grains (Barooah 1970, Lahiri 1975). The smelting of Iron was chief industry in Khasi hills, and considerable amount of Iron and limestones were exported to Bengal (Shakespeare 1914).

During the British rule in India, the occupation of various indigenous communities of north eastern India followed with occupation of Bengal. The British came in possession of Sylhet in 1765. In 1775, Zamindars of the Mechapara and Karaibari invaded Garo Hills and brought the Garo territories under their control. During early 19th century, the Burmese invaded a number of places in north eastern India, then part of Chittagong, Sylhet and Bengal. The Burmese invaded Cachar and were at border of the Jaintia Hills by 1824. Subsequently, the British declared war on Burma in 1824, and signed a treaty with Khasis on 10th March for combating the Burmese invasion. The British coaxed the Duwan Rajah into construction of a corridor through the Khasi and the Jaintia hills to connect Assam valley with Surma valley. In 1823-24, David Scott signed agreements with a number of Garo chiefs

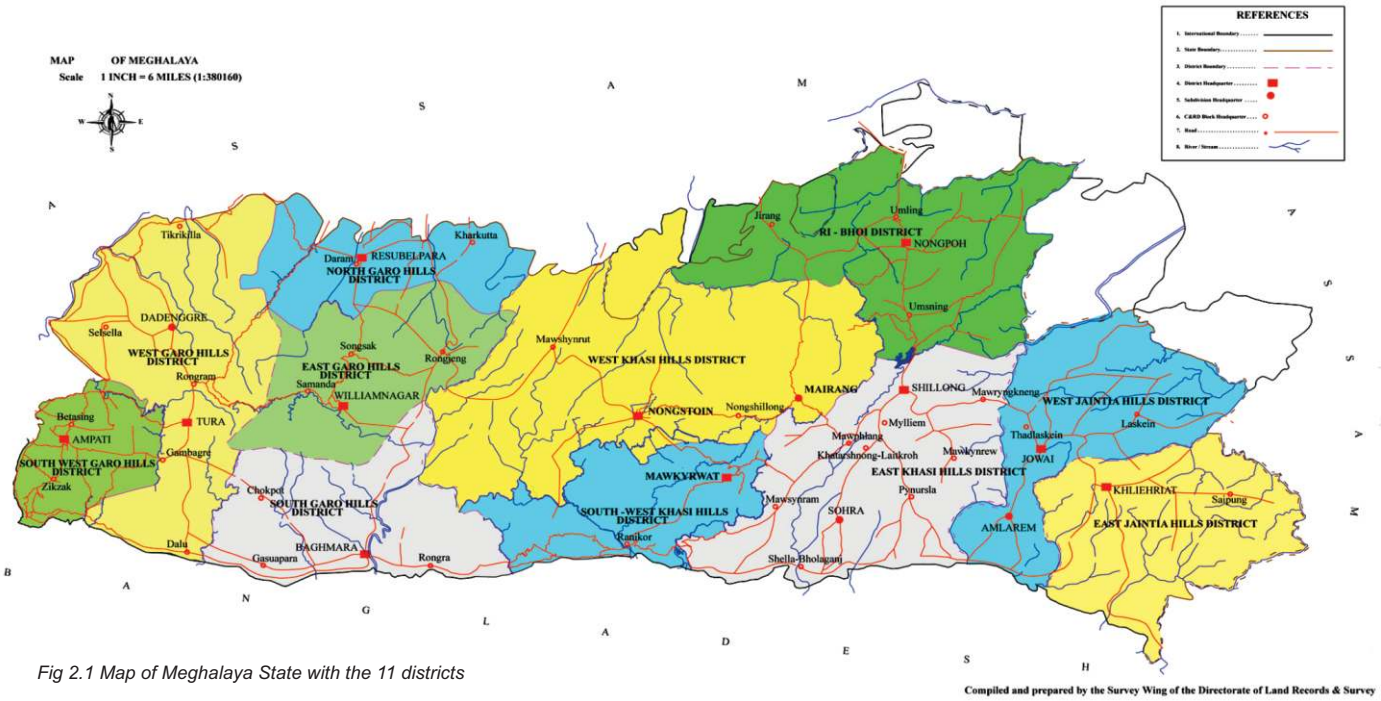

Fig 2.1 Map of Meghalaya State with the 11 districts

for construction of road across the state. However, the road remained uncompleted due to uprising of U Tirot Sing against British intrusion and continued resistance by the Garos. The British than invaded the Garo, Khasi and Jaintia hills to subjugate its people them. This was met with stiff resistance. In Jaintia hills, U Kiang Nangbah lead a revolt against British colonialism. The construction of road and subsequent occupation and taxes levied by the British lead to a number of uprising in Khasi, Jaintia and Garo Hills. U Tirot Sing finally surrendered to British and was banished to Dhaka, where he died in 1835. Pa Togan Sangma led the first uprising in Garo Hills against the British on December 12, 1872. His followers fought with the traditional weapons, however they finally fell to the British with advanced guns. U Kiang Nangbah was captured in 30 December 1862 and executed (Lahiri 1975, Barooah 1970, Chowdhury 1996).

2.3 Physical Features

The state of Meghalaya is physiographically a plateau region. The general altitude of this plateau lies between 300 m msl to 1500 m msl. This plateau is characterized by gentle slopes in northern and western region; however, the southern and eastern slopes are very steep forming gorges.

Meghalaya is divided into three physiographic regions -

1. The Western Meghalaya (Garo Hills)
2. The Central Meghalaya (Khasi Hills)
3. The Eastern Meghalaya (Jaintia Hills)

This region is also known popularly as Shillong plateau, which is an extension of the massive block of peninsular India. It is cut off from the table land by alluvial valley of Ganga-Brahmaputra region. The western Meghalaya is dissected by the Tura range and Arbela range running south east to North West. Gneissic rocks are generally exposed in western Meghalaya. The Precambrian basement of Meghalaya, a remnant of the northeasterly extension of the Indian Peninsula, is a segment which has undergone multiple phases of deformation leading to folding and fracturing of the rocks (GSI, 2009).

2.3.1 Geology and Soil

The southern part of Garo Hills is covered by limestone. The Siju cave is located in this limestone terrain (GSI, 2009). Several rivers and a network of their tributaries and lateral streams dissect the plateau, standing as a watershed between the Surma valley of Bangladesh to the south and Brahmaputra valley on the north. The limestone-covered country over southern Garo, Khasi and Jaintia Hills represent typical karst topography.

The geological formation in Meghalaya is composed of rocks belonging to:

(a) Archaean - Proterozoic Gneissic Complex
(b) Khasi Basic - Ultrabasic Intrusives of Proterozoic age
(c) Shillong Group of meta - sediments of Meso-Proterozoic age
(d) Granite Plutons viz. Kyrdem, Nongpoh and Mylliem Granite Plutons and South Khasi batholith of Neo Proterozoic - Lower

Palaeozoic age

(e) Lower Gondwana sedimentary rocks of Carboniferous - Permian age

(f) Cretaceous volcanic rocks represented by Sylhet Trap and Alkaline-Ultramafic-Carbonatite complex of Sung

(g) Cretaceous - Tertiary shelf sediments

(h) Pleistocene to recent fluvial sediments (GSI, 2009)

The hills soils are derived from earlier gneissic complex materials and are dark brown to dark reddish-brown in colour and vary in depth from 50-200 cm. Texturally these are loamy to fine loamy. The soils of the plains adjacent to the northwest and southern plateau are composed of alluvial very deep, dark brown to reddish-brown colour to sandy-loam to silty-clay. The rainfall washed organic matter makes the soil in hills and particularly in plains rich in organic carbon, which is also a measure of nitrogen supplying potential of the soil. This soil is deficient in available phosphorous and medium to low in available potassium (NRDM).

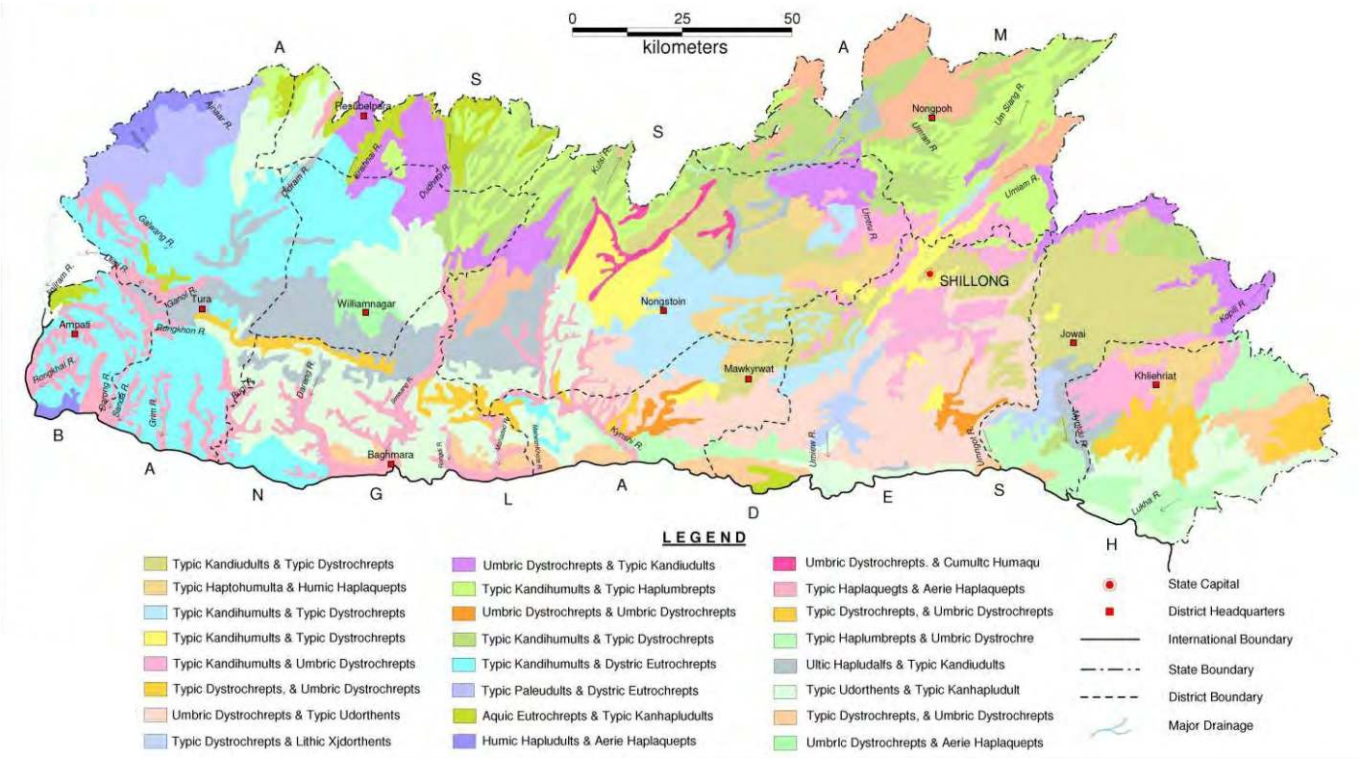

fig 2.2 Soil map of Meghalaya

Source: CGWBNER, ministry of water resources

Table 2.1 Soil Types in Meghalaya State

S.No.	Type of Soil	Properties	Agriculture Use
1.	Laterite	Derived directly from residuary base and intermediate igneous rocks by the weathering in hot climates. These soils are deficient in potash, phosphoric acid and lime.	Not useful for agriculture
2.	Red Loamy or Ferruginous Red	Formed by weathering of rocks like granite, gneisses and diorites. These soils are poor in lime, potash, iron oxide, phosphorus, nitrogen and humus.	Suitable for cultivation of paddy, potato, fruits and other crops in plains and terraces
3.	Red and Yellow	This soil type is generally fine textured, ranging from loam to silty loam and are suitable for cultivation of rice and horticultural crops.	Suitable for rice and horticulture crops
4.	Alluvial	The soil textures vary from sandy to clayey-loam with varying degree of nitrogen and are highly acidic in nature.	Good for cultivation of rice and jute

Source: NBSS & LUP, 1993, Broad soil classification

Table 2.2 Minerals Of Meghalaya

S.N o.	Minerals	Distributions	Reserves
1.	Coal	Tertiary coalfields are distributed at southern extremity of Shillong plateau and southern periphery along the border with Bangladesh.	600 million tons (MTs) reserves. 350 MTs recorded from Garo Hills, 170 MTsfrom Khasi Hills and 75 MT from Jaintia Hills
2.	Limestone	Most deposits are in southern side of the state. Major limestone deposits are found are Cherrapunjee, Mawlong, Ishamati, Shella, Komorrah in East Khasi hill, Borsora and Bagii in West Khasi hill, Lakadong, Lumshnong and Nongkhlieh in Jaintia hills, Darrang Era-Aning, Siju, Chokpot in South Garo hills (GSI, 2009)	15100 Mts of limestone deposits are estimated in Meghalaya. The important limestone deposits are known as Sylhet limestone, Prang limestone, Tharia limestone and Kupli limestone.
3.	Sillimanite	The Sonapahar sillimanite area of West Khasi Hills District is the only area in the state where lensoid bodies of massive sillimanite mineral are found.	Total reserve of 55 MTs (GSI, 2009), which is about 95 % of India's total reserve.
4.	Kaolin/Clay	White clay is found near Sohrarim and on Cherrapunjee Road. White clay is reported from Nongalbibre in South Garo Hills and Rongrengre in East Garo Hills districts. Fireclay is found near Jowai and Larnai, the latter one being highly plastic.	Reserve of crude clay is 6.5 MTs in Sohrarim and 8,100 tonnes in Cherrapunjee. Total reserve of Fire clay is 11 MTs and Kaolin 88 MTs (GSI, 2009).
5.	Uranium	Uranium deposits at Domiasiat area of West Khasi Hills district.	Estimated 9.22 MTs of reserve in state
6.	Other Minerals	Oil and Natural gas deposits are also known to have been located east of Baghmara.	Minor minerals - copper, corundum, gold, iron, gypsum, quartz, phosphorite, pyrites, Khasi greenstone, dolerite and feldspar.

2.3.2 Minerals of Meghalaya

Characteristically, the state of Meghalaya is comprised of the oldest as well as the youngest rock formations. The state is quite rich in certain mineral deposits. The important mineral deposits which are rich from economic point of view are limestone, coal, silimanite, clay and uranium (Figure 2.2, Table 2.2).

2.4 Climate

The state has a temperate climate. The undulating topography of high to low altitude topography influences the climate of the state (Rai *et al.* 1998). The low elevation of the western Meghalaya has a fairly high temperature for most part of the year, i.e. March to October with August as the hottest month having the mean maximum and mean minimum temperature as 24° C and 17° C, respectively. Meghalaya is the wettest region of the world; Mawsynram in Khasi plateau currently holds the record for maximum rainfall in a year (11,873 mm, 2015), and till a decade back Cherrapunjee in close proximity, held the record. The summer monsoon are responsible for most of this high rainfall during the months of May to August and in these four months alone two third of the rainfall of the year showers in this region. The average annual rainfall in western Meghalaya is 268.90 mm. Winter is conspicuously dry, rainfall less than 80 mm in four months, November - February.

The monsoon clouds bearing moisture first strikes the southern part of the state causing heavy downpour, but as it reaches northern part of the state the rainfall decreases. The rainfall in south eastern part is above 400 cm, and in northern parts it's around 250 - 300 cm. The rainfall is particularly very high in the shillout plateau averaging around 719 cm. The world wettest place Mawsynram, now receives an average of 1187 cm of rainfall annually, in last decade this rainfall has reached averages of 1392 cm. Cherrapunjee, the earlier wettest place, lying in the Cherra plateau, also receives a high average of 1177 cm of rain annually.

2.5 Biological Profile

2.5.1 Forest Types

According to Kanjilal *et al.*(1934 - 40), the forests of Meghalaya can broadly be grouped under the tropical and temperate type, mainly based on the altitude, rainfall and composition of dominant species. Characteristic feature of these forest as per Joshi (2004) along with corresponding classes as recocognised by champaion & seth (1967) are given in table 2.3

2.5.2 Agriculture

Meghalaya is basically an Agricultural State with about 81% of its total population depending entirely on agriculture for their livelihood, the net cropped area is only about 9.87% of the total geographical area of the State. In Meghalaya, summer is for a period of about 5 months, from May to September, with torrential rains caused by the southwest Monsoon. Rainfall varies from place to place and from altitude to altitude. The amount of rainfall over Cherrapunjee and Mawsynram is the highest in the world. During the last two decades, rainfall in Cherrapunjee has ranged between 11,995 mm to 14,189 mm; and rainfall in *Mawsynram* ranged between 10,689 mm to 13,802 mm.

During 1999 to 2006 there has been a net decline in cropped area in the state from 2,30,985 (000' ha) to 2,19,119 (000' ha). The current fallow land remained unchanged but the other uncultivable land and waste land in Meghalaya has increased (Area Production Yield Principal Crops-1999-2007). Most of the area of state under crops (60%) is utilized for food grain production. With recent advances in crop varieties and high yielding varieties of food grains (Mansuri, Pankaj IR 8, Ir36 paddy variety for Rabi season and Megha I and Megha II cold tolerating varieties of rice) an increase in production has also been observed in Meghalaya.

2.5.2.1 Agro-Climatic Conditions of Meghalaya

The Indian peninsula is composed of fifteen Agro-climatic Zones and Meghalaya is classified under Zone II comprising of the other North Eastern states. This zone is again sub-divided into sub-regions on the basis of topography, rainfall, temperature, soil type, cropping systems and geographical proximity. The Agro-climate of Meghalaya falls under Sub-Region II of the Zone and is further divided into five Agro-climatic sub-zones for devising development strategies and action programmes in the agri horticultural sector, as follows:

- **Hills and Northern Slope** comprising of the lower plateau in the north and western part of West Garo Hills, northern part of East and West Khasi Hills and the north eastern part of Jaintia Hills.
- **Central Hyperthermic Plateau** comprising of the central plateau of the Garo Hills and a portion of the central plateau of West Khasi Hills District.
- **Central Thermic Plateau** comprising of the central plateau of East Khasi Hills, West Khasi Hills and Jaintia Hills District.
- **Southern Slopes and Valleys (East)** comprising of the east and northern part of Jaintia Hills, southern part of East Khasi Hills and a portion of the southern fringe of West Khasi Hills.
- **Southern Slopes and Valleys (West)** comprising of the southern part of West Garo Hills and a small segment of the southern part of West Khasi Hills.

  In general, Meghalaya has a monsoon climate with natural vegetation profile ranging from tropical to temperate type. The climate however varies with the altitude and physiographic difference of landmass.

2.5.2.2 The major agriculture systems and crops in Meghalaya

1) Settled paddy cultivation: In general the permanent wet rice cultivation land are privately owned. By 2005-6,106.07 (000' ha) of land was under rice cultivation, which is 82.4% of the total food grain sown area (Meghalaya Agriculture profile, 2006).The other important cereals include maize, millet etc. Meghalaya state have now 42 percent area of paddy converted with high yielding varieties producing nearly 2300kg/ha. Similarly, maize and wheat production has also reached new high with varieties yielding more than double or 2.5 times respectively compared to 1971-72. The yield of maize has reached 1218 kg/ha and wheat at 1508 kg/ha.

2) Jhum cultivation: In Meghalaya alone nearly 52,290 families depend on jhum cultivation. Annually 530 km^2 of land is slashed and burned for cultivation and nearly 2650 km^2 area of state was once under *jhum* cultivation (Task Force on Shifting Cultivation, 1983). A yearly loss of around 77 km^2 of forest cover is attributed to *jhum*. However, nearly 20 km^2 of *jhum* is also recovered each year to natural forest (FSI, 1997. Over the years there has not been much change in population dependent on *jhum* cultivation, a large number of families and population are still practicing *jhum* cultivation in the state (51,428 families and population of 2,57,140; Jeeva *et al.* 2005)

The traditional *jhum* cultivation practiced in Meghalaya by the Garo, Khasi and Jaintia tribes are mixed cropping system with high crop diversity. This *jhum* cultivation is mostly for subsistence with excess produce traded in local markets for surplus income. Among War Khasi and most other tribes the crops own for commercial purpose are potato and turmeric or ginger followed by potato, colocasia, pumpkin and chili to a lesser extent. Cropping was done for a year, with the season beginning from the mouth of April to September (Mishra 1981). The fallow period varies in different tribes, the War-War and Khrang Khasi keep the land fallow for a period of 8-15 year, Garos for a period 7-9 years, whereas Karbis keepthe land fallow for only 3-5 years (Deb *et al.* 2013). Various *jhum* modifications are practised by several communities of north eastern states, e.g. *Jhum* with multiple cultivation, jhum

Table 2.3 Forest Types in Meghalaya

Sl. No.	Forest Type	Distribution
Tropical forests		
1.	Tropical Wet Evergreen Forests	Distributed in high rainfall areas and near catchments areas. Trees exhibit clear zonation with dense, impenetrable herbaceous undergrowth.
2.	Tropical Semi-evergreen Forests	These forests occupies the northeastern and northern slopes of the state, typically upto elevations of 1200m and annual rainfall of 150 - 200 cm with a comparatively cooler winter. The number of species here is less than the evergreen zone. There are also a few deciduous species eg. *Careya arborea, Dillenia pentagyna* and *Callicarpa arborea.* There is clear stratification of the trees in these forests.
3.	Tropical moist and dry deciduous Forests	Below 150 cm rainfall and at low elevations. Represented by only sub-climax or man-made forests characterized by seasonal leaf shedding. Recurrent forest fires are a common phenomenon here. Deciduous forests are extensively distributed across the state.
4.	Bamboo tracts	Bamboo tracts appear in jhum fallows of 10 - 15 years. These forests at places form pure strands. The common bamboo species are *Dendrocalamus hamiltonii, Dendrocalamus giganteus, Bambusa bambos, Cephalostychum latifolium, Melocanna bambusoides,* etc. Bamboo also appears in comparatively older forests in the canopy gaps.
5.	Grasslands and Savannas	Grasslands are only a result of removal of original forest cover. The rolling grasslands covering large areas aredistributed throughout the Shillong plateau, around Riangdo, Ranikor, Weiloi, Mawphlang, Mawsynram, Cherrapunjee, Shillong, Jowai, Jarain and Sutnga in the Khasi and Jaintia hills and major parts of West Garo hills.
Sub-Tropical forests		
6.	Subtropical Forests	Occur between 1000 m and 1350 masl and in deep valleys along the river banks. They are composed mainly of evergreen forests and show abundant growth of mosses and epiphytes. The upper canopy of the forest is occupied by *Alcimandra cathecartii, Betula almoides, Castanopsis sp., Lithocarpus elegans, Manglietia insignis, etc.* and the lower layer is composed of *Adina cardifolia, Daphne involucrate, Ethretia acuminata, Garuga pinnpata, Milletia prainii, Syzygium macrocarpus etc.*
7.	Subtropical Pine Forests	These forests are confined to higher reaches of the Shillong plateau and upper slopes of Khasi and Jaintia hills, in a narrow belt showing an east - west direction. *Pinus kesiya* is the principal species, often forming pure strands. These forests have developed on shifting cultivation sites and replacement of broad-leaved tree species.
Sal forests		
8.	Alluvial Sal	This conforms to North Indian Tropical Moist Deciduous,Kamrup Alluvial Sal Forests (3C/C2 d (iv)).
9.	Foothill and Plateau Sal	This conforms to the North India Tropical Moist Deciduous, Eastern Hill Sal Forests (3c/C1a).
10.	Very Moist Sal Bearing Forests	Khasi Hills Sal (3C/C1 a (ii)).
11.	Temperate Forests	Occur at about 1000 m, mostly along the southern slope of Khasi and Jaintia Hills and areas of high rainfall (200 - 500 cm per year) with a severe winter during November - March. Ground frost is also common during December - January. These climax forests are usually found in isolated pockets along valleys, slopes, rivers and streams. The tree species in general show bushy and are stunted forming a dense canopy. At lower elevation an intermixing of tropical and sub-tropical elements namely *Castanopsis kurzii, C. armata, Elaeocarpus prunifolius, Ficus nemoralis, Myrica esculenta, Manglietia insignis, Schima wallichi, Eurya japonica etc.* are observed.

Source: Joshi 2004

interspersed with alder trees *(Alnus nepalensis)*. In Meghalaya also, several local communities have adapted new techniques such as use of cover crop, tree retentions, weed management, soil conservation using poles and logs, and introduction of cash crops with fallow management to increase production of *jhums.* These modifications are less destructive to forests and generate higher returns (Deb *et al.* 2013).

3) Horticulture: In the mountainous state, horticultural crops yields the best benefits, prompting emphasis by the Agriculture department. The geo-climatic situation of Meghalaya also offers scope for growing different horticultural crops such as fruits, vegetables, spices, medicinal and aromatic crops of high economic value. A wide range of tropical, sub-tropical and temperate fruits such as mandarin orange, pineapple, banana, lemon, guava, pear, plum etc are grown in the State. The state is also suitable for growing a large variety of vegetables both indigenous and exotic varieties (Meghalaya Agriculture Profile, 2006).

4) Cash crop plantations: There are three important plantation crops in the state viz., arecanut, cashewnut and tea. In recent years coconut has been introduced but the area and production is still too small.

(a) Arecanut: Arecanut is an important cash crop of the state and has been grown in Meghalaya since time immemorial. In the recent years this crop has been introduced on the northern slopes of Khasi Hills in the Ri-Bhoi district and is found to be doing well. Between 2001- 02 to 2005 - 06 the arecanut plantation grew at rate of 0.72%, and 1.98% in area and production respectively (Meghalaya Agriculture Profile, 2006).

(b) Tea: The potential of Meghalaya hills for growing tea was explored by the Tea Board through establishing experimental stations at *Umsning* in Ri-Bhoi District (2.5 ha); *Riangdo* in West Khasi Hills District (2.0 ha) and *The bronggiri* in West Garo Hills District (1.6 ha) in the year 1976 – 77. The encouraging results prompted tea board to encourage tea plantations in Meghalaya. The Agriculture Department established a Tea Nursery at *Umsning* in Ri - Bhoi District and *Rongram* in the west Garo Hills District in 1982 - 83. Apart from the two tea nurseries i.e. *Umsning* and *Rongram*, the Government under the Directorate of Horticulture has started small-scale tea nurseries at *Riangdo, Thadlaskein, Umwang* and Upper Shillong. Several new tea nurseries are also planned in all districts to make tea a household crop. During 1984 - 85 to 2005-06 about 1320 ha of land have been brought under tea plantation, producing about 5610 MT of green tea leaves.

Rishi Kumar

Fig. 2.3 Paddy Field in Meghalaya

Table 2.4 Land Use Statistics Of Meghalaya 2011-13

Land Classification	Ri-Bhoi District		East Khasi Hills		West Khasi Hills		Jaintia Hills		East Garo Hills		West Garo Hills		South Garo Hills		Meghalaya		Variation Increases (+) Decreases (-)
	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	2011-12 Apprv.	2012-13	
1. Geographical Area	2,44,800	2,44,800	2,74,800	2,74,800	5,24,700	5,24,700	3,81,900	3,81,900	2,60,300	2,60,300	3,67,700	3,67,700	1,88,700	1,88,700	22,42,900	22,42,900	0
2. Reporting Area	2,44,277	2,44,374	2,74,886	2,74,856	5,23,935	5,24,661	3,81,379	3,81,241	2,60,115	2,60,152	3,67,670	3,67,320	1,88,575	1,88,650	22,40,837	22,41,254	417
3. Forest (Classed and Unclassed)	86,902	86,905	1,07,080	1,07,085	2,06,515	2,06,527	1,54,025	1,54,029	1,24,525	**1,24,530**	1,64,759	1,64,765	1,02,283	1,02,286	9,46,089	9,46,127	38
4. Area not available for Cultivation																	0
(i) Area under non agriculture use																	0
a. Water Loged Land									18	18	1,010	1,004			1,028	1,022	-6
b. Social forestry	2,416	2,426	3,028	2,989	3,050	3,049	2,679	2,668	2,372	2,371	2,628	2,673	3,025	3,027	19,198	19,203	5
c. Land Under Still Water	1,945	1,968	4,796	4,789	5,920	5,917	4,302	4,299	2,631	2,634	6,186	6,189	3,179	3,177	28,959	28,973	14
d. Other Land	9,681	9,698	11,911	11,913	17,390	17398	11,532	11,615	1,622	1,627	4,982	5,006	1,147	1,159	58,265	58,416	151
Total (a to d)	14,042	14,092	19,735	19,691	26,360	26,364	18,513	18,582	6,643	6,650	14,806	14,872	7,351	7,363	1,07,450	1,07,614	164
(ii) Barren and Unculturable Land	19,358	19,369	34,249	34,239	48,694	48,702	13,820	13,817	4,654	4,651	7,191	7,177	3,778	3,779	1,31,744	1,31,734	10
Total (i and ii)	**33,400**	**33,461**	**53,984**	**53,930**	**75054**	**75,066**	**32,333**	**32,399**	**11,297**	**11,301**	**21,997**	**22,049**	**11,129**	**11,142**	**2,39,194**	**2,39,348**	**154**
5. Other Cultivated Land																	0
a. Permanent Pastures and Other Grazing Lands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
b.Land under Misc. tree Crops and Grooves, etc.	29,706	29,707	17,250	17,249	43571	43,982	17480	17,479	25,214	25,247	24,554	24,185	6,440	6,446	1,64,215	1,64,295	80
c. Cultivable Wastelands	56,956	56,987	48,028	48,059	1,01,197	1,01,182	114090	11,3903	36,917	36,913	14,744	14,736	18,957	18,964	3,90,889	3,90,744	-145
Total (a+b+c)	**86,662**	**86,694**	**65,278**	**65,308**	**1,44,768**	**1,45,164**	**1,31,570**	**1,31,382**	**62,131**	**62,160**	**39,298**	**38,921**	**25,397**	**25,410**	**5,55,104**	**2,22,039**	**- 65**
6. Fallow Lands																	0
a. Fallow Lands other than Current Fallow	8,861	8,847	5,924	5,921	47,722	47,759	17,619	17,611	20,238	20,240	35,282	35,267	19,534	19,548	1,15,180	1,55,193	13
b. Current Fallows	6,173	6,181	4,795	4,778	18,959	18,933	9,750	9,755	4,915	4,901	10,689	10,674	4,812	4,826	60,093	60,048	45
Total (a + b)	**15,034**	**15,028**	**10,719**	**10,699**	**66681**	**66,692**	**27,369**	**27,366**	**25153**	**25,141**	**45,971**	**45,941**	**24,346**	**24,374**	**2,15,273**	**2,15,241**	**- 32**
7. Net Area Sown	22,279	22,286	37,825	37,834	30,917	31,212	36,082	36,065	37,009	37,020	95,645	95,644	25,420	25,438	28,5177	2,85,499	322
8. Area Sown More than Once	2,916	2,947	7809	7,811	6,772	6,861	339	414	5,337	5,339	25,369	25,355	5,498	5,499	54,040	54,226	186
9. Total Cropped Area	25,195	25,233	45,634	45,345	37,689	38,073	36,421	36,479	42,346	42,359	1,21,014	120999	30,918	30,937	3,39,217	3,39,725	508

Source : Department of Agriculture Meghalaya

(Area = in hectares)

fig. 2.4 A Jhum Field getting ready in Garo Hills, Meghalaya

(c) Cashewnut : Cashewnut is also one of the plantation crop extensively grown, particularly in Garo Hills. Due to lack of proper processing facility the bulk of the produce is sold outside the state as raw products. The area under Cashew is rapidly increasing especially at the reclaimed *jhum* land. Over last few years there is a significant increase in area, production and productivity *viz*, 1.51, 14.63 and 13.60 percent respectively.

5) Floriculture : The climatic favorability of Meghalaya makes it a potential area for cultivation of ornamental crops. It also enables low cost cultivation of a variety high value, long lasting and off- season flowers such as orchids, bulbous plants, Bird of paradise, *Chrysanthemum Gerbera*, Gladiolus, Marigold, Carnations etc. However, the lack of market potential is a major constraint for floriculture in the state. For encouraging floriculture, government has set up Centre of Excellence for rose (Ri Bhoi District) and *Anthurium* (East Garo Hills District) which served as demonstration models. These centers have encouraged farmers to take up floriculture on their own effort with technical support and subsidies from the government.

2.5.2.3 Other grains and cash crops

Pulses occupy a smaller share in area and production under food grains in Meghalaya. The pulses include cowpea, pea, lentils, *arhar*, gram, black gram, and *rajma*. The crop is grown mainly in the plains of the Garo Hills Districts. The area and production in the state was 3426 ha and 2622 MT respectively. The other important cash crops include Potato, Ginger, Turmeric, Black Pepper, Areca nut, Bay leaf, Betel vine, Short-staple cotton, Jute, Mesta, Mustard and Rapeseed etc. are also grown in the State. The fiber crops in the state, namely, cotton, jute and *mesta* are exclusive traditional crops of Garo Hills. Except cotton, the production of other fiber crops is stagnant or even declining over last 16 years.

2.5.2.4 Vegetables

The agro-climatic conditions in Meghalaya favours cultivation of vegetables throughout the year. The area and production in the vegetables have increased over the last few decades. Vegetables like Cabbage, Cauliflower, Radish and Squash are regularly exported from Meghalaya. In fact, revenue returns from vegetables in Meghalaya tend to be higher than that of cereals. The other important vegetables of the State are beans, carrots, peas and tomatoes.

The local community particularly living in forest areas are still dependent on wild plants for their various requirements. The indigenous communities make use of wide range of plants resources from wild. For example, plants parts such as, leaves of *Alternanthera philoxeroides, Bergenia ciliata, Diplazium esculentum, Pteris sp., Mussaenda roxburghii, Vaccinium donianum, Thunbergia grandiflora, Houttuynia cordata, Sambucus javanica, Medinella erythrophylla, Olax acuminata* and *Tetrastigmata thomsoniantum,* flowers of *Buddleja asiatica* and *Corylopsis himalayana* are often cooked with meat and fish. Seeds of

fig. 2.5 Tea Plantation at Chandigre, Garo Hills

Hodgsonia macrocarpa, Sterculia hamiltonii and *Sterculia roxburghii* are also eaten either roasted or cooked.

2.5.2.5 Fruits

The variation of altitude, soil and climatic conditions provide ample scope for the cultivation of a wide variety of horticultural crops. Horticultural crops currently grown in the state include bananas, oranges, pineapple, papaya, lemon, jackfruit, and litchi, temperature fruits such as plum, peach, and pear. Among the crops, Pineapple, Citrus (Mandarin Orange), Limes and Bananas are the most important ones. The local community also prefer fruits from the wild including *Baccaurea sapida, Calamus esculentus, Docynia indica, Dillenia indica, Elaeagnus sp, Ficus neriifolia, Ficus auriculata, Garcinia paniculata, Garcinia lancifolia, Rubus niveus, Rubus rugosus, Gardinia companulata, Syzygium cumini, Lepisanthes rubiginosa, Ardisia floribunda, Meyna spinosa, Debregeasia longifolia* and *Actinida callosa.* Large production of several varieties of fruits in the state provides great potential for fruit processing industries.

2.5.3 Poultry and Livestock

In recent years the output of livestock and poultry has increased at a considerable rate vis-a-vis the human population increase in the state. Even then the per capita production or the total production of the state is still quite low e.g. 75 grams of milk per day per person and 38 eggs per person per year is available in the state. Thus for reaching a respected production of poultry and livestock, considerable efforts are needed *

The daily demand for animal husbandry product in Meghalaya is rising, which include chicken, mutton, pork, beef and fish, however the production has not met the demand in state. Thus, large quantities of meat and poultry products are imported from neighboring state and Bangladesh.

2.6 Social Structure and Culture

The three main indigenous communities in Meghalayas are namely Khasi, Garo and Jaintia, other major indigenous communities include *Karbi, Mikir* and minor ones like the *Hajong, Koch* and *Rabha* (Singh 1994, Sangma 1998). The Khasi society is divided into clan or *'Kurs'* which are actually out grown families. The Garo society is divided into three major clan or *'Katchis'* viz. Marak, Sangma and Momin. Each of the *'Katchis'* or clan is further subdivided into numbers of lineages called *'Machongs'* (Nongkynrih 2014). Matrilinealism, the system of inheritance and succession of the properties from parents to the female child, is prevalent in the three major communities. The matrilineal system of Khasis and Jaintias is also characterized by the succession of property to the youngest daughter called *'Ka Khadduh'* (Gurdon 1907). Similar clan and traditional laws exist in Garo Hills regarding inheritance of the youngest daughter (Playfair 1975). According to the customary laws of Garos and Khasis, a husband has no right to his wife's ancestral property. In the Jaintia, according to the *Pnar* customary and traditional laws, the clan has claims to this property even the self-acquired property of male. Among the War Khasis, however, property passes to all the children, male and female, in equal shares but among the War Jaintias, only the female children get the inheritance.

In 1842, Roman script was adopted for Khasi language, and the first western education system was introduced. Till next 100 years there were only primary and secondary school education in Meghalaya. In 1924 with establishment of the first college by Christian Brothers of Ireland, higher education reached local people of the state. The literacy rate in Meghalaya has grown from 26.92 % in 1961 to 75.48 % in 2011, which is above the national average. The education board of the state has an ambitious vision to catch up soon with other Indian states and to compete internationally in coming years.

2.6.1 Traditional Customary Rituals

For Khasis, Jaintias and Garos, dances and music are essence of all the festivities and is an important part of various religious ceremonies. Some of the important religious festivals of the people of Meghalaya are *'Nongkrem dance'* (Das 2015), *'Beh Deinkhlam'*, *'Shad Sukmynsiem'* or *'Weiking dance'*, *'Wangala dance'*. The traditional customary rituals of Khasis are called *'Niam Tynrai'* (Anon 1991).

Ka Pomblang Nongkrem or *Nongkrem* dance is one of the most important and elaborate festivals of the Khasis. This religious festival, is a five day event, held annually at Smit (11 km from Shillong), headquarter of Chief (Syiem) of Khyrim. Earlier the festival was held in May, but in recent years it is being celebrated in November. This festival is celebrated as a thanks giving to Goddess *Ka Blei Synshar* for the good harvest and prosperity. An important part of this festival is *Pomblang* (decapitation of goats) ceremony where goats offered to the 'Syiem' of Khyrem, and the deity of Shillong peak (*U-Lei Shillong*). The Syiem is the administrative head of the Hima (Khasi State). *Ka Syiem Sad* (literally the Syiem priestess), is the caretaker of all religious ceremonies of the Hima. The Myntries (Council of Ministers), the priests and the people in general celebrate the festival with rhythmic form of prayers.

Shad Sukmynsiem literally translated as 'Dance of the joyful heart' is another important festivals of the Khasis. This dance is for thanks giving to the god. Young girls in traditional attire and ornaments and men in traditional and colourful dresses participate in this dance. An important part of this dance is also the Khasi drums and flute. This is a three day festival, held every year in Shillong in month of April (Shullai 1994).

Beh Deinkhlam (in Jaintia = driving away the plague with sticks), is the most important festival of the Jaintias and is celebrated after the crop sowing. This festival seeks blessing of the gods for good harvest, better life on Earth and next life in heaven. Men decorated in traditional attires dance to the music and women offer sacrificial food to the spirits of their ancestors. Men go round the town and beat the roof of every house with bamboo poles, calling upon the plague demon to leave the house. The culmination of the celebrations is with a tug-of-war (Tariang 1989, Lamare 2005).

The *Wangala* dance is the biggest festival of the Garos, celebrating the harvest by worshiping the Sun God of fertility *Saljong*. Traditionally there is no particular date for *Wangala* and each village can propose the dates. However, in recent years it is usually celebrated between October-November. All the villages assemble at *Asanang* village. The dance and music is initiated in a field by "*Rugala*" ceremony, followed by "*Sasat Soa*" (the ceremony of incense), inside the house of the Chief (*Nokma*) of Asanang. The Chief inaugurates the festival by uttering a few words of incantation and pouring rice beer and rice powder over a collection of field produce offered to the Gods. People dress in their traditional garments (*Dakmanda, Daksari*, or *Gando*), headgear (*do'me*) and dance to music played on long, oval-shaped drums *Dama* (Sangma 1998).

2.7 Governance

The state of Meghalaya, similar to other Indian states, follow an elected political system comprising a 60 member legislative assembly formed by elected representatives from the three regions of the state.

2.7.1 Local Administration (District Councils)

The local administration of the state vests in the Autonomous District Councils setup under the provisions of the Sixth Schedule to the Constitution of India. There are three such councils:

1. The Garo Hills Autonomous District seated at Tura covering the East Garo Hills, West Garo Hills and South Garo Hills Districts.
2. The Khasi Hills Autonomous District seated at Shillong covering the East Khasi Hills, West Khasi Hills and Ri Bhoi Districts.

3. The Jaintia Hills Autonomous District seated at Jowai covering the Jaintia Hills only.

The District Councils are constituted by the elected members. The leader of the largest party/group is appointed by the Governor as the Chief Executive Member (CEM). On the advice of such CEM, a number of members are appointed by the Governor as Executive Members. The CEM and the EMs constitute the Executive Committee of the Autonomous District Councils and exercise its Executive Powers.

Under the Sixth Schedule of the constitution the District Councils enjoy legislative, executive and judicial powers mainly over the following items:

- Land other than reserve forests
- Forests other than reserve forests
- Use of any land or water course for agricultural purposes
- Regulation in the practice of *Jhum* or other forms of shifting cultivation
- Establishment of village or town administration including village or town police and public health and sanitation.
- Appointment and succession of Chiefs and their powers
- Establishment of village or town Committees or Councils and their powers
- Regulation of laws or inheritance of property
- Marriage
- Social customs

2.7.2 Traditional Administration

Traditionally the Jaintias, the Khasis and the Garos were ruled by their Clan Chiefs with the assistance of the village councils *(Durbars*), variously named as the *Dolois* among the Jaintias, the *Syiems, Lyngdohs, Wahadadars* etc. among the Khasis and the *Nokmas* among the Garos. Whereas, one of the *Dolois* rose to the status of a *Raja* with infrastructure of a kingdom, the *Syiem's* powers and status does not rise up to that level. The position of a Nokma extends to his village and its satellite villages only. The village councils or Durbar plays an important role in the running of the village administration.

The village head in Garos is known as *Nokmas* (Playfair 1975). The *nokmaship* is also inherited mostly to the youngest daughter of *Nokma*. The maternal relatives of the Nokmas are called *Maharis* and they play an important part in designs of the village and selection of new *Nokma*. Cases where the Nokmaship has not transferred to the youngest daughter, the other daughter will be the preference, and this decision is taken by the *Mahris*. The husband of the *Nokma* has the executive power. Marriage is mainly by

fig. 2.7 Nongkrem Dance, Khasi Hills

consent of both individuals and their families, and a male has to leave his ancestral house and settle in the wife's village. With changing beliefs and social system, the inheritance of property in recent times is also changing in cities and town, however such inheritance by both males and females is relatively rare (Playfair 1975). The *Nokmas*, the village head with the help of *Laskars* administer the village community. *Laskars* are appointed by the Nokmas. Land belonging to the *Nokma* is only in name, and anyone can cultivate crop in it as per the permission or agreement received from the *Nokma*, who usually consults his wife's *Machong* (Clan) before taking the final decision.

In Jaintias Doloi is elected from the male members of founding clan of Elaka (group of villages), once elected the Doloi holds the charge till his life unless he is expelled by collective decision of the clan. He is the head of the Elaka but he is assisted by the Doloi durbars or Raid durbars. The Syiems were later formed and has power over mainly the plan regions of Jaintias, the hills are still under Doloi control and syiem is nominal head. Syiem came into existence with formation of a confederation moving toward a state formation in Jaintias (Gassah 1980, 1998).

The Khasi society is characterized by Durbar Shnong or the village councils, an assembly of all the adult males of a village functioning under a village headman, Rangbah Shnong. With growth of the matri-clan or Kur extended political systems developed. The political system of adjacent villages is called durbar raid politically coordinating Durbar Shong. Several Raids join together to form the Syiemship with chief Syiem. Hima Durbar, a ministry of advices under *Syiem's* leadership has the power to legislate, adjudicate and execute the law (Laloo 2014).

Altogether there are sixteen Syiemships whose Syiems are sanctioned by clans. The Syiems are only titular heads and the Durbar decides everything. In important matters the State Durbar or Executive Council, of which the Myntris are members, plays the decisive role through democratic process under the Syiem as the presiding officer. The Syiem is usually succeeded by his eldest sister's son selected by an electoral college. If the members of the Electoral College do not agree, then opinion is sought from all the adult members of the Syiemship.

2.8 Land use Practices and Resource Governance

The pattern of land ownership and type of tenure plays an important part in land use and agricultural planning. The special status according to 6th schedule of Indian constitution imparts a special status to land ownership systems in Meghalaya and other parts of North Eastern India. In Meghalaya the land ownership system is broadly of two types, i.e. riotwary and customary land system (Tiwari & Shahi 2011). In *riotwary* system the government deals directly with the land owners without interference of intermediaries. The customary land ownerships however vary in different indigenous communities in Meghalaya. These private land holdings still cannot be sold to outsiders (non-local persons).

In the three regions of Meghalaya the land tenure system varies according to administration and religious beliefs of the people. Various customary and other laws dealing with land and forests in Khasi and Jaintia Hills include, the *Law Kyntang, Law Adong, Law Lyngdoh, Law Shnong, Law Raij, Law Sumar, Law Kur* etc. Since the British rule these systems have remain unchanged (Simon 1996). These systems and practices were recognized in the state and maintained by respective district councils after independence.

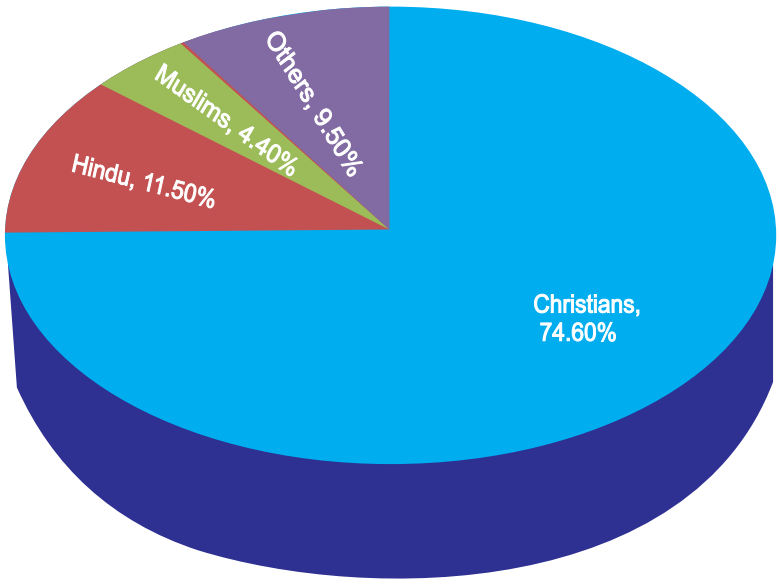

fig. 2.6 Religious Profile of People of Meghalaya

The Garo

Riotwari system is present in most areas of the Garo Hills. Individuals do not own village land but has a right on a portion of village land for shifting cultivation. In areas of wet rice cultivations, however, private ownership has emerged and is permanent land holdings.

The land among Garos is under control of the clan and is known as *A'King* land, which is headed by the Nokma. The *Nokma* is a female head, her husband acts on her behalf in decision making process of the clan. The territory under the *Nokma* is known as abheng land. The Nokma, however, cannot sell land to outsider or other village without consent of the respective Maharis (clan members). Outsider can use the village aking land by consent of Nokma with an undertaking to pay a tax called Harshel. The *Nokma* also have a say in distribution of land for jhum cultivation, and other *abeng* resources such as forests (Banerjee 1972). The land use rights may not translate into any property rights. The right to the land for a particular period remains with a villager to whom land has been allotted by *Nokma* and during this the family may keep the land as *jhum* fallow or cultivate it. The person who plants a tree inherits the rights to tree even after transfer of land to another person in following years by the village *Nokma.*

The Jaintia

In Jaintia a diverse form of land use and tenure is practiced except for the government or District Council lands. The different categories of land are:

a) *Ri Kynti or* private land

b) *Raij Land:* All Raij lands converted to permanent paddy attracts an annual revenue, Hali, which varies according to fertility of land. No such system or revenue exist in Khasi Hills.

c) *Land under Zamindars:* These are border areas of Jaintia and Khasi Hills the big land holders are called Zamindars, a remnant of colonial system. The Zamindars lease out their land for rent in form of cash or kind.

The Doloi has power and authority to grant licenses and *pattah* for cultivation of terrace wet rice. An individual utilizing these rice cultivation pay a yearly fee to the Doloi, which is shared by the Doloi and his deputies. The division of land for *Jhum* cultivation in Raj land is done by the village headmen and other village officials. The *jhum* land is divided according to abilities of families (Gassah 1980).

Box 2.1 Traditional Administration in Khasi, Jaintia and Garo Hills

HIMA SYIEM - (Syiemships)-16
Mylliem, Khyrim, Nongkhlaw, Jirang, Rambrai, Nongstoin, Sohra, Langrin, Myriaw, Bhowal, Mawiang, Nongspung, Maharam, Nobosohphoh, Mawsynram and Malaisohmat

HIMALYNGDOH- (Lyngdohships)-3
Sohiong, Mawphlang and Lynniong

HIMA SIRDAR- (Sirdarships)- 25
Myrdon, Nongpoh, Mawlong, Mawdon, Nonglwai, DwaraNongtyrnem, Pamsanngut, Mawbeh, Marbisu, Laitkroh, Laitlyngkot, Sinai Mawshynrut, Synnei, Saitsohpen, Mawsmai, Wahlong, Sohbar, Nongbah, Tyrna, Nongjri, Tynriang and Umniuh Tmar, Jyrngam and Nonglang

HIMAWAHADADAR- (Wahadadarships)-1
Shella

ILAKADOLLOI- (Dolloiships) - 19
Jowai, Nongbah, Mynso, Nongjngi, Shangpung, Raliang, Shilliang Myntang, Sutnga, Narpuh, Rymbai, Nartiang, Nongkhlieh, Nongtalang, Darrang, Lakadong, Amwi, Satpator, Saipung and Maskut

NOKMA (Nokmaship) - 80 (approx.)
There are nearly 80 *lasker elakas* and *nokmas*

The Khasi

In Khasi system there are numerous laws and criteria for ownership of land. The basic four ownership types are detailed below (Haloi 1984).

a) Private ownership: Single person or a family has absolute right over the land, the person can buy sell or rent the land as needed. There is no tax required to be paid to any authority. The State or any other authority can only be involved in case of disputes, when bought to the assembly of village. The land under these categories are -
I Ri-Nongtmmen ii) *Ri-Maw* iii) *Ri-Khurid* iv) *Ri-Bitor* v) *Ri-Dabhol* vi) *Ri-Shutang* vii) *Ri-Phriang* viii) *Ri-Spah* ix) *Ri-Langdung* x) *Ri-Samla* and xi) *Ri-Nongmei Nongpa.*

b) Common property of small groups: In this type of land the owner's right, especially to transfer the land is subjected to control of a group-assembly. The group may be members of clan or group of clans. The members of each group are owners of land and have their own durbars (assembly), however no one is entitled to sell the land (Chowdhury 1978). The right of transfer of land rests with the concerned assembly; there is no tax to be paid.

c) Community land: This is a common land belonging to an entire community, irrespective of current use by members. This land cannot be transferred by the user to other individuals without the consent of community. Each member of community can have use rights, occupancy rights and even in some cases heritable rights but with the approval of the community assembly. This land can be inherited by a person if he uses it according to the rights given for consecutive years, however he cannot transfer the land

to anyone else. If a person makes permanent improvement such as plantation of fruit tree, or wet paddy or permanent building, he or she may be endowed with transfer rights to other members of Khasi community. In case the land is not maintained, it can be handed over to the community.

In addition to these there are other special land kept by the community for specific uses such as for religious purposes i.e. *Ri-Law Kyntang, Ri-Law Niam* and *Ri-Law Lyngdoh.* For the purposes of firewood, water and timber etc. land such as *Ri-Law Adong, Ri-Law Sang, Ri-Law Shnong* and *Ri-Law Sumar.*

d) Government land: Any land leased, purchased or acquired by the state government.

2.8.1 Forest Management

Meghalaya being a region inhabited by people who have close links with forest and who depend on forests for their livelihood, forest have played a very important role in the cultural and traditional lives of people. These forests not only served as important areas of religious customs but also as important areas of natural resources essential for survival of the societies. Thus these forests were accorded various forms of protection by the ruling class and villagers. Currently two types of forest system exists in Meghalaya,

1. The state controlled forests,
2. The community forests controlled by the autonomous district councils.

Forest management in Meghalaya before British occupation has been according to traditions and rituals. Many of these systems were not based on contemporary science, however they very effective in protection and conservation of forest. The sacred groves, medicinal plant groves, village forests etc. accorded community accepted protection to the patches of forests. The Khasi customary law divided forests into different types, sacred forests *(Law kyntang*), village forests *(Law shnong)*, village restricted forests *(Law Adong)*, *Law Raid, Law Ri-Sumar, Law Ri-Kynti* were various forms of private forests, *Law Kur* was the clan forest and *Law Lum Jingtep* as the cemetery forests. The Village restricted forests and sacred groves provided various ecosystem services like upper catchment of watershed, conservation of wildlife or medicinal plants. And most villages had a number of these forests (Tiwari *et al.*2010).

Box 2.2 National Policies and Policy Instruments Impacting NRM Sector in Meghalaya

- Supreme Court Orders, 1996-2002
- The Scheduled Tribes and other traditional forests dwellers (Recognition of forest rights) Act, 2006
- National Forest Policy, 1854, 1952 and 1988
- North East Forest Policy, 2002 (Draft)
- National Biodiversity Strategy and Action Plan, 2002
- Joint Forest Management (JFM) 1990 and Forest Development Agency (FDA) Guidelines, 2002
- Wildlife (Protection) Act, 1972 and amendments, 2013
- Forest (conservation) Act, 1980 & amendments, 1988
- National Mining Policy 2003
- Mines and Mineral Act, 1957
- Mines and Mineral (Regulation and Development) Amendment act, 1994
- Biodiversity Act, 2002
- Biodiversity Rules, 2004
- Indian Constitutional Provision for NRM
- The Cattle Trespass Act, 1871 (1 of 1871)
- The Elephant Preservation Act, 1879 (VI of 1879)
- Indian Fisheries Act, 1897
- Livestock Importation Act, 1898
- Wild Birds and Animal Protection Act, 1912
- Prevention of Cruelty to Animal Acts, 1960
- Prevention of Cruelty to Animal Rules, 1960
- Prevention of Cruelty (capture of animals) Rules, 1972
- The Wildlife (Transactions and Taxidermy) Rules, 1973
- The Wildlife (Stock declaration) Rules, 1973
- The Wildlife Licensing (additional matters for consideration) Rules, 1983
- Transport of Animals Rules, 1983
- Prevention of Cruelty to Animals (Registration of Cattle Premises) Rules, 1978

2.8.2 Forest Policies

The National Level policies regarding environment and forests are framed exclusively by the MoEFCC and it also has a regulatory role over other resources related to environment such as mineral, water, and agriculture, marine, coastal and land resources. While framing these policies the various state departments are also consulted. The state level policies flow from the national policies and similar developmental processes at the state level (Barik & Darlong 2008).

In addition to the state machinery and departments in North Eastern India, being a 6th schedule area, there few more institutions which are involved in framing polices:

(i) Regional Planning Body, i.e., the North Eastern Council (NEC)
(ii) Autonomous District Councils (ADC)
(iii) Village Councils/ Traditional Bodies

In addition to the above formal policy making bodies in the state, in North Eastern India, there are a spectrum of traditional institutions ranging from clan, village to supra-community level organizations eg. *Elaka* Chiefs in the forms of *Syiemship, Doloiship, Nokmaship, Sirdarship,* etc. In Meghalaya these traditional institutions frame rules, regulations and policies to manage the natural resources under their respective domain. Such rules and regulations in most cases are customary and are passed down to generations.

2.8.3 Forest Ownership

The state owned forests account for just 12 % of the total forested area of the state. It is however the best funded and best managed forest land due to central government funding, presence of staff and bureaucracy to manage these forests (Dasgupta & Symlieh 2006). The state forest can be classified into the following six categories (Tiwari *et al.* 1999):

I Reserved forests (including government forests, national parks and wildlife sanctuaries) covering about 993 km^2, and owned and managed by the state forest department. Local communities have very few rights over this land.

ii) Unclassified forest, covers 7146.5 km^2 of forest under control of local communities, where the communities enjoy full rights. Most of these forests are also used for shifting cultivation.

iii) Private forests cover 384 km^2 belong to individuals and who use it for personal consumption.

iv) Protected forests cover 129 km^2 for forest used by local communities for personal consumption. These forests are controlled by state forest department but local communities have rights to the forest.

v) Village forests, cover 25.9 km^2, are forests used for subsistence purposes by the villages, these are demarcated and registered under United Khasi-Jaintia Management of Forest Act 1958.

vi) Community (Raij) forests, which cover 768.0 km^2 of community area and are managed by the Raij or commune head under local administration.

Box. 2.3 State and Autonomous District Council Policies and Policy Instruments for NRM in Meghalaya

ADC Policies and Policy Instruments impacting NRM in Meghalaya

- The Garo Hills District (Jhum) Regulation, 1954
- The Garo Hills District (Forest) Act, 1958
- The United Khasi and Jaintia Hills Autonomous District (Management and Control of Forest) Act, 1958
- United Khasi-Jaintia Hills Autonomous District (Management and Control of Forests) Rules, 1960
- Khasi Hills Autonomous District (management and Control of Forests, Revised rate of Royalty) Rules, 1984

State Policies and Policy Instruments impacting NRM in Meghalaya

- Meghalaya Forest Regulation (Application and Amendment) Act, 1973
- The Garo Hills Regulation, 1882 (Regulation 1 of 1882)
- Meghalaya Forest Regulation (Application and Amendment) Act, 1973
- Meghalaya Forest (Removal of Timber) Regulation Act, 1981
- Meghalaya Tree Preservation Act, 1976
- Meghalaya Forest (Removal of Timber) (Regulation) Rules, 1982
- Meghalaya Forest Authority Act, 1991
- Meghalaya Protection of Catchment Area Act, 1988
- AWIL Fees Act, 1960
- The Bengal Cruelty to Animal Act, 1869
- The Meghalaya Wild Animal and Birds Protection Act, 1971 (Act 9 of 1971)

Source: Barik and Darlong 2008

III Biodiversity Profile and Conservation in Meghalaya

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03 Biodiversity Profile and Conservation in Meghalaya

3.1 Introduction

Meghalaya falls under the Indo-Myanmar Biodiversity Hotspot zone (Myers 1988 & 2000). Meghalaya is endowed with a rich biodiversity due to its unique geographical position at the meeting point of Indo-Malayan and Eastern Himalayan bio-geographical regions. Thus, it shares biodiversity elements including flora and fauna from both the regions. Meghalaya also shares rich species diversity containing species from Indo-China and rest of India. The diverse landscape of the state also supports a large array of forest types and species.

The biological diversity of the region has its origin in the geological tectonic movements which caused the Indian plate to move off from Gondwana landmass and collide with the Eurasian landmass. This collision resulted in exchange or biota between the two landmasses, India carrying the Gondwana forms and part of Asia containing particularly the Malayan forms. A 'biotic ferry model' has been proposed to explain this phenomenon, according to which the rafting Indian plate carried Gondwana forms to Asia (Mani 1974, McKenna 1995, Hedges 2003 & Briggs 2003).

The scope of the current chapter list as follows:

1) The chapter lists species of various taxa present in the state, including information on rare and endangered species.
2) The chapter prioritizes endemic, threatened and endangered species of flora and fauna.
3) The chapter presents a profile of PAs are presented with status of biodiversity.
4) The chapter gives an overview of biodiversity and conservation system in the state (modern and traditional systems) with special reference to forests outside protected areas.

3.2 Flora of Meghalaya

The diverse flora of the region includes elements from tropical Indo-China, Indo-Malayan or temperate East Asia and the Gondwana heritage of Deccan Plateau. The high altitudinal range, topography, varied rainfall and edaphic conditions accord a unique array of vegetation to the state, which ranges from tropical to sub-tropical types (Gatphoh 1937, Kanjilal *et al.* 1982, Raychaudhuri 1992, Hussain 1992 & 1994, Elias 1994, Kharbuli *et al.* 1999). Biogeographically the region is divided into i.e. Eastern Himalayas and north east India (Rodgers & Panwar 1988).

The flora of Meghalaya comprise about 4,243 species of flowering plants belonging to 1449 genera and 216 families (Mao *et al.* 2016), of which a large number ofspecies are endemic (Khan *et al.* 1997). The flora of the Khasi and Jaintia hills is most richly saturated by eastern Asiatic elements, and the area is one of the most important centers of survival of the tertiary flora of eastern Asia (Takhtajan 1988). Many species face threat of extinction in the state due to various direct and indirect anthropogenic pressures. Rao and Haridasan (1983, 1985 & 1987) reported 54 rare and threatened plants, and have listed 44 rare dicotyledonous plants from Meghalaya.

Meghalaya harbours a rich diversity of orchids (Family: Orchidaceae), of which nearly 110 genera and 439 taxa are reported from the state (Rao & Singh 2015, Appendix 13). However, many authors believe that Meghalaya may have more species of orchids and many are still to be discovered. Meghalaya is also considered as center of origin for a number of crop plants like rice, and Citrus based on the large number of wild relatives found in the state. Several orchid species of ornamental value such as species of *Dendrobium, Pleione, Paphiopedilum* and *Vanda* having become rare in the state. *Podocarpus neriifolia, Cyathea gigantean, Ilex khasiana* and *Balanophora dioca* and saprophytic orchids *viz., Galeola falconeri, Epipogium roseum, Eulophia sanguinea* have become rare due to habitat destruction (Kataki 1986).

fig. 3.1 Dendrobium ochreatum orchid

MBB

The Pteridophytic flora of India comprises 67 families, 191 genera and more than 1,000 species (Dixit 1984). BSI lists 484 sp. of pteridophytes in the checklist for the state (Mao *et al.* 2016), however, full diversity of taxa from the state is not accessed properly. Nearly 113 species of *pteridophytes* have been reported from Nokrek National Park and its surroundings (Singh *et al.* 2011). Chandra *et al*. (2008) list the rare, threatened and vulnerable pteridophytic flora of various Indian states including Meghalaya. Over the last few decades many pteridophyte species namely, *Dipteris wallichii* and *Cyathea gigantea* have become rare in Meghalaya. *Ilex embeloides*, *Styrax hookerii* and *Fissistigma verrucosum* that are extremely rare were reported after many decades from sacred grove (Upadhaya 2002, Jamir & Pandey 2003).

fig.3.2 Nepenthese khasiana

Gangulee (1969-80) worked extensively on bryophyte flora of Meghalaya and reported 248 species of mosses belonging to 120 genera from different parts of state, mainly from Khasi Hills. He reported *Bryum argenteum, Bryum medianum, Bryum caespiticium, Bryum alpinum, Bryum porphyroneuron* and *Bryum paradoxum* from Khasi hills. Meghalaya has 31 species of *Frullania*, a new species of the genus has been reported as *Frullania udarii* (Nath & Singh 2006). In addition to these, recent surveys and studies have documented a few new species for the state of Meghalaya. *Bryum coronatum* is recorded recently (West Garo hills) from specimen collected by (Singh & Nath 2007, Singh & Lal 1999 & Bansal & Nath 2012) reported the occurrence of 6 species of the genus *Porella* from Meghalaya state. In 2013, *Leptolejeunea subdentata* has been reported as new to Meghalaya from Khasi Hills (Verma *et al*. 2013).

The state harbours about 850 species of medicinal plants, of which 377 species are used by 70-80% population. Similarly, there are 249 wild species of edible plants belonging to 153 genera which are still consumed by people in Meghalaya (Sawian *et al*. 2007). Some of the medicinally important species reported are *Acorus calamus, Asparagus racemosus, Garcinia cowa, Myrica esculenta, Panax pseudoginseng* and *Rauwolfia serpentina* etc. (GoM, 2005).

The state is also endowed with many interesting taxa e.g. three species of insectivorous plants *Nepenthes khasiana* and *Drosera peltata* and *D. burmanii*. *N. khasiana* is endemic to Meghalaya and listed in Appendix I of CITES and placed in Schedule VI of the Wildlife (Protection) Act, 1972. The Khasi and Jaintia hills are considered to be the center of diversity for several primitive families such as *Elaeocarpaceae, Elaeagnaceae, Anonaceae, Ranunculaceae, Piperraceae, Menispermaceae, Caryophyllaceae, Lauraceae, Myricaceae, Lazarbiaceae* and primitive genera like *Schizandra, Corylopis, Myrica, Magnolia* and *Michelia.*

Most of the endemic and threatened species of the state are confined to the protected forests and sacred groves. Some of the species endemic to Meghalaya include *Aeschynanthes parasiticus, A. superba, Callicarpa psilocalyx, Camellia caduca, Citrus latipes, Ilex embeloides, Impatiens khasiana, I. laevigatum, Lindera latifolia, Paramignya micrantha* and *Rubus khasianus* (Balakrishnan 1981, 1983).

3.2.1 Endemic Plant Species of the State

A study by Lakadong and Barik (2006) reported 239 species of endemic plants in the state of Meghalaya. The largest family of endemic plants is Poaceae followed by 14 genera and 17 species of Orchidaceae and (11 genera and 13 species) Rubiaceae. Maximum 22 genera and 33 species number of endemics are herbs (36%), followed by trees (27%), shrubs (25%), lianas and climbers (8%) and shrubs only 4%. Out of these 36 species are also medicinal plants. The concentration of endemics was noted to be most in Jowai i.e. 61 species (25.5%) followed by Jarain with 51 species (21.3%), Nokrek with 42 species (17.6%) and Shillong with 41 species (17.2 %) (Lakadong & Barik 2006: Appendix (5) lists the endemic flora of Meghalaya.

3.3 Faunal Diversity of Meghalaya

The faunal diversity of Meghalaya constitutes a total of 5538 species recorded so far, of a total 89,451 species known from India. Nearly 35% of Indian Mammals and 50% of Vertebrates including birds are represented in the state (ZSI,1995). Invertebrates are

represented by 2114 genera and 4580 species, of which 3624 species are insects. Among invertebrates, the porifera is the smallest group represented by only one genus and one species (Pattanayak 1999).

Meghalaya has 139 species of Mammals, 659 species of Birds, 107 species of Reptiles, 55 species of Amphibia and 152 species of Fishes. Of these, 35 species of Mammals are endangered, vulnerable or insufficiently known. Similarly, 10 species of birds and 9 species of reptiles are either endangered or vulnerable. Along with the species diversity, the State has a significant percentage of endemic elements (Daniel 1983, Talwar & Jhingran 1991, Sharma 1998 & 2006, Sharma & Sharma 1999, Kharbuli *et al.* 1999).

The high diversity of region is also apparent in number of new species of invertebrates described in recent years from the state. Four new caryophyllaeid species of the genus Lytocestus from cat fishes, three from *Clarias batrachus* and one from Heteropneustes fossilis (Bloch), from Guwahati (Assam) and Shella (Meghalaya) are described (Tandon & Das 2005). In 2014, a new species of leafhoppers including Scaphoideus ramamurthyi was discovered from Barapani, Meghalaya (Meshram 2014).

3.3.1 Mammals

A total of 139 species of mammals, belonging to 83 genera and 27 families, have been reported form Meghalaya by Zoological Survey of India based on intensive and extensive surveys in various Protected Areas (Das *et al*. 1995). The fauna of the region includes both lowland Indo-Malayan and highland Palearctic elements.

Chiroptera (bats) represent the largest group of mammals in tropics compared to temperate forests. In Meghalaya though diversity of bats is seemingly very high, most of the species are yet to be identified properly. The Karst topography of Meghalaya contain some of the longest and largest caves of India, these caves support a wide variety of taxa, particularly the bats. In 2012, Ruedi *et al*. discovered two new species of bats from Khasi and Jaintia hills. Further Ruedi *et al.* (2014) discovered new colonies of the rare Wroughton's Free-tailed Bat *Otomops wroughtoni* from Meghalaya. Thus, it is now evident that number of this rare species is only around 200 individuals in the wild. However, the superstitions associated with bat meat consumption is a major threat to the species of bats in Meghalaya.

Box 3.1 Faunal Diversity of Meghalaya-Summary

Taxa	Genera	Species
Vertebrates	451	1112
Mammalia	83	139
Aves	232	659
Reptilia	51	107
Amphibia	11	55
Pisces	74	152
Invertebrates	**2114**	**4580**
Bryozoa	3	5
Arthropoda	1825	3901
Annelida	25	49
Mollusca	67	223
Nematoda	49	77
Rotifera	30	111
Platyhelminthes	56	83
Medusae	2	2
Porifera	1	1
Protozoa	56	128

Modified from ZSI, 1995, 1999, 2000

Primates

This mammalian order is well represented in Meghalaya having 7 species including Western Hoolock Gibbon *(Hoolock hoolock)*, four species of macaques viz., Northern Pig-tailed Macaque *(Macaca leonina)*, Stump-tailed Macaque *(Macaca arctoides),* Rhesus Macaque *(Macaca mulatta)* and Assamese Macaque *(Macaca assamensis)*. One species of leaf-eating langur i.e. the capped langur *(Trachypithecus pileatus)*, and the only strepsirrhine and nocturnal primate, the Bengal Slow Loris *(Nycticebus bengalensis)*. The 2003 CAMP report (Molur *et al*. 2003) comprehensively assess the information present on status and distribution of all primate species of South Asia. A recent survey at Balpakram NP reports presence of all 7 species in this park and its surroundings (Kakati & Srikant 2016).

The western hoolock gibbon is mainly found in wet tropical forest of the state, the main strongholds being the West Garo Hills, South Garo Hills, West Khasi Hills, Ri-Bhoi and Jaintia Hills districts. In recent years the population of the species has declined nearly 90 % (Kumar *et al.* 2009). Alfred and Sati (1990) for the first time assessed the population of the species in Garo Hills Districts, they reported 130 individuals in 42 groups at 28 localities in the district. Sati (2011) reported 82 individuals of the species in 25 groups at 15 locations in the state.

Bengal Slow Loris *(Nycticebus bengalensis)* is a solitary strepsirrhine nocturnal primate, is also the largest of the slow loris species. Its distribution and status in wild is not well known at present, but sporadic surveys have revealed its presence in many locations in the state (Radhakrishna *et al.* 2006, Radhakrishna *et al*. 2006 & 2010). Limited data on such species is available, reports and research papers indicate their presence of this vulnerable species (IUCN) in Balpakram and Nokrek National Parks, Siju Wildlife Sanctuary , Baghmara Range Forest and many community reserves in West, East and South Garo Hills.

The capped langur *(Trachypithecus pileatus)*, a species closely related to golden langur, is distributed across Meghalaya. It is a very colourful leaf-eating primate with bright golden-yellow front and a black coloured cap on the head. The black cap on the head differentiates this species form the golden langur. The rhesus macaque *(Makkre chisam: Garo)* has been reported from all the districts of Meghalaya except Jaintia Hills (IUSPP report and Momin 2002 in Molur *et al*. 2003. In most areas, however, its population is declining in the state (Molur *et al.* 2003). The Northern Pig tailed macaque (*A. rini makkre/ Makkre Ki. mi: Garo*) has been

recently separated from Sundaland Pig tailed macaque of southern South East Asia. Choudhury (2003) reported it from all districts of Meghalaya, particularly in Songsek, Narpuh and Saipung RF, Nongkhyllem WLS, Balpakram NP, Siju WLS and Arangiri. In Meghalaya it is not easily observed and population assessment available from few sites indicate that it's declining (Molur *et al* 2003). In recent years, it is observed from regions surrounding Nokrek National Park (2011-13, Kumar *Pers. Obs.*), Balpakram National Park, Siju WLS and adjoining region (Kakati & Srikant 2016).

The Stump-tailed macaque (*Makkre Ki. Mi. katong/ Ki. Mi. dongja:* Garo) is known as a monkey with short tail or no tail. Though many authors indicate their presence in South Garo Hills, Meghalaya, proper surveys or sightings are very rare. It is reported from South Garo Hills and Nokrek National Park region (Chetri *et al. unpublished* and IUSPP report, in Molur *et al.* 2003). In recent years to sighting records exist from areas close to Balpakram National Park in South Garo Hills (Kakati & Srikant 2016) and near Nokrek National Park region where local people also indicate presence. However, their status in Meghalaya is totally unknown. The eastern sub-species of Assamese macaque *(Macaca assamensis)* is also reported from Meghalaya, particularly from Garo Hills, Balpakram NP, Siju WLS and Songsek RF. Its population is reported to be declining (Momin 2002 in Molur *et al.* 2003). In areas around South Garo Hills they have also been observed to raid crops.

Carnivores

In Meghalaya records of two large cats are relatively frequent, particularly the leopard *(Panthera pardus)* and state animal, clouded leopard *(Neofelis nebulosa)*. Research work on their behavior, ecology is limited and status in the state is unknown.

The state has reports of three bear species. The Asiatic black bear*(Selenarctos thibetanus)* is widely distributed in the state (Sathyakumar & Choudhury 2007). The Malayan sun bear *(Helarctos malayanus)* is very rare and occurs at low densities. It is mainly reported from specimens collected from East Garo Hills, West Garo Hills and Balpakram NP (Blanford 1888-89, Sclater 1891). Information based on interviews with hunters indicate its presence in Baghmara, Tronggpeng near Cherrapunjee, Mawsynram, forest of West Khasi Hills, Narpuh and Saipung RF in Jaintia Hills (Choudhury 2011). The presence of this species is reported from Tura Wildlife Division of East and West Garo Hills (Choudhury *et al.* 2012). Sloth bear *(Melursus ursinus)* is known from a single specimen in the state, and have never been sighted or reported in the state. No information is available on population of the three species in Meghalaya. Poaching for meat and bear parts along with habitat destruction are the major threats to these species (Choudhury, *et al.* 2012, Sathyakumar *et al.* 2012).Binturong *(Arctictis binturong)* has also been reported from the state. It is a vulnerable species and faces similar threats as the red panda such as habitat degradation and fragmentation. Both species are in need of conservation of their habitat and connectivity. Presence of the endangered red panda (*Aliurus fulgens*) is disputed (Choudhury 1997 & 2001). The endangered dholes or Indian wild dogs *(Cuon alpinus)* though widely distributed throughout Asia and South-East Asia, face direct threat from loss of prey base and retaliatory killing (Lyngdoh *et al.* 2014).

Table 3.1 Ungulates & Insectivorous species from Meghalaya

S.No.	Species	Common name	IUCN Status
1	*Capricornis thar*	Himalayan serow	Near Threatened
2	*Rusa unicolor*	Sambar	Vulnerable
3	*Muntiacus muntjak*	Barking deer	Least Concern
4	*Sus scrofa*	Wild pig	Least Concern
5	*Manis pentadactyla*	Chinese Pangolin	Critically Endangered
6	*Manis crassicaudata*	Indian Pangolin	Endangered

fig. 3.2 (a) Hoolock gibbon in Community Forests of Garo Hills

fig. 3.2 (b) Slow loris at Balpakram NP

fig. 3.2 (c) Capped langurat Balpakram NP

fig. 3.2 (d) Pig - tailed macaque at Nokrek NP

Table 3.2 Some Carnivore Species Reported form Meghalaya

Sl.No.	Species	Common name	IUCN Status
1	*Canis aureus*	Asiatic golden jackal	Least Concern
2	*Vulpes bengalensis*	Bengal fox	Least Concern
3	*Martes flavigula flavigula*	Yellow throated martin	Least Concern
4	*Mustela kathiah*	Yellowbellied weasel	Least Concern
5	*Melogale personata nipalensis*	Burmese ferret badger	Least Concern
6	*Arctonyxcollaris*	Hogbadger	Vulnerable
7	*Lutra lutra monticola*	Common otter	Near Threatened
8	*Lutra perspicillata perspicillata*	Smoothcoated Indianotter	Vulnerable
9	*Aonyxcinereusconcolor*	Oriental smallclawed otter	Vulnerable
10	*Viverra zibetha zibetha*	Large Indian civet	Least Concern
11	*Viverricula indica*	Small Indian civet	Least Concern
12	*Paradoxurus hermaphrodites*	Common palm civet	LeastConcern
13	*Paguma larvata neglecta*	Masked palm civet	Least Concern
14	*Herpestes auropunctatus*	Small Indian mongoose	Least Concern
15	*Herpestes edwardsi*	Indian grey mongoose	Least Concern
16	*Herpestes urva*	Crab eating mongoose	Least Concern

(*Source:* Johnsingh and Jhala 2008, Gogoi 1981, IUCN 2017)

Johnsingh (1985) recorded dhole in Meghalaya and other North Eastern states. Pack of dholes in recent years have been reported from Nokrek, Balpakram and there vicinity (Samrakshan Trust, 2005).

Ungulates

Even though the state has an undulating topography and fragmented forested habitats, it harbours a large population of the elephant i.e. 1811 reported in 2007. Many of these elephant sub populations travel from Assam and Bangladesh to parts of Meghalaya, following traditional routes which are now blocked due to linear infrastructures, building and cities. Williams and Johnsingh (1996), identified some traditional routes of elephants in the region. Tiwari *et al.* (2010) identified five corridors in this region for passage of elephants along their traditional or possible routes.

Other important ungulates from Meghalaya include the endangered Asiatic wild water buffalo *(Bubalus arnee)*. Reference to the species are recorded from Rewak in South Garo Hills (Munrowd 1945), and populations were thriving in Rewak, Balpakram, and neighbouring regions of Baghmara, Siju in South Garo Hills and West Khasi Hills. It is still found in Balpakram and adjacent areas of Khasi Hills (Choudhury 1994 & 2010) with populations that are quite small with groups of about 10-20 individuals.

The Indian Gaur *(Bos gaurus)* has a very fragmented distribution and populations across India. In Meghalaya, the three vital populations of gaur are reported *viz.*, Kamrup-Ri-Bhoi-West Khasi hills, Garo-West Khasi hills and Jaintia Hills- Barail regions. In Meghalaya, gaur is mainly found in South Garo Hills and West Khasi Hills districts, and small numbers in Nongkhyllem WLS in Ri-Bhoi district. Few individuals have also been spotted in various other forested areas of the state (Choudhury 2002).

3.3.2 Aves

Meghalaya is rich in avifauna with about 659 species. Of these 34 species are globally threatened species. Many threatened, near threatened and restricted ranged species are also reported from the region (Endemic Bird Area 130, Statterfield *et al.* 1998). Five restricted range species from this EBA have been reported from the state (Table3.3). The green peafowl (*Pavo muticus*) once abundant in the state has been recently extirpated (McGowan *et al.* 1998, Choudhury 2009b). Birdlife International has identified nine IBAs in the state. The management of these areas are important for protection and

Dark rumped swift

James Eaton

Table 3.3.3 Endemic Birds of Eastern Himalayas (Stattersfield et al. 1998)

Endemism	Common Name	Scientific Name
Endemic Bird Area 130-Eastern Himalayas	Grey sibia	*Heterophasia gracilis*
	Dark-rumped swift	*Apus acuticauda*
	Tawny-breasted wren babbler	*Spelaeornis longicaudatus*
	White-naped yuhina	*Yuhina bakeri*
	Black-browed leaf- warbler	*Phylloscopus cantator*

long term viability of naturally occurring bird population in the geographic distribution of the species (Islam & Rehmani 2004). Birdlife International has identified sites known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome. These species forming part of the assemblage are referred to as Biome-restricted species. Birdlife International reports presence of Tawny-breasted Wren babbler (*Spelaeornis longicaudatus)*, the Khasi Hills Swift or Dark rumped swift *(Apus acuticauda)*, Globally Vulnerable and range restricted birds found in the hills of Meghalaya *(Khasi Hills)* and Manipur or Mizoram respectively.

3.3.3 Reptiles

Snakes

Major F. Wall (1908) was the first herpetologist to exclusively look at the diversity of snake species in Khasi Hills. He reported 29 species of snakes from this area. The ZSI (Ghosh *et al.* 1984) updated the records for the state with 36 snakes. Followed by Mathew (1995) who updated the list further to a total of 56 species. At present, a total of 65 species of snakes mainly belonging to family Typhlopidae, Pythonidae, Colubridae, Elepidae and Viperidae are so far known from the state (Appendix 21). The state shows two distinct assemblages *viz.,* mid elevation dwelling assemblages having species such as *Amphiesma khasiensis, Liopeltis frenatus, Orthriophis hodgsonii, Rhadinophis frenatus, Sibynophis collaris, Sinomicrurus macclellandi, Typhlops jerdonii* and *Ovophis monticola*. Among the lower elevation dwelling assemblages are species such as *Amphiesma xenura, Boiga quincunciata, Pareas monticola, Ptyas korros,Psammodynastes pulverulentus,Rhabdophis subminiatus,Bungarus fasciatus, Bungarus niger* and *Naja kaouthia.* Khasi – Garo and Jaintia hill so far is known to harbour highest Ophidian diversity among northeast India. Species such as *Typhlops tenuicollis, Amphiesma modesta, Calamaria pavimentata, Oligodon catenatus, Oligodon theobaldi, Orthriophis hodgsonii, Stoliczkia khasiensis* are only known from this region so far. The fauna of the region shows significant overlap with Lushai Hills followed by Upper Assam. Recently a new genus and species has been discovered from meghalaya named as Smithophis by giri *et al* (2019)

Ovophis monticola

Lizards

A total of 29 species of Lizards are so far reported from Meghalaya (Appendix 21). All the three species of monitor lizard are found in the state viz.,*Varanus bengalensis*, *Varanus flavscens* and *Varanus salvator* (Mathew 1995) and they are protected under Schedule I of the Wildlife (Protection) Act, 1972. The Tokay Gecko *(Gekko gecko)* is widespread across the lower elevation of the state. The family agamidae is represented by *Calotes maria, C.emma, C. versicolor, Japalura planidorsata* and monotypic *Oriocalotes paulus.* Among *Gekkonidae, Cnemaspis assmensis, Cytodactylus khasiensis, Hemidactylus platyrus, Hemidactylus brooki, H. frenatus, H.garnoti* and *Gekko gecko* are frequently encountered near human habitations as well as in forested areas. The family Scincidae is represented by five species of which *Sphenomorphus alpepalberus* was discovered recently from one of the sacred groves of the state. *Calotes maria* the Khasi Hills forest lizard, is endemic to Khasi Hills in Meghalaya and Mizoram. The small forest lizard *Oriocalotes paulus* is a species of agamid lizard, endemic to eastern Himalayas, Khasi Hills, Sikkim and China (Smith 1935).*Japalura planidorsatais* endemic to Myanmar, Khasi Hills and Garo Hills in Meghalaya, Cachar, Northern Chin Hills, and Mizoram. *Sphenomorphus courcyanum* (Annandale, 1912) is also endemic to India (Assam, Meghalaya, Mizoram), China (South Xizang i.e Tibet). *Varanus flavescensis* endemic to Indian subcontinent, it is found in flood plains of the Indus, Ganges and Brahmaputra rivers in Indian subcontinent. *Amphiesma xenura* Cherrapuji Keelback, *Stoliczkaia khasiensis*, Khasi earth snake is endemic to Khasi and Garo Hills. The King cobra, *Ophiophagus Hannah* is a vulnerable species distributed in South and South East Asia (Mathew 1995).

Tokay gecko *(Gekko gecko)*, is one of the most poached species for Chinese medicines, Emma Gray's forest lizard *(Calotes emma)* also faces threats due to live animal extraction for pet trade. Other lizard species of the state also faces threats due to habitat destruction, poaching and pet trade.

Table 3.4 Threat Status of Birds in Meghalaya

Status	Common name	Scientific name
Critically Endangered	Oriental white-backed vulture	*Gyps bengalensis*
	Slender-billed vulture	*Gyps tenuirostris*
Endangered	White-winged duck	*Cairina scutulata*
Vulnerable	Greater spotted eagle	*Aquila clanga*
	Wood snipe	*Gallinago nemoricola*
	Dark-rumped swift	*Apus acuticauda*
	Rufous-necked hornbill	*Aceros nipalensis*
	Tawny-breasted wren-babbler	*Spelaeornis longicaudatus*
Near Threatened	Darter	*Anhinga melanogaster*
	Lesser grey-headed fish-eagle	*Ichthyophaga humilis*
	Red-headed vulture	*Sarcogyps calvus*
	White-cheeked hill-partridge	*Arborophila atrogularis*
	Blyth's kingfisher	*Alcedo hercules*
	Great pied hornbill	*Buceros bicornis*
	Brown hornbill	*Anorrhinus tickelli*

White winged Wood Duck
Dick Daniels

Table 3.5 Important Birds Areas of Meghalaya

SNo.	IBA Sites Name	IBA Criteria
IN-ML-01	Balpakram complex	A1, A2, A4i
IN-ML-02	Mawphlang Sacred Grove	A1, A2
IN-ML-03	Nokrek National Park	A1, A2, A3
IN-ML-04	Nongkhyllem Wildlife Sanctuary	A1
IN-ML-05	Narpuh Reserve Forests	A1, A2
IN-ML-06	Riat Khwan Umiam	A1, A2
IN-ML-07	Saipung	Data deficient
IN-ML-08	Upper Shillong	A1, A2
IN-ML-09	Cherrapunjii	A1, A2

IBA Criteria: A1-Threatened species; A2- Endemic Birds Areas (130: Eastern Himalayas); A3- Biome 8: Sino-Himalaya Subtropical Forests, Biome 9: Indo-Chinese Tropical Moist Forests; A4i- > or equal 1% bio-geographic Population

fig. 3.3 Wildlife from Balpakram NP, Meghalaya

Barking Deer

Hog Badger

Porcupine

Wild Pig

Indian Hare

Sambar Deer

Kashmira Kakati & Shikha Srikant

Turtles and tortoises

A total of 13 species of turtle and tortoises, belonging to 10 genus are reported from Meghalaya (Mathew 1995, Ahmed & Das 2010), these belong to mainly Bataguridae, Testudinidae or Trionychidae families. Most of these are either data deficient or threatened or vulnerable species, with narrow range of distribution restricted to South Asia or South and South East Asia. *Manouria emys,* the Asian forest tortoise, *Indotestudo elongata,* elongated tortoise, *Batagur dhongoka,* the three striped roof turtle are the endangered species of turtles or tortoises reported from Meghalaya. *Hardella thurjii,* Crowned river turtle and *Geoclemys hamiltonii*, the black spotted turtle, *Pangshura tecta*, The Indian roofed turtle, *Melanochelys tricarinata,* Three-keeled Tortoise and *Nilssonia hurum*, Peacock-marked soft shelled turtle are vulnerable species of turtle distributed in Meghalaya, and other parts of India, Bangladesh, Nepal and Pakistan. *Cyclemys gemeli,* Brown stream terrapin, *Melanochelys trijuga,* Indian Black Turtle are near threatend species distributed across South Asia and South East Asia. *Cuora mouhotii,* the keeled box turtle distributed in China, India, Laos, Burma, Vietnam, and probably also exists in Bangladesh (Das 1990, Ahmed & Das 2010).

Most of the turtle and tortoises species face direct threats from habitat loss and exploitation for meat. Pollution and destruction of water bodies including rivers is also a major threat to the species. Illegal felling, Jhum cultivation, over- fishing are the major reasons for habitat loss in North Eastern India. The large bodied turtles face more threat from collection for meat and in this also soft shelled turtles are the most frequently exploited ones. *Nilssonia hurum, L. punctata* (Das & Gupta 2004) are the most commonly exploited species in plains and *Manouria emys* in the Hills (Bhupathy *et al.* 1992). Loss of habitat connectivity and over fishing are other major threats to the species (Ahmed & Das 2010).

3.3.4 Amphibians

A total of 55 species of amphibians belonging to 32 genera are so far known from Meghalaya state (Appendix 20). The class amphibian is represented by all the three extant orders namely Caudata, Anuran and Apoda. These belong to primarily Chikilidae, Ichthyophiidae, Megophryidae, Bufonidae, Hylidae, Microhylidae, Ranidae, Dicroglossidae, and Rhacophoridae. There Himalayan Crocodile Salamander *Tylototriton verrucosus* was reported only once from Shillong (Das 1984). This species number is significantly more than earlier records. Das *et al.* (1995) reported only 33 species belonging to 11 genera from Meghalaya. Some of the earliest known species from the state are *Clinotarsus altocola* (Boulenger 1882), *Limnonectes khasianus* (Anderson1871), *Philautus garo* (Boulenger 1919) and *Rhacophorus bipunctatus* (Ahl 1927).

Nearly 30% of the amphibian fauna of Meghalaya are endemic to the state. This is highest for any Northeast Indian state. The genus Ichthyophis (Striped Caecilian) showed maximum enedemicity with four species. The African relict family Chikilidae also has two species as endemic to the state. The unique Rock toad of the genus Bufoides contain two species*, Bufoides meghalayanus* and *Bufoides kempii* and are regarded as threatened as they are restricted to the rocky plateau of the state.

The amphibian fauna of the state needs further exploration to determine hitherto the unrecorded cryptic diversity. This is evident from the fact that 12 species of amphibians are described in last ten years. A new megophryid frog of the *Leptolalax khasiorum* was described from the sacred groves of Mawphlang, East Khasi Hills, north-eastern India recently (Das *et al.* 2010). Mathew and Sen (2009) reported a new species of *Leptobrachium nokrekensis* (synonym *Leptolalax khasiorum)*, (Amphibia: Anura: Megophryidae) from Didarikchibama, Nokrek Biosphere Reserve, East Garo Hills district.

Purkayastha and Matsui (2012) discovered *Fejerverya sengupti* from Mawphlang Sacred groves of Khasi Hills. Mathew and Sen (2009b) reported 3 new species of Caecilian from Nokrek region of Garo Hills *(Ichthyophis alfredii, I. daribokensis* and *I. nokrensis).* Kamei *et al.* (2012) discovered a new family of limbless amphibians called chikilidae from the state and other parts of NE India, which has ancient links to Africa. Indicating high diversity of Amphibians in Meghalaya, with large number of species still being discovered. Unique reproductive mode of tree hole breeding and oophagy was reported in *Nasutixalus jerdoni* species from Meghalaya.

Box 3.2 Herpetofauna of Meghalaya

The herpetofauna of the state is very diverse and it attracted number of taxonomists and explorer to state. Thomas Claverhill Jerdon (1811-1872), a member of Asiatic Society was one of the first explorer who made observations on herpetofauna of Khasi Hills. Jerdon's work included two papers that dealt with his collection from India and a paper published in 1870, where he described several new species of amphibians and reptiles including enigmatic African relative of tree frog *Hyla annectans* from Khasi hills. Most of his collections were deposited in British museum, London as he was planning a major contribution with Albert Gunther. But Jerdon's untimely death during one of his expeditions led Gunther and subsequently Boulenger of British museum to describe many new species collected by Jerdon. Large ground dwelling pit viper *(Protobothrops jerdonii)* was named after him by Gunther in the year 1875.

3.3.5 Pisces

The two main river systems of Meghalaya are the Brahmaputra in the north and Barak River in the south and a large number of smaller rivers forming tributaries etc. to these river systems. 152 species belonging to 74 genera all across Meghalaya have been reported (Das *et al*.1995). A recent survey of seven districts of Meghalaya by Ramanujam *et al.* (2010) reveals fishes belonging to Cyprinidae family were most dominant in number of species, followed by Sisoridae, Cobitidae, Bagridae and Channidae. The authors also report that the maximum fish diversity was at low altitude of 0-100 m asl.

Caves of Meghalaya are still an unexplored system. Kottelat *et al.* (2007) described a new species of loach *Schistura papulifera* from a cave of the Synrang Pamiang. A species closely related to *Schistura sijuensis* (Menon 1987: *Noemacheilus sijuensis)* is also recorded from caves of Siju area in Garo Hills.

The conservation status of fishes from Meghalaya has not been assessed properly. However, based on the data available for North Eastern region (Goswami *et al.* 2012), nearly 27 % of the species are either Endangered or Threatened, 23 % species are Vulnerable, and rest of the species were either Least Concern or Data Deficient. Five critically endangered species are reported form the region including nemacheiline loach *(Schistura papulifera*) endemic to Krem Synrang Pamiang caves in Jaintia Hills. *Neolissochilus hexagonolepis* and *Tor spp.* are the important sport fishes inhabiting the fast flowing rivers and streams of the state. A total of 29 species of the fishes found in the state are threatened due to various anthropogenic activities.

3.3.6 Invertebrates

The invertebrate diversity of Meghalaya is represented by 4,580 species belonging to 2094 genera. The Fauna of Meghalaya series by ZSI (1995-2000) gives an exhaustive list of invertebrates including 223 species of mollusks belonging to 67 genera and 28 families. Tandon and Das (2005) have reported four new species of the genus *Lytocestus* (Caryophyllidea, Lytocestidae) from catfishes of the state. Sharma and Sharma (2011) reports 70 species of rotifers from Nokrek Biosphere Reserve, of which eight species namely *Brachionus mirabilis, Tripleuchlanis plicata, Lecane arcula, L. blachei, Sinantherina socialis, S. spinosa, Philodina citrina* and *Rotaria macroceros* are new records from the state of Meghalaya. Every year, new species of insects are discovered from Meghalaya. For example, in 2014 alone, five species of insects viz.,*Micraspis pusillus, Alaptus jowainus, Paraleptomenes darugiriensis, Gonatocerus jaintiacus, Berta apopemta* were recorded (ZSI, 2014).

A total of 298 species of butterflies have been reported from Garo Hills, eight of which are listed under Schedule I and 33 under Schedule II of Wildlife (Protection) Act, 1972 (Kunte *et al.* 2012, Sondhi *et al*. 2013). This is rather a conservative count based on the short surveys and it is felt that systematic surveys could yield more records and entire state is likely to have over 500 species of butterflies.

3.4 Agricultural crops and Livestock Diversity

Meghalaya is considered a part of Vavilov's center of origin of crop plants due to its high diversity of plants which are of economic importance to mankind (Vavilov 1949, Sauer 1952, Harris 1990 & 2007). The origin of the Asian rice *(Oryza sativa)*, is believed to have happened in foothills of North Eastern India or South- East Asian region. Some pockets of Meghalaya still cultivate varieties of rice which are around 6000 years old. The state has ten varieties of indigenous paddy which are cultivated by local communities in Garo and Khasi hills (Banerjee 2013). North East Centre for Rural Livelihood Research (NECR) lists 62 varieties of rice from Assam and Meghalaya.

The North Eastern region of India including Meghalaya is also considered as the center of the origin of *Citrus* spp., including *C. indica* (Bhattacharya & Dutta 1956, Singh 1981 & Sharma *et al.* 2004). *C. indica* is considered as the most primitive species and perhaps the progenitor of cultivated Citrus. A total of 17 Citrus species, their 52 cultivars and a few probable natural hybrids are reported from this region (Singh 1981).

The state exhibits a high genetic diversity among wild banana, viz., *Musa acuminata* and *M. balbisiana*. *M. flaviflora* is localized to Manipur and Meghalaya. Varieties of Khasi Hills are still not accessed and need systematic collection and conservation. Some native varieties of mango, *Mangifera indica* and *M. khasiana* are reported from the state.

The state like other parts of northeastern India is endowed with a rich diversity of wild fruits, berries and trees such as *Pyrus, Rubus, Ribes* and *Prunus*. The Shillong plateau in Meghalaya has many Prunus species such as *P. napalensis, P. undulata* and *P. cerasoides*. *Pyrus pyrifolia* var. cubha makai *(P. serotina Red)* is grown semi commercially in Meghalaya. In addition a large number of other tropical and subtropical fruits belonging to the genera *Garcinia, Artocarpus, Phyllanthus, Annona, Averrhoa, Persia, Aegle, Passiflora, etc.*, are found growing wild in the region. One of the indigenous fruits that requires attention is jackfruit,

Box 3.3 Chirstmas Bush frog- The Little Endemic Frog of Shillong, Meghalaya

a) A calling male

b) a mating pair

Bitupan Borah and Abhijit Das

The christmas Bush frog or Shillong Bush frog *(Raorchestes shillongensis)* is one of the critically endangered and endemic frogs of Meghalaya. It is a tiny frog ranging in size between 14 to 21 mm with an "X" shaped mark on its back. Information regarding ecology and biology of this species is very limited. Based on a recent survey of this species conducted by WII it was revealed that it lives in the dense bushes around backyards and forest edges of Shillong plateau. The species is found between 1000 to 1900 m asl, primarily in and around few protected areas viz., Mawlai Reserved Forest, Laitkor Reserved Forest, Upper Shillong Reserved Forest, community conserved forests such as Mawphlang sacred groves, forested tracts of Cherrapunjee, Elephant falls, and Sweet falls, which are highly disturbed. The species breeds during ends of May to July and the females lay 8-17 eggs on moist soil under leaf litter. As in other bush frogs, eggs of this species undergo direct metamorphosis avoiding the free swimming tadpole stage and froglets hatch after one month. Breeding biology of the species is similar to that of Sri Lankan Bush frog, *Pseudophilautus regius* the habitat of the Malki forest and adjacent areas are rapidly degrading due to anthropogenic activities such as heavy collection of fuel wood, forest fires, and accumulation of non-biodegradable garbage. Cleaning of forests, bushes around forests and human habitation, and use of chemical fertilizers and pesticides in the surroundings of Malki and Upper Shillong forest are the major threats to bush frog and other herpetofauna in the state.

which grows abundantly in Meghalaya with a large number of cultivars.

The indigenous breeds of cattle in the state is reported to be declining and during 1997-2003 there was an increase in crossbred cattle by 35.3% compared to an increase of 0.8 % in indigenous cattle (Khan *et al*. 2012).

The indigenous cattle species or varieties need to be documented and promoted by do are neither properly recorded nor promoted by the state departments. There are 18,000 buffaloes in the state, most of them being the swamp variety. Three genetic groups of goats are recognized in the state, viz., Assam hill goat, Sikkim local and Black Bengal goat besides the non-descript goats. Pig is one of the most important livestock in the state with estimated population of 4.19 lacs, which are mostly non-descript local, crossbred and exotic breeds (Khan *et al.* 2012). *Niang megha* is an indigenous breed or pig from Meghalaya reared for pork and bristle purpose .

Animal Husbandry and Veterinary department has established Four Cattle breeding farms viz., Indo-Danish Project, Upper Shillong, (East Khasi Hills); Regional Cross Bred Cattle Breeding Farm, Kyrdemkulai (Ri Bhoi district); Cattle Farm, Khliehtyrshi, (Jaintia Hills district) and Livestock Farm, Rongkhon (West Garo Hills) have been established to produce improved breeding stock for development of cattle in the state. The main emphasis is to develop cross breeds which is favorable to the farmers.

The local varieties of poultry ducks in Meghalaya include *Miri, Davo Thigir* and *Brahma*, which are reared for their specific characteristics. Miri is an efficient egg producing breed. Brahma and Davo Thigir are reared for meat. Some duck varieties, *viz.*, *Pati* and *Nageswari* found in Meghalaya are of non-descript and dual purpose type (Khan *et al*. 2012). The region possesses some of the rare and uncommon ornamental fish having a tremendous potential for exporting. Some of the potential ornamental fish are *Brachydanio merio, Danio dangila, Esomus danricus, Batia dario*. However, due to the destruction of habitat and fishing methods, many of the indigenous fish fauna are under serious threats (Khan *et al.* 2012).

fig. 3.4 Herpetofauna of Meghalaya State

Common slug snake (Pareas monticolous)

Khasi Hills bent-toed Gecko (Cyrtodactylus khasiensis)

Large-eyed bamboo snake (Pseudozenodon macropus)

Green fan-throated lizard (Ptyctolaemus gularis)

Xenophrys major

Twin-spotted flying frog (Rhacophorus bipunctatus)

Bitupan Borah

3.5 Protected Area Coverage

Protected Areas in Meghalaya have been established by acquiring land from the local communities. Thus these PAs are surrounded mainly by community lands or some private forests. They include National Parks, Wildlife Sanctuaries, Reserved Forests and Conservation Reserves. These PAs constitute only 6% of geographical area of the state and yet they provide best protection to the biodiversity of the state as no other activities are allowed inside these PAs, except NTFP extractions according to the rights of the communities. In comparison the larger area of forest in community lands faces much greater threat from land use conversions, extractions, construction etc. Most of the community forests lack any legal protection, and thus PAs are the best refuge for the flora and fauna of the state.

3.5.1 National Park and Sanctuaries

3.5.1.1 Nokrek National Park, established in 1986, is located at the junction of East Garo Hills, West Garo Hills and South Garo Hills. It is spread across East and West Garo Hills districts. It follows the mountainous ridges of Nokrek and Tura extending towards South Garo Hills. Though this park covers an area of 47.48 km^2, most places in the NP are less than 5 km in width. The park plays a significant role in conservation of regional biodiversity typical of the Garo Hills hence, the area surrounding the National Park has been declared as the Nokrek Biodiversity Reserve (UNESCO1988). The forest habitat mainly consist of Tropical Evergreen, Moist Deciduous, Tropical Semi-evergreen, Sub tropical Evergreen forests and Riverine forests (Prabhu *et al.* 2010).

Table 3.6 Protected Areas of Meghalaya

S.No	National Parks	Area (km^2)
1	Balpakram National Park- South Garo Hills	352.00
2	Nokrek National Park- East Garo Hills	47.48
	Total	**399.48**
	Sanctuaries	
1	Nongkhyllem Wildlife Sanctuary - Ri-Bhoi (North Khasi Hills) District	29.00
2	Siju Wildlife Sanctuary-South Garo Hills	5.18
3	Baghmara Pitcher Plant Sanctuary - South Garo Hills	0.02
4	Narpuh Wildlife Sanctuary - East Jaintia Hills	59.9
	Total	**94.10**
	Elephant Reserves	
1	Garo Hills Elephant Reserve	3,500 (Total)
2	Khasi Hills Elephant Reserve	1,331 (Total)
	Total	**4831**

(Source:Meghalaya Forest Department)

The fauna of the NP include many threatened and endangered species of mammals, including Asian elephant. Various studies have indicated the effect of fragmentation of habitats due to *jhum* cultivation (Kumar and Marcot 2010, 2008, Marcot *et al*. 2002, 2011) and its effect on the landscape. Several corridors have thus been proposed to link the habitat of Asian elephant connecting Nokrek NP to Balpakram, other Reserved Forests and along their traditional migratory route to Assam (Tiwari *et al.* 2010). Eight species of cats including, leopard cat (*Prionailurus bengalensis*), golden cat *(Catopuma temminckii),* clouded leopard *(Neofelis nebulosi)*, marbled cat (*Pardofelis marmorata*), Fishing cat *(Prionailurus viverrinus),* jungle cat (*Felis chaus)* and leopard *(Panthera pardus)*, have been reported from the park (Choudhury 2003 b). However, in recent years there have been no sightings of tiger inside the park. The local communities in Nokrek Biosphere Reserve have also not reported any signs of tiger. The main canids are golden jackal *(Canis aureus)* and wild dog *(Cuon alpinus).* The NP also has records of Asiatic black bear *(Ursus thibetanus)* and sun bear *(Helarctos malayanus).* A single record of sloth bear *(Melursus ursinus)* also exists from the region, (Das *et al*. 1995, Choudhury 2011, Choudhury *et al.* 2012). Large Indian civet *(Viverra zibetha)*, Small Indian civet *(Viverricula indica)*, and Himalayan palm civet *(Paguma larvata)* are the small predators. Wild pig *(Sus scrofa)*, Sambar *(Rusa unicolor),* barking deer *(Muntiacus muntjak),* serow *(Nemorhaedus sumatraensis)* and Gaur *(Bos gaurus)* are the major ungulates (Gogoi 1981, Choudhury 2002).Other important species reported from Nokrek NP include Red Panda *(Ailurus fulgens)* and Binturong *(Arctictis binturong)*, slow loris *(Nycticebus bengalensis)*, pig-tailed macaque *(Macaca leonina)*, stump-tailed macaque *(Macaca arctoides)*, rhesus macaque *(Macaca mulatta),* capped langur *(Trachypithecus pileatus)* and western hoolock gibbon *(Hoolock hoolock*).

Nokrek NP has been listed among Important Bird Areas (IBAs IN-ML-03) with globally threatened, restricted range and Biome-restricted species (A1, A2 and A3). About 150 bird species have been recorded from this park (Lahkar *et al.* 2002a) including one restricted ranged species Grey sibia *(Heterophaisa gracilis)*and 36 Biome species (Biome-9 - Indo-Chinese Tropical Moist Forest, below 1,000 m and Biome-8 - Sino-Himalayan Subtropical Forests(Birdlife International). Other important species of the birds are Rufous-necked Hornbill *(Aceros nipalensis)*, Oriental White-backed *(Gyps bengalensis)* and Slender-billed vulture *(G. tenuirostris).* Lahkar *et al.* (2006) reported interesting records of hitherto unreported species from Meghalaya i.e. Black Stork *(Ciconia nigra)* and Ashy Minivet *(Pericrocotus divaricatus)* from Nokrek NP.

3.4.1.2 Balpakram National Park, covering an area of 220 km^2 is situated in South Garo Hills. This park was provisionally notified in 1985, and declared fully functional National Park on January 31st 1986. Balpakram lies in the high biodiversity region of Indo-Burma biodiversity hotspot. The literal meaning of Balpakram is the *'land of perpetual winds'*. It occupies a distinct place in

Fig. 3.5 Settled Paddy Cultivation in Garo Hills, Meghalaya

the lore, legends and beliefs of the Garos. The local inhabitants believe this hill to be the resting place for the departed souls. This belief is due to many strange yet natural formations, physical and biological, found in the area. (Haridasan & Rao 1985 & 1987). Nearly 700 species of orchids are presumed to be present here (Kakati 1986). The pitcher plant *Nepenthes khasiana* (endangered IUCN 2013) and rare Lady's slipper orchids are some noteworthy species, which are in need of immediate conservation measures (Singh *et al.* 2011, Jalal *et al.* 2009). Many species of epiphytes are also found in this region.

A total of 85 species of mammals are recorded from the NP (Das *et. al.*, 1995), 23 species of amphibians, 33 species of reptiles and 199 species of avifauna revealing its richness (Pawar & Birand 2001). It is home to endangered (IUCN) Asian elephant *(Elephas maximus)*, Hoolock gibbon *(Hoolock hoolock)*, Gaur *(Bos gaurus) (Choudhury 2002)* serow *(Capricornis sumatraensis)*, goral (*Nemorhaedus goral)*, endangered and lesser cats such as the clouded leopard *(Neofelis nebulosa).* Balpakram has a remnant population of the endangered wild water buffalo *Bubalus arnee* and the lowland population of the red panda *(Ailurus fulgens)* (Choudhury 2001 & Choudhury 2010). The NP also has records of Asiatic black bear *Ursus thibetanus* and sun bear *Helarctos malayanus.* Record of sloth bear *(Melursus ursinus)* also exists from the region. Hunters are familiar with the species and indicate presence in Balpakram NP (Choudhury 2011, Choudhury *et al.* 2012). A recent camera trap study (Kakati & Srikant 2015) reported 49 mammal species from Balpakram-Baghmara landscape. Kakati and Srikant (2014) recorded the first photo evidence of small-toothed palm civet *(Arctogalida trivirgata)* from India during the camera trap study and record for ferret badger (Kakati *et al.* 2014).

The bird life of the NP include a rich variety of rare and endangered species including the Oriental pied hornbills *(Anthracoceros albirostris)* and great pied Hornbills *(Buceros bicornis)* to Whitecheeked Hill-partridge *(Arborophila atrogularis)*, peacock pheasant *(Polyplectron bicalcaratum)* and Kaleej pheasant *(Lophura leucomelanos)* and the restricted range species, grey sibia *(Heterophasia gracillis)*. Reports of large tree-perching ducks from hunters also indicate historic presence of white-winged wood duck *(Asarcornis scutulata)*, which survived till 1990s (Choudhury 1996, 2002b). The critically endangered slender-billed vultures *(Gyps tenuirostris)* and white-rumped vulture *(Gyps bengalensis)* were also common in 1990s. Red backed sea eagle kites *(Haliastur indus)* are seen in large number in the wetlands of the NP (Choudhury 2009a). Other birds of prey recorded from time to time are: black baza *(Aviceda leuphotes)*, crested goshawk *(Accipiter trivirgatus*), black eagle *(Ictinaetus malayensis),* common buzzard *(Buteo buteo)*, oriental honey buzzard *(Pernis ptilorhyncus)*, pied falconet *(Microhierax melanoleucos)*, and Amur falcon *(Falco amurensis)* during passage (Islam & Rahmani 2005).

fig. 3.6 Camera Trap Photos from Balpakram National Park

Leopard cat

Clouded leopard

Leopard

Marbled cat

Small Indian civet

Jungle cat

fig. 3.7 Nepenthes khasiana: The Only Pitcher Plant of India

3.5.1.3 ***Siju Wildlife Sanctuary*** is a small sanctuary of 5.2 km^2, which was established in 1979. It is situated in South Garo Hills along the bank of Simsang river and is also dotted with some well-known limestone caves of Meghalaya. Siju WLS shares flora and fauna with Balpakram National Park and forms an important bird diversity complex with Balpakram NP (IBA, IN-ML-01). It ranges in altitude between 90 to 200 m above mean sea level. A total of 257 species of angiosperms comprising 213 genera and 83 families have been reported from the WLS (Roy *et al*. 2014). Dicotyledons dominate the flora with 67 families, 158 genera and 189 species and monocotyledons comprise 16 families, 55 genera and 68 species. Of these 12 species are rare for the state of Meghalaya and listed under CITES (Roy *et al.* 2014).

3.5.1.4 ***Baghmara Pitcher Plant Sanctuary*** was established in 1984 and is located in South Garo Hills in close vicinity to Balpakram National Park and Siju WLS. It covers a small area of 0.02 km^2, and is one of the few PA set aside to protect a single species of plant, the endemic insectivorous pitcher plant.

3.5.1.5 ***Nongkhyllem Wildlife Sanctuary*** was established in 1981, this sanctuary is spread across 29 km^2 area of Ri-Bhoi (North Khasi Hills) District of Meghalaya. It is also an Important Bird Area in north eastern India (IBA- IN-ML-04, A1). Nongkhyllem WLS along with Nongkhyllem Reserve Forest (9,691 ha) and adjoining community forests forms an important biodiversity area in Meghalaya. The topography of the area is undulating with altitude ranging from 200 msl to 950 msl, and include the Archean Plateau. The rivers in the north and west, the Umtrew, Umran and Umtasor etc. cut across the plateau forming deep gorges. The sanctuary also has a natural lake called Birbah in southern part covering nearly 20 ha, and few artificial lakes and reservoirs. The forest in the conservation area mainly consist of Tropical Semi-evergreen forests along the rivers and streams and deciduous sal forests in southern areas. The old jhum areas surrounding the sanctuary mainly consist of recovering grasses and bamboos such as *Oxytenanthera nigrociliata* and *Dendrocalamus hamiltonii.* The Forest Department has planted Sal *(Shorea robusta)* and Teak *(Tectona grandis)*. Along the stream banks wet grasslands are dominated by *Alpinia allughas, Arundo donax* and *Neyraudia reynaudina* (Choudhury 1998).

The wildlife sanctuary and surrounding are rich in avifauna having over 400 species reported so far. Some of the important bird species reported form this area include the swamp francolin *(Francolinus gularis)*,in the wet grasslands of Nongpoh Valley, and the valleys of the Umran Rivers. Other prominent species include the Near Threatened white-cheeked hill partridge *(Arborophila atrogularis),* Kaleej pheasant *(Lophura leucomelanos)*, red junglefowl *(Gallus gallus)* and grey peacock pheasant *(Polyplectron bicalcaratum)*. The sanctuary is also a potential habitat for the globally threatened Wood Snipe (*Gallinago nemoricola* Choudhury 1998).

The sanctuary harbours a sizeable population of wild Asian elephant (Choudhury 1999). Other notable mammals include leopard cat, jungle cat, fishing cat, leopard, clouded leopard, tiger, wild dog, Asiatic black bear and sloth bear, rhesus macaque, western Hoolock gibbon, slow loris, capped langur, sambar, barking deer, gaur, binturong and Malayan giant squirrel (Choudhury *et al*. 2012).

Among reptiles, Asian leaf turtle *(Cyclemis dentate)*, Water monitor lizard *(Varanus salvator)* and common monitor lizard *(Varanus bengalensis)* are recorded. Indian rock python *(Python molurus)*, king cobra *(Ophiophagus hannah),* common krait *(Bungarus caeruleus)*, banded krait *(Bungarus fasciatus)*, buffstriped keelback *(Amphiesma stolata)* and vipers such as green or bamboo pit viper *(Trimeresurus gramineus)*, have been recorded from the sanctuary (Choudhury 1998).

3.4.1.6 ***Narpuh Wildlife Sanctuary***, the first PA of Jaintia Hills,was declared in 2014 by changing Narpuh Reserved Forest into wildlife sanctuary. With an area of 59.9 km^2 it is an important addition to the PA of the state. Narpuh still has some undisturbed primary forests. It has tropical climate with hot summers, extremely wet monsoon and cool and dry winters. The major forest type include Cachar Tropical Evergreen Forest, Subtropical Hill Forest, wet grassland and abandoned jhums.

Narpuh has been identified as one of the Important Bird Areas (IN-ML-05), under the A1 and A2 criteria (IBA). Lahkar (2002b) reports 140 species of birds from this area, including the globally threatened Rufous-necked Hornbill and Tawny-breasted Wren-babbler *(Spelaeornis longicaudatus)*. The latter is an endemic bird of India, known from small areas in Meghalaya, Assam and Manipur (Ali & Ripley 1987, BirdLife International 2001). Narpuh lies in Eastern Himalayas Endemic Bird Area (EBA-130, Stattersfield *et al.* 1998). Some of the biome restricted species include White cheeked hill partridge, grey peacock pheasant, sultan tit and black-backed Forktail. Species belonging to biome 7 and 8 are grey-headed parakeet, mountain bamboo-partridge, blue-throated barbet, bay woodpecker, Blyth's kingfisher, black-winged cuckoo-shrike, short-billed minivet, orange-bellied Chloropsis, white-throated bulbul, slaty-backed forktail, rufous-bellied niltava, Nepal tit-babbler, small niltava, maroon oriole, streaked spiderhunter, grey treepie, lesser necklaced laughing thrush, yellow-breasted babbler and greater necklaced laughing thrush (Lakhar 2002 b).

Narpuh has very high diversity of primates (seven species) including slow loris, stump-tailed macaque, pig-tailed Macaque, common rhesus macaque, Assamese macaque, capped langur, and endangered western hoolock gibbon (Choudhury1998 & 2002c). Feline species include clouded leopard, tiger, common leopard, yellow-throated marten and golden cat. Among canids, dhole or wild dog and golden jackal are frequent. The sanctuary also harbours Chinese pangolin, serow, Asian elephant, and Asiatic brush-tailed porcupine. Other important mammals species found in the sanctuary are the Asiatic black bear, Malayan sun bear, leopard cat, jungle cat, Himalayan palm civet, large Indian civet, small Indian civet, binturong, gaur, sambar and barking deer or muntjac (Choudhury 1998 & 1999).

3.5.2 Elephant Reserves

The state has a sizable population of Asian elephant which range across the large landscapes often outside the protected areas. Elephant census data indicate an increase in population from 1840 in 1998 to 1868 in 2002 (State Forest Department, 2002). In 2007-2008 the elephant population declined to 1811 individuals.

As elephants migrate over large distances, the small protected areas of the state (with exception of Balpakram NP) would be unable to maintain viable populations of elephants. Small PAs, therefore lead to conflicts between humans and elephants. The conflict management policy in the state is to diffuse the conflicts through anti-depredation activities and habitat improvement, in addition the economic status of the people in this landscape is also alleviated *via* eco-development etc. In order to achieve the protection and conservation of one such population Meghalaya government has notified (vide- No.132/2000/97 dated 31st October 2001) a 3500 km^2 area as Elephant Reserve under Project elephant. Similarly another proposal is for declaration of 1331 km^2 area in West Khasi Hills district has also been proposed to reduce conflict, protect both elephants and humans and to improve habitat for reduction in Human wildlife conflict in the state. This proposal has already been accepted by the Government of India in principle and its final notification is awaited.

Both the elephant reserves encompass large areas of human-habitation, which increase the complexity of managing the free ranging mega-herbivores outside the PAs. A combined effort of State Forest Department, district council and village committees would be needed to ensure protection and viability of elephants in the landscape. It also brings to the fore, the need for a much more integrated PA and community forest planning and management in a state like Meghalaya where communities, hold and control most of the forest area. There are also trans boundary issues with elephant movement in state which have to be dealt with international co-operation.

3.5.3 Reserved Forests

There are 23 Reserved Forests (RFs) in the state with area varying from 0.44 km^2 to 150 km^2 covering a total of 712.74 km^2 area. The largest of these is Saipung RF in Jaintia Hills district (150.35 km^2, Table 3.3.3). Nongkhyllem RF is the second largest RF of the state and it lies adjacent to Nonkhyllem WLS. The Narpuh Block I and II of Jaintia Hills are among the other large RFs. Though Garo Hills has two National Parks and many RFs, the total area under lagal protection is still inadequate given the richness of biodiversity and need for long term conservation of mega-herbivores such as Asian elephant.

Table 3.7 Reserved Forests of Meghalaya State

Sl. No	Name of Reserved Forests	Gazette Notification and date	Area (km^2)
1	2	3	4
1	**Jaintia Hills District**		
	Saipung R.F.	No. 26/7/1876 and 5 of 17.10.1877	150.35
	Narpuh Bl. I	No. 3978 F of 17.6.1909	62.42
	Narpuh Bl. II	No. 1106 R of 9.3.1918	98.68
			Total : 311.45
2	**East Khasi Hills District**		
	Riatkhwan R.F.	No. 806 R of 5.3.1892 & 4287 R of 1.9.1892	3.91
	Shyrwat R.F.	No. FOR.179/80/187 of 28.3.1988	0.44
	Riat Laban R.F.	No. FOR 179/80/183 of 28.3.1988	2.05
			Total : 6.40
3	**Ri – Bhoi District**		
	Nongkhyllem R.F.	No. 4692 F of 23.7.1909 & 864 G. J of 4.2.1939	125.91
	Umsaw R.F.	No. GFR 234/46/3 of 16.12.1946	0.44
			Total : 126.35
4	**East Garo Hills District**		
	Chimabongshi R.F.	No. 28, dt 19.6.1883 & FOR/Sectt/492/63/4 dt 22.12.1965	23.28
	Dhima R.F.	No. 28 of 19.6.1883 & 3715 R of 11.8.1904	20.72
	Dilma R.F.	No.28 of 19.6.1883	2.59
	Rajasimla R.F.	No. 28 of 19.6.1883 & 665 R of 15.2.1899	18.13
	Ildek R.F.	No.28 of 19.6.1883	2.59
	Darugiri R.F.	No. 28 of 19.6.1883 & 373 R of 29.1.1932	10.36
	Songsak R.F.	No. 29 of 1.10.1885 & 3583 R of 5.9.1902	23.31
	Rongrenggiri R.F.	No. 28 of 19.6.1883 & 375 R of 29.1.1932	36.26
	Dambu R.F.	No. 22 of 12.3.1880 & 4276 R of 14.10.1962	18.13
			Total : 155.37
5	**West Garo Hills District**		
	Dibru Hills R.F.	No. 28 dt.19.6.1883 & 3526 R of 10.12.1930	15.02
	Tura peak R.F.	No. FOR.10/75/32 dt 23.6.1982	4.19
			Total : 19.21
6	**South Garo Hills District**		
	Baghmara R.F.	No. 12 dt 24.2.1887	43.91
	Angratoli R.F.	No. 3 dt 7.11.1883 & 2478 R of 15.6.1915	30.11
	Rewak R.F.	No. 44 dt. 7.11.1883 & 1699 R of 26.7.1932	6.47
	Emangiri R.F.	No. 44 dt. 7.11.1883 & 1699 R of 26.7.1932	8.29
	Siju R.F.	No. 44 dt. 7.11.1883 & 1699 R of 26.7.1932	5.18
			Total : 93.96
			Total Reserved Forests : 712.74

3.5.4 Community Reserves

Community Reserves or Conservation Reserves are special category of protected areas which serve as buffer zones to National Parks and Sanctuaries or corridors between PAs. These are mainly owned by the Government but community and private ownership may also exist with subsistence rights of the communities or have private owned lands. This category of protected areas was introduced in the Wildlife (Protection) Amendment Act of 2002 and it recognizes that local communities can participate in protection of threatened species and natural resources, and thus the law accords official recognition to such efforts. These categories were also created to strengthen conservation in and around existing or proposed protected areas.

Table 3.8 Area Acquired for Declaration as Reserved Forest (Notification Awaited)

Sl No	Name	Area (km²)	District
1	Nongumiang	0.31	West Khasi Hills
2	Cittingiri	2.40	South Garo Hills
	Total	**2.71**	

Meghalaya has a large number of Community Reserves, the largest for any Indian state. Which in itself is a unique and commendable initiative by the communities and Meghalaya Forest Department. As most of the forests of Meghalaya are owned by the communities, it is not surprising that many new community reserves are being declared each year. Presently there are 41 community reserves in the state with West Garo Hills having the highest number (7), followed by South Garo Hills (6) (Figure 3.14). There are five such reserves each in Ri-Bhoi district and West Jaintia Hills, four in East Khasi Hills, three each in South West Khasi, West Khasi, East Garo and North Garo Hills, and only 2 in East Jaintia Hills.

3.6 Sacred Groves

The indigenous ethnic communities in Meghalaya have close links with the forests and wildlife. They have inherited a tradition of dedicating a part of forest to their deities in the form of sacred groves (Gurdon 1975). *Ryngkew, Basa, Labasa* are some of the deities to whom these groves are dedicated. In addition to the religious sites set aside for traditional religious practices some of the sacred groves also serve as burial ground, with rights of the land residing with priest, community or headman of the village. There are a large number of sacred groves in the state and these are known by different names according to the rules regarding control of the land. The laws dealing with these sacred groves are very strict, misuse of the area and its resources can lead to punishments in form of heavy fines and social isolation from the community. In most of the sacred groves plucking a flower, fruit or even deadwood is not allowed, except for religious purposes with the permission of the priest. The sacred groves serve as sites for several social and cultural rituals and religious ceremonies. In Khasi hills the sacred groves are of three kinds (Tiwari *et al.*1998) - *Law Lyngdoh* are the groves ruled by the priest *Lyngdoh, Law Niam* are the places of traditional religion *Niam trai, Law Kyntang* are the groves where the area is under control of the village headman.

Table 3.9 Protected Forests

Sl. No	Name	Area (km²)	District
1	Upper Shillong P.F.	7.66	East Khasi Hills
2	Short Round P.F.	1.13	East Khasi Hills
3	Laitkor P.F.	3.25	East Khasi Hills
4	Green Block No.	20.21	East Khasi Hills
5	Umkhuti P.F.	0.14	Ri-Bhoi
	Total	**12.39**	

(Source: Meghalaya Forest Department)

In Jaintia, sacred groves are known as *Khlaw U Blei* or *Khloo Blai,* and in Garo it is known as *Asong Khosi.*The strict customary laws related to protection of sacred groves have also resulted in improved conservation of a wide variety of flora and fauna. These groves also play a vital role in environmental amelioration as many of these sites form important watersheds and catchment of several rivers and streams. Even though Meghalaya has many recorded sacred groves, the more famous ones are the Mawphlang and Mawsmai sacred groves. In the Selbalgre village of Garo Hills, community conserved gibbon reserve along with Sacred grove has also become an important gibbon conservation area (Kaul *et al.* 2010). Recently, Meghalaya Forest Department has listed as many as 125 sacred groves in the state including those which need to be recognized and notified.

3.6.1 Governance of Sacred Groves

Sacred groves are declared under the United Khasi and Jaintia Hills Autonomous District (Management & Control of Forests) Act, 1958 and Garo Hills Autonomous District (Management & Control of Forests) Act 1961. According to this Act, the sacred groves are to be managed and controlled by the Lyngdoh (priest or religious head) or other person(s), who are entrusted with the religious ceremonies for the locality or village, in accordance with the customary practices and rules framed by the Executive Committee of the concerned Autonomous District Council. This Act (Section 7) prohibits felling of trees inside the sacred groves without the written sanction of the concerned Chief Forest Officer or any other officers. Section 9 of the Act states that no tree shall be felled or removed from the *Law Lyngdoh, Law Niam* and *Law Kyntang* (Sacred groves) except for purpose connected with the religious function or ceremonies recognized and sanctioned by the *Lyngdoh* or other persons in accordance with section 4 (b).

The sacred groves range in size from a few to 1200 hectares and altogether they cover more than 10,000 ha area of the state

(Tiwari *et al.* 2011). Most of the sacred groves are located in the catchments of important rivers and streams covering nearly 10,250 hactares of catchment areas, 9621 ha around origin of perennial rivers and streams and 6454 ha cover fragile hill slopes (Tiwari *et al*.1998). For example, the *Lum Shyllong* sacred grove is the source of as many as 9 streams, and the Shillong city is totally dependent on water supply from this sacred grove (Tiwari *et al.* 1999 & Tripathi 2001).

3.6.2 Biodiversity in Sacred Groves

Sacred groves of Meghalaya represent the remnants of primary forests outside the PA network, and are key reservoirs of biodiversity (Gadgil & Vartak 1975, 1976, Khiewtam & Ramakrishnan 1989, Tiwari et al. 1998, Bhagwat & Rutte 2006). These groves provide a wide variety of ecosystem services such as regulating, provisioning, cultural and supporting services. They also play important role in maintenance of sub-surface hydrology and water quality (Tiwari *et al.* 1998), conservation of soil, dispersal of seeds maintaining populations of pollinators and predators, propagules for colonization, sites for cultural practices and indigenous knowledge of communities (Ramakrishnan & Ram 1988, Godbole *et al.* 1998, Godbole & Sarnaik 2004, Tiwari *et al*. 1998 a,b, Singh *et al*. 1998) (Khan *et al*. 2008). The sacred groves in Meghalaya also harbour relatively higher species diversity compared to other forests (Upadhaya 2002, Jamir & Pandey 2003, Tiwari *et al*. 1998). Upadhaya (2002) recorded 546 species of vascular plants from five sacred groves of Jaintia Hills. Of these, 91 species were either rare or endangered. 60 species were endemic to North Eastern India and 26 species endemic to Meghalaya.

In recent years, it has been observed that traditional knowledge and cultural practices in the state are on decline resulting in shrinkage and degradation of many of these sacred groves. The changes in traditional way of life is attributed to be the main reason for changes in people's attitude toward these forests. Increasing population pressure, changing values and rapid economic growth are the main reasons for loss of sacred groves (1998, Tiwari *et al.* 1998 & 1999).

The cutting of trees for timber, fuelwood, NTFPs and cattle grazing have resulted in changes in plant communities and botanical organization of several sacred groves (Mishra *et al.* 2004, Chaudhary *et al*. 2013). The sacred grove at Mawphlang on Shillong plateau is perhaps the best known and protected grove still free from human disturbance.

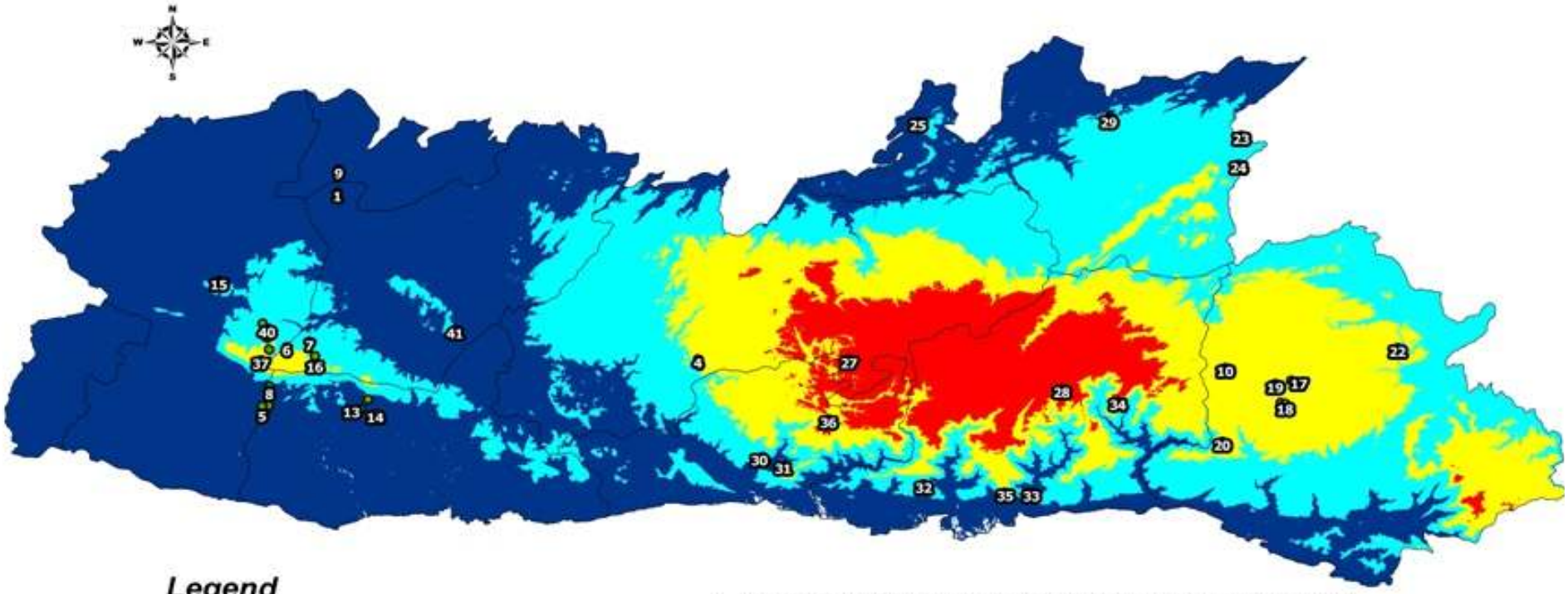
3.7 The Caves of Meghalaya

The topography of Meghalaya is hilly reaching to an altitude of 1966 m (Shillong peak) and include deep valleys, plateau and ridges. A deep band approximately 200 km long and 30 km wide of limestone, occasionally interstratified with sandstone beds encircles all along the southern and eastern margins of this plateau. The limestone band extends from west to east along the southern boundary of the state which runs in the west towards the West Garo Hills through the West and East Khasi Hills extending towards the Jaintia Hills. Such a topography coupled with centuries of erosion due to excessive rainfall have led to the formation of caves and cavernicoles in the state.

Acidic groundwater or underground channels of water continuously react with limestone leaving cavities where further panoramic speleothems develop over millions of years. Cave environments represent unique and fragile ecosystem. Perpetual darkness, high humidity, high carbon dioxide concentration and low energy input are some of the general characteristics distinguishing the caves. The organisms adapted to such ecosystems often exhibit a high degree of specialization in terms of physiology, behavioral and morphological adaptations (Vandel 1965, Gunn 2004 & Biswas 2009) commonly referred to as Troglomorphism. Organisms colonize caves for various reasons, e.g., temporary shelter, easy availability of food or as an escape cover.

During past few decades under an international cave expedition project, more than 1000 cave openings have been recorded in the state . Some of the caves have already been enlisted in the world map of longest and deepest caves. *Albeit*, the discovery of new caves could be only a fraction of the total number of existing caves in Meghalaya. With the regular discovery of new caves in the state the attention of researchers working on various aspects of cave science has also increased recently.

Caves in Meghalaya were heavily exploited during 2nd world war when tonnes of guano deposits were extracted which served as a major source of phosphorous to be used in bullets and bombs (Biswas 2016). Some of the well-known caves at the time were Siju cave of Garo Hills district, the Mawkhyrdop and Mawsmai caves in Sohra and Syndai cave in Syndai village. Recently MAA has initiated cave expedition works jointly with the international cavers under a project ‘Caving in the Abode of Clouds’. Till date the team members of this project alone have explored and mapped more than 400 km of subterranean passages in Meghalaya.



1 Kitmadamgre Community Reserve 22 Khloo Blai Ka Raij U Landoh longlang
2 Bandarigre Community Reserve 23 Raid Nongbri Community Reserve
3 Dangkipara Community Reserve 24 Lum Jusong Community Reserve
4 Nongumiang Community Reserve 25 Jirang Community Reserve
5 Mikadokgre Community Reserve 26 Raid Nonglyngdoh Community Reserve
6 Sakalgre Community Reserve 27 Kpoh Eijah Community Reserve
7 Baladinggre Community Reserve 28 Miewsyiar Community Reserve
8 Dumitdikgre Community Reserve 29 Nongsangu Community Reserve
9 Aruakgre Community Reserve 30 Lumkohkriah Community Reserve
10 Ka Khloo Langdoh Kur Pyrtuh CR 31 Unsum Pitcher Plant CR
11 Paromgre Community Reserve 32 Lawbah Community Reserve
12 Ka Khloo Pohblai Mooshutia CR 33 Ryngud Community Reserve
13 Rekmangre Community Reserve 34 Ryngibah Community Reserve
14 Eman Asakgre Community Reserve 35 Thangkharang Community Reserve
15 Mongalgre Community Reserve 36 Phudja-ud Community Reserve
16 Mandalgre Community Reserve 37 Daribokgre Community Reserve
17 Khloo Blai Sein Raij Tuber CR 38 Selbalgre Community Reserve
18 Ka Khloo Thangbru Umsymphu CR 39 Sasatgre Community Reserve
19 Khloo Blai Kongwasan Khloo Blai Chyrmang CR 40 Chandigre Community Reserve
20 Ka Khloo Amrawan CR 41 Resu Haluapara Community Reserve
21 Dura Kalakgre Community Reserve

fig. 3.8 Community Reserves of Meghalaya

3.7.1 Cavernicoles or the cave animals

Harries *et al.*, (2008) presents a review on reported cavernicoles of Meghalaya. However, some of the notable common cavernicoles reported from the caves of Meghalaya include a terrestrial gastropod (*Opeas cavernicola*), two species of terrestrial isopod and an aquatic decapods (*Macrobrachium cavernicola*). From the caves of Cherrapunji (East Khasi Hills) two species of isopods have been reported viz. *Burmoniscus kempi* and *Cubaris cavernosus*. From the caves of Jaintia hills two orthopteran species viz. *Diestrammena brevifrons frieli, Diestrammena caecus* and a dictyopteran - *Spelaeo blatta caeca* have been identified. Spider of genus *Heteropoda* also inhabits these caves, Fage (1924) discovered *H. robusta* from the caves of Meghalaya.

Many new species of cavernicoles have also been discovered from Meghalaya in last few years. The new species include a large spider, *Heteropoda fischeri* (Jager 2005; Fig. 3.9, A), a depigmented fish with vestigial eyes, *Schistura papulifera* (Kottelat *et al.* 2007; Fig. 3.9, B) and bat species, *Murina jaintiana* and *Murina pluvialis* (Ruedi *et al.* 2011). In addition, after a long time *Otomops wrougtoni,* a critically endangered bat species was again reported from the caves of Jaintia Hills (Figure 3.10). It is facing extinction threats due to habitat loss and degradation. The great evening bat (Ia io), the only living species in the genus Ia, was also reported recently from the caves of Jaintia Hills (Ruedi *et al.* 2011). It mainly occurs among the limestone caves between altitudes 400-1700 msl. It is one of the biggest bats from micro-chiropteran groups that reaches a length of 90 to 105 mm (Figure 3.11).

Otomops wroughtoni is a species listed as Data Deficient due to little knowledge of taxonomy, population size, distribution, ecology and threats. Until very recently this species was only known from one locality in India. In the last ten years the species has been recorded from four sites in north eastern India (Meghalaya) and a site in Cambodia suggesting a much larger range than previously thought

Table 3.10 (a): Longest Caves

Cave	Name	State	Length
1	Krem LIAT PRAH/UM IM/LABBIT M / RUBONG	Meghalaya	30,397m
2	Krem TYNGHENG/DIENGJEM	Meghalaya	21,775m
3	Krem KOTSATI/UMLAWAN	Meghalaya	21,530m
4	Krem UMTHLOO-SYNRANG LABBIT	Meghalaya	18,181m
5	Synrang PAMIANG	Meghalaya	14,157m
6	PIELKLIENG-SIELKAN POUK	Meghalaya	12,434m
7	Krem SHRIEH	Meghalaya	8,862m
8	Krem LABIT KSEH	Meghalaya	7,499m
9	Krem KHUNG	Meghalaya	7,349m
10	Krem MAWKHYRDOP (Mawmluh)	Meghalaya	7,194m

Table 3.10 (b): Deepest (Glacier Ice Caves omitted)

Cave	Name	State	Vertical Range/Depth
1	Synrang PAMIANG	Meghalaya	317m (+4m/-313m)
2	Krem KOTSATI	Meghalaya	215m (+6m/-209m)
3	Krem UMJASEW	Meghalaya	197m (-197m)
4	Krem UMTHLOO	Meghalaya	188m (-188m)
5	PIELKHLIENG-SIELKAN POUK	Meghalaya	180m (-180m)
6	PAKAW PUK	Meghalaya	170m (-170m)
7	Krem SHRIEH	Meghalaya	169m (-169m)
8	Krem RISANG	Meghalaya	154m (-154m)
9	Krem WAH SER	Meghalaya	145m (-145m)
10	Krem SHIEN KHLIEH	Meghalaya	143m (-143m)

fig. 3.9 Syndai Cave in Jaintia Hills vulnerable to pollution and desecration

A) *Heteropoda fischeri* most commonly found in the walls of the caves of Jaintia Hills.

© Jayanta Biswas

B) *Schistura papulifera* the 1st true cave fish of India inhabiting in the subterranean water pools of Jaintia hills.

fig. 3.10 New Species of Cavernicoles from Meghalaya

fig. 3.11 Otomops wrougtoni

fig. 3.12 The Great Evening bat, Ia io (the largest bat in the vesper bat family and the only living species in the genus) from Jaintia Hills

F. Simpson

3.7.2 Conservation issues for cavernicoles

In regards to the biodiversity conservation issue, the Khasi and Jaintia hills have come to limelight in recent years due to excessive mining of coal, limestone and other minerals. Opencast mining as well as rat-hole mining lead to pollution of water bodies, streams and subterranean environment. It is seen that most of the popular caves have been heavily degraded due to accumulation of garbage. The Krem Liat Parah, located in Elaka Nongkhlieh of Jaintia Hills is threatened due to lime stone extraction and cement industries. In addition to limestone mining, coal mining has also affected a number of caves and their biodiversity. The influx of large amount of coal dust from such mines inside the caves has polluted the complete subterranean habitat. Excessive flooding in various caves is also a major drawback of Rat-hole Mining. Flood water gets often accumulated in the excavated pits and ultimately enters into the nearby caves (Biswas 2016). Long time over flooded conditions ultimately erode the cave sediments. The most threatened caves from the Rat-hole mining in Jaintia Hills are *Krem Liat prah* and *Labit* etc.

Meghalaya is the third uranium rich state in the country. Uranium mining pose another major threat to its caves. The state holds about 16 per cent of India's uranium reserves having an estimated deposit of around 13,500 tonnes in West Khasi hills. "UCIL" started extraction in early 1990s which was stopped due to the local agitations on account of environmental concerns. However, as per the recent verdict from Union Minister of State for Atomic Energy the mining is still under consideration. If the mining is resumed, a high degree of safeguards will be required so that the natural environment including caves and cavernicoles of the state are not damaged irreparably (Borah 2008).

In recent years there has been an increased environmental awareness among local communities in the state. This has prevented many mining and cement industries in ecologically sensitive areas. People's agitation prevented Lafarge India Pvt. Ltd. from setting up a cement manufacturing unit near Narpuh Reserve Forest (Shiva *et al.* 2011). Similarly, agitation prevented a cement plant near Siju caves and Balpakram NP.

Fig. 3.13 Nohwet-Riwai Living Root Bridge on river Thailong in East Khasi Hills, Meghalaya

3.8 The Living Root Bridges of Meghalaya

The Living Root Bridges of Meghalaya are formed from the trained roots of a native fig tree, *Ficus elastica* which increase accessibility and connectivity of the people across deep gorges or rivers. This ingenious engineering of the local communities in Khasi and Jaintia hills is an example of unique traditional knowledge inherited by them through generations. The bridge making involves training the living roots of fig trees over multiple generations across the streams and rivers (Box. 3.3). It is estimated that more than 100 such bridges exist in Khasi and Jaintia hills today. Of these, only 11 have been properly documented (Table 3.10; Fig. 3.12, 3.13). According to the village elders these bridges are more like 'Guardians of Environment' as they check soil erosion and leasing of nutrients along riverine areas, help in maintenance of water and air quality, provide food and cover to a variety of wildlife. During the extreme weather conditions such as heavy rains and flash floods, these bridges provide access to agricultural fields, market places and communication across villages.

Use of *Ficus elastica* for construction of living bridges not only helps in maintaining local ecosystems and environmental security but also serves as important connecting link between two sides of rivers. *Ficus*, being a keystone species in these forests, supports a large number of other organisms (Shankar 2015).

Recently there has been concerns regarding over use of the sites having living root bridges by tourists, infrastructure development and accumulation of garbage due to irresponsible tourism (Das 2017). For preventing overburdening of these bridges, it is essential to promote responsible tourism, prevent use of concrete, steel and burnt bricks as construction materials around these bridges and declaring these sites as ecologically sensitive green-zones and declaring bridge premises as plastic- and chemical free zones (Das 2017, *pers. comm*. Sanjeev Shankar). Involvement of well-informed local communities is essential to not only conserve these bridges but also to provide benefit of these traditional knowledge back to the communities.

The future plan of action required for conservation in this regard includes comprehensive documentation of all the Living Root Bridges. There is also a need to declare these sites as BHSs under section 37 of the Biological Diversity Act, 2002 or cultural heritage sites under the UNESCO Convention on Intangible Cultural heritage, 2003. Such declarations and mitigation measures could provide protection against their destruction. These concerns are addressed in various section of the MBSAP, Action Plan 9.3.4 particularly deals with Living Root Bridges.

Table 3.11 Eleven Well-known Living Root Bridges of Meghalaya

Sl.no.	Location	Span in meters	Growth stage
1.	Nohwet-Riwai	22.9	Well-established
2.	Wahryngkoh	4.6	About to be established
3.	Mawkyrnot	76.2	Initial stage
4.	Mawkyrnot	45.7	Initial stage
5.	Mawkyrnot	76.3	About to be established
6.	Nongthymmai	18.3	About to be established
7.	Nongthymmai	24.4	Initial stage
8.	Nongthymmai	6.1	Well-established
9.	Nongriat	12.2	Well-established
10.	Nongriat	15.2	Well-established
11.	Nongriat	18.3	About to be established

(Modified after Shankar 2015)

fig. 3.14 Major Living Root Bridges of Meghalaya

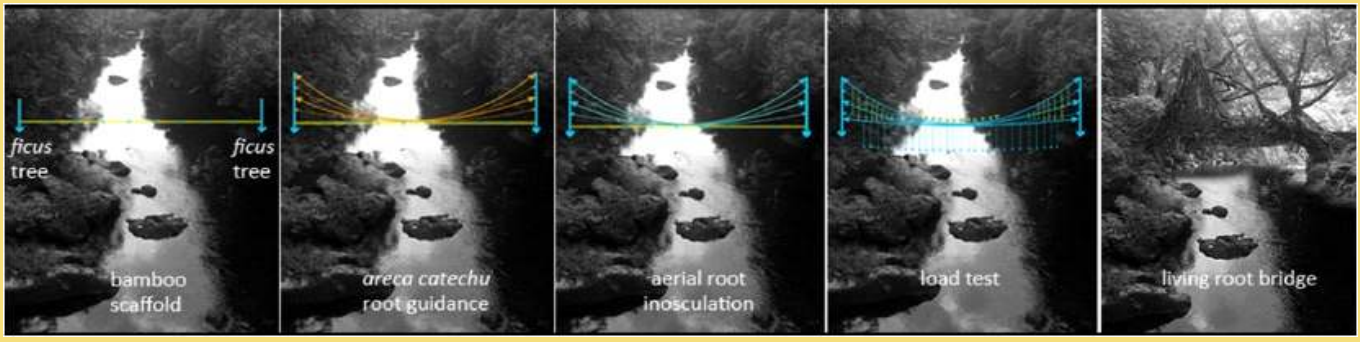
Nohwet-Riwai Living Root Bridge

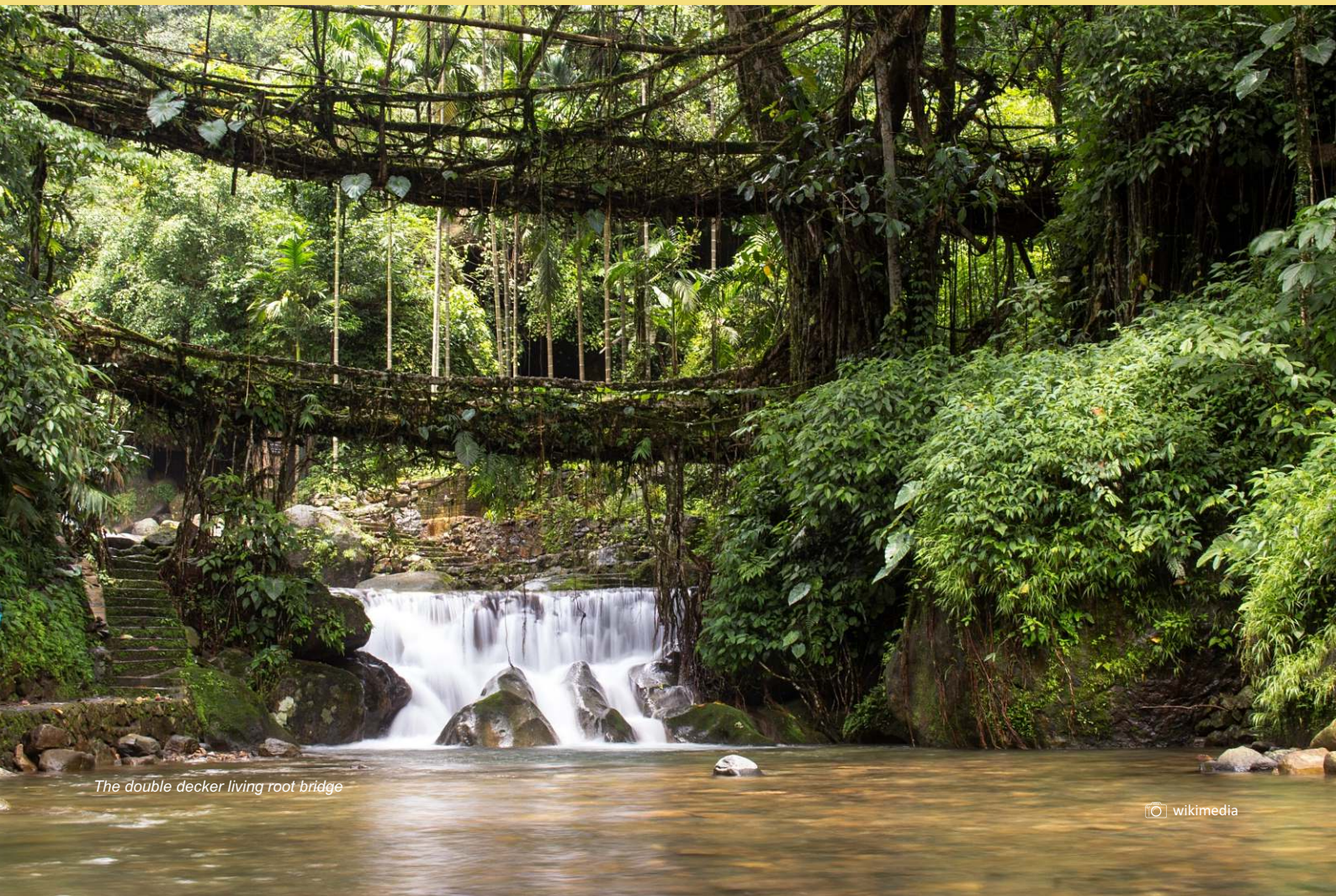
Living root bridge Nongriat Village, Cherrapunjee

Under construction living root bridge (about 52 m long) Mawkyrnot village near Pynursla.

Box 3.3 The process of making Living Root Bridges of Meghalaya

The process of making these living bridges is fairly long as it might take 15-30 years to complete a bridge across a stream. Many generations continue directing and protecting the Ficus elastica until it grows into a full bridge. The process involves recurrent joining of Ficus aerial roots over a gorge or stream. The process begins with placing the young roots in hollow trunks of areca nut (*Areca catechu)*. These trunks provide essential nutrition, protection to the young roots and guidance system by redirecting the movement of these roots across the hollow tube. A bamboo scaffold holds this assemblage across the gorge or river. Over time the roots increase in thickness and strength and ultimately the Areca poles are no longer needed. The bamboo scaffolds also need regular maintenance and replacement as they can degenerate due to heavy rains. Gradually more roots are added to the primary root to form steps and handrails. Finally, addition of planks, rocks, and soil the network of roots becomes strong enough to act as bridge. In 10-15 years the root system becomes stable enough to support weight of people across the bridge and ultimately the bamboo scaffold is discarded. In contrast to ordinary wooden bridges which deteriorate in this humid climate the Living Root Bridges become stronger with passage of time. These bridges vary in length from 4 to 76 meters and range in width from 1-4 meters across. They are also able to take weight of around 50 people depending on maturity and strength. With time there is a progressive increase in load bearing capacity of the living root bridges. The Living Root bridges, thus reflect rich bio-cultural heritage and unique traditional knowledge of indigenous ethnic communities of Meghalaya (Shankar 2015, MBB).





The double decker living root bridge

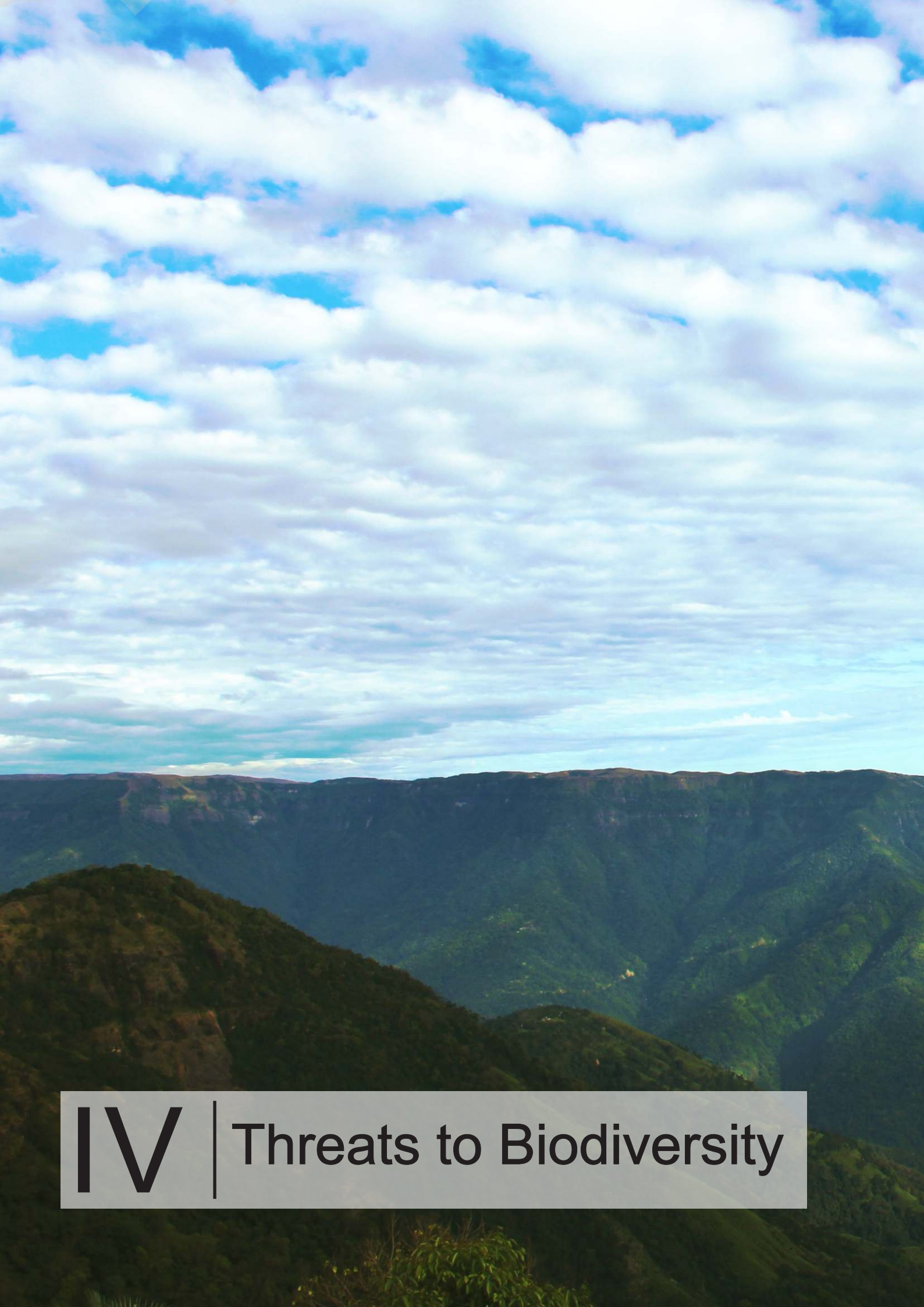
wikimedia

Many endemic, vulnerable, threatened, endangered (IUCN) species from Meghalaya are facing threats of habitat loss, over exploitation or loss of connectivity for dispersal. Chapter 4 lists most of these threats to the species and landscapes. The PAs are the best protected landscapes, these are also connected via community forests. There is need to prepare and implement Management Plans, Working Plans for PAs and community reserves. Many village forests or sacred groves also need protection from commercial exploitation or expanding plantations. There is need to accord legal protection to such forests. Meghalaya has already declared 41 conservation reserves, many others are needed to be declared to protect these landscapes. There is also an opportunity in declaring new areas as PAs with encouragement to communities by Forest Department and District Council. Long term incentive schemes for such community areas will earn a good will of the villagers and ensure conservation of landscapes for multiple species. Many other community reserves needs to be also preserved under village or community laws.

Among the flora, the pitcher plant (*N. Khasiana*) and many endemic orchids are being smuggled out from their habitat. There is a need to curb this over exploitation via better resource use management or implementation of bio-piracy laws with involvement of local communities, Forest Department and Police Department. Organizations like BSI and NBRI can contribute to capacity building of various state departments and communities in this regard. Better laws for mining and construction close to the natural habitat would be an important step in maintaining floral diversity of these areas.

There is a need to develop a landscape level conservation approach for various species. For carnivores species like clouded leopard, there is need to initiate studies on their distribution, population and threats to the species. Among primates, the hoolock gibbon is the most revered species and there is need to study their populations in various pockets of community forests or PAs. The mega herbivore, Asian Elephants are another important flagship species and the creation of Elephant Reserves is an important step to ensure survival of this mega-herbivore. However, as the species migrate over long distances, it would also be important to provide elephant corridors to connect various patches of forests along its migration routes (Tiwari *et al.* 2010). CAPs of such species are needed to protect them with the landscape.

The rivers and riverine systems are another landscape which needs emphasis to protect many endangered and endemic aquatic species. The Barak and Brahmaputra rivers basins are the two major waterways, Simsang is another major river of Meghalaya. Survival of several Mahseer species *viz. Neolissochilus hexagonolepis* and *Tor spp*., is also threatened by destructive fishing and overharvesting. Fish sanctuaries can provide a good refuge to these species and there is a need to encourage these traditional management systems. More scientific and sustainable harvesting of fishes and aquatic species is required to conserve these species and their habitats.



IV | Threats to Biodiversity


MBB

04 Threats to Biodiversity

4.1 Introduction

Current trends in biodiversity loss have been mainly attributed to anthropogenic pressures in the form of over-exploitation of bio-resources, degradation and loss habitats, rapid spread of invasive alien species (IAS) and climate change. Loss of biodiversity has serious consequences for ecosystem functioning and flow of goods and services which would affect human well being. The intricate relationship between rural communities with forests ecosystems makes them vulnerable to degradation, especially in Meghalaya where both rural and urban population depend heavily on forests for daily needs of water, food and other services.

In Meghalaya, over the last few decades fragmentation of forests, mining, over exploitation of many species of plants, large scale land-use changes have led to loss of biodiversity. Fragmentation of community forests is a common issue across the state, mainly driven by deteriorating jhum cultivation. Most of the forest in the state is secondary in nature resulting from jhum fallows, which are largely infested by IAS. Similarly, coal and limestone mining in many parts of the state especially South Garo Hills, Khasi Hills and Jaintia Hills districts have affected native biodiversity. The southern boundary of Nokrek National Park, and areas around Baghmara- Balpakram complex are dotted with numerous mines, ultimately affecting the biodiversity of the state with direct and indirect effects on environment.

The threats, based on their type of effect on biodiversity and habitats are classified into direct and indirect threats. Direct threats include over-exploitation, habitat loss, mining and land-use changes. The indirect threats are pollution, climate change and population pressure affecting health of ecosystem, resource availability etc. This chapter deals with the current threats to the flora, fauna, natural habitats, environment and wellbeing of indigenous communities in Meghalaya.

4.2 Direct Threats

The threats to biodiversity and ecosystem services in the state of Meghalaya is summarized in the following section.

4.2.1 Over-exploitation of Forest Products

One of direct and major threats to biodiversity and ecosystem services in Meghalaya is over-exploitation of forests leading to soil erosion and land degradation. As most of the people living in and around forests are primarily dependent on forest products, there is excessive extraction of Non Timber Forest Products (NTFP) from the protected areas, community forests and village forests. Some of the NTFP extracted from the forested areas include medicinal plants, fruits, vegetables, brooms etc. The harvesting of Agar *(Aquilaria malaccensis)*, many orchid species and medicinal plants from the forests is a regular practice in the southern parts of the Nokrek Biosphere Reserve. Many species of orchids are illegally smuggled out of the biosphere reserve and sold in nearby markets by the local villagers (Singh *et al*. 2011).

These NTFPs contribute a big part of the local income and also in state finances (Tiwari & Kumar 2008, Tynsong & Tiwari 2011ab, Tynsong *et al*. 2012). It is estimated that nearly 50,000 MT of bamboo is extracted from the forest for supply to various paper mills. Small quantity of bamboo is also used for preparation of pickles and fermented slices (Bhatt *et al*. 2005), construction, handicrafts and manufacture of plywood and food items. Broom grass extraction from forest is turning from NTFP extraction into a more commercial monoculture plantations. Broom grass is an important NTFP and source of cash income for the rural communities in the state. The bay leaf grows naturally in sub-tropical humid forests of Meghalaya, at 100 to 1200 msl. The average production in the state is of 31897 MT per year.

Many species of plants in the state are extracted from wild due to high price they fetch in regional or local markets. For example, the pitcher plant, an endemic species of Meghalaya, is heavily extracted from its habitat due to its medicinal properties, leading to decline of the species from Nokrek National Park, where earlier it was quite common (Singh *et al* 2011). Other species heavily exploited from the wild include *Panax pseudoginseng, Rauvolfia serpentina, Dipteris wallichii, Cyathea gigantean, Ilex embeloides, Styrax hookerii, Fissistigma verrucosum, Taxus baccata, Tinospora cordifolia, Vinca rosea, Stychonos nux-vomica, Dichora febrifuga* etc. Tiwari (2002) reported 380 different types of NTFPs which are collected by the people of Meghalaya. It is estimated that nearly 57 % of the households in rural areas are engaged in NTFP collection (Kumar & Tiwari 2008). A study by Tiwari (2000) found that over extraction of NTFP is responsible for threatened status of many species of plants. Eleven species of medicinal plants are now endangered and three are vulnerable. One of the main reasons for fast depletion of community forests is also intensive extraction of NTFPs (Kumar 2002).

Fishes are another group of species in the state which are facing severe threats due to over harvesting. Some of the recent fishing methods such as poison fishing, using poison from plants (*Calotropis gigantea, Cassia fistula, Costus speciosus, Garuga pinnata, Pongamia pinnata, Wrightia tinctoria*) and toxic chemicals pose a great threat to all the aquatic species and also to the communities dependent on these rivers, Singh & Borthakur 2015. In recent years much worse methods of fishing have also emerged, e.g. electric fishing and explosion fishing practices have also been reported in Nokrek region. These fishing methods are detrimental to aquatic ecosystem and also to the health of local communities who are dependent on rivers for their daily food requirements.

4.2.2 Mining

The state is endowed with extremely rich mineral wealth. It has nearly 600 million tons of coal deposits, about 15100 M.T.of limestone, and one of the few Uranium mines of the country, sillimanite, clay and other minor minerals. The minor minerals include copper, corundum, gold, iron, gypsum, quartz, phosphorite, pyrites, Khasi greenstone, dolerite and feldspar. Oil and Natural gas deposits are also known to occur in Khasi and Jaintia hills.

Since, Meghalaya has special provisions under 6th Schedule of Indian constitution, it is also one of the most mined state with local communities and individuals claiming ownership of the mines. The mining in many parts of the state has resulted in a large number of 'rat-hole' mines and quarries for coal and limestone. Large areas of forests are also used as temporary dump sites for coal and limestones. Mining is the major cause of land degradation in the state. With new mining areas being discovered in villages, the land use of the area changes drastically from village area or forested areas to mining or dumping areas. Even though a ban on 'rat-hole' mining in 2014 has abated further mining activities, yet the landscape still remains scarred and it would take a long time to recover.

Coal Mining

Most of the coal deposits in Meghalaya are concentrated in Garo Hills (i.e. about 350 MT). Khasi and Jaintia Hills also have large coal deposits (170 MT and nearly 75 MT respectively), which are being extracted since mid-1800s. At present large scale coal mining is going on in Garo and Jaintia Hills Districts. By and large the exploitation of coal is privately controlled by small scale ventures. Open cast mining, rat-hole mining and open storage pits are some of the common method of coal extraction and storage in the state. The mining changes physical, chemical and microbial nature of the soil (Ghose 2004). The microbial population of the soil declined drastically and the soil in mined areas is usually deficient in organic carbon and NPK, ultimately making it infertile (Ghose 2004). One of the major effects of coal mines on land and water is leaching of acidic discharges from the mined areas. The Acid Mine Drainage (AMD) refers to the acidic discharges from coal or metal mines where sulphur bearing rock (pyrite: Fe_2S) comes in contact of air and water to form sulphuric acid with dissolved Iron and other heavy metals. Leaching of this drainage in streams and rivers causes acidification and heavy metal poisoning, leading to mass killing of aquatic biota, particularly the fish diversity (Jeffree & Williams 1975). The AMD also adversely affects a number of plant species in the mining area and its vicinity, as observed in *N. khasiana*, necrotic spots on leaf and pitcher are observed in areas affected by the leachate (Prasad & Jeeva 2009).

Mining discharges makes the water more acidic with increased conductivity. A study on mining discharges in Jaintia hills indicated that mining increases the concentration of chloride, phosphate, nitrate, sulphate, sodium and potassium in the polluted water bodies (Sarma 2005 & 2008). Thus the water becomes unsuitable for aquatic life. In Meghalaya the severe effect of mining can be seen in the waters of Simsang river and Lukha, Myntdu rivers of South Garo Hills and Jaintia Hills respectively, these rivers became lifeless due to heavy coal discharges (Goswami & Jesudasan 2012, Lamare & Singh 2014).

Coal mining also results in habitat degradation and landscape dotted with mining spoils in Nokrek Biosphere Reserve (Sarma & Barik 2011). There was drastic reduction in trees and shrub diversity. Another study in Jaintia hills points to higher herbaceous diversity of mined areas and differences in dominant tree species. Though the tree diversity was unaffected, the tree density was nearly double in un-mined areas (Sarma *et al.* 2010).

The environmental concerns raised by the indiscriminate coal mining in Meghalaya prompted National Green Tribunal (NGT) to ban rat-hole mining on April 14th 2014. This issue is still being discussed as ban on coal extraction has direct economic implications for the state.

Limestone Mining

The whole lime extraction process from quarries has the potential to affect the biodiversity both directly and indirectly (Misra 2002). It include activities like quarrying, blasting, processing and transportation of products which not only affect the topography of the area but the quarry waste or by-products also are sources of environmental pollution (Montenegro *et al*. 2005). The mining

in Meghalaya has resulted in deforestation, removal of top fertile soil, disturbances of ecosystems near mine areas and contamination of water. A recent study on effect of limestone mining in Jaintia hills indicate that water quality degradation in mined areas is not restricted to coal mining but limestone mining also results in elevated level of pH, Electrical Conductivity, Total Dissolved Solids, hardness, alkalinity, sulphate and phosphorus concentrations (Lamare & Singh 2014). Indiscriminate dumping and release of affluent in water bodies has polluted water in nearby streams and ponds. This has caused a serious concern regarding availability of potable water and water for irrigation in vicinity of mined areas (Lamare *et al*. 2014).

Stone Quarrying

The upturning of sand, clay and gravel during the stone quarry not only drives away most of the faunal species from the area but is also detrimental to floral species and agricultural land in the adjacent landscapes (Lameed & Ayodele 2010). Quarrying also affects the health of the human population living in the area due to high concentration of particulate matter and drinking of unclean water affected by quarries (Nartey *et al.* 2012).

Meghalaya is dotted with a large number of stone quarries throughout the Garo, Khasi and Jaintia hills. Many of the individually owned quarries are illegal i.e., without proper state licenses. The pollution from these quarries have affected local residents with high levels of air, water and noise pollution (CEPRD). This inconvenience prompted village and district administration to take action against 250 illegal quarries in *Garobadha* and *Hallidayganj* road (Garo Hills) and close it down. National Green Tribunal has also issued directives to stop stone quarries and sand mining from the riverbeds as these affect the biodiversity and ecosystems surrounding these extraction areas and are also detrimental to human health.

4.2.3 Forest Degradation and Habitat Loss

The forest cover of Meghalaya was highest in 1985-87 i.e. 73.41% (16,466 km^2) and since then it gradually decreased. The 70.78% of forest cover during 1991 had further decreased to 69.48 % by 2001. However, the forest cover of the state has recovered after 2001 and reached back to its earlier level (77-78%) and is stable since last decade with changes observed in forest density. Since 2009 there is an increase in very dense forest and moderately dense forest at the expense of open forest. The area under various cover classes of forests in the state are given in the following table (4.1).

,

fig. 4.1 Rat Hole Mine of Meghalaya

The tree cover of the state pertaining to plantations indicate an increase from 578 km^2 - in 2011 to 608 km^2 by 2013. The livestock population of the state stands at 1.82 million (FSI 2011 & 2013).

Land use changes in the form of forest degradation, clearing of forest for mining, construction of roads, cause forest cover loss, forest fragmentation and also degradation. Habitat loss is the greatest threat to wildlife and biodiversity. Habitat loss is primary cause of extinction of species and is considered as the main threat (85%) to all IUCN's Red Listed species. Forest loss and degradation is mainly caused by conversion of forest to agriculture, timber and firewood harvest, over extraction and over grazing. Commercial felling of trees for both timber and firewood has caused extensive degradation of forests, particularly in the unclassed forests of the state. During 1995 to 2005 a total of 9,43,355 m^3 of timber was extracted by the three autonomous district councils in the state through illegal felling (Singh *et al.* 2008). Though, Supreme Court of India has banned commercial extraction of timber from these forests, illegal extraction is still prevalent in some pockets of the state.

Fragmentation of natural ecosystems intensifies edge effect, where edges are more susceptible to light, wind, weather and invasive species. Small fragmented forests are not able to maintain the species diversity and continuously lose species. These fragmented forests act like islands in a matrix of agricultural fields and human habitations. The first species to become extinct from these fragments are larger sized species which are unable to survive in the smaller areas, and the equilibrium of species colonizing and disappearing from an area also get disturbed due to lesser number of species are able to move across habitat gaps.

The natural forests in Meghalaya are increasingly getting fragmented to smaller patches (<1 km^2). A study by Tripathi (2002) revealed the intricate linkages exists between disturbance and size of fragments. All fragments studied were mildly disturbed, the smaller patches were relatively more disturbed than the larger ones. A follow up study revealed that the tree species richness and diversity showed an increasing tendency with increase in fragment size and decrease in the degree of disturbance in the forest fragments (Tripathy *et al.* 2010). These effects corroborate with similar inferences drawn for faunal species and fragmented landscapes according to the island biogeography theory treating these fragments as islands in matrix of agriculture and developed or built up area (MacArthur & Wilson 1967).

The recent changes in agricultural land use and cropping pattern has brought drastic change in agricultural systems of the state. The traditional diet of the people was millet and during 18th century import of rice started from the plains. At present rice has become staple diet of Meghalaya and most of it is imported from other states such as Punjab and Andhra Pradesh. This crop use and food habits have changed the cropping pattern in the state. This part of India has also remained untouched by Green Revolution (Behera *et al.* 2015).

fig. 4.2 Coal Mine of Meghalaya

fig. 4.3 Water Pollution due to Coal Mine Discharges in Rivers of Meghalaya

4.2.4 Shortening of Jhum Cultivation Cycles

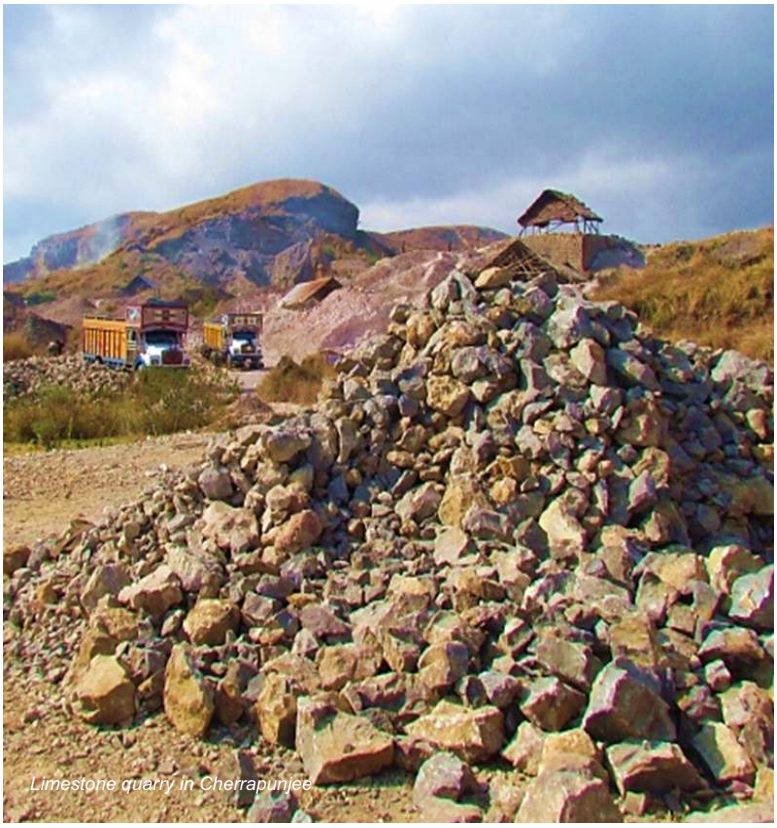
The increasing population, globalization and demand for cash income has pushed the traditional *jhums* to a formof distorted *jhum* practices.The original *jhum* cycle allowed maintenance of forest cover through a process ofrestoration for 10-15years, which is now reduced to 3-5years. The shortening *jhum* cycle has therefore depleted soil nutrients there by reducing production and affecting recovery of forests. An increasing incidence of *jhum* and shortening of *jhum* cycle are the main factors responsible for the loss of forest cover and significantreduction in agricultural outputs (Mishra & Ramakrishnan 1982, Ramakrishnan 1985, Kushwaha & Kuntz 1993).

During1995 to1997, 1,875km^{2}of tropical forest (1.14% of northeast Indian forest) was converted to cropland under *jhum* (FSI, 1998). Jhum cultivation has created mosaic of various land use categories, with land in various stages of recovery. The recent increase in jhum, illegal felling, logging and other activities has increased forest fragmentation and loss of old forests (>30 years old). The study on forest management in Garo Hills Conservation area found highly fragmented patches of forests in south western portion of Garo Hills (Kumar *et al*. 2002). Task force on shifting Cultivation (1983) estimated that nearly 3.81 million ha of forest areas in North Eastern India has been deforested for *jhum*. Garo Hills still harbours good forest cover compared to other parts of the state, however the jhum cultivation has caused a large scale conversion of primary forests to secondary forests and forest was lost at annual rate of 4.5% between 1972-73 and 1977 (Negi 1984). Even though undisturbed forest are essential inside protected areas, long rotational cycle jhum comparatively is better than monocultures in maintaining faunal diversity (avifauna: Raman 2001). The recent advances in *jhum* cultivation i.e. multi-crop *jhum* from single crop *jhum* has helped bring down jhum cultivation areas.

4.2.5 Forest Fires

Approximately half of India's forest fires occur in North Eastern region.The forests of this region are subjected to severe fire episodes during the January-May period every year mainly due to slash-and-burn agricultural practices. They also have implications for human health and on the socio-economic system of affected regions.The majority of the forest fires in North eastern India were detected in Meghalaya, Mizoram, Manipur, Nagaland and Tripura (Kharol *et al.* 2008). Thirty two percent of the areas in Meghalaya is prone to forest fire and bore nearly 12% of the fire incidents of NE India (Chakraborty *et al*. 2014).

An assessment of forest fires in Meghalaya reveals that most of the fire incidents are concentrated in East Garo Hills and Jaintia Hills. Vulnerability of areas to fire depend on the vegetation type of the area. Agriculturall and and dense bamboo vegetation were more vulnerable to forest fires, whereas, evergreen forests, scrub and open areas had low vulnerability to forest fires (Chakraborty *et al.* 2014).



Limestone quarry in Cherrapunjee

4.2.6 Human-elephant Conflict

Human-wildlife conflict is common in areas close to the forest, particularly in areas where people grow food crops. Wild herbivores are major cause of depredation in these areas, and livestock of people are also under threat from wild carnivores. Mega herbivores and large carnivores are major cause of concern in many areas due to the threat to life. In Meghalaya, most of the conflict are caused due to the Asian elephant, wild pigs, barking deer and sometime macaques or langurs etc.

Meghalaya harbours a sizeable population of Asian elephants. Owing to higher interspersion of human habitation in the elephant habitats and traditional migration routes, elephants and humans come across each other more frequently. Thus, Human-elephant conflict (HEC) is reported to be 'round-the-year' phenomenon in the state with maximum damage caused during the cropping season. However, the compensation paid for crop damage is not commensurate with the loss of villagers. Unless this is rectified the conflict will grow and may also lead to death and injury to elephants. Increased protection and law enforcement, alternative cropping patterns, eco-development, conservation awareness and anti-depredation measures were suggested to minimize the HEC (Gurung & Choudhury 2000).

Elephant related human deaths and injuries are relatively high in Garo Hills. During 2000 to 2006 nearly 22 people lost their lives and 39 persons were injured (Tiwari *et al.* 2010). Thus over the years HEC has increased and elephant mortalities are also rising because of retaliatory killings and electrocutions. Tolerance for wildlife in general, has also decreased because of the extreme stress on both sides. Large scale conversion of elephant habitat to monocultures, logging and mining are serious threats to habitat integrity in the landscape (Datta-Roy *et al.* 2009). Five corridors have been suggested in the landscape to allow age old movement and migratory routes of the elephant in Garo Hills and one corridor Saipung-Narpuh in Jaintia Hills (Tiwari *et al.* 2010). However, some of these corridors now are totally blocked and free movement of elephants in the landscape is restricted.

In the Garo hills, the major crops are wet paddy (grown in the lowland areas and valleys or beside rivers) and jhum paddy, maize and millets (planted on the slopes by shifting cultivators). The seasonality of elephant visits were found to coincide with the period of crop ripening in these two major cropping seasons (Datta-Roy *et al.* 2009). Participatory monitoring is an important tool to collect information related to human – wildlife conflict in community owned areas, however imperfect detection and reporting can occur in remote areas. Accessibility of crop fields and availability of crops is major driver of crop depredation, crops field close to forest edges face more crop depredation during crop ripening seasons, particularly for the paddy (Goswami *et al.* 2015).

Table 4.2 Forest Cover Changes in Meghalaya

Year	Very Dense Forest (VDF)	Moderate Dense Forest (MDF)	Open Forest (OF)	Scrubs	Total Forest Cover **
2001	5,681		9,903	259	15,843
2003	6,491		10,348	169	17,008
2005	7,146		9,842	181	17,169
2009	410	9,501	7,410	211	17,321
2011	433	9,775	7,067	485	17,275
2013	449	9,689	7,150	372	17,288
2015	449	9,584	7,184	348	17,217

Source: FSI 2001, 2003, 2005, 2009, 2011, 2013, 2015; ** Total forest cover does not include scrubs

4.2.7 Invasive Alien Species

Invasive alien species (IAS) are considered among the major threats to global biodiversity. These species not only affect the life cycle of native species but also alter the habitat conditions negatively affecting the regeneration of many species leading to loss of wildlife habitat and ecosystem services. Invasive species of flora and fauna can progress through the stages of introduction, establishment and dispersal to a full range through various pathways. In India, most of the invasive species are intentional or unintentional introductions. A detailed study on status and distribution of invasive plants in Meghalaya by Naithani (2014) reveals that the following species have led to drastic changes in the structure and composition of native vegetation in the state: *Lantana camara, Mikania micrantha, Eupatorium adenophorum, Bidens pilosa, Triumfetta rhomboidea, Ageratum conyzoides, Mikania micrantha, Spilanthes clava, Hyptis suaveolens, Spermacoce hispida, Sida acuta* and *Solanum viarum*. This study has also given an exhaustive list of invasive plants in various districts.

Detailed studies on the impacts of IAS on biodiversity and ecosystem services have not been assessed in the state. However, it is evident that a significant proportion of the state, especially along the margins of the PAs, RFs and natural areas are heavily infested with invasive alien plants (IAPs) have caused rapid decline in forage for wild herbivores and loss of habitat. Excessive growth of unpalatable species such as *Lantana* and *Eupatorium* suppress the regeneration of native species especially ground flora including terrestrial orchids. Currently, there is no mechanism to tackle the terrestrial and aquatic invasive species in a coordinated and integrated manner.

4.2.8 Monocultures

In contrast to *Jhum* cultivation which is a reversible change of forest cover, plantations irreversibly convert the forest into monocultures of cashew, areca nut, orange, pineapple, tea etc., thereby causing loss of forest area and faunal diversity. According to the Agricultural Department of Meghalaya, over the last 2-3 decades there has been a yearly increase in these plantations e.g. areca nut plantation has increased at rate of 361 hectare in last five years. In case of tea, the incentive schemes of the cash and insecticide subsidy to tea growers (i.e. 1984-85 to 2000-01), has bought about 508 ha of land under tea plantation in the State. Similar increases in various other plantation crops are seen over last three decades (Meghalaya Agriculture Profile, 2006).

In many areas of Meghalaya, *jhum* cultivation maintained a high diversity of crops interspersed with natural vegetation. In villages of Pynursla Block, *jhums* used to have 60 varieties of crops planted at the same time for meeting the basic needs of the indigenous communities. However, the replacement of these *jhums* with monocultures like broom grass cultivation has cleared off all the shrubs and trees in the area. The land is devoid of any other natural vegetation but of just one species. This type of monoculture reduces biodiversity in the environment.

fig. 4.4 Jhum fire is Responsible for most of the forest Fires in Meghalaya

Due to commercial importance of species like broom grass (*Thysanolaena maxima*), fallow jhum have been converted into monocultures of cash crops like broom grass. Broom cultivation adversely affect the area and make them unsuitable for food crop production. The financial attraction of cash crops have diverted land from jhums to plantations, villages practicing jhum cultivate more varieties of food crops, and villages switching over to cashcrops are abandoning cultivation of food crops altogether for cash crop monocultures with marginal production of one kind of cereal (Behera *et al*. 2015). This has given rise to large areas under monocultures, with reduced crop diversity, reduced habitat diversity and declining biodiversity.

These monocultures are also linked to livelihood of local communities and have localized positive or negative effects. In some areas small patches of broom grass, orange plantations etc. do not affect biodiversity negatively, however, in other areas there can be a negative impact of large scale monocultures. Species such as pineapple and tea monocultures can be detrimental to wild species which require canopy cover, whereas other plantations like coffee, orange, cashew may still allow species to coexist in the plantations. Thus each of these monocultures have to be addressed considering local conditions.

4.2.9 Poaching and Illegal Trade in Wildlife Parts

Subsistence hunting has been practised in Meghalaya since time immemorial. However, with changing land uses and increasing human population, the availability of wild animals has drastically reduced over time. Hunting is thus major cause of decline of species and loss of biodiversity, including disappearance of large mammals. In many *Akings* in Garo Hills there has been significant intrusion of market forces in wildlife trade. In War Khasis a number of indigenous methods are used to hunt birds and as most of the bird hunting is carried out during the breeding seasons of the bird, it has become unsustainable and negatively affect local bird diversity (Tynsong *et al.* 2012 b). Even people living in cities visit villages and forest areas for hunting on weekend for sports. Villages in Garo Hills, still hunt a variety of species, almost entirely off the village forests. The prevailing militancy in the state has also been responsible for hunting of wild animals, and proliferation of trade in animal parts. In Garo Hills, there have been incidents of elephant poaching by militants for meat and the tusks also find way to the wildlife trade. Number of animals which comes to jhum or crop fields are also trapped and hunted. One of the most important reasons for difficulty in addressing hunting in some of these areas is interdependence of socio-economic needs and protein requirement of some of the rural and traditional communities (Aiyadurai 2011).

Studies on bush meat and hunting in Jaintia hills report that pelts and bones of species such as clouded leopard, common leopard, leopard cat, and scales of Chinese pangolin were usually sold through a middleman, who was locally known amongst the hunters as paikaar. The paikaars were reported to be based at Silchar, Karimganj, Kalain and Lakhipur towns in the adjacent Barak Valley of Assam and Jaintiapur, Tarapur and Kanaighat in the adjacent Surma Valley of Bangladesh with whom the local hunters would get in touch in the event of availability of trade items. There were no recorded instances or reports of any regulations on hunting at any forest site by any communal decree (Goswami 2015).

A survey on hunting patterns in Jaintia Hills by Goswami (2015) indicated that the majority of hunters (48%) operated both in the Reserved Forests as well as *Elaka* forests while 37% reported that they hunt exclusively in the *Elaka* forests and 15% hunted exclusively in the Reserved Forests. In terms of distribution of hunting sites in the landscape, most of the high and medium hunting intensity sites were located in the *Elaka* forests (Goswami 2015).

In Nokrek Biosphere Reserve (NBR), Garo Hills, large number of birds are still illegally captured and traded. As a result a number of birds have become rare, endangered or even extinct due to hunting, trapping for illegal trade. In Garo Hills the overexploitation is for particular bird families' viz., parakeets, pigeons and pheasants, which are hunted for personal and local market consumption (Singh & Borthakur 2015).

4.3 Indirect Threats

4.3.1 Pollution

The Meghalaya State Pollution Control Board (MSPCB) has 7 stations across the state to assess air quality. The data from all these stations for 2013 indicate most of the parameters are within the prescribed standards of National Ambient Air Quality standards across the state, except for Particulate Matter (PM10) levels which was found to be above the National standards at most of the stations.

The water pollution in the state is quite widespread, an assessment by CAG found water of 28 out of 31 water bodies in the state was not fit for drinking (CAG report 2014). MSPCB conducts water quality monitoring over 20 rivers, streams, lakes, springs and well. A total of 54 sampling locations (47 nos. of surface water and 7 nos. of ground water) are also monitored. MPCB also reports widespread pollution in the water bodies of the state. The yearly assessments (2013 - 14) not only reports very low dissolved oxygen in most of the rivers e.g. Umkhrah, Umshyrpi, Umshyrpi, Nanba, Umiam Lake and Umtrew River. The total coliform count

was observed to be above 5000 mpn/100ml in Umkhrah, Umshyrpi, Nanbah River rivers. Nanba, Umiam Lake and Umtrew rivers are also subjected to pollution arising out of direct disposal of solid and liquid waste from residential & commercial areas, automobile workshops and agricultural runoff. The amount of waste received by the two rivers Umkhrah and Umshyrpi is much beyond their assimilative capacityand cannot be put to any beneficial uses (MSPCB 2013-14).

CAG report (2014) also points out violation of bio-medical waste disposal rules by health institutions in the state. The coal mining related discharges has converted many rivers in the state unfit for aquatic life, the Lukha, Kyrhukhla and Lunar river of East Jaintia Hills district, Myntdu river in West Jaintia Hills district and Simsang river in East Garo Hills and South Garo Hills have turned acidic and blue due to the toxicity. The MSPCB (2012) declared that the mine-related run off for state of the rivers and indicated that affluent from these mines are major cause of water pollution in the state.

Most of the fishes and aquatic species are affected by mining and pollution related contamination of water. The mining discharges along with agriculture discharges containing agro-chemicals are a major threat to the biodiversity of rivers, streams etc. The agro-chemical discharges from farms around the NBR has polluted and poisoned rivers like Simsang, Didare and many streams originating from Nokrek and Tura peak. This has led to drastic decline in fish populations and destroyed the fish diversity in these rivers (Singh & Bokrthakur 2015).

4.3.2 Unsustainable Development and Population Pressure

Urbanization is one of the major reason for habitat loss and depletion of community forests (Kumar 2002). Construction of roads, built up areas etc. not only cause forest loss, but fragment forests, effect the fragile habitats particularly in hill tops, where such construction can lead to high soil erosion due to loss of vegetation cover. This also leads to a fragile habitat in such hill tops, leading to landslides etc. Human encroachment on forest areas is also a major reason for habitat loss and fragmentation. In the state nearly 1309 ha of land belonging to Reserved Forest etc. is encroached by people (MoEFCC, 2009). Encroachment is not a new phenomenon in the state but in recent years it is predominantly in areas adjacent to Assam and urban areas of Meghalaya.

Only a few studies looked at the urbanization and related land use changes in state of Meghalaya. Ryngnga and Ryntathiang (2013) report an extensive urban build up over last three decades in Shillong. Urban built up at the expense of natural areas has been observed in most of the towns and cities in Meghalaya, with a doubling of cities and townships in the state. A 20 % increase in urban population has been also reported in last decade (Census of India, 2011).

Road construction in Garo Hills has deforested 461 ha area in six forest divisions during 1971-2001. The six ranges under Garo Hills Forest Division include Baghmara, Holloidanga, Dainadubi, Darugiri, Songsak and Rongrengiri. As covered in earlier section road construction lead to natural hazards like landslides and subsequent effects on flora due to soil erosion. This affects the stability of hillsides and makes them more prone to natural calamities, soil erosion deficient in water retention and cause biodiversity loss (Bera *et al*. 2006).

The human population of Meghalaya is 29.66 lakh as per census of 2011 against 23.19 lakh in 2001, exhibiting a growth rate of 27.95 %. Compared to the other North Eastern states the decadal growth rate of population of Meghalaya is much higher. This is due to the higher birth rate compared to other states. This population growth rate has been much higher during 1980s and is declining every decade (Census of India 1991- 2011). Nearly 80% of population of the state lives in rural and only 20% in urban areas.

Rapid infrastructure development such as highways, new buildings, especially in the migratory routes of elephants corridors has increases the incidences of human-elephant conflict. A number of human and agricultural activities, have affected the movement of elephant between West Garo Hills and Nokrek National Park (Tiwari *et al.* 2010). The poorly designed power lines have also resulted in large number of elephant deaths in the state. It is seen that low hanging cables and damaged electric poles have caused most of the electrocutions. Electrical cables passing through forests also pose a threat to many arboreal species such as gibbons and capped langur. Increasing number of electrocuted gibbons and other primates are being reported from forested areas every year (Florian Magne, *pers. comm*.). Many of such electrocuted gibbons do not survive for long.

Poverty is another major indirect driver affecting biodiversity and leading to environment degradation. In Meghalaya, 22% of urban population is below poverty line and as many as 45 slums have been notified in six towns. Settlement of poor and their economic upliftment often take precedence over environment and leads to disintegration of traditional values and fragmentation of land. The urban poor are also most vulnerable to climate change (MCCAP 2011).

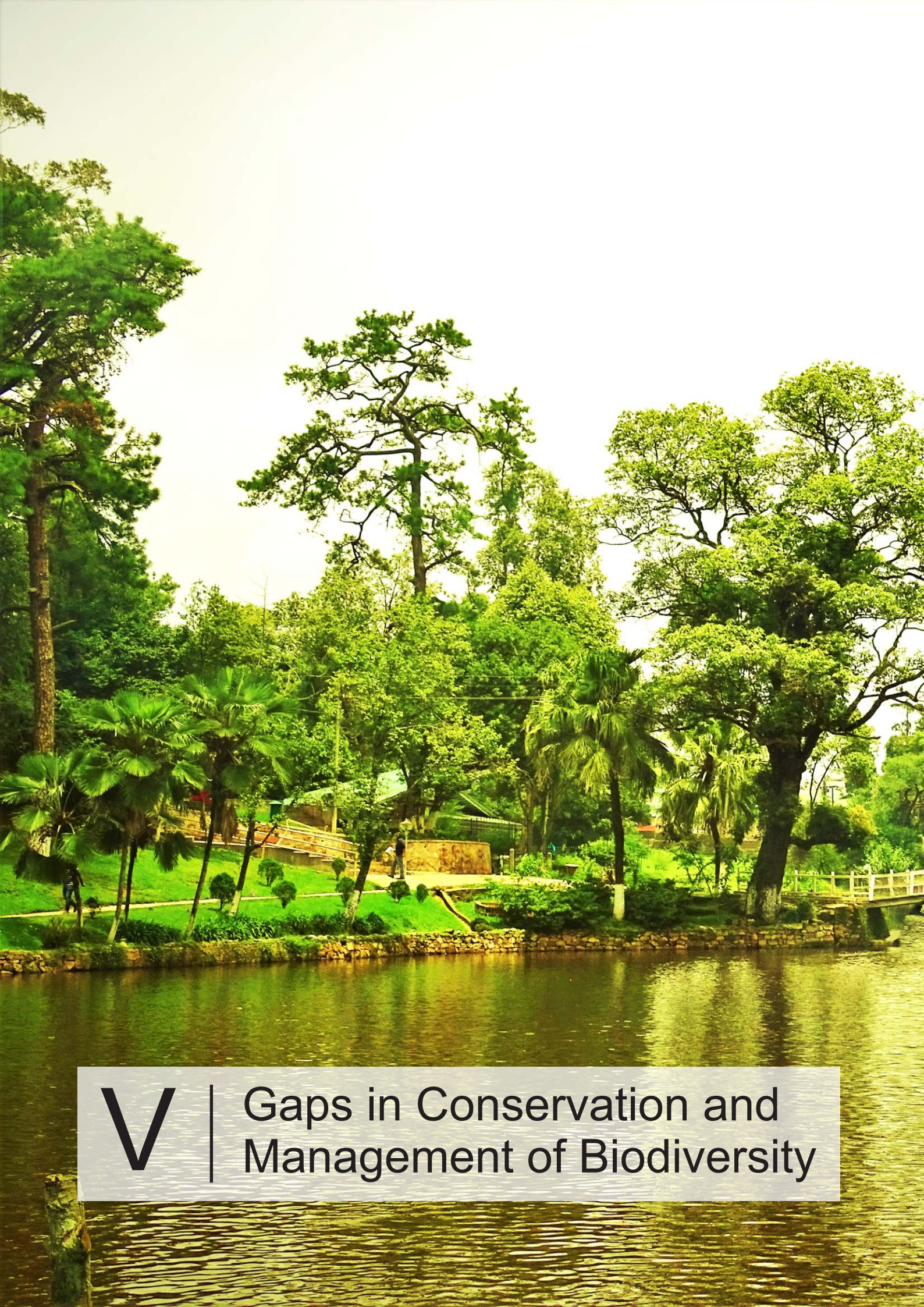
The recent changes in cropping pattern have bought drastic decline in agro biodiversity of the state. The traditional diet of the people was millet and during 18th century subsequent, import of rice started from the plains. At present rice has become staple diet of Meghalaya resulting in large scale changes in cropping patterns and loss of local varieties of millet and indigenous rice crops (Behera *et al.* 2015).

4.3.3 Climate Change

The data from IMD and Climate Research Institute CCRI indicate significant change in climatic pattern in the state. Overall, the temperature shows an increase throughout the state with localized variations. The western part of the state exhibits an increase in minimum temperature while the central part exhibits a high increase in maximum temperature. It is predicted that during 2021 to 2050, there would be an increase in temperature in different districts by 1.6 to 1.9^{0}C. It is also seen that there has been an overall increase in rainfall during last 100 years. The district of West and East Garo Hills, however, showed drastic decrease in rainfall (MSCCAP, 2011). These are, however, still the preliminary results and more extensive data collection and analysis is required to project climate change predictions for the state. Climate change can have strong influence on agricultural production, mediated by combined effects of changes in temperature, rainfall and also increasing pest outbreaks. A growth simulation model based on INFOCROP (Aggarwal *et al.* 2006 ab), predicts high to moderate vulnerability of rice crop in terms of production in various districts (MSCCAP, 2011). Even though, Meghalaya is the wettest place on earth, the state is still experiencing shortage of potable water during summer. Studies on climate change in eastern Himalaya indicate that the climatic changes could lead to diminishing crop and livestock diversity which will have implications for agrobiodiversity and food security (Sharma *et al*. 2009). Climate change, especially warming is known to cause upward migration of both plant (Parolo & Rossi 2008, Holzinger *et al*. 2008) and animals (Sekercioglu *et al.* 2012, Kannan & James 2009). Climate change increase risk for species with narrow geographic range or climatic range (Hannah *et al*. 2007), particularly larger or more specialized species (Sodhi *et al*. 2004 & 2010). At present, studies on effect of climate change on wildlife diversity of the state are lacking. Extensive fine scale information on climatic factors and primary field surveys to record species response are required to prepare more robust localized predictions, mitigation measures and adaptation strategies.

Table 4.3 Summary of Threats to Biodiversity of Meghalaya State

S.No.	Threats	Place/Area	Intensity
	Direct Threats		
1	Over-exploitation of Forest Products	PAs and Community Forests	High
2	Mining	Community Lands	High, but at present coal mining abated
3	Forest Degradation and Habitat Loss	PAs and Community Forests	Moderate
4	Distortion in Jhum Cultivation	Jhums	High
5	Forest Fires	PAs and Community Forests	Moderate
6	Human-elephant Conflict	Fringes of Forests and Community Forests	Moderate
7	Invasive Species	Agriculture Areas and Forests	Moderate
8	Monocultures	Community Forests and Jhums	Low/Moderate
9	Poaching and illegal Trade in Wildlife Parts	PAs and Community Forests	Moderate
	Indirect Threats		
1	Pollution	Mainly in Cities, but spreading to rural areas	Low with High Pollution Zones
2	Unsustainable Development and Population Pressure	All over the state	Moderate
3	Climate Change	All over the state	Moderate



V | Gaps in Conservation and Management of Biodiversity

05 Gaps in Conservation and Management of Biodiversity

5.1 Introduction

Meghalaya assumes a special position in Indian sub-continent due to its biogeographic location and socio-cultural history. It has a rich assemblage of flora, fauna and traditional knowledge related to use of biological resources. The state ranks very high in terms of literacy rate within India. The embedded cultural ethos of the people has always driven thoughts for environmental conservation. The state has a well-knit and cohesive democratic society, respectful socio-religious sentiments, unique matrilineal system that is closely linked with nature and biodiversity. The state is also known for a rich tradition of conservation in the form of 'sacred groves' since time immemorial, traditional ecological engineering techniques of building 'living roots bridges', and efficient waste management techniques in the daily lives of the people, e.g. villages Mawlynnong. Despite a number of positive socio - cultural features, the state faces a number of challenges pertaining to conservation of biodiversity. Major issues include habitat degradation, unscientific and extensive mining, shortening of jhum cycle, rapid spread of invasive alien species, poaching and illegal trade of bio-resources, and lack of co-ordination among the conservation and development agencies. These issues need to be addressed urgently following participatory approaches, common vision and well-planned collective action.

Meghalaya is spread over a geographical area of 22,429 km^2 of this, ca. 77% (17,217 km^2) area is covered by forests of various categories i.e. very dense, moderately dense and open forests (SFR, 2015). The state forest cover is above the national goal of 33% and also more than prescribed 60 % forested area in case of hilly states. The Protected Areas (PAs) cover about 6% of the total forested area, and about 728 km^2 area of forests fall under the category of Reserved Forests and Protected Forests. Thus, much of the forested tract in the state lies outside the PA network. However, most of these forests are considerably degraded and fragmented. In terms of floral diversity, there are 3128 species of flowering plants, many of which are endemic to the state of Meghalaya (Khan *et al.* 1997). Nearly 35 % faunal species of the country are represented in the state (Das *et al.* 1995).

This Chapter flags the potential gaps in management and conservation of species and their habitats that need to be aligned with the current vision of the MBSAP in accordance with the National Biodiversity Targets. The gaps in financial resources and policies that affect the biodiversity conservation are also outlined. Mitigations for these gaps are outlined in accordance to the Aichi Targets and National Biodiversity Targets in the subsequent chapter.

5.2 Gaps in PA Management

- The Management Effectiveness Evaluation report (Mathur *et al.* 2015) comprehensively lists the strengths and weaknesses and proposed action points to achieve the targets for the three PAs of Meghalaya, viz., Nokrek NP, Balpakram NP and Nonkhyllem WLS. Similar assessments for other PAs are lacking. The major gaps in the management of the PAs in the state include : lack of comprehensive assessment of threats to PAs and species; lack of public participation in management of PAs, and lack of trained and adequate staff in the PAs (Box 5.1).
- There is a need for landscape level conservation planning in the state. Such a plan covering key wildlife areas, critical wildlife habitats outside PAs, wildlife corridors, ecologically sensitive zones, existing PAs and multiple use zones would be needed for overall conservation of biodiversity. With exception of Balpakram NP and adjoining PAs, most of the PAs in Meghalaya are mall and isolated. Compared to many hill states of India, Meghalaya has very low (6% of the forests) PA coverage. Conservation status of the buffer forests, contiguity of the PAs and critical biological corridors have not been assessed so far.

5. 3 Gaps in Management of Community Forests and Reserved Forests

- Presently there are over 100 prominent community forests in the state, of which only 41 have been declared as Community Conserved Areas (CCAs). Remaining forests and sacred grooves are reportedly facing increasing threats from commercial exploitation of bio-resources and unsustainable *jhum* especially on steeper slopes. However, their conservation status has not been ascertained.
- Studies by Tiwari *et al.* (1998) and Khan *et al*. (2008) have flagged the problems pertaining to management of sacred groves in Meghalaya. The erosion of traditional conservation practices, and neglect of religious beliefs towards nature

have been the major reasons for loss and degradation of sacred groves. Economic factors particularly poverty, socio cultural changes, loss of traditional ways of resource use are the other factors. Most of the community forests have not been studied in terms of ecosystem services and conservation values.

- There are gaps between the customary laws, indigenous local knowledge related to *jhum* cultivation and management of community forests. Similarly, there are wide gaps between the state and national policies and local practices resulting in unabated degradation and fragmentation of forests in the state

  There is no institutional mechanism to monitor or assess the status of community forests, enhance awareness and education programs for communities. Better awareness and education can play a vital role in sustainable forest use, which can provide continued benefits to communities.
- There are no schemes for joint management of community forests with involvement of Forest Department and other state agencies.
- There is lack of incentives to communities for declaring their village or community forests as a conservation reserve or CCA.

5.4 Gaps in Species Management and Conservation

- Presently most of the research and short term studies in Meghalaya focus on basic surveys of flora and fauna. Despite a long history of such surveys, new species are regularly being added to the state. There is a dearth of information on most of the endangered, threatened and rare species. Information on populations of species and their habitats are needed for future monitoring and formulation of conservation strategies.
- Absence of long term monitoring programme for threatened and endangered species within PAs and community forests is a major gap. Baseline information and data on status of several threatened species e.g., *Aquilaria khasiana, Gymnocladus assamicus, Illex khasiana, Jasminum adenophyllumm, Nepenthes khasiana, Nymphaea tetragona, Gyps bengalensis, Gyps tenuirostris, Sarcosgyps calvus, Philatus shillongensis, Hoolock hoolock, Elephas maximus, Neofelis nebulosa* etc. are required, (Gazette of India Extraordinary, II-3, 2009)
- There is lack of species specific conservation strategies and species recovery programme for endemic, threatened and
- critically endangered species in the state.
- The state needs to revise forestry working plans as per the new National Working Plan Code (2014) that recommends mainstreaming of biodiversity conservation. Similarly, all Conservation Reserves and PAs will require comprehensive management plans.

5.5 Gaps in Conservation of Agro-biodiversity and Domestic Livestock

- There is a need for Native crop varieties, land races and wild relatives of crop plants to be catalogued completely.
- Inadequate supply and poor public distribution of quality planting material and seeds of crop varieties is a major challenge in the state (Deka 2015). Also, there is a lack of proper incentive for local farmers who maintain local breeds of livestock and crop varieties.
- The farmers in Meghalaya suffer due to lack of access to credit schemes. Such a scheme could be used for promotion of conservation of native biodiversity. In many states of India a significant proportion of agricultural credit is provided by co-operative institutions.
- The farmers in the state generally lack capacity for maintaining indigenous breeds, feeding and management of indigenous livestock that requires a strong extension work from the Department of Animal Husbandry.
- The silkworm cultivators in the state are inadequately equipped. They lack proper incentives and marketing opportunities. Skill enhancement and other inputs to ensure that farmers receive a fair price for their produce are other necessities (Upadhyay & Barman 2013).

5.6 Gaps in Integrated Planning and Resource Allocation for Biodiversity Conservation

- Currently there is limited effort for integrated planning for conservation of biodiversity and sustaining ecosystem services. These activities are directly linked with the Sustainable Development Goals (SDGs). Therefore apart from the Department of Environment, various other agencies such as Finance, Planning and Rural Development also need to participate in planning.
- Each state department has targets and priorities which sometimes overlaps with other departments. However, most of the state departments work in isolation and do not make attempts to converge and cooperate with related sectors. Fisheries, Forestry and Agriculture are the primary natural resource based sectors in the state, where many sectoral targets overlap. These sectors need coherence and convergence.
- Many sectors such as trade, fiscal policies, land revenue, mining, transport and agricultural sector also have a significant influence on forests and natural resources. However, there is a need for cross sectoral linkages to identify strategies and policies that negatively affect biodiversity and ecosystems.
- For integrated natural resource management, participatory planning and close coordination and coherence between the state, district councils and local institutions are needed.
- There is a need for devising guidelines and mechanisms for establishment of access and benefit sharing agreements between the communities which own the genetic resources and industries who require these resources.

Box 5.1 Management Effectiveness Evaluation for PAs of Meghalaya

The Management Effectiveness Evaluation report for PAs of India (Mathur *et al.* 2015) traces its origin in the global IUCN MEE initiative. This report evaluates the effectiveness of PA management in terms of biodiversity conservation, participatory planning and effective management. The MEE report of India included a SWAP analysis of the strength, weakness and action plans of 125 PAs. Based on a critical review of the management issues and practices in the four PAs of Meghalaya i.e., Nokrek NP, Balpakram NP,Nongkhyllem WLS and Siju WLS, following points emerge:

A. Management Strengths

1. The values of and threats to the PAs systematically identified and assessed.
2. There are no human habitations inside the PAs.
3. Most the PAs have comprehensive management plans.
4. Local stakeholders have been identified and dialogues have been initiated for participatory management of the PAs.
5. The PAs safeguard conservation of several threatened species and local biodiversity.
6. A considerable progress has been made to mitigate human-wildlife conflicts around these PAs.
7. These sites are well integrated into larger conservation landscapes and connected with Community Reserves and a Biosphere Reserve.
8. There is an institutional mechanism to use financial resources for the conservation and management of biodiversity.
9. The PA management authorities have mechanism to address the issues of sustainable livelihoods for the bio-resource dependent communities around the fringes of the parks.

B. Management Weaknesses

1. There is no mechanism to monitor the populations of threatened species systematically.
2. There is no mechanism to involve the local communities in joint forest management (JFM) in the absence of JFM Committees or eco-development committees.
3. All the PAs suffer due to inadequate number of frontline staff and inadequate funding to meet the management objectives.
4. There are no interpretation centres and websites for these PAs which are necessary for extension and conservation education.
5. There are incidences of illegal felling and hunting within the PAs.
6. There is absence of any systematic habitat restoration programme or projects in PAs.

C. Actionable Points

1. Status of threatened taxa both flora and fauna needs to be assessed on regular basis and effects of management intervention on such species need to be documented.
2. Stakeholder involvement in conservation programmes need to be enhanced through formalization of eco-development committees and JFMCs.
3. Allocation of more financial resources and timely release of funds to PA management are needed.
4. Adequate number of trained frontline staff and officers are needed for each PA.
5. Incidences of illegal felling and illegal hunting and wildlife trade needs to be curbed effectively.
6. Nature interpretation centres and websites for disbursement of information regarding PAs needs to be established.
7. Appropriate habitat restoration plans should be conceived.
8. The complaint reporting system must be made more efficient and responsive.
9. The role of NGOs are needed to be evaluated and if required, they should be involved in studies, monitoring and management of PAs.

Table 5.1 Summary of Gaps in Management, Conservation, Policies and Actions

5.1.1	**Gaps in PA management**
a)	Need of comprehensive assessment of threats to PAs and species
b)	Need of public participation in management of Pas
c)	Need of trained staff
d)	Need of landscape level conservation planning
e)	Gaps in assessment of biological corridors
5.1.2	**Gaps in management of community forests and Reserved Forests**
a)	CCA status and legal protection conferred to very few community forests
b)	Need for studies on role of these community forest on biodiversity conservation, ecosystem services and conservation values
c)	Gaps between state and national policies and local practices
d)	Gap in connectivity of community forests and the state forests which hampers migration and dispersal of mega-fauna
e)	Lack of awareness, vocational training etc. in communities for better and sustainable management of community forests
f)	Need for joint management of community forests
g	Lack of proper incentives to communities for declaring village forests as CCAs and maintaining CCAs
5.1.3	**Gaps in species management and conservation**
a)	gap in information most of the endangered, threatened and rare species.
b)	Absence of long term monitoring programme for these species within Pas and community forests.
c)	Need for Conservation Action Plans and species recovery programme for critically endangered species
d)	Need to revise existing working plans and management plans for all PAs.
e)	Need of institutional mechanism to collet baseline data for species
5.1.4	**Gaps in conservation of agro-biodiversity and domestic livestock**
a)	Gap in information on most of the endangered, threatened and rare species.
b)	Absence of long term monitoring programme for these species within PAs and community forests.
c)	Need for Conservation Action Plans and species recovery programme for critically endangered species
d)	Need to revise existing working plans and prepare management plans for all Pas.
e)	Need of institutional mechanism to collect baseline data for species.
a)	Need for documentation of native crop varieties, land races and wild relatives of crop plants
b)	Lack of supply of good quality planting materials, local varieties of seeds and livestock breeds
c)	Lack of access to credit schemes to promote conservation of native biodiversity
e)	Silkworm cultivators in the state are inadequately equipped, lack incentives and market access
5.1.5	**Gaps in integrated planning and resource allocation for biodiversity conservation**
a)	Lack of integrated planning for conservation of biodiversity and sustaining ecosystem services
b)	Lack of coherence and convergence between state departments
c)	Lack of understanding of cross-linkages in policies of different departments leading to policies that negatively affect biodiversity
d)	Lack of coordination between state, DCs and local institutions for natural resource management
e)	Lack of guidelines for establishment of ABS
f)	Lack of understanding and coordination for biodiversity related finance by different government departments.
5.1.6	**Gaps in state policies and action**
a)	Lack of integration in sectoral policies for SDGs
b)	Absence of participatory planning and on ground implementation
c)	Lack of integration of biodiversity values in state planning and policies
d)	Gaps in existing policies and implementation
e)	Lack of laws and awareness regarding bio-piracy
f)	Lack of awareness among communities regarding genetic resources and community rights
5.1.7	**Need for capacity building and strengthening of Institutions**
a)	Need assessment of capacity building and awareness requirements of VCs and BMCs
b)	Need for capacity building of frontline forest staff for participatory planning and adaptive management of forests and forest resources.
c)	Need to employstaff and procure required equipment for protection and conservation of biodiversity
5.1.8	**Information gaps and research needs**
a)	Need for economic valuation of ecosystem services and biodiversity for PES and ABS mechanisms
b)	Need to achieve ABS through REDD+ and environment certifications etc.
c)	Need to protect TEK of indigenous communities against theft, bio-piracy and unjust practices of traders and Industries
d)	Lack of compensation to communities for utilization of community resources
e)	Biodiversity registers are lacking at present and there is lack of awareness regarding their role in claiming community rights
f)	Lack of monitoring, tracking and reporting mechanism for forest and genetic resources

- Lack of understanding and coordination for biodiversity related finance by different government departments. The Biodiversity Finance Initiative (BIOFIN) is an innovative tool which builds an economic case for increased investment in the management of ecosystems and biodiversity. BIOFIN aims to develop a methodology for quantifying the biodiversity finance gap for improving cost-effectiveness, and for developing comprehensive national resource mobilising strategies.

5.7 Gaps in State Policies and Action

- Very little attempts have been made at integrating the sectoral policies such as Industry, Mining, Agriculture, Rural Development and Tourism for mainstreaming sustainable development goals into these sectors.
- In the absence of participatory planning, many programmes and policies remain on paper and have not been implemented on ground.
- There is a lack of integration of biodiversity values into state planning and their adaptation as policy instruments.

5.8 Need for Capacity Building and Strengthening of Institutions

- The need for capacity building and awareness generation have not been assessed for the community based organizations such as Village Councils (VCs) and Biodiversity Management Committees (BMCs) in the state. These assessments would be useful for developing curricula and conservation education programmes and creating harmony with district and state level institutions towards achieving the national and state level targets of biodiversity conservation.
- The frontline forest staff of state Forest Department need to be trained in participatory planning and adaptive management for managing forests and forest resources.
- The State Forest Department is understaffed and under equipped at present. There is need to engage more staffs and procure required equipment for better protection and conservation of biodiversity.

5.9 Information Gaps and Research Needs

- There is a need for theme based research in various fields related to biodiversity to meet awareness and educational goals of the state.
- Economic valuation of biodiversity and ecosystem services allows the local communities and policy makers to realize the significance of their resources and formulate mechanisms for payment for ecosystem services (PES). There is, however, absence of standard accounting procedures and tools for economic valuation of these services. Some of the critical and highly useful services such as watershed functions, access to clean drinking water, soil conservation and landslide prevention, need to be evaluated and incorporated in integrated conservation and development planning.
- Meghalaya has tremendous potential to account for Carbon under Reduced Emissions from Deforestation and Forest Degradation (REDD+) and environmental certification (Redford *et al*. 2015), however this potential is yet to be realised.
- Documentation of traditional knowledge on use of biodiversity in the state is far from complete. Hence access and benefit sharing (ABS) mechanism has not been developed yet. Rules for ABS in the context of Meghalaya needs to be formed.
- Traditional Ecological Knowledge practitioners of the indigenous communities still lack any effective protection or compensation for losses against theft, bio-piracy and unjust practices of traders and industries.
- Many community resources are being utilized without proper protection or compensation to the communities.
- The community biodiversity registers have not been formed yet, local communities and BMCs are not fully aware of the rights and state government have not been able to make them aware of the importance of biodiversity registers in claiming community rights.
- There is absence of appropriate monitoring, tracking and reporting mechanisms for forest and genetic resources (Upadhyay & Barman 2013).

VI State Biodiversity Strategies and Action Plan

Aswin Kumar

06 State Biodiversity Strategies and Action Plan

The purpose of this Biodiversity Strategy and Action Plan for the state of Meghalaya (MBSAP) is to promote effective implementation of the Convention on Biological Diversity (CBD) through a shared vision, clear mission, strategic goal and targets.

6.1 Vision

The vision of this Plan is to bring all the stakeholders on a common platform and work towards "Living in harmony with nature" in consonance with the larger goal i.e., "*By 2050, biodiversity is valued, restored, conserved, and wisely used through effective participation of local communities and integration of best practices of traditional knowledge, ensuring sustained flow of ecosystem services for overall well-being of all people of Meghalaya.*"

6.2 Mission

The mission of the MBSAP is to take effective and urgent action to mainstream biodiversity conservation and halt the loss of biodiversity of the state by 2030, for sustaining essential services, and human well-being. To achieve this, Meghalaya would work towards reducing pressures on ecosystems, restoration of degraded ecosystems and sustainable management of natural resources in participation with local communities. In addition, the state departments would protect genetic diversity and work towards sharing of benefits from the use of genetic resources and traditional knowledge with local communities. Awareness of biodiversity and its values would be promoted and mainstreaming of biodiversity in policies and practices would be ensured through the states' ministries, departments and public institutions in partnership with local community groups/civil society and the private sector.

6.3 Guiding Principles and Goals

The MBSAP is based on a detailed national biodiversity action plan (2008) supplemented by an addendum (NBAP Addendum, 2014). Following the principles of NBSAP, all the states of India are required to prepare the state BSAPs. Subsequent to the recommendations of the 10th Conference of the Parties (COP) in 2010, it has been decided that all the BSAPs would lay special emphasis on Access and Benefit Sharing (ABS) mechanism as outlined and agreed under Aichi Biodiversity Targets. These Targets are further grouped within five goals. Parties are invited to set their own targets within flexible framework, taking into account national needs and priorities, while also bearing in mind national contributions to the achievement of the global targets.

The Meghalaya BSAP takes guidance not only from CBD, and the 20 Aichi Biodiversity Targets but also from the NBAP, which in turn is adoption of Aichi Targets for implementation at National level. The five strategic goals of the Aichi Biodiversity Targets are -
The strategies and action plan for the state of Meghalaya, have been realigned under the 12 targets listed as Meghalaya Biodiversity Target (MBT), which emanate from the National Biodiversity Targets, prioritized according to state's biodiversity, socio-cultural setting and governance. The strategies for each of these MBTs are developed for achieving the targets through state and non-governmental mechanisms, with incorporation of these MBTs in the state planning process. Each of the MBTs and their strategies are based on strong rationale for the state.

Strategic goal A

Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

Strategic goal B

Reduce the direct pressures on biodiversity and promote sustainable use

Strategic goal C

Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

Strategic goal D

Enhance the benefits to all from biodiversity and ecosystem services

Strategic goal E

Enhance implementation through participatory planning, knowledge management and capacity building

The strategies and action plans corresponding to each of the Meghalaya Biodiversity Targets are as follows:

6.4 Strategies and Action plan

6.4.1

MBT 1

MBT 1 By 2030, a significant proportion of the state's population, especially the youth, is aware of the values of biodiversity, and the steps they can take to conserve and use it sustainably.

Aichi 1 By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.

6.4.1.1 Rationale

Meghalaya is a state with a fairly good forest cover (77%, FSI, 2015). Most of the forests in the state (>90% geographical area) are owned by the local communities. The State Forest Department controls only about 6% area of the forested tracts. Most of the people (80%) in the state are dependent on agriculture. The slash and burn cultivation is the mainstay of the people in the state, which is getting distorted with reduced *jhum* cycles leading to loss of productivity, depletion of soil moisture and nutrients. Most of the people in the state live in vicinity of the forests, and subsist heavily on them for various resources. Presently there is hardly any institutional mechanism to increase awareness about biodiversity and environmental conservation among the local people. Since, literacy in the state is higher than national average (75.48%, Census of India, 2011), one way to increase awareness about biodiversity and natural resources would be to engage the youth through existing educational institutions.

Rural youth in the state can be engaged meaningfully in the conservation of biodiversity and natural resources partly through their school curricula i.e., Environment Education. Environmental Education is made a compulsory subject in Meghalaya since 2007 and is assessed internally by grades (MBOSE; Chharliani 2014). However, it is not treated like other core subjects due to lack of awareness, lack of qualified teachers, and shortage of funds. Environmental education is not on priority in the education system in the state. Thus, for achieving the state biodiversity target the environmental education has to be integrated in the state education policy and the values of biodiversity have to be identified as a thrust area for students to learn about. Lack of such formal and informal education need to be introduced and mainstreamed into education policy of the state. This policy will take care of the gaps in environmental education in the state not only for the formal education sector but also in the informal sector addressing school dropouts and youths from the villages and urban areas.

MBT 1

6.4.1.2 Strategies and Actions

Actions

Strategy 1.1	***Enhance environmental awareness and values of biodiversity among the youth.***
1.1.1	Assess the awareness about environment and values of biodiversity among youth
1.1.2	Identify the gaps in information regarding environmental awareness among the youth and target groups, i.e., school children and youth involved in agriculture and various development programs
1.1.3	Develop curricula on biodiversity conservation and sustainable management for schools and colleges and implement
1.1.4	Plan and organize regular environmental and biodiversity awareness workshops for students in school, colleges, agriculture sector, vocational training institutes, and other workplaces

Actions

Strategy 1.2	***Mainstreaming environmental education, research and conservation awareness in the state education policy***
1.2.1	Review current environmental curricula of the state and incorporate biodiversity components
1.2.2	Review the state education policy and suggest necessary amendments by including environmental education, research and biodiversity conservation awareness
1.2.3	Identify agencies involved in environmental education, research and awareness raising programs and set up a coordination mechanism for education and awareness
1.2.4	Review informal education programs of the institutions such as ICAR, NBPGR etc. as per state environmental education policy of the state and suggest modifications to streamline these programs
1.2.5	Incorporate indigenous traditional knowledge and traditional eco-friendly industries related to biodiversity conservation in the state education curricula

Actions

Strategy 1.3	***Build capacity of educational and training institutes in imparting environmental education, research and advocacy programs.***
1.3.1	Conduct need assessment surveys for informal education sector and plan for capacity enhancement training programs and workshops.
1.3.2	Conduct need assessment for formal education sector and develop plan for capacity enhancement
1.3.3	Explore future possibilities and present funding for environmental capacity building via corporate social responsibility (CSR) initiatives
1.3.4	Organize capacity building training programs and workshops for formal and informal educational institutions

6.4.1.3 Indicators

Indicators

1	Trend in number of students taking biodiversity and environment courses or research at higher education in formal and informal sectors such as ICAR, NBPGR, BSI and ZSI
2	Number of schools enrolled in the National Environment Awareness Campaign, Paryavaran Mitra Programme, Gyan Vigyan Vidyalaya, birdwatching clubs
3	Trend in number of government financed projects related to biodiversity and conservation
4	Trends in visit to Protected Areas, natural history museums, exhibitions and zoological/botanical gardens
5	Trends in number of Biodiversity Management Committees (BMCs) constituted/operationalized
6	Trends in number of people's biodiversity registers (PBRs) prepared

Specific actions

6.4.1.4	Specific Actions
1	For enhancing environmental and biodiversity awareness among youth regular (e.g. biannual) environmental and biodiversity awareness workshops and programs need to be organized by the State Education Board, Forest Department, other educational institutions, vocational training institutions, Agriculture Department and research institutes in the state
2	Encourage the use and development of dedicated biodiversity portals through electronic means or websites that include information, interaction and up to date knowledge for all sections of the public which include database, maps, species information, discussions, opportunities, research highlights in the fields of biodiversity and relevant updates
3	The state education policy needs to be redrafted for mainstreaming environmental education. The informal environmental and biodiversity educational programs or institutions such as NBPGR, IARI, Forest Department, and other institutions should also be reviewed and streamlined for maximum impact on the informal sector. These programs should also be streamlined to the new education policy of the state
4	Capacity enhancement of educational institutes, schools, other biodiversity related institutions (with respect to environmental and biodiversity awareness) in both formal and informal education sectors need to be undertaken through enhanced exposure and funding. Non-government funding for this capacity enhancement should also be explored through corporate CSR, corporate biodiversity funding, institutional funding and NGOs
5	Educational institutions, state departments and research institutions should also encourage students to take up projects, trainings or Ph.D. students in environment, forestry and biodiversity management related aspects
6	Incorporate study of indigenous traditional knowledge (ITK) of the state into the secondary school curricula. Sacred groves, living root bridges, and other traditional knowledge related to biodiversity conservation, art and culture should be integrated in school education system
7	Awareness to local communities regarding ill effects of vegetation and top soil loss is also essential for their support during such exercises and in stopping further deforestation of such fragile areas
8	Promote R&D in cottage industries such as eri or muga silk cultivation and silk production via traditional technologies to enhance livelihood and biodiversity conservation
9	Specific initiatives in areas of concern towards awareness, education and research in biodiversity themes such as climate change, soil erosion, wild life conservation traditional knowledge pollution, eco development, catchment areas landscape level planing for conservation and flagship species

6.4.2

MBT 2

MBT 2: By 2030, values of biodiversity are integrated in state planning processes, development programmes and poverty alleviation programmes.

Aichi 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are incorporated into national accounting, as appropriate, and reporting systems.

6.4.2.1 Rationale

Biodiversity and ecosystem services are closely linked with rural livelihoods, other cultural traditions, and social entrepreneurship. In recent years, emphasis has been laid on computing these values in economic terms, so as to realize their significance in planning process. In Meghalaya, no attempts have been made towards valuation of biodiversity or ecosystem services. Only a few *ad hoc* (REDD+ related) studies in forest reserves have looked at valuation of biodiversity. Thus, a comprehensive valuation of these services from the protected areas and community conserved areas is needed. At the same time, there is a need to build capacity of state agencies in valuation and build institutional mechanisms for accounting

The focus of this target is thus to build state capacity for valuation of biodiversity and ecosystem services and incorporation of these values in state planning, policy making, formulation of poverty alleviation strategies and preparation of developmental plans

Actions Actions Actions

6.4.2.2	Strategies and Actions
Strategy 2.1	***Set up an institutional mechanism for valuation of biodiversity and ecosystem services***
2.1.1	Identify a lead agency to coordinate valuation of biodiversity and ecosystem services
2.1.2	Take stock of initiatives in valuation of biodiversity and ecosystem services
2.1.3	Develop institutional arrangements for implementing biodiversity and ecosystem valuation programs, including developing linkages with relevant agencies
Strategy 2.2	***Build capacity for valuation of biodiversity and ecosystem services***
2.2.1	Assess current capacity, gaps and needs for valuation of the biodiversity and ecosystem services
2.2.2	Build capacity in valuation of the biodiversity and ecosystem services and integration of values into state and national planning and policy making process and accounting system
Strategy 2.3	***Mainstream biodiversity conservation and ecosystem management into environmental policy, legislations and development plans***
2.3.1	Review state level policies and legislations to mainstream biodiversity and ecosystem services, with involvement of marginalized communities
2.3.2	Incorporate biodiversity and ecosystem service values into relevant state documents such as the five year development plan
2.3.3	Mainstream biodiversity conservation in the state level poverty alleviation programmes and strategies
Strategy 2.4	***Engage poorest section of the society in conservation / forestry projects***
2.4.1	Engage forest dependent marginal farmers in central and state government schemes such as MGNREGA, Green India Mission, REDD+ and other schemes to prevent further degradation of forest ecosystems
2.4.2	Integrate rural livelihoods with the Integrated Basin Development and Livelihood Promotion programme

Indicators

6.4.2.3 Indicators	
1	Trends in number and effectiveness of measures developed in the MGNREGA and Integrated Watershed Management Programme
2	Trend in number and coverage of studies related to biodiversity - TEEB etc
3	Trend in capacity building for valuation of biodiversity
4	Trends in reflection of biodiversity and ecosystem services in policy decisions, planning and reporting processes
5	Trend in engagement of marginal farmers, communities involved in eco-restoration and conservation programs

Specific actions

6.4.2.4 Specific Actions	
1	Valuation of biodiversity and ecosystem services is one of the most important steps for preventing misuse and destruction of these services. As the process of valuation requires inputs and coordination of a number of institutions, a core committee must be formed by the Department of Environment of the state involving institutions with experience in these valuations. The Economics of Ecosystem and Biodiversity (TEEB), UNEP, The Energy Research Institute(TERI), and Indian Institute of Forest Management (IIFM), Bhopal are the pioneering institutes in India, which have developed methodologies and evaluated ecosystem services in various landscapes. North Eastern Hill University with their expertise in working in Meghalaya on biodiversity and ecosystems is also one of the institutes in the state whose expertise could be utilized in evaluating values of biodiversity and ecosystem services
2	The Technical Committee with inputs from national institutions can also play a major role in development of capacity for regular monitoring of biodiversity and ecosystem services. Capacity building of local and state institutions duly backed by establishment of institutional mechanism for regular monitoring would be most desirable action
3	The state level policy makers need to be sensitized about role of biodiversity and ecosystem services in development. Workshops and consultative meetings, would be needed for state policy makers, the valuation committee, Forest Department and other stakeholders for incorporation of the value into state planning, policies, accounting process and developmental plans
4	Policy and administrative reforms are needed for convergence of key line agencies so that conservation and development, rural livelihood programmes are integrated
5	Initiate new programmes and projects on eco-restoration, eco-development, REDD + etc. in and around PAs under state and central schemes and engage poorest sections of society in order to reduce exploitative pressure on forests

6.4.3

MBT 3

6.4.3 MBT 3: Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are developed and actions put in place by 2030 for environmental amelioration and human well-being.

Aichi 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

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

6.4.3.1 Rationale

Meghalaya, being a 6th Schedule state in India, allows local communities to retain ownership of the land. Like other states of the north eastern India, it has a very different land tenure system.The state has only a few Protected Areas PAs, which have been established by buying forest from the local communities. In order to strengthen biodiversity conservation, the state needs to notify and protect additional high biodiversity areas viz. (IBAs), Key Biodiversity Areas (KBA), RAMSAR sites and areas rich in crop-wild relatives. There is urgent need to map these areas in the state and initiate appropriate conservation measures.

Many ecologically fragile areas are prone to degradation and fragmentation. Hence, identification of direct and indirect causes of degradation, mapping of degraded areas (habitat and ecosystems), and setting up mechanisms to restore these areas are priority activities proposed to meet this target.

6.4.3.2 Strategies and Actions

Actions Actions Actions

Strategy 3.1	***Map biodiversity rich habitats and ecologically sensitive sites***
3.1.1	Identify biodiversity rich sites and habitats outside PAs
3.1.2	Identify and map ecologically sensitive sites
3.1.3	Identify important localities and degraded areas for eco-restoration
Strategy 3.2	***Identify major driver or causes of environmental degradation***
3.2.1	Assess various drivers of environmental degradation and identify the major drivers
3.2.2	Assess status and trends of biodiversity and ecosystem services and integrate with state policies
3.2.3	Assess and explore linkages between positive effects of these interventions on human well being
Strategy 3.3	***Reduce the rate of habitat degradation, loss and fragmentation***
3.3.1	Account for the extent and rate of habitat loss due to forest clearance, fragmentation and degradation
3.3.2	Initiate eco-restoration programmes through participatory process in highly degraded areas, especially round PAs and mined sites
Strategy 3.4	***Address the major causes of habitat loss and environmental degradation***
3.4.1	Enhance awareness on forest fire and other potential factors causing habitat loss
3.4.2	Strengthen state fire management program in terms of human capacity, research, technology, coordination, surveillance and response system
3.4.3	Scale up community-based forest fire management approaches
3.4.4	Identify key drivers of habitat loss and degradation, and develop strategies to minimize them.
3.4.5	Develop policy and programs to engage local communities in management of forests and by providing alternative or additional sustainable livelihood schemes
3.4.6	Integrate Biodiversity Offset mechanisms in Management Plan of the PA, for compensation of biodiversity impacts associated with developmental projects

6.4.3.3 Indicators

Indicators

1. Change in proportion of forest cover in different forest categories
2. Changes in areas under riverine ecosystems and wetlands
3. Changes in water quality and water flow
4. Trend in afforestation and Assisted Natural Regeneration
5. Trends in slash and burn agriculture
6. Status of selected indicator species (eg. gibbons, elephants, clouded leopard, *N. khasiana*)
7. Trend in soil health records awarded titles under FRA in forest areas

6.4.3.4 Specific Actions

Specific Actions Specific Actions Specific Actions

1. Geographical Information System and georeferenced images has become one of the major tools in understanding species distributions, conservation of species and ecosystem management. Institutions with expertise and ground knowledge on both aspects of GIS and species diversity may be approached to prepare GIS based interactive maps for identifying areas with high biodiversity, ecologically sensitive areas, critical ecosystems and areas which need restoration inputs. NESAC,NRSA, ISRO and IIRS have expertise in this field and the state government needs to collaborate with these agencies for preparing such maps which can further conservation planning
2. Scientific studies need to be initiated to examine the level of extraction of various NTFPs and its effect on the biodiversity and ecosystems. Permissible limits of extraction needs to be established for each NTFP category. In this regard Forest Departments may collaborate with local colleges and universities for taking up such studies in the RFs and Community Forests
3. The state government needs to develop incentives for sustainable harvesting and good management practices. Illegal harvesting and extraction also need to be monitored, and discouraged
4. Massive awareness programme on illegal trade of wildlife products need to be initiated for general public, state police department and other stake holders. Local communities should be made aware of the management practices adopted by other communities eg. Khonoma nature reserve. Communities must be encouraged to manage extraction of resources by proclamation of local laws and implementation state level policies, through a system of fine and punishment
5. Community based forest fire prevention, control and monitoring programme consisting of a state wide fire control mechanism needs to be setup. Rapid response teams consisting of community leader's *viz., Nokmas, maharis,* village council members, could be made in each village or cluster of villages. Areas should be designated according to potential fire risk and fire zones. The rapid response team should be equipped with latest fire control equipment, and must be alerted whenever a *jhum* is being burned in any village to prevent spread of fires in community areas and forests
6. The state government and district councils need to define policies for deforestation or construction on hill tops which are a major reason for habitat loss, soil erosion, landslides, mudslides and barren areas. For abatement of degradation of ecosystems, maintenance of valuable top soil for agriculture and to prevent natural calamities, the development or construction and clearance of forest on hill tops must be stopped immediately
7. Habitat restoration and afforestation programs are essentially needed for hill tops, steep slopes and degraded watersheds which need immediate intervention by Forest Department, District Councils and Agriculture Department. The hill tops around Nokrek, Balpakram NP, and other fragile areas are immensely important and need to be taken up on priority basis. This would contribute to human welfare by aquifer recharges, providing continuous water resources to local population, preventing top soil loss benefiting agriculture etc
8. Pollution from mines, industries, vehicles and ecological disturbances can have adverse effect of human health and well being. Likewise pollution of water bodies affects health of aquatic ecosystem and biodiversity. The state needs to collect baseline data on the status of environmental health with the help of technically qualified agencies. Such endeavors should be encouraged through funding and awards. The result of these studies could be utilized in preparing policies for pollution control, sustainable use of bio-resources with minimum impact on biodiversity and ecosystems in the state
9. Diversion of forest lands to non-forest uses, particularly for mining and building roads need to be minimised. A comprehensive eco-restoration of these areas is also needed and existing technologies need to be applied for rehabilitation of mined areas. Required funds for these programmes could be made available by the Ministry of Environment and Forests, Govt. of India under Green India Mission or CAMPA funds

Specific Actions

10. As mining and other forms of pollution including vehicular and industrial are related to a number of adverse health effects, awareness about this needs to be done amongst mining sector and general public. A well-structured awareness programs should be undertake for all stakeholders

11. Most of the mines do not comply with environmental management or scientific methods. It is also essential to undertake proper EIA notification to check for environmental problems related to mining, particular EPA 1986 or the EIA notification 1994. Unauthorized Rat-holes mines are prone to collapse and thus are very risk prone, and no safety procedure is followed in the community or privately owned mines in the state. Effective mining policy needs to be implemented and mines should not be allowed unless mine owners adhere to the protocols of safety, pollution control (water, air and land) and mining methods which reduce risk to human health both for the miners and the population living in vicinity

12. Mining is one of the major cause of water pollution (Eugene & Singh 2014). Proper management and conservation of water resources by the various stakeholders, particularly mine owners and cement plant managers is needed to safeguard aquatic life. State pollution control board and mining and mineral department must take steps to stop discharges of mining wastes in rivers, or mining in the river basin or vicinity. Steps must also be taken to recover the degraded aquatic habitats in the river bed and river basins of these rivers

13. Eco-restoration of mines are essential to avoid continued pollution form them, most of these pollutants also pose a greater threat nearby caves, water bodies and land for many years after abandonment. Department of mines and minerals should come up with proper guidelines for closure of mines, and also must provide technology to communities for eco-restoration and filling up of mines. The heavily mined areas of South Garo Hills, Khasi Hills and Jaintia Hills should be the priority areas for restoration and afforestation

14. State conservation agencies need to work with educational institution and wildlife related NGOs for identification of critical wildlife corridors and eco-sensitive habitats and development of strategies for their management

15. Public private partnership (PPP) models for state reserve forests and areas around protected forests have been very successful method to engage communities. Some of the major success stories of PPP model have been the JFM initiated in Arabari, West Bengal (Poffenberger & Singh, 1989, Sarin 1993), and now a widely used PPP model in India, Community Forest and leasehold forestry in Nepal, and Community Based Natural Resource Management in Bhutan (Sharma *et al.* 2006). Similarly, successful models of joint forest management (JFM) needs to be replicated in the state under PPP models (JFM, REDD+). As the livelihood of community depends on these forests, a program enhancing sustenance of these community forests with state help would be beneficial for both the local communities and biodiversity

6.4.4

MBT 4

MBT 4: Terrestrial and inland aquatic and wetland ecosystems and associated species are conserved effectively and equitably, with specific emphasis on climate change effects and adaptations.

Aichi 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Aichi 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

6.4.4.1 Rationale

A large number of aquatic species and their habitats particularly the riverine and inland wetlands are threatened in the state. The state of Meghalaya has experienced considerable change in the pattern of precipitation and hydrology in recent years (MSCCAP 2011), which have long term repercussion for the regional biodiversity and ecosystem functioning. However, there are no baselines on climate change and its impact on the biodiversity of the state. Hence, there is a need to initiate studies for enhancing adaptation and resilience to the effects of climate change.

Conservation status of many rare, endangered, threatened species in the state especially aquatic species of Meghalaya have not been well documented. Data on distribution and status of clouded leopard, different species of macaques, *Mahseer* etc. needs to be further documented. Thus a comprehensive assessment of various taxa is required and species based conservation action plan is needed to be prepared and implemented.

6.4.4.2 Strategies and Actions

Actions

Strategy 4.1	*Strengthen conservation programs for state wetlands, rivers and aquatic species*
4.1.1	Identify important wetlands, rivers, streams, river basins, lakes and catchment areas which are facing threat of destruction, pollution or anthropogenic pressures
4.1.2	Develop policies, guidelines and state laws which enable protection against anthropogenic intervention in aquatic systems and catchment areas of the stats
4.1.3	Implement guidelines and policies related to conservation of aquatic ecosystems, and control of pollution through SPCB, Mining Department etc
4.1.4	Adopt policies for in-situ conservation of aquatic species e.g. several *mahseer* species in the state rivers, streams, lakes etc
4.1.5	Encourage fish sanctuaries, implement non-fishing seasons, and prevent over exploitation and introduction of invasive species in water bodies of the state

Actions

Strategy 4.2	*Strengthen conservation programs for the unique karst ecosystems of the state*
4.2.1	Identify and document the key karst ecosystems of the state
4.2.2	Frame guidelines for anthropogenic interventions and protection of karst ecosystems and its biodiversity
4.2.3	Prevent destruction of caves and restore caves degraded by pollution and mining

Actions

Strategy 4.3	*Assess the impacts of climate change on biodiversity and ecosystems*
4.3.1	Develop a network of long-term climate monitoring stations for the generation of comprehensive climate data
4.3.2	Promote inter-disciplinary research on climate change, biodiversity, and ecosystems
4.3.3	Institute a state mechanism to collate and share data and information generated from research for the development and implementation of adaptation measures and policy decisions
4.3.4	Conduct systematic awareness and educational programs on the impacts of climate change on biodiversit.

Actions

Strategy 4.4	***Strengthen climate change adaptation measures***
4.4.1	Develop a policy on climate change with special focus on food security, biodiversity and water
4.4.2	Develop appropriate long-term ecosystem-based adaptation measures to minimize impacts of climate change on vulnerable ecosystems, biodiversity and communities
4.4.3	Strengthen implementation of immediate targeted actions for prioritized ecosystems
4.4.4	Integrate long-term ecosystem-based adaptation measures into plans and programs

Actions

Strategy 4.5	***Enhance management effectiveness of the Protected Area System and community forests***
4.5.1	Evaluate the management effectiveness of Protected Areas and Biological Corridors
4.5.2	Complete zonation of PAs by 2018
4.5.3	Enhance local community participation in the management of PAs
4.5.4	Review the functionality of Biological Corridors for demarcation, operationalization and legal protection
4.5.5	Review and evaluate Community Reserves, Conservation Reserves and CCAs
4.5.6	Monitor and assess the status and trends of biodiversity within the Protected Area System and community forests
4.5.7	Promote and support trans-boundary management and regional partnership initiatives
4.5.8	Encourage local communities to declare community forests as CCAs by providing schemes for improving livelihood
4.5.9	Prioritize critical areas that connect forest patches and reduce fragmentation for declaration as CCAs District councils should also legally declare these as protected forests reserves with management benefits to communities
4.5.10	Provide incentives to local communities for declaring CCAs and for biodiversity conservation
4.5.11	Earmark funds for research and conservation of cards of sensitive ecosystem such as karst systems

Actions

Strategy 4.6	***Establish sustainable financing measures for the Protected Area System and CCAs***
4.6.1	Develop and implement REDD + activities to support conservation financing
4.6.2	Institutionalize and upscale Payment for Ecosystem Services (PES) initiatives
4.6.3	Upscale nature recreation and eco tourism programs with a financial plough back mechanism
4.6.4	Explore additional innovative financing mechanisms

Actions

Strategy 4.7	**Assess the status of prioritized taxonomic groups and species and the factors affecting them**
4.7.1	Develop a state mechanism and evaluate the conservation status of prioritized taxonomic groups and species
4.7.2	Update the status of Red Listed species which are endemic to Meghalaya
4.7.3	Assess threats to long term survival of prioritized species

Actions

Strategy 4.8	***Strengthen conservation programs for prioritized species***
4.8.1	Prioritize species for conservation based on nationally agreed or state criteria
4.8.2	Develop and implement species-based conservation action plans for prioritized species
4.8.3	Enhance capacity in species-based conservation and monitoring
4.8.4	Strengthen institutional and legal capacities to combat wildlife poaching

6.4.4.3	**Indicators**

Indicators

1	Change in number, area and percentage of PAs, CCAs and Biodiversity Heritage Sites
2	Trend in Biological corridors legally recognized as community reserves, conservation reserves
3	Changes in area and ecological status of wetland through implementation of integrated management plans
4	Change in abundance and diversity of water bird species in wetlands over time
5	Identification of state critical endangered species
6	Population trend of selected species
7	Status and trend of ambient air quality; monitoring water quality, trends in noise levels
8	Trends in pollution status of wetlands of international (Ramsar sites), national and state (identified by state government) importance
9	Trends in biodiversity-inclusive climate change adaptation and mitigation measures formulated or implemented

6.4.4.4 Specific Actions

Specific Actions

Specific Actions

Specific Actions

1. The upper montane region of Meghalaya including forests of Shillong plateau lack any form of legal protection These forests harbor a rich array of floral and faunal diversity comparable to Himalayan temperate broadleaf forests. There is a need to strengthen conservation through community participation and enhancing the proportionate area under CCA
2. The state government needs to provide incentive to local communities for declaration of the village forests, sacred groves or lakes as Community Reserves or other CCAs. Award and prizes should be given to communities for biodiversity conservation and for following traditional knowledge which favours biodiversity
3. Capacity building programs for communities should be undertaken to assess, document, monitor and manage the biodiversity at local level. More areas irrespective of ownership need to be brought under Protected Area network or Community Conserve Area network
4. Research support for conservation of fragile ecosystems and threatened category of species should be provided by the forest department, universities, colleges and other departments of the state
5. Studies on rare, endemic, threatened and endangered species and their conservation need should be encouraged and promoted by the state departments. Ministry of Environment and Forest should provide grants for undertaking these studies, for preparation of Conservation Action Plans and for implementation of the Conservation Action Plans of species and taxonomic groups
6. Identification, initiation of stronger protection and monitoring of landscape level, flagship and keystone species such as elephants, hoolock gibbons and clouded leopards etc. must be mandated. It is vital that source populations and vital connectivity between species is maintained through corridor intactness
7. Colleges, universities and other institutions in the state should promote and fund climate change studies. The effect of climate change and ways to mitigate it should also be studied to frame climate change policies. Various state institutions like forest department, agriculture departments, irrigation department, HRD ministry, tribal affairs department etc. also should encourage students to take up these studies. Climate change adaptations should be integrated in livelihood of people, to mitigate its effects on the income of the people. In addition climate change resilience and adaptation must also be developed in communities to address the effect of this change on livelihood and existence of local communities
8. New ways of financing for conservation of species and landscape like the REDD+ and Payment for Ecosystem Services must be developed for PAs and CCAs in the state. Ecotourism can also work in areas with potential for biodiversity and landscape related tourism. Many villages in Nokrek Biosphere reserve, near Balpakram complex, living root bridges, CCAs and NP and sanctuaries have good potential of developing eco-tourism, through local homestays, nature trails, bird watching trails, trekking, boat rides, cave exploration and other adventure sports etc.
9. Fish reserves are an ingenious system in Garos, where fishes are not allowed to be fished for few few streches of the stream. These practices should be encouraged. In Jaintia and Khasis many fish protection or traditional fishing systems are used that are beneficial to the fishes and aquatic life. Such indigenous systems of protection and fishing should be encouraged by the various government departments, institutions and NGOs
10. Fishing during breeding seasons should be totally stopped in all streams of the state
11. All the Mahseer species present in the state are declining fast, and state fisheries department must take steps to ensure survival of the species and its habitat. Rehabilitation and awareness program of fisheries department in collaboration with Directorate of Cold Water Fisheries Research (DCFR) should be extended to include other mahseer and critical fish species and in wider regions of the state also
12. A directives regarding affluent discharge in streams and lakes must be implemented. Coal and limestone discharges should be totally stopped by means of better environmental policy of the state. These policies must also have legal action for polluters and polluters must treat the affluent before discharging in water bodies if they wish to continue extraction or emissions
13. Ensure proper Guidelines, policies and better practices for mining, industries and vehicles. Laws pertaining to persecution of industry, individual or communities for pollution must be made aware to the polluters, and must be implemented strongly by the SPCB in collaboration with state executive, judiciary and police force
14. State forest department should prepare a state priority list of species based on national criteria. Furthermore, the list of species on the verge of extinction as per the Biodiversity Act must be updated and follow up actions to improve their status must be taken
15. The capacity of forest staff monitoring these species should also be enhanced regularly with training and workshops. Illegal trade and poaching can also be controlled with proper training of forest staff in patrolling, legal actions etc
16. As in Meghalaya forest outside PAs have good populations of most of the endangered, threatened and priority species, local communities must be also involved in protection, monitoring and conservation of these species by means of forming village forest or community forest protection squads. Local village leadership must be involved in protection and conservation of species and its habitat in their village

parameters. Incentive schemes for the villages should also be devised to motivate them to conserve these species and habitats.

Specific Actions

17. Electrocution is a major threat to elephant and arboreal species, particularly mammals like primates, squirrels etc. Regular upkeep of electric poles and wires with pass through forested areas or elephant migration routes should be undertaken, for cables passing particularly through forests or in between forest patches by the Power department and Meghalaya State Electricity Regulatory Commission
18. In order to prevent electrocution deaths of Asian elephants, proper guidelines must be followed (Guidelines for linear infrastructure intrusions in natural areas: roads and powerlines, 2011)
19. For powerlines passing through natural areas, the following additional safeguards must be implemented: a) removing earth wires (and modifying earthing methods), b) modifying line, pole and tower design and placement, to minimize visual (aesthetic), ecological (impact), and wildlife mortalities c) installing underground cables in preference to overhead cables, especially in sensitive stretches
20. Joint forest management and similar practices in Himalayan region has been very effective in addressing the climate change via carbon sequestration and also extraction of forest produce for meeting subsistence needs (Banskota *et al*. 2007). There is a need for both PAs and community forests to be jointly managed by communities with help from state Forest Department for increasing the protection, reduction of anthropogenic pressure, and for maintaining connectivity with larger patches. JFMC must be strengthened and applied to forest outside PAs also
21. Capacity of rural, urban citizens, planning departments etc. is needed to be enhanced on climate change impacts and preparedness. Such as developing capacity on solid waste management, effective distribution of water and services, urban management. Awareness also must be generated at community level to involve communities in the capacity building measures and training (MSCCAP, 2011)

Specific Actions

22. Various research and studies are also needed for carrying capacity mapping, mapping of the vulnerable urban poor in the state (MSCCAP, 2011)
23. Preparation of environmental profile in Green House Gas emission inventory by setting up monitoring stations across state and by providing training to monitoring personnel (MSCCAP, 2011)
24. The state universities, various departments must initiate and encourage studies and investment of resources into NTFPs and forest resources for adaptation into climate change (MSCCAP, 2011)
25. There is a need to formulate landscape level conservation plan for flagship species such as Asian elephant using participatory approach involving multi-stakeholders including those who are concerned with conservation, abating human-elephant conflicts and management of the species.
26. Capacity building of frontlines staff in capture, handling and transport of threatened species of wildlife (e.g. gibbons) from isolated smaller habitat fragments to safer habitats
27. Develop strategies to control the populations of free ranging feral and domestic animals in the wildlife habitats
28. One of the important programmes visualized by the GoM in this direction is the Integrated Basin Development and Livelihood Promotion program (IDBLP). The MBB needs to align its goals and objectives with IDBLP for better livelihood options for local communities.

6.4.5

MBT 5

MBT 5: By 2030, ecosystem services, especially those related to water, human health, livelihood and wellbeing, are enumerated and measures to safeguard them are identified, taking into account the need of women and local communities, particularly poor and vulnerable sections.

Aichi 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

6.4.5.1 Rationale

The ecosystem services are defined as the benefits people obtain from the ecosystems (MA 2005). These benefits include provisioning services such as food, medicine, fuel, and water; regulating services e.g., services that regulate climate, soil erosion and disease outbreaks; and cultural services such as recreational and spiritual benefits from natural areas. The services or benefits can differ across the society, age or gender. Provisioning ecosystem services or products from an ecosystem only become a service when someone harvests it or receives a direct benefit from the product. For regulating ecosystem services, all of the people in the area of the ecosystem or downstream may benefit from their existence without any harvesting or management of the ecosystem taking place. Management of an area may seek to increase the supply of regulating ecosystem services, perhaps for the benefit of particular groups such as farmers or urban residents. Similarly, cultural services of a natural area such as sacred grove depends on the values attached to the area by various groups of the society. The concept of ecosystem services helps in improving the management of any area in terms of ensuring the continued flow of key services and ensures support of the society as a whole. Thus, ecosystem services contribute to overall human well-being and changes in ecosystems and economies affect people and society and vice versa.

Thus, this target focuses on identifying key ecosystems and forest areas, and access the status and value of the services provided. As most of the rural population in Meghalaya depend on forests and ecosystem services, and some of the most marginal societies live in vicinity of these forests, it would be essential to identify ecosystem services which are essential for sustenance of the indigenous or local communities, women and children of the state. Proper strategies will be put in place for safeguarding these critical ecosystems and habitats and their services for the wellbeing of the people of Meghalaya and the country.

Actions

6.4.5.2	*Strategies and Actions*
Strategy 5.1	*Assess key ecosystem services, their flow and use by various groups*
5.1.1	Establish baseline data on key ecosystems services (ESS) from PAs, RFs, and CCAs and flows of these services
5.1.2	Document the patterns of ESS flow across various sections of society including women and poorer sections
5.1.3	Device strategies to integrate ESS into the state level development planning
Strategy 5.2	*Safeguard health of key ecosystemsso as to sustain ecosystem services*
5.2.1:	Identify the major drivers affecting health of ecosystems
5.2.2:	Initiate awareness programmes on ecosystem health and long term ecological security.
5.2.3:	Restore and augment degraded ecosystems for sustaining ecosystem services

Indicators

6.4.5.3	Indicators
1	Trend in number of people with access to primary and secondary education, health services, safe drinking water, electricity and road connectivity
2	Trend in number of people with access to potable water, Trend in number of households with tap water connections
3	Trend in ecosystem services from PAs, CCAs, community forests etc.
4	Trend in conservation measures undertaken to protect critical ecosystems and its services

Specific Actions

6.4.5.4	Specific Actions
1.	Guideline and framework for valuation of ESS from PAs, RFs, and CCAs need to be developed and relevant agencies are to be trained in carrying out the task of valuation of ESS. The PAs, CCAs, RFs, Village Reserve Forests, Sacred Groves, Living Root Bridges, Fish Reserves and other natural areas in the state need to be assessed for their ESS flow and values
3.	Awareness drive for understanding the value of biodiversity and ecosystem services need to be undertaken in areas around such critical ecosystems and forested habitats to not only inform communities about the worth of the ecosystems but also for informing them the loss in terms of water, food and other resources whenever an ecosystem or habitat is destroyed
4.	Identify and maintain traditional values which are essential in recognizing and maintaining ecosystem service flow to the local communities.

6.4.2

MBT 6

MBT 6: By 2030, invasive alien species (IAS) and their pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed.

Aichi 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.

6.4.6.1 Rationale

Rao and Sagar (2011), Shankar *et al.* (2011) and Naithani (2014) have conducted initial assessment of invasive flora of Meghalaya and discussed the changing pattern of flora in the region due to invasives. However, the pathways though which these invasive are affecting the local vegetation structure have not been ascertained. Mitigation measures are needed to be developed to tackle some of these invasives in the natural habitats. Agricultural fields, especially jhum fallows are quites usceptible to invasions by IAS. Therefore, the focus of this target is to collate information on invasive species in the state, mechanism of invasion, human activities which cause rapid invasion and spread of IAS and to develop and implement measures to control and eradicate the priority invasive species.

6.4.6.2 Strategies and Actions

Actions

Strategy 6.1	*Improve understanding on IAS and native species with high potential of invasion*
6.1.1	Complete state level and regional level inventory of IAS and native or naturalized species with potential for invasiveness along with the distribution and pathways of introduction
6.1.2	Develop modules on invasive species for incorporation in the training curricula of relevant institutions.
6.1.3	Promote education and awareness on invasive species and their impacts
6.1.4	Build technical capacity on invasive species management
6.1.5	Monitor and map the spread of invasive alien species in different parts of the state and investigate the pattern of invasion
6.1.6	Assess the impacts of IAS on the native flora, fauna and soil biodiversity. This can be useful in the impacts of IAS on the native flora, fauna and soil biodiversity. This can be useful in evaluating the success of IAS eradication programmes

Actions

Strategy 6.2	*Identify invasive species pathways and changes in areas affected by IAS*
6.2.1	Assess the damage and changes in natural systems and agricultural systems due to IAS
6.2.2	Develop mechanism for IAS monitoring and control in the state
6.2.3	Develop guidelines to prevent weeds and IAS spread and incorporate into policy documents

Actions

Strategy 6.3	*Develop and implement measures to protect natural and agriculture ecosystems against IAS*
6.3.1	Assess the impacts of IAS and native invasive species on agrobiodiversity and production
6.3.2	Develop management strategies for established high-risk species, taking into account the effects of climate change
6.3.3	Develop and implement guidelines to manage and regulate entry and introduction of IAS
6.3.4	Develop an institutional framework for IAS management and regional collaboration

Indicators

6.4.6.3	**Indicators**
1	Trend in baseline creation of IAS spread and extent in each districts of the state
2	Number and coverage of management plans developed for prioritized invasive species and integration with PA management plans and wetland management plans
3	Change in area affected by invasive species

Specific Actions

6.4.6.4	**Specific Actions**
1	Establish baseline data on the area and spread of IAS in the state. Through the use of RS & GIS. species specific management plan and strategies including guidelines for prevention, control and management needs to be prepared
2	Many species such as *Lantana, Eichhornia, Chromolaena, Parthenium, Ageratina, Mikania* etc. have become quite common in PAs of the state also. Programmes comparising comprising local people from the communities can be formed in various districts.
3	Develop guidelines for management and monitoring of IAS from natural areas with the help of various stakeholders including Agriculture Department and the State Forest Department.
4	Take steps to control spread of invasive dwarf bamboo species in the state particularly along *jhum* cultivations

6.4.7

MBT 7

MBT 7: By 2030, measures are adopted for sustainable management of agriculture, forestry and fisheries.

Aichi 6: By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

Aichi 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

Aichi 8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.

6.4.7.1 Rationale

Various state departments along with the education department of state universities, regional universities and various public sector institutions have over the years accessed the biodiversity in forests, rivers and agricultural ecosystems. The state forestry, fisheries and agricultural legislation are guided by sustainable management practices. However, in Meghalaya the land belongs to the communities, and state government has little control of the practices employed in these areas, thus an institutional mechanism is needed to be developed for sustainable management of these areas and species. There is also high levels of exploitation of these resources, and direct and indirect threats from mining, slash and burn cultivation and land use changes. Thus further studies are required to access the ecology of many of these species, the threats to their survival and possible mitigation measures. The management of these areas and species in a sustainable way to reduce effect of these extraction for sustainable use and to ameliorate effect of various threats to these ecosystems is the main aim of this target.

Environmental pollution is also a major threat to all of these habitats, ecosystems and various species. A state mechanism thus also has to be developed to control and to mitigate effect of these pollutants. Mining and jhum cultivation has a major effect on forests, fisheries and also to an extent on agricultural ecosystems. State guidelines and policies are thus essential for managing and sustainable use to these biological resources.

6.4.7.2 Strategies and Actions

Actions

Strategy 7.1	*Strengthen information base, institutional and technical capacity in the conservation and sustainable utilization of fish and aquatic biodiversity*
7.1.1	Identify a lead agency to coordinate inventory of aquatic biodiversity
7.1.2	Conduct a state wide inventory and documentation of fish and other aquatic species diversity
7.1.3	Strengthen institutional and technical capacity in fish and aquatic biodiversity conservation and sustainable utilization
7.1.4	Strengthen local and traditional fish conservation practices with incentives e.g. Fish sanctuaries etc.
7.1.5	Develop and implement sustainable management plans for fish and key aquatic biodiversity
7.1.6	Formulate policies for sustainable use of bio-resources in the state

Actions

Strategy 7. 2	*Identify threats to aquatic life and fish biodiversity and take steps to ameliorate them*
7.2.1	Analyze local fishing methods, particularly those which are detrimental to aquatic life e.g. poison fishing, electric fishing and using explosives for fishing
7.2.2	Prepare guidelines and policy documents to prevent detrimental fishing practices and other developmental activities, which may affect the aquatic ecosystems
7.2.3	Prevent pollution of aquatic systems by formulating and implementing rules related to discharges of urban and industrial wastes into the water bodies

Actions

Strategy 7.3	*Improve management of private forest, State Forest, and village forests for sustainable production of goods and services*
7.3.1	Identify community forests which fall outside the Forest Management Units and lack management plans; bring these forest patches progressively under sustainable management regimes
7.3.2	Review and update codes of best practices and guidelines for holistic sustainable forest management
7.3.3	Constitute a Monitoring and Evaluation mechanism to assess the efficacy of the management plans in terms of sustainability
7.3.4	Promote sustainable management practices in village forests and grazing land

Actions

Strategy 7.4	*Strengthen good governance for sustainable management of forests.*
7.4.1	Strengthen transparency through access to information and consultative or participatory approaches
7.4.2	Enhance institutional capacity for sustainable management of resources and effective delivery of services
7.4.3	Strengthen capacity and empower local communities for sustainable management of resources

Actions

Strategy 7.5:	*Promote sustainable agricultural practices that ensure conservation of biological diversity.*
7.5.1	Assess biodiversity indices based species biodiversity in major farming systems
7.5.2	Introduce appropriate measures for conservation of biodiversity in the agricultural systems
7.5.3	Promote organic farming as per the state or National Agriculture Development Plan
7.5.4	Promote Sustainable Land Management practices supporting biodiversity conservation such as Integrated Pest Management, Integrated Soil Fertility Management Practices, Irrigation Water Management Technologies, Improved Pasture Management and Fodder development
7.5.5	Explore innovative approaches to incentives the adoption of sustainable agricultural practices through product diversification, niche marketing, premium pricing for organic products and products derived from sustainable sources etc
7.5.6	Promote agro - forestry based farming practices
7.5.7	Provide loans and micro-finance opportunities to farmers for sustainable agriculture

Actions

Strategy 7.6	*Major pollutants affecting environment are maintained as per the National environmental standards.*
7.6.1	Strengthen implementation of environmental standards for all major pollutants
7.6.2	Strengthen monitoring and reporting mechanisms for all major sources of pollution
7.6.3	Strengthen environmental performance reporting system by industries
7.6.4	Take steps to reduce usage of plastic and declare Meghalaya as plastic-free State

Actions

Strategy 7.7	*Strengthen research and technical capacity for documenting, monitoring and assessing the impacts of major pollutants.*
7.7.1	Document and quantify major pollutants
7.7.2	Develop capacities to assess and monitor major pollutants
7.7.3	Strengthen research and technologies to assess and monitor impacts of major pollutants on environment, including biodiversity
7.7.4	Adhere to the national baseline for river water quality and develop state baselines

6.4.7.3 Indicators

Indicators

1.	Trend in area under jhum cultivation, trend in jhum cycles.
2.	Trend in usage of agrochemical fertilizers
3.	Trends in increased acreage under crop production (organic and inorganic)
4.	Trend in use of bio-fertilizers, bio-fuels, organic manure and vermicomposts
5.	Trend in proportion of products derived from sustainable sources
6.	Trend in over exploitative inland fishing
7.	Trend in traditional fishing practices

	6.4.7.4	Specific Actions
Specific actions Specific actions	1.	Initiate projects on inventory of aquatic biodiversity of the state covering streams, rivers, lakes etc
	2.	Destructive fishing such as electric fishing, poison fishing and explosion fishing needs to be stopped immediately by enacting laws, policies etc. The State forest department, fisheries department, state institutions like district council, Nokmas council etc. need to take steps to prevent and stop such destructive fishing
	3.	Mining discharges pollute rivers and lakes and makes them inhabitable for aquatic life. Laws and regulation to curb such destruction of riverine habitats need to be formalized by the forest department, fishery department, mining department and pollution control board of the state
	4.	Prepare Conservation plan for aquatic endangered and threatened species for the state and implement at various streams, rivers, lakes and pond level
	5.	Promote Organic farming with programmes such as the Meghalaya Organic Mission which is a step toward achieving it and implementation of this plan with sustainable harvesting would be beneficial for achieving low impact on environment and would prevent agriculture related impact on biodiversity and local ecosystems
	6.	Monocultures are more detrimental to biodiversity as compared to traditional jhum cultivation. Settled agriculture and plantations which ecologically and economically important trees in a mixed culture, multiple cropping etc. must be encouraged. Agriculture department incentives for alternative farming and reducing jhum plantation needs to ensure that no incentives is given for large scale commercial monoculture plantations
	7.	Restore degraded habitats with high growing trees. Area specific native forest tree species for the state can be promoted for utilization. There is a need to establish pilot sites, seed banks and gardens of organic agriculture harbouring high genetic diversity with novel institutions including green markets to ensure farmers' participation or NGOs who facilitate such activities
	8.	Attention is needed to improve the viability of small farms by improving their accessibility to both input and output markets. There is a need to enhance utilisation of Intensive Integrated Farming System (IIFS) to reduce waste and generate maximum output from native and traditional breeds/species
	9.	There needs to be stronger efforts to integrate and develop sustained goals for organic farmers in the purview of biodiversity conservation
	11.	The 'Shifting Cultivation Task Force' of Meghalaya has recommended certain environmentally friendly farming practices including horticulture and high value crops in jhum fields and better fallow management with NTFP and agro-forestry. These recommendations need to be reviewed by state government and implemented appropriately with technical support from IARI, ICAR, and IFAD etc
	12.	More scientific way of jhums and also ways to prolong the jhum cycle are needed to prevent negative effects of short term jhum cycles. Jhum cultivation with alder trees or innovations like cover crop, tree retentions, multiple cropping, water conservation, weed management, new methods of soil conservation and introduction of cash crops with fallow management have high potential in the state

MBT 8

MBT 8: By 2030, genetic diversity of cultivated plants, domestic livestock, and their wild relatives, including other socio- economically as well as culturally vulnerable species is maintained, and strategies are developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Aichi 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

6.4.8.1 Rationale

Meghalaya is one of the richest states in north eastern India in terms of crop genetic resources. The state falls within Indo-Malayan center of crop diversity. It is regarded as the center of origin of Citrus with *Citrus indica* as the progenitor of all cultivated Citrus (Singh 1981). As many as 54 varieties of Citrus have been reported from the state. A citrus gene sanctuary has been established in Nokrek Biosphere Reserve. Similarly, north eastern India including Meghalaya has been considered one of the center of origin of rice, millet and various species of bamboo.

National Bureau of Plant Genetic Resources (NBPGR) and National Bureau Animal Genetic Resources (NBAGR) may work closely with MBB to document these resources and help in identification and conservation of indigenous species and breeds.

6.4.8.2 Strategies and Actions

Actions

Strategy 8.1	*Strengthen conservation of agrobiodiversity and indigenous breeds of domestic livestock*
8.1.1	Develop strategies for conservation of prioritized crops and livestock species
8.1.2	Strengthen technical capacities and infrastructure for ex-situ conservation of agro-biodiversity, including crop's wild relatives
8.1.3	Identify and declare heritage sites for native crop varieties and crop wild relatives
8.1.4	Review current legal and policy framework to address agro-biodiversity conservation and sustainable use
8.1.5	Strengthen and diversify ex-situ and in-situ conservation approaches, including conservation incentives (e.g., promoting geographical indication products), modern germplasm storage for seedbank and gene banks such as cryopreservation etc

Actions

Strategy 8.2	***Strengthen national capacities in documentation and management of agrobiodiversity conservation and sustainable utilization***
8.2.1	Complete the documentation and diversity assessment of key cultivated crops and domesticated animals, including crop wild relatives
8.2.2	Develop capacity to undertake diversity studies of crops and domesticated animals
8.2.3	Strengthen capacities in on-farm management of crops and domesticated animals and in-situ conservation of crop wild relatives

6.4.8.3 Indicators

Indicators

1	Trend in number of indigenous, domesticated breeds and crop varieties (in situ)
2	Effectiveness of initiatives and measures taken to conserve indigenous animal varieties and indigenous crop varieties
3	Trend in germplasm accessions in ex-situ collection (crops and breeds)

	6.4.8.4	Specific Actions
Specific Actions	1	Agro-biodiversity is a safeguard against food security for growing human population. Maintenance of agro-biodiversity is also needed as a safeguard against pathogens and climate change. Many wild relatives of *jhum* crops and crops cultivated in *orchards* or wet cultivation are now on decline Documentation of these crops and domestic animal breed need to be undertaken by NBPGR, NBAGR, colleges and educational institutions in the state
	2	Identify and document hotspots of wild gene pool such as Citrus, wild banana, ginger, wild tea etc
	3	Protection of these varieties needs to be done through various *ex-situ* or *in-situ* methods of conservation like heritage sites for crop varieties, gene bank, crop bank etc. should be initiated by the state Agriculture Department
	4	Many hardy varieties of crops must be tested and promoted by the agriculture departments Varieties developed from these wild crop relatives can also be beneficial to local farmers. ICAR and related agricultural research institutions should also undertake such research and promote these varieties with help of the state agriculture departments. Incentive schemes for farmers should also be designed for varieties which have better potential in an area vs varieties being used in the area
	5	Provide incentives to farmers for growing wild and traditional varieties with known advantages e.g. drought resistant, pest resistant crops etc. Wild and traditional varieties must also be promoted for consumption by the state forest department
	6	Capacity building or the farmers, and livestock keepers should be undertaken by agriculture, animal husbandry departments, ICAR, NBPGR, NBAGR on regular basis

6.4.9

MBT 9

MBT 9: By 2030, national initiatives using communities 'traditional knowledge" relating to biodiversity are strengthened, with the view to protecting this knowledge in accordance with national legislations and international obligations.

Aichi 18: By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.

6.4.9.1 Rationale

Meghalaya has as many as 13 distinct indigenous ethnic communities distributed in Garo, Khasi and Jaintia hills. As most of the population of Meghalaya still lives in rural areas, and are dependent on various forest resources, their traditional knowledge related to use of bio-resources is very rich. In last few decades, several studies have been initiated on documenting Traditional Knowledge systems of these communities. However, most of these studies have focused on medicinal plants and edible wild plants. Thus a proper inventory of traditional knowledge is lacking in most places. The integration of Traditional Knowledge and customary practices in biodiversity conservation and sustainable use of resources through state legislation is the aim of this target.

6.4.9.2 Strategies and Actions

Actions

Strategy 9.1	*Promote Traditional Knowledge (TK) and Customary Practices relevant to biodiversity conservation and sustainable use*
9.1.1	Inventorise and document TK and Customary Practices relevant to biodiversity conservation and sustainable use
9.1.2	Explore innovative measures to strengthen and incentivize TK and customary Practices that promote biodiversity conservation and sustainable use
9.1.3	Strengthen measures to prevent mis-appropriation of TK associated with genetic resources and Customary Practices

Actions

Strategy 9.2	*Build state capacities for the protection, preservation and utilization of TK and Customary Practices relevant to biodiversity conservation and sustainable use*
9.2.1	Build capacities on TK, ABS, Intellectual Property (IP), Community Protocols, documentation of Customary Practices, Negotiations, Contract Agreements, etc
9.2.3	Promote targeted awareness and education series on ABS, TK and Customary Practices for the general public, policy makers, academia, private sector and the local communities
Strategy 9.3	*Document and promote bio-cultural services*
9.3.1	Identify and document bio-cultural heritages of the state
9.3.2	Document Cultural Ecosystem Services (CES)
9.3.3	Promote bio-cultural practices like traditional food, clothing, handicraft, recipes, traditional medicines, and customary cultural practices that do not cause adverse impacts on biodiversity values of the state
9.3.4	Declare important living root bridges as Biodiversity Heritage Site (BHS) under section 37 of the BDA, 2002 or cultural heritage sites under the UNESCO Convention on Intangible Cultural heritage, 2003

Actions

Strategy 9.4	*Prevent destruction and degradation of bio-cultural heritage sites*
9.4.1	Prepare policies for sustainable ecotourism in and around bio-cultural heritage sites
9.4.2	Prevent degradation and pollution of bio-cultural sites *via* declaring these sites as no plastic and no garbage zones
9.4.3	Organize cleaning and habitat improvement drives to restore degraded and polluted sites

6.4.9.3 Indicators

Indicators

1. Number of traditional herbal formulations and traditional medicines documented.
2. Number of potential 'bio-piracy' or wrong patents cases prevented
3. Number of patents and ABS based on TK derived from folk knowledge
4. Training and Capacity building at local and community levels
5. Number of BMCs and PRI institutions trained
5. Trends in collection of plants providing raw drugs used in Indian system of medicine
6. Documentation and awareness meetings, capacity building , workshops and conferences for various target groups
7. Trends in incentive schemes for sustenance of cultural heritage like arts and crafts and festivals

6.4.9.4 Specific Actions

Specific Actions

1. Meghalaya is very rich in indigenous traditional knowledge (ITK) related to bio-resource use and biodiversity conservation. State departments must provide funds, permissions and technical skills in creating an inventory of this information
2. Promote awareness towards TKs and customary practices regarding conservation. Capacity building workshop thus can be organized by state research institutions, ministry of tribal affairs, forest department, agriculture department etc., for the indigenous communities as well as policy makers for promoting and utilizing these and for ABS mechanisms
3. 'Living root bridges' are one of the finest example of traditional knowledge. Steps should be taken to protect and maintain these practices by promoting them as UNESCO Heritage sites of the world
4. Innovative ways to use these TKs and associated genetic resources must also be explored which promote biodiversity conservation and sustainable use. It is also essential to discourage and prevent some customary practices associated with biodiversity loss and unsustainable use in present context
5. Traditional Ecological Knowledge practitioners of the indigenous communities must be accorded ABS through, a) integrity (collection etc. not violate traditional and customary laws), b) protection, and c) compensation (UNDP 2014)
6. Cultural Heritage of the indigenous tribes like indigenous festivals, landscapes and practices should be encouraged via related government departments

MBT 10

MBT 10: By 2020, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Utilization as per the Nagoya Protocol are operational, consistent with national legislations.

Aichi 16: By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

6.4.10.1 Rationale

Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) has been one of the fundamental objectives of Convention on Biological Diversity. In 10th meeting of the Conference of the Parties (COP 10) on 29 October 2010 in Nagoya, Japan, the Nagoya Protocol on ABS was adopted and entered into force on 12 October, 2014. Its objective is the fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.

There is thus an urgent need to develop proper guidelines and implementation mechanism for fair and equitable sharing of benefits. There is also a need to implement strict control for dealing with threats of bio-piracy, as most of the state is easily accessible to individuals and organizations from India and also abroad, the threats to biodiversity through bio-piracy can undermine the effort to have an equitable ABS system. The benefits of ABS should reach the communities responsible for maintaining the species or providing the traditional knowledge regarding the species; bio-piracy thus has to be dealt with stricter control and regulation mechanisms. Thus, this target not only aims at achieving proper ABS policy, legal framework and implementation mechanism but also will protect the genetic resources of the state.

6.4.10.2 Strategies and Actions

Actions

Strategy 10.1	*Develop a state policy and legal framework for the implementation ofthe Access and Benefit Sharing Policy*
10.1.1	Develop a state policy based Access and Benefit Sharing (ABS) mechanism
10.1.2	Review and recommend for amendment/revision of the Biodiversity Acts in line with the state ABS policy
10.1.3	Develop regulations to facilitate implementation of the state ABS mechanism

Actions

Strategy 10.2	*Strengthen the implementation of a fair and equitable ABS model*
10.2.1	Establish appropriate institutional, legal and administrative measures for the implementation of the ABS regime
10.2.2	Strengthen education and awareness on the ABS regime
10.2.3	Explore and pilot ABS ventures at local, and state levels with inputs from National ABS ventures
10.2.4	Create a state ABS fund for empowering local communities to engage in biodiversity conservation
10.2.5	Strengthen state capacities to implement the ABS regime

Actions

Strategy 10.3	*Implement strict control mechanism on bio-resource and genetic resource piracy*
10.3.1	Document and Inventorise genetic resources of the state
10.3.2	Prepare bio-resource collection guidelines
10.3.3	Implement wildlife protection act 1972, international laws dealing with trade and extraction and bio-piracy
10.3.4	Organize awareness programmes for policy makers, state executives, police department, district councils and village councils regarding genetic resources and related laws
10.3.5	Build capacity of wildlife and territorial frontline staff of forest department, district councils, CCA protection squads and communities maintaining CCAs for dealing with Bio-piracy
10.3.6	Provide incentives to local communities for prevention of genetic resource piracy
10.3.7	Provide information on states' bio-resources to police department, airport authorities and customs officials for prevention of genetic resource piracy

	6.4.10.3	Indicators
Indicators	1.	Trend in number of proposals for intellectual property rights
	2.	Trends in number of cases for seeking prior approval of MBB for transferring the results of research to companies for commercial purposes
	3.	Trends in number of cases for seeking approval of bio-resources and associated traditional knowledge for commercial utilization
	4.	Trend in cases related to bio-piracy reported by communities and Forest Department

	6.4.10.4	Specific Actions
Specific Actions	1.	National ABS policies need to be customized and harmonized with customary laws of Meghalaya for preparing state ABS policy. This will require a thorough review and consultation involving various state, district council and local institutions
	2.	The MBB needs to document traded and non-traded commodities, the non-traded commodities from community owned lands can be included in ABS process
	3.	Pilot ABS ventures could be initiated with experienced institutions, local and state level institutions like National Biodiversity Authority, MBB and other state departments.
	4.	An ABS fund for empowering local communities must be set up by the state machinery. Institutions like Forest department, Agriculture department, ministry of tribal affairs and various state institutions should contribute to establishment and disbursement of funds to local communities for biodiversity conservation, ecosystem services and for conservation of sustainable TKs and customary practices and for conservation of genetic resources.
	5.	Strict mechanism to control bio-piracy needs to be established by the state forest and agriculture departments with help of the state judiciary and police force. These policy and laws must be implemented across the state in state PAs, community areas, institutions and the entry and exit points of the state via state check posts, forest gates, border check posts etc. The police force, army, local institutions, local communities and forest department staff should also be trained and made aware of the bio-piracy, and legal mechanisms to control it.
	6.	Mechanisms should be explored by Forest Department and Agriculture Department to extend the bio-piracy control laws to community forests.
	7.	MBB needs to also prepare guidelines for bio - resource collection with help of educational and scientific institutions.
	9.	The MBB and the local BMCs must develop a database to determine ownership of genetic resources through effective consultation process and information exchange with stakeholders such as the Autonomous District Councils, Durbars, Nokmas, Sirdars, Religious entities etc. It is essential that relevant check points and data repository be linked and maintained for preventing unauthorized access or biopiracy and ensure explicit consensus on Mutually Agreed Terms (MAT).

Mawphlang Sacred Grove

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Box 6.1 A pilot ABS mechanism: Mawphlang Sacred Grove

A pilot level program for involvement of access and benefit sharing (ABS) mechanism, biodiversity offsetting mechanism and also payment for ecosystem services (PES) has been initiated in the state through REDD+ programme in Mawphlang. The REDD+ project mobilizes participating communities to address local drivers of deforestation including forest fires, illegal logging, uncontrolled surface mining and unsustainable slash and burn farming. Performance based PES are broken down into Assisted Natural Regeneration (ANR) contracts, opportunity cost compensation, and net revenue distribution designed to capitalize women administered micro-finance organizations. Federation technical staff, local NGOs and government work with communities to identify actions to strengthen indigenous resource management institutions by formalizing forest management committees, developing written by-laws, reviewing, codifying resource use rules and regulations, and developing new partnerships with local government and private sector organizations. Under the project, each community formulates a long-term natural resource management plan and village development strategy (Poffenberger 2015, Lyngdoh 2015).

Socio-economic Benefits from the Mawphlang Project

- Build community institutions including the Local Working Committee as an operational natural resource management (NRM) unit and form of Self-Help Groups (SHGs) to foster entrepreneurial activities.
- Establish financial accounts with local banks and operate women administered micro-finance institutions.
- Provide jobs through constructing 50 km of fire lines and 500 hectares of forest restoration activities each year.
- Initiate commercial animal husbandry enterprises by exchanging low quality community cattle and goats for stall-fed pigs and chickens, develop sustainable organic farming and horticultural systems.
- Adopt fuel-efficient, smokeless stoves
- Create partnerships with Government of India's NRM and livelihood projects

6.4.11

MBT 11

MBT 11: By 2030, an effective, participatory and updated State Biodiversity Action Plan is made operational at state level, with incentives for biodiversity conservation, abolition of incentives which harm biodiversity, and involvement of all stakeholders in preparing and implementing the state BSAP.

Aichi 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio economic conditions.

Aichi 4: By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

Aichi 17: By 2015, each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.

6.4.11.1 Rationale

The central and state governments have launched various schemes for the welfare of people from remote areas of the state. However, some of these schemes sometime come in conflict with the conservation of biodiversity. There are many areas where incentives from state government would be beneficial e.g. community conserved areas, sacred groves, protected medicinal or traditional gardens, fish sanctuaries etc. Thus, the state government must relook at the schemes, which impact the states biodiversity, and promote new schemes, which can provide incentives for conservation of the biodiversity via traditional methods.

Some of the natural resources in the state are under extreme extraction pressures. NTFP extraction by villagers are now reaching a commercial scale in some region. The *Nepenthes khasiana* is known to have declined in Nokrek Biosphere Reserve due to extreme extraction process. However, there is little information on safe ecological limit of extraction of many of these natural resources. Therefore, the focus of this target would also be on science based sustainable management of resources.

With guidelines for preparing a new state BSAP in lines of the National BSAP, according to the 20 Aichi targets, the earlier version of state BSAP is to be rewritten with new data and incorporation of new strategies and action plan. This state BSAP will serve as the guiding principal for the biodiversity planning and management in the state. An implementation mechanism based on various government departments, stakeholders and public institutions will also be developed for implementation of the BSAP and monitoring of the status over the years for achieving biodiversity conservation and sustainable management in the state.

6.4.11.2 Strategies and Actions

Actions

Strategy 11.1	*Reform incentives affecting biodiversity negatively*
11.1.1	Review and identify incentives of various government department, institutions and NGOs that are detrimental to biodiversity
11.1.2	Reform harmful incentives as appropriate
Strategy 11.2	*Strengthen incentives promoting conservation and sustainable use ofbiodiversity*
11.2.1	Review and redefine incentive-based conservation including Integrated Conservation and Development Projects considering sustainability, equity, community ownership and participation
11.2.2	Explore incentives such as Payment for Ecosystem Services (PES), Community-Based Sustainable Tourism(CBST), Eco-tourism and agro-tourism for conservation and sustainable use of biodiversity by the local communitie

Actions	11.2.3	Revisit and prioritize the Crop Promotional Program to strengthen agro-biodiversity conservation, development and management at the community level
	11.2.4	Initiate pilot Crop and Livestock Insurance Schemes for sustainable management of agro-biodiversity and to reduce the impacts of human-wildlife conflict
	11.2.5	Recognize and celebrate the role of the custodians of agro-biodiversity and promote conservation stewardship
	Strategy 11.3	*Develop guidelines and policy for environmental amelioration and human well-bein*
Actions	11.3.1	Review effect of natural resource extraction on environment
	11.3.2	Initiate study on effect of environment degradation and pathways which effect human health
	11.3.2	Develop guidelines and policies for preventing environmental degradation and restoration of degraded areas
	Strategy 11.4	*Strengthen science-based management of natural resources*
Actions	11.4.1	Carry out studies on ecological limits of vulnerable production and consumption sectors
	11.4.2	Initiate and promote interdisciplinary research in sustainable productionand consumption of natural resources for developing natural resources management plans
	Strategy 11.5	*Promote sustainable use and consumption of natural resources*
Actions	11.5.1	Carry out resource mapping of wood and NTFPs and develop sustainable management guidelines.
	11.5.2	Promote the use of efficient technologies for harvesting, processing and marketing of forest resources.
	11.5.3	Promote alternatives to timber to reduce pressure on natural resources.
	11.5.4	Integrate traditional use of natural resources (grazing, leaf litter, fodder) with sustainable management plans
	11.5.5	Promote and encourage community participation in the implementation of sustainable management plans of natural resources
	Strategy 11.6	*Strengthen capacity in natural resources management e.g. medicinal plants, NTFP, wild edible plants, plants of traditional use*
Actions	11.6.1	Assess capacity gaps in natural resource management
	11.6.2	Strengthen capacity based on the capacity gap analysis
	Strategy 11.7	*Adopt the revised state BSAP as a guiding document for biodiversity management*
Actions	11.7.1	Revise the BSAP in line with national and state priorities and Aichi Biodiversity Targets through a participatory and inclusive approach
	11.7.2	Institute and document the process and procedure of BSAP preparation and revision
	11.7.3	Adopt the BSAP as a state guiding document for all programmes of work related to biodiversity conservation and sustainable use
	11.7.4	Mainstream actions prioritized in BSAP into relevant stakeholder plans and programs
	11.7.5	Raise awareness on MBSAP and prioritized state targets
	Strategy 11.8:	*Establish a state mechanism for implementation of the BSAP*
Actions	11.8.1	Establish a dedicated coordination unit for BSAP implementation and resource mobilization, including monitoring and reporting
	11.8.2	Develop and implement an effective monitoring and evaluation plan for the achievement of state biodiversity targets

Indicators

6.4.11.3	Indicators
1.	Trends in formulation and implementation of policies suggested in MBSAP
2.	Number of harmful incentives identified and reformed
3.	Number of positive incentives reviewed and strengthened
4.	Trends in MBSAP actions integrated into relevant sectorial plans and programs
5.	Trend in capacity enhancement training given to policy makers, communities, office bearers in government departments
6.	Trend in capacity enhancement training to teachers, students, educational institution for promotion of natural resource management and research

Specific Actions

6.4.11.4	Specific Actions
1.	Harmonise detrimental incentive schemes amongest various departments. Agriculture Department, IFAD etc., Ministry of Mines, Road transport authority, and many other departments, institutions and NGOs, have initiated various incentive schemes for local communities, for state revenue generation etc. Some of the incentives are at direct clash with the state initiative for protection of forest and wildlife
3.	Careful planning of infrastructure development needs to be done with involvement of Forest Department, District Councils, and local institutions
6.	Community based natural resource management needs to be encouraged by incentives via state Forest, Fisheries and Agriculture Departments
8.	Livestock loss or crop depredation is major cause of conflict and by providing compensation or insurance for these, a large part of conflict can be mitigated. In many areas of world local communities themselves manage a mechanism by which crop loss, livestock depredation is assess with additional help from forest department. A strategy of forest department where communities are involved in assessing and disbursement of compensation or insurance schemes for the villagers have helped reduce human-animal conflicts to a large extent. The creation of effective, low-maintenance barriers and other deterrents must also be explored
9.	Incorporation of modern tools for assessment and detection of crop depredation, conflict and compensation payment systems would effectively address bias in reporting. The predictions from these tools would also avoid conflict situations and such reliable and effective monitoring tools would also allow us to understand the mechanism responsible for these special and temporal pattern of HEC
10.	Pilot livestock and crop insurance schemes must be initiated by agriculture and animal husbandry department to not only reduce human - wildlife conflict but also for sustainable management of agrobiodiversity. Results from these schemes can be used for preparing a state policy or long-term welfare schemes
11.	An important concept is Payment for Environmental Services (PES) which has gained popularity among conservation communities. Most important of these are financial rewards for carbon sequestration, potential solutions for human-wildlife conflict and payment to communities for maintaining wildlife, biodiversity etc. in their community forests in form of entry charges, rewards etc. A sense of ownership of the community conserved area also encourages people in conservation, as the wildlife, biodiversity etc. is their own
12.	Many local communities make handicraft items from NTFP etc. or by-products of local or forest product. Encouraging these handicrafts, local utility materials which do not pressurize the forest for extraction also encourages local communities

6.4.12

MBT 12

MBT 12: By 2030, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011-2020 and the state targets are identified and the Strategy for Resource Mobilization is adopted.

Aichi 19: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.

Aichi 20: By 2020, at the latest, the mobilization of financial resources for effectively implementing the Strategic Plan for Biodiversity 2011-2020 from all sources, and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization, should increase substantially from the current levels. This target will be subject to changes contingent to resource needs assessments to be developed and reported by Parties.

6.4.12.1 Rationale

Implementation of the state Biodiversity Action Plan will depend on allocation of various resources by number of government departments, public institutions and state machinery. The guiding principles and action plans as outlined by the state Biodiversity Targets will help in achieving biodiversity conservation and sustainable development of the state. Meghalaya being one of the first Indian state to initiate development of the BSAP, it will also inspire and contribute to biodiversity conservation in the rich north eastern region of India.

Even though Meghalaya has committed to a science based conservation and sustainable management effort, there are lack of studies in the state to guide this endeavor. As the state can learn from nearby states and nearby countries. However, there is limited literature on science based conservation and sustainable development from the region. There is vast gap in knowledge and technologies. Thus, there is need to develop collaborative initiatives with national and international institutions and agencies to bridge the gap in information and technologies for biodiversity conservation and sustainable use. The focus of this target is also thus to foster biodiversity related information, development of collaborative initiatives with responsible national and international agencies to fill the gap in information and also to access and promote technologies for achieving sustainable use and conservation.

6.4.12.2 Strategies and Actions

Actions

Strategy 12.1	*Strengthen evidence-based policy and decision-making.*
12.1.1	Analyze existing biodiversity data and information gaps.
12.1.2	Strengthen research to generate biodiversity information and expand knowledge base.
12.1.3	Promote accessibility and sharing of biodiversity information and knowledge.
12.1.4	Promote evidence-based decision-making on policies affecting biodiversity.
Strategy 12.2	*Promote transfer and adoption of technologies related to biodiversity management.*
12.2.1	Support and promote inter and intra-disciplinary research on biodiversity and related technologies.
12.2.2	Strengthen state mechanisms to coordinate, promote and review transfer and adoption of appropriate technologies (e.g. HWC management, Forest fire management).
12.2.3	Promote sustainable procurement initiatives such as Green Public Procurement.

Actions

Strategy12.3:	*Strengthen institutional mechanisms and good governance to coordinate fund mobilization for Meghalaya state BSAP implementation.*
12.3.1	Adopt the Meghalaya state BSAP as a guiding document for biodiversity management in the state.
12.3.2	Establish the Meghalaya Biodiversity Committee as the state coordination agency for MBSAP implementation and resource mobilization.
12.3.3	Establish a funding window for Meghalaya state BSAP implementation with innovative funding mechanisms.

Actions

Strategy 12.4	*Mobilize financial resources to support implementation of the Meghalaya state BSAP*
12.4.1	Review the financial gap for implementation of the Meghalaya state BSAP
12.4.2	Implement BIOFIN process for assessing state finance for biodiversity conservation
12.4.3	Develop and implement Resource Mobilization Plan
12.4.4	Allocate funds as per the Resource Mobilization Plan
12. 4.5	Monitor effective and efficient utilization of available funds
Strategy 12.5	*Mainstreaming of biodiversity conservation and sustainable development*
12.5.1	Generate awareness on biodiversity conservation and sustainable development
12.5.2	Develop programmes for participatory planning and biodiversity conservation
12.5.3	Coordinate and harmonize among sectoral plans

Indicators

6.4.12.3	Indicators
1.	Trends in financial resources made available for implementing Aichi and Biodiversity Targets
2.	Trend in human resource made available for implementing Aichi and State Biodiversity Targets
3.	Trends in technical resources made available for implementing State Biodiversity Targets
4.	Trends in assessment of gaps in biodiversity finance
5.	Trends in innovative finance mechanisms utilized for implementation of MBSAP

Specific Actions

6.4.12.4	Specific Actions
1.	Adopt and strengthen institutional mechanism for fund mobilization and BSAP implementation
2.	Technological innovations in field of agriculture, forestry, wildlife, conservation, sustainable management etc. should be made available to various sectors to offset biodiversity loss
3.	The state forest department must analyze various schemes of the state departments and public institutions to look at the impact of these schemes, and identify the biodiversity related schemes of other departments which would benefit biodiversity and ecosystems
4.	A strategy for resource mobilization for achieving the BSAP targets must be in place with taking into account various state departments, public institutions, NGOs etc
5.	BIOFIN is an innovative mechanism which builds an economic case for increased investment in the management of ecosystems and biodiversity. The state government needs to initiate measures to assess gaps in biodiversity funding, developing comprehensive state resource mobilizing strategies
6.	Innovative funding mechanisms must be explored for MBSAP implementation
	The responsibility of implementing these strategies and action plans rests on various state, national and non- governmental institutions, Government of Meghalaya Departments and research institutions. Table 6.1 lists the action plans and an indicative list of responsible institutions. The implementation mechanism is discussed in subsequent chapter

		Action Plan	Indicative Agencies	Time frame
		Enhance environmental awareness and values of biodiversity among the youth		
Strategy 1.1	1.1.1	Assess the awareness about environment and values of biodiversity among youth	Meghalaya Board of Secondary Education (MBOSE), CBSE, ICSE, Department of Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department, Meghalaya MHRD, Centre for Environment Education NE, CPR Environmental Education Centre, Department of Biotechnology	2020
Strategy 1.1	1.1.2	Identify the gaps in information regarding environmental awareness among the youth and target groups, i.e., school children and youth involved in agriculture and various development programs.		2022
Strategy 1.1	1.1.3	Develop curricula on biodiversity conservation and sustainable management for schools and colleges and implement		2024
Strategy 1.1	1.1.4	Plan and organize regular environmental and biodiversity awareness workshops for students in school, colleges, agriculture sector, vocational training institutes, and other workplaces		2020
		Mainstreaming environmental education, research and conservation awareness in the state education policy		
Strategy 1.2	1.2.1	Review current environmental curricula of the state and incorporate biodiversity components	MBOSE, CBSE, ICSE, Department of Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department	2020
Strategy 1.2	1.2.2	Review the state education policy and suggest necessary amendments by including environmental education, research and biodiversity conservation awareness		2020
Strategy 1.2	1.2.3	Identify agencies involved in environmental education, research and awareness raising programs and setup a coordination mechanism for education and awareness	Department of Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department	2022
Strategy 1.2	1.2.4	Review informal education programs of the institutions such as ICAR, NBPGR etc. as per state environmental education policy of the state and suggest modifications to streamline these programs		
Strategy 1.2	1.2.5	Incorporate indigenous traditional knowledge and traditional eco-friendly industries related to biodiversity conservation in the state education curricula	Department of Education, Directorate of Higher and Technical Education	2022
				2022
		Build capacity of educational and training institutes in imparting environmental education, research and advocacy programs		
Strategy 1.3	1.3.1	Conduct need assessment surveys for informal education sector and plan for capacity enhancement training programs and workshops.	Department of Education, Directorate of Higher and Technical Education, MBOSE,	
Strategy 1.3	1.3.2	Conduct need assessment for formal education sector and develop plan for capacity enhancement		2022
Strategy 1.3	1.3.3	Explore future possibilities and present funding for environmental capacity building via corporate social responsibility (CSR) initiatives	State Forest Department, District Council, Ministry of Tribal Affairs, Ministry of Forest and Environment, CEE, Autonomous District Councils, Department of North Eastern Region (DoNER)	2022
Strategy 1.3	1.3.4	Organize capacity building training programs and workshops for formal and informal educational institutions.	Department of Education, Directorate of Higher and Technical Education , State Forest Department, District Councils, NGOs	2024
				2026

		Action Plan	Indicative Agencies	Time frame
	Set up an institutional mechanism for valuation of biodiversity and ecosystem services			
Strategy 2.1	2.1.1 2.1.2 2.1.3	Identify a lead agency to coordinate valuation of biodiversity and ecosystem services Take stock of initiatives in valuation of biodiversity and ecosystem services Develop institutional arrangements for implementing biodiversity and ecosystem valuation programs, including developing linkages with relevant agencies	MBB, Indian Institute of Forest Management (IIFM), IIMs, Ministry of Forest and Environment, Institute of Economic Growth (IEG), Indra Gandhi Institute for Development Research (IGIDR) MoEFCC, State MoEF, IIFM, MBB, IEG, IIMs	2018 2020 2022
	Build capacity for valuation of biodiversity and ecosystem services			
Strategy 2.2	2.2.1 2.2.2	Assess current capacity, gaps and needs for valuation of the biodiversity and ecosystem services Build capacity in valuation of the biodiversity and ecosystem services and integration of values into state and national planning and policy making process and accounting system	MoEF&CC NEHU, State Planning Department, MBB, state colleges MBB, Indian Institute of Forest Management (IIFM), IIMs, Ministry of Forest and Environment, Institute of Economic Growth (IEG), Indra Gandhi Institute for Development Research (IGIDR)	2020 2022
	Mainstream biodiversity conservation and ecosystem management into environmental policy, legislations and development plans			
Strategy 2.3	2.3.1 2.3.2 2.3.3	Review state level policies and legislations to mainstream biodiversity and ecosystem services, with involvement of marginalized communities Incorporate biodiversity and ecosystem service values into relevant state documents such as the five year development plan Mainstream biodiversity conservation in the state level poverty alleviation programmes and strategies	MBB, FD, all GoM departments All GoM departments, State Planning Department, MBB	2020 2024 2024
	Engage poorest section of the society in conservation / forestry projects			
Strategy 2.4	2.4.1 2.4.2	Engage forest dependent marginal farmers in central and state government schemes such as MGNREGA, Green India Mission, REDD+ and other schemes to prevent further degradation of forest ecosystems Integrate rural livelihoods with the Integrated Basin Development and Livelihood Promotion programme	State Planning Department, MBB, FD, Ministry of Rural Development, Social Welfare Dept. MBDA, Ministry of Rural Development, FD, MBB	2022 2020

		Action Plan	Indicative Agencies	Time frame
		Map biodiversity rich habitats and ecologically sensitive sites		2018
Strategy 3.1	3.1.1	Identify biodiversity rich sites and habitats outside PAs	FSI, FD, District Councils, NRSA, Department of Space, North East Space Application Centre	2018
	3.1.2:	Identify and map ecologically sensitive sites	FD, Department of Space, North East Space Application Centre, Wetland international - South Asia, SACON, BNHS, Department of Fisheries, Ministry of Water Resources, Soil and Water Conservation	2020
	3.1.3:	Identify important localities and degraded areas for eco-restoration		2020
		Identify major driver or causes of environmental degradation		
Strategy 3.2	3.2.1	Assess various drivers of environmental degradation and identify the major drivers	FD, Department of Space, North East Space Application Centre, Wetland international - South Asia, SACON, BNHS, Department of Fisheries, Ministry of Water Resources, Soil and Water Conservation	2020
	3.2.2	Assess status and trends of biodiversity and ecosystem services and integrate with state policies	FD, MBB, State Planning Department, Ministry of Water Resources, Soil and Water Conservation, North Eastern Regional Institute of Water and Land Management	2024
	3.2.3	Assess and explore linkages between positive effects of these interventions on human well being	MBDA, Ministry of Rural Development, FD, MBB, MHRD, Ministry of Health and Family Welfare	2027
		Reduce the rate of habitat degradation, loss and fragmentation		
Strategy 3.3	3.3.1	Account for the extent and rate of habitat loss due to forest clearance, fragmentation and degradation	FSI, FD, District Councils, NRSA, Department of Space, North East Space Application Centre	2020
	3.3.2	Initiate eco-restoration programmes through participatory process in highly degraded areas, especially round PAs and mined sites	FD, DCs, local communities, NGOs, Agriculture Department, Green India Mission, Central Mine Planning and Design Institute (CMPDI), NEHU, NGOs like WTI, Samrakshan, Community Forestry International (CFI)	2022
		Address the major causes of habitat loss and environmental degradation		
Strategy 3.4	3.4.1	Enhance awareness on forest fire and other potential factors causing habitat loss	FD, Universities in state, colleges, MBB	2020
	3.4.2	Strengthen state fire management program in terms of human capacity,research, technology, coordination, surveillance and response system	Fire and Emergency services of state police, MBB, FD, local communities, NGOs	2024
	3.4.3	Scale up community-based forest fire management approaches		2024
Strategy 3.4	3.4.4	Identify key drivers of habitat loss and degradation, and develop strategies to minimize them	FD, MBB, FSI, NESAC, state Universities and colleges	2022
	3.4.5	Develop policy and programs to engage local communities in management of forests and by providing alternative or additional sustainable livelihood schemes	FD, MBB, MBDA, All state Departments,	2024
	3.4.6	Integrate Biodiversity Offset mechanisms in Management Plan of the PA, for compensation of biodiversity impacts associated with developmental projects	FD, MBB	2024

		Action Plan	Indicative Agencies	Time frame
		Strengthen conservation programs for state wetlands, rivers and aquatic species		
Strategy 4.1	4.1.1	Identify important wetlands, rivers, streams, river basins, lakes and catchment areas which are facing threat of destruction, pollution or anthropogenic pressures	FD, MBDA, SPCB, Dept. of Water Works	2020
	4.1.2	Develop policies, guidelines and state laws which enable protection against anthropogenic intervention in aquatic systems and catchment areas of the state		2022
Strategy 4.1	4.1.3	Implement guidelines and policies related to conservation of aquatic ecosystems, and control of pollution through SPCB, Mining Department etc.	FD, SPCB, Dept of Mines, CPCB	2025
	4.1.4	Adopt policies for in-situ conservation of aquatic species e.g.several *mahseer* species in the state rivers, streams, lakes etc	FD, Fisheries Dept., MBDA	2024
	4.1.5	Encourage fish sanctuaries, implement non-fishing seasons, and prevent over exploitation and introduction of invasive species in water bodies of the state	FD, DCs, Fisheries Dept	2020
		Strengthen conservation programs for the unique karst ecosystems of the state.		
Strategy 4.2	4.2.1	Identify and document the key karst ecosystems of the state	FD, MBB, Meghalaya Adventure Association, Universities and colleges of state	2019
	4.2.2	Frame guidelines for anthropogenic interventions and protection of karst ecosystems and its biodiversity		2020
	4.2.3	Prevent destruction of caves and restore caves degraded by pollution and mining	SPCB, FD, MBB, Dept of Mines, local communities	2024
		Assess the impacts of climate change on biodiversity and ecosystems.		
Strategy 4.3	4.3.1	Develop a network of long-term climate monitoring stations for the generation of comprehensive climate data	Research institutions, NEHU, IISc climate change dept., Indian Meteorological Department, WII, Climate change cell FD	2022
	4.3.2	Promote inter-disciplinary research on climate change, biodiversity, and ecosystems	Ministry of Agri. , Forest Department, Minister of Water Resources, Soil and Water Conservation, North Eastern Regional Institute of Water and Land Management, ZSI, BSI, ICAR etc.	2020
Strategy 4.3	4.3.3	Institute a state mechanism to collate and share data and information generated from research for the development and implementation of adaptation measures and policy decisions	FD, MBB, NBA, Agriculture Department, State Planning commission	2024
	4.3.4	Conduct systematic awareness and educational programs on the impacts of climate change on biodiversity	FD, MBB, ICAR, NBAGR, NBPGR, Education Department, Ministry of higher Education, NGOs, Agriculture Department, Department of Fisheries	2022
		Strengthen climate change adaptation measures.		
Strategy 4.4	4.4.1	Develop a policy on climate change with special focus on food security, biodiversity and water	Agriculture Dept., FD, MBB, Fisheries Department, DCs, local communities	2024
	4.4.2	Develop appropriate long-term ecosystem-based adaptation measures to minimize impacts of climate change on vulnerable ecosystems, biodiversity and communities		2024

	4.4.3	Strengthen implementation of immediate targeted actions for prioritized ecosystems.	FD, DCs, MBB, Agriculture Department, Fisheries Department	2020
	4.4.4	Integrate long-term ecosystem-based adaptation measures into plans and programs.		2026
	Enhance management effectiveness of the Protected Area System and community forests.			
Strategy 4.5	4.5.1	Evaluate the management effectiveness of Protected Areas and Biological Corridors.	FD, MBB, Universities and colleges, NGOs, WII	2020
Strategy 4.5	4.5.2	Complete zonation of PAs by 2018.	FD	2020
Strategy 4.5	4.5.3	Enhance local community participation in the management of PAs.	FD, MBB, DCs	2022
Strategy 4.5	4.5.4	Review the functionality of Biological Corridors for demarcation, operationalization and legal protection.	FD, MBB, DCs	2022
Strategy 4.5	4.5.5	Review and evaluate Community Reserves, Conservation Reserves and CCAs.	FD, MBB, DCs	2022
Strategy 4.5	4.5.6	Monitor and assess the status and trends of biodiversity within the Protected Area System and community forests.	FD, MBB, DCs, village councils, local community institutions	2024
Strategy 4.5	4.5.7	Promote and support transboundary management and regional partnership initiatives.	FD, DCs	2026
Strategy 4.5	4.5.8	Encourage local communities to declare community forests as CCAs by providing schemes for improving livelihood.	FD, MBB, DCs	2019
Strategy 4.5	4.5.9	Prioritise critical areas that connect forest patches and reduce fragmentation for declaration as CCAs. District councils should also legally declare these as protected forests reserves with management benefits to communities.	FD, MBB, DCs, MBDA, Agriculture Department, Fisheries Department	2020
Strategy 4.5	4.5.10	Provide incentives to local communities for declaring CCAs and for biodiversity conservation.	FD, MBB, DCs, MBDA, Agriculture Department, Fisheries Department	2020
Strategy 4.5	4.5.11	Earmark funds for research and conservation of cards of sensitive ecosystem such as karst systems		2020
	Establish sustainable financing measures for the Protected Area System and CCAs.			
Strategy 4.6	4.6.1	Develop and implement REDD + activities to support conservation financing.	FD, MBB, Dcs	2024
Strategy 4.6	4.6.2	Institutionalize and upscale Payment for Ecosystem Services (PES) initiatives.	FD, MBB	2024
Strategy 4.6	4.6.3	Upscale nature recreation and eco tourism programs with a financial plough back mechanism.	Tourism Dept, FD, MBB, DCs, Social Welfare Dept.	2026
Strategy 4.6	4.6.4	Explore additional innovative financing mechanisms.	MBB, FD	2022
	Assess the status of prioritized taxonomic groups and species and the factors affecting them.			
Strategy 4.7	4.7.1	Develop a state mechanism and evaluate the conservation status of prioritized taxonomic groups and species.	FD, DCs, MBB	2022
Strategy 4.7	4.7.2	Update the status of Red Listed species which are endemic to Meghalaya.	FD, DCs, Universities and colleges	2022
Strategy 4.7	4.7.3	Assess threats to long term survival of prioritized species.	FD, DCs, Universities and colleges	2022
	Strengthen conservation programs for prioritized species.			
Strategy 4.8	4.8.1	Prioritize species for conservation based on nationally agreed or state criteria.	FD	2022
Strategy 4.8	4.8.2	Develop and implement species-based conservation action plans for prioritized species.	FD, DCs, MBB	2024
Strategy 4.8	4.8.3	Enhance capacity in species-based conservation and monitoring.	FD, DCs, Universities and colleges	2026
Strategy 4.8	4.8.4	Strengthen institutional and legal capacities to combat wildlife poaching.	FD, DCs, Law Dept., MBB	2026

		Action Plan	Indicative Agencies	Time frame
		Assess key ecosystem services, their flow and use by various groups		
Strategy 5.1	5.1.1	Establish baseline data on key ecosystems services (ESS) from PAs, RFs, and CCAs and flows of these services	FD, MBB, Dcs	2022
	5.1.2	Document the patterns of ESS flow across various sections of society including women and poorer sections	FD, MBB, DCs, MHRD, Universities and colleges	2024
	5.1.3	Device strategies to integrate ESS into the state level development planning	FD, MBB, DCs, Planning Department	2026
		Safeguard health of key ecosystem as to sustain ecosystem services		
Strategy 5.2	5.2.1	Identify the major drivers affecting health of ecosystems	FSI, NRSA, NESAC, FD, MBB, Dcs,	2020
	5.2.2	Initiate awareness programmes on ecosystem health and long term ecological security	FD, DCs, MBB, Universities and colleges, Ministry of Health and Family Welfare	2020
	5.2.3	Restore and augment degraded ecosystems for sustaining ecosystem services	FD, DCs, MBB, MHRD, Ministry of Health and Family Welfare	2024

		Action Plan	Indicative Agencies	Time frame
		Improve understanding on IAS and native species with high potential of invasion		
Strategy 6.1	6.1.1	Complete state level and regional level inventory of IAS and native or naturalized species with potential for invasiveness along with the distribution and pathways of introduction	FD, MBB, DCs, Universities and colleges	2020
	6.1.2	Develop modules on invasive species for incorporation in the training curricula of relevant institutions	Department of Higher Education, FD, MBB, Wetland International - South Asia, SACON, BNHS, ICFRE (Forest Invasive species cell), WII, Agriculture Department, Universities and colleges, Fisheries Dept	2022
	6.1.3	Promote education and awareness on invasive species and their impacts		2020
	6.1.4	Build technical capacity on invasive species management		2022
Strategy 6.1	6.1.5	Monitor and map the spread of invasive alien species in different parts of the state and investigate the pattern of invasion		2022
	6.1.6	Assess the impacts of IAS on the native flora, fauna and soil biodiversity. This can be useful in evaluating the success of IAS eradication programmes		2026
		Identify invasive species pathways and changes in areas affected by IAS		
Strategy 6.2	6.2.1	Assess the damage and changes in natural systems and agricultural systems due to IAS	FD, MBB, Wetland International - South Asia, SACON, BNHS, ICFRE (Forest Invasive species cell), WII, Agriculture Department, Universities and colleges, Fisheries Dept.	2022
	6.2.2	Develop mechanism for IAS monitoring and control in the state		2024
	6.2.3	Develop guidelines to prevent weeds and IAS spread and incorporate into policy documents	FD, MBB, Agriculture Department, Planning Department, Fisheries Dept., ICFRE (Forest Invasive species cell)	2022
		Develop and implement measures to protect natural and agriculture ecosystems against IAS		
Strategy 6.3	6.3.1	Assess the impacts of IAS and native invasive species on agrobiodiversity and production	FD, MBB, Agriculture Department, Planning Department, Fisheries Dept., ICFRE (Forest Invasive species cell)	2022
	6.3.2	Develop management strategies for established high-risk species, taking into account the effects of climate change		2024
	6.3.3	Develop and implement guidelines to manage and regulate entry and introduction of IAS		2024
	6.3.4	Develop an institutional framework for IAS management and regional collaboration		2026

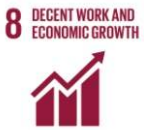
		Action Plan	Indicative Agencies	Time frame
	Strengthen information base, institutional and technical capacity in the conservation and sustainable utilization of fish and aquatic biodiversity			
Strategy 7.1	7.1.1	Identify a lead agency to coordinate inventory of aquatic biodiversity	Fisheries Dept., Fishery Survey of India, National Fishery Development Board, NBFGR, FD, MBB	2018
	7.1.2	Conduct a state wide inventory and documentation of fish and other aquatic species diversity		2020
	7.1.3	Strengthen institutional and technical capacity in fish and aquatic biodiversity conservation and sustainable utilization		2022
	7.1.4	Strengthen local and traditional fish conservation practices with incentives e.g. Fish sanctuaries etc.	FD, DCs, village councils, , Social Welfare Dept., NBFD	2020
	7.1.5	Develop and implement sustainable management plans for fish and key aquatic biodiversity	Fisheries Dept., Fishery Survey of India, National Fishery Development Board, NBFGR, FD, MBB	2024
	7.1.6	Formulate policies for sustainable use of bio-resources in the state		2026
	Identify threats to aquatic life and fish biodiversity and take steps to ameliorate them			
Strategy 7.2	7.2.1	Analyze local fishing methods, particularly those which are detrimental to aquatic life e.g. poison fishing, electric fishing and using explosives for fishing	Fisheries Dept., Fishery Survey of India, National Fishery Development Board, NBFGR, FD, MBB	2020
	7.2.2	Prepare guidelines and policy documents to prevent detrimental fishing practices and other developmental activities, which may affect the aquatic ecosystems	FD, Fisheries Department, SPCB, Mining Department	2022
	7.2.3	Prevent pollution of aquatic systems by formulating and implementing rules related to discharges of urban and industrial wastes into the water bodies	SPCB, FD, MBB, Mine Dept., DCs,	2022
	Improve management of private forest, State Forest, and village forests for sustainable production of goods and services			
Strategy 7.3	7.3.1	Identify community forests which fall outside the Forest Management Units and lack management plans; bring these forest patches progressively under sustainable management regimes	DCs, FD, Agriculture Department, IFAD, village councils	2020
	7.3.2	Review and update codes of best practices and guidelines for holistic sustainable forest management	FD, DCs, IIFM, National Medical Plant Board (NMPB),	2022
	7.3.3	Constitute a Monitoring and Evaluation mechanism to assess the efficacy of the management plans in terms of sustainability	FD, DCs, Universities and colleges, MBB, WII etc.	2024
	7.3.4	Promote sustainable management practices in village forests and grazing land	FD, DCs, village councils, Ministry of Tribal Affairs, Ministry of Rural Development	2024
	Strengthen good governance for sustainable management of forests.			
Strategy 7.4	7.4.1	Strengthen transparency through access to information and consultative or participatory approaches.	Agriculture Department, ICAR, NBPGR, IFAD, NEHU, State colleges, Community Forestry International (CFI)	2020
	7.4.2	Enhance institutional capacity for sustainable management of resources and effective delivery of services.	Green India Mission, IIFM, IIMs, FSI, FRI, ICFRE, Agriculture Dept.	2024
	7.4.3	Strengthen capacity and empower local communities for sustainable management of resources.	FD, Agriculture Department, ICAR, NBPGR, IFAD, NEHU, State colleges, ICFRE	2024

	Promote sustainable agricultural practices that ensure conservation of biological diversity			
Strategy 7.5	7.5.1	Assess biodiversity indices based species biodiversity in major farming systems	Agriculture Department, , ICAR, NBPGR, IFAD, NEHU, State colleges, ICFRE	2022
	7.5.2	Introduce appropriate measures for conservation of biodiversity in the agricultural systems.		2024
	7.5.3	Promote organic farming as per the state or National Agriculture Development Plan	Agriculture Department, ICAR, NBPGR, IFAD, Dept. Of Fisheries, Fishery Survey of India, National Fishery Development Board, NBFGR, Water Works Dept., Soil & Water Conservation Dept., Animal Husbandry Dept.,	2018
	7.5.4	Promote Sustainable Land Management practices supporting biodiversity conservation such as Integrated Pest Management, Integrated Soil Fertility Management Practices, Irrigation Water Management Technologies, Improved Pasture Management and Fodder development		2018
Strategy 7.5	7.5.5	Explore innovative approaches to incentivize the adoption of sustainable agricultural practices through product diversification, niche marketing, premium pricing for organic products and products derived from sustainable sources etc	Agriculture Department, ICAR, NBPGR, IFAD, DCs, village councils	2024
	7.5.6	Promote agro - forestry based farming practices	Agriculture Department, Ministry of social welfare, Planning Dept., IFAD, NGOs, public and private banks, Rural Development Dept., Finance Department	
	7.5.7	Provide loans and micro-finance opportunities to farmers for sustainable agriculture		2026
	Major pollutants affecting environment are maintained as per the National environmental standards			
Strategy 7.6	7.6.1	Strengthen implementation of environmental standards for all major pollutants	SPCB, CPCB, State Police Department, FD	2020
	7.6.2	Strengthen monitoring and reporting mechanisms for all major sources of pollution	SPCB, CPCB, universities, colleges	2022
	7.6.3	Strengthen environmental performance reporting system by industries	SPCB, CPCB Universities, Colleges, NGOs	2022
	7.6.4	Take steps to reduce usage of plastic and declare Meghalaya as plastic-free State	SPCB, CPCB, FD, Planning Department, State Police Department, DCs, village councils	2017/2022
	Strengthen research and technical capacity for documenting, monitoring and assessing the impacts of major pollutants			
Strategy 7.7	7.7.1	Document and quantify major pollutants	SPCB, CPCB, Universities, Colleges, NGOs	2020
	7.7.2	Develop capacities to assess and monitor major pollutants	SPCB, CPCB, Universities, Colleges, NGOs	2020
	7.7.3	Strengthen research and technologies to assess and monitor impacts of major pollutants on environment, including biodiversity	SPCB, CPCB, Universities, Colleges, NGOs	2022
	7.7.4	Adhere to the national baseline for river water quality and develop state baselines	SPCB, CPCB	2024

		Action Plan	Indicative Agencies	Time frame
		Strengthen conservation of agrobiodiversity and indigenous breeds of domestic livestock		
Strategy 8.1	8.1.1	Develop strategies for conservation of prioritized crops and livestock species	Agriculture Department, Animal Husbandry Dept., Fisheries Dept.	2020
	8.1.2	Strengthen technical capacities and infrastructure for ex-situ conservation of agro-biodiversity, including crop's wild relatives	Agriculture Department, IFAD, ICAR, NBPGR, DCs	2022
	8.1.3	Identify and declare heritage sites for native crop varieties and crop wild relatives.		2022
	8.1.4	Review current legal and policy framework to address agro-biodiversity conservation and sustainable use	Agriculture Department, Planning Dept., Law Dept.	2020
Strategy 8.1	8.1.5	Strengthen and diversify ex-situ and in-situ conservation approaches, including conservation incentives (e.g., promoting geographical indication products), modern germplasm storage for seedbank and gene banks such as cryopreservation etc	Agriculture Department, IFAD, ICAR, NBPGR,	2024
		Strengthen national capacities in documentation and management of agrobiodiversity conservation and sustainable utilization		
Strategy 8.2	8.2.1	Complete the documentation and diversity assessment of key cultivated crops and domesticated animals, including crop wild relatives	Agriculture Department, Animal Husbandry Dept., Fisheries Dept., MBB, BMCs	2020
	8.2.2	Develop capacity to undertake diversity studies of crops and domesticated animals	Agriculture Department, IFAD, ICAR, NBPGR, Animal Husbandry Dept., Fisheries Dept., Universities and Colleges	2022
	8.2.3	Strengthen capacities in on-farm management of crops and domesticated animals and in-situ conservation of crop wild relatives	Agriculture Department, Animal Husbandry Dept., Fisheries Dept., IFAD, ICAR, NBPGR, NBAGR	2022

		Action Plan	Indicative Agencies	Time frame
	Promote Traditional Knowledge (TK) and Customary Practices relevant to biodiversity conservation and sustainable use			
Strategy 9.1	9.1.1	Inventorise and document TK and Customary Practices relevant to biodiversity conservation and sustainable use	FD, MBB, DCs, Universities and Colleges	2020
	9.1.2	Explore innovative measures to strengthen and incentivize TK and customary Practices that promote biodiversity conservation and sustainable use		2022
	9.1.3	Strengthen measures to prevent mis-appropriation of TK associated with genetic resources and Customary Practices	NBA, MBB, Police Department, DCs, village councils, Rural Development Dept., Tribal Affairs Dept.	2022
	Build state capacities for the protection, preservation and utilization of TK and Customary Practices relevant to biodiversity conservation and sustainable use			
Strategy 9.2	9.2.1	Build capacities on TK, ABS, Intellectual Property (IP), Community Protocols, documentation of Customary Practices, Negotiations, Contract Agreements, etc	NBA, MBB, FD, DCs, BMCs, Universities, Colleges, National Botanical Research Institute, other state biodiversity board eg. Uttarakhand	2022
	9.2.3	Promote targeted awareness and education series on ABS, TK and Customary Practices for the general public, policy makers, academia, private sector and the local communities		2022
	Document and promote bio-cultural services			
Strategy 9.3	9.3.1	Identify and document bio-cultural heritages of the state	NBA, MBB, FD, Tribal Affairs Dept., Rural Dev. Dept., Art and Culture Dept., Universities, Colleges	2020
	9.3.2	Document Cultural Ecosystem Services (CES)		2020
	9.3.3	Promote bio-cultural practices like traditional food, clothing, handicraft, recipes, traditional medicines, and customary cultural practices that do not cause adverse impacts on biodiversity values of the state		2020
	9.3.4	Declare important living root bridges as Biodiversity Heritage Site (BHS) under section 37 of the BDA, 2002 or cultural heritage sites under the UNESCO Convention on Intangible Cultural heritage, 2003		2020
	Prevent destruction and degradation of bio-cultural heritage sites			
Strategy 9.4	9.4.1	Prepare policies for sustainable ecotourism in and around bio-cultural heritage sites	CCB, SPCB, FD, DCs, Village Councils, communities	2022
	9.4.2	Prevent degradation and pollution of bio-cultural sites *via* declaring these sites as no plastic and no garbage zones		2020
	9.4.3	Organize cleaning and habitat improvement drives to restore degraded and polluted sites		2022

	Action Plan		Indicative Agencies	Time frame
	Develop a state policy and legal framework for the implementation ofthe Access and Benefit Sharing Policy.			
Strategy 10.1	10.1.1	Develop a state policy based Access and Benefit Sharing (ABS) mechanism	NBA, MBB	2019
	10.1.2	Review and recommend for amendment/revision of the Biodiversity Acts in line with the state ABS policy	NBA, MBB, FD, Planning Dept., DCs, Village Councils	2022
	10.1.3	Develop regulations to facilitate implementation of the state ABS mechanism		
	Strengthen the implementation of a fair and equitable ABS model			
Strategy 10.2	10.2.1	Establish appropriate institutional, legal and administrative measures for the implementation of the ABS regime	NBA, MBB, FD, Planning Dept., DCs, Village Councils	2024
	10.2.2	Strengthen education and awareness on the ABS regime	Dept. of Higher Education, NBA, MBB, FD, DCs, Village Councils	2020
	10.2.3	Explore and pilot ABS ventures at local, and state levels with inputs from National ABS ventures	NBA, MBB, FD, Dcs	2022
	10.2.4	Create a state ABS fund for empowering local communities to engage in biodiversity conservation		2024
	10.2.5	Strengthen state capacities to implement the ABS regime		2022
	Implement strict control mechanism on bio-resource and genetic resource piracy			
Strategy 10.3	10.3.1	Document and Inventorise genetic resources of the state	NBA, MBB, FD, Dcs, BMCs, Universities, Colleges	2020
	10.3.2	Prepare bio-resource collection guidelines		2020
	10.3.3	Implement wildlife protection act 1972, international laws dealing with trade and extraction and biopiracy	NBA, MBB, FD, Dcs	2024
	10.3.4	Organize awareness programmes for policy makers, state executives, police department, district councils and village councils regarding genetic resources and related laws	NBA, MBB, FD, DCs, NGOs	2020 2022
	10.3.5	Build capacity of wildlife and territorial frontline staff of forest department, district councils, CCA protection squads and communities maintaining CCAs for dealing with Bio-piracy	NBA, MBB, FD, DCs, NGOs, Village Councils	2020
	10.3.6	Provide incentives to local communities for prevention of genetic resource piracy	NBA, MBB, FD	2020
	10.3.7	Provide information on states' bio-resources to police department, airport authorities and customs officials for prevention of genetic resource piracy		



		Action Plan	Indicative Agencies	Time frame
	Reform incentives affecting biodiversity negatively			
Strategy 11.1	11.1.1	Review and identify incentives of various government department, institutions and NGOs that are detrimental to biodiversity	NBA, MBB, FD, GoI Departments	2020
	11.1.2	Reform harmful incentives as appropriate	MBB, FD, all GoM Departments	2024
	Strengthen incentives promoting conservation and sustainable use of biodiversity			
Strategy 11.2	11.2.1	Review and redefine incentive-based conservation including Integrated Conservation and Development Projects considering sustainability, equity, community ownership and participation	MBB, FD, all GoM Departments	2024
	11.2.2	Explore incentives such as Payment for Ecosystem Services (PES), Community-Based Sustainable Tourism(CBST), Eco-tourism and agro-tourism for conservation and sustainable use of biodiversity by the local communities	MBB, FD, DCs, Village Councils	2024
Strategy 11.2	11.2.3	Revisit and prioritize the Crop Promotional Program to strengthen agrobiodiversity conservation, development and management at the community level	Agriculture Dept., ICAR, NBPGR, IFAD, Rural Dev. Dept., Social Welfare Dept., NGOs	2020
	11.2.4	Initiate pilot Crop and Livestock Insurance Schemes for sustainable management of agro-biodiversity and to reduce the impacts of human-wildlife conflict	Agriculture Dept., ICAR, NBPGR, IFAD, Animal Husbandry Dept., NBAGR, FD, Fisheries Dept.	2022
	11.2.5	Recognize and celebrate the role of the custodians of agro-biodiversity and promote conservation stewardship	MBB, FD, DCs, Village Councils, NGOs	2022
	Develop guidelines and policy for environmental amelioration and human well-being.			
Strategy 11.3	11.3.1	Review effect of natural resource extraction on environment	MBB, FD, Agriculture Dept., Fisheries Dept., Dcs, Universities, Colleges	2022
	11.3.2	Initiate study on effect of environment degradation and pathways which effect human health.	CPCB, SPCB, Rural Dev. Dept., Social Welfare Dept., NGOs, Dept. of Mines, FD, Universities, Colleges	2022
	11.3.2	Develop guidelines and policies for preventing environmental degradation and restoration of degraded area		2024
	Strengthen science-based management of natural resources			
Strategy 11.4	11.4.1	Carry out studies on ecological limits of vulnerable production and consumption sectors		2024
	11.4.2	Initiate and promote interdisciplinary research in sustainable productionand consumption of natural resources for developing natural resources management plans	MBB, FD, Agriculture Dept., Fisheries Dept., , Universities, Colleges, NGOs, ICAR, NBPGR, NBAGR	2018

	Promote sustainable use and consumption of natural resources			
Strategy 11.5	11.5.1	Carry out resource mapping of wood and NTFPs and develop sustainable management guidelines	FD, DCs, MBB, Universities, Colleges, NGOs, ICAR	2022
	11.5.2	Promote the use of efficient technologies for harvesting, processing and marketing of forest resources.	FD, DCs, MBB	2024
	11.5.3	Promote alternatives to timber to reduce pressure on natural resources	FD, DCs, MBB, Universities, Colleges, NGOs	2024
	11.5.4	Integrate traditional use of natural resources (grazing, leaf litter, fodder) with sustainable management plans	FD, DCs, MBB, Planning Dept.	2024
	11.5.5	Promote and encourage community participation in the implementation of sustainable management plans of natural resources	FD, DCs, MBB,	2024
	Strengthen capacity in natural resources management e.g. medicinal plants, NTFP, wild edible plants, plants of traditional use			
Strategy 11.6	11.6.1	Assess capacity gaps in natural resource management	FD, DCs, MBB, Universities, Colleges, NGOs, ICAR, NGOs etc.	2024
	11.6.2	Strengthen capacity based on the capacity gap analysis		2026
	Adopt the revised state BSAP as a guiding document for biodiversity management			
Strategy 11.7	11.7.1	Revise the BSAP in line with national and state priorities and Aichi Biodiversity Targets through a participatory and inclusive approach	MBB	2017
	11.7.2	Institute and document the process and procedure of BSAP preparation and revision	MBB	2017
	11.7.3	Adopt the BSAP as a state guiding document for all programmes of work related to biodiversity conservation and sustainable use		2017
	11.7.4	Mainstream actions prioritized in BSAP into relevant stakeholder plans and programs	MBB, all GoM Dept., Planning Department,	2020
	11.7.5	Raise awareness on MBSAP and prioritized state targets		2018
	Establish a state mechanism for implementation of the BSAP			
Strategy 11.8	11.8.1	Establish a dedicated coordination unit for BSAP implementation and resource mobilization, including monitoring and reporting		
	11.8.2	Develop and implement an effective monitoring and evaluation plan for the achievement of state biodiversity targets		

		Action Plan	Indicative Agencies	Time frame
		Strengthen evidence-based policy and decision-making		
Strategy 12.1	12.1.1:	Analyze existing biodiversity data and information gaps	FD, MBB, Dept. of Agriculture, Dept. Of Fisheries, DoAH&Vet.	
	12.1.2:	Strengthen research to generate biodiversity information and expand knowledge base		
	12.1.3:	Promote accessibility and sharing of biodiversity information and knowledge		
	12.1.4:	Promote evidence-based decision-making on policies affecting biodiversity	MBB, All GoM Ministries and Departments	
		Promote transfer and adoption of technologies related to biodiversity management.		
Strategy 12.2	12.2.1:	Support and promote inter and intra-disciplinary research on biodiversity and related technologies		
	12.2.2:	Strengthen state mechanisms to coordinate, promote and review transfer and adoption of appropriate technologies (e.g. HWC management, Forest fire management)	MBB, All GoM Ministries and Departments	
	12.2.3:	Promote sustainable procurement initiatives such as Green Public Procurement		
		Strengthen institutional mechanisms and good governance to coordinate fund mobilization for Meghalaya state BSAP implementation		
Strategy 12.3	12.3.1:	Adopt the Meghalaya state BSAP as a guiding document for biodiversity management in the state	MBB, All GoM Ministries and Departments	
	12.3.2:	Establish the Meghalaya Biodiversity Committee as the state coordination agency for MBSAP implementation and resource mobilization	MBB, FD, All GoM Ministries and Departments	
	12.3.3:	Establish a funding window for Meghalaya state BSAP implementation with innovative funding mechanisms	Dept. of Planning, Dept. of Finance, FD, MBB, NGOs, Public institutions in state	
		Mobilize financial resources to support implementation of the Meghalaya state BSAP		
Strategy 12.4	12.4.1:	Review the financial gap for implementation of the Meghalaya state BSAP	MBB, FD, Finance Dept., Planning Dept.	2020
	12.4.2:	Implement BIOFIN process for assessing state finance for biodiversity conservation	FD, All GoM Dept	2020
	12.4.3:	Develop and implement Resource Mobilization Plan	Finance Dept., All GoM Dept., MBB, Planning Dept.	2022
	12.4.4:	Allocate funds as per the Resource Mobilization Plan	FD, MBB, Planning Department, Finance Department, All GoM Departments	2024
	12. 4.5:	Monitor effective and efficient utilization of available funds		2024
		Mainstreaming of biodiversity conservation and sustainable development		
Strategy 12.5	12.5.1:	Generate awareness on biodiversity conservation and sustainable development		2020
	12.5.2:	Develop programmes for participatory planning and biodiversity conservation	FD, MBB, Planning Department, Finance Department, All GoM Departments	2024
	12.5.3:	Coordinate and harmonize among sectoral plans		2026

Tabel no.6.1 Meghalaya Biodiversity Targets - Indicators and Responsible Agencies

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
 1 By 2026, a significant proportion of the state's population, especially the youth, is aware of the values of biodiversity, and the steps they can take to conserve and use it sustainably.	*1.1 Enhance Environmental awareness and values of biodiversity among the youth.* *1.2 Mainstreaming Environmental Education and Conservation Awareness in the state Education Policy.* *1.3: Build capacity of educational and training institutes in imparting environmental education and advocacy programs.*	Trends in incorporating awareness and attitudes towards environmental conservation through communication and mainstream education	Number of students opting for higher-level elective subject and specialization in environmental / conservation education and informal education through ICAR, NBPGR, Forest Department etc.	DoE, MBOSE, Directorate of Higher and Technical Education, ICAR, NBPGR, FD	2-4 years
			Number of schools enrolled in the National Environment Awareness Campaign, Paryavaran Mitra Programme, Gyan Vigyan Vidyalaya, birdwatching clubs	MMHRD, FD, DoE, CEE NE, CPR Environmental Education CentreMBOSE, Department of Biotechnology	2-4 years
			Trend in number of government financed projects related to biodiversity and conservation.		2-4 years
			Trend in participation in informal training and awareness camps	ICAR, NBPGR, FD	2-4 years
			Trends in coverage of environment related programmes and projects with enhanced involvement of youth	IYCN, SAYEN, Directorate of Sports and Youth Affairs	2-4 years
			Trends in visit to Protected Areas, natural history museums, exhibitions and zoological/botanical gardens especially by schools and college students	Forest Department (Wildlife Wing), Central Zoo Authority (CZA), CEE, ZSI, BSI	2-4 years
		Trend in promoting awareness at local levels	Trends in number of Biodiversity Management Committees (BMCs) constituted/operationalized	Meghalaya Biodiversity Board	

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
			Trends in number of Biodiversity Management Committees (BMCs) constituted/operationalized		2-4 years
			Trends in number of people's biodiversity registers (PBRs) prepared	Forest Department, District Council, Ministry of Tribal Affairs, CEE, Department of North Eastern Region (DoNER)	2-4 years
			Trends in number of Joint Forest Management Committees (JFMCs) constituted/operationalized		
2 By 2026, values of biodiversity are integrated in state planning processes, development programmes and poverty alleviation strategies.	***2.1:*** *Set up an institutional mechanism for valuation of biodiversity and ecosystem services.* ***2.2:*** *Build capacity for valuation of biodiversity and ecosystem services.* ***2.3:*** *Mainstream biodiversity conservation and ecosystem management into environmental policy, legislations and development plans.* ***2.4:*** *Improve livelihood options for communities to prevent degradation of ecosystems they depend on.*	Trends in incorporating natural resource/biodiversity/ecosystem service values in state planning processes and developmental program	Trends in number and effectiveness of measures developed in the MGNREGA and Integrated Watershed Management Programme for protection and enhancement of ecosystem services and biodiversity	Community and Rural Development Department, Indian Institute of Forest Management (IIFM), IIMs, Ministry of Forest and Environment, Institute of Economic Growth (IEG), Indra Gandhi Institute for Development Research (IGIDR)	5 years
			Trend in number and coverage of studies related to biodiversity - TEEB etc		
			Trend in capacity building for valuation of biodiversity		
			Trends in area covered by catchment area treatment plan under development projects	State Irrigation Department	5 years
		Trend in integration of biodiversity and ecosystem service values	Trends in reflection of biodiversity and ecosystem services in policy decisions, planning and reporting processes	MoEFCC, State MoEF, IIFM, SBB, IEG, IIMs	5 years
		Trends in policies considering biodiversity and ecosystem services	Trends in identification, assessment and strengthening of incentives that reward positive contributions to biodiversity and ecosystem services	State Ministry of Corporate Affairs	5 years
		Trend in engagement of poorest section of society	Trend in engagement of marginal farmers, communities involved in ecorestoration and conservation programs	Forest Department, Agriculture Department, Department of Rural Development	3-4 years

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
 **3** Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are developed and actions put in place by 2020 for environmental amelioration and human well-being.	***3.1:*** *Map biodiversity rich habitats and ecologically sensitive sites.* ***3.2:*** *Assess effects of ecological and environmental degradation on human wellbeing.* ***3.3:*** *Reduce the rate of habitat degradation and fragmentation.* ***3.4:*** *Address the major causes of habitat loss and environmental degradation where possible.*	Trends in forest cover and connectivity	Change in proportion of forest cover in different forest categories (VDF, MDF, OF and Scrubs)	Forest Survey of India (FSI), North East Space Application Centre (NESAC)	1 years
		Trend in aquatic ecosystems	Changes in areas under riverine ecosystems and wetlands (terrestrial)	Department of Space, NESAC , Wetland international - South Asia, SACON, BNHS, Department of Fisheries, Ministry of Water Resources, Soil and Water Conservation	2-4 years
			Number of wetlands under integrated wetland management plan		2-4 years
		Trend in river water quality and quantity	Changes in water quality (by interception, diversion and treatment of domestic sewage and preventing agricultural runoff, toxic wastes, industrial affluent, chemical wastes from mining) and water flow	SPCB, Dept. of Fisheries, Dept. of Mining, NGOs, Ministry of Water Resources, Soil and Water Conservation, North Eastern Regional Institute of Water and Land Management	2-4 years
		Trend in afforestation and restoration	Trend in afforestation and Assisted Natural Regeneration	Forest Department, Green India Mission, North East Space Application Centre, FSI, NEHU, NGOs	2-4 years
			Rehabilitation of mined out areas		
		Prevention of deforestation and fragmentation of forests and conservation of critical ecosystem	Trends in slash and burn agriculture	State Agriculture Department, State Forest Department, Ministry of Water Resources, Ministry of Rural Development, North Eastern Regional Institute of Water and Land Management	2-4 years
			Trends in conservation of hill/mountain ecosystems, conservation of river basins		
			Status and trend in water table, groundwater resources		2-4 years
		Species restoration after forest and water body restoration	Trend in forest fires incidence	Forest Department, District Council, Village Council	2 years
			Status of selected indicator species (gibbons, elephants, clouded leopard, *N. khasiana*)	Forest Department, District Council Forest Department, NGOs, ZSI, BSI	2-4 years
		Trends in maintenance of fertility in agricultural lands using natural methods and means	Trend in soil health records awarded titles under FRA in forest areas	Ministry of Agri. , State Forest Department, Minister of Water Resources, Soil and Water Conservation, North Eastern Regional Institute of Water and Land Management	2-4 years
			Organic carbon and humus buildup		2-4 years

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
 **4** Terrestrial and inland aquatic and wetland ecosystems and associated species are conserved effectively and equitably, with specific emphasis on climate change effects and adaptations.	***4.1:*** *Strengthen conservation programs for state wetlands, rivers and aquatic species.* ***4.2:*** *Strengthen conservation programs for the unique karst ecosystems of the state.* ***4.3:*** *Assess the impacts of climate change on biodiversity and ecosystems.* ***4.4:*** *Strengthen climate change adaptation measures.* ***4.5:*** *Enhance management effectiveness of the Protected Area System.* ***4.6:*** *Establish sustainable financing measures for the Protected Area Systems and CCAs.* ***4.7:*** *Assess the status of prioritized taxonomic groups and species and the factors affecting them.* ***4.8:*** *Strengthen conservation programs for prioritized species.*	Trend in PA coverage under four legal categories	Change in number / area / percentage of PAs	WII, Forest Department	5 years
			Trend in financial resource mobilized for PAs	Forest Department	5 years
		Trend in Community Conserved Areas based conservation measures	Area/ number of initiatives, CCAs	UNDP, ATREE, District Council, Forest Deparment	2-4 years
		Trend in coverage under Biodiversity Heritage Sites (BHS) under the Biological Biodiversity Act 2002	Change in number / area/ percentage of proposed or declared BHS over time	SSB, NBA	2-4 years
		Trend in number of biological corridors operationalised	Trend in Biological corridors legally recognized as community reserves, conservation reserves	Forest Department, District Councils, NGOs	2-4 years
		Trend in Wetlands and its biodiversity	Changes in area and ecological status of wetland through implementation of integrated management plans	SACON, Wetland International - South Asia, DoS, NESAC, BNHS, Forest Department, NGOs, NEHU, State colleges	2-4 years
			Change in abundance and diversity of water bird species in wetlands over time		2-4 years
		Trend in Important Bird Areas (IBAs)	Change in number / area of Important Bird Areas (IBAs) over time	BNHS	3 years
		Status and population trend of critical endangered Terrestrial and aquatic species	Identification of state critical endangered species	State Forest Department, Autonomous Council, BSI, ZSI , WII, SACON, BNHS, NCF, WWF, WTI, IISc	2-4 years
			Population trend of selected species		5 years
		Trend in air quality, water quality and noise pollution	Status and trend of ambient air quality; monitoring water quality, trends in noise levels	CPCB, SPCB	Yearly
			Trends in pollution status of wetlands of international (Ramsar sites), national and state (identified by state government) importance	CPCB, SPCB, Fisheries Department, Agriculture and Irrigation Department, Indian Institute of Toxicology Research	2 years
		Trend in areas of exceptional agricultural biodiversity and their threat status	Assessing the conservation status of landraces and varieties to highlight threatened status and therefore promote conservation	Ministry of Agriculture, NEHU, ICAR, State Biodiversity Board	5 years

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
		Trend in PA coverage under four legal categories	Trends in biodiversity-inclusive climate change adaptation and mitigation measures formulated / implemented	State Climate Change Cell	5 years
5 By 2026, ecosystem services, especially those related to water, human health, livelihood and wellbeing, are enumerated and measures to safeguard them are identified, taking into account the need of women and local communities, particularly poor and vulnerable sections.	***5.1:*** *Access needs of women, local communities, especially poor and vulnerable communities.* ***5.2:*** *Safeguard key ecosystems and ecosystem services.*	Human-development index-standard of living in Meghalaya	Trend in number of people with access to primary/secondary education/health services/safe drinking water / electricity / Road connectivity	MoHRD, Ministry of Health and Family Welfare	2-4 years
			Trend in number of women with access to primary/secondary/ education /health services/safe drinking water / electricity / Road connectivity		2-4 years
		Trends in wetlands significant for delivering freshwater being brought under integrated management	Area of wetland such as lakes and ponds under integrated management	SACON, Wetland International - South Asia, BNHS, NESAC, DoS	2-4 years
		Trends in proportion of people using improved water services	Trend in number of people with access to potable water, Trend in number of households with tap water connections	Ministry of Drinking Water and Sanitation	2-4 years
		Trends in availability of urban greenspaces	Area under greenspaces in urban centers (as a proxy to conservation of urban biodiversity)	Ministry of Urban Development, School of Planning and Architecture	2-4 years
		Trend in ecosystem services	Trend in ecosystem services from PAs, CCAs, community forests etc	Forest Department, District Councils, Research Institutions	2-4 years
		Trend in measures taken to safeguard ecosystems and its services	Trend in conservation measures undertaken to protect critical ecosystems and its services	Research Institutions, NEHU, State colleges, Forest Department	2-4 years

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
6  By 2026, invasive alien species and pathways are identified and strategies to manage them developed so that populations of prioritised invasive alien species are managed.	***6.1:*** *Improve understanding on Invasive Alien Species and native species with potential for invasiveness.* ***6.2:*** *Identify invasive species pathways and changes in areas affected by AIS* ***6.3:*** *Develop and implement measures to protect natural and agriculture ecosystems against IAS.*	Trends in invasive and alien species management	Trend in baseline creation of IAS spread and extent in each districts of the state	State Forest Department, District Council, Wetland International - South Asia, SACON, BNHS, ICFRE (Forest Invasive species cell), WII, Agriculture Department	2-4 years
			Number and coverage of management plans developed for prioritized invasive species and integration with PA management plans and wetland management plans		2-4 years
			Change in area affected by invasive species		2-4 years
			Trend in inclusion of IAS in annual plan of forestry operations	Forest Department, District Councils	2-4 years
7  By 2026, measures are adopted for sustainable management of agriculture, forestry and fisheries.	***7.1:*** *Strengthen information base, institutional and technical capacity in the conservation and sustainable utilization of fish and aquatic biodiversity.* ***7. 2:*** *Identify threats to aquatic life and fish biodiversity and take steps to ameliorate them.* ***7.3:*** *Improve management of private forest, State Forest, and village forests for sustainable production of goods and services.* ***7.4:*** *Strengthen good governance for sustainable management of forests.* ***7.5:*** *Promote sustainable agricultural practices that ensure conservation of biological diversity.* ***7.6:*** *Major pollutants affecting environment are maintained as per the National environmental standards.*	Trends in sustainable agriculture	Trend in area under jhum cultivation, trend in jhum cycles	Forest Survey of India , Dept. of Agriculture	3-5 years
			Trend in usage of agrochemical fertilizers	Dept. of Agriculture	3-5 years
			Trend in use of bio-fertilizers, bio-fuels, organic manure and vermicomposts		3-5 years
			Trends in increased acreage under crop production (organic/inorganic)		3-5 years
			Trend in enhanced use of landraces		3-5 years
		Trend in sustainable forestry	Trend in analysis of agricultural policies and programmes that adversely affect ecosystem services	Agriculture Department, Green India Mission, NEHU, State colleges, Community Forestry International (CFI)	3-5 years
			Trend in area of degraded forests	Green India Mission, IIFM, IIMs, FSI, FRI, ICFRE	3-5 years
			Trend in areas of restored forests		
			Trend in proportion of products derived from sustainable sources		3-5 years

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
		Trends in sustainable agriculture	Trend in catch per unit effort	Dept. Of Fisheries, Fishery Survey of India, National Fishery Development Board, NBFGR	3-5 years
			Trend in over exploitative inland fishing		3-5 years
			Trend in traditional fishing practices	NBFD, Dept. of Tribal Affairs, Social Welfare Dept.	3-5 years
8 By 2026, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socio- economically as well as culturally vulnerable species is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.	***8.1:*** *Strengthen management of agrobiodiversity and livestock diversity.* ***8.2:*** *Strengthen national capacities in documentation and management of agrobiodiversity conservation and sustainable utilization.*	Animal genetic diversity	Trend in number of indigenous/domesticated breeds (in situ)	National Bureau of Animal Genetic Resources (NBAGR) Department of Animal Husbandry, Department of Agriculture, Agricultural Universities	2-4 years
			Effectiveness of initiatives/measures taken to conserve indigenous animal varieties		2-4 years
			Trend in germplasm accessions in ex-situ collection	NBAGR, Agricultural Universities	2-4 years
		Plant genetic diversity	Trend in number of indigenous varieties (in situ)	National Bureau of Plant Genetic Resources (NBPGR)	2-4 years
			Trend in area under cultivation, production/yield (in situ)	Agricultural Universities	2-4 years
			Effectiveness of initiatives/measures taken to conserve indigenous crop varieties and their relatives	Department of Agriculture	2-4 years
			Trend in germplasm accessions in ex situ collections	National Bureau of Forest Genetic Resources (NBFGR)	2-4 years

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
9 By 2026, national initiatives using communities 'traditional knowledge" relating to biodiversity are strengthened, with the view to protecting this knowledge in accordance with national legislations and international obligations.	***Aichi 18*** ***9.1:*** *Promote Traditional Knowledge (TK) and Customary Practices relevant to biodiversity conservation and sustainable use.* ***9.2:*** *Build state capacities for the protection, preservation and utilization of TK and Customary Practices relevant to biodiversity conservation and sustainable use.* ***9.3:*** *Document and promote bio-cultural services diversity.* ***9.4:*** *Prevent destruction and degradation of bio-cultural heritage sites.*	Trends in documentation/data abstraction and management	Number of traditional herbal formulations documented	TKDL-AYUSH-CSIR Unit	2-4 years
			Number of folks uses of medicinal plants documented from PBRs prepared by BMCs	NBA, SSB	
		Trend in access agreement related to indigenous traditional knowledge (ITK)	Number of potential 'bio-piracy' / wrong patents cases prevented	TKDL-AYUSH-CSIR Unit	2-4 years
			Number of patents and ABS based on TK derived from folk knowledge	Controller General of Patents, Designs & Trademark, NBA	2-4 years
		Trends in grass root innovations and traditional practices	Number of innovations and traditional practices documented	National Innovation Foundation (NIF), NBA, NEHU	2-4 years
		Trends in capacity building related to TK and PBRs	Training / Capacity building at local and community levels	NBA, SBBs and FRLHT, BSI, State Forest Service College and training centers, ICFRE	2-4 years
			Number of BMCs and PRI institutions trained		
		Trends in conservation and sustainable use of medicinal plants used by Meghalaya medical heritage	Number of Medicinal Plants Conservation Areas (MPCA)established in state	MoEFCC, National Medical Plant Board (NMPB), FRLHT	2-4 years
			Trends in collection of plants providing raw drugs used in Indian system of medicine	NMPB	
		Trend in documentation and awareness of the conservation tradition in ITK	Documentation and awareness meetings/ capacity building / workshops / conferences for various target groups (NGOs, CBOs, Mahila Mandals, Academicians)	CPREEC, NBA, SSB, MoHRD	2-4 years
		Trend in bio-cultural services	Trends in documentation of cultural heritage sites	MBB, Ministry of Tribal Afairs, Ministry of Rural Development	2-4 years
			Trends in incentive schemes for sustenance of cultural heritage like arts and crafts and festivals		

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
10 By 2026, Access to Genetic Resources and the Fair and Equitable Sharing or Benefits Arising from Utilization as per the Nagoya Protocol are operational, consistent with national legislations	*10.1: Develop a state policy and legal framework for the implementation of the Access and Benefit Sharing Policy.* *10.2: Strengthen the implementation of a fair and equitable ABS model. Action* *10.3: Strict control mechanism on bio-resource and genetic resource piracy*	Trend in access to genetic resources and equitable sharing of benefits	Trend in number of proposals for intellectual property rights	NBA, SSB, Department of Agriculture, Department of Fisheries and Animal Husbandry, ICAR, Controller general of Patents, Design and Trademarks, Dept. of Tribal Affairs	2-4 years
			Trends in number of cases for seeking prior approval of MBB for transferring the results of research to companies for commercial purposes		2-4 years
			Trends in number of cases for seeking approval of bio-resources and associated traditional knowledge for commercial utilization		2-4 years
			Trend in cases related to bio-piracy reported by communities and Forest Department	FD, MBB, District Councils, village councils	2-4 years
11 By 2026, an effective, participatory and updated State biodiversity action plan is made operational at state level, with incentives for biodiversity conservation, abolition of incentives which harm biodiversity, and involvement of all stakeholders in preparing and implementing the state BSAP.	***11.1:*** *Reform incentives affecting biodiversity negatively.* ***11.2:*** *Strengthen incentives promoting conservation and sustainable use of biodiversity.* ***11.3*** *Develop guidelines and policy for environmental amelioration and human well-being.* ***11.4:*** *Strengthen science-based management of natural resources.* ***11.5:*** *Promote sustainable use and consumption of natural resources.* ***11.6:*** *Strengthen capacity in natural resources management.* ***11.7:*** *Adopt the revised state BSAP as a guiding document for biodiversity management.* ***11.8:*** *Establish a state mechanism for implementation of the BSAP.*	Progress in implementing of State Biodiversity Action Plan	Trends in formulation and implementation of policies suggested in MBSAP	SBB, State Planning Board, MoEFCC, NBA, Agriculture, Animal Husbandry Department, and Fisheries Department	2-4 years
		Reform incentives affecting biodiversity	Number of harmful incentives identified and reformed.		2-4 years
			Number of positive incentives reviewed and strengthened.		
		Trends in incorporation of biodiversity in sectoral plans	Trends in MBSAP actions integrated into relevant sectorial plans and programs.	MBB, NBA, State Planning Dept.	
		Strengthen capacity in natural resource management	Trend in capacity enhancement training given to policy makers, communities, office bearers in government departments.	FD, Agriculture Department, Animal Husbandry Department, Fisheries Department	
			Trend in capacity enhancement training to teachers, students, educational institution for promotion of natural resource management and research	Education Department, MBOSE, ICAR, Agriculture Department, FD, Animal Husbandry Department, Fisheries Department	

Meghalaya Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
12  By 2026, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011-2020 and the state targets are identified and the Strategy for Resource Mobilization is adopted.	***12.1:*** *Strengthen evidence-based policy and decision-making.* ***12.2:*** *Promote transfer and adoption of technologies related to biodiversity management.* ***12.3:*** *Strengthen institutional mechanisms and good governance to coordinate fund mobilization for Meghalaya state BSAP implementation.* ***12.4:*** *Mobilize financial resources to support implementation of the Meghalaya state BSAP.*	Trends in availability of financial, human and technical resources for achieving 20 Aichi Biodiversity Targets and 12 State Biodiversity Targets	Trends in financial resources made available for implementing Aichi and Biodiversity Targets for Meghalaya State through various sectors	State Planning Department, MoEFCC, NBA, DoNER	3-5 years
			Trend in human resource made available for implementing Aichi and State Biodiversity Targets	MBB, NBA, MoHRD (Meghalaya)	3-5 years
			Trends in technical resources made available for implementing State Biodiversity Targets	DoS, NESAC, Indian Meteorological Department (IMD)/Ministry of Earth Sciences, NEHU, WII	3-5 years
			Trends in assessment of gaps in biodiversity finance	NBA, MBB	3-5 years
			Trends in innovative finance mechanisms utilized for implementation of MBSAP	NBA, SBB, FD	3-5 years

VII | Implementation Plan and Resource Mobilization


MBB

07 Implementation and Resource Mobilization Plan

7.1 Introduction

The success of depends on a well-defined implementation framework and commitment for action on the ground. This plan comprises possible opportunities in policy interventions, institutional roles, financial mobilization and human resource mobilization. The financial resources available for implementation of the plan can be tracked from various departments and schemes in the state, and this can be optimized for conservation, preservation and sustainable use of bio-resources and biodiversity. The objective of the implementation plan is to achieve biodiversity conservation and sustainable development by allocation of various resources by government departments, institutions and NGOs. The strategy chapter provides directions to the various department to achieve these targets, and the implementation plan requires these agencies to develop a collaborative effort for filling the gaps and to promote better technologies to achieve these goals.

7.2 Opportunities for Policy Interventions and Synergies

A review of policies and their gaps is presented in chapter 2 & 6, some of these policies which affect biodiversity in the state are forest related acts and laws, natural resource management policy, agriculture policy, education policy, tourism policy etc. Though many sectors have well defined policies which are favourable to biodiversity, their implementation is a major challenge. For example, the mines and mineral policy of the state has laid out guidelines to prevent mining in biodiversity sensitive areas, rivers and other water bodies and caves, though, the present predicament of mining in the state do not follow these guidelines. Similar guidelines and policies exist in various forest, natural resource management, however, many of these are not being followed. It is also essential to build synergies between these policies so that multiple departments do not have policies that are contradictory to polices of other departments. Biodiversity conservation in the state can be strengthened by improving the interoperability between these policies and their proper implementation.

The chapter 2 (box 2.2 & 2.3), lists the national, state and DC's natural resource management policies, and the review by Barik & Darlong (2008) recommends encouragement of forest based livelihood opportunities to benefit the region and it's local communities. Similarly, few policies are still to be adopted or implemented in the state e.g. ABS policy. The national ABS policy with local level modifications can be adopted by the state.

India is a signatory to seven major international conventions or treaties. The state government also needs to also fulfil these agreements and their directives. The Aichi targets and corresponding MBTs also fulfill commitment to these conventions.

Table 7.1 lists the synergies existing between the MBTs and international treaties and conventions.

7.3 Meghalaya Biodiversity Targets and Sustainable Development Goals

The MBTs originates from the 20 Aichi Biodiversity Targets, and the state's Sustainable Development Goals can be built into these targets, as Aichi targets go beyond conservation of biodiversity to conservation of nature for human well-being. The MBTs create a linkage between biodiversity and sustainable development and incorporates biodiversity values in state planning process. The MBTs also link several international biodiversity related agreements into the state biodiversity targets which form parts of SDGs. As Aichi targets are already under formulation and implementation, their synchrony with SDGs would also help in achieving the SDGs in the state. As the biodiversity goals of the state aims to improve livelihood, access and benefit sharing, traditional knowledge, sustainable development, maintenance of ecosystem services for the communities, they also fulfill major targets of the SDGs.

To access which National Biodiversity Targets achieves the SDGs, an exercise was undertaken by the country to assess the synergies between these goals for the country. The MBTs follow the country's NBTs with similar synergies with SDGs. The MBT1 which aims to create biodiversity awareness, also utilizes education to create awareness pertaining to good health, ecosystem

Table. 7.1 Synergies between 7 Biodiversity Conventions and MBTs

Meghalaya Biodiversity Targets	Convention on Biological Diversity	CITES*	Convention on Migratory Species	Int. Treaty on Plant Genetic Resources	Ramsar Convention	World Heritage Convention	International Plant Protection Convention
Biodiversity awareness	■					■	
Biodiversity valuation and poverty alleviation	■						
Safeguarding natural habitats	■	■	■	■	■		
Protected areas	■	■	■		■	■	■
Ecosystem services	■	■	■	■	■		■
Managing invasive species	■	■	■		■		■
Sustainable landscapes	■			■			■
Maintaining genetic diversity	■			■			■
Protecting traditional knowledge	■			■		■	■
Access and benefit sharing	■			■			
Inclusive governance	■					■	
Resource mobilization	■	■	■	■	■	■	■

*** Convention on International Trade in Endangered Species of Wild Fauna and Flora. Source: NBSAP, 2014.**

■ **Synergies with MBTs**

services, improved crops, genetic diversity, threats to biodiversity etc. thus fulfilling targets of End hunger (SDG 2), Good health and well-being (SDG 3), Quality education (SDG 4), Gender equality (SDG 5), and Decent work and economic growth (SDG 8). MBT2 (Biodiversity valuation and poverty alleviation) fulfils targets of a number of SDGs pertaining to poverty (SDG 1), hunger (SDG 2), education (SDG 4), good health and well-being (SDG 3), decent work and economic health (SDG 8), reduced inequalities (SDG 10), sustainable cities and communities (SDG 11), climate action (SDG 13) and partnership for the goals (SDG 17).

Similarly, The MBT target of safeguarding natural habitat (MBT 3) aims to safeguard both life on land (SDG 15) and below water (SDG 14), safeguards clean water access (SDG 6) and make communities sustainable (SDG 11). Such synergies exist between different MBTs and SDGs. Each MBT synergizes with multiple targets of different SDGs. These synergies are listed in Table (7.2) in a more simplistic manner. Each SDGs list several targets for sustainable development under the goal. However, it would not be possible for MBTs to attain all SDG targets via BSAP process. One major SDG which remains untouched by MBTs is SDG 16 (peace, justice and strong institutions). Many SDG targets under different goals are also not covered under the MBTs and BSAP process.

Most of the state departments face much greater compulsion in achieving SDGs, and thus they cannot afford to neglect guidelines and directives of MBTs, that ultimately fulfill the targets of the SDGs. It must also be realized that for achieving the SDGs, the MBTs can be a very strong mechanism and the state would benefit and progress rapidly in achieving the SDGs, by adopting MBTs in planning and implementation process. The SDGs present many more targets to achieve sustainable development for human well-being via safeguarding nature and natural resources.

7.4 Opportunities for Institutional & Inter alia – profile wise role and mandate

The primary responsibility of implementing the coordinating and activities listed in the BSAP lies with the Meghalaya State Biodiversity Board, its district level coordination committees and BMCs. Each target is further assigned to one or more relevant Departments or Ministries of central and state government, District Councils, and local institutions for advance planning and allocation of required funds under respective sector. There are three major central government institutions (MoEFCC, NEC & DoNER), nearly 30 state government departments or ministries (including Forest Department, Agriculture and allied Departments etc., Table 7.3), three District Councils which are involved in biodiversity management and conservation in the state. In addition there are few central research institutions such as Indian Institute of Forest Management (IIFM), Indian Institute of Managements (IIMs), Institute of Economic Growth (IEG), etc. and several state institutions (NEHU, BSI, colleges etc.) which have mandate of documentation, long term monitoring and scientific management of bio-resources in Meghalaya. The Government of Meghalaya departments and ministries have their specific agendas and schemes and these synchronize with different MBTs (Table 7.4 and Appendix 23). Thus for achieving the goals of the MBTs, these specific departments also need to align their activities accordingly.
The MBSAP table (7.4) lists the responsible institutions for carrying out each of the action plan envisaged for achieving MBTs. All these institutions need to adopt a coherent and converging strategy for resource mobilization for achieving the MBSAP.

7.5 Opportunities for Financial Resource mobilization

In a short exercise for calculating biodiversity finance (BioFin), all the schemes of GoM and few schemes of central government institutions were analyzed for their role in biodiversity management and conservation. A total of 431 schemes were listed and following a discussion with members of most of the state government agencies, only 326 schemes were found to be responsible for BioFin in the state (Annexure 24). The BioFin table lists these schemes according to their contribution to biodiversity (percentage contribution according to Rio Marker categories, Table 7.4) and classified as one benefitting either natural resource management, protection, etc. (Table 7.5). The total expenditure in each schemes for biodiversity finance was calculated by multiplying with percentage contributions (Rio Marker, Table 7.4). The BioFin process provides policy makers an important tool to analyze finances available according to different government schemes and so that they can provide detailed recommendations based on requirement of finances for each category of biodiversity conservation process.

Many of the state government's schemes have contributed to more than one BioFin category and this contribution is increasing every year (Multiple Category; Table 7.5, Fig. 7.3). Contribution to sectoral mainstreaming, restoration has been declined in the state over last four years (Table 7.4, Fig. 7.3). Natural resource management is the main emphasis of most of the allied departments and thus maximum expenditure is observed in this sector (Fig. 7.1).

Enhancing implementation and natural resource management is the major component of most of the multiple category schemes thus contrary to impression from earlier table (Table 7.5 & Fig. 7.1), both are well represented in the state's expenditure (Fig. 7.2).
It appears that the funds available for ABS and sectoral mainstreaming are quite low, and the state needs to contribute more towards these categories in the state's schemes (Table 7.5, Fig. 7.1, 7.3).

Table 7.4 Rio Markers for BioFin Expenditure calculations

S.No	BioFin Categories	Percentage
1	Non/Immeasurable	0%
2	Marginal	1-5%
3	Low	5-25%
4	Medium	25- 75 %
5	High	75-90%

However, these BioFin expenditure calculations are a preliminary results of consultation with representative of each state department. Only a much more robust analysis is required by each central or state department to calculate a more precise BioFin. And each department needs to also analyse whether they are achieving their departmental targets and biodiversity conservation targets via resource allocation to these schemes. It will help them to assess if they need to change the financial investment in some schemes to streamline them for biodiversity conservation according to needs of MBSAP. Over the next few years steps needs be taken to access financial needs for implementation of BSAP and possible financial solutions. MBB has several opportunities for international, regional and domestic funding which the can be channelized for biodiversity conservation by government, civil, community and private partners.

Table 7.5 Expenditure in 326 schemes of Meghalaya state during 2011-15 (In Lakhs rupees)

BioFin Classification	2011-12	2012-13	2013-14	2014-15
Sectoral mainstreaming	89.0	64.5	53.8	15.4
Restoration	193.7	130.2	90.8	72.3
Protection	190	202.9	210.7	228.9
Enhancing Implementation	211.8	110.2	205.8	150.6
Access and Benefit sharing	100	75	50	50
Natural resource use	887.7	981.7	264.7	216.1
Others	52.3	40	48.2	51.2
Multiple Category*	483	400.5	725.5	998
Total expenditure in BioFin	2208	2005	1650	1783

7. 5 Opportunities for human resource mobilization and outreach

Human resource mobilization and outreach are the two most important strategies to achieve the biodiversity conservation targets. Synergies are also essential between the Finance Department, Education Department and Forest Department to provide resources for research and development, capacity building of state institutions, and for awareness to various stakeholders. The MBTs require coordination among various government departments, public institutions, education institutions and local institutions and their resources. Human resource and outreach is also required in some non-allied sectors like legal and mines and minerals for implementation of various acts, rules and laws for protection of natural ecosystems.

Steps for mobilizing resources

1) Constitute and empower BMCs target wise
2) Initiate incentive programmes for youth
3) Initiate enhancement programmes in formal and informal education
4) Demarcate CRs and CCAs
5) Allocate funds for nature conservation and skill development for monitoring by the communities via rural development and eco tourism programmes
6) Promote research in the state Institutions, education and public sectors
7) Promote schemes for biodiversity, particularly for women, economically poor section of society
8) Strengthen ABS awareness and mechanism for support
9) Initiate State and District council support schemes
10) Built capacity of state institutions and communities for natural resource management
11) Initiate programmes for awareness regarding biodiversity management and policies to the state executives, communities etc

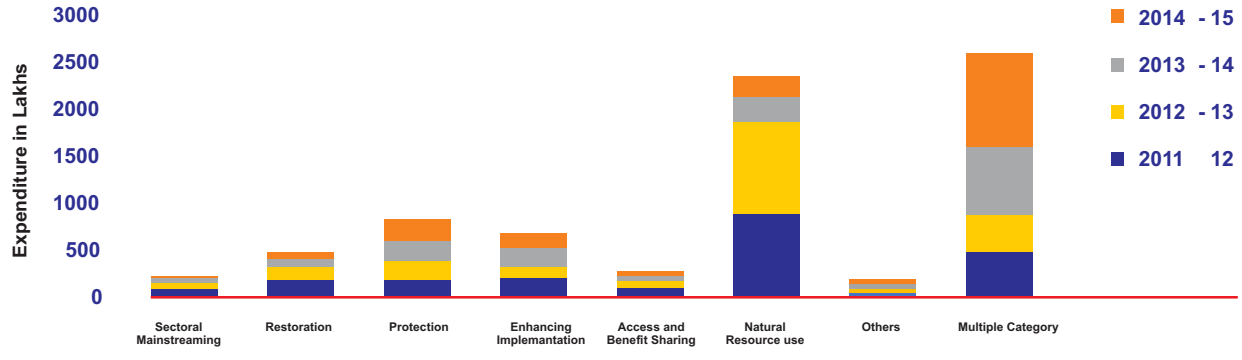


fig 7.1 Expenditure in BioFin Categories during 2011 -2015

Table 7.2 Linkages MBT, NBT, Aichi & SDGs

	MBT	NBT	Targets	Aichi	Sustainable Development Goals 2030								
1	*Biodiversity awareness*		By 2026, a significant proportion of the state's population, especially the youth, is aware of the values of biodiversity, and the steps they can take to conserve and use it sustainably.										
2	*Biodiversity valuation and poverty alleviation*		By 2026, values of biodiversity are integrated in state planning processes, development programmes and poverty alleviation programmes										
3	*Safeguarding natural habitats*		Strategies for reducing rate of degradation, fragmentation and loss of all natural habitats are developed and actions put in place by 2026 for environmental amelioration and human well-being.										
4	*Protected areas*		Terrestrial and inland aquatic and wetland ecosystems and associated species are conserved effectively and equitably, with specific emphasis on climate change effects and adaptations.										
5	*Ecosystem services*		By 2026, ecosystem services, especially those related to water, human health, livelihood and wellbeing, are enumerated and measures to safeguard them are identified, taking into account the need of women and local communities, particularly poor and vulnerable sections.										
6	*Managing invasive species*		By 2026, invasive alien species (IAS) and their pathways are identified and strategies to manage them developed so that populations of prioritized invasive alien species are managed.										
7	*Sustainable landscapes*		By 2026, measures are adopted for sustainable management of agriculture, forestry and fisheries.										
8	*Maintaining genetic diversity*		By 2026, genetic diversity of cultivated plants, farm livestock, and their wild relatives, including other socio- economically as well as culturally vulnerable species is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.										
9	*Protecting traditional knowledge*		By 2026, national initiatives using communities 'traditional knowledge" relating to biodiversity are strengthened, with the view to protecting this knowledge in accordance with national legislations and international obligations.										
10	*Access and benefit sharing*		By 2020, Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from Utilization as per the Nagoya Protocol are operational, consistent with national legislations.										
11	*Inclusive governance*		By 2026, an effective, participatory and updated State biodiversity action plan is made operational at state level, with incentives for biodiversity conservation, abolition of incentives which harm biodiversity, and involvement of all stakeholders in preparing and implementing the state BSAP.										
12	*Resource mobilization*		By 2026, opportunities to increase the availability of financial, human and technical resources to facilitate effective implementation of the Strategic Plan for Biodiversity 2011-2020 and the state targets are identified and the Strategy for Resource Mobilization is adopted.										

Table 7.3 Synergies between the Mandate and Schemes of Government of Meghalaya Departments/Ministries with MBT

S. No	Department /Ministries	MBT 1	MBT 2	MBT 3	MBT 4	MBT 5	MBT 6	MBT 7	MBT 8	MBT 9	MBT 10	MBT 11	MBT 12
1	Land Revenue and Land Ceiling	2		4			√						
2	Department of Urban Development	√			1								
3-5	Education, Sports & Youth Affairs and Arts and Culture Department	29								5			
6	Public Relations Department	3								1			
7	Planning Department	3			1	4		√				√	2
8	Co-Operation Department	1				1		1	2				
9	North-Eastern Council	1			1	3		3					
10	Agriculture Department (& Horticulture)	3						53	1			√	
11	Fisheries Department	√			3			11				√	
12	Soil and Water Conservation			14	7			3					
13	Animal Husbandry And Veterinary				√			63	√				
14	Sericulture and Weaving							1					
15	Commerce and Industries							1				√	√
16	Mining and Geology Dept.			√								√	
17	Community and Rural Development		√	√								√	
18	Public Health Engineering Department			√								√	
19	Finance Department											√	√
20	Public Works Department			√		√						√	√
21	Health & Family Welfare Department			√		√						√	
22	Tourism Department				√	√						√	
23	Water Resources Department				√	√		√				√	
24	Information Technology Department	√			√								
25	Directorate Information and Public Relations	√											
26	Law Department					√							
27	Food Civil Supplies and Consumer Affairs			√		√		√				√	
28	Social Welfare Department*			√		√		√				√	√

* Includes - Ministry of Women and Child Development, Ministry of Social Justice and Empowerment, Ministry Minority Affairs, Ministry of Human Resource Development

7. 6 Monitoring and Evaluation Framework

A monitoring framework is absolutely essential to track the progress and achievements of the objectives of Meghalaya State Biodiversity Targets, their implementation and possible implications. To facilitate monitoring of trends and recording progress in implementation of the 12 MBTs, a monitoring framework has been designed. The NBSAP also uses a similar monitoring framework for assessment of implementation of NBTs. The state monitoring plan has been formed by a review and consultative process with various state departments and public institutions. As with the Action plans of the MBTs and responsible agencies, these Institutions have been selected based on their identified mandate, domain expertise and geographical coverage. The monitoring framework is a small subset of action plans for evaluating the progress.

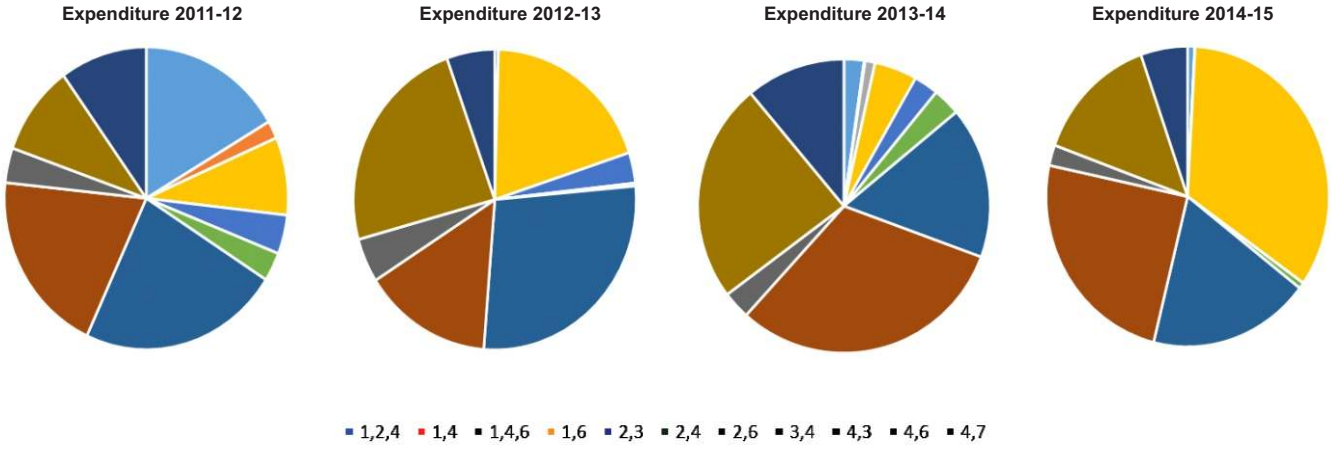


fig 7.2 Details of BioFin Expenditure in Multiple Category Schemes during 2011 -2015

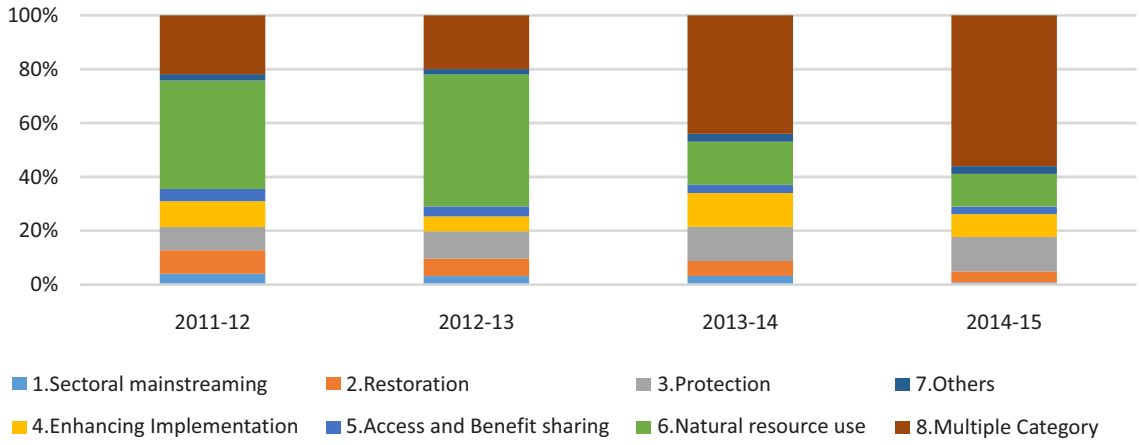


fig 7.3 Changes in Expenditure in BioFin Categories over 2011-2015

The monitoring plan is arranged according to the 12 MBTs, for each MBT few broad composite indicators have been identified, the descriptive indicators divide the composite indicator in identifiable quantitative targets, followed by responsible agencies and a time frame for assessment and reporting (Appendix 24; Table 7.5). As multiple agencies or institutions in the state and the country have expertise in the fields indicated by the descriptive indicator, a coordination among responsible agencies is essential to monitor these targets. The main coordinating agency for most of these targets remains the respective state government departments and the forest department and MBB remains the main coordinating agency.

The MBB needs to work closely with all the implementation agencies for each target and by creating required thematic groups and forums. These thematic groups can coordinate assessment and discussions on monitoring, evaluation and reporting on periodic progress of each indicator. The MBB also need to establish coordination mechanisms for biodiversity information management via various state agencies. This monitoring and evaluation framework is also an essential tool for policy makers to assess the effect of particular policies related to the 12 MBTs. A relatively short time frame of 2 to 3 years for assessment of most of the indicators also provide inputs to the policymakers regarding the effectiveness of the policy and if there is need to policies.

Appendices

Khraw Kharmalki

Appendix 1

List of Notified Community Reserves in Meghalaya (February, 2016)

S. No.	Name	Year of Estd.	Area (km^2)	Distt.
1	Ka Khloo Thangbru Umsymphu	2014	0.196	East Jaintia Hills
2	Ka Khloo Pohblai Mooshutia	2014	0.335	East Jaintia Hills
3	Ka Khloo Langdoh Kur Pyrtuh	2014	0.154	West Jaintia Hills
4	Khloo Blai Sein Raij Tuber	2014	0.965	West Jaintia Hills
5	Khloo Blai Kongwasan Khloo Blai Chyrmang	2014	0.07	West Jaintia Hills
6	Khloo Amrawan	2015	1.29	West Jaintia Hills
7	Khloo Blai Ka Raij U Landoh longlang	2016	0.15	West Jaintia Hills
8	Mandalgre Community Reserve	2013	0.5	East Garo Hills
9	Daribokgre Community Reserve	2013	1.73	East Garo Hills
10	Dura Kalkgre Community Reserve	2013	0.6	East Garo Hills
11	Dumitdikgre Community Reserve	2013	0.7	West Garo Hills
12	Sakalgre Community Reserve	2013	1.22	West Garo Hills
13	Sasatgre Community Reserve	2013	0.6	West Garo Hills
14	Selbalgre Community Reserve	2013	0.2	West Garo Hills
15	Chandigre Community Reserve	2013	0.37	West Garo Hills
16	Baladingre Community Reserve	2013	0.5	West Garo Hills
17	Mongalgre Community Reserve	2014	0.2	West Garo Hills
18	Aruakgre Community Reserve	2014	1.0	North Garo Hills
19	Resu Haluapra Community Reserve	2014	0.5	North Garo Hills
20	Kitmadamgre Community Reserve	2014	0.7	North Garo Hills
21	Rongma Paromgre Community Reserve	2013	0.62	South Garo Hills
22	Rongma Rekmangre Community Reserve	2013	1.92	South Garo Hills
23	Eman Asakgre Community Reserve	2013	0.30	South Garo Hills
24	Bandarigre Community Reserve	2013	0.67	South Garo Hills
25	Mikadogre Community Reserve	2013	0.01	South Garo Hills
26	Dangkipara Community Reserve	2014	0.025	South Garo Hills
27	Raid Nongbri Community Reserve	2014	0.7	Ri-bhoi
28	Lum Jusong Community Reserve	2014	0.7	Ri-bhoi
29	Jirang Community Reserve	2014	2	Ri-bhoi
30	Raid Nonglyngdoh/ Pdah Kyndeng Community Reserve	2014	0.75	Ri-bhoi
31	Nongsangu Community Reserve	2014	1.0	Ri-bhoi
32	Nongumiang Community Reserve	2003	0.31	West Khasi Hills
33	Kpoh Eijah Community Reserve	2014	0.17	West Khasi Hills
34	Miewsyiar Community Reserve	2014	0.87	West Khasi Hills
35	Phudja-ud Community Reserve	2014	1.2	South West Khasi Hills
36	Umsum Pitcher Plant Community Reserve	2014	0.4	South West Khasi Hills
37	Lumkohkriah Community Reserve	2014	6.11	South West Khasi Hills
38	Lawbah Community Reserve	2014	2.1	East Khasi Hills
39	Ryngibah Community Reserve	2014	0.8	East Khasi Hills
40	Ryngud Community Reserve	2014	5.22	East Khasi Hills
41	Thangkharang Community Reserve	2014	1.11	East Khasi Hills
	Total Area (sq km)		**38.89**	

Source: *ENVIS WIIhttp://www.wiienvis.nic.in/Database/; Meghalaya Forest Department

Appendix 2

List of Sacred Groves in Meghalaya

Si.No.	Sacred Grove Name	Sacred Grove Location	Area (Hectares)
		District - East Garo Hills	
1	Bora Miapara	Bora Miapara	1
2	Ganna Ram Rock	Megapgiri	30
3	Jongola	Jongola	1
4	Kimpra Hills	Risubakrapara	20
5	Konkal Hills	Risubakrapara	10
6	Miapara Rongadom	Miapara	1
7	Rautagiri	Rautagiri	37
8	Walchi Ruram Hills	Risubakrapara	25
		District - East Khasi Hills	
9	Diengkain	Umwai	400
10	Dienglengbah	Rngiksheh	0.50
11	Ingkhrum	Cherrapunji	0.25
12	Ingkhrum	Cherrapunji	0.25
13	Kharai Law Lyngdoh	Nongkhieng	150
14	Khlaw Ram Jadong	Mawsmai	50
15	Kynsang	Mawlong	150
16	Law Adong	Mawsmai	400
17	Law Adong Laitryngkew	Laitryngkew	20
18	Law Adong, Khlieh Shnong	Cherrapunji	90
19	Law Blei Beh	Mawsmai	120
20	Law Dymmiew	Sohrarim	200
21	Law Kyntang, Khlieh Shnong	Cherrapunji	90
22	Law Lieng	Sohrarim	20
23	Law Lyngdoh	Mawphlang	75
24	Law Lyngdoh Lyting Lyngdoh	Lyntilew	100
25	Law Lyngdoh Mawshun	Mawshun	100
26	Law Lyngdoh, Smit	Nongkrem	6
27	Law Mawsaptur	Sohrarim	50
28	Law Nongshim	Mawmihthied	5
29	Law Suidnoh	Lait-Ryngew	80
30	Law-ar-Liang	Lait-Ryngew	25
31	Lawthymmal	Cherrapunji	2
32	Law-u-Niang	Lait-Ryngew	10
33	Lum Diengjri	Khadar Shnong	25
34	Lum Shillong	Laitkor	7
35	Madan Jadu	Lait-Ryngew	5
36	Maw Kyrngah	Umwai	1200
37	Mawlong Syiem	Mawsmai	120
38	Mawlot	Phyllut	20
39	Raid Shabong Law Adong	Wahpathew-urksew in Pynursla	700
40	Niangdoh	Wahlong	0.0
41	Mawmang	?	15
42	Mawryot	Wahlong	40
43	Mawsawa	Mawmluh	50
44	Mawthoh	Umwai	30
45	Nongbri	Pyndeng-Nongbri	5
46	Pohsurok	Cherrapunji	0.50
47	Pom Shandy	Mawsmai	80
48	Rangbaksaw	Cherrapunji	1
49	Rilaw Khaiti	Wahlong	35
50	Swer	Lum Swer	12
51	Umkatait	Dieng Ksiar	100
52	Umthri	Nongduh	80
53	Umtong	Umwai	400
54	Wahkhem	Khadar Blang	10
55	Wanning Sawkpoh	Shngimawlein	7
56	Lum Shyllong	Laitkor	7
57	Rijaw	Wahlong	35

Sl.No.	Sacred Grove Name	Sacred Grove Location	Area (Hectares)
58	Dienglengbah	Rngiksheh	0.50
		District - Jaintia Hills	
59	Blai Law	Raliang	50
60	Dpepat Myndihati	Sutnga	15
61	Ka Pun Lyngdoh	Raliang	15
62	Khlaw Blai	Dien Shynrum	15
63	Khlaw Byrsan	Raliang	50
64	Khloo Lyndoh	Jowai	15
65	Khloo Paiu Ram Pyrthai	Jowai	150
66	Law Kyntang	Shanpung	400
67	Lawianlong	Jowai	12
68	Lumtiniang Mokaiaw	Syndai	25
69	Mokhain	Jowai	45
70	Poh Lyndoh	Shanpung	30
71	Poh Moorang	Raliang	20
72	Poh Puja Ko Patti	Raliang	4
73	Trepale Jowai	Jowai	70
		District - Ri Bhoi	
74	Nong Lyndoh, Nongkhrai	Nongpoh	90
75	Pahamodem	Umsaw Nongkhrai	900
76	Sohpethneng	Nongpoh	90
		District - West Garo Hills	
77	Angalgiri	-	20
78	Asigiri	-	4
79	Damalgiri	-	50
80	Daronggiri	-	25
81	Goragiri	-	25
82	Jelbongpara	-	20
83	Jhanjipara	-	7
84	Sadolpara	-	30
		District - West Khasi Hills	
85	Boro Miaparara-Rayggadam	Bora Miapara	1
86	Ganna Ram-ram Rock	Bokma Megap giri	30
87	Jongola Ranggadam	Jongala	1
88	Kimpra Hills	Resubakrapara	20
89	Kongkal Hills	Resubakrapara	10
90	Kyllai Lyngngun, Mariam	Nobosohphoh Syiemship	80
91	Law Adong Lyngdoh, Mawlong	Nongkhlaw Syiemship	200
92	Law Kyntang, Mawlangwir	Maharam	300
93	Law Kyntang, Mawten	Maharam	100
94	Law Kyntang, Whawiaw	Maharam Syihip	100
95	Law Lyngdoh, Kinglang	Maharam Syihip	200
96	Law Lyngdoh, Nonglait	Mawiang Syiemship	50
97	Law Lyngdoh, Nonglyngkien	Maharam Syihip	90
98	Law Lyngdoh, Rangmaw	Maharam Syihip	400
99	Lawren	Nongstoin	10
100	Lum Blei, Nonglyngkien	Maharam Syihip	55
101	Lum Sanglia, Nonglyngkien	Maharam Syihip	45
102	Rautagiri Sacred grove	Rautagiri	37
103	Wahlang-Nongklung	Nongklung	10
104	Walchi Ruram Hills	Resubakrapara	25
105	Nongkynrih Sacred Grove	NongKynrih	100

Source: Meghalaya Forest Department

Appendix 3

Population of different livestock species in Meghalaya

Livestock Population (000)	1997	2003	% Increase / decrease
Crossbreed cattle	17	23	35.29
Indigenous cattle	738	744	0.81
Total cattle	755	767	1.59
Buffaloes	17	18	5.88
Total bovines	772	785	1.68
Sheep	17	18	5.88
Goats	280	327	16.79
Pigs	351	419	19.37
Others	2	2	0.00
Total Livestock	1422	1551	9.07

Source: Livestock census, 2003

Appendix 4

Extinct or presumed extinct plant species of Meghalaya

Plants Extinct and Possibly/Presumed Extinct	
1	*Albertisia mecistophylla* (Miers) Forman **Menispermaceae**
2	*Begonia brevicaulis* DC **Begoniaceae**
3	*Carex repanda* Clarke **Cyperaceae**
4	*Eriocaulon barba-carpae* Fyson **Eriocaulaceae**
5	*Pleione lagenaria* Lindl. **Orchidaceae**
6	*Zeuxine pulchra King* et Pantl. **Orchidaceae**
7	*Cyclea debiliflora* Miers **Menispermaceae**
8	*Sterculia khasiana* Debbarman **Sterculiaceae**
9	*Ceropegia arnottiana* Wight **Asclepiadaceae**
10	*Ceropegia lucida* Wall. **Asclepiadaceae**
Source: BSI (http://www.bsienvis.nic.in/Database/E_3942.aspx)	

Appendix 5

Endemic plant species of Meghalaya

	Endemic Plant Species
1	*Aphyllorchis vaginata* Hook.f. **Orchidaceae**
2	*Adinandra griffithii* Dyer **Ternstroemiaceae**
3	*Aechmanthera leiosperma* C.B.Clarke **Acanthaceae**
4	*Alsodeia racemosa* Hook.f. et Thoms. **Violaceae**
5	*Anacolosa ilicoides* Mast **Olacaceae**
6	*Baliospermum micranthum* Muell.-Arg. **Euphorbiaceae**
7	*Calliandra griffithii* Benth. **Mimosaceae**
8	*Callicarpa psilocalyx* C.B.Clarke **Verbanaceae**
9	*Camelia caduca* C.B.Clarke ex Brandis **Theaceae**
10	*Ceropegia angustifolia* Vahl. ex Decne. **Asclepiadaceae**
11	*Citrus latipes* Hook.f. et Thoms. ex Hook. f. **Rutaceae**
12	*Corybus purpurens* Joseph et Yoganarasimhan **Orchidaceae**
13	*Cynanchum wallichi* (Hook.f. et Thoms.) Hutch. **Asclepiadaceae**
14	*Dactylicapnos torulosa* (Hook.f. et Thoms.) Hutch. **Fumariaceae**
15	*Daphne shillong* Banerji **Thymelaeaceae**
16	*Eria ferruginea* Lindl. **Orchidaceae**
17	*Eria pusilla* Lindl. Orchidaceae
18	*Eriobotrya angustissima* Hook. f. **Rosaceae**
19	*Gastrodia exilis* Hook.f. **Orchidaceae**
20	*Glochidion thomsonii* Hook.f. **Euphorbiaceae**
21	*Goldfussia glabrata* (Nees) N.P.Balakrishnan **Acanthaceae**
22	*Goodyera recurva* Lindl. **Orchidaceae**
23	*Goodyera robusta* Hook. f. **Orchidaceae**
24	*Gymnostachyum venustum* T.Anders. **Acanthaceae**
25	*Habenaria concinna* Hook. f. **Orchidaceae**
26	*Habenaria furfuracea* Hook.f. **Orchidaceae**
27	*Habenaria khasiana* Hook.f. **Orchidaceae**
28	*Hediychium dekianum* A.S. Rao et Verma **Zingiberaceae**
29	*Ilex embelioides* Hook.f. **Aquifoliaceae**
30	*Ilex venulosa* Hook.f. **Aquifoliaceae**
31	*Ilex khasiana* Purakayastha **Aquifoliaceae**
32	*Impatiens acuminata* Benth . **Balsaminaceae**
33	*Impatiens khasiana* Hook.f. **Balsaminaceae**
34	*Impatiens laevigata* Wall. **Balsaminaceae**
35	*Impatiens porrecta* Wall. **Balsaminaceae**
36	*Trias pusilla* Joseph et Deka **Orchidaceae**
37	*Trivalvaria kanjilalii* D.Das **Annonaceae**
38	*Ischaemum hirsutum* Spreng. **Poaceae**
39	*Ischaemum hubbardi* Bor **Poaceae**
40	*Lindera latifolia* Hook.f. **Lauraceae**
41	*Liparis acuminata* Hook.f. **Orchidaceae**
42	*Micropora mannii* Hook.f. Tang et Wang **Orchidaceae**
43	*Nepenthes khasiana* Hook.f. **Nepenthaceae**
44	*Paramignya micrantha* Kurz **Rutaceae**
45	*Pantlingia serrata* N.C.Deori **Orchidaceae**
46	*Pennilabium proboscidcum* A.S.Rao et J.Joseph **Orchidaceae**
47	*Phlogacanthus wallichii* C.B.Clarke **Acanthaceae**
48	*Photinia cuspidata* (Bertol.) N.P.Balakrishnan **Rosaceae**
49	*Photinia polycarpa* (Hook.f.) N.P.Balakrishnan **Rosaceae**
50	*Pogostemon strigosus* Benth. **Lamiaceae**
51	*Pteracanthus nobilis (*C.B.Clarke) Bremek **Acanthaceae**
52	*Pteracanthus rubescens* (T.Anders.) Bremek **Acanthaceae**
53	*Pteracanthus urophyllus* (Nees) Bremek **Acanthaceae**
54	*Rhynchospora griffithii* Boeck. **Cyperaceae**
55	*Rubus khasianus* Cardot **Rosaceae**
56	*Salix psylostigma* Anders. **Salicaceae**
57	*Senecio jowaiensis* N.P.Balakrishnan **Asteraceae**

Appendix 6

Rare, Endangered and Threatened Flora of Meghalaya

Sl.No	Rare, Endangered and Threatened Taxa
	En = Endangered , **I** = Indeterminate , **R** = Rare , **V** = Vulnerable
1	*Acranthera tomentosa* R.Br. ex Hook.f. **Rubiaceae V**
2	*Adinandra griffithii* Dyer **Theaceae En**
3	*Aerides fieldingii* Williams **Orchidaceae I**
4	*Aerides vandara* Reichb. **Orchidaceae I**
5	*Agrostemma khasianum* Clarke **Rubiaceae I**
6	*Albertisia mecistophylla* (Miers.) Forman **Menispermaceae I**
7	*Anthoxanthum clarkei* (Hook.f.) Ohwi **Poaceae En & R**
8	*Aphyllorchis vaginata* Hook.f. **Orchidaceae I**
9	*Apodytes benthamiana* Wight **Icacinaceae I**
10	*Arachnis clarkei* (Reichb.f.) J.J.Smith **Orchidaceae I**
11	*Ardisia quinquangularis* A.DC **Myrsinaceae I**
12	*Ardisia rhynchophylla* Clarke **Myrsinaceae I**
13	*Begonia rubro-venia* Hook.f. var. meisneri Clarke **Begoniaceae R**
14	*Bulbophyllum moniliforme* Part. et Reichb.f. **Orchidaceae En & R**
15	*Calanthe alismaefolia* Lindl. **Orchidaceae I**
16	*Carex rara* Boott. **Cyperaceae I**
17	*Carex remota* L. **Cyperaceae En & R**
18	*Ceropegia angustifolia* Wight **Asclepiadaceae V**
19	*Ceratostylis teres* Reichb.f. **Orchidaceae En & R**
20	*Cleisostoma paniculata* (Ker.-GAwl.) Garay **Orchidaceae R**
21	*Clematis apiculata* Hook.f. et Thoms. **Ranunculaceae En**
22	*Coelogyne barbata* Griff. **Orchidaceae I**
23	*Coelogyne cristata* Lindl. **Orchidaceae I**
24	*Coelogyne nitida* (Wall. ex Don) Lindl. **Orchidaceae I**
25	*Coelogyne prolifera* Lindl. **Orchidaceae I**
26	*Corybus purpureus* Joseph et Yoganarasimhan **Orchidaceae R**
27	*Crotalaria neveoides* Griff. **Fabaceae I**
28	*Cyclea debiliflora* Miers **Menispermaceae I**
29	*Diplomeris pulchella* D.Don **Orchidaceae I**
30	*Elaeagnus conferta* Roxb. ssp. dendroidea Servattaz **Elaeagnaceae En**
31	*Eriocaulon gregatum* koern. **Eriocaulaceae R**
32	*Euonymus bullatus* Wall.ex Lindl. **Celastraceae I**
33	*Fimbristylis stolonifera* Clarke **Cyperaceae R**
34	*Galeola lindleyana* Reichb.f. **Orchidaceae I**
35	*Gastrodia exilis* Hook.f. **Orchidaceae I**
36	*Goniothalamus simonsii* Hook.f. et Thoms. **Annonaceae I**
37	*Goodyera recurva* Lindl. **Orchidaceae I**
38	*Hedychium calcaratum* A.S.Rao et D.M.Verma **Zingiberaceae I**
39	*Hedychium dekianum* A.S.Rao et D.M.Verma **Zingiberaceae I**
40	*Hedychium gracillimum* A.S.Rao et D.M.Verma **Zingiberaceae I**
41	*Hedychium gratum* A.S.Rao et D.M.Verma **Zingiberaceae I**
42	*Hedychium rubrum* A.S.Rao et D.M.Verma **Zingiberaceae I**
43	*Hoya lobii* Hook.f. **Asclepiadaceae V**
44	*Ilex embeloides* Hook.f. **Aquifoliaceae I**
45	*Ilex khasiana* Purakayastha **Aquifoliaceae I**
46	*Ilex venulosa* Hook.f. **Aquifoliaceae R**
47	*Indopolysolenia wallichii* (Hook.f.) Bennet **Rubiaceae R**
48	*Inula kalapani* Clarke **Asteraceae R**
49	*Ixonanthes khasiana* Hook.f. **Ixonanthaceae V**
50	*Lasiobema scandens* (L.) de Wit var. horsefieldii (Wall. ex Prain) de Wit **Fabaceae I**
51	*Leptodermis griffithii* Hook.f. **Rubiaceae I**
52	*Liparis pulchella* Hook.f. **Orchidaceae I**
53	*Michelia punduana* Hook.f. Thoms. **Magnoliaceae R**
54	*Neanotis oxyphylla* (G.Don) Lewis **Rubiaceae R**
55	*Nepenthes khasiana* Hook.f. **Nepenthaceae En**

Endemic Plant Species	
58	*Sympagis maculata* (Nees) Bremek **Acanthaceae**
59	*Taeniophyllum khasianum* Joseph et Yoganarasimhan **Orchidaceae**
60	*Tarphochlamys affinis* (Griff.) Bremek **Acanthaceae**
61	*Tetrastigma obovatum* Gagnep. **Vitaceae**
62	*Trachyspermum khasianum* H.Wolff **Apiaceae**
63	*Thrixspermum musciflorum* A.S.Rao et J.Joseph **Orchidaceae**

Source: BSI (http://www.bsienvis.nic.in/Database/E_3942.aspx)

Sl.No	Rare, Endangered and Threatened Taxa
56	*Ophiorrhiza subcapitata* Wall. ex Hook.f. **Rubiaceae En**
57	*Ophiorrhiza tingens* Clarke ex C.E.C.Fischer **Rubiaceae En**
58	*Ophiorrhiza wattii* C.E.C.Fisch. **Rubiaceae En**
59	*Phaius mishmiensis* Reichb.f. **Orchidaceae I**
60	*Phanera khasiana* (Baker) Thoth. **Fabaceae I**
61	*Phanera wallichi* (Macbr.) Thoth. **Fabaceae I**
62	*Phoenix rupicola* T.Anders. **Arecaceae V**
63	*Pholidota calceata* Reichb.f. **Orchidaceae I**
64	*Pollia pentasperma* Clarke **Commelinaceae I**
65	*Polygala tricholopha* Chodat **Polygalaceae En**
66	*Pyrenaria khasiana* R.N.Paul **Theaceae I**
67	*Rhododendron formosum* **Ericaceae En**
68	*Schisandra grandiflora* (Wall.) Hook.f. et Thoms. **Schisandraceae I**
69	*Scleria alta* Boeck. **Cyperaceae I**
70	*Senecio mishmi* Clarke **Asteraceae V**
71	*Silene khasiana* Rohrb. **Caryophyllaceae I**
72	*Smilacina fusca* Wall. **Convallariaceae I**
73	*Trivalvaria kanjilalii* D.Das **Annonaceae En**
74	*Uvaria lurida* Hook.f. et Thoms. **Annonaceae R**
75	*Vanda coerulea* Griff. ex Lindl. **Orchidaceae R**

Source: BSI (http://www.bsienvis.nic.in/Database/E_3942.aspx

Appendix 7

Dye yielding plants of Meghalaya

Sl. No	Scientific name	Local name	Colour of dye
1.	*Berberis nepalensis*	Dieng niangmat	yellow
2.	*Musa spp.*	Ka lakait	red
3.	*Wallichia sp.*	Tlai nili	green
4.	*Artocarpus lakoocha*	Snep dieng byntah	brown
5.	*Myrica nagi*	snep dieng sohliya	Brown and black
6.	*Smilax sp.*	Dyngkhong shiah krot	Red
7.	*Adhatoda vasica*	Lamuseh ne jamynsek	Yellow
8.	*Albizzia odoratissima*	Kreitja ne kreit saw	Madder brown
9.	*Cordia myxa*	Diengmong	Yellow
10.	*Baccaurea sapida*	Snep dieng sohjew nesoh	Black
11.	*Quercus spp.*	Sning iong	Black
12.	*Castanopsis indica*	Ka stap	Black
13.	*Quercus sp.*	Diengsai	Black
14.	*Castonopsis tribuloides*	Diengsohot	Black
15.	*Artocarpus integrifolia*	Sohphan	Yellow
16.	*Curcuma spp* .	Shynrai	Yellow
17.	*Diospyros sp.*	Sohkhyllung ne soh	Black
18.	*Erythrina indica*	Diengsong	Red
19.	*Oroxylum indicum*	Ka johon ne tokon	Primer
20.	*Eugenia fructicosa*	Sohum ne sohramei	Black
21.	*Fagopyrum esculenta*	Jatira ryngkew	Yellow
22.	*Lagerstroemia parviflora*	Lyngshing	Black
23.	*Mallotus philippinensis*	Diengsnikor	Yellow
24.	*Mangifera indica*	Diengsohpieng	Black
25.	*Terminalia chebula*	Dieng soh kyrkhah	Black
26.	*Eugenia fructicosa*	Dieng sohum	Black
27.	*Morinda tinctoria*	Larnong	Yellow and Red
28.	*Emblica indica*	Soh mylleng	Black
29.	*Quercus fenestrata*	Diengsai	Black
30.	*Rubia khasiana*	U rhoi	Red
31.	*Spondias mangifera*	Sohpa-ir	Black
32.	*Symplocus crataegoides*	Dieng iong ne jamaiang	Yellow
33.	*Symplocus racemosa*	La pongdong	Red
34.	*Tagetes erecta*	Tiew mungor	Yellow
35.	*Tamarindus indica*	Soh kyngtoi	Red
36.	*Terminalia chebula*	Dieng soh kyrkhah	Black
37.	*Toddalia aculeata*	Jyrmi sohsat	Yellow
38.	*Vitex negundo*	Tohtit dkhar	Mordant
39.	*Strobilanthus haeditolius*	Sybu	Blue and Black

Source: NEBRC, NEHU

Appendix 8

Wild Edible Plants of Meghalaya

S.No.	Scientific name	Local name	Family	Mode of Utilization
1.	*Acanthopanax trifoliatus*	Kenbut (Mk)	Araliaceae	Young shoots are cooked
2.	*Adhatoda vasica*	Devglamch (K)	Acanthaceae	Cooked as vegetable
3.	*Alocasia indica*	Kimchit nokam (G)	Araceae	Cooked as vegetables
4.	*Amaranthus gangeticus*	Chantili (G)	Amaranthaceae	Cooked as vegetables
5.	*Amblyanthus glandulosus DC*	Jia herew (J)	Myrcinaceae	Cooked as vegetables
6.	*Amorphophallus bulbifer (Roxb.)Bl.*	Jianthynrew(J)	Araceae	Cooked as vegetables
7.	*Antidesma diendrum*	Aburok-arabok (G)	Euphorbiaceae	Eaten raw
8.	*Argyria nervosa*	Jatapmasi (K), Soh ring kang	Convolvulaceae	Leaves are eaten raw
9.	*Artocarpus heterophyllus, var I*	Soh-phan khlaw (K)	Moraceae	Cooked as vegetables
10.	*Artocarpus heterophyllus, var II*	Soh-phan (K)	Moraceae	Dried seeds powdered and stored and this is boiled with water and eaten as a substitute for rice during famine or scarcity.
11.	*Azadirachta indica*	Neemu (G)	Meliaceae	Cooked as vegetables
12.	*Baccaurea sapida*	Soh ramdieng (K), dojuka (G)	Euphorbiaceae	Flower is eaten raw
13.	*Phanera purpurea*	Muyung-laphang (K) megong (G)	Caesalpiniaceae	Leaves and flower is cooked as vegetables
14.	*Begonia palmata*	Hurmaw(G) Jajew(Mk)	Begoniaceae	Young shoots are cooked and eaten. Fruits yield a dye used as ink
15.	*Begonia roxburghii*	Kimchare (G)	Begoniaceae	Leaves and shoots are cooked with dry fish
16.	*Begonia Hatacoa*	Johoksier (K)	Begoniaceae	Stem is edible
17.	*Brassaiopsis palmata*	Eri (G)	Araliaceae	Leaves are fed to Eri silk worms
18.	*Buddlija macrostachya*	Jalong krem (K)	Buddijaceae	Barks are chewed with betal leaf
19.	*Calamus yunnanensis / acanthospathus*	Rie (G)	Araceae	Shoots are pounded, fermented and then sundried and stored for off season
20.	*Cardamine macrophylla*	-	Brassicaceae	Leaves are used as vegetable
21.	*Casearia graviolens*	Bolong miandok (G)	Bixacaceae	Leaves are used as vegetable and twigs are cooked and eaten
22.	*Castonopsis indica*	Chhakku khokrok (G)	Fagaceae	Fruits are eaten raw
23.	*Centella asiatica*	Kynbat moina(K), Brahmi(G)		Roots and Leaves are eaten raw or cooked for dysentry, skin disease, diabetes etc.
24.	*Chlorophytum arundinaceum*	Soh-kyian	Liliaceae	Cooked as Vegetable
25.	*Cirsium verutum*	Soh chlia (K)	Asteraceae	Seeds are aromatic, eaten raw
26.	*Cleome viscosa*	-	Cleomaceae	Seed are used for flavoring curry
27.	*Codonopsis parviflora*	Ja tyndong (K)	Campanulaceae	Leaves are cooked and eaten
28.	*Colocasia affinis*	Goneusu (G)	Araceae	Roots are cooked with dry fish
29.	*Colocasia esculenta*	Matchitangong (G)	Araceae	Roots are cooked as vegetables
30.	*Corchorus capsularis*	Mehku (G)	Tiliaceae	Leaves are cooked as vegetable
31.	*Corchorus aestuans*	Amalthchu(G)	Amaryllidaceae	Roots are cooked as vegetables
32.	*Cordia grandis*	Kotra (Mk)	Ehreliaceae	Resin is used as adhesive
33.	*Crataeva nurvala*	Jong sia (G)	Cleomaceae	Shoots are cooked and eaten
34.	*Crinum pretense*	Amaltchu (G)	Amaryllidaceae	Root are cooked as vegetable
35.	*Baliospermum solanifolium*	Marthu arong (Mk)	Euphorbiaceae	Leaves are used for fermenting liquor
36.	*Croton tiglium*	Runi bih (G)	Euphorbiaceae	Fruits are used as antidote
37.	*Cryptolepis sinensis*	-	Periplocaceae	Branches are used as fishing rods
38.	*Cucurbita moschata*	Pathaw (K)	Cucurbitaceae	Eaten raw
39.	*Cyathocalyx martabanicus*	-	Annonoceae	Ripe fruits is edible
40.	*Dendrocalamus halmiltonii*	Binh (G) Nain	Poacaceae	Shoot are pounded and used as pickle and also for of season
41.	*Desmondium triflorium*	Memang-mong-arabak (G)	Fabaceae	Leaves are cooked and mixed with dry fish
42.	*Dillenia indica*	Agachi(G) , Dieng Soh Karbam (K)	Dillaniaceae	Unripe fruits are cooked with dry fruits
43.	*Elaeagnus latifolia*	Soh Shang(K), chhokhua (G)	Elaeagnaceae	Fruit are eaten raw
44.	*Elaeocarpus floribundus*	Jolpai (G), Ok-hi sinsigti (Mk)	Elaeocarpiaceae	Fruits are edible and used for making pickle.
45.	*Elatostema dissectum*	-	Urticaceae	Leaves and fruits are edible , either raw or cooked
46.	*Eryngium foetidum*	Etucha-bellock(G)	Apiaceae	Leaves are cooked as vegetables
47.	*Fagopyrum esculentum*	Jarain (K)	Polygonaceae	Leaves are cooked and eaten
48.	*Ficus auriculata*	-	Moraceaae	Shoots are used as vegetables
49.	*Ficus prostata*	-	Moraceae	Bark are eaten with betal leaf
50.	*Fiscus hispida*	Thamusa(G)	Moraceae	Unripe fruits are cooked as vegetables and ripe ones are eaten raw.

S.No.	Scientific name	Local name	Family	Mode of Utilization
51.	*Garcinia pedunculata*	Soh denae(K), Thizou(G)	Guttiferaceae	Fruit are eaten raw
52.	*Gaultheria fragrantissima*	La thynrait	Ericaceae	Fruits edible, leaves used for tea
53.	*Gnetum montanum*	Jagingriube(Mk)	Gnetaceae	The seeds are chewed as substitute for areca nut
54.	*Hedyotis diffusa*	Mangaluk(Mk)	Rubiaceae	Leaves are eaten with fish after child birth.
55.	*Hibiscus pungens*	Kaldha(G)	Malvaceae	Leaves are cooked as vegetables
56.	*Hodgsonia macrocarpa*	Soh-Lyot (K)	Curcurbitaceae	Leaves as Silk worm feed
57.	*Homalomena aromatica*	Kimchit nokam(G)	Araceae	Petiole are cooked as vegetables
58.	*Ipomea racemosa*	Setre budu(G)	Convolvulaceae	Cooked as vegetables also consumed boiled
59.	*Ixora subsessilis*	Sang rura(G)	Rubiaceae	Cooked preferably mixed with dry fish
60.	*Mallatus philippinensis*	Setre budie(G)	Euphorbiaceae	Unripe fruits are cooked as vegetable
61.	*Malvastrum tricuspidatum*	Som zalik (G)	Malvaceae	Seeds are cooked as vegetables and bark are used as condiments
62.	*Manihot esculenta*	Phondiew	Euphorbiaceae	Barks are taken with betal leaf
63.	*Monochoria hostata*	Garopaksi gachli (G)	Pontederiaceae	Petioles are cooked with dry fish
64.		Moringa pterygosperma	Sajna(G) , Rodina (K)	MoringaceaeLeaves, flowers and fruits are usually cooked with dry fish
65.	*Myrica nagi*	Sohphie (K)	Myricaseae	Eaten raw and also used for making pickles
66.	*Oxalis latifolia*	Soh dkhiew (K)	Oxalidaceae	Plant is used as vegitable
67.	*Oxyspora paniculata*	Long tang	Melastomaceae	Eaten raw
68.	*Pedicularis carnosa* *	Sam dipo (G) samthapar (K)	Scrophulariaceae	Leaves and roots are cooked and eaten as vegetable
69.	*Peperomia pellucida*	Bithe (G)	Piperaceae	Leaves are cooked as vegetables
70.	*Phlogacanthus thyrsiflorus**	Verua kain cheit (G)	Acanthaceae	Leaves and flower are cooked with fish and meat
71.	*Phrynium pubinerve*	Balgate (G)	Zingiberaceae	Roots are cooked as vegetables
72.	*Phyllanthus emblica*	Bon bakeri(G)	Euphorbiaceae	Fruits are eaten raw also mixed with curry
73.	*Phyllanthus parvifolius*	Jala mat kha(K), memang ambri (G)	Euphorbiaceae	Fruits are eaten raw also mixed with curry
74.	*Phytolacca acinosa*	Iada	Phytolaccaceae	
75.	*Piper diffusum* *	Sohmrit (K)	Piperaceae	Fruit as spice
76.	*Plectranthus mollis*	Chichittoni (G)	Lamiaceae	Leaves are cooked as vegetables
77.	*Persicaria chinensis*	U niuh tmar	Polygonaceae	Shoot are pounded, fermented, exracted and then sun dried for off season use
	Portulaca oleracea	Stilchi (G)	Portulaceae	Leaves are cooked as vegetable
78.	*Rhynchotechum ellipticum*	Regong(G)	Gesneriaceae	Leaves are cooked with dry fish
79.	*Rhynchotechum vestitum*	Regong-chu (G)	Gesneriaceae	Leaves are coked as vegetables along with sodium bicarbonate
80.	*Rubus ellipticus*	Dieng- soh -sah (K)	Rosaceae	Eaten raw
81.	*Smilax perfoliata*	Shiah -krot (K)	Smilacaceae	Shoot are pounded, fermented, extracted and then sun dried for off seasons use
82.	*Sonchus oleraceous*	Soh lamjew (K)	Asteraceae	Fruits are eaten raw
83.	*Strobilanthus sp.*	Samoong (G)	Sam-siphara (K)	AcanthaceaeLeaves are cooked as vegetable
84.	*Zanthoxylum acanthopodium*	Jaiur khlaw (K)	Rutaceae	Fruits is pungent and spicy and are used as a spice
85.	*Zanthoxylum armatum*	Jaiur (K)	Rutaceae	Fruits are aromatic and used as spice
86.	Zanthoxylum khaisanum	Sumet-cheng(G), Jaiur khasi (K)	Rutaceae	Leaves as vegetable, fruits aromatic and gives a tingling sensation and usually used for chutney/spice
87.	*Zanthoxylum limonella*	Hajor(Mk)	Rutaceae	Leaves as vegetables and the spines is of medicinal importance

K - Khasi, G - Garo, Mk - Mikir

*Unresolved names, Source: Kayang (2007)

Appendix 9

Bamboos of Meghalaya

Sl. No.	Botanical name	Mode of Utilization
1.	*Arundinaria callosa*	Arrows, ekra walls
2.	*Arundinaria griffithiana*	Arrows, ekra walls
3.	*Arundinaria hirsute*	Arrows, ekra walls
4.	*Arundinaria hookeriana*	Arrows, ekra walls
5.	*Arundinaria mannii*	Arrows, ekra walls
6.	*Arundinaria polystachya*	Arrows, ekra walls
7.	*Arundinaria prainii*	Arrows, ekra walls
8.	*Arundinaria suberecta*	Arrows, ekra walls
9.	*Bambusa nutans*	Arrows, ekra walls
10.	*Bambusa villosa*	Fishing rods
11.	*Bambusa bambos*	Construction
12.	*Bambusa khasiana*	Construction
13.	*Bambusa pallida*	Shoots as vegetable, culm as construction material
14.	*Bambusa tulda*	Shoots as vegetable, culm as construction material
15.	*Bambusa vulgaris*	Shoots as vegetable, culm as construction material
16.	*Cephalostachyum capitatum*	Ekra wall, arrows
17.	*Cephalostachyum palidum*	Ekra wall, arrows
18.	*Chimonobambusa khasiana*	Ekra wall, arrows
19.	*Dendrocalamus beckerii*	Shoots as vegetable, culm as construction material
20.	*Dendrocalamus giganteus*	Construction
21.	*Dendrocalamus hamiltonii*	Construction
22.	*Melocanna baccifera*	Shoots as vegetable, culm as construction material
23.	*Melocanna bambusoides*	Shoots as vegetable, culm as construction material
24.	*Oxynanthera nigrociliata*	Fencing,etc
25.	*Phyllostachys manii*	Fencing, etc.
26.	*Pseudostachyum polymorphum*	Construction

Source: NEBRC, NEHU

Appendix 10

Canes and Rattans of Meghalaya

Sl.	Botanical name	Uses
1.	*Calamus acanthospathus*	Furniture, decor items, thatch
2.	*Calamus erectus*	Furniture, decor items, thatch, fruits edible
3.	*Calamus flagellum*	Furniture, decor items, thatch, fruits edible
4.	*Calamus floribundus*	Furniture, decor items, thatch, fruits edible
5.	*Calamus gracilis*	Furniture, decor items, thatch, fruits edible
6.	*Calamus guruba*	Furniture, decor items, thatch
7.	*Calamus latifolius*	Furniture, decor items, thatch
8.	*Calamus leptospadix*	Furniture, decor items, thatch
9.	*Caryota urens*	Furniture, decor items, thatch
10.	*Licaula peltata*	Leaves for thatching
11.	*Pandanus odaritissimum*	Furniture, decor items, thatch
12.	*Phoenix sylvestris*	Brushes for floors, fruits edible
13.	*Phoenix aculia*	decor items, thatch, fruits edible
14.	*Wallichia caryotoides*	decor items, thatch
15.	*Wallichiana densiflora*	decor items, thatch

Source: NEBRC, NEHU

Appendix 11

Thatch Grasses and Reeds of Meghalaya

Sl. No.	Species	Mode of Utilization
1.	*Arundo donax*	Thatch
2.	*Cymbopogon khasianus*	Fodder, oil yielding
3.	*Cynodon dactylon*	Lawn grass
4.	*Echinochloa crus-pavonis*	Fodder
5.	*Eleusine coracana*	Seeds for local brew
6.	*Eleusine indica*	Fodder
7.	*Imperata cylindrica*	Fodder
8.	*Phragmites karka*	Mat making
9.	*Saccharum spontaneum*	Mat making
10.	*Setaria verticillata*	Local drink
11.	*Themeda caudata*	Local drink
12.	*Themeda intermedia*	Local drink
13.	*Themeda villosa*	Local drink
14.	*Thysanolaena maxima*	Brooms for sweeping

Source: NEBRC, NEHU

Appendix 12

Mushroom Diversity of Meghalaya

S.No	Species	Local name	Status	Edibility
1.	*Agaricus arvensis*	Tit buid	Common	No
2.	*Agaricus campestris*	Tit buid	Common	No
3.	*Agaricus silvicola*	Tit buid	Common	No
4.	*Agaricus sp.*	Tit tung	Common	Yes
5.	*Amanita tymnopsis*	Not Available	Rare	No
6.	*Boletus aereus*	Not Available	Common	Yes
7.	*Boletus badius*	Not Available	Common	Yes
8.	*Boletus edulis*	Tit bun	Rare	Yes
9.	*Boletus regius*	Not Available	Common	Yes
10.	*Cantharellus cibarius*	Tit stem	Common	Yes
11.	*Collybia allegretti*	Tit snier masi	Common	Yes
12.	*Entoloma euthelum*	Not Available	Rare	Yes
13.	*Geastrum sp*	Not Available	Rare	No
14.	*Gomphus floccosus*	Tit tyndong	Rare	Yes
15.	*Helvella spp*	Tit syiar	Common	Yes
16.	*Inocybe cutifracta*	Tit snier	Common	Yes
17.	*Lactarius deliciosus*	Tit dud	Rare	Yes
18.	*Lactarius sanguifluus*	Tit dud	Rare	Yes
19.	*Lentinus spp.*	Tit sohpailen lieh	Rare	Yes
20.	*Lepiota pardolota*	Not Available	Common	No
21.	*Lepiota phylyctaenodes*	Not Available	Rare	No
22.	*Pholiota sp.*	Not Available	Rare	No
23.	*Polyporus pernnis*	Not Available	Common	No
24.	*Ramaria formosa*	Tit tnaw syiar	Common	Yes
25.	*Ramaria holorubella*	Tit lbong hati	Common	Yes
26.	*Russula emetica*	Not Available	Rare	No
27.	*Russula virescens*	Not Available	Rare	No
28.	*Scleroderma verucossum*	Tit bol	Common	Yes
29.	*Suillus granulatus*	Tit tah	Common	No
30.	*Tricholoma imbricatum*	Tit kher	Common	Yes
31.	*Tricholoma terreum*	Tit sohpailen	Common	Yes

Source: NEBRC, NEHU

Appendix 13 Orchid species of Meghalaya

S.No	Species	Locations				
1	Acampe ochracea (Lindl.) Hochr.	Dawki	Nongpoh	Garampani	Raliang	
2	Acampe papillosa(Lindl) Lindl.	Burnihat	Nongpoh	Raliang	Gokha	Rongrenggre-GaroHills
3	Acampe rigida (Buch.-Ham. ex J.E.Sm.)	Bhoilymbong	Nongpoh			
4	Acanthephippium striatum Lindl.	Jowai	Mawsynram	Mawmluh		
5	Acanthephippium sylhetense Lindl.	Cherrapunjee	Umwai Nongpoh			
6	Aerides multiflora Roxb.	Bholaganj	Burnihat Dawki	Nongpoh	Umsning-Noomati	
7	Aerides odorata Lour.	Burnihat	Dawki Garo Hills	Nongpoh		
8	Agrostophyllum brevipes King &Pantl.	Jowai	Leska			
9	Agrostophyllum callosum Rchb.f.	Cherrapunjee	Kynshi Mawphlang	Pynursla	Shillong Peak	
10	Agrostophyllum flavidum Phukan	Shillong Peak				
11	Agrostophyllum planicaule (Wall, ex Lindl.) Rchb.f.	Mawsmai	Cherrapunjee	Dawki	Syndai	Jarain
12	Anoectochilus brevilabris Lindl.	Mawphlang	Pynursla	Jarain		
13	Anoectochilus roxburghii (Wall.) Lindl.	Lumshnong	Khasi Hills	Barapani		
14	Anthogonium gracile Lindl.	Cherrapunjee	Mawmluh	Jowai	jarain	Laitlyngkot
15	Aphyllorchis montana Rchb.f	Jaintia Hills	Garo Hills			
16	Appendicula cornuta Blume	Jaintia Hills (Leska).				
17	Arachnis labrosa (Lindl. & Paxton) Rchb.f.	Markasa	Umsaw Dawki			
18	Arundina graminifolia (D.Don) Hochr.var. graminifolia	Cherrapunjee	Mawsmai forest	Dawki	Jowai	Pynursula
19	Arundina graminifolia (D.Don) Hochr. var. revoluta (Hook.f.)	Pongtung	Amlarcm	Cherrapunjee		
20	Ascocentrum ampullaceum (Roxb.) Schltr.	Jaintia Hills	Mawsmai			
21	Biermannia quinqueccallosa King & Pantl.	Jowai				
22	Brachycorythis galeandra (Rchb.f.) Summerh.	Cherrapunjee	Laitlyngkot	Mawryngkneng	Nongkrem	Nongstoin
23	Brachycorythis helferi (Rchb.f.) Summcrh.	Cherrapunjee	Laitlyngkot	Mawryngkneng	Nongkrem	Nongstoin
24	Bulbophyllum affine Lindl.	Barapani	Cherrapunjee	Mawlai	Shillong	Nongpoh
25	Bulbophyllum ambrosia (Hance) Schltr.	Barapani				
26	Bulbophyllum bisetum Lindl.	Jowai				
27	Bulbophyllum blepharistes Rchb.f.	Cherrapunjee				
28	Bulbophyllum candidum (Lindl.) Hook.f.	Shillong Peak	Malki Hills	Mawphlang	Sohrarim	
29	Bulbophyllum careyanum(Hook.) Spreng.	Bholaganj	Pynursla	Nongpoh		
38	Bulbophyllum depressum King & Pantl.	Khasi Hills	Jowai-jarain.			
39	Bulbophyllum elatum (Hook.f) J.J.Sm.	Jowai	Mawphlang			
40	Bulbophyllum forestii Seidenf.	Tuber Sacred Grove				
41	Bulbophyllum gamblei (Hook.f.) Hook.f.	Jowai	Nongstoin			
42	Bulbophyllum griffithii (Lindl.) Rchb.f.	Upper Shillong	Balapakram			
43	Bulbophyllum guttulatum (Hook.f.) N.P. Balakr.	Cherrapunjee	Khasi Hills			
44	Bulbophyllum gymnopus Hook.f.	Cherrapunjee	Mawsmai	Shillong	Sati Falls	Khasi & Jaintia Hills
45	Bulbophyllum gyrochilum Seidenf.	Jowai	Jaintia Hills			
46	Bulbophyllum helenae (Kuntze) J.J. Sm.	Pynursla	Shillong Peak	Cherrapunjee		
47	Bulbophyllum hirtum (Sm.) Lindl.	Barapani	Cherrapunjee	Shillong	Khasi Hills	Nongpoh
48	Bulbophyllum hymenanthum Hook.f	Mairang	Mawsynram			
49	Bulbophyllum jejosephii JJ.Verm., Schuit. & de Vogel	Mawphlang				
50	Bulbophyllum khasyanum Griff.	Cherrapunjee				
51	Bulbophyllum leopardinum (Wall.) Lindl.	Pynursla	Sadew forest	Sohrarim	Shillong	
52	Bulbophyllum leptanthum Hook.f.	Khasi Hills				
53	Bulbophyllum manabendrae D.K.Roy, Barbhuiya & A.D.Talukdar	Balpakram Nat.Park	Khundol Gup			
54	Bulbophyllum moniliforme Parish & Rchb.f.	Jarain				
55	Bulbophyllum oblongum (Lindl.) Rchb.f.	Garo Hills				
56	Bulbophyllum odotatissimum (Sm.) Lindl.	Barapani	Cherrapunjee	Khasi Hills		
57	Bulbophyllum ornatissimum (Rchb.) J.J. Sm.	Khasi Hills	Nongpoh			
58	Bulbophyllum penicillium Parish & Rchb.f	Jowai-jarain				
59	Bulbophyllum piluliferum King & Pantl.	Jowai				
60	Bulbophyllum polyrhizum Lindl.	Jowai				
61	Bulbophyllum protractum Hook.f.	Jowai				
62	Bulbophyllum repens Griff.	Mairang	Khasi Hilis	Dawki		
63	Bulbophyllum reptans (Lindl.) Lindl.	Jowai	Jarain Mairang	Mawphlang	Shillong Peak	
64	Bulbophyllum retusiusculum Rchb.f.	Mawphlang				
65	Bulbophyllum roseopictum J.J.Verm., Schuit. & de Vogel	Mairang	Mawphlang	Elephant Falls	Shillong Peak	Amwee.
66	Bulbophyllum roxburghii(Lindl.) Rchb.f.	Meghalaya				
67	Bulbophyllum sarcophyllum (King & PantL) JJ.Sra.	Jaintia Hills				
68	Bulbophyllm scabratum Rchb.f.	Cherrapunjee	Khasi Hills	Shillong	Mawsmai	
69	Bulbophyllum secundum Hook.f.	Jarain				
70	Bulbophyllum sikkimense (King & PantL) J.J. Sra	Meghalaya				
71	Bulbophyllum spathulatum (Rolfe ex H.W. Cooper) Seidenf.	Jowai	kynshi-Markasa	Shillong Peak	Malki	
72	Bulbophyllum stiatum (Griff.) Rchb. F.	Jowai	kynshi-Markasa	Shillong Peak	Malki	
73	Bulbophyllum sunipia J.J.Verm., Schuit. & de Vogel	Jowai	Jarain	Kyllang rock	Markasa-Patharkhang Nongkhlaw	
74	Bulbophyllum tortuosum Lindl.	Nongpoh				
75	Bulbophyllum trichocephalum (Schltr.)Tang & F.T.Wang	Khasi Hills				
76	Bulbophyllum tricorne Seidenf. & Smitin.	Dawki				
77	Bulbophyllum triste Rchb.f.	Nongpoh	Nongstoin			
78	Bulbophyllum umbellatum Lindl.	Pynursla	Khasi Hills	Dawki	Shillong	
79	Bulbophyllum vridiflorum (Hook.f.) Schltr.	Cherrapunjee				
80	Bulbophyllum wallichii (Lindl.) Rchb.f.	Jowai				
81	Calanthe alismifolia Lindl.	Sohrarim				
82	Calanthe anthropophora Ridl.	Garo Hills				
83	Calanthe clavata Lindl.		Dawki-Jowai-Jarain	Pynursla		
84	Calanthe densflora Lindl.	East Khasi Hills	Pynursla	Shillong	Jowai	Laukos
85	Calanthe herbacea Lindl.	Rangbyneng	Jarain			
86	Calanthe mannii Hook.f.		Mawphlang-Shillong	Elephant Falls		
87	Calanthe masuca (D. Don) Lindl.		Nongstoi	Jarain Cherrapunjee		

S.No	Species	Locations				
88	Calanthe odora Griff.		Cherrapunjee			
89	Calanthe puberula. Lindl.	Jowai	Lawkyntang	Mawphlang	Shillong	
90	Calanthe triplicata (Willcmet) Ames	Rangbyneng	(Khasi Hilis).			
91	Callostylis rigida Blume		Pynursla			
92	Cephalantheropsis longipes (Hook.f.) Ormerod	Sohrarim	Cherrapunjee	Mawsmai	Jarain	Pynursla dawki
93	Cephalantheropsis obcordata (Lindl.) Ormerod	Pynursla	Mukhaialong Sacred Grove			
94	*Ceratostylis himalaica.* Hook.f.	Jarain	Cherrapunjee			
95	*Cetatostylis subulata* Blume	Jaintia Hills	Jarain		Garo Hills	
96	*Chamaegastrodia asraoa* (Joseph & Abbar.) Seidenf.	August-September.	Distrib.: Pynursla.			
97	*Chamaegastrodia vaginata* (Hook.f.) Seidenf.	Mawrnluh				
98	*Cheirostylis grifithii* Lindl.	Mawphlang	Mawmluh	Mawsmai		
99	*Cheirostylis pusilla* Lindl.	Khasi Hills	near Mahadeo	Balpakram		
100	*Chiloschista lunifera* (Rchb.f.) Schltr.	Khasi Hills				
101	*Cleisocentron pallens* (Cathcart ex Lindl.) N.Pearce & RJ.Cribb	Nongpoh				
102	*Cleisostoma appendiculatum* (Lindl.) Benth. & Hook.f. ex B.D.Jacks.	Jarain	Khasi hills	Nongstoin	Garo hills	
103	*Cleisostoma aspersum*(Rchb.f.) Garay	Khasi Hills.				
104	*Cleisostoma filiforme* (Lindl.) Garay	Umsaw	Nongpoh			
105	*Cleisostoma linearilobatum*(Seidenf. & Smitin.) Garay	Khasi Hills				
106	*Cleisostoma paniculatum* (Ker Gawl.) Garay	Pongtung	Garo Hills			
107	*Cleisostoma racemiferum*(Lindl.)	Jowai-Ramtai	Syndai	Umsaw-Nongpoh		
108	*Cleisostoma simondii*(Gagnep.) Seidenf.	Khasi Hills	Garo Hills			
109	*Cleisostoma striatum* (Rchb.f.) N.E.Br	Shillong Peak				
110	*Cleisostoma subulatum* Blume	Garo Hills	Nongpoh	Pedning slu Kop	Umrangshu.	
111	*Coelogyne barbata* Griff.	Sohrarim	Cherrapunjee	Mawsmai		
112	*Coelogyne corymbosa* Lindl.	Dympep	Mawphlang	Sohrarim	Nongpoh	
113	*Coelogynecristata* Lindl.	Cherrapunjee	Shillong			
114	*Coelogyne fimbriata* Lindl.	Cherrapunjee	Nongstoin			
115	*Coelogyne flaccida* Lindl.	Jarain	Jowai	Shillong-Jowai		
116	*Coelogyne fuliginosa* Lodd. ex Hook.	Cherrapunjee.				
117	*Coelogyne fuscescens* Lindl.	Sohrarim	Cherrapunjee.			
118	*Coelogyne holochila* P.KHunt & Summerh.	Sankher	Pynursla			
119	*Coelogyne longipes* Lindl.	Cherrapunjee.				
120	*Coelogyne micrantha* Lindl.	Cherrapunjee	Jowai		Nongkhlaw	Nongstoin
121	*Coelogyne nitida* (Wall, ex D.Don) Lindl.	Cherrapunjee				
122	*Coelogyne occultata* Hook.f.	Cherrapunjee	Jarain			
123	*Coelogyne ovalis* Lindl	Pongtung	Sohrarim		Sheila	Nongpoh
124	*Coelogyne prolifera* Lindl.	Cherrapunjee	Mawsmai		Jarain	
125	*Coelogyne punctulata*. Lindl.	Amwee	Cherrapunjee		Mawmluh	Mawsmai Jarain
126	*Coelogyne roizadae* S.K.Jain & S.Das	Cherrapunjee				
127	*Coelogyne rigida Parish* & Rchb.f.	Jowai	Jarain.			
128	*Coelogyne schultesii* S.KJain & S.Das	Cherrapunjee				
129	*Coelogyne stricta* (D. Don) Schltr.	Jarain				
130	*Coelogyne suaveolens* (Lindl.) Hook.f.	Cherrapunjee	Jowai		Nongkhlaw	Nongpoh Umsning-onmati.
131	*Coelogyne viscosa* Rchb.f.	Jowai	Barapani	Cherrapunjec	Oomscra	Nongpoh.
132	*Corybas himalaicus* (King & Pantl.) Schltr.	Elephant Falls				
133	*Corymhorkis veratrifolia* (Reinw.) Blume	Tura				
134	*Crepidium acuminatum*(D.Don) Szlach.	Cherrapunjee	Pynursla		Mairang	Nongstoin Umsaw
135	*Crepidium biauritum* (Lindl.) Szlach	Jowai.				
136	*Crepidium calophyllum* (Rchb.f.) Szlach.	Baghmara	Khasi Hills.			
137	*CrepiSum josephianum* (Rchb.f.) Marg.	Cherrapunjee				
138	*Crepidium khasianum* (Hook.f.) Szlach.	Jarain	Shillong			
139	*Crepidium maximowiczianum*(King & Pantl.) Schltr.	Khasi Hills	Jaintia Hills			
140	*Cryptochilus* sanguinea Lindl.	Cherrapunjee	Mawsmai	Dawki-Pynursla	Jowai	Jarain
141	*Cryptostylis arachnites* (Blume) Blume	Khasi Hills				
142	*Cymbidium aloifolium* (L.) Sw.	Umsning	Nongpoh	Burnihat		
143	*Cymbidium bicolor* Lindl.	Nongpoh	Garo Hills			
144	*Cymbidium cochleare* Lindl.	Jarain	Jowai	Nongstoin		
145	*Cymbidium cyperifolium* Lindl.	Jarain	Nongstoin			
146	*Cymbidium devonianum* Paxton	Cherrapunjee				
147	*Cymbidium eburneum* Lindl.	Markasa	Sonapahar-Nongstoin	Shillong	Mairang	
148	*Cymbidium elegans* Lindl.	Mawphlang	Nongkhlaw	Shillong Peak	Smit	Nongpoh
149	*Cymbidium ensifolium* Sw. var. ensifolium	Nongstoin	Sonapahar			
150	*Cymbidium ensifolium* Sw. var. munronianum	Jowai (near Selating Lake)	Nongstoin			
151	*Cymbidium erythraeum* Lindl.	Jaintia Hills				
152	*Cymbidium hookerianum* Rchb.f	Khasi Hills				
153	*Cymbidium iridiolides* D.Don	Mawryngkneng	Barapani	Bhoilymbong	Khasi Hills.	
154	*Cymbidium lancifolium* Hook.f.	Cherrapunjee	Jowai	Nongstoin	Pynursla	Shillong Peak
155	*Cymbidium macrorhizon* Lindl.	Shillong	Elephant Falls			
156	*Cymbidium mastersii* Griff, ex Lindl.	Pongtung	Shillong			
157	*Dendrobium acinaciforme* Roxb	Cherrapunjee	Jowai	Nongpoh.		
158	*Dendrobium amoenum* Wall, ex Lindl.	Cherrapunjee	Jowai	Nongpoh		
159	*Dendrobium anceps* Sw.	Mawphlang	Nongpoh			
160	*Dendrobium aduncum* Wall.	Khasi Hills				
161	*Dendrobium aphyllum* (Roxb.) C.E.C.Fisch.	Dawki	Barapani	Nongpoh	Nongstoin	Garo Hills
162	*Dendrobium bicameratum* Lindl.	Cherrapunjee	Nongstoin			

S.No	Species	Locations				
163	*Dendrobium cariniferum* Rchb.f.	Jaintia Hills.				
164	*Dendrobium chrysanthum* Lindl.	Cherrapunjee	Shillong	Kalapani	Pynursla	Sohrarim.
165	*Dendrobium chrysotoxum* Lindl.	Khasi Hills				
166	*Dendrobium chryseum* Rolfe	Shillong				
167	*Dendrobium crepidatum* Lindl. & Paxton	Cherrapunjee	Nongthymmai	Nongpoh		
168	*Dendrobium cumulatum* Lindl.	Jarain	Khasi Hills			
169	*Dendrobium denneanum* Kerr.	Nongstoin	Nongp	Umsaw		
170	*Dendrobium densiflorum* Lindl.	Cherrapunjee	Tharia	Nongstoin	Nongpoh	Garo Hills.
171	*Dendrobium denudans* D. Don	Khasi Hills				
172	*Dendrobium devonianum* Paxton	Cherrapunjee	Jowai			
173	*Dendrobium eriiflorum* Griff.	Jowai	Nongpoh	Mairang	Kyllang rock	
174	*Dendrobium falconeri* Hook.f.	Khasi Hills	Garo Hills			
175	*Dendrobium farmeri* Paxton	Khasi Hills				
176	*Dendrobium fimbriatum* Hook.	Shillong	Nongstoin	Nongpoh		
177	*Dendrobium formosum* Roxb. ex Lindl.	Nongstoin	Nongpoh			
178	*Dendrobium gibsonii* Lindl.	Cherrapunjee	Shillong	Nongkhlaw		
179	*Dendrobium heterocarpum* Wall, ex Lindl.	Jowai	Nongkhlaw	Shillong	Crinoline Falls	
180	*Dendrobium hookerianum* Lindl.	Cherrapunjee	Elephant Falls	Mawphlang	Shillong Peak	Pynursla.
181	*Dendrobium infundibulum* Lindl.	Nongpoh				
182	*Dendrobium jaintianum* Sabap.	Jaintia Hills				
183	*Dendrobium jenkinsii* Wall, ex Lindl.	Nongpoh	Sonapahar			
184	*Dendrobium khasianum* Deori	Khasi Hills				
185	*Dendrobium lindleyi* Steud.	Shillong	Umsning Nongpoh			
186	*Dendrobium lituiflorum* Lindl.	Jarain	Nongpoh			
187	*Dendrobium longicornu* Lindl.	Kynshi	Markasa	Mawphlang	Nongkrem	Pynursla-Dawki
188	*Dendrobium moniliforme*(L.) Sw.	Shella-Cherrapunjee				
189	*Dendrobium moschatum* (Buch.-Ham,) Sw.	Nongpoh	Jaintia Hills			
190	*Dendrobium nobile* Lindl.	Barapani	Nongpoh	Nongstoin		
191	*Dendrobium ochreatum* lindl.	Cherrapunjee	Shillong	Mawphlang	Jaintia Hills	Padingshin Kap
192	*Dendrobium polyanthum* Wall, ex Lindl.	Khasi Hills	Jowai	Raliang	Nongpoh	
193	*Dendrobium porphyrochilum* Lindl.	Sohrarim				
194	*Dendrobium pulchellum* Roxb. ex Lindl.	Khasi Hills				
195	*Dendrobium praecinctum* Rchb.f.	Jarain				
196	*Dendrobium primulinum* Lindl.	Cherrapunjee				
197	*Dendrobium ruckeri* Lindl.	Cherrapunjee	Pongtung	Nongpoh	Garo Hills	
198	*Dendrobium salaccense*(Blume) Lindl.	Nongstoin	Sonapahar			
199	*Dendrobium stuposum* Lindl.	Cherrapunjee	Nongkhlaw	Shillong		
200	*Dendrobium sulcatam* lindl.	Dawki	Umsning			
201	*Dendrobium terminale* Parish & Rchb.f.	Jowai	Nongpoh			
202	*Dendrobium transparens* Lindl.	Barapani	Dawki			
203	*Dendrobium wardianum* Warner	Khasi Hills	Mawsynram.			
204	*Dendrobium williamsonii* J.Day & Rchb.f.	Jowai	Shillong Peak	Nongkhlaw		
205	*Didymoplexis pallens* Griff.	East Khasi Hills	Pynursla Raliang	Jaintia Hills		
206	*Dienia ophrydis*(J.Koenig) Seidenf.	Cherrapunjee	Jowai	Nongpoh		
207	*Diplomeris pulchella* D. Don	Sohrarim	Dympep	Cherrapunjee	Mawmluh	Mawsmai
208	*Diploprora championii* (Lindl.) Hookf.	Cherrapunjee	Pynursla Jarain.			
209	*Epigeneium amplum* (Lindl.) Summerh.	Jarain	Pongtung	Barapani	Nongstoin	
210	*Epigeneium fuscescens*(Griff.) Summerh.	Dawki	Jarain			
211	*Epigeneium naviculare* (N.P. Balakr. &S.Chowdhury) Hynn. & Wadhwa	Dawki	Pongtung	Pynursla		
212	*Epigeneium rotundatam* (Lindl.) Summerh	Tuber Sacred Grove	Jaintia Hills.			
213	*Epipogium roseum* (D.Don) Lindl.	Mawphlang	Pynursla	Nongpoh		
214	*Eria acervata* Lindl.	Shillong	Sonapahar	Nongpoh		
215	*Eria amica* Rchb.f.	Sutunga	Jarain	Cherrapunjee	Mawsmai	Nongpoh
216	*Eria apertiflora* Summerh.	Khasi Hills				
217	*Eria bambusifolia* Lindl.	Sutunga				
218	*Eria biflora* Griff.	Nongkhyllum	Umthalong	Shillong		
219	*Eria bipunctata* Lindl.	Cherrapunjee				
220	*Eria bractescens* Lindl.	Garo Hills				
221	*Eria. carinata* Gibson	Cherrapunjee	Shillong	Dawki-Pynursla	Pongtung	
222	*Eria clavicaulis* Wall, ex Lindl.	Jarain	Pynursla			
223	*Eria coronaria* (Lindt.) Rchb.f.	Cherrapunjee	Mairang Laitkor	Mawphlang		
224	*Eria crassicaulis* Hook.f.	Khasi Hills (Pomrang).				
225	*Eria excavata* Lindl.	Barapani	Cherrapunjee	Mawphlang	Mawryngkncng	Nongstoin
226	*Eria ferruginea* Lindl.	Cherrapunjee				
227	*Eria glandulifera* Deori & Phukan	Mawsmai				
228	*Eria javanica* (Sw.) Blume	Nongpoh	Nongstoin			
229	*Eria. laniceps* Rchb.f.	Khasi Hills.				
230	*Eria lasiopetala*(Willd.) Ormerod	Dawki	Shillong	Mahadeo forest	UmpBng	
231	*Eria muscicola* (lindl.) Lindl.	Jaintia Hills	Mawmluh	Umwai	Cherrapunjee	Mawsmai
232	*Etia. paniculata* Lindl.	Jarain	Jowai	Pynursla-Dawki		
233	*Etia pannea* Lindl.	Jaintia Hills	Jarain	Cherrapunjee		
234	*Etia pudica* Ridl.	Jaintia Hills				
235	*Eria. pumila* Lindl.	Cherrapunjee	Jaintia Hills			
236	*Eria pusilla* (Griff.) Lindl.	Cherrapunjee	Mawmluh	Chunay	Pomrang	Pongtung
237	*Eria spicata* (D.Don) Hand.-Mazz.	Mawphlang	Dympep Cherrapunjee	Laitlyngkot	Jowai	

S.No	Species	Locations				
238	*Eria stricta* Lindl.	Umlow	Jarain-Dawki	Nongstoin		
239	*Eria tomentosa* (J.Koenig) Hook.f.	Khasi Hills	Cherrapunjee			
240	*Eria vittata* Lindl.	Shillong				
241	*Etiodes barbata* (Lindl.) Rolfe	Kyllang rock	Shillong			
242	*Etythrodes blumei* (lindl) Schltr	Jaintia Hills	Jharani			
243	*Esmeralda clarkei* Rchb.f.	Kyllang rock				
244	*Esmeralda cathcartii* (Lindl.) Rchb.f.	Khasi Hills				
245	*Eulophia. bicallosa* (D.Don) P.FHunt & Summerh.	Khasi Hills	Cherrapunjee	Jowai		
246	*Eulophia, bracteosa* Lindl.	Cherrapunjee				
247	*Eulophia graminea* Lindl.	Tharia forest				
248	*Eulophia spectabilis*(Dennst.) Suresh	Barapani	Shillong Peak			
249	*Eulophia zollingeri*(Reichb.f.) J.J.Sm.	Cherrapunjee	Jarain.			
250	*Flickingeria fugax* (Rchb.f.) Seidenf.	Cherrapunjee	Nongstoin	Pynursla		
251	*Flickingeria macraei* (lindl.) Seidenf.	Nongpoh	Tura West Khasi Hills.			
252	*Flickingaria ritaeana* (King & Pantl.) A.D.Hawkes	Jowai				
253	*Galeola falconeri* Hook.f.	Mawphlang	Mairang Barapani	Pariong		
254	*Galeola lindleyana* Rchb.f.	Barapani				
255	*Gastrochilus acutifolius* (Lindl.) Kuntze	Cherrapunjee	Mawsmai	Jowai	Jarain	Sutnga
256	*Gastrochilus calceolaris* (Buch.-Ham. ex Sm.) D.Don	Cherrapunjee	Dawki			
257	*Gastrochilus distichus* (Lindl.) Kuntze	Mawphlang				
258	*Gastrochilus inconspicuus* (Hook.f.) Kuntze	Jowai	Nongpoh	Sohrarim	Nartiang	Umsaw
259	*Gastrochilus intermedius*(Griff, ex Lindl.) Kuntze	Khasi Hills.				
260	*Gastrodia exilis* Hook.f.	Amwee	Raliang			
261	*Geodorum densiflorum* (Lam.) Schltr	Nongpoh	Jarain Cherrapunjee			
262	*Goodyera foliosa* (Lindl.) Benth. ex C.B. Clarke	Cherrapunjee	Mahadeo	Boodi Bazar	Jowai	
263	*Goodyera hispida* Lindl.	Cherrapunjee				
264	*Goodyera procera* (Kcr-Gawl.) Hook.	Barapani	Mahadeo	Shillong Peak	Shillong-Jowai	Nongpoh
265	*Goodyera recurva,* Lindl.	Mawphlang.				
266	*Goodyera schlcchtendaliana* Rchb.f. var. *robusta*	Upper Shillong				
267	*Goodyera schlechtendaliana* Rchb.f. var. *schlechtendaliana*	Mawphlang	Shillong Peak	Upper Shillong	Laitkor	Sohrarim
268	*Goodyera viridiflora* (Blume) Lindl. ex D.Dietr.	Nongpoh	Jaintia Hills	Mongat		
269	*Habenaria acuifera* Wall, ex Lindl.	Barapani	(Cherrapunjee	Jowai	Garampani-Jowai	Jarain
270	*Habenaria arietina* Hook.f.	Cherrapunjee	Laitlyngkot	Dympep		
271	*Habenaria dentata* (Sw.) Schltr.	Shillong	Umsaw Nokrek Peak			
272	*Habenaria khasiana* Hook.f.	Balpakram	Cherrapunjee	Jarain	Jowai	Laitlyngkot
273	*Habenaria malleifera* Hook.f.	Mairang	Nongkhlaw.			
274	*Habenaria marginata* Colebr.	Baghmara.				
275	*Habenaria pantlingiana* Ktaenzl.	Mawsmai				
276	*Habenaria pectinata* D.Don	Cherrapunjee	Dympep Laitlyngkot	Kalapani		
277	*Habenaria reniformis* (D.Don) Hook.f.	Shillong	Lower New Colony	Laban	Nongkhlaw	Sheila.
278	*Herminium lanceum* (Thunb. ex Sw.) Vuikj.	Cherrapunjee	Elephant Falls	Jowai-Jarain	Laitlyngkot	Nartiang
279	*Herpysma longicaulis* Lindl.	Cherrapunjee				
280	*Hetaeria afftnis* (Griff.) Seidenf. & Ormerod	Jowai	Mawmluh			
281	*Liparis acuminata* Hook.f.	Jowai	Mawphlang	Balapakram.		
282	*Liparis assamica* King & Pantl.	Shillong Peak.				
283	*Liparis bistriata* K.C.Parish & Rchb.f.	Nongstoin				
284	*Liparis bootanensis* Griff.	Cherrapunjee				
285	*Liparis cespitosa* (Thouars) Lindl.	Cherrapunjee	Upper Shillong	Pynursla		
286	*Liparis cordifolia* Hook.f.	Khasi Hills				
287	*Liparis deflexa* Hook.f.	Laitlyngkot.				
288	*Liparis delicatula* Hook.f.	Kynshi	Shillong Sweet falls			
289	*Liparis elliptica* Wight	Jowai	Pynursla Sutunga	Sohrarim	Cherrapunjee.	
290	*Liparis luteola* Lindl.	Jowai	Jarain Cherrapunjee	Mawsmai	Pynursla.	
291	*Liparis mannii* Rchb.f.	Mawphlang.				
292	*Liparis nervosa*(Thumb.) Lindl. var. *khasiana* (Hook.f.) P.K.Sarkar	Khasi Hills				
293	*Liparis nervosa* (Thumb.) Lindl. var. *nervosa*	Garampani-Jowai	Jarain			
294	*Liparis odorata* (Willd.) Lindl.	Shillong Peak				
295	*Liparis petiolata* (D.Don) P.F.Hunt & Summerh	Mawphlang	Shillong Peak	Cherrapunjee	Mawsmai.	
296	*Liparis plantaginea* Lindl.	Khasi Hills.				
297	*Liparis resupinata* Ridl.	Laitkor	Mawphlang	Shillong Peak	Laitiyngkot.	
298	*Liparis rupestris* Griff.	Nongkhlaw.				
299	*Liparis stricklandiana* Rchb.f.	Khasi Hills	Pynursla			
300	*Liparis torta* Hook.f.	Khasi Hills.				
301	*Liparis vestita* Rchb.f.	Nongstoin	Jarain			
302	*Liparis viridiflora* (Blume) Lindl.	Shillong	Cherrapunjee	Nongkhlaw	Pongtung	Pynursla
303	*Luisia brachystachys* (Hindi.) Blurne	Nongkhlaw	Upper Shillong			
304	*Luisia flliformis* Hook.f.	West Khasi Hills				
305	*Luisia psyche* Rchb.f.	Shillong	Smit Jowai			
306	*Luisia teretifolia* Gaudich.	Dawki	Umsning Baghmara			
307	*Luisia trichorrhiza* (Hook.) Blume	Jaintia Hills	Khasi Hills	Nongstoin		
308	*Luisia volucris* Lindl.	Jowai	Khasi Hills			
309	*Micropera mannii* (Hook.f.) T.Tang & F.T.Wang	Cherrapunjee	Shillong Jowai	Pynursla-Dawki	Garampani.	
310	*Micropera obtusa* (Lindl.) T.Tang &c F.T.Wang	Garo Hills	Jowai Nongpoh	Garampani		

S.No	Species	Locations				
237	*Eria spicata* (D.Don) Hand.-Mazz.	Mawphlang	Dympep Cherrapunjee	Laitlyngkot	Jowai	
238	*Eria stricta* Lindl.	Umlow	Jarain-Dawki	Nongstoin		
239	*Eria tomentosa* (J.Koenig) Hook.f.	Khasi Hills	Cherrapunjee			
240	*Eria vittata* Lindl.	Shillong				
241	*Etiodes barbata* (Lindl.) Rolfe	Kyllang rock	Shillong			
242	*Etythrodes blumei* (lindl) Schltr	Jaintia Hills	Jharani			
243	*Esmeralda clarkei* Rchb.f.	Kyllang rock				
244	*Esmeralda cathcartii* (Lindl.) Rchb.f.	Khasi Hills				
245	*Eulophia bicallosa* (D.Don) P.FHunt & Summerh.	Khasi Hills	Cherrapunjee	Jowai		
246	*Eulophia, bracteosa* Lindl.	Cherrapunjee				
247	*Eulophia graminea* Lindl.	Tharia forest				
248	*Eulophia spectabilis*(Dennst.) Suresh	Barapani	Shillong Peak			
249	*Eulophia zollingeri*(Reichb.f.) J.J.Sm.	Cherrapunjee	Jarain.			
250	*Flickingeria fugax* (Rchb.f.) Seidenf.	Cherrapunjee	Nongstoin	Pynursla		
251	*Flickingeria macraei* (lindl.) Seidenf.	Nongpoh	Tura West Khasi Hills.			
252	*Flickingeria ritaeana* (King & Pantl.) A.D.Hawkes	Jowai				
253	*Galeola falconeri* Hook.f.	Mawphlang	Mairang Barapani	Parlong		
254	*Galeola lindleyana* Rchb.f.	Barapani				
255	*Gastrochilus acutifolius* (Lindl.) Kuntze	Cherrapunjee	Mawsmai	Jowai	Jarain	Sutnga
256	*Gastrochilus calceolaris* (Buch.-Ham. ex Sm.) D.Don	Cherrapunjee	Dawki			
257	*Gastrochilus distichus* (Lindl.) Kuntze	Mawphlang				
258	*Gastrochilus inconspicuus* (Hook.f.) Kuntze	Jowai	Nongpoh	Sohrarim	Nartiang	Umsaw
259	*Gastrochilus intermedius*(Griff, ex Lindl.) Kuntze	Khasi Hills.				
260	*Gastrodia exilis* Hook.f.	Amwee	Raliang			
261	*Geodorum densiflorum* (Lam.) Schltr	Nongpoh	Jarain Cherrapunjee			
262	*Goodyera foliosa* (Lindl.) Benth. ex C.B. Clarke	Cherrapunjee	Mahadeo	Boodi Bazar	Jowai	
263	*Goodyera hispida* Lindl.	Cherrapunjee				
264	*Goodyera procera* (Kcr-Gawl.) Hook.	Barapani	Mahadeo	Shillong Peak	Shillong-Jowai	Nongpoh
265	*Goodyera recurva,* Lindl.	Mawphlang.				
266	*Goodyera schlcchtendaliana* Rchb.f. var. *robusta*	Upper Shillong				
267	*Goodyera schlechtendaliana* Rchb.f. var. *schlechtendaliana*	Mawphlang	Shillong Peak	Upper Shillong	Laitkor	Sohrarim
268	*Goodyera viridiflora* (Blume) Lindl. ex D.Dietr.	Nongpoh	Jaintia Hills	Mongat		
269	*Habenaria acuifera* Wall, ex Lindl.	Barapani	(Cherrapunjee	Jowai	Garampani-Jowai	Jarain
270	*Habenaria arietina* Hook.f.	Cherrapunjee	Laitlyngkot	Dympep		
271	*Habenaria dentata* (Sw.) Schltr.	Shillong	Umsaw Nokrek Peak			
272	*Habenaria khasiana* Hook.f.	Balpakram	Cherrapunjee	Jarain	Jowai	Laitlyngkot
273	*Habenaria malleifera* Hook.f.	Mairang	Nongkhlaw.			
274	*Habenaria marginata* Colebr.	Baghmara.				
275	*Habenaria pantlingiana* Ktaenzl.	Mawsmai				
276	*Habenaria pectinata* D.Don	Cherrapunjee	Dympep Laitlyngkot	Kalapani		
277	*Habenaria reniformis* (D.Don) Hook.f.	Shillong	Lower New Colony	Laban	Nongkhlaw	Sheila.
278	*Herminium lanceum* (Thunb. ex Sw.) Vuikj.	Cherrapunjee	Elephant Falls	Jowai-Jarain	Laitlyngkot	Nartiang
279	*Herpysma longicaulis* Lindl.	Cherrapunjee				
280	*Hetaeria afftnis* (Griff.) Seidenf. & Ormerod	Jowai	Mawmluh			
281	*Liparis acuminata* Hook.f.	Jowai	Mawphlang	Balapakram.		
282	*Liparis assamica* King & Pantl.	Shillong Peak.				
283	*Liparis bistriata* K.C.Parish & Rchb.f.	Nongstoin				
284	*Liparis bootanensis* Griff.	Cherrapunjee				
285	*Liparis cespitosa* (Thouars) Lindl.	Cherrapunjee	Upper Shillong	Pynursla		
286	*Liparis cordifolia* Hook.f.	Khasi Hills				
287	*Liparis deflexa* Hook.f.	Laitlyngkot.				
288	*Liparis delicatula* Hook.f.	Kynshi	Shillong Sweet falls			
289	*Liparis elliptica* Wight	Jowai	Pynursla Sutunga	Sohrarim	Cherrapunjee.	
290	*Liparis luteola* Lindl.	Jowai	Jarain Cherrapunjee	Mawsmai	Pynursla.	
291	*Liparis mannii* Rchb.f.	Mawphlang.				
292	*Liparis nervosa*(Thumb.) Lindl. var. *khasiana* (Hook.f.) P.K.Sarkar	Khasi Hills				
293	*Liparis nervosa* (Thumb.) Lindl. var. *nervosa*	Garampani-Jowai	Jarain			
294	*Liparis odorata* (Willd.) Lindl.	Shillong Peak				
295	*Liparis petiolata* (D.Don) P.F.Hunt & Summerh	Mawphlang	Shillong Peak	Cherrapunjee	Mawsmai.	
296	*Liparis plantaginea* Lindl.	Khasi Hills.				
297	*Liparis resupinata* Ridl.	Laitkor	Mawphlang	Shillong Peak	Laitiyngkot.	
298	*Liparis rupestris* Griff.	Nongkhlaw.				
299	*Liparis stricklandiana* Rchb.f.	Khasi Hills	Pynursla			
300	*Liparis torta* Hook.f.	Khasi Hills.				
301	*Liparis vestita* Rchb.f.	Nongstoin	Jarain			
302	*Liparis viridiflora* (Blume) Lindl.	Shillong	Cherrapunjee	Nongkhlaw	Pongtung	Pynursla
303	*Luisia brachystachys* (Hindi.) Blurne	Nongkhlaw	Upper Shillong			
304	*Luisia flliformis* Hook.f.	West Khasi Hills				
305	*Luisia psyche* Rchb.f.	Shillong	Smit Jowai			
306	*Luisia teretifolia* Gaudich.	Dawki	Umsning Baghmara			
307	*Luisia trichorrhiza* (Hook.) Blume	Jaintia Hills	Khasi Hills	Nongstoin		
308	*Luisia volucris* Lindl.	Jowai	Khasi Hills			
309	*Micropera mannii* (Hook.f.) T.Tang & F.T.Wang	Cherrapunjee	Shillong Jowai	Pynursla-Dawki	Garampani.	

S.No	Species	Locations				
310	*Micropera obtusa* (Lindl.) T.Tang &c F.T.Wang	Garo Hills	Jowai Nongpoh	Garampani		
311	*Micropera pallida* (Roxb.)Lindl.	Pongtung	Garampani.			
312	*Micropera rostrata* (Rosb.) N.P.Balakr.	Cherrapunjee	Mawmluh	Jowai	Mawsmai	Umkhlaw
313	*Monomeria barbata* Lindl.	Khasi Hills				
314	*Neogyaa gardneriana* (Lindl.) Rchb.f.	Cherrapunjee	Mawmluh	Nongkhlaw	Jaintia Hills	Pynursla-Dawki
315	*Nephelaphyllum palchrum* Blume	Khasi Hills				
316	*Nephelaphyllum cordifolium* (Lindl.) Blume	Cherrapunjee	Jarain			
317	*Nervilia aragoana Commons* ex Gaudich.	Mawphlang	Shillong-Jowai			
318	*Nervilia khasiana* (King &Pant.) Schltr.	Jarain				
319	*Nervilia macroglossa* (Hook.f.) Schltr.	Khasi Hills				
320	*Nervilia plicata* (Andrews) Schltr.	Siju WLS	Garo Hills			
321	*Oberonia acaulis* Griff.	Cherrapunjee	Jowai	Nongstoin	Shillong	Jaintia Hills
322	*Oberonia brachystachys* Lindl.	Garo Hills				
323	*Oberonia caulescens* Lindl.	Cherrapunjee	Jowai	Jaintia Hills	Nongstoin	Shillong Peak
324	*Oberonia clarkei* Hook.f.	Shillong				
325	*Oberonia ensiformis* (Sm.) Lindl.	Cherrapunjee	Mawmluh	Bholaganj	Nongpoh	Umfing.
326	*Oberonia falconeri* Hook.f.	Jowai.				
327	*Oberonia jenkinsiana* Griff, ex Lindl.	Dympep	Laitlyngkot	Laitkor	Shillong Peak	
328	*Oberonia. mannii* Hook.f.	Pynursla	Balat	Mawphlang	Sohrarim	Shillong Peak
329	*Oberonia mucronata* (D. Don) Ormerod & Seidenf.	Jaintia Hills	Nongstoin	Mawmluh	Bholaganj	Sutnga
330	*Oberonia obcordata* Lindl.	Chcrrapunjee	Sohrarim	Mawmluh.		
331	*Oberonia pachyrachis* Rchb.f. ex Hook.f.	Jaintia Hills	Leska			
332	*Oberonia pyrulifera* King & Pantl.	Cherrapunjee	Jowai			
333	*Oberonia recurva* Lindl.	Nongpoh				
334	*Oberonia ritaii* King & Pantl.	Jowai	Jaintia Hills	Amwee		
335	*Oberonia rufilabris* Lindl.	Garo Hills.				
336	*Oberonia teres* A.F.G.Kerr	Mukhaialong Sacred Grove	Jaintia Hills.			
337	*Odontochilus crispus* (Lindl.) Hook.f	Cherrapunjee.				
338	*Odontochilus elwesii* C.B.Clarke ex Hook.f.	Sohrarim.				
339	*Odontochilus grandiflorus* Benth. & Hook.f.	Khasi Hills				
340	*Odontochilus lanceolatus* (Lindl.) Blume	Khasi Hills	Pongtung			
341	*Ornithochilus difformis* (Wall ex Lindl.) Shltr.	Cherrapunjee	Mawsmai	Pynursla	Jaintia Hills	Nangalbibra-Garo Hills
342	*Otochilus albus* Lindl.	Dympep	Jowai	Jowai-Jarain	Shillong Peak.	
343	*Otochilus fuscus* Lindl.	Amwee	Pundua	Sohrarim	Jowai	Kyllang rock
344	*Otochilus lancilabius* Seidenf.	Mawmluh	Mawphlang.			
345	*Otochilus porrectus* Lindl.	Cherrapunjee	Pynursla	Sohrarim	Shillong Peak.	
346	*Pachystoma pubescens* Blume	Shillong	Jowai.			
347	*Panisea demissa* (D.Don) Pfitzer	Khasi Hills				
348	*Panisea uniflora* (Lindl.) Lindl.	Khasi Hills.				
349	*Paphiopedilum hirsutissimum* (Lindl. ex Hook.f.) Stein	Bhoilymbong	Jowai.			
350	*Paphiopedilum insigne* (Wall, ex Lindl.) Pfitzer	Cherrapunjee	Shillong			
351	*Paphiopedilum venustum* (Wall, ex Sims) Pfitzer	Jarain	Pynursla Syndai.			
352	*Papilionanthe teres* (Roxb.) Schltr.	Bholaganj	Dawki	Burnihat	Mairang	Nongpoh
353	*Papilionanthe uniflora* (Lindl.) Garay	Jaintia Hills	Markasa Shiilong Peak	Burnihat	Mawphlang.	
354	*Papilionanthe vandarum* (Rchb.f.) Garay	Cherrapunjee	Mawphlang	Markasa	Shiilong Peak	Malki Hills.
355	*Pecteilis susannae* (L.) Raf.	Cherrapunjee	Ri-bhoi.			
356	*Pecteilis triflora* (D.Don) Tang & F.T.Wang	Shillong	Nongpoh	Umsaw.		
357	*Pelatantheria insectifera* (Rchb.f.) Ridl.	Jowai	Pynursla.			
358	*Pennihbium proboscideum* A.S.Rao & J.Joseph	Umran-Umsaw	Nongpoh.			
359	*Peristylus affinis* (D. Don) Seidenf.	Barapani				
360	*Peristylus constrictus* (Lindl.) Lindl.	Khasi Hills.				
361	*Petistylus cubitalis* (R.Br.) Kracnzl	Pynursla.				
362	*Peristylus densus* (Lindl.) Santapau & Kapadia	Cherrapunjee	Jowai	Laitlyngkot	Mawsmai	Mawsynram
363	*Peristylus gracilis* Blume	Jarain	Shiilong Peak.			
364	*Peristylus goodyeroides* (D.Don) Lindl.	Burnihat	Leska	Nongpoh		
365	*Peristylus hamiltonianus* Lindl.	Shillong	Upper Shillong.			
366	*Peristylus lacertifer* (Lindl.) JJ-Sm.	Barapani	Chcrrapunjee	Mawsmai	Shiilong	Baghmara
367	*Peristylus mannii* (Rchb.f.) S.M.Mukerjee	Cherrapunjee	Laitlyngkot	Mairang	Mawphlang	Shiilong Peak.
368	366. *Peristylus parishii* Rchb.f.	Nongpoh				
369	*Peristylus richardianus* Wight	Upper Shiilong.				
370	*Phaius flavus* (Blume) Lindl.	Cherrapunjee.				
371	*Phaius mishmensis* (Lindl. & Paxton) Rchb.f.	Barapani	Cherrapunjee			
372	*Phaius tancarvilleae* (L'Her.) Blume	Cherrapunjee	Nongpoh	Pynursla-Dawki		
373	*Phalaenopsis deliciosa* Rchb.f.	Balpakram National Park.				
374	*Phalaenopsis mannii* Rchb.f.	Dulong	Darugiri-Garo Hills.			
375	*Phalaenopsis taenialis* (Lindl.) Christenson & Pradhan	Mairang	Shiilong Peak	Pongtung	Raliang	Wards Lake
376	*Pholidota articulata* Lindl.	Kashlong	Kyllang rock	Cherrapunjee	Umatsor	Nongpoh.
377	*Pholidota convallariae*(F.C.Parish & Rchb.f.) Hook.f.	Dympep	Jowai Nongpoh	Pongtung	Shangpung	
378	*Pholidota imbricata* Hook. [PhoLidata calceata Rchb.f.].	Bholasa	Cherrapunjee	Markasa	Nongkhlaw	jowai
379	*Pholidota pallida* Lindi. [Pholidota imbricata Hook. var. sessilis Hook.f.].	Cherrapunjee	Dympep Jowai	Shillong Peak.		
380	*Pholidota recurva* Lindl.	Podeng Slui.				
381	*Pholidota rubra* Lindl.	Cherrapunjee	Mawmluh	Jarain	Jowai.	
382	*Phreatia elegans* Lindl.	Cherrapunjee	Mawsmai	Sohrarim.		
383	*Phreatia laxiflora* (Blume) Lindl.	Jarain.				

S.No	Species	Locations				
384	*Platanthera concinna* (Hook.f.) Kraenzl	Khasi Hills	Kalapani.			
385	*Platanthera dyeriana* (King & Pantl.) Kraenzl.	Laitlyngkot	Mawsynram			
386	*Pleione humilis* (Sm.) D.Don	Dympep	Mawphlang	Shillong-Jowai		
387	*Pleione maculata* (Lindl.) Lindl. & Paxton	Cherrapunjee	Jowai Nongstoin	Pongtung		
388	*Pleione praecox* (Sm.) D.Don [*Epidendrum praecox* Sm.].	Cherrapunjee	Dienglieng	Dympep	Mawphlang	Sohrarim
389	*Podochilus cultratus* Lindl.	Balpakram National Park.				
390	*Podochilus khasianus* Hook.f.	Pongtung	Pynursla-Dawki			
391	*Polystachya concreta* (Jacq.) Garay & H.R.Sweet	Ribhoi	Morengkleng	Nonpoh.		
392	*Porpax elwesii* (Rchb.f.) Rolfe	Pynursla	Jarain.			
393	*Porpax gigantea* Deori	Pynursla	Jarain.			
394	*Pteroceras teres* (Blume) Holttum	Jaintia Hills, Pongtung	Jowai-Badarpur Road		Burnihat Garampani	
395	*Rhomboda lanceolate* (Lindl.) Ormerod	Jowai	Khasi Hills (Pomrang)	Nongstoin.		
396	*Rhombodapulchra* (King & Pantl.) Ormerod & Av. Bhattacharjee	Mawphtang				
397	*Rhynchostylis retusa* (L.) Blume [Epidendrum retusum L.].	Bholaganj	Dawki Raliang	Nongpoh	Jaintia Hills	
398	*Robiquetia succisa* (Lindl.) Seidenf. & Garay	Umsaw.				
399	*Saccolabiopsis pusilla* (Until.) Scidenf. & Garay	Cherrapunjee-Shillong.				
400	*Satyrium nepalense* D.Don	Cherrapunjee	Mawsynram.			
401	*Schoenorchis gemmata* (Lindl.) JJ. Sm.	Jowai	Jarain.			
402	*Smitinandia micrantha* (Lindl.) Holttum	Jarain	Cherrapunjec	Pongtung	Dawki	Mawsmai
403	*Spathoglottis pubescens* Lindl.	Shillong	Laban Mylliem	Sohrarim	Cherrapunjee	
404	*Spiranthes sinensis* (Pets.) Ames	Mawphlang	Upper Shillong	Cherrapunjee.		
405	*Staurochilus ramosus* (Lindl.) Seidenf.	Balat	Ranikor.			
406	*Stereochilus hirtus* Lindl.	Khasi Hills.				
407	*Stigmatodactylus serratus* (Deori) A.N.Rao	Shillong Peak				
408	*Taeniophylhm crepidiforme* (King & Pantl) King & Pantl.	Nongpoh	Elephant Falls.			
409	*Taeniophyllum glandulosum Blume*	Shillong	Laitumkbrah	Jowai-Jarain	Pynursla	Sankher
410	*Tainia latifolia* (Lindl.) Rchb.f.	Jarain	Pynursla.			
411	*Tainia minor* Hook. F	Dympep	Bampathang			
412	*Tainia vridifusca* (Hook.) Benth. ex Hook.f	Jarain	Cherrapunjee			
413	*Thelasis bifolia* Hook.f.	Cherrapunjee	Jarain.			
414	*Thelasis khasiana* Hook.f.	Jowai	Nongkhlaw	Barapani	Amwee	Pomrang
415	*Thelasis longifolia* Hook.f.	Jowai.				
416	*Thelasis pygmaea* (Griff.) Lindl.	Nongpoh	Cherrapunjee.			
417	*Thrixspermum centipeda* Lour.	Shillong Peak.				
418	*Thrixspermum musciflorum* A.S.Rao & J.Joscph	Umran	Umsaw Pongtung	Nongpoh		
419	*Thrixspermum pauciflorum* (Hook.f.) Kuntze	Khasi Hills				
420	*Thrixspermum pygmaeum*(King & Pantl.) Holttum	Cherrapunjee				
421	*Thunia alba* (Lindl.) Rchb.f.	Cherrapunjee	Nongkhlaw	Nongpoh	Pongtung	Pynursla.
422	*Trichotosia dasyphylla* (KCParaish & Rchb.f.) Kraenzl.	Jarain	Cherrapunjee	Nongpoh.		
423	*Trichotosia pulvinata* (ndl.) Kraenzl.	Cherrapunjee	Dulong.			
424	*Tuberolabium coarctatum*(King & Pantl.) J.J.Wood.	Amwee (Jaintia Hills).				
425	*Uncifera acuminata* Lindl.	Cherrapunjee	Sohrarim	Dympep	Pynursla.	
426	*Uncifera obtusifolia* Lindl.	Pynursla	Pongtung	Jarain	Nongthlaw	Umran
427	*Vanda alpina* (Lindl.) Lindl. [*Luisia alpina.* Lindl.].	Jarain	Nongstoin	Lum-soh phate loneng-Ribhoi.		
428	*Vanda coerulea* Griff, ex Lindl.	Shillong	Nongpoh-Barapani	Jowai	Garo Hills.	
429	*Vanda cristata* Lindl.	Jowai	Pongtung	Raliang	Tura.	
430	*Vanda jainii* A.S.Chauhan	Sonapahar (West Khasi Hills).				
431	*Vanda pumila* Hook.f.	Nongstoin.				
432	*Vandopsis undulata* (Lindl.) J.J.Sm.	Jarain	Mawphlang	Elephant falls	Laitkor	Shillong Peak
433	*Zeuxine affinis* (Lindl.) Benth. ex Hook.f.	Jowai	Shillong Elephant falls	Laitkor	Sadew	
434	*Zeuxine agyokuana* Fukuy	Mawphlang.				
435	*Zeuxine flava* (Wall, ex Lindl.) Trimen	East Khasi Hills	Shillong.			
436	*Zeuxine goodyeroides* Lindl.	Khasi Hills.				
437	*Zeuxine gracilis* (Breda) Blume	Khasi Hills.				
438	*Zeuxine nervosa* (Wall, ex Lindl.) Benth. ex Trimen	Nongstoin	Smit.			
439	*Zeuxine strateumatica* (L.) Schltr.	Khasi Hills	Garo Hills			

Source: Rao and Singh 2015

Appendix 14

Medicinal Plants used by the Garo

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
1.	*Abroma angusta*	Bon khopai	Sterculiaceae	The oil extract from the endosperm is consumed for fever and also applied externally for ring worm and scabies
2.	*Acanthus leucostachysis*	Sam sikal	Acanthaceae	Decoction of leaves mixed with the extract of tuber of *Allium sp* and leaves of *Thunbergia* sp is applied externally for swelling fever, toothache.
3.	*Acanthus leucostachyus*			Leaves are pounded and applied as poultice
4.	*Achyranthus aspera*	Minamkachi	Amaranthaceae	The roots powder mixed with crushed snails are apply to cure leprosy
5.	*Acorus calamus*	Betse	Araceae	Root juice for cough and cold
6.	*Aegle marmelos*	Belethi	Rutaceae	The root and bark are used in the form of a decoction as remedy for melencholia, intermittent, fevers and palpitation of the heart. Leaves are used for ophthelmia and ulcers
7.	*Anthocephalus chinensis*	Mi-bol	Rubiaceae	Leaves decoction is reported to be used for gargling in aphthea or stomatitis; the stem bark is astringent, fabrifugel and anti-diuretic properties and is given in cough
8.	*Antidesma burnius*	Bol-aborak	Euphorbiaceae	The leaves are eaten with rice for treating syphilitic ulcers
9.	*Aporusa dioica*	Chhamolja	Euphorbiaceae	Fruit used for curing stomachache and gastritis
10.	*Arisaema jacquemontii*	Jinjok	Araceae	The tuberous extract is given for ringworms; it is also applied for various skin diseases
11.	*Aristolochia cathcartii*	Baro-warkhut	Aristolochiaceae	Extract from root are used for stomach ailments
12.	*Artemisia vulgaris*	Sak-sak	Asteraceae	Fresh leaves are pounded with roots of *Capparis assamica* for headache and severe bleeding
13.	*Asparagus filicinus*	Riching	Asparagaceae	Tuber extract are used to treat gripe in infants
14.	*Asparagus racemosus*	Som riching	Asparagaceae	Roots extract are consumed orally for fever.
15.	*Boerhavia diffusa*	Samdelma	Nyctaginaceae	The leaves are boil with rice and garlic, and the water is rubbed on the body to cure rheumatic pains.
16.	*Bombax ceiba*	Bolchu	Bombaceae	The flowers are used for astringent and are applied in coetaneous troubles. The bark is mucilaginous and its infusion is given as a demulcent, emetic and tonic, and its aqueous extract mixed with curd is used to check blood dysentery.
17.	*Bonnaya reptans*	Sam-reng chick	Scrophulariaceae	For snake bite decoction of leaves and roots is consumed orally, also rubbed on bitten place.
18.	*Butea monosperma*	-	Papilionaceae	Powdered seed, mixed with juice of the rhizome of *Cyperus rotundus,* administered for delirium
19.	*Calotropis giganteus*	Akom-aring	Asteraceae	For malaria extract of fresh leave sis consumed orally
20.	*Canscora andrographioides*	Sak sre	Gentianaceae	Paste of roots and leaves is applied on cuts and wounds and applied externally in skin disease
21.	*Capparis assamica*	Mantori	Capparaceae	For headache and general body pain the extract of dried leaves and roots mixed together with the fresh leaves of *Artemisia vulgaris* is consumed orally
22.	*Cassia fistula*	Soneru	Caesalpiniaceae	Root, bark, the pulp from fruits, seeds and leaves, a decoction of these is used as purgative tonic and febrifuge.
23.	*Centella asiatica*	-	-	Whole plant is eaten to relieve dysentery and diarrhoea
24.	*Chonemorpha fragrans*	Kotchibeta	Apocynaceae	The powdered root and stem are given for stomach disorders, chest pain, and rheumatism-
25.	*Citrus latipes*	Tanaka	Rutaceae	Fruit juice is taken as an appetizer. Crushed leaves are applied on gouty and rheumatic joints
26.	*Clematis montana*	-	Ranunculaceae	Roots are very effective against cough and cold
27.	*Costus speciosus*	Karami	Zingiberaceae	Decoction of roots is consumed orally
28.	*Crepis fuscipappa*	Pon bihar	Asteraceae	Fresh leaves extract is used as ear drop
29.	*Curcuma aromatica*	Tikegopl	Zingiberaceae	In gastric troubles green leaves are chewed raw for asthma, tuberculosis, blood impurity
30.	*Deeringia amaranthoides*	sanum	Amaranthaceae	Fresh leaves paste is applied on forehead for fever, headache, nose bleeding, dysentery
31.	*Desmodium laxiflorum*	Bhutu hom	Papilionaceae	Roots and leaves are of medicinal importance
32.	*Disporum calcaratum*	Tike jakriting	Liliaceae	Aqueous extract of tubers is used for eyes
33.	*Dracaena ensifolia*	Milam	Liliaceae	Decoction of leaves and roots is taken orally for cold, malaria and rheumatism
34.	*Drymaria cordata*	-	Caryophyllaceae	Used as antidote for snakebites
35.	*Elephantopus scaber*	Achaksn	Compositae	The root crushed and given to patients with heart and liver problem
36.	*Elephantopus sp.*	Samskal -	Asteraceae	Aqueous extract consumed orally to induce abortion, also to treat urinary disorders also used as contraceptive.
37.	*Emblica officinalis*	Amalaki	Euphorbiaceae	As medicine for skin diseases, blood pressure.
38.	*Fagopyrum cymosum*	-	-	Leaves are used as medicinal salad
39.	*Garcinia cowa*	Tekra rengron	Guttiferaceae	Aqueous extract of the bark is sprayed in the surroundings of the house as pesticides, sprinkled in water as mosquito larvicide
40.	*Geodorum purpureum*	Matea bas	Zingiberaceae	Leaves and tubers are grinded and the paste is applied on forehead for malaria, whooping cough
41.	*Globba clarkei*	Dike holdiram	Zingiberaceae	Aqueous extract of leaves and roots is consumed orally for dysentery
42.	*Hedychium sp.*	-	Zingiberaceae	Tuber are used for respiratory failure
43.	*Hedyotis scandens*	Sam rating	Rubiaceae	Decoction of the dried leaves is taken for cough and cold
44.	*Holarrhena antidysenterica*	Bol-matra	Apocynaceae	Dried bark and seeds soaked in water and the solution in case of amoebic dysentery
45.	*Homalomena aromatica*	Roathi	Araceae	Decoction of its rhizome is applied externally in case of swelling, pimples, skin sores

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
46.	*Houttuynia cordata*	-	Saururaceae	Medicinal salad to bring down blood sugar
47.	*Hydrocotyle javanica*	Mana-muni	Apiaceae	Leaves are used for cough, cold and fever and taken orally
48.	*Itea chinensis*	Myllone	Saxifragaceae	Decoction of leaves is applied externally for skin disease
49.	*Ixora acuminate*	Saoltua	Rubiaceae	Aqueous extract of leaves and flowers is consumed orally and also used as blood purifier
50.	*Jasminum lanceolaria*	Pipli	Oleaceae	For ringworm extract of leaves and roots is applied externally, used only in case of children
51.	*Justicia gendarussa*	Dochenpok	Acanthaceae	Decoction of leaves is drunk for body pain
52.	*Lasia spinosa*	Timulona	Araceae	Decoction of the rhizome is used as an antidote and also as poison with other ingredients
53.	*Litsea khasiana*		Lauraceae	Medicinal oil used as deodorants
54.	*Melia composite*	Sural	Meliaceae	Aqueous extract of leaves either boiled or raw is consumed for gastric ulcers
55.	*Milletia pachycarpa*	Khariu	Fabaceae	Leaves extract is consumed orally as vermifuge
56.	*Molineria recurvata*	Rekosi	Hypoxidaceae	Fresh leaves and tubers paste is taken orally for diarrohea or dysentery
57.	*Mycetia longifolia*	Janthro	Rubiaceae	Extract of leaves and roots are applied on forehead for high fever or blood pressure
58.	*Nepenthea khasiana*	Mimankuchi	Nepenthaceae	Leaves are used for indigestion and kidney problem
59.	*Notsiatum herpeticum*		Icacinaceae	The whole plant is of medicinal importance and used to treat influenza
60.	Oenanthe stolonifera	Bopo goli ting	Apiaceae	Fresh leaves is taken orally for stomachache, constipation etc
61.	*Oldenlendia diffusa*	Chenong	Rubiaceae	Leaves and tender leaves are boiled in water and after cooling is applied as eye drop for sore eyes and other eye diseases
62.	*Oldenlendia nudicaulis*	Chenogn-ri	Rubiaceae	For general debility, leaves extract is taken orally
63.	*Ophiopogon intermedius*	Ticea ohik	Liliaceae	Leaf paste is applied on minor cuts and wounds
64.	*Ophiopogon subcapitata*	Samachik	Rubiaceae	Decoction of roots and leaves is mixed with honey and is taken orally for fever, sore throat, tonsils and also for facial blemishes
65.	*Paedaria foetida*	Gandharadal	Rubiaceae	Either juice of the leaf or the leaf itself fried with rice powder and given to cure dysentery or indigestion
66.	*Paedaria sp.*	Pashum	Rubiaceae	Root extract is taken for stomach disorder
67.	*Pagostemon parviflorus*	Sam-sanum	Lamiaceae	Extract of fresh leaves is consumed orally for headache
68.	*Parabaena sagittaria*	Chiongbombuelu	Menispermaceae	Roots extract is applied externally for skin disease
69.	*Phlogacanthus tubiflorus*	Som rongtek	Acanthaceae	Leaves extract is taken orally during high fever
70.	*Pilea lancifolia*	Sam-rongtek	Urticaceae	For fever decoction of leaves is administered orally to children; also for anti dandruff.
71.	*Plumbago zeylanica*	Agea	Plumbaginaceae	For general debility in children a piece of root is tied on the neck
72.	*Polygonum chinensis*	Samichang	Polygonaceae	For urinary disorders aqueous extract of root and the leaves of *Hedyotis scandens* is consumed orally
73.	*Polygonum nepalensis*	Samichang	Polygonaceae	Medicinal salad control of blood pressure
74.	*Pothos kunstleri*	Garore	Araceae	For toxicity extract of fresh leaves and stem is taken orally
75.	*Pouzolzia indica*	Fakruom	Urticaceae	For urinary and spleen disorders decoction of root and leaves ia taken orally
76.	*Rhaphidophora hookeri*	Dhukentri	Araceae	For snake and dog bite paste of leaves and root extracted. Extract is taken orally, paste is applied on the injury
77.	*Rhus semialata*	Khitma	Anacardiaceae	Ripe fruits are taken to relieve diarrhea and dysentery
78.	*Rubus moluccanus*	Thekhi-sembok	Rosaceae	Paste of root applied on cuts for blood clothing and to prevent swelling
79.	*Smilax prolifera*	Marangwa	Liliaceae	Hot root poultice is used for hydrocoel. Aqueous extract of leaves and roots along with banana flowers is consumed orally for labor pain
80.	*Sonerila maculate*	Pak-soaga	Melastomataceae	
81.	*Spatholobus roxburghii*	Maribata	Papilionaceae	The bark is used for toothache and gum troubles.
82.	*Spilanthus acmella*	Sam atching	Asteraceae	Fresh leaves mixed with mustard oil are made into paste which is applied as poultice on forehead for fever
83.	*Strobilanthas scaber*	Sam siphra, bimchat	Acanthaceae	Extract of young leaves is applied for itching and applied externally
84.	*Swertia chirata*	Chirata	Gentianaceae	Boiled leaves or stems are used as anti-helminthic agent and lowering blood pressure
85.	*Symplocos racemosa*	Boligpok	Symplocaceae	Decoction of barks is consumed orally for indigestion and impared blood circulation
86.	*Tacca laevis*	Colbere	Taccaceae	Tubers are boiled mixed with honey and bark of *Shorea assamica* made into powder. Decoction is taken orally
87.	*Terminalia chebula*	Artak, salukal	Combretaceae	Decoction of dry fruits is taken orally for diarrhea, stomach pain, spleen disorders
88.	*Thunbergia coccinea*	Kakku budu	Acanthaceae	Leaves and roots of *Acanthus leucostachyus* are pounded and applied as poultice for bone fracture
89.	*Valeriana hardwickii*		Valerianaceae	The plant juice is applied against poisonous stings of insects and scorpions.
90.	*Zanthoxylum khasianum*	Sumitchory	Rutaceae	Both leaves and seeds are used as medicinal spices
91.	*Zingiber officinalis*	Ada	Zingiberaceae	Used as medicinal spice for fever, cough and cold
92.	*Zingiber ruben*		Zingiberaceae	Used as medicinal spice for fever, cough and cold

Appendix 15

Medicinal Plants used by the Khasis

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
1.	*Acorus calamus*	U-bet	Araceae	Leaves boiled in water for 2-3 hours and the vapour inhaled for influenza and headache.
2.	*Adenostemma lavenia*	Soh-byrthit	Asteraceae	Leaves paste is applied to cuts and wounds; also applied to treat bites of poisonous insects and caterpillars.
3.	*Adiantum phillipense*	Tyrkhang khyllai	Adiantaceae	Paste of leaves are applied to fractured bones
4.	*Aegle marmelos**	Diengsohbel	Rutaceae	Leaf juice taken orally for fever. Mixed with crushed chillies and applied topically for treatment of abcess
5.	*Ageratum conyzoides*	Ksangd agiem	Asteraceae	Paste of leaf and lime is applied to cuts which acts as homeostatic.
6.	*Ajuga bracteosa*	Tiew khmut tuta	Lamiaceae	Crushed leaves are used as astringent to stop bleeding. Leaf decoction with honey and ginger juice is used for high fever and respiratory congestion.
7.	*Albizzia chinensis*	Dieng phallut	Mimosaceae	Bark decoction is applied on ringworm and also as antidote to insect bite
8.	*Allium hookeri*	Ja uat	Liliaceae	Bulbs are crushed and applied on burns.
9.	*Allium tuberosum*	Jyllang	Liliaceae	Extract of whole plant is used against problems, specially for hypertension
10.	*Alysicarpus monilifer*	-	Fabaceae	Whole plant is made to a paste with ginger and mustard oil and used as antidote for snake bite.
11.	*Ambrosia artimisifolia*	Kynbat japan rit	Asteraceae	Young leaves are crushed and applied on wounds and cuts to stop bleeding and to promote healing.
12.	*Amomum aromaticum*	Ilashi saw	Zingiberaceae	During nausea and vomiting, the rhizome is smashed and made into paste in hot water and taken directly.
13.	*Anaphalis adnata*	Skhor blang	Asteraceae	Paste made of leaves and lime applied to cure moematomia
14.	*Antidesma thwaitesianum*	Soh-syllai	Euphorbiaceae	Patients suffering from pains in the joins are bathed with the solution from the boiled leaves.
15.	*Astilbe rivularis*	Pdah	Saxifragaceae	The leaves are eaten raw to cure toothache; also given for blood purification
16.	*Averrhoa carambola*	Sohpyrshong	Averrhoaceae	Ripe fruit are taken as medicine for jaundice.
17.	*Azadirachta indica*		Meliaceaae	Boiled leaves extracts are used for diarrhea and dysentery.
18.	*Bauhinia variegate*	Dieng tharlong	Caesalpiniadeae	Flowers are boiled and eaten for piles for dysentery for 6-7 days
19.	*Begonia josephi*	Jajew	Begoniaceae	The bulbs are eaten raw incase of stomach pain and indigestion
20.	*Begonia palmata*	jajewmaw	Begoniaceae	Paste made of underground parts applied on swellings due to vaccination. Stems and leaves eaten raw as an antidote for poisoning and vomiting. Stem and leaves eaten raw for stomach troubles.
21.	*Benincasa hispida**	Pathawiong	Cucurbitaceae	Leaf juice taken orally or cough, leaf juice mixed with salt and taken orally for fever
22.	*Berberis microcarpa**	Diegsnong	Berberidaceae	Juice of the root, stem bark (equal proportion) applied to skin disease, filtered juice is us eye drop. Decoction of root bark juice is taken orally for treatment of fever. Powerd of root is soaked at home for 7 days and taken orally as laxative
23.	*Berberis wallichiana*	Dieng niangmat	Berberidaceae	Decoction of young twigs mixed with leaf juice of *Oxalis richardiana* is given for dysentery, diluted decoction of leaves is used for conjunctivitis
24.	*Betula alnoides*	Dienglieng	Betulaceae	Root extract is given for indigestion and flatulence
25.	*Biophytum sensitivum*	-	Oxalidiaceae	Leaves paste is applied on the forehead of the patient suffering from headache, giddiness and fever.
26.	*Bonnaya reptans*	Kra-thang syndat	Scrophulariaceae	Juice of crushed leaves mixed with milk and taken to cure urinary ailments.
27.	*Boerhaavia diffusa**	Dieng-punar	Nictaginaceae	Leaves in curry for hypotension, Root joice mixed with crushed chilies taken orally for bronchial asthama, leaf juice taken orally for treatment of jaundice
28.	*Brugmansia suareolens*	Sla-toh-toh	Solanaceae	Leaves dried on fire mixed with leaves of *Solanum torvum* and tubers of *Flemingia* sp. Ground to a paste is rubbed on body in case of bodyache and also applied on boils.
29.	*Cannabis sativa*	Kynja	Cannabaceae	The leaves and fruits are applied for skin diseases and stomach disorder
30.	*Capsicum annum*	Soh-mynken syiar	Solanaceae	Fruits mixed with leaves of *Dendrobium bakeril, ficus sp., Grewia disperma., Neyraudia meyraudiana, Tinospora cordifolia* and tubers of *Zingiber* sp, and a Vitaceae member *Kumbatlatnut* (Khasi) are ground to a paste and applied on snake bite.
31.	*Cinnamomum glandiferum*	Diengsing	Lauraceae	Decoction of leaves and inner bark is given for fever, cold and cough. Fruit paste is applied on rheumatic joints
32.	*Cinnamomum pauciflorum*	Dieng tarthia	Lauraceae	Extract of bark and young shoots mixed with coconut oil, is used as an antiseptic
33.	*Cinnamomum tamala*	La tyrppad	Lauraceae	Leaves fried in mustard oil and placed on tooth to remove toothache.
34.	*Cissus quadragularis**	Kynbat-harjora	Vitaceae	Paste of plant applied topically for fractured or dislocated bones, plant juice is used as eardrop for otorrhea, powdered plant mixed with mustard oil for massaging for rheumatoid arthritis.
35.	*Citrus latipes*	Sohkymphor	Rutaceae	Fruit juice is taken as an appetizer; crushed leaves are applied on gouty and rheumatism joints. Juicy slices of fruit are rubbed on rashes and ringworm
36.	*Clematis loureriana*	Sladienglum	Ranunculaceae	Crushed roots powdered with pepper is effective remedy for cough and common cold.
37.	*Clitoria ternatea**	U-misyntiew	Pailionaceae	Root powder taken orally with water for Ascariasis and fever. Root powerd taken orally with "ghee" /butter or with milk or juice of termeric for snake bite.
38.	*Colocasia esculcenta*	La wang	Araceae	Tender leaves tied on forehead in case of high temperature due to fever. Partially cooked corms for rickets disease.
39.	*Conyza bonariensis*	Kynbat symbai pum pum	Asteraceae	Decoction and residue of leaves are used as astringents on cuts.
40.	*Costus speciosus*	Sla pangmat	Zingiberaceae	Rhizome cut and ground into pieces and the powdered eaten against bronchitis., inflammation & anemia and rheumatism
41.	*Crossocephalum crepidioides*	Jali	Asteraceae	Leaves are crushed and the juice is taken to treat constipation and other stomach disorders

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
42.	*Curcuma angustifolium*	Khniang-soh-pet	Zingiberaceaae	Paste of rhizome and leaves boiled in water and given to children for gripe.
43.	*Curcuma domestica*	Shynrai stem	Zingiberaceae	Rhizome paste with leaves of *Limdera latifolia* and fruits of *Piper longum* applied for various skin disease; paste of rhizome of this plant, ginger and mustard oil applied and tied around fractures to set the bone.
44.	*Daphne bholua*		Thymelaeaceae	Roots are used for intestinal troubles
45.	*Delphinium altissimum*	Bad soh-plihrit	Ranunculaceae	Leaves are made into paste and is applied as plaster to glandular swellings
46.	*Delphinium altissimum*	Bat- sohplihrit	Ranunculaceae	Leaf and root paste is applied to glandular swellings
47.	*Dendrobium mochatum*	Tiew dieng	Orchidaceae	The leaves juice is used as the ear-drops for ear pain
48.	*Desmodium gangeticum*		Papilionaceae	The roots crushed and mixed with ginger are administered for dysentery
49.	*Dirchrocephala bicolor*	Liang poh tiew	Asteraceae	Paste made of young leaves applied to wounds and cuts to stop bleeding and quick healing
50.	*Drymaria cordata*	Bat-nongrim	Caryophyllaceae	The whole plants is crushed and the juice is applied for burns, skin diseases and snake bites
51.	*Elephantopus scaber*	Kynbat skrut sriang	Asteraceae	Aqueous extract consumed orally to induce abortion, also to treat urinary disorders also used as contraceptive.
52.	*Eleusine indica*	Lang krai	Poaceae	Root juice is used for jaundice
53.	*Elsholtziz blanda*	Bat-skain	Lamiaceae	The juice of the leaves is applied for mosquito bites and as mosquito repellant.
54.	*Engelhardtia spicata*	Dieng lyba	Juglandaceae	Fine paste made from inflorescence and young leaves is applied on scabies and other skin diseases
55.	*Enhydra fluctuans**	Kynbat hingcha	Asteraceae	Leaf juice for skin disease, taken orally for liver disease, concentrated juice is used as laxative
56.	*Erigeron karvinskianus*	Kynbat tiew star	Asteraceae	Crushed leaves are applied on cuts or wounds as an astringent
57.	*Erythrina arborescens*	Dieng-song	Papilionaceae	The leaves are made into paste with ginger and applied for skin diseases of pig.
58.	*Eupatorium cannabinum**	Kynbat nongrim	Asteraceae	Leaves and young shoot ground and applied to wounds and burns. The juice is used for dysentery treatment
59.	*Eupatorium adenophorum*	Bat iong	Asteraceae	Crushed leaves applied on injuries
60.	*Fiscus bengalensis*	Diengjri	Moraceae	Powdered leaves mixed with curd used as anti-diarrhoeal. Bark powder mixed with equal amount of *F. religiosa* bark powder and this paste is applied on fractured part. Milky exudate is applied externally in rheumatoid arthritis.
61.	*Fiscus virens*	Dieng soh phohkhlaw	Moraceae	Leaves are boiled and given for loss of appetite
62.	*Garcinia cowa*	Soh syrum	Clusiaceae	Extract of crushed fruits mixed with little lime added to boiled water and the vapour inhaled for severe headache and cold The fruit is powdered after sun drying and used for dysentery
63.	*Garuga pinnata*	Dieng khiang	Burseraceae	Fruits juice is given for indigestion, stem juice is applied for conjunctivitis and leaf juice with honey is given for asthma.
64.	*Gaultheria fragmentissima**	Soh-lingthrait	Ericaceae	Decoction of leaves with mustard oil used for rheumatoid arthritis and internaly for amenorrhoea and oligomenorrhoea. Powder of leaves mixed with water used for diarrhea.
65.	*Glochidion khasicum*	Jalwai	Euphorbiaceae	Leaves eaten for dysentery and associated stomach troubles
66.	*Gmelina arborea*	Dieng laphiang	Verbenaceae	Berries are used as a purgative. Root juice is used as antidote for snake bite and insect stings. Root juice is taken for treatment of fever and leaf juice is taken orally for treatment of cough*.
67.	*Gomphostemma parviflora*		Labiatae	Leaves paste is applied on the forehead of the patient suffering from headache, giddiness and fever.
68.	*Hede nepalensis*	Mei soh poramshre	Araliaceae	Berries are used as purgative. Fine paste made from tender leaves is applied on mumps
69.	*Hedyotis scandens*	Mo-shoh shu	Rubiaceae	Ground leaves taken for gastric troubles; Decoction of the dried leaves is taken for cough and cold
70.	*Hedyotis verticillata*	Jyrmi skei	Rubiaceae	Leaves paste can be managed on the whole body to reduce body temperature.
71.	*Hodgsonia heteroclite*	Soh risa	Curcubitaceae	Paste from roots with ginger and lime cures fever
72.	*Holmskioldia sanquinea*		Verbenaceae	Root extract is used to relieve fever.
73.	*Houttynia cordata*	Jamyrdoh	Saururacae	Leaves are eaten raw for blood purification and also applied to treat sores and boils.
74.	*Hyplianthera stricta**	Dieng diki	Rubiaceae	Infusion of leaves orally for labour.
75.	*Hypocharis radicata*	bat jhur kthang	Asteraceae	Tender leaves are eaten raw or boiled to control stomach upset
76.	*Indigofera tinctoria*		Papilionaceae	Powdered roots are made into paste and applied to heal wounds
77.	*Ipomea uniflora*	Tiew turoi	Convolvulaceae	Aqueous extract of leaves is taken orally for cholera, vomiting
79.	*Jatropa curcas**	Dieng songdakhar	Euphorbiaceae	Leaf juice is used in treatment of amenorrhoea and oligomenorrhoea. Stem juice mixed with water taken orally for dysentery. Seed oil applied for haemorrhoids. Leaf and bark juice are used for skin disease.
80.	*Justicia gendarussa**	Dieng nili	Acanthaceae	Leaf juice is used as antiseptic and haemtostatic. It is applied externally in cuts and wounds, in nasal drops for nasal bleeding and mouth wash for apthe. Used internally for dyseyntry (blood in stool).
81.	*Kaempferia foetida*	Ingsmoh	Zingiberaceae	Medicine for stress stomach trouble and as general tonic
82.	*Leea crispa**	Dieng-ja-lowan	Lauraceae	Decoction of leaves and bark taken orally for dysentery. Bark grounded and applied on boils and bruises.
83.	*Lindera pulcherrima*	Sia-sia	Lauraceae	The bark is made into a paste and applied to wounds of various types also rubbed on the body to relieve rheumatic pains.
84.	*Litsea khasiana*	Dieng mosu	Lauraceae	Powdered roots alson with *Piper nigrum* and sugar candy is given for chronic bronchitis
85.	*Maesa indica*	Dieng soh jala	Myrsinaceae	Ripe berries is used as a vermifuge and taken orally
86.	*Mahonia nepalensis*	Dieng-tiang-mat	Berberidaceae	The green peel of bark is scraped and crushed and the juice in diluted with water. Then the solution is used as eye drops for various eye diseases.
87.	*Mahonia pycnophylla*	Ningmat	Berberidaceae	The juice of the bark and leaves diluted with distilled water and used as an eye disease
88.	*Mallotus philippensis*	Dieng chandan	Euphorbiaceae	Powdered fruits with little sugar is given for tapeworm

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
89.	*Melia azedarach*	Dieng ja rasang	Meliaceae	Barks is used as an anthelmintic, leaves and fruits are used as febrifuge to cure malarial fever, flowers are crushed and applied as poultice on skin eruption
90.	*Mimosa pudica**	Kynabat Samthiah	Mimosaceae	Crushed leaf and root (1:1) mixed with water and past is applied for haemorrhoids and fistula. Affected part is bandaged for 24 hrs with reapplication.
91.	*Mimusops elangi**	Dieng bakul	Sapotaceae	Bark juice is used as gargle for treatment of apthae and pyorrhoea
92.	*Momordica charantia**	Karela	Cucurbitaceae	Fruit juice aken orally as hypoglycemic, antirheumatic, liver problem, as blood purifier, fruit juice mixed with leaf juice is applied on haemorrhoides.
93.	*Musa paradisiaca**	Kakait	Musaceae	Juice collected from plant or fruit juice mixed with curd is taken orally for treatment of diorrhoea and dysentery. Raw fruit crushed is topically applied on abscess.
94.	*Nelumbium speciosum**	Syntiew padma	Nymphaeceae	Flower juice is taken orally in treatment of asthama. Leaf juice is used a gargle for aphthae. Juice of carpel is taken oraly to prevent miscarriage.
95.	*Nepenthes khasiana*	Ksetphare	Nepenthaceae	The juice of young flowers or unopened pitchers mixed with rice beer (ka kyiad) and taken to cure stomachache, eye sores or urinary troubles. Water collected in pitcher is used as eye and ear drop.* The flower and water paste is taken orally for treatment of cholera.*
96.	*Nyctenthes arbor-tristis**	Diengdawainieh	Oleaceae	Leaf juice takn orally as anti -helmintic. Flower juice taken orally for black water fever. Flower powder is mixed with honey and taken orally as antispasmodic.
97.	*Oroxylem indicum**	Diengtiti-kong-ling	Bignoniaceae	Root and bark juice is taken orally to control diarrhea and dysentery.
98.	*Osbeckia crinata*	Soh-lyngkthut	Melastomaceae	Leaves paste is applied on wounds of various types, against snake bites, and also used to stop nose bleeding.
99.	*Oxalis corniculata*	Jabuit	Oxalidaceae	Used as medicine for diarrhoea
100.	*Pandanus tectorius*		Pandanaceae	The juice are applied for skin diseases, including leprosy.
101.	*Panicum maximum*	Lang-ator	Poaceae	Leaves boiled in water and vapour inhaled as an effective remedy for headache
102.	*Parochetus communis*	Khia-knoi	Papilionaceae	The plant is wrapped in a big leaf and put in hot ashes until it becomes soft and half boiled. Then it is squeezed to extract the juice, which is mixed with water and sugar and is given to babies for stomach ache and other stomach disorders.
103.	*Phlogacanthus thyrsiflorus**	Soh-ja-jut	Acanthaceae	Fruit and leaf ash (1:1) mixed and taken orally for treating fever.
104.	*Phonera khasiana*	Jarmi bin khlaw	Caesalpiniaceae	Seeds extract is applied as a demulcent in dried and cracked skin during winter
105.	*Piper griffthii*	Mrit khlaw	Piperaceae	Dried seeds powdered and mixed with honey and the yolk of egg and this is taken for severe cough
106.	*Piper longum**	Soh-mrit-khlaw	Piperaceae	Powdered fruit mixed with honey is taken orally in treatment of enlarged spleen.
107.	*Pithecellobium bigeminum*	Dieng yap yar	Mimosaceae	Seeds are boiled and taken as blood purifier
108.	*Pittosprum nepaulense**	Dieng-sying	Pittospraceae	Decoction of bark is concentrated and taken orally for treating cough and fever.
109.	*Plantago major*	Riew-kai	Plantaginaceae	The crushed plant is used as an ointment for burns.
110.	*Plantago major*	Shkor blang	Plantaginaceae	Leaves paste used for bandaging of wounds; leaves warm into the fire and wilted leaf is kept pressed on boiled for quick burst and removal of puss
111.	*Plumbago zeylanica*	Diengshitu	Plumbaginaceae	Root and bark (1:1) are ground to paste and applied locally for treatmen of haemorrhoids and skin diseases. Decoction of root and bark is taken orally for treatmen of diarrhea.
112.	*Potentilla fulgens**	Lyngniang-bru	Rosaceae	Plant juice is used as antispasmodic, Root is chewed for treatment of pyorrhea. Plant paste is used externally on ulcers.
113.	*Pouzolzia hirta*	Memsleh	Urticaceae	The roots are used for hair tonic. The roots are crushed or boiled in water which is then used in the bath to promote good hair growth.
114.	*Pseudognaphalium luteoalbum*	Tiew kubi	Asteraceae	Leaves decoction is used as an astringent to stop bleeding from cuts or wounds and also applied on gouty and rheumatic joints
115.	*Psidium guajava*	Soh priam	Myrtaceae	The leaves crushed and the extract is drunk in case of chronic dysentery.
116.	*Rhododendron arboretum**	Dieng-tiew-saw	Ericaceae	Young leaves are pounded and applied over forehead as febrifuge. Flowers are taken orally to treat dysentery.
117.	*Rosa indica*	Dieng-tiew-jain heh	Rosaceae	Seed poser mixed with water taken orally for dysentery.
118.	*Rhus semialata*	Sohma	Anacardiaceae	The fruits are soaked in water which is drunk for stomach ache. Buds are boiled and taken for diarrhoea.
119.	*Rorippa indica*	Tyrso khlaw	Brassicaceae	Paste made from seeds is rubbed on bleeding gums in scurvy.
120.	*Rorippa nasturtium-aguaticum*	Tyrso-um	Brassicaceae	Whole plant taken boiled or raw as a tonic usually during pneumonia or other pulmonary ailments
121.	*Rubia cordifolia*	Rhoi	Rubiaceae	The Leaves paste is applied for ulcer and the crushed roots for poisonous stings of insects and caterpillars.
122.	*Rubus ellipticus*	Soh-shiah	Rosaceae	The fruits and crushed roots are used to cure dysentry.
123.	*Sapindus mukorossi**	Soh pariah	Sapindaceae	Fruit paste mixed with water is takne orally vefore food in treatment of epilepsy.
124.	*Schefflera hypoleuca*	Sla tymphu	Araliaceae	Decoction of tender roots is given as a tonic after child birth
125.	*Schima wallichii*	Diengngan	Theaceae	Young leaves are boiled, the solution is taken to cure flatulence.
126.	*Schizandra repanda f. discolor*		Lamiaceae	The leaves are boiled and the water turns reddish, this water is given for high fevers. Often it is given in combination with other plants.
127.	*Sida acuta**	Soh byrthit bah	Malvaceae	Leaf juice is taken orally to treat fever.
128.	*Sida rhombifolia**	Soh byrthit rit	Malvaceae	Powdered root bark mixed with sugar and milk is taken orally and applied locally for treatment of snake bite. Decoction of leaves is used to treat hysteria.
129.	*Smilax glabra*	Khong	Smilacaceae	The juice of leaves is applied for skin diseases. Sometimes the leaves are dried and the resultant powder, mixed with oil, is applied for skin diseases.
130.	*Sphaeranths indicus**	Bat lyngkgmong	Asteraceae	Seed and root (1:1) are ground and taken orally as anthemintic. Bark paste is applied locally for treatment of haemorrhoids.

Sl. No	Scientific Na	Local Name	Family	Mode of Utilization
131.	*Swertia chirayita**	Sharita	Gentianaceae	Root juice is applied externally on scabies and internally to prevent abortion.
132.	*Synotis cappa*	Tiew kubi sla lieh	Asteraceae	Paste made up of young leaves is applied in boils
133.	*Taxus baccata*	Soh bilat iong	Taxaceae	Leaves paste along with ginger is made into paste and applied on tumors. Used in treatment of epilepsy and irregular mensturation. *
134.	*Terminalia chebula*	Soh salukah	Conbretaceae	Fruits are roasted and eaten as a diuretic. Root paste is used for conjunctivitis
135.	*Tinospora cordifolia**	ksaiblet	Menispermaceae	Decoction of leaves, bark and root (1:1:1) taken orally for treatment of diarrhea and dysentery. Leaf juice is applied over burns.
136.	*Toddalia asiatica*	Soh sat khlaw	Rutaceae	Decoction of root bark is administered to cure malarial and ether periodic fevers
137.	*Tylophora indica**	Kynbat kylian	Asclepiadaceae	Root powder mixed with little milk or root juice is used in treatment of aphthae. Fruit powder mixed with milk is taken orally to remove gall bladder stone.
138.	*Vernonia anthelmintica**	Kynbat-jiraiong	Asteraceae	Power of seed is takenorally with water as anthelmintic. Seed powder moistened with water is applied over snake bite. Leaf juice is al used as nasal drop.
139.	*Viscum anrticulatum**	Mangkariang-khlen-sia	Santalaceae	Plant paste is applied over snake bite area and also over cuts and wounds.
140.	*Vitex negundo**	Tohrih-dkhar	Lamiaceae	Root bark is frounded and mixed with local liquor, this past is applied over neck in treatment of epilepsy. Warm leaves are applied in rheumatoid arthritis. Leaf power mixed with water is used in treatment of fever.
141.	*Vitex peduncularis**	U-shyrtoh	Lamiaceae	Decoction of leaf and bark is taken orally for treatment of feer
142.	*Zanthoxylum acathopodium*	Ja-iur	Rutaceae	Medicinal spice for stomach disorders, fish poison insecticide and vermicide.
143.	*Zingiber zerumbet*	Ing-Blei	Zingiberaceae	Fresh rhizome are eaten to relieve stress
144.	*Zizyphus jejuba**	Dieng-soh-broi	Rhamnaceae	Leaf powder of this and Ficus flomerata is applied locally in scorpion sting. Leaf juice is mixed with salt taken orally for treatment of dysentery.
145.	*Zizyphus mauritiana*	Sohbroi	Rhamnaceae	Indicator for chicken plague

Appendix 16
Medicinal Plants used by the Jaintia tribe of Meghalaya

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
1.	*Acorus calamus*	Bat-ksuid	Acoraceae	Root extract are used for treating cough and cold; Solution of water and crushed root taken internally for stomach pain and toothache.
2.	*Aegle marmelos*	Sohbel	Rutaceae	Fruits are taken for treating stomach disorders
3.	*Allium tuberosum*	Jyllang	Liliaceae	Medicinal salad for cough and cold
4.	*Alpinia bracteata*	Latara	Zingiberaceae	Crushed rhizome placed in mouth against toothache and decay.
5.	*Alpinia galangal*	Phlang sow	Zingiberaceae	Paste from rhizome applied externally as an ointment for skin disease.
6.	*Arisaema sp.*	Hadembsein	Araceae	Extract of ripe fruits as insecticide
7.	*Aristolochia sp. catcartii*	Patiksang	Aristolochiaceae	Extract from the roots are used as antidote for food poisoning
8.	*Aristolochia saccata*	Krahlahit	Aristolochiaceae	Tuber extracts are used for treating stomach-ache.
9.	*Aristolochia tagala*	Khurthlong	Aristolochiaceae	Juice obtained by crushing roots is a good tonic.
10.	*Asparagus filicinus*	Batniangsohpet	Asparagaceae	Extract is used as medicine for gripe in infants
11.	*Asparagus racemosus*	Phlang chokriawsea	Liliaceae	Juice of rhizome and water used for infections of umbilicus
12.	*Borreria articularis*	Phlang bhoi	Rubiaceae	Paste from crushed leaves applied to stop bleeding from cuts as homeostatic
13.	*Careya arborea*	Styngkrain	Barringtoniaceae	Decoction of crushed bark to cure dysentry.
14.	*Senna tora*	Tawblei	Leguminosae	Leaf paste is applied on ringworm and other skin diseases
15.	*Centella asiatica*	Khlein syiar	Apiaceae	Freshly eaten for dysentery and Paste of root and runners taken for stomach-ache. Paste from leaves with that of Drymaria cordata, Oxalis carniculata eaten to cure dysentry. A decoction of this plant is good for cough and cold and also as a blood purifier
16.	*Centranthera grandiflora*	Phlang stem	Scrophulariaceae	Crushed root pieces soaked in water and supernatant juice for curing I nfections of umblicus.
17.	*Cinnamomum camphora*	Dieng-pingwait	Lauraceae	Leaf extracts are taken to relieve cough, cold, fever etc.
18.	*Citrus medica*	Soh-kwit	Rutaceae	Juice from ripe fruits with mustard rubbed on forehead and body to reduce fever and headache and body pain.
19.	*Curcuma longa*	Shynrai	Zingiberaceae	Spice and medicine for cough, cold, allergy, boils etc.
20.	*Curcuma montana*	Chyrmit khlow	Zingiberaceae	Paste from rhizome applied all over the body for high temperature and headache.
21.	*Curcuma zeodarla*	Chyrmit loom	Zingiberaceae	Paste from fresh rhizome, ginger and mustard oil applied and tied around fractures for easy healing of bones.
22.	*Daphne cannabina*	Murit	Thyneliaceae	Crushed bark and leaves chewed for preventing tooth decay
23.	*Drymaria cordata*	Slia-slia	Caryophyllaceae	The decoction of crushed leaves and young parts are applied on cuts to stop bleeding
24.	*Dysoxylum procerum*	Sla-khro	Meliaceae	The decoction of crushed leaves drunk to cure dysentery
25.	*Phyllanthus emblica*	Sohmylleng	Phyllanthaceae	Edible and used as medicine for skin disease pickle
26.	*Eupatorium adenophorum*	Phlang Burma	Asteraceae	Crushed leaves applied don injuries
27.	*Eupatorium odoratum*	Phlang Dkhae	Asteraceae	Crushed leaves applied as an haemostatic to stop bleeding

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
28.	*Fagopyrum acutatum*	Jarain	Polygonaceae	Medicinal salad
29.	*Flemingia procumbens*	Sohphlang	Leguminasae	Edible and used as anti-helminthic agent
30.	*Garcinia lanceaefolia*	Soh-suit	Clusiaceae	Fruits eaten raw for stomach trouble
31.	*Gaultheria fragrantissima*	Lathynrait	Ericaceae	Extract of methyl salicylate from the leaves is used as medicine for arthritis, rheumatism and other ailments of the joints
32.	*Gerbera macrophylla*	Phlang-sniooh	Asteraceae	Paste made of whole plant applied to cure wounds and skin diseases of pigs
33.	*Habenaria acuifera*	Phlang stem	Orchidaceae	Crushed rhizome eaten for stomach troubles
34.	*Hedychium sp.*	Shynraikhlaw	Zingiberaceae	Directly taken as medicine for respiratory failure
35.	*Hedyotis uncinella*	La jam	Rubiaceae	Crushed leaves applied to insect stings
36.	*Houttuynia cordata*	Jamyrdoh	Saururaceae	Medicinal salad for lowering blood sugar
37.	*Hydrocotyle javanica*	Kynbat-syiar	Apiaceae	Leaf paste with little water is a laxative, tonic and antipyretic
38.	*Kaempferia rotunda*	Phlang san	Zingiberacae	Crushed rhizomes applied on swellings and boils
39.	*Kaempferia rotunda*	Ingsmoh	Zingiberaceae	Taken raw as vegetable as well as medicine for stomach disorders
40.	*Leucosceptrum canum*	Lalieh	Lamiaceae	After boiling fresh leaves in water the decoction is rubbed over fractured or dislocated parts to reduce pain and quick healing
41.	*Nepenthes khasiana*	Tiew rakot	Nepenthaceae	Extracts from the pitcher are taken to relieve indigestion and kidney trouble
42.	*Paedaria foetida*	Nangra puhung, Batiewtung	Rubiaceae	Paste of leaves and roots applied on skin diseases; Extracts from stem are used for stomach disorders
43.	*Panax pseudoginseng*	Jynseng	Araliaceae	Extract as general tonic to relieve stress
44.	*Piper brachystachyum*	Choi	Piperaceae	Crushed fruits chewed to stop toothache
45.	*Plectranthus costa*	Phlang rootluli	Liamaceae	The whole plants is crushed and paste is good for healing bone fractures and for bandages
46.	*Polygonum cepitatum*	Samtympei	Polygonaceae	The juice from crushed leaves is drunk for common stomachache
47.	*Polygonum nepalensis*	Ja-ut	Araliaceae	Medicinal salad for control of blood pressure
48.	*Polygonum perfoliatum*	Shrat	Polygonaceae	Crushed leaves and roots mixed with water and taken to cure dysentery and diarrhoea
49.	*Pouzolzia hirta*	Taknor	Urticaceae	Crushed leaves applied on boiled and insects stings
50.	*Rhododendron sp.*	Tiewsaw	Polygonaceae	Eaten raw to control blood pressure
51.	*Rhus chinensis*	Sohmluh	Anacardiaceae	Fruits are eaten raw for diarrheoa and dysentery
52.	*Rhus semialata*	Sama	Anacardiaceaae	Fruits eaten for stomach pian
53.	*Sarcandra glabra*	Soh-krismas	Chloranthaceae	Paste of crushed leaves applied or rubbed on the body to bring down high temperature during fever.
54.	*Solanum barbisetum*	Sohshiah	Solanaceae	Medicinal salad for lowering blood pressure and blood sugar
55.	*Solanum khasianum*	Sohpdok	Solanaceae	The fruit is known to contain solasodine, a very potent anti-fertility steroid
56.	*Solanum xanchocarpus*	Sohngang	Solanaceae	Berries are taken to lower blood pressure
57.	*Sonchus asper*	Jalynniar	Compositae	Medicinal salad for lowering blood pressure and blood sugar
58.	*Spilanthes acmella*	Hooin	Asteraceae	The flower heads are held tight in between the jaws to cure toothache.
59.	*Swertia chirata*	Batwieh	Gentianaceae	Cooked leaves are taken as vermicide
60.	*Taxus baccata*	Kseh-Blei	Taxaceae	The compound taxol extracted from the bark possesses anti-carcinogenic properties besides others
61.	*Tinospora sinensis*	Jyrmibteng	Menispermaceae	Oil extract as ointment for fractures and dislocated bones
62.	*Viburnum foetidum*	Sohlang	Adoxaceae	Fish baits, medicine for skin diseases
63.	*Zanthoxylum khasianum*	Jaiur	Rutaceae	Medicinal spice, treatment of fever cough and cold
64.	*Zingiber officinalis*	Ingbah	Zingiberaceae	Medicinal spice, treatment of fever cough and cold
65.	*Zingiber rubens*	Ingmakhir	Zingiberaceae	Medicinal spice, treatment of fever cough and cold
66.	*Zingiber zerumbet*	Ing-Blei	Zingiberaceae	Medicinal spice, treatment of fever cough and cold

Appendix 17

Common Mammals found in Meghalaya

S. No	Scientific Name	Common Name
1.	*Arctictis binturong*	Binturong or bear cat
2.	*Bos gaurus*	Gaur or Indian Bison
3.	*Calloscriurus pygerythrus*	Hoary bellied Himalayan squirrels
4.	*Canis aureus*	Jackal
5.	*Canus cupus Linn*	Indian wolf
6.	*Capricornis sumatrensis*	Serow
7.	*Rusa unicolor*	Sambhar
8.	*Cuon alpinus*	Dhole or Indian wild dog
9.	*Dremomys lokriah*	Orange bellied Himalayan squirrel
10.	*Elephas maximus*	Asiatic Elephant
11.	*Felis bengalensis*	Leopard cat
12.	*Felis chaus*	Jungle cat
13.	*Felis temmincki*	Golden cat
14.	*Gannomys bodius*	Bay Bamboo Rat
15.	*Golunda ellioti*	Indian bush Rat
16.	*Herpestes*	Common Mongoose
17.	*Herpestes urva*	Crab-eating Mongoose
18.	*Hylobates hoolock*	Hoollock
19.	*Hylopetes alboniger*	Parti coloured flying squirrel
20.	*Hystrix hodgsoni*	Hodgson porcupine
21.	*Hystrix indica*	Indian porcupine
22.	*Lepus nigricollis ruficaudatus*	Rufoustailed Hare
23.	*Lutra lutra*	Common Otter
24.	*Lutra perspillata*	Smooth Indian rat
25.	*Macaca assamensis*	Assamese macaque
26.	*Macaca mulatto*	Rhesus Macaque
27.	*Manis crassicaudata*	Inidan Pangolin
28.	*Manis pentadactyla*	Chinese pangolin
29.	*Martes flavigula*	Himalayan yellow throated Marten
30.	*Melarsus ursinus*	Sloth Bear
31.	*Melogale moschata*	Chinese ferret Badger
32.	*Muntiacus muntjak*	Barking deer
33.	*Neofelis nebulosa*	Clouded leopard
34.	*Nycticebus coucang*	Slow loris
35.	*Panthera pardus*	Leopard
36.	*Panthera tigris*	Tiger
37.	*Petaurista petaurista*	Common Giant flying squirrel
38.	*Presbytis pileatus*	Capped langur
39.	*Rhizomys pruinosus*	(Hoary) bamboo rat
40.	*Rousettus leachenaulti*	Fruit bat
41.	*Rutafa bicolor*	Malayan Giant Squirrel
42.	*Selenarctos thibetanus*	Himalayan Black bear
43.	*Viverra zibetha*	Large Indian Civet
44.	*Viverricula indica*	Small Indian Civet

Source: NEBRC, NEHU

Appendix 18

Birds of Meghalaya

S. No	Scientific Name	Common Name
1.	*Accipiter badius*	Shikra
2.	*Accipiter species*	Hawk
3.	*Aegithalos concinnus*	Red headed tit
4.	*Aegithina tiphia*	Common lora
5.	*Acridotheres tristis*	Common myna
6.	*Aethopyga nepalensis*	Nepal yellow-backed sunbird
7.	*Anas crecca*	Common teal
8.	*Anhinga melangaster*	Darter
9.	*Anthraceros coronatus*	Indian pied hornbill
10.	*Chalcoparia singalensis singalensis*	Ruby cheek sunbird
11.	*Apus nipalensis*	House swift
12.	*Arachnothera longirostris*	Little spider hunter
13.	*Ardeola grayii*	Pond heron
14.	*Alcedo atthis*	Common kingfisher
15.	*Bambusicola fytchii*	Mountain Bamboo partridge
16.	*Brachypteris montana*	White browned short wing
17.	*Bubo bubo*	Eurasian Eagle owl
18.	*Bulbulcus ibis*	Cattle egret
19.	*Buceros bicornis*	Great Indian pied hornbill
20.	*Buteo buteo japonicus*	Japanese buzzard

S. No	Scientific Name	Common Name
21.	*Buterides striatus*	Little green heron
22.	*Ceryle rudis*	Pied kingfisher
23.	*Collocalia sonneratia*	Bay banded cuckoo
24.	*Collocalia brevirostris*	Himalayan swiftlet
25.	*Megaceryle lugubris*	Crested kingfisher
26.	*Chloropsis cochinchnensis*	Jerdon's chloropsis
27.	*Columba livia*	Blue rock pigeon
28.	*Gracula religiosa*	Hill myna
30.	*Criniger flaveolus*	White throated bulbul
31.	*Dicaum chrysorr-heum*	Yellow-vented flower pecker
32.	*Dicrurus adsmilis*	Black drongo
33.	*Dicrurus paradiseus*	Greater racket-tailed drongo
34.	*Ducula badia*	Mountain imperial pigeon
35.	*Egretta garzetta*	Little egret
36.	*Emberiza spodocephala*	Black faced bunting
37.	*Erithacus chrysaeus*	Golden bush robin
38.	*Erithacus hyperythrus*	Rufous-bellied bush robin
39.	*Estrilda amandava*	Red munia
40.	*Falco tinuculus*	Kestrel
41.	*Francolinus gularis*	Swamp partridge
42.	Garrulax phoeniceus	Crimson-winged laughingthrush
43.	*Garrulax ruficollis*	Rufous-necked laughingthrush
44.	*Garrulax albogularis*	White-throated laughingthrush
45.	*Gorsachius melanolophus*	Tiger or Malay bittern
46.	*Heliastur indus*	Brahminy kite
47.	*Hypsipetes flavalus*	Brown cared bulbul
48.	*Ictinaeus malayansis*	Black eagle
49.	*Katupa flavipes*	Tawny fish owl
50.	*Katupa zeylensis*	Brown fish owl
51.	*Lanius cristatus*	Brown shrike
52.	*Lanius schach tricolor*	Black-headed shrike
53.	*Lanius tephronotus*	Greybacked or Tibetan shrike
54.	*Leiothrix argentauris*	Silver-earned mesia
55.	*Leiothrix lutea*	Red-billed leiothrix
56.	*Leptoptilos dubius*	Greater adjutant stork
57.	*Lonchura malacca*	Black headed munia
58.	*Lonchura puntulata*	Spotted munia
59.	*Lophura leucomelana*	Khaleej pheasant
60.	*Loriculus vernalis*	Indian lorikeet
61.	*Melophus lathami*	Crested bunting
62.	*Microhierax melanolencos*	White legged falcon
63.	*Milvus migrans*	Pariah kite
64.	*Minla cyanouroptera*	Blue winged siva
65.	*Monticola rufiventris*	Cestnut-bellied rock thrush
66.	*Anthus godlewskii*	Blyth's pipit
67.	*Nycticorax nycticorax*	Night heron
68.	*Otus scops*	Scops owl
69.	*Psittacula alexandri*	Red breasted parakeet
70.	*Psittacula cyanocephala*	Northern blossom headed parakeet
71.	*Psittacula roseate*	Assam blossom headed parakeet
72.	*Psittacula krameri*	Rose-ringed parakeet
73.	*Paradoxornis ruficeps*	Greater Red-headed parrot bill
74.	*Parus major*	Grey tit
75.	*Parus monticolus*	Green-backed tit
76.	*Passer domesticus*	House sparrow
77.	*Passer montanus*	Tree sparrow
78.	Passer rutilans	Cinnamom tree sparrow
79.	Pellorneum ruficeps	Spotted babbler
80.	*Perdicula manipurensis*	Manipur bush quail
81.	*Pericrocotus flammeus*	Scarlet minivet
82.	*Pericrocotus roseus*	Rosy minivet
83.	*Pericrocotus solaris*	Yellow throat minivet
84.	*Phalacrocorax carbo*	Great cormorant
85.	*Phoenicurus auroreus*	Daurian red start
86.	*Ploceus philippinus*	Baya weaver bird
87.	*Podiceps cristatus*	Great crested grebe
88.	Polyplectron bicalcaratum	Peacock pheasant
89.	*Psittacula eupatria*	Alexandrine parakeet
90.	*Pteruthius melanotis*	Chesnut-throated shrike babbler
91.	*Pycnonotus cafer*	Red vented bulbul
92.	*Streptopelia decaocto*	Indian ring dove
93.	*Streptopelia tranquebarica*	Red turtle dove
94.	*Sarcogyps calvus*	King vulture
95.	*Spilornis cheela*	Crested serpent eagle
96.	*Streptopelia chinensis*	Spotted dove
97.	*Streptopelia orientalis*	Oriental turtle dove
98.	*Treron curvirostra*	Thick-billed Green pigeon
99.	*Treron pompadora*	Ashy headed Green pigeon

S. No	Scientific Name	Common Name
100.	*Treron sphenura*	Wedge-tailed Green pigeon
101.	*Trichastoma abbotti*	Abbott's babbler
102.	*Turdus feai*	Fea's thrush
103.	*Turdus ruficollis ruficollis*	Red throated thrush
104.	*Upupa epops*	Hoope
105.	*Vanellus indicus*	Red wattled lapwing
106.	*Yuhina bakeri*	White napped yuhina
107.	*Zoothera citrana*	Orange headed ground thrush
108.	*Zosterops palpebrosa*	Indian white eye

Source: NEBRC, NEHU

Appendix 19
Checklist of Amphibians

Sl. No.	Species	Common Name	Family	IUCN
1.	*Chikila gaiduwani*[5]	Gaiduwan's chikila	Chikilidae	
2.	*Chikila fulleri*	Fuller's Caecilian	Chikilidae	DD
3.	*Ichthyophis alfredii*[6]	Alfred's Striped Caecilia	Ichthyophiidae	
4.	*Ichthyophis daribokensis*[6]	Daribok's Striped Caecilian	Ichthyophiidae	
5.	Ichthyophis nokrekensis[6]	Nokrek's Caecilian	Ichthyophiidae	
6.	*Ichthyophis garoensis* [2]	Garo Hills Caecilian	Ichthyophiidae	DD
7.	*Megophyrs parva*	Concave-crowned horned toad	Megophryidae	LC
8.	*Scutiger sikkimensis*	Sikkim Lazy Toad	Megophryidae	LC
9.	*Xenophrys oropedion*		Megophryidae	
10.	*Leptolalax khasiorum*[1]		Megophryidae	
11.	*Megophrys megacephala*	Big Headed Horned Frog	Megophryidae	
12.	*Bufoides kempi*	Kemp's Asian Tree Toad	Bufonidae	DD
13.	*Duttaphrynus himalayanus*	Himalayan toad	Bufonidae	LC
14.	*Duttaphrynus melanostictus*	Asian Common toad	Bufonidae	LC
15.	*Bufoides meghalayanus*	Khasi Hill Rock toad	Bufonidae	
16.	*Hyla annectens*	Indian Hylid Frog	Hylidae	
17.	*Microhyla berdmorei*	Berdmore's Chorus Frog,	Microhylidae	LC
18.	*Microhyla ornata*	Ant frog, Black throated frog	Microhylidae	LC
19.	*Kaloula pulchra*	Banded bull frog	Microhylidae	LC
20.	*Amolops marmoratus*	Afghan Frog	Ranidae	LC
21.	*Amlolops formosus*	Assam sucker frog	Ranidae	LC
22.	*Clinotarsus alticola*	Assam Hills frog	Ranidae	LC
23.	*Hylarana taipehensis*	Two-striped grass frog	Ranidae	LC
24.	*Odorrana livida*	Large-eared Rock Frog	Ranidae	DD
25.	*Hylarana daemeli*	Wood Frog	Ranidae	LC
26.	*Amolops gerbillus*		Ranidae	LC
27.	*Hylarana garoensis*	Boulenger's Garo Hill Frog	Ranidae	LC
28.	*Hydrophylax malabaricus*	Fungoid frog	Ranidae	LC
29.	*Odorrana mawphlangensis*	Mawphlang Wart Frog	Ranidae	DD
30.	*Hydrophylax leptoglossa*	Cope's Assam frog	Ranidae	LC
31.	*Amolops assamensis*	Assam Stream Frog	Ranidae	
32.	*Humerana humeralis*	Boulenger's Green Frog	Ranidae	LC
33.	*Hoplobatrachus tigerinus*	Indian bullfrog	Dicroglossidae	LC
34.	*Ombrana sikimensis*	Jerdon's Circular-flapped Frog	Dicroglossidae	LC
35.	*Euphlyctis cyanophlyctis*	Indian skipper frog	Dicroglossidae	LC
36.	*Limnonectes khasianus*	Rivulet Frog	Dicroglossidae	DD
37.	*Fejervarya limnocharis*	Assam grass frog	Dicroglossidae	LC
38.	*Limnonectes mawlyndipi*	Mawlindip Frog	Dicroglossidae	DD
39.	*Fejervarya sengupti*		Dicroglossidae	
40.	*Fejervarya teraiensis*	Terai wart frog	Dicroglossidae	LC
41.	*Fejervarya pierrei*	Pierrie's cricket frog	Dicroglossidae	LC
42.	*Theloderma andersoni*	Tubercled Small Treefrog	Rhacophoridae	LC
43.	*Chiromantis cherrapunjiae*	Cherrapunjee bush frog	Rhacophoridae	DD
44.	*Philautus garo*	Garo Hills Bubble-nest Frog	Rhacophoridae	VU
45.	*Philautus kempiae*	Kemp's bush frog	Rhacophoridae	DD
46.	*Raorchestes shillongensis*	Shillong bush frog	Rhacophoridae	CR
47.	*Polypedates leucomystax*	Common tree frog	Rhacophoridae	LC
48.	*Rhacophorus bipunctatus*	Double-spotted red-webbed tree frog	Rhacophoridae	LC
49.	*Rhacophorus maximus*	White-lipped Treefrog	Rhacophoridae	LC
50.	*Chiromantis cherrapunjiae*	Cherrapunjee bush frog	Rhacophoridae	DD
51.	*Feihyla vittata*	Lateral-striped Opposite-fingered Treefrog	Rhacophoridae	LC
52.	*Nasutixalus jerdonii*[3]	Jerdon's Bush Frog	Rhacophoridae	DD
53.	*Polypedates teraiensis*	Terai tree frog	Rhacophoridae	
54.	*Rhacophorus rhodopus*	Red-webbed Flying Frog	Rhacophoridae	
55.	*Theloderma asperum*	Vietnamese Mossy Frog	Rhacophoridae	LC

DD: Data Deficient, LC: Least Concern, VU: Vulnerabale, ER: Endangered, CR: Critically Endangered, NE: Not Evaluated

Mathew 1995, [1] Das *et al.* 2010, [2]Pillai & Ravichandran 1999, [3]Biju *et al.* 2016, [4]Pillai and Chanda 1973, [5]Kamei *et al.* 2013, [6]Mathew and Sen 2009

Appendix 20
Checklist of Reptiles form Meghalaya

Sl. No.	Species	Common Name	Family	IUCN
		Snakes		
1.	*Indotyphlops braminus*	Brahminy blind snake*	Typhlopidae	NE
2.	*Typhlops diardii*	Diard's blindsnake*	Typhlopidae	LC
3.	*Indotyphlops jerdoni*	Jerdon's worm snake*	Typhlopidae	NE
4.	*Indotyphlops tenuicollis*	Samagutin worm snake*	Typhlopidae	DD
5.	*Python bivittatus*	Burmese python[$]	Pythonoidea	VU
6.	*Liopeltis frenatus*	Günther's reed snake*	Colubridae	LC
7.	*Calamaria pavimentata*	Collared reed snake*	Colubridae	LC
8.	*Ptyas korros*	Indo-Chinese rat snake*	Colubridae	NE
9.	*Ptyas mucosa*	Oriental rat snake[$]	Colubridae	NE
10.	*Oligodon albocinctus*	Light-barred kukri snake*	Colubridae	LC
11.	*Oligodon cyclurus*	Cantor's kukri snake*	Colubridae	LC
12.	*Oligodon dorsalis*	Gray's kukri snake*	Colubridae	NE
13.	*Oligodon theobaldi*	Theobald's kukri snake*	Colubridae	LC
14.	*Oligodon cinereus*	Günther's kukri snake*	Colubridae	LC
15.	*Boiga cyanea*	Green cat snake*	Colubridae	NE
16.	*Blythia reticulata*	Blyth's reticulate snake, iridescent snake*	Colubridae	DD
17.	*Boiga gokool*	Common cat snake, Indian gamma snake*	Colubridae	NE
18.	*Boiga siamensis*	Gray cat snake[$]	Colubridae	NE
19.	*Chrysopelea ornata*	Ornate flying snake, golden flying snake*	Colubridae	NE
20.	*Orthriophis hodgsoni*	Hodgson's Ratsnake*	Colubridae	NE
21.	*Orthriophis cantoris*	Cantor's ratsnake*	Colubridae	NE
22.	*Rhabdophs bicolor*	Yellow-bellied forest snake	Colubridae	NE
23.	*Oreocryptophis porphyracea*	Black-banded trinket snake*	Colubridae	NE
24.	*Coelognathus radiata*	Copperhead rat snake*	Colubridae	LC
25.	*Lycodon jara*	Twin spotted wolf snake*	Colubridae	LC
26.	*Dendrelaphis proarchos*	Eastern bronzeback[$]	Colubridae	NE
27.	*Dendrelaphis cyanochloris*	Wall's bronzeback$	Colubridae	LC
28.	*Dendrelaphis gorei*	Eastern Himalayan Bronze-brown Snake[$]	Colubridae	LC
29.	*Lycodon aulicus*	Indian wolf snake[$]	Colubridae	NE
30.	*Lycodon zawi*	Zaw's wolf snake[$]	Colubridae	LC
31.	*Lycodon fusciatus*	Banded wolf snake[$]	Colubridae	NE
32.	*Sibynophis collaris*	Collared black-headed snake*	Colubridae	LC
33.	*Orthriophis taeniurus*	Beauty snake[$]	Colubridae	NE
34.	*Ahaetulla prasina*	Gunther's whip snake[$]	Colubridae	LC
35.	*Bungarus faciatus*	Banded krait*	Elapidae	LC
36.	*Sinomicrurus macclellandi*	Mac Clelland's coral snake*	Elapidae	NE
37.	*Naja kaouthia*	Monocledcobra*	Elapidae	LC
38.	*Ophiophagus hannah*	King cobra*	Elapidae	VU
39.	*Bungarus bungaroides*	Northeastern hill krait*	Elapidae	NE
40.	*Bungarus niger*	Greater black krait*	Elapidae	NE
41.	*Ovophis monticola*	Mountain pit viper*	Viperidae	LC
42.	*Protobothrops jerdonii*	Jerdon's pit viper*	Viperidae	LC
43.	*Trimeresurus stejnegeri*	Stejneger's pit viper*	Viperidae	LC
44.	*Trimeresurus erythrurus*	Red-tailed bamboo pit viper*	Viperidae	LC
45.	*Trimeresurus albolabris*	White-lipped pit viper*	Viperidae	LC
46.	*Trimeresurus popeorum*	Pope's green pit viper*	Viperidae	LC
47.	*Trimeresurus gumprechti*	Gumprecht's green pitviper[$]	Viperidae	LC
48.	*Amphiesma khasiensis*	Khasi Hills keelback*	Natricidae	NE
49.	*Amphiesma parallela*	Yunnan keelback*	Natricidae	NE
50.	*Amphiesma modestum*	Modest keelback*	Natricidae	LC
51.	*Amphiesm stolatum*	Striped Keel-back*	Natricidae	NE
52.	*Amphiesma platyceps*	Himalayan keelback*	Natricidae	NE
53.	*Amphiesma xenura*	Cherrapunjee Keelback keelback*	Natricidae	DD
54.	Xenochrophis cerasogaster	Painted keelback*	Natricidae	LC
55.	*Trachischium monticola*	Mountain worm-eating snake*	Natricidae	NE
56.	*Xenochrophis piscator*	Checkered keelback*	Natricidae	NE
57.	*Rhadinophis frenata*	Green trinket snake*	Natricidae	NE
58.	*Rhadinophis prasinus*	Green bush rat snake*	Natricidae	LC
59.	*Rhabdophis himalayana*	Orange-collared keelback*	Natricidae	NE
60.	*Rhabdophis subminiatus*	Red-necked keelback*	Natricidae	LC
61.	*Pareas monticola*	Common slug snake*	Pareatidae	NE
62.	*Psammodynastes pulverulentus*	Common mock viper*	Lamprophiidae	NE
63.	*Enhydris enhydris*	Rainbow water snake[$]	Homalopsidae	LC
64.	*Pseudoxenodon macrops*	Large-eyed bamboo snake*	Pseudoxenodontidae	LC
65.	*Stoliczkia khasiensis*	Khasi red snake*	Xenodermatidae	NE

Sl. No.	Species	Common Name	Family	IUCN
		Lizards		
1.	*Cyrtodactylus khasiensis*	Khasi Hills bent-toed gecko*	Gekkonidae	NE
2.	*Hemidactylus platyurus*	Flat-tailed house gecko*	Gekkonidae	LC
3.	*Hemidactylus frenatus*	Common house gecko*	Gekkonidae	LC
4.	*Hemidactylus brooki*	Brooke's house gecko*	Gekkonidae	NE
5.	*Gekko gecko*	Tokay gecko*	Gekkonidae	NE
6.	*Cnemaspis assamensis*	Assamese day gekko[$]	Gekkonidae	NE
7.	*Hemidactylus garnoti*	Indo-Pacific gecko[$]	Gekkonidae	NE
8.	*Ptyctolaemus gularis*	Green fan-throated lizard*	Agamidae	EN
9.	*Calotes jerdoni*	Indo-Chinese forest lizard*	Agamidae	DD
10.	*Calotes emma*	Emma Gray's forest lizard*	Agamidae	NE
11.	*Calotes versicolor*	Oriental garden lizard*	Agamidae	NE
12.	*Calotes maria*	Khasi Hills forest lizard*	Agamidae	NE
13.	*Oriocalotes paulus*	Small forest lizard*	Agamidae	NT
14.	*Japalura planidorsata*	Smooth-scaled mountain lizard*	Agamidae	VU
15.	*Lygosoma albopunctata*	White-spotted supple skink[$]	Scincidae	NE
16.	*Sphenomorphus apalpebratus@*		Scincidae	NE
17.	*Sphenomorphus indicus*	Indian forest skink*	Scincidae	NE
18.	*Sphenomorphus maculatus*	Stream-side skink*	Scincidae	NE
19.	*Eutropis carinata*	Keeled Indian Mabuya*	Scincidae	LC
20.	*Eutropis macularia*	Bronze mabuya*	Scincidae	NE
21.	*Eutropis multifasciata*	Many-lined sun skink*	Scincidae	NE
22.	*Takydromus khasiensis*	Java grass lizard, Khasi Hills long-tailed lizard*	Lacertidae	EN
23.	*Takydromus sexlineatus sexlineatus*	Asian grass lizard*	Lacertidae	LC
24.	*Ophisaurus gracilis*	Burmese glass lizard*	Anguidae	NT
25.	*Varanus bengalensis*	Bengal monitor*	Varanidae	LC
26.	*Varanus salvator*	Water monitor*	Varanidae	LC
27.	*Varanus flavescens*	Yellow monitor or golden monitor*	Varanidae	LC
		Turtles and tortoises		
1.	*Cyclemys gemeli*	Asian leaf turtle*#	Bataguridae	NE
2.	*Cuora mouhotii*	Keeled box turtle*#	Bataguridae	EN
3.	*Geoclemys hamiltoni*	Black pond turtle*#	Bataguridae	VU
4.	*Hardella thurjii*	Crowned river turtle*#	Bataguridae	VU
5.	*Batagur dhongoka*	Three-striped roofed turtle*	Bataguridae	EN
6.	*Pangshura sylhetensis*	Assam roofed turtle*#	Bataguridae	EN
7.	*Pangshura tecta*	Indian roofed turtle*	Bataguridae	LC
8.	*Melanochelys tricarinata*	Three-keeled land tortoise*	Bataguridae	VU
9.	*Melanochelys trijuga*	Indian black turtle#	Bataguridae	NT
10.	*Indotestudo elongata*	Elongated tortoise*#	Testudinidae	EN
11.	*Manouria emys*	Asian forest tortoise*#	Testudinidae	EN
12.	*Lissemys punctata*	Indian flapshell turtle*#	Trionychidae	LC
13.	*Nilssonia hurum*	Indian peacock softshell turtle*	Trionychidae	VU

*Mathew 1995, Mathew 1983, [#]Ahmed & Das 2010, [$]Personal communication Dr. Abhijit Das, [@]Datta-Roy *et al.*2013

Appendix 21
Threatened Mammalian Fauna of Meghalaya

S.No	Scientific name	Common name	Status
1.	*Ailurus fulgens*	Red Panda	Endangered
2.	*Aonyx cinerea concolor*	Oriental Small Clawed Otter	Vulnerable
3.	*Arctictuis binturong*	Binturong	Endangered
4.	*Arctonyx collaris*	Hog Badger	Data Deficient
5.	*Belomys pearsoni*	Small Flying Squirrel	Vulnerable
6.	*Bos gaurus*	Gaur	Vulnerable
7.	*Bubalus bubalis*	Water Buffalo	Endangered
8.	*Capricornis sumatraensis*	Serow	Vulnerable
9.	*Cervus duvaucelli*	Swamp Deer	Vulnerable
10.	*Elephus maximus indicus*	Asiatic Elephant	Vulnerable
11.	*Felis bengalensis bengalensis*	Leopard Cat	Vulnerable
12.	*Felis temmincki*	Golden Cat	Endangered
13.	*Helarctos malayanus*	Malayan Sun Bear	Endangered
14.	*Hylobates hoolock*	Hoolock Gibbon	Endangered
15.	*Hylopetes alboniger alboniger*	Particoloured Flying Squirrel	Vulnerable
16.	*Macaca articodes*	Stumptail Macaque	Vulnerable
17.	*Macaca nemestrina*	Pigtail Macaque	Vulnerable
18.	*Manis pentadactyla aurita*	Indian Pangolin	Data Deficient
19.	*Martes falvigula falvigula*	Yellow Throated Marten	Vulnerable
20.	*Melogale personata nepalensis*	Ferret Badger	Vulnerable
21.	*Mustela kathiah*	Weasel	Vulnerable
22.	*Neofelis nebulosa*	Clouded Leopard	Endangered
23.	*Nycticebus coucang bengalensis*	Slow Loris	Data Deficient
24.	*Paguma larvata neglecta*	Himalayan Palm Civet	Vulnerable
25.	*Panthera pardus fusca*	Leopard	Vulnerable
26.	*Panthera tigris tigris*	Tiger	Vulnerable
27.	*Paradoxurus hermaphroditus*	Palm Civet	Vulnerable
28.	*Pardofelis marmorata (Felis marmorata)*	Marbled Cat	Endangered
29.	*Petaurista alborufous candidulus*	Wroughton's Flying Squirell	Vulnerable
30.	*Petaurista magnifucus*	Hodgson's Flying Squirrel	Vulnerable
31.	*Petaurista petaurista*	Giant Flying Squirrel	Vulnerable
32.	*Presbytis pileatus*	Capped Langur	Vulnerable
33.	Tetraceros quadricornis	Fourhorned Antelope	Vulnerable
34.	*Viverra zibetha zibetha*	Large Civet	Vulnerable
35.	*Viverricula indica*	Small Indian Civet	Vulnerable

Source: ZSI, Shillong

Appendix 22

BioFin Expenditure according to Schemes (calculated according to Rio Markers).
Categories: 1. Sectoral mainstreaming, 2. Restoration, 3. Protection, 4. Enhancing Implementation, 5. Access and Benefit sharing, 6. Natural resource use, 7. Others

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
		Peripheral Departments						
1	Land Revenue Land Ceilings	Creation of Website for DisasterManagement.	4	1,3	12	17	20	20
2		Training on Disaster Management.	4	3	113	280	429	464
3		Establishment of Libraries.	4	1	20	6	6	6
4		Human Resource Support in Disaster Management	4	3	49	40	114	143
5		Construction of Ayurvedic/ Homeopathic Dispensaries etc.	4,6	3	0	0	1,060	150
6	Department of Urban Development	Urban Infrastructure & Governance (JNNURM)	4	0	0	1745	4,316	5,958
7	Education Sports & Youth Affairs	Establishment for Textbooks Cum reference book section	4	1	16	11	14	16
8		Promotion of science	4	1	0	132	1196	120
9		Improvement of College Libraries	4	1	4	0	0	0
10		Youth Green Campaign Movement	4	1	0	5,000	10,000	2,000
11		Adventure programme	4	1	8	16	8	0
12		N.SS Implementation of regular NSS activities	4	1	64	81	100	99
13		Holding of District & State Level Exhibition Fairs	4	1	0	0	0	110
14		Production of folk literature	4	1	2	2	2	2
15		State Sahitya Academy	4	0	0	0	0	8
16		Heritage Protection EW&R Dist/Ew&S Garo/Jaintia Hill	4	1	31	0	0	0
17		Establishment of State Archive	4	1	339	427	406	395
18		Strengthening and Development of State Archives	4	1	0	0	192	0
19		Development of State Archives	4	1	0	0	1066	0
20	Education Sports & Youth Affairs and Arts and Culture Department	District Library at Tura	4	1	0	317	288	406
21		District Library at Jowai	4	1	0	450	433	608
22		State Central Library Shillong	4	1	1739	1589	1730	1912
23		District Library at Nongstoin	4	1	190	199	180	215
24		District Library at Williamnagar	4	1	397	254	313	293
25		Raj Ram Mohan Roy Library foundation	4	1	15	15	30	30
26		District Library at Nongpoh	4	1	199	202	214	241
27		District Library at Baghmara	4	1	206	205	225	127
28		State museum and Archives	4	1,9	566	629	774	674
29		District Museum at Tura	4	1,9	474	473	556	738
30		District Museum at Jowai.	4	1,9	70	98	121	117
31		District Research office Tura/Shillong	4	1	5	11	6	11
32		Educational Research and Survey in Rural Areas	4	1	0	0	163	0
33		Research and Documentation inKhasi/Jaintia/Garo	4	1,9	0	0	46	0
34		Incentive Art and Culture DevelopmentProgramme	4	1	297	300	300	300
35		International Centre for performingArts and Culture Shillong.	4	1	0	0	0	10896
36		Tribal Research Institute Shillong.	4	1,9	52	54	61	76
37	Public Relations Department	Directorate of Information and PublicRelation	4,7	1	0	0	513	608
38		Rural Broadcasting and Public AddressSystem	4	1	0	0	23	17
39		Field Publicity and Information Centers		1	0	0	19	14

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
40		Science Technology and EnvironmentCouncil	1	1	1300	1300	1500	2363
41		S & T Entrepreneurship Programme	1	5	75	0	92	0
42		Science Centre	1	1	360	900	549	689
43		Bio-Resources Development	1	7	4640	5200	5200	3356
44		Climate Change Management	1,2,4	4	80000	1600	16000	8000
45	Planning Department	Integrated Basin Development Project cum Livelihood Programme	5	5	100000	75000	50000	50000
46		Institute of Entrepreneurship	1	5	22500	750	1500	1500
47		Mission under the Integrated Basin & Livelihood Development Programme	1	5	60150	56340	45000	7500
48		Institute of Natural Resources	6	7	7500	750	7500	750
49		Promotion of Bio-Technology	7	12	0	40	400	200
50		Promotion of a Regional Centre for Science & Technology	7	1,12	0	100	372	0
51	Co-Operation Department	Assistance to Cooperative Union undertaking Co-operative Education programme	1,4	1	98	70	70	100
52		Share Capital Contribution to Livestock Coops.	6	8	504	906	1057	585
53		Share Capital Contribution processing for Tea/Cashewnut etc.	6	8	375	317	0	0
54		Share Capital Contribution to Fishery Co-operative Societies	6	7	1750	2948	3159	0
55		Share Capital Contribution to Tourism Cooperative Societies	1,4	5	9090	0	776	450
56	Schemes Under North-Eastern Council	Seed Testing Laboratories	4,7	0	0	0	0	4661
57		Project on Horticulture Development at Nokrek Region East Garo Hills	4	5,7	0	2376	0	0
58		Lemon Cultivation	6	7	0	1401	0	0
59		Integrated Development of Muga Seed Project	6	5,7	525	0	0	0
60		Don Bosco Community Information Centre	4	1	0	1500	450	0
61		Capacity building for Service Providers in Tourism Sector	4	5	362	0	0	0
62		Improvement of Marngar Lake at Marngar Village Ri-Bhoi District	4	4	4533	0	0	0
63	Economic Advice And Statistics (Planning Department)	State Statistics Organizations	4,6	0	25615	0	0	32163
64		Improvement Primary Statistics including Agriculture C.D. Statistics and other Primary Statistics	4	0	8	0	0	12
65		Agricultural Statistic Division-	4	0	49	0	0	69
66	Agriculture And Allied Services	Directorate of Agriculture.	7	7	5373	5031	6267	6111
67		Directorate of Horticulture	7	7	1907	0	2234	1494
68		Scheme for Intensive Agriculture in selected areas	6	7	1094	1058	1183	1296
69		Setting up of the Seed Testing Laboratory in Meghalaya	6	7	0	0	150	0
70		Upper Shillong Farm	4	7	43	53	69	71
71		Local green manure and rural composts composition	4	7	15	76	17	21
72		Soil Testing Laboratory	4,6	7	1074	1252	1071	1173
73		State Soil Survey Organization	4	0	0	331	359	408
74		Bio- Control Laboratory	6	7	367	224	372	383
75		Development of arecanut and betel leaves including jute cotton and sugarcane for sale at subsidized rate	3	7	412	879	165	179
76		Development of Ginger and Turmeric including Sale of Plants at subsidized rates	6	7	114	152	59	160

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
77		Potato Development including sale of seeds at subsidized rate	6	7	2102	2371	2355	2691
78		Experimental Tea Plantation	4	7	306	249	196	192
79		Regional Centre for Training & Production of Mushrooms-	4	7	663	647	694	657
80		National Mission on Oilseeds and Oil Palm	4	7	0	0	0	749
81		Plantation Crops Development (Arecanut/Cashewnut/Coconut/Pineapple/Bamboo/Agar	6	7	0	0	4461	1946
82		Spices Development (Ginger/Turmeric/Large Cardamom/ Black Pepper)	6	7	1485	1039	1500	1922
83		Tuber Crops Development (Potato/Tapioca/Colocasia)	6	7	6143	6122	6317	6805
84		Regional Centre for Training and Production of Mushroom	6	7	455	496	613	487
85		Indigenous Crops Development	2	8	2421	3117	3025	0
86		Winter Cropping and Dev. of Cultivable land	6	7	4840	5603	2146	1435
87		Maize Development through cluster approach	6	7	3099	3711	3549	827
88		Organic Manure	6	7	18	0	1081	1109
89		Tea Development Scheme	4	7	282	246	358	262
90		Integrated Farming in Micro Watershed		7	0	0	1245	0
91		State Rice Mission	4	7	0	1350	14980	3000
92		Farmer's Institute		7	2907	2679	3016	2902
93		Demonstration in cultivator's field	4	7	106	92	86	98
94		Basic Agricultural Training Centre	4	7	297	331	357	375
95		Agri. Information Units (Hort.)	4	7	60	67	70	40
96		Capacity building of the Departmental Personnel(Hort.)		1	0	10	10	54
97		Terra Madre Conference	4	1	0	112	435	0
98		Training of Educated Rural Youth for Promotion of Self Employment Through Farm Based Activities (TERYPSEFA)	4	1	0	0	64	0
99		Land use Survey.	4	0	249	230	279	263
100		Implementation of E-Governance(Agri.)	4	7	36	36	40	28
101		Implementation of E-Governance (Hort.)	4	7	10	5	6	7
102		Vegetable development including sale of vegetable sed rates-	6	7	953	314	341	330
103		Shillong fruit Garden	4,6	7	562	505	458	503
104		Development in Horticulture including sale of fruit- etc. at subsidized rates	6	7	6846	6725	6939	7495
105		Establishment of regional Progeny Orchard cum Horticulture Nursery for Sub-Tropical Fruits(Mynkre)	6	7	340	273	266	302
106		Vegetable Development Scheme	6	7	548	605	545	248
107		Development and Maintenance of Orchard-cum-Horticulture Nurseries	6	7	11718	13395	13609	11039
108		Fruits Development	6	7	0	2175	2486	1074
109		Floriculture Development	6	7	4185	3595	5268	973
110		Development of Strawberry Cultivation	7	7	89	277	100	53
111		Horticulture Mission under Integrated Basin Development Programme 2012-2013	1,6	7	0	430	5065	0
112		Vegetable Garden	6	7	0	544	617	835
113		Maintenance of Horti-Hubs		7	0	1501	2386	1243
114		Central Assistance for C.S.S (Hort.)	4,6	7	0	0	0	41396
115		Special Plan Assistance (Hort.)		7	0	0	6750	0
116		State Share against Central Schemes (Hort.)		7	0	0	0	188
117		Special Central Assistance (Mission Organic-Hort.)		7	0	0	0	34500
118		National Food Security Mission	4,6	7	0	0	0	14437
119		Special sub-project strengthening Agriculture Extension in North Eastern States	6	7	0	0	0	6109
120		Support to State extension Programmes for extension reform.	6	7	0	0	0	10598
121		National Mission for Sustainable Agriculture (NMSA)	4	7	0	0	0	7459

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
122		Fruit Research Station	4,6	7	364	441	337	374
123		Agricultural Research Stations and Laboratories	4,6	7	4021	4516	4903	5051
124		Research project on rice	7	7	168	150	181	185
125		Flood Management and River Training Works	3	4	675	5600	626	0
126		Miscellaneous Training Programme	4	4	1	0	0	0
127		Provision for awareness Education & Knowledge in Water Resources	4	4	63	15	30	2
128		Repair Renovation & Restoration of Water Bodies	7	4	7500	0	0	0
129		Promotion of Water User Efficiency	6	4	450	73	0	0
130		Water Quality Management in Water Resources	4	4	42	2	0	0
131		Integrated Development of Water Resources	6	4	115000	160750	0	2500
132		Water Harvesting	6	4	25000	0	4700	910
133		Climate change study & adaptation for the water resources sector including infrastructures and procurement of equipment	4	4	0	1500	162	0
134		Water Resource Development Agency	6	4	0	1000	2500	0
135		Accelerated Irrigation Benefits Programme	6	4	565523	600000	0	0
136	Soil And Water Conservation	Directorate of Soil Conservation	7	3	3410	3256	3683	3826
137		Divisional Soil Conservation Offices	7	3	12655	11378	13258	16521
138		Soil Conservation Range Offices	7	3	15266	14107	14714	16466
139		Project formulation Cell	7		2120	2165	2138	2503
140		Establishment of Evaluation Units	7		273	278	313	35
141		Cash Crop Division	6	7	27813	26258	28776	30981
142		Watershed Management Division	6	3	15677	14667	16069	16005
143		Soil Conservation Survey Schemes	4	3	943	863	1022	1128
144		Soil Testing Works	4		132	1006	160	163
145		Erosion Control Works	6	3	62	3789	814	455
146		Afforestation	2,6	3	601	504	723	5146
147		Water Conservation and Distribution Works	6	3	47	3777	292	42
148		Cash Crop Development Works	4	7	4100	5163	6641	8750
149		Conservation Works*in Urban Area	3	3	7	744	1923	9
150		Water Harvesting Works/Farm Ponds etc.	6	4	50	3708	250	107
151		Integrated Watershed Management Programme (IWMP)	1,6	4	11436	37499	0	334432
152		Conservation Training Institute	4	3	5156	4653	5718	7261
153		Training at Soil Conservation Centers	4	3	7674	7029	7925	7246
154		Extension Programmes and Information Services	4		55	48	53	71
155		Jhum Control Schemes	2	3	9406	9161	9555	10024
156		Watershed Management	6	4	1194	1176	826	1246
157		Commercial Crops Development Board	1,6	7	17322	2800	2800	4000
158		Soil Conservation scheme under NABARD Loan.	6	3	50721	60000	100902	68129
159		Integrated Wasteland Development Programme	2	4	142262	55029	11459	1495
160		Accelerated Irrigation Benefits Programme (AIBP)	4	4	94249	0	67125	0
161		Integrated Watershed Management Programme (IWMP) (State Share)	1,6	4	11436	37499	26482	0
162		Repair Renovation & Restoration of Water Bodies	6	4	0	0	0	0
163		Soil Conservation Research Centre	4	3	560	600	606	599
164	Animal Husbandry And Veterinary Department	Directorate of Animal Husbandry and Veterinary	4,7	7	3304	3438	3789	3874
165		District Offices	4,7		4039	4000	2740	7858

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
166		Sub-Divisional Offices	4,7		7473	7571	5404	5139
167		Veterinary Information Unit	4	7	1869	2080	2467	2890
168		Meghalaya State Fodder and Dairy Development Board	6	7	376	302	622	452
169		State Veterinary Council	4,7	7	15	0	0	0
170		Meghalaya State Livestock Mission under the Integrated Basin Development & Livelihood Programme	1,4,6	7	0	0	8000	0
171		Veterinary Hospitals and Dispensaries	4	7	1096	572	303	266
172		Veterinary Dispensary taken from C.D.Blocks	4	7	855	876	1004	1130
173		Mobile Veterinary Dispensary	4	7	479	446	484	511
174		Veterinary Aid Centers	4	7	570	628	702	751
175		Vigilance Unit	4	7	226	230	313	353
176		Rinderpest surveillance Containment Vaccination Programme	3	7	5662	5869	6466	7147
177		Animal Disease Surveillance	3	7	762	1055	925	896
178		Systematic Control of Livestock Disease of National Importance	4	7	27	33	34	35
179		Assistance to State for Control of Animal Diseases (ASCAD).	4	7	7	0	0	0
180		Extension of Vet. Aid Services	4	7	0	4	0	0
181		Scheme for establishment of new dispensaries under NABARD Loan	4,3	7	233	29	580	746
182		Veterinary Dispensaries	4,3	7	90	747	1175	1278
183		State Contribution for establishment of new Dispensaries under NABARD Loan	4,3	7	0	131	172	3
184		Livestock Inspectors Offices	4,3	7	261	255	330	320
185		Key Village Scheme	4,3	7	1931	1735	1945	2015
186		Cross Breeding Schemes	4,3	7	564	569	594	642
187		Intensive Cattle Development Project	4,3	7	7179	7549	8415	8555
188		Indo-Danish Project	4,3	7	1830	1890	2025	2075
189		Bull/Calf Rearing Farm and Breeding Centre	4,3	7	531	551	588	412
190		Livestock Farms Garo Hills	4,3	7	908	948	1066	1017
191		Cross Breed Cattle Breeding Project Kyrdemkulai /Jowai	4,3	7	1122	1219	1274	1200
192		Cattle Farm Jaintia Hills	4,3	7	890	829	896	928
193		Bufallo Farm Garo Hills	4,3	7	236	218	243	240
194		Poultry Farm Tura/Jowai	4,3	7	997	974	1239	1075
195		Poultry Farm Bhoi	4,3	7	899	1054	1216	1125
196		Poultry Farm Mawryngkneng	4,3	7	300	357	382	459
197		Central Hatchery and Chick Rearing Farm Bhoi/Garo/Jowai	4,6	7	633	647	709	749
198		Poultry Farm Nongstoin	4,6	7	292	283	323	292
199		Poultry Farm Simsangiri/Williamnagar	4,6	7	379	427	404	319
200		Regional Poultry Breeding Farm Kyrdemkulai	4,6	7	2802	1856	2312	2124
201		Poultry Farm Mairang	4,6	7	219	219	330	200
202		Poultry Farm Phulbari/Williamnagar	4,6	7	159	157	165	193
203		Poultry Development Programme under SLPP	4,6	7	640	702	842	845
204		Broiler Farm Kyrdemkulai	4,6	7	227	255	287	270
205		Distribution of Poultry Unit	4,6	7	176	326	326	0
206		Poultry Farm Baghmara	4,6	7	159	241	233	199
207		Broiler Farm (Assanangre)	4,6	7	286	290	349	308
208		Poultry Breeding Farm Nongpiur	4,6	7	300	59	212	101
209		Sheep & Goat Farm	4,6	7	341	354	365	392
210		Sheep Extension Unit	4,6	7	53	50	76	70

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
211		Sheep & Goat Farm Khasi Hills	4,6	7	173	206	186	187
212		Rabbit Farm Nongpiur	4,6	7	14	18	17	16
213		Pig Farm Mawryngkneng	4,6	7	490	508	569	562
214		Pig Farm Tura/Rongjeng	4,6	7	731	614	638	681
215		Pig Farm Jowai	4,6	7	333	328	673	549
216		Pig FarmNongstoin	4,6	7	279	266	286	294
217		Pig FarmBaghmara	4,6	7	261	223	232	263
218		Piggery Production under S.L.P.P	4,6	7	1738	1936	1810	1854
219		Distribution of Piggery Unit	4,6	7	180	330	330	0
220		Pig Farm Mairang	4,6	7	177	199	221	210
221		Pig Farm Dalu	4,6	7	422	390	442	437
222		Regional Pig Breeding Farm Kyrdemkulai	4,6	7	1285	1410	1757	1195
223		Pig Farm Pynursla	4,6	7	428	449	503	550
224		Pig Farm Sohra	4,6	7	81	113	158	94
225		Rural Cluster approach on Piggery Development	4,6	7	0	0	135	0
226		Pig Breeding Farm West Garo Hills	4,6	7	0	31	106	55
227		Pig Breeding Farm West Khasi Hills	4,6	7	127	184	167	154
228		Establishment Pig Breeding Farm Nongpyiur	4,6	7	154	160	300	160
229		Assistance to Self Help Group Societies on Pig Farming	4,5	7	600	600	600	0
230		Livestock Census Office	4	7	94	92	107	120
231		State Vet. Council	4,7	7	5	0	17	48
232	Fisheries Department	Directorate Office	4		311	312	352	348
233		District office	4		662	643	781	882
234		Induced Breeding Centers	6	7	720	593	475	703
235		Fish Farming Centers	6	7	931	840	1007	1090
236		Survey and Engineering Wing for Fisheries	6	7	428	427	459	661
237		Fish seed Production and Demonstration Centre	3	7	8297	9473	10208	9230
238		Development of Reservoir and Lakes	3	7,4	3902	3867	4285	4335
239		Conservation and Legislation for protection of fish	6	7	14973	15166	17632	16949
240		Trout Culture	6	7	1194	937	1219	1315
241		Regional Fish Seed Farm Jamgei	6	7	1162	1166	1387	1659
242		Reclamation of Bheel Fisheries	6	7,4	1097	1175	1320	1044
243		State Aquaculture Mission	4,6	7,4	0	73943	151114	30482
244		Extension	4,6	7	1653	1361	1430	1635
245	Industries (Sericulture and Weaving) Department	Muga farm Centers and block plantation including Tassar.	6	7	5824	5799	7005	7029
246	Industries Department	Apiculture Mission under IBDP	6	7	0	21040	7947	1396
247	Transport (Tourism) Department	Development of Tourist Spots	4,7	3	26624	0	59638	22690
248		Production of Documentary Film on Meghalaya	4		2758	0	0	0
249		Improvement works at Nartiang village and Syndai Cave	2, 3	4	104	0	115	208
250		13th Finance Commission Award Development of caves	2, 3	4	6250	0	0	0
251	Forest Department	Headquarters Organization	4		19384	23974	24527	30273
252		Forest Utilization Office	4	7	1735	2279	2630	3835
253		Divisional Forest Officer	3,4	4	12003	12329	15769	25699
254		Forest ranges and beat offices	3,4	4	49922	44744	49716	39212
255		Strengthening of Staff in District Councils	4	4	800	911	960	960
256		Integrated Forest Villages Development	4	4,7	30	28	30	30

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
257		Sports (All India Forest Sports Meet at Chennai)	7		18	1	1	0
258		Payment due to MESEB /Municipal						
		Board/Telephone Bills (BSNL)	4		93	89	93	105
259		Twelfth /Thirteenth Finance Commission						
		Award for maintenance of Forests	3,4	7	31581	0	157700	177333
260		Expenditure of Chairman/Dy. Chairman / Vice						
		Chairman (Meghalaya Forest Dev. Corp.)	4		1332	1045	1455	1067
261		Studies and Training in Forest Colleges	4	7	1859	4039	3901	1116
262		Studies & Training in Forest School	4	7	5580	5711	6264	5339
263		Mass Education and Cultural Operation for preservation of Forest	4	1,4	555	592	731	650
264		Forest Resources Survey Division	4		4437	4321	4690	5206
265		Demarcation and consolidation (excluding extension) of Forest	3	7,4	685	806	804	623
266		Working Plan Division	4,7	4,7	6464	7005	7973	8585
267		Statistical Planning and Evaluation Unit	4	4,7	585	663	609	450
268		Roads and Bridges	3		362	800	756	484
269		Construction and maintenance of Departmental buildings	4		784	2100	1825	3631
270		Establishment of Parks and Botanical gardens	6	4,7	4029	3895	4311	3158
271		Timber Treatment and Seasoning Plant	6	7	489	458	615	879
272		Silviculture Works (Regeneration)	2	4,7	67	67	198	95
273		Setting up of Corporation and Project						
		Formulation Cell for Development of Forest	4	7	672	609	622	0
274		Forest Protection Schemes and works	3	4	51277	49128	55162	52003
275		Conservation of Orchids and Multiplication Project	2,4	4, 8	998	1289	2220	2072
276		Provision for deputed Forest Staff to District Councils and Meghalaya Forest Authority	4		1110	235	100	50
277		Forest Nurseries	2,6	4,7	6551	7036	7476	5924
278		Expenditure on Environmental Forestry and Vonomohotsava	2,6	1	7425	2873	3687	3570
279		Recreation Forestry	7	7	3565	3205	4538	3818
280		Social Forestry	2,6	3, 11	80083	81972	89717	101509
281		Umbrella Project/Ecological Sohra						
		Restoration Project	2	3	5815	6121	6229	5610
282		Teak wood Plantations	2	7	2722	2611	3710	3641
283		Plywood Plantations	2	7	4211	4679	7390	5777
284		Salwood Plantations	2	7	2212	2858	3102	4025
285		Plantation of quick growing species	2	7	5046	5650	5638	5506
286		Plantation of Medicinal Plants	2	7,8	7942	8524	7686	8551
287		Miscellaneous Afforestation Schemes	2	3	3013	3115	4096	11497
288		Preservation/Protection of Sacred Groves	3	4	0	0	150	0
289		Afforestation of critical catchment Areas	2	3	1446	11216	10921	0
290		Operation Soil Watch	4	4	2081	2076	2311	2036
291		Afforestation of Plan catchment area of Umiam Hydro Electric Project	2	3,4	3290	3457	3792	4046
292		Afforestation of catchment area of Kopili Hydro Electric project	2	3,4	2495	3061	2473	88
293		Ecological Restoration of Cherrapunjee	2	3,4	1378	1515	1519	1954
294		Forestry Mission under the IBDP	2	3,4	0	9998	9993	9998
295		Removal of Forest Produces by Government Agency	3	7	321	132	350	193
296		Removal of Forest Produce by Consumers and purchasers	3	7	4	2	6	27
297		Drift Waif Wood and confiscated Forest Produces	3		2	5	13	17

S. No.	Name of the Department	Name of the Scheme	Category of Scheme	MBTs	Total expenditure for Biodiversity (000)			
					2011-12	2012-13	2013-14	2014-15
298		Financial Assistance to Forest Development Corporation of Meghalaya	4	7	236	350	350	350
299		Financial Assistance to the Meghalaya State Medicinal Plants Board	2,6	4	1700	3200	3200	3200
300		Financial Assistance to Meghalaya State Bio-Diversity Board	2,4		13926	0	20000	4540
301		Financial Assistance to Meghalaya State Pollution Control Board (MSPCB)	4	7	0	0	0	6139
302		Financial Assistance to State Environment Impact Assessment Authority (SEIAA)	4	7	0	0	0	435
303		Payment for compensation for depredation by wild animals	3	12	1020	200	1080	1500
304		Establishment of Wild Life Sanctuary	3	4	46001	56429	60312	51258
305		Other Wild Life Preservation Works	3	4	46233	48018	52740	65899
306		Ecology and Environment	2,6	3,4	13957	15315	16319	14119
307		Park's Development	3	3,4	2997	3301	3277	3335
308		Garden Superintendent Park and his Establishment	4		31	60	79	96
309		Lady Hydari Park Establishment	3,4	4	2018	1868	2012	1953
310		State Central Library Establishment	4	1	121	118	130	137
311		Wards Lake Establishment	4	4	889	813	942	1056
312		Pinewood Park and Other Garden	4	4	69	71	93	98
313		Other Gardens and Parks under Khasi Hills Division	4	4	59	67	67	76
314		Contribution to Eco. Development Society	4	5	5321	5033	5904	6298
315		Central Assistance for CSS including JFM	2,6	5	0	0	0	28880
316		Central Assistance to State Plan (CASP)	2,6		0	0	0	21539
317		Establishment of Parks and Sanctuaries (WILD LIFE PRESERVATION)	3	4	21308	440	0	0
318		Establishment of Parks and Sanctuaries (CENTRAL SECTOR SCHEMES)	3	4	0	16441	11041	31357
319		Establishment of Forest Statistical Division	4		1264	1304	1446	1372
320		Establishment of Forest Research Division including Laboratory	4		4933	5185	5819	6039
321		Protection of Area with rare plant	3	4	500	600	600	586
322		Tree Improvement Development	4	3	850	707	973	1167
323		Building of P.C.C.F.'s Office	4		75	208	0	0
324		Construction of Departmental Buildings	4		0	0	879	389
325		Intensification of Forest Management Scheme	2,3	7	13757	13182	19586	0
326		Twelfth/Thirteenth Finance Commission under Special Problem	4		22515	0	0	0
		Total				2210950	2010113	16631281821763

Appendix 23

Stakeholder Consultative Meetings

S. No	Attendees

1st Consultative meeting on MBSAP, 24th November 2015; Time: 2:30 PM - 5:00 PM. Venue : Sylvan House, Conference Hall

1. Mr. C. Budnah, IFS, PCCF, HoFF, Forest Department,
2. Mr. TTC Marak, IFS, PCCF (Retd.), TRAC Committee Member,
3. Mr. Y.S. Shullai; APCCF (Biodiversity), Forest Department,
4. Mr. C.P. Marak, APCCF (SF & E), Forest Department
5. Mr. A. K. Shrivastava, CEO MP Board, CCF (Terr.), Forest Department
6. Mr. D. Sathiyan, Member Secretary, Meghalaya Biodiversity Board
7. Prof. R. N. K. Hooroo, Dept. of Zoology, North East Hill University,
8. Dr. Krishna Upadhaya, Dept. of Basic Science and Social Science, North East Hill University
9. Prof. S.K. Barik, HOD Dept. of Botany, North East Hill University,
10. Prof. B. K. Tiwari, Dept. of Env. Science, North East Hill University,
11. Dr. Desmond L. Kharmawphlang, Folk Literature and ITK, North East Hill University
12. Mr. Atanu Bora, Researcher, MBB grant recipient,
13. Mr. M. R. Marak, ACFO, Garo Hills Autonomous District Council,
14. Mr. Allen Perry Ch. Momin, ACFO, Garo Hills Autonomous District Council,
15. Mr. F. W. Blah, CFO, Jaintia Hills Autonomous District Council,
16. Mr. D. Lyngdoh, Range Officer, Khasi Hills Autonomous District Council
17. Smt. S. Dkhar, Deputy Director, Fisheries Dept.,
18. Ms. Ilona. J. Kharkongor, Zoological Survey of India,
19. Mr. T.Iangjuh, Bio-Resources Developmental Centre
21. Dr. Gautam Kumar Bera, Anthropological Survey of India
22. Dr. K. L. Chaudhary, Dept. of Botatny, Lady Keane College
23. Dr. Bashida Massar, Dept. of Zoology, St. Anthony College
24. Mr. Brian D. Kharpran, Cave Biologist, Gen. Secretary, Meghalaya Adventurer's Association
25. Ms. Rosanna Lyngdoh, Board Director, Impulse NGO Network
26. Mr. Salvador Lyngdoh, Scientist D, Wildlife Institute of India
27. Dr. Rishi Kumar, Project Associate, Wildlife Institute of India

2nd Consultative meeting on MBSAP, 13th December 2016, Time: 10:00 PM - 5:30 PM, Venue : Sylvan House, Conference Hall

1. Mr. C. Budnah, IFS, PCCF, HoFF, Forest Department,
2. Mr. C.P. Marak, PCCF (T), Forest Department
3. Mr. B.S. Kharmawphlng, APCCF (Control), Forest Department
4. Mr. D. Sathiyan, Member Secretary, Meghalaya Biodiversity Board
6. Mr. P.R. Marak, IFS, CF, Garo Hills Region, Tura
7. Mr. S.K. Budnah, DFo (Social Forestry), Ri-Bhoi District, Nongpoh
8. Mr. I. Arul Gnana Mathuram, DFO (WL), Khasi Hills
9. Mr. S. N. Sangma, IFS, Director, Balpakram National Park, Baghmara
10. Mr. R.K.Marak, MFS, DFO (Social Forestry), West Garo Hills, Tura
11. Dr. K.K. Kharmihpen, J.D, AH& Vet. Dept., Shillong
13. Mr. I.A. Khongmen, Living Roots Eco-Tourism Society, Shillong
14. Mr. Toki Blah, President, ICARE, Shillong (IAS retd.)
15. Ms. Jennifer Lyngdoh, Scientist - D, ZSI, Shillong
16. Mr. RRBR Thabah, Director NRM, MBDA, Shillong
17. Dr. A. A. Mao, BSI, ERC, Shillong
18. Dr. Khur B. Mukhim, Lady Keane College, Shillong
19. Mr. Samares Bandyopadhyay, Head of Mining, GMS India Pvt., Ltd., Consultant to GoM
20. Dr. C.S. Rao, Head, Dept. of Botany, St. Anthony's College, Shillong
21. Mr. N. Suting, Jt. Dir., Direcorate of Commerce and Industries, Shillong
22. Mr. I.Z. Wreang, Asst. Dir, Cottage Industries, Direcorate of Commerce and Industries, Shillong
23. Shri Tambor Lyngdoh, PD, Khasi Hills, Federation of Hima, Shillong
24. Mr. H. L. Ryntathiang, Lyngdoh, Hima Lyngiong
25. Smt. R.K. Sangma, DFO, SF, West Garo Hills, Tura
26. Smt. H Lato, DFO, WL, Jainita Hills
27. Mrs. M.B.Ritshong, Senior Engineer (Water Resources), Shillong
28. Mr. B. Lyngdoh, ACF (WL), Shillong
29. Smt. L.J. Syiemiong, IFS, DFO (SF), East Khasi Hills, Shillong
30. Mr. P.G.S. Syiem, Shillong
31. Shri L.S. Lyngdoh, Dep. Dir. DSEL, Meghalaya, Shillong
32. Prof. S.K. Barik, HOD Dept. of Botany, North East Hill University,
33. Prof. B. K. Tiwari, Dept. of Env. Science, North East Hill University,
34. Dr. A. K. Mishra, Principal Scientist and Head, National Bureau of Plant Genetic Resources
35. Mr. T.Iangjuh, Bio-Resources Developmental Centre
36. Mr. Brian D. Khaupran, Cave Biologist, Gen. Secretary, Meghalaya Adventurer's Association
37. Dr. G.S. Rawat, Dean, Wildlife Institute of India, Dehradun
38. Mr. Salvador Lyngdoh, Scientist D, Wildlife Institute of India, Dehradun
39. Dr. Rishi Kumar, Project Associate, Wildlife Institute of India, Dehradun

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