THE MEGHALAYA STATE BIODIVERSITY STRATEGY AND ACTION PLAN

DRAFT

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United Nations Decade on Biodiversity

MEGHALAYA BIODIVERSITY BOARD
SHILLONG

भारतीय वन्यजीव संस्थान
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FOREWORD

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Abbreviations and Acronyms

BSAP Biodiversity Strategies and Action Plan

MFD Meghalaya Forest Department

MoEFCC Ministry of Environment Forest & Climate Change

WII Wildlife Institute of India

FSI Forest Survey of India

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

The ethnic communities of Meghalaya have lived in a profound communion with nature since time immemorial. 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. The communities in Meghalaya have long acknowledged this role of 'nature in man and man in nature' (Mawrie 1981, Kharkongor 1981).

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.

The earliest evidence of life on earth, is of single cell prokaryotic organisms 3.8 billion years ago (Mojzsis *et al.* 1996), it took almost a billion years for complex form of life and multicellular organisms to evolve. The form of life we see now consisting of various invertebrates and vertebrates organisms came into existence over last 635 million year ago (Maloof *et al.* 2010). In this long history of life on earth, human evolution has been of much recent origin. Humanoid forms are different from the close relative chimpanzees, evolved in the last 2 Million Years Ago (1.6-2.2 MYA, Li and Chen 2001), and *Homo sapiens* dispersed to various continents from Africa around 1.4-1 MYA (Cann *et al.* 1987).

1.2 History of Conservation Movements in the World

The history of human civilizations is around 10,000 years old (Douglas and Winterhalder 2006; Maisels 1993) and the impact of humans on biodiversity i.e. species and ecosystem together till industrial revolution was very slow and gradual. However after industrial revolution (1760 in Britain; Allen 2009), the impact of human mediated changes and direct extraction has resulted in mass extinction of lager number of species. In contrast to this the last major species extinction happened 65 million years ago when dinosaurs were wiped off from earth. These recent extinction of over 500 species of vertebrates, particularly mammals, birds, reptiles and amphibians in the last 150 years is now termed as the sixth mass extinction on the planet (Brooks *et al.* 2008).

The early environmental or ecological movements in the west have been related to pollution and hazardous waste discharges from the industries. These discharges affect humans working in the industries directly and through various forms of air, water and land pollution affected a much larger population living in cities and villages. Nineteenth century saw emergence of various conservation societies to protect species under threat from hunting, fur trade etc. In 20th century, the adverse effect of human exploitations on wild species came to light with the extinction of last passenger pigeon and endangerment of 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. The western movement for biodiversity conservation and environmental protection started from these efforts and writings during mid-1900s.

1.3 History of Indian Conservation Movements

In India there has been a tradition of wildlife conservation since time immemorial. However in recent years the Chipko movement has left a strong impact on Indian environment and wildlife movement and conservation traditions. In 1730 AD, 363 *bishnois* sacrificed their lives to protect *Khejri* trees, sacred to their traditions, against an order of the King. These villagers followed the traditions of 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 Praksh Bhatt and Shri Sunder Lal Bahuguna. In April 1973 villagers of Gopeshwar village mondal 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 Garwhal Himalayas.

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 shrink 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 forest department 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 state. This movement brought to light the people' struggle against commercial forestry, and it forced the government to change 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.

'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.

1.4 Conservation Traditions 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, the declining *jhum* cycles have caused concern with increasing fragmentation of forest in community areas (Ranjan and Upadhyay 1999). However, compared 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 elephant find place in tribal stories and mythologies, and people living close to forest have a very high tolerance for these species (Tiwari *et al.* 2010). The Garos revere Hoolock gibbons as the protector of land, and are seldom harm them. The elephant related conflicts in *jhum* areas and paddy fields find empathy in the villagers for both humans and wild animals. As the state has a very large population that is still living and coexisting with wildlife, most of the population face some form of human-wildlife conflict; yet most of these conflicts remain localized and wildlife is seldom targeted and eliminated. However, to sustain human-wildlife association and co-existence, government incentives and compensation can play a major part.

1.5 Convention on Biological Diversity

The World Charter for Nature adopted by the U.N 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 wording in the UN charter does not impose any laws on people for reducing anthropogenic effects on nature and for conservation of sustainability of natural resources.

The utilitarian arguments take into account the value of biodiversity and conservation beyond just aesthetic or moral values, but how these have a value in economic sense, which we would lose. This argument takes into account the direct and indirect services, provided by biodiversity to humans, which positively enhances quality of life and provide economic benefits. IUCN/UNEP/WWF (1991) thus recognize 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 United Nations Environment Programme (UNEP) formed an *ad hoc* 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 *ad hoc* 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. 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.

1.6 The Need of Meghalaya Biodiversity Strategy and Action Plan [MBSAP]

In accordance to the National Biodiversity Strategy and Action Plan, various regional BSAPs are also required for achieving the CBD objectives. Meghalaya prepared its first BSAP in 2004 compiled by Dr. B. Kharbuli, Dept. of Zoology, North Eastern Hill University (NEHU) with contribution from various NEHU faculties and people working in Meghalaya.

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.

Aichi Biodiversity Targets

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.

The Meghalaya Chapter of the National Biodiversity Strategy and Action Plan [NBSAP] 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 National Biodiversity Authority.

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, 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.

1.7 Scope of the Meghalaya State Biodiversity Strategy and Action Plan

The MBSAP attempts to involve multiple stakeholder, experts, organizations, entities mad 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 Institutions / 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 community conserved areas (CCA). 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 on status of biodiversity in the state to a document giving a direction to the strategies and action plan for addressing the threats to biodiversity, and as an implementation too.

The redefined objectives of the MBSAP are:

i) To assess the present status of biodiversity, its conservation inputs and initiatives and the threats relevant to the state

ii) To identify gaps in the policy framework of various departments of the State Government

iii) To project the common man'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/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 stakeholder 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 and 22 appendices. 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 a 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

To fulfill the objectives outlined above, the following methodology and approaches have been adopted by the team in preparation of the NBSAP:

i) Field trips and surveys to collect primary and secondary information's

ii) Literature and statistical surveys, both primary and secondary

iii) Consultative and Core Group meetings with representatives of Forest Departments, state institutions, universities, colleges, district councils and other stakeholders.

iv) Holding of Public meetings and hearings

v) Discussions with local experts and knowledgeable individuals

CHAPTER 2

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 (Chowdhury 1996, Playfair 1929, Barooah 1970). 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.

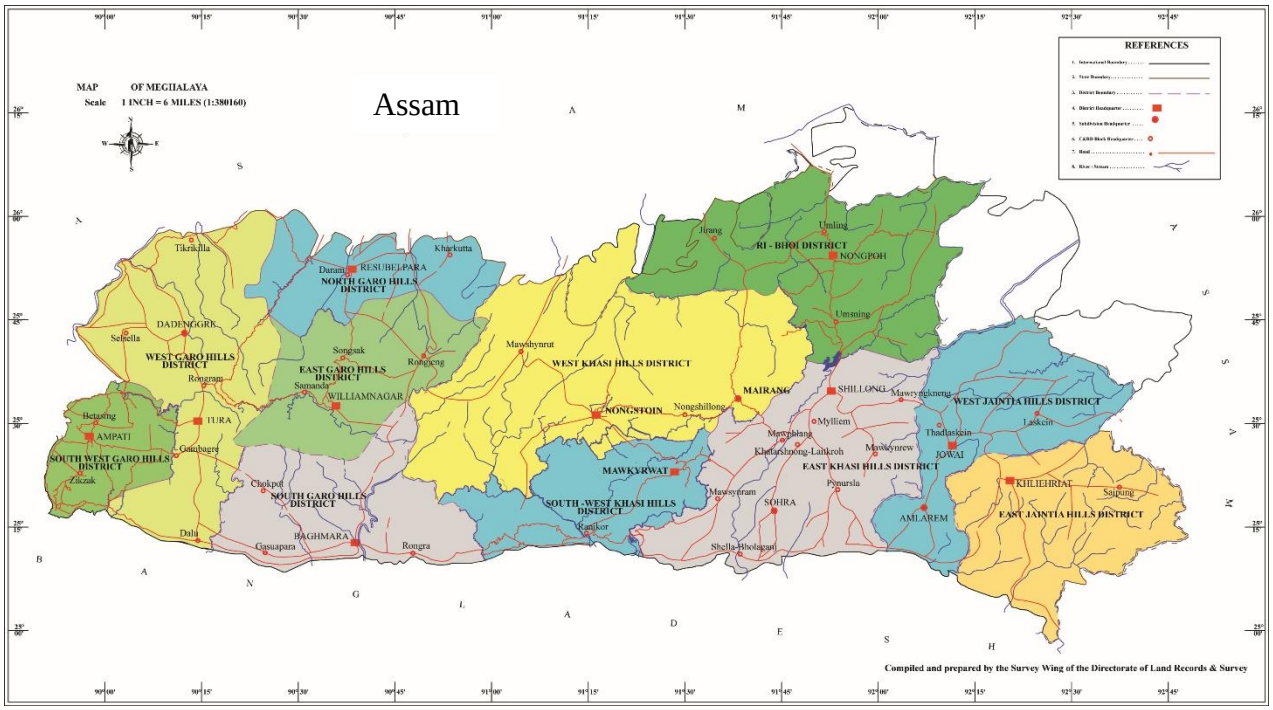
The three geographical sub-regions of Meghalaya, viz., Khasi, Garo and Jaintia hills are among the wettest regions of the world, with clouds persisting in various areas nearly throughout the year (*in Sanskrit, Meghalaya = abode of the clouds*). Meghalaya, is among the richest states of India in terms of 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 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 Hill, Ri-bhoi, West Jaintia Hills and East Jaintia Hills lying between 25°47" - 26°10" N latitude and 89°45" – 92°45" E longitude and covers 22,429 km^2 area (State of the Environment Report, 2005). 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 (Figures 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% 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, the North Eastern India has a lone connecting link between Indian subcontinent and East Asia, and this region is an important passage for migration to East Asia. 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).

Fig 2.1 Map of Meghalaya State with the 11 districts



The history of settlement in the North Eastern India is quite unique with multiple waves of immigration of various indigenous communities from the three lineages (Reddy *et al.* 2007; Kumar and Reddy 2003; Cordaux *et al.* 2004).

The indigenous communities of Khasis, Jaintias and the Garos are of Paleo-Mongoloid descent, who were one of the earliest waves of the East Asian settlers in Meghalaya. The Garos, belongs 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 and Das 2003).

Among the Khasi Jaintia groups, the Jaintias or Synteng are the older branch of the indigenous community (Gurdon 1907). They have a fairly long traditional historical account of the kingdom and dynasties. They are also known as the *Pnar* people. During the colonial period both Khasis and Jaintias were referred to as Khasis. It may be presumed that they were settled in the present homeland, which they called *'Ka Ri Khasi', 'Ka Ri Synteng'*. The *Mon Khmer* Khasi, Jainita and *Tibeto-Burman* Garo language has many local variations and spoken in different dialects. English was adopted as the script for the different variations of these languages in Meghalaya. 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 historical/mythological Indo Aryan literature first to mention "Khasi" (Playfair 1975, Sen 1985).

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 Mechapara and Karaibari invaded Garo Hills and bought Garos under their control. This was direct result of Garo raids on plains, and this occupation of Garo Hills did not stop these raids. In 1823-24 David Scott signed agreements with a number of Garo chiefs. However this work could not be completed and the raids continued. The British suppressed the Garos and imposed fines and government tributes (Barooah 1970).

During early 1700, the Khasis used to come to trade in silk, cotton goods, iron, wax, honey and ivory in exchange for rice, salt and dry fish to Pandua border of Sylhet (Barooah 1970). The Khasis depended on trade center in Pandua for their entire supplies of grains (Lahiri 1975). The smelting of Iron was chief industry in Khasi hills, and considerable amount of Iron was exported to Bengal via Pandua in Sylhet. Lime stone from the Khasi Hills was another major trade material to Bengal, soon British officials of the East India Company begin trading in highly profitable trade of limestones (Shakespeare 1914).

During early 19th century Burmese invaded number of places in North Eastern India, then part of Chittagong, Sylhet and Bengal or outside the British Indian territory. Thus British declared a war on Burma in 1824, by then Burmese have invaded Cachar and also the border of the Jaintia Hills. Finding a greater advantage of contacts with Khasis, the British signed a treaty with them on 10th

March 1824 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. However, the road remained uncompleted due to uprising of U Tirot Sing against British intrusion (Chowdhury 1996). In Jaintia hills U Kiang Nangbah lead a revolt against this British colonialism. The construction of this 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 1841. 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 1962 and executed. Martyrs like U Tirot Sing, U Kiang Nangbah and Pa Togan Sangma are the three well known freedom fighters from these hills, who lead uprising against the colonial power and laid their life for freedom (Chowdhury 1996, Barooah 1970, Lahiri 1975).

2.3 Physical Features

The state of Meghalaya is physiographically a plateau region. The general altitude of this plateau lies between 300 meter msl to 1500 meter 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).

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 metasediments 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)

2.3.1 Soils

The hills soil 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, Meghalaya; http://megagriculture.gov.in/PUBLIC/agri_scenario/soil.aspx).

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, 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

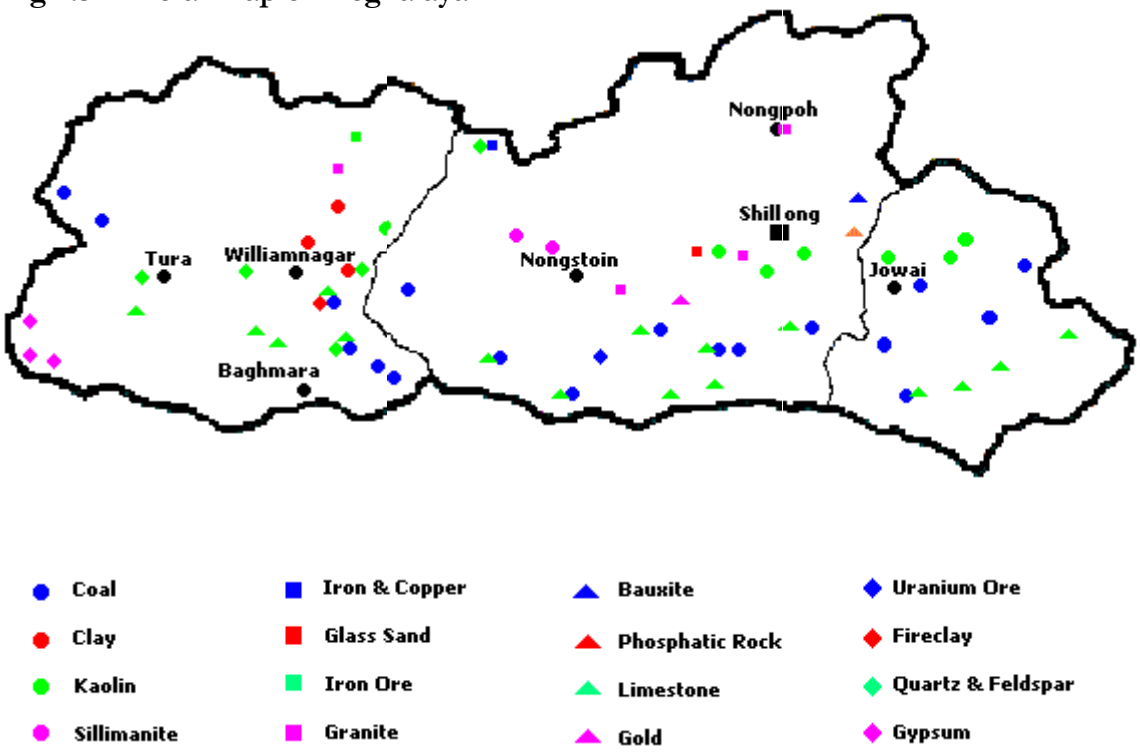
2.3.2 Minerals of Meghalaya

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 2.3, Table 2.2).

Table 2.2 Minerals of Meghalaya

S. No.	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 MTs from 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 Soharim 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 MT 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.

Fig 2.3 Mineral Map of Meghalaya



Source: meghalaya.nic.in (Official website of Meghalaya)

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 400.00 cm, and in northern parts it's around 250-300 cm. The rainfall is particularly very high in the shilling plateau averaging around 719 cm. The world wettest place Mawsynram, now receives an average of 1187.3 cm of rainfall annually, in last decade this rainfall has reached averages of 1392.3 cm. Cherrapunjee, the earlier wettest place, lying in the Cherra plateau, also receives a high average of 1177.7 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.

2.5.1.1 Tropical Forests

These forests are present in areas up to an elevation of 1200 m and with an average rainfall of about 100 – 250 cm. There are numerous subtypes within this category such as evergreen, moist and dry deciduous forests, etc.

Table Forest types in Meghalaya

S. No.	Forest Type	Distribution
	Tropical Forests	
	Tropical Wet Evergreen Forests	Distributed in high rainfall areas and near catchments areas. Trees exhibit clear zonation with dense, impenetrable herbaceous undergrowth.
	Tropical Semi-evergreen Forests	These forests occupies the northeastern and northern slopes of the state, typically up to 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 in these forests such as *Careya arborea, Dillenia pentagyna* and

		Callicarpa arborea. There is clear stratification of the trees in these forests.
	Tropical moist and dry deciduous Forests	Below 150 cm 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.
	Bamboo tracts	Bamboo tracts appear in *jhum* fallows of 10 – 15 years. These forests at places form pure strands. The common bamboo species in Meghalaya are *Dendrocalamus hamiltonii, Dendrocalamus giganteus, Bambusa bambos, Cephalostychum latifolium, Melocanna bambusoides,* etc. Bamboo also appears in comparatively older forests where there are some gaps in the canopy.
	Grasslands and Savannas	Grasslands are only a result of removal of original forest cover. The rolling grasslands covering large areas are distributed 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.
Subtropical Forests		
	Subtropical Forests	Occur between 1000m and 1350m amsl 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.
	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 like *Eaeocarpus lancifolius, Erythrina arborescens, Quercus griffithii, Schema wallichii, S. khasiana* etc.
Sal Forests: These forests have sal contributing to more than 20 % of the stand.		

	Alluvial Sal	This type conforms to type North Indian Tropical Moist Deciduous Kamrup Alluvial Sal Forests (3C/C2 d (iv)).
	Foothill and Plateau Sal	This type conforms to the type North India Tropical Moist Deciduous Eastern Hill Sal Forests (3c/C1a).
	Very Moist Sal Bearing Forests	Khasi Hills Sal (3C/C1 a (ii)).
	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 climatic climax forests are usually found in isolated pockets along valleys, slopes, rivers and streams. The tree species in general show bushy and stunted habit. They form 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 in these forests

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 (Department of Agriculture). In Meghalaya, summer is for a period of about 5 months, from May to September, with torrential rains caused by the South West 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 2005-6 there has been a net decline in cropped area in the state from 230985 (thousand hectare) to 219119 (thousand hectare). 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, an increase in production has also been observed in Meghalaya. High yielding varieties of paddy like Mansuri, Pankaj IR 8 and other varieties like IR36 for Rabi season, supporting the multi-cropping system has been encouraged and cultivated in most of the state. Megha I and Megha II, the cold tolerating varieties of rice developed at ICAR, Meghalaya was released in 1991-92 for high altitude regions of the state (BSAP, 2004).

2.5.2.1 Agro-Climatic Conditions of Meghalaya

The Indian peninsula is composed of 15 (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 continuity /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 average annual rainfall is about 2600 mm over western Meghalaya, between 2500 to 3000 mm over northern Meghalaya and about 4000 mm over south-eastern Meghalaya

(meghalaya.gov.in). The climate however varies with the altitude and physiographic difference of landmass.

Table 2.1 Land Use Statistics of Meghalaya

	1997-98	**1998-99**	**2003-4**
	Area in hectares		
1.Land under forest	2240900	950000	941786
2. Not available for cultivation			
2.1 Land put to non-agricultural uses	83264	83356	90215
2.2 Barren and uncultivable land	138643	136889	137730
3. Other cultivated land excluding fallow land			
3.1 Land under misc. tree groves	155648	155025	156619
3.2 Cultivable waste land	465568	465645	451098
4. Land available for agriculture			
4.1 Current Fallow land	67032	67483	63447
4.2 Fallow land other than current fallows	163476	164117	167313
4.3 Net Sown Area	217669	218385	218892
5. Area Reporting	2240900	2240900	2227100
6. Area sown more than once	44123	44445	46680
7. Gross sown area	261792	262830	265572
8. Cropping Intensity	1.20	1.20	1.21

Source: Directorate of Agriculture, Govt. of Meghalaya; Meghalaya Wasteland Atlas

2.5.2.2 The major agricultural 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 thousand hectare 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 of producing nearly 2300kgs/ha, similarly maize and wheat production has also reached new high with varieties yielding 1218 kg/ha compared to just 534 kg/ha in 1971-72 for maize and for wheat the improvement has been nearly 2.5 times reaching 1508 kg/ ha compared to 611 kg/ha in 1971-72.

2) *Jhum* cultivation: Slash and burn cultivation or *jhum* cultivation is practiced by almost 100 indigenous tribes in all the North Eastern states of India. 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).

Fig. 2.11 Slash and Burn (*Jhum*) burning in Garo Hills, Meghalaya

(Photo: Rishi Kumar)

Studies on the economics and efficiency of shifting agriculture by Ramakrishnan and his colleagues showed that, *jhum* is an ingenious system of organic multiple cropping well suited to the heavy rainfall areas of the hill tracts (Rathore *et al.* 2010). The economic and energetic efficiency of *jhum* is higher than alternative forms of agriculture such as terrace and valley cultivation.

The traditional *jhum* cultivation practiced in Meghalaya by the Garos, Khasis 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. In the war Khasis and most other tribes the crops sown 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 month of April to September (Mishra 1981). The fallow period varies in different tribes the Khasi of War-War and Khrang keep the land fallow for a period of 8 - 15 years, Garo for a period 7 - 9 years, whereas Karbi keep the land fallow for only for 3 - 5 years (Deb *et al.* 2013).

The traditional *jhum* practices in the state are being modified with time, some of these modifications increase the yields or changes the time period before cultivation of same *jhum* area. In modified system, the most common crops sown during the first season is potato (*Solanum tuberosum*) while cabbage (*Brassica oleraceae* var. capitata), cauliflower (*Brassica oleraceae* var. botrytis), pea (*Pisum sativum*) and radish (*Raphanus sativus*) are preferred during the second season. Most of these modified *jhums* use verities of crops, e.g. in *War-War* and *Khrang* villages 14 to 16 crops are grown, in *Kuswai* and *Khulia* villages 24 crops are grow, and in *Sasatgre* and *Chaekwatgre* villages of Garo Hills 30 - 35 crops are grown. In most of these modified *jhums*, all these crops are grown simultaneously, along with many beneficial tree species. This mixed cultivation of trees and crops resemble agroforestry system that allows maintenance of higher crop biodiversity. Another innovation seen in Garo Hills was conversion of lower hill slopes into flat land for cultivation of paddy, whereas the rest of the hill is used for mixed cropping or cash crop production under *jhum*. Across Meghalaya, variety of crops are planted in the *jhum* fallow lands, e.g. bay leaf, jackfruit and black pepper by Khasi community (Khrang village), banana and broom grass are planted by Karbi farmers (*Kuswai* village), and Arecanut and Citrus plant by Garo people (Sasatgre village) (Deb *et al.* 2013).

In the adjoining states various forms of *jhums* is cultivated, e.g., some with multiple cultivation, some interspersed with alder trees (*Alnus nepalensis*). In Meghalaya the local communities have adapted various new techniques to increase production of *jhums*, which are less destructive to forests and generate higher returns. These innovations include, use of cover crop, tree retentions, weed management, soil conservation using poles and logs, and introduction of cash crops with fallow management (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 (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 reas was explored by the Tea Board through establishing Tea Experimental Stations at *Umsning* in Ri-Bhoi District (2.5 ha); *Riangdo* in West Khasi Hills District (2.0 ha) and *Thebronggiri* in West Garo Hills District (1.6 ha) in the year 1976 – 77.

Fig. 2.4 Tree Plantation at Chandigre, Garo Hills

(Photo: Rishi Kumar)

The encouraging results from these experimental plot 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. Between 1984 – 85 to 2005-06 about 1320 hectares of land have been brought under tea plantation in the state producing about 5610 MT of green tea leaves during 2005-06.

(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 as reclaimed *jhum* areas. Over last few

years there is a significant increase in area, production and productivity viz; 1.51, 14.63 and 13.60 percent respectively (Meghalaya Agriculture Profile, 2006).

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 constrains for floriculture in the state. Thus according to the Agricultural department, the Horticulture development in the state should be encouraged through technological, entrepreneurship training and supply of inputs and planting materials. For encouraging floriculture government has sept up Centre of Excellence for Rose (Ri Bhoi District) and *Anthurium* (East Garo Hills District) which served as demonstration models. These center have encouraged farmers to take up floriculture on their own effort with technical support and subsidies from the government (Meghalaya Agriculture Profile, 2006).

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 M.T. respectively (Meghalaya Agricultural Profile, 2006). 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 crop is stagnant or even declining over last 16 years (Meghalaya Agricultural Profile, 2006).

2.5.2.4 Vegetables

Meghalaya is known for its vegetables in the Northeast. 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.

Fig. 2.5 Taro a common Jhum Crop

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

2.5.2.5 Fruits

Meghalaya is blessed with tropical, semi-tropical and temperate climates. 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 prefere fruits from the wild including *Baccaurea sapida*, *Calamus esculentus*, *Docynia indica, Dillenia indica, Elaeagnus sp, Ficus neriifolia, Ficus auriculata, Garcinia paniculata, Garcinia lancifolia, Rubus nivcus, Rubus rugosus, Gardinia campanulata, 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.

2.6 Social Structure and Culture

Meghalaya is a diverse state. It holds a sizeable populations of indigenous people. The three main indigenous communities are namely Khasis, the Garos and Jaintias, other major indigenous communities include *Karbis*, *Mikir*s and minor ones like the *Hajongs*, *Kochs* and *Rabhas* (Singh, 1994; Sangma, 1998). Matrilinealism, is the system of inheritance and succession of the parents to the children. 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. 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. 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 (Nongkynrih 2014). Each of the '*Katchis'* or clan is further subdivided into numbers of lineages called *'Machongs'*. The village head is known as *Nokmas* (Playfair, 1975*)*. As the property is inherited by females only, 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 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.

In 1842, English 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 but and to compete internationally in coming years (Draft Meghalaya Education Policy, 2013).

Traditional Customary Rituals

The traditional customary rituals of Khasis are called '*Niam Tynrai*'. For Khasis, Jaintias and Garos, dances are essence of all the festivities and is an important part of various religious ceremony. 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' etc (Anon 1991).

Fig. 2.6 *Nongkrem Dance*

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 thanksgiving to Goddess *Ka Blei Synshar* for the good harvest and prosperity. An important part of this festival is *Pomblang* (decapitation of goats) Ceremony, at which goats offered by subjects to the 'Syiem' of Khyrem, are sacrificed and offerings are made to the ancestor of the ruling clan 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 high priest and the people in general all join in this festival, which is a rhythmic form of prayer for the well-being of all.

Fig. 2.7 Beh Deinkhlam festival celebrated at Jowai, *Jaintia Hills*

Beh Deinkhlam is the most important festival of the Jaintias and is celebrated after the crop sowing is over. "*Khlam*" means 'Plague or Pestilence' and "*Behdein*" means to drive away the plague with sticks. It is a very popular and colorful festival of the Jaintias where only men take part in the dancing to the tune of drums and flute. Women play an important role in offering sacrificial food

to the spirits of their ancestors. They invoke their aid and intercession, so that life on Earth will be good and better for the next one in heaven. Men go round the town and beat the roof of every house with bamboo poles calling upon the plague demon to leave the house. This is done early on the first day of the festival. The culmination of the celebrations is the tussle, as seen in a tug-of-war, for a large undressed beam by two groups of people opposed to each other. This festival seeks blessing of the god for good harvest (Tariang 1989; Lamare 2005; BSAP, 2004).

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).

Fig. 2.8 Shad Suk Mynsiem

Fig. 2.9 Wangala dance, Garo Hills

Wangala is a harvesting festival and celebrates the Sun God of fertility, Saljong. The Wangala *Dance* is the biggest of all the festivals of the Garos performed in connection with the *Jhum* cultivation. It is characterized by beating of drums with folk dance and music. During Wangala, people young and old dress in their traditional colourful garments (*Dakmanda, Daksari*, or *Gando*) and feathered headgear (*do'me*) and dance to music played on long, oval-shaped drums (*Dama*). Traditionally there is no particular date for this festival and each village can propose the dates and time. However, it is usually celebrated between October-November. All the village dance and music teams assemble at *Asanang* village, headquarters of Rongram division. The occasion is initiated right in the field by a simple but impressive ceremony known as "*Rugala"* which is followed by the ceremony of incense known as "*Sasat Soa*". This is performed inside the house of the Chief (*Nokma*) of the village. The Chief, amidst burning of incense, the beating of drums and the chanting of the people, utters a few words of incantation and pour rice beer and sprinkles rice powder over a collection of field produce offered to the Gods and is followed by

celebrations including drinking and dancing. People, young and old, boys and girls, in their colourful costumes with feathered headgears, dance to the tunes of music played on long oval-shaped drums (Sangma 1998).

2.7 Governance

The total Gross State Domestic Product in 2014-15 was 13,347 crore (4.2 billion dollars), which is annually increasing at rate of 10.84 % over the last decade (Directorate of Economics & Statistics, Governments of Meghalaya). Meghalaya has a strong floriculture sector and is one of the leading states in the Northeast in terms of production and supply of cut flowers to mainland consumer markets. About 14 % (3,108 Km^2) of Meghalaya is covered by bamboo forests, and the state is one of the leading bamboo producers in the country (http://www.ibef.org/states/Meghalaya.aspx#sthash.T4bz4vea.dpuf).

Meghalaya has a hydroelectric power potential of around 3,000 megawatt (MW) due to abundant rivers systems, out of which only 510.45 MW has been utilized so far. Its total ground water potential of 1226.44 million cubic meter (MCM) provide only 1041.99 MCM as utilizable for irrigation (Meghalaya Human Development Report, 2008).

At national level, Meghalaya ranks poorly in the Human Development Index (HDI), which slumped from 21st rank in 1991 to 24th rank by 2001 (National Human Development Report 2001). The Human Development Index value of 0.365 is also lower than the all-India average of 0.381. Similarly, in case of per capita income, in 1990-91 Meghalaya ranked 18th (Economic Survey 2000-01, p. S-12) which has slightly improved to 17th in 2001 (Minister of State for Statistics & Programme Implementation).

As far as the Gender-related Development Index (GDI) is concerned, Meghalaya is in a better position compared to most of the states in India due to matrilineal society. The GDI rank of Meghalaya was 12th in 1981 and improved to 7th in 1991.However, the decline in HDI rank raises questions that the resources are not effectively used for the well-being of the people and have slowed the rate of development compared to other Indian states (MHDR, 2008).

2.7.2 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 members representing different District Councils constituencies, elected on the basis of universal adult franchise like members of the Legislative Assembly. The leader of the largest party/group returned to the Council is appointed by the Governor as the Chief Executive Member. 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

2.7.3 Traditional Administration

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

HIMA LYNGDOH- (Lyngdohships)-3
Sohiong, Mawphlang and Lynniong

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

HIMA WAHADADAR- (Wahadadarships)-1
Shella

ILAKA DOLLOI- (Dolloishipss) - 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*

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.

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.

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.

2.8 Land use Practices and Resource Governance

2.8.1 Land use practices of local communities

The pattern of land ownership and type of tenure plays and 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 and 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 holding are 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.

2.8.1.1 The Garos

Riotwari system is present in in most areas of the Garo Hills. Villagers do not own 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*.

2.8.1.2 The Jaintias

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. These 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. And 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).

2.8.1.3 The Khasis

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 bonging 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 – 1) *Ri-Law Kyntang*, 2) *Ri-Law Niam*, 3) *Ri-Law Lyngdoh* and for the purpose of firewood, water and timber etc. are : 1) *Ri-Law Adong*, 2) *Ri-Law Sang*, 3) *Ri-Law Shnong*, 4) *Ri-Law Sumar*.

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

2.8.3 Animal Husbandry

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 (Animal Husbandry and Veterinary Department; http://www.megahvt.gov.in/profile.html).

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

Table 2.2 Animal Husbandry Infrastructure in Meghalaya

Sl. No.	Infrastructure	1972	2012
1	Veterinary Hospitals	1	4
2	Veterinary Dispensaries	29	92
3	Veterinary Aid Centres	10	51
4	Mobile Veterinary Dispensaries	3	15
5	Vigilance Unit	-	3
6	Intensive Cattle Development Project	-	2
7	Stockman Centers	2	63
8	Key Village Centre		16
9	Cattle Breeding Farm	1	4
10	Poultry Farm	3	12
11	Pig Farm	2	13
12	Sheep & Goat Farm	1	2
13	Buffalo Farm	-	1
14	Duck Farm	-	1
15	Fodder & Fodder Seed Production Farm	-	2
16	Fodder Demonstration Farm	-	3
17	Feed Mill	-	2
18	Rabbit Farm	-	1
19	Check Post	-	4
20	Vaccine Depot	-	1
21	State Disease Diagnostic Laboratory	-	1
22	District Disease Diagnostic Laboratory	-	7
23	Vocational Training Centre	-	2
24	Dairy Plant	1	3
25	Chilling Centre	-	3
26	Creamery & Ghee making Centre	1	1

2.8.4 Forestry Policy and 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 system were not based on contemporary science, however, were very effective in protection and conservation of forest. The sacred grooves, 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 waters shed, conservation of wildlife or medicinal plants. And most villages had a number of these forests (Tiwari *et al.* 2010).

2.8.5 Forest Policies

The National Level policies regarding environment and forests are framed exclusively by the Ministry of Environment, Forests and Climate Change 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 and 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 *Syimship, 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 pass down to generations (Barik and Darlong 2008).

North - East Forest Policy, 2002 (Draft)

Shukla Commission was setup by the planning commission for analyzing the gaps in infrastructure development and it suggested setting up a North East Forest Policy Committee (NEFPC). This committee was constituted by Ministry of Environment and Forests in 1998 to suggest suitable Forest Policy for the North Eastern Region within the framework of the National Forest Policy, 1988. NEFPC recommends encouragement of forest based livelihood opportunities to benefit the region and local communities.

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)
- Project Tiger Guidelines
- 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, 1991
- Wildlife (Protection) Act, 1980
- 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

Source: Barik and Darlong 2008

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

2.8.6 Forests 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 and 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 993.0 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.

The Reserved and Protected Forests have very little contribution to community needs as these forests are under state control with limited rights of people. Unclassified forests is the most utilized form of forests where communities have full rights and the use it according to their need. *Jhum* cultivation and main extraction for fuelwood, timber and NTFP occurs in this forest. The village forests are mainly utilized for subsistence need of communities like fodder and fuelwood (Dasgupta and Symlieh 2006).

2.8.7 Wastelands of Meghalaya

Diversity in the physical landscape is the cumulative effect of both geological and geomorphological processes since millions of years. This has finally resulted in the formation of a variety of land with its associated land systems, forms and surficial material, such as mountains, hills, valleys, plateaus, plains etc.

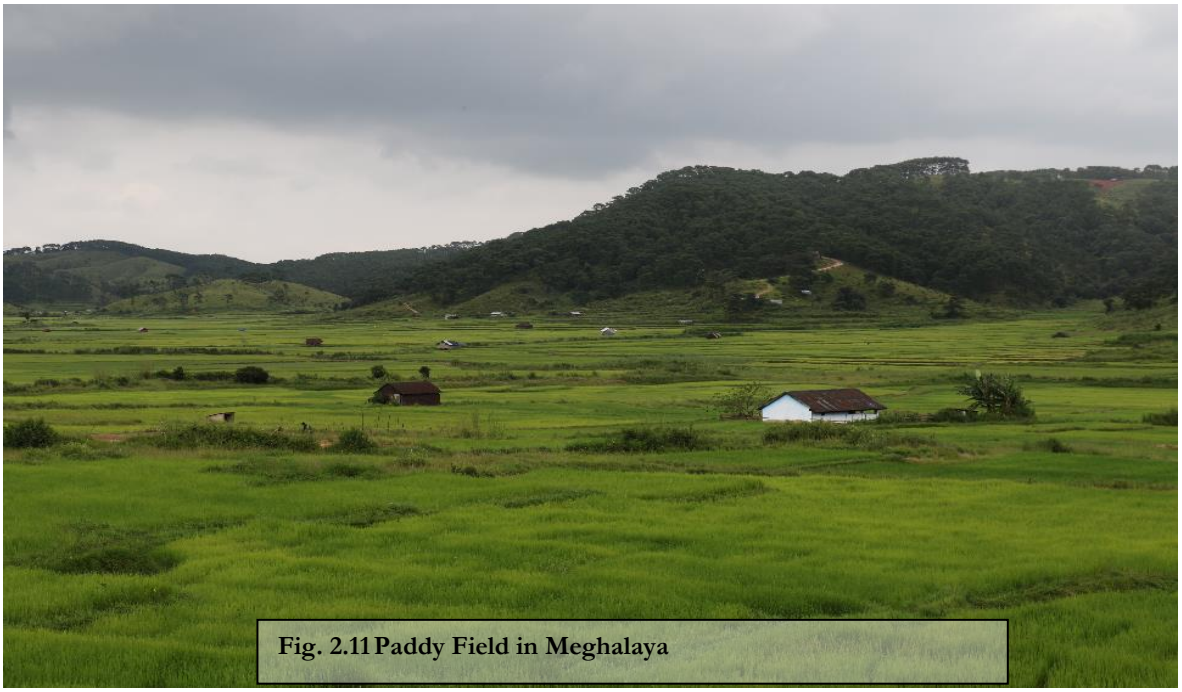


Fig. 2.11 Paddy Field in Meghalaya

(Photo: Rishi Kumar)

Meghalaya being a hilly state has nearly 40 percent of its land under shifting cultivation. The practice of shifting cultivation in Meghalaya is undertaken in upland forest, much of it on steep slopes resulting in severe soil erosion and causing tremendous loss of fertile top soil, and destruction of vegetation in the area. In Meghalaya, wastelands are of three types 1) *jhum* cultivation, 2) barren/rocky waste and, 3) degraded forests. As per Wasteland atlas of India 2011, land under *jhum* cultivation in Meghalaya is 227.52 km^2, while 254.34 km^2 is barren rocky/stony waste and the total wasteland in Meghalaya is 4081.43 km^2 including the land with scrub 3262.58 km^2 and 268.11 km^2 of abandoned *jhum*, 68.88 km^2 of degraded/underutilized forests. There is a small area under lake or reservoir.

CHAPTER 3

Biodiversity Profile and Conservation in Meghalaya

3.1 Introduciton

Meghalaya falls under the Indo-Myanmar Bioddiversity Hotpot zone (Myers 1988, 2000). Meghalaya is endowded 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.

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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 chapter:

1) The chapter lists species of various taxa present in the state, including information on rare and endangered species.
2) The Chapter prioritises 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). Floristically this region mainly consist of two types of flora i.e. Eastern Himalayas and north east India (Rodgers and Panwar 1988).

The flora of Meghalaya comprise about 3,128 species of flowering plants of which a large number of species 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 of face threat of extinction in the state due to various direct and indirect anthropogenic pressures. Rao and Haridasan (1983) reported 54 rare and threatened plants, and Haridasan and Rao (1985-1987) 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 and Singh 2015, Appendix 13). However, many authors believe that Meghalaya may have more species of orchids and many are still to be discovered (Kakati 1986). 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*, *Paphiopedilu*m 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 from Meghalaya

(Photo: MBB)

The Pteridophytic flora of India comprises 67 families, 191 genera and more than 1,000 species (Dixit 1984). 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 and Pandey 2003).

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 and 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 and Lal (1999) (Bansal and Nath 2012). Singh and Nath (2007) 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 (http://megforest.gov.in/ activity_medic_plants.html). 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 *Rauvlfia serpentina*, etc. (State of Environment Report of Meghalaya, 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/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) on 239 identified species of endemic plants revealed the dominance pattern of different genera. The largest taxonomic group (178 genera and 79 families) was constituted by Poaceae followed by 14 genera and 17 species of Orchidaceae and 11 genera and 13 species of Rubiaceae. Maximum number of endemics are herbs (36%), followed by trees (27%), shrubs (25%), lianas and climbers (8%) and shrubs only 4% (Lakadong and Barik 2006). 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 and 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 the 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).

Box 3.1 ***Faunal Diversity of Meghalaya-Summary***

	No. of Genera	No. of Species
Vertebrates		
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)

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 and Jhingran 1991, Sharma 1998, 2006, Sharma and 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 catfishes, three from *Clarias batrachus* (L.) and one from *Heteropneustes fossilis* (Bloch), from Guwahati (Assam) and Sheila (Meghalaya) are described (Tandon and Das 2005). In 2014 a new species of leafhoppers

including new species of *Scaphoideus ramamurthyi Meshram,* was discovered from Brapani, 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* (Mammalia: Chiroptera: Molossidae) 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.

Primates

This mammalian order is well represented in Meghalaya having 7 speciesincluding 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 and 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.* 2010). There is almost no data on its behaviour and ecology from India. However many 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, Nonkhyellam 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 (Samrakshan Trust, Kakati and Srikant 2016).

Fig. 3.2 Primates of Meghalaya

(Photo: Rishi Kumar)

The Sump-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 (Chetry *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 (Samrakshan Trust 2005, Kakati and 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 (Samrakshan Trust Annual Report 2005, 2006-7).

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 behaviour, 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 and Choudhury 2007). The Malayan sun bear (*Helartos 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). Questionnaire survey (WTI) also reveals its presence in Tura Wildlife Division of East and West Garo Hills (in Choudhury *et al.* 2012). Sloth bear (*Meursus ursinus*) is known from a single specimen in the state, and have never been sighted or reported in the state (Choudhury *et al* 2012, Sathyakumar *et al* 2012). 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).

The endangered red panda (*Ailurus fulgens fulgens*) locally called *Matchebel* in *Garo,* is reported mainly from Nokrek and Balpakram areas of Garo Hills and adjacent forests of West Khasi Hills. In Siju WLS the lowest altitude population of the species is reported at altitude of 200 meter msl (Choudhury 1997, 2001), as the species has been reported only at high latitudes of 1500 m or higher. The species is protected under Schedule I of the Indian Wildlife (Protection) Act, 1972 and listed in Appendix I of the CITES list of species. Binturong (*Actictis bintourong*) (Choudhury 1997, 2001) has also been reported from the state. It is a vulnerable species and faces similar threats as by the red panda ie. habitat degradation and fragmentation. Both species are in need of conservation of their habitat and connectivity.

The endangered dholes or Indian wild dogs (*Cuon alpinus*) though widely distributed throughout Asia and South-East Asia, faces direct threat from loss of prey base and retaliatory killing. Proper population estimates are not available for the species (Kamler *et al.* 2015). 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). Table 3.1 list number of other carnivores reported from the state.

Table 3.1 Some Carnivore Species Reported form Meghalaya

S.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*	Yellow bellied weasel	Least Concern
5	*Melogale personata nipalensis*	Burmese Ferret Badger	Least Concern
6	*Arctonyx collaris*	Hog- Badger	Vulnerable
7	*Lutra lutra monticola*	Common Otter	Near Threatened
8	*Lutra perspicillata perspicillata*	Smooth-coated Indian Otter	Vulnerable
9	*Aonyx cinereus concolor*	Oriental small-clawed 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	Least Concern
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

(Johnsingh and Jhala 2008, Gogoi 1981; IUCN 2017)

Ungulates

Among the herbivores of the state the endangered Asian Elephant is most striking. Even though the state has an undulating topography and fragmented forested habitats, it harbours a large population of the elephant ie. 1811 reported in 2007 (Meghalaya Forest Department). Many of these elephant subpopulations 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 is reported viz., Kamru-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).

Table 3.2 Some Common Ungulates Reported from Meghalaya

S.No.	Species	Common name	IUCN Status
1	*Capricornis thar*	Himalayan serow	Near Threatened
2	*Rusa unicolor*	sambar	Vulnerable
3	*Tetracerus quadricornis*	four horned antelope	Vulnerable
4	*Muntiacus muntjak*	barking deer	Least Concern
5	*Sus scrofa*	wild pig	Least Concern
6	*Manis pentadactyla*	Chinese Pangolin	Critically Endangered
7	*Manis crassicaudata*	Indian Pangolin	Endangered

(Source: Samrakshan Trust, IUCN 2017)

Fig. 3.3 Wildlife from Meghalaya

(Photos: Kashmira Kakati & Shikha Srikant)

3.3.2 Aves

Similar to the other North Eastern states, Meghalaya is very 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 (Table 3.3). 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 Important Bird Areas in the state. The management of these areas are important for protection and long term viability of naturally occurring bird population in the geographic distribution of the species (Islam and Rehmani 2004).

Table 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*

Table 3.4 Important Birds Areas of Meghalaya

Sl No.	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 Natinal 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

Biome species: 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.

Table 3.3 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*

Box 3.1 **Herpetofouna**

Calotes jerdoni

The herpetofauna of the state is very diverse and it attracted number of taxonomists and exploreres 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. Subsiquently over the years, many species has been named after him in recognition of his contribution to identification of herpetofauna.

(Photo:Bitupan Borah)

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. Zoological Survey of India (Ghosh *et al.*

1984) updated the records for the state with 36 snakes. Mathew (1995), updated the list to a total of 56 species of snakes. 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 evetation dwelling assembladges 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 (Coefficient of Biogeographic resemblance 0.62) followed by Upper Assam (0.59).

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, Calotes emma, C. versicolor, Japalura planidorsata*, and monotypic *Oriocalotes paulus*. Among Gekkonidae, *Cnemaspis assmensis, Cytodactylus khasiensis, Hemidactylus platyrus, Hemidactylus brooki, H. frenatus, Hemidactylus 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 (Tibet) (Smith 1935).

Japalura planidorsata is endemic to Myanmar and Assam, Khasi Hills & Garo Hills in Meghalaya, Cachar, N Chin Hills, and Mizoram. *Sphenomorphus courcyanum* (Annandale, 1912) is also endemic to

India (Assam, Meghalaya, Mizoram), China (S Xizang = Tibet) (The reptile database).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.

Turtles and tortoises

A total of 13 species of turtle and tortoises, belonging to 10 genus are reported from Meghalaya (Mathew 1995, Ahmed and 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 threated 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 and Das 2010, IUCN Red list).

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 (Ahmed and Das 2010). *Nilssonia hurum, L. punctata* (Das and 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 overfishing are other major threats to the species (Ahmed and 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* (Anderson 1871), *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 determined hitherto 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.

Box 3.2 *X*-mas Bush frog- The Little Endemic Frog of Shillong, Meghalaya

The X-mas 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 21mm 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*.

a) A calling male

b) a mating pair

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.

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Fig. 3.4 Herpetofauna from Meghalaya State

Pareas monticolous

Cyrtodactylus khasiensis

Pseudozenodon macropus

Ptyctolaemus gularis

Xenophrys major

Rhacophorus bipunctatus

(Photo:Bitupan Borah)

Purkayastha and Matsui (2012) discovered *Fejervarya 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.

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. Surveys by Zoological Survey of India reports 152 species belonging to 74 genera all across Meghalaya (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 4580 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* (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 India's 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 and Livestock Diversity

Meghalaya is considered a part of Vavilov's center of origin of crop plants to to its high diversity of plants which are of economic importance to man kind (Vavilov 1949, Sauer 1952, Harris 1990, 2007). The origin of the Asian rice (*Oryza sativaI)*, 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 (Meghalaya Mission for Indigenous Knowledge). 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 India including Meghalaya is also considered as centre of the origin of *Citrus* spp., including *C. indica* (Bhattacharya and 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 *Citru*s species, their 52 cultivars and a few probable natural hybrids are reported from this region (Singh 1981).

The state exhibit 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 north eastern India is endowed with a rich diversity of wildfruits, 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, which grows abundantly in Meghalaya with a large number of cultivars.

There are, however, gaps in information regarding commercial crops and varieties of traditional crops. There is a lack of proper information regarding genetic diversity of crop plants in the state (Asati and Yadav 2004).

Livestock Diversity

The traditional livestock diversity of Meghalaya has not been fully documented. 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).

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 indigenous cattle species or verities are neither properly recorded nor promoted by the veterinary 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 lack, 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 (NBAGR, Accession No. INDIA_PIG_1300_NIANGMEGHA_09002).

Fig. 3.5 Settled Paddy Cultivation in Garo Hills, Meghalaya

(Photo: Rishi Kumar)

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).

Biodiversity Conservation in the State

3.5 Protected Areas coverage

Protected Areas in Meghalaya have been established by acquiring land from the local communities. Thus these PAs are surrounded by mainly 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 biodiverstity 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

3.4.1.1 ***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 (UNESCO 1988). The forest habitat mainly consist of Tropical Evergreen, Moist Deciduous, Tropical Semi-evergreen, Sub tropical Evergreen forests and Riverine forests (Prabhu *et al.* 2010).

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)*, leopard (*Panthera pardus)*, and tiger (*Panthera tigris)* have been reported from the park (Choudhury 2003b). 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)* (Choudhury 1997, 2001, Gogoi 1981), 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 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.

Balpakram is floristically one of the most diverse places in India (Haridasan and 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 and Birand 2001). It is home to endangered (IUCN) Asian elephant (*Elephas maximus*), tiger (*Panthera tigris*), Hoolock gibbon (*Hoolock hoolock*) Gaur (*Bos gaurus*) (Choudhury 2002) and 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 and 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 (*Malogale*) (Kakati *et al.* 2014).

Fig. 3.6 *Nepenthes khasiana:* The Only Pitcher Plant of India

(Courtesy: Meghalaya Biodiversity Board)

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. Brahminy 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 (Birdlife International: Important Bird and Birdlife Areas*,* Islam and Rahmani 2005).

3.4.1.3 ***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 of which 9 species are listed under CITES (Roy *et al.* 2014).

3.4.1.4 ***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 (*Nepenthes khasiana*).

3.4.1.5 ***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 areas 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 (Choudhury 1998). 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 (Choudhury 1998). 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* was declared in 2014 by changing Narpuh Reserved Forest into wildlife sanctuary and is the first PA of Jaintia Hills. 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 a small areas in Meghalaya, Assam and Manipur (Ali and Ripley 1987, BirdLife International 2001). Narpuh also 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 (Lahkar 2002b). 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 laughingthrush, yellow-breasted babbler and greater necklaced laughingthrush (Lahkar 2002b).

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 (Choudhury 2002c, Choudhury 1998). 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 (Choudhury 1998). Other important mammals species found in the sactuary are the Asiatic black bear, Malayan sun bear, leopard cat and jungle cat, Himalayan palm civet, large Indian civet, small Indian civet, binturong, gaur, sambar and barking deer or muntjac (Choudhury 1999).

Table 3.4 Protected Areas of Meghalaya

Sl No	National Parks	Area (sq kms)
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	533.892 (Core), 2900 (Buffer) & 3500 (Total)
2	Khasi Hills Elephant Reserve	1,331 (Total)
	Total	**4831**

Source: Meghalaya Forest Department

3.5.2 Elephant Reserves

The state has a sizable populations 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 polulation declined to 1811 individuals. Since then Meghalaya Forest Department has not undertaken any furher elephant surveys. Due to this high density of elephants in the state, for their protection, state has devised various policies. Recently Wildlife Trut of India and Samrakshan Trust have been working with Forest Department towards securing habitat and corridors for the species and enhancing awareness of communities for conservation of elephants and their habitats.

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 concurrence/ notification is awaited.

Table 3.5 Reserved Forests of Meghalaya State

Sl. No	Name of Reserved Forests	Gazette Notification and date	Area (in sq. km.)
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
	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
	Songsak R.F.	No. 29 of 1.10.1885 & 3583 R of 5.9.1902	23.31
			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

Table 3.6 Area Acquired by Forest Department for Declaration as Reserved Forest (Notification Awaited)

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

Table 3.7 Protected Forests

Sl. No	Name	Area (sq. km.)	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. 2	0.21	East Khasi Hills
5	Umkhuti P.F.	0.14	Ri-Bhoi
	Total	**12.39**	

*****Meghalaya Forest Department

Both the elephant reserves encompass large areas of human-habitation, which increase the complexity of managing the free ranging megaherbivores 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.

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 megaherbivores such as Asian elephant.

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 due to strengthen conservation in and around existing or proposed protected areas.

Meghalaya has a large number of Community Reserves, the largest for any Indian state. Which in itself unique and commendable initiatve 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 3.12). 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. A list of Community Reserves in Meghalaya is given in Appendix 3.1.

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 fht eform of sacred groves (Gurdon 1975). *Ryngkew, Basa, Labasa* are some of the deities to whom these groves are dedicated. In additional 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 grove 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) –

1) *Law Lyngdoh* are the groves ruled by the priest *Lyngdoh*.
2) *Law Niam* are the places of traditional religion *Niam trai.*
3) *Law Kyntang* are the groves where the area is under control of the village headman.

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 as many as 105 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 and Control of Forests) Act, 1958 and Garo Hills Autonomous District (Management and 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/trees 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 (priest) 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 hectares 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).

3.5.2. *Biodiversity in Sacred Groves*

Sacred groves of Meghalaya represent the remnants of primary forests outside the PA network, and are key reservoirs of biodiversity (Bhagwat & Rutte 2006, Gadgil & Vartak 1975, 1976, Khiewtam & Ramakrishnan 1989, Tiwari *et al.* 1998). 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 (Khan *et al.* 2008), maintaining populations of pollinators and predators, propagules for colonization, sites for cultural practices and indigenous knowledge of communities (Ramakrishnan and Ram 1988, Godbole *et al.* 1998, Godbole and Sarnaik 2004, Tiwari *et al.* 1998 a, b, Singh *et al.* 1998).

The sacred groves in Meghalaya also harbour relatively higher species diversity compared to other forests (Upadhaya 2002, Jamir and 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 (Khurana 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 and Cavernicoles 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 continiously 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 di-oxide 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 (Baskar *et al.* 2009). 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 'Meghalaya Adventures Association' 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 kilometers of subterranean passages in Meghalaya (Prokop 2014).

3.5.2.1 *Cavernicoles or the Cave animals*

Common cavernicoles reported from the caves of Meghalaya include a terrestrial gastropod (*Opeas cavernicola*), two species of terrestrial isopod (*Philoscia dobakholi* and *Cubaris cavernosus*) 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-*Spelaeoblatta caeca* have been identified. Spider of genus *Heteropoda* also inhabits these caves, in 1920s Fage (1924) discovered *H. robusta* from the caves of Meghalaya.

Fig. 3.7 Syndai Cave in Jaintia Hills

(Courtesy: State Biodiversity Board)

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), a depigmented fish with vestigial eyes, *Schistura papulifera* (Kottelat *et al.* 2007), 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 3.8). It is facing extinction threats due to habitat loss and degradation.

Fig. 3.8 Critically Endangered (IUCN) Cavernicole, *Otomops wrougtoni*

fig

(Photo - State Biodiversity Board) (Photo - Manuel Ruedi)

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 400–1,700 msl. It is one of the biggest bats from micro-chiropteran groups that reaches a length of 90 to 105 millimetres (Figure 3.9).

3.5.2.2 *Conservation issues for cavernicoles*

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 Hlls 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, Um Lm and Labit etc.

Fig. 3.9 The Great Evening bat, *Ia io* from Jaintia Hills

(Photo - Manuel Ruedi)

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. "Uranium Council of India Limited" 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 safeguard 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. Similarly, agitation prevented a cement plant near Siju caves and Balpakram NP.

3.8 Living Root Bridges of Meghalaya

The living root bridges of Meghalaya are example of unique traditional knowledge which has been inherited by the communities in the state (Fig. 3.10). These bridges serves as the most effective way of maintaining communication across villages. These bridges are engineered by manipulating the secondary roots of Ficus species (mainly *Ficus elastic*a, called *Dieng jri*). The aerial roots are made to grow horizontally through tunnels of beetle nut trunk or bamboos. Over the years these roots get trained through hollow poles) to the other side of the streams and eventually grow to an extent that they supersede any support. They develop such an extensive root networks all across that ultimately this broad pathway is laid with stones and handrails (Fig. 3.11). Being a living system these roots also take care of the wear and tear over the years of use. The whole process may take 20 to 25 years, and life of such bridges can be as long as 500 years. These bridges vary in length from 15 to 55 meters and from 1-4 meters across. They are also able to take weight of around 50 people at a time.

This traditional system is an example of ingenuity of the local communities, with almost no inputs, and which in its longevity overtakes any human constructed structure. Thus it is pertinent to preserve these bridges as well as the traditional knowledge which have made the community self-reliant in creating modes of travel across the streams and rivers. These communities live in one of the heaviest rainfall areas of the world, where structures made of steel and bricks will not survive beyond few decades due to rust and stream overflows.

The root bridges are also used by wild animals particularly during heavy monsoon. Being entirely made of ficus root, some rocks and earth, with some human modifications, it also serves as a preferred

bridge for the wildlife of the area. These areas are also culturally important areas for the indigenous communities.

Fig. 3.10 Major Living Root Bridges of Meghalaya

(Photo - State Biodiversity Board)

Fig. 3.11 *Mawlynnong* Living Root Bridge on river Thailong in East Khasi Hills, Meghalaya

(Photo: Meghalaya Biodiversity Board)

Conclusion

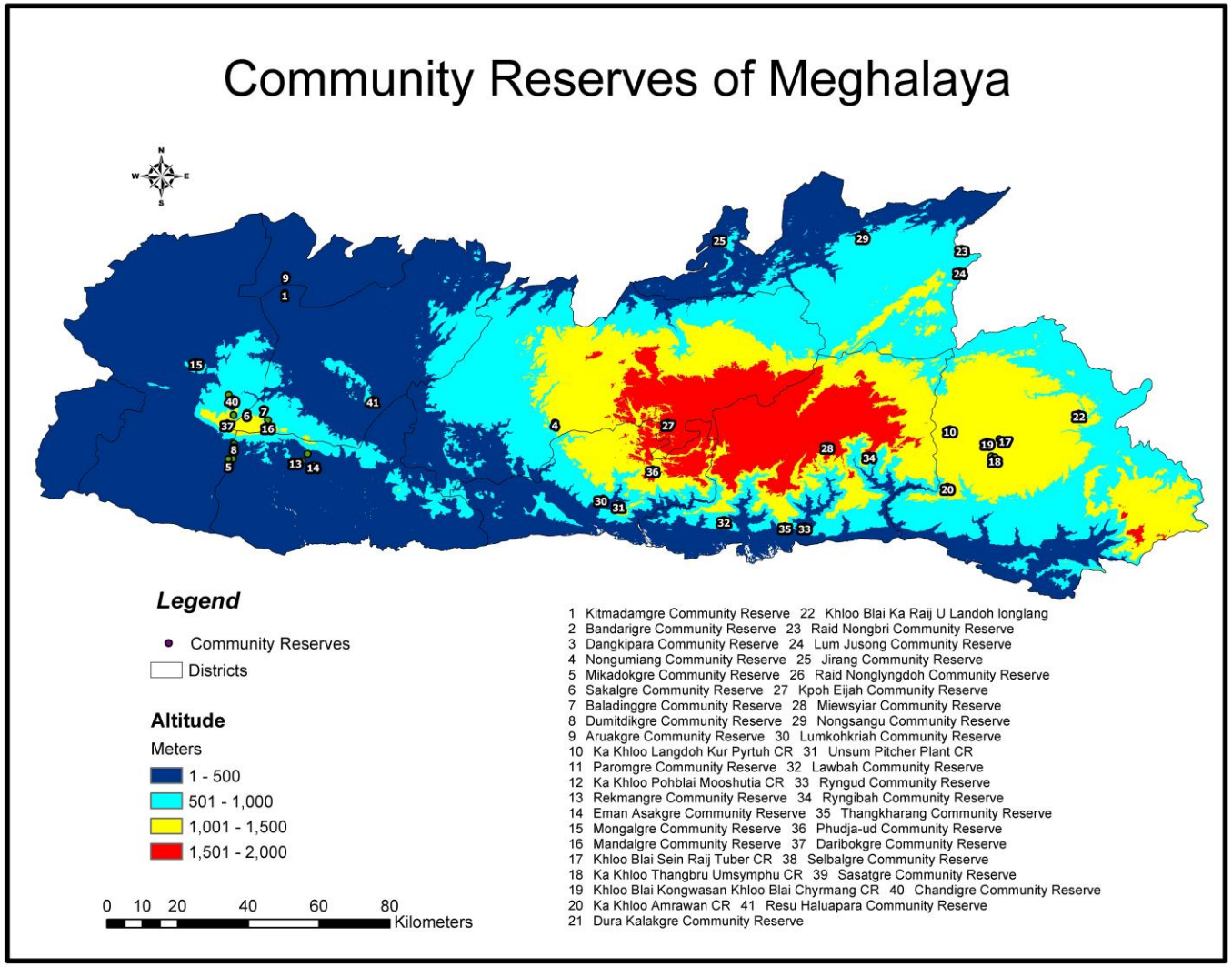
Many endemic, vulnerable, threatened, endangered (IUCN) species from Meghalaya are facing threats of habitat loss, over exploitation or loss of connectivity for dispersal. Chapter 4 list most of these threats to the species and landscapes. Among the flora, the pitcher plant (*N. Khasiana*) and many endemic 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. BSI and NBRI can contribute to capacity building of various state departments and communities in this regard.

Among mammals, particularly for the carnivores, and flagship species like clouded leopard, red panda and binturong etc. better species Conservation Action Plans (CAPs) are needed to protect them with the landscape these species inhabit. 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. There is need to again prepare conservation action plan for the species and implement already existing CAPs (Kumar *et al.* 2015). The creation of Elephant Reserves would definitely be a good 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). Electrocution is another major issue facing the pachyderm in Meghalaya, implementation of better electric pole management needs to be undertaken by electricity boards in discussion with forest department.

Meghalaya is also endowed with several Mahseer species, their survival is also threatened by destructive fishing and overharvesting. Fish sanctuaries can provide a good refuge to these species and should be encouraged. Avoiding fishing during monsoons also should be encouraged to allow recovery of aquatic species.

Similar to the species, some of the important landscape of the state need better protection, less interference and better management. 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 needs 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 other are needed to be declared to protect these landscapes. Forest Department and District Council should also encourage villages who wish to declare their village forests as PAs etc. with long term incentive schemes. Many other community reserves should also be preserved under village or community laws. Even though Meghalaya is known for its cleanliness, garbage and particularly plastic is destroying many important heritages of the state. There is need to ban use of plastic and better manage waste disposal.

Fig. 3.12 Community Reserves of Meghalaya



Limestone quarry in Cherrapunjee

(Courtesy: Rishi Kumar)

Chapter 4

Threats to Biodiversity

4.1 Introduction

Current trend in biodiversity loss are mainly attributed to anthropogenic pressures in the form of overexploitation 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 wellbeing. Hence, it is of utmost concern of the present day society (Diaz *et al.* 2006). The intricate relationship between rural communities with forests ecosystems makes them vulnerable to degradation. In Meghalaya both rural and urban population depend heavily on forests for daily needs of water, food and other services, and thus are liable to be affected due to ecosystem degradation and loss of biodiversity.

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 and Kumar 2008, Tynsong and Tiwari 2011a, b, 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 (Tiwari and Kumar 2008). 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 (Tiwari and Kumar 2008). 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 (Tiwari and Kumar 2008).

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 (*Nepenthes khasiana*), 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 serpentine*, *Dipteris wallichii, Cyathea*

gigantean, Ilex embeloides, Styrax hookerii and *Fissistigma verrucosum, Taxus baccata, Tinospora cordifolia, Vinc rosea, Stychonos nus-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 (CUTS 2002, in Kumar and 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* etc., and toxic chemicals pose a great threat to all the aquatic species and also to the communities dependent on these rivers (Singh and Borthakur 2015). In recent years much worse methods of fishing has 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 M.T.). Khasi and Jaintia Hills also have large coal deposits (170 M.T. and nearly 75 M.T. 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 and 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 and 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, Sarma 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 and Jesudasan 2012, Lamare and Singh 2014).

Coal mining also results in habitat degradation and landscape dotted with mining spoils in Nokrek Biosphere Reserve (Sarma and Barik 2011). There was drastic reduction in trees and shrub diversity (Sarma and Barik 2011). Another study in Jaintia hills points to higher herbaceous diversity of

mined areas and differences in dominant tree species. Thought the tree diversity was unaffected, yet, 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.

Fig. 4.1 Rat Hole Mine of Meghalaya

(Courtesy: Chandrasekar Reddy)

Fig. 4.2 Coal Mine of Meghalaya

(Courtesy: Chandrasekar Reddy)

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 lime stone mining in Jaintia hills indicate that water quality degradation in mined areas is not restricted to coal mining but lime stone mining also results in elevated level of pH, Electrical Conductivity, Total Dissolved Solids, hardness, alkalinity, sulphate and phosphorus concentrations (Lamare and 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 portable water and water for irrigation in vicinity of mined areas (Lamare *et al.* 2014).

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

(Photo: Arwat Challam)

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 and 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 (Centre for Environment Protection Research and Development). 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 at these effect the biodiversity and ecosystems surrounding these extraction areas and also are 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 sq. km) 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).

Table 4.1 Forest Cover Changes in Meghalaya

Year	Very Dense Forest (VDF)	Moderate Dense Forest (MDF)	Open Forest (OF)	Scrubs	Total Forest Cover **
2001	5681		9903	259	15843
2003	6491		10348	169	17008
2005	7146		9842	181	17169
2009	410	9501	7410	211	17321
2011	433	9775	7067	485	17275
2013	449	9689	7150	372	17288
2015	449	9584	7184	348	17217

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

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 943355.12 cubic meter 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 on 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 and Wilson 1967).

The recent changes in agricultural land use and cropping pattern has bought drastic change in agricultural systems of the state. The traditional diet of the people was millet and during 18^{th} 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).

Table 4.2 Land Use Statistics of Meghalaya from 1996 to 2004

Land Classification	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**	**2003-04**
Reporting area for land utilization statistics	22409	22409	22409	22409	22409	22409	22409	22409
Forest	9353	9340	9470	9415	9418	9505	9470	9472
Not available for cultivation	2237	2261	2225	2246	2155	2254	2253	2254
Other uncultivated land excluding fallow land	6324	6315	6214	6224	6303	6064	6008	5996
Fallow land	2345	2338	2286	2306	2314	2343	2384	2357
Net sown area	2164	2156	2214	2217	2218	2105	2155	2192
Area sown more than once	441	441	444	456	450	466	466	466
Total cropped area	2605	2597	2658	2673	2668	2571	2621	2659

Source: Directorate of Economics and Statistics, Meghalaya 2003, 2005

4.2.4. Distortion in *Jhum* Cultivation

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

During 1995 to 1997, ca 1,875 km^2 of tropical forest (ca 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 harbors 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.

Fig. 4.4 Slash and Burn (*Jhum*) in Garo Hills, Meghalaya

(Photo: Rishi Kumar)

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 percent of the fire incidents of NE India (Chakraborty *et al.* 2014).

Fig. 4.5 *Jhum* fire, Responsible for Most of the Forest Fires in Meghalaya

(Courtesy: Rishi Kumar)

An assessment of forest fires in Meghalaya state reveals that most of the fire incidences are concentrated in East Garo Hills and Jaintia Hills. Vulnerability of areas to fire depend on the vegetation type of the area. Agricultural land 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).

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. Megaherbivores 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 harbors a sizable 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 and 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, Samrakshan Trust). 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, and this have effect on compensation paid and increase in human wildlife conflict. Occupancy analysis provides a better tool to access and mitigate these conflicts. 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).

4.2.7. Invasive 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., there by 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 hectares 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.

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 cash crops 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 of cash crop plantations, 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 effect 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 (Samrakshan Trust). 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 bushmeat 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 over exploitation is for particular bird families' viz., parakeets, pigeons and pheasants, which are hunted for personal and local market consumption (Singh and Borthakur 2015).

4.3. Indirect Threats

4.3.1. Pollution

The Meghalaya State Pollution Control Board (MSPCB) have 7 station across the state to access 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. Particulate Matter 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, 4 lakes and 7 spring/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 5000mpn/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 capacity and 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 and 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, buildup areas etc. not only cause forest loss, they are 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, Meghalaya 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. 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 (Bera *et al* 2006). 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, 66,889, 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, 2011, 2001, 1991). Nearly 80% of population of the state lives in rural and only 20.0 % in urban areas.

Rapid infrastructure development such as highways, new buildings, especially in the migratory routes of elephants / corridors 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 powerlines have also resulted in large number of elephant deaths in the state. It is seen that low hanging cables and damaged/bent electric poles have caused most of the electrocutions. Electrical cables passing through forests are also threat to many arboreal species such as gibbon, capped langur. 'The Association SVVA' that is involved in rehabilitation of rescued gibbons and other primates, also feels unprotected electric wires are a major threat to the arboreal species. They are receiving increasing number of electrocuted gibbons and other primates 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 town. 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 agrobiodiversity of the state. The traditional diet of the people was millet and during 18th century and subsequently 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 crops (Behera *et al.* 2015).

4.3.3. Climate Change

The data from Indian Meteorological Department and Climate Research Institute (CRU TS) 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 degree Celsius. 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 (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.* 2006a, b), 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 and Rossi 2008, Holzinger *et al.* 2008) and animals (Sekercioğlu *et al.* 2012, Kannan and 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.

Chapter 5

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[1]. 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-resorces, 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).

[1] *Mawlynnong* is a village in the East Khasi Hills district of the Meghalaya state, India. It is famous for its matrilineal society as well as having been recognized as Asia's cleanest village.

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 (Chapter 6).

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.
- There is a lack of 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 small 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 grooves 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.
- There is lack of institutional mechanism for baseline data collection about species at state and national level.

5.5 Gaps in Conservation of Agrobiodiversity and Domestic Livestock

- Native crop varieties, land races and wild relatives of crop plants have not been catalogued properly.
- 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 if 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 and Barman 2013).

5.6 Gaps in Integrated Planning and Resource Allocation for Biodiversity Conservation

- Currently there is hardly any 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. These departments also control the bulk of financial resources.

- 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 lack of understanding of the cross sectoral linkages to identify strategies and policies that negatively affect biodiversity and ecosystems.
- For integrated natural resource management, participatory planning and closer coordination and coherence between the state, district councils and local institutions are needed.
- There are no guidelines and mechanisms for establishment of access and benefit sharing agreements between the communities which own the genetic resources and industries which needs these 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 (UNDP-BIOFIN http:// www.biodiversityfinance.net/). BIOFIN process is yet to be initiated properly in the state of Meghalaya.

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.

- Though, the GoM has adopted several policies and programmes dealing with management of natural resources, human welfare and sustainable development in the state, there are wide gaps between the existing policies and practices on the ground. Such gaps need to be bridged through participatory planning and closer coordination among various departments and better governance.
- There is lack of proper Bio-piracy law and its awareness among communities, state police department and frontline staff of Forest Department.
- There is gap in formation of biodiversity register by the various BMCs in the state. Local communities are not fully aware of their rights and state government has not been able to make them aware of these rights related to genetic resources they own.

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

- 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.

Table 5.1 Gaps in Management, Conservation, Policies and Actions

S.No.	Gaps in management, conservation, policies and actions
5.2	***Gaps in PA management***
a)	Lack of comprehensive assessment of threats to species
b)	Lack of public participation in management of PAs
c)	Lack of trained staff
d)	Lack of landscape level conservation planning
e)	Gaps in assessment of biological corridors
5.3	***Gaps in management of community forests and Reserved Forests***
a)	CCA status and legal protection conferred to very few community forests
b)	Lack of 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 incentives to communities for declaring village forests as CCAs and maintaining CCAs
5.4	***Gaps in species management and conservation***
a)	Gap in information on most of the endangered, threatened and rare species, or critical landscapes
b)	Absence of long term monitoring programme for these species within PAs and community forests.
c)	Lack of Conservation Action Plans and species recovery programme for critically endangered species
d)	Need to revise working plans
e)	Lack of institutional mechanism to collect baseline data for species
5.5	***Gaps in conservation of agrobiodiversity and domestic livestock***
a)	Lack of 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
d)	Local farmers lack capacity for scientific breeding, feeding and management of indigenous livestock
e)	Silkworm cultivators in the state are inadequately equipped, lack incentives and market access
5.6	***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.
5.7	***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 on ground
e)	Lack of laws and awareness regarding bio-piracy

f)	Lack of awareness among communities regarding genetic resources and community rights
5.8	***Need for capacity building and strengthening of Institutions***
a)	Need assessment of capacity building and awareness requirements of VCs and BMCs
b)	Capacity building of frontline forest staff for participatory planning and adaptive management of forests and forest resources.
c)	Need to employ staff and procure required equipment for protection and conservation of biodiversity
5.9	***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

The purpose of this Biodiversity Strategy and Action Plan (BSAP) for the state of Meghalaya 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, conserved, restored and wisely used maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people of Meghalaya."

6.2 Mission

The mission of the BSAP is to take effective and urgent action to halt the loss of biodiversity of the state in order to ensure that by next ten years i.e. 2026, ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being and poverty alleviation. To ensure this, stressors on ecosystems are reduced, degraded ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided for conservation, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the participatory approach.

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 -

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 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.

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: 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.

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 (Meghalaya Agricultural Profile, 2006). The slash and burn cultivation is the main stay 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.

6.4.1.2 Strategies and Actions

Strategy 1.1: *Enhance environmental awareness and values of biodiversity among the youth.*

Action 1.1.1: Assess the awareness about environment and values of biodiversity among youth.

Action 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.

Action 1.1.3: Develop curricula on biodiversity conservation and sustainable management for schools and colleges and implement.

Action 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.

Strategy 1.2*: Mainstreaming environmental education and conservation awareness in the state education policy.*

Action 1.2.1: Review current environmental curricula of the state and incorporate biodiversity components.

Action 1.2.2: Review the state education policy and suggest necessary amendments by including environmental education and biodiversity conservation awareness.

Action 1.2.3: Identify agencies involved in environmental education and awareness raising programs and set up a coordination mechanism for education and awareness.

Action 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.

Action 1.2.5: Incorporate indigenous traditional knowledge and traditional eco-friendly industries related to biodiversity conservation in the state education curricula.

Strategy 1.3: *Build capacity of educational and training institutes in imparting environmental education and advocacy programs.*

Action 1.3.1 Conduct need assessment surveys for informal education sector and plan for capacity enhancement training programs and workshops.

Action 1.3.2 Conduct need assessment for formal education sector and develop plan for capacity enhancement.

Action 1.3.3 Explore future possibilities and present funding for environmental capacity building *via* corporate social responsibility (CSR) initiatives.

6.4.1.3 Indicators:

1. Trend in number of students taking biodiversity and environment courses at higher education in formal and informal sectors such as ICAR, NBPGR, BSI and ZSI.
2. Trend in informal courses, awareness and capacity building programs of school, colleges and other institutions.
3. Trend in state education policy, i.e. incorporation of more aspects of environment and biodiversity conservation.
4. Trends in the proportion of population aware of biodiversity.
5. Environmental Education Policy of the state in place and status of its implementation.
6. Trends in the implementation of biodiversity-related CSR initiatives.
7 Trends in promotion and productivity of traditionally eco-friendly industries that enhance livelihood and biodiversity conservation

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 / Ph.D. students in environment, forestry and biodiversity management related aspects.
6. Awareness and education programmes also need to be initiated in rural areas.
7. 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.
8. 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.
9. Promote cottage industries such as eri/muga silk cultivation and silk production via traditional technologies to enhance livelihood and biodiversity conservation

6.4.2 MBT 2: By 2026, 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 Relevance

Biodiversity and ecosystem services are closely linked with rural livelihoods, other cultural traditions, and social entrepreneurships. In recent years, emphasis has been laid on computing these values in economic terms, so as to realize their significance I 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.

6.4.2.2 Strategies and Actions

Strategy 2.1: *Set up an institutional mechanism for valuation of biodiversity and ecosystem services.*

Action 2.1.1: Identify a lead agency to coordinate valuation of biodiversity and ecosystem services.

Action 2.1.2: Take stock of initiatives in valuation of biodiversity and ecosystem services.

Action 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.*

Action 2.2.1: Assess current capacity, gaps and needs for valuation of the biodiversity and ecosystem services.

Action 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.*

Action 2.3.1: Review state level policies and legislations to mainstream biodiversity and ecosystem services, with involvement of marginalized communities.

Action 2.3.2: Incorporate biodiversity and ecosystem service values into relevant state documents such as the five year development plan.

Action 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.*

Action 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.

Action 2.4.2: Integrate rural livelihoods with the Integrated Basin Development and Livelihood Promotion programme.

6.4.2.3 Indicators:

1. Trends in the capacity for valuation of biodiversity and ecosystem services.
2. Trends in the number of valuation studies in the state.
3. Trends in the number of legislations/guidelines with biodiversity values integrated.
4. Number of marginal farmers engaged in restoration/conservation programmes.

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, 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 / central schemes and engage poorest sections of society in order to reduce exploitative pressure on forests.

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 2026 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*., Important Bird Areas (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

Strategy 3.1: *Map biodiversity rich habitats and ecologically sensitive sites.*

Action 3.1.1: Identify biodiversity rich sites and habitats outside PAs.

Action 3.1.2: Identify and map ecologically sensitive sites.

Action 3.1.3: Identify important localities and degraded areas for eco-restoration.

Strategy 3.2: *Identify major driver or causes of environmental degradation.*

Action 3.2.1: Assess various drivers of environmental degradation and identify the major drivers.

Action 3.2.2: Access status and trends of biodiversity and ecosystem services and integrate with state policies

Action 3.2.3: Assess and explore linkages between positive effects of these interventions on human wellbeing.

Strategy 3.3: *Reduce the rate of habitat degradation, loss and fragmentation.*

Action 3.3.1: Account for the extent and rate of habitat loss due to forest clearance, fragmentation and degradation.

Action 3.3.2: Initiate eco-restoration programmes through participatory process in highly degraded areas, especially around PAs and mined sites.

Strategy 3.4: *Address the major causes of habitat loss and environmental degradation.*

Action 3.4.1: Enhance awareness on forest fire and other potential factors causing habitat loss.

Action 3.4.2: Strengthen state fire management program in terms of human capacity, research, technology, coordination, surveillance and response system.

Action 3.4.3: Scale up community-based forest fire management approaches.

Action 3.4.4: Identify key drivers of habitat loss and degradation, and develop strategies to minimize them.

Action 3.4.5: Develop policy and programs to engage local communities in management of forests and by providing alternative or additional sustainable livelihood schemes.

Action 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:

1. Trends in extent and rate of habitat loss.
2. Trends in forest fire incidences (excluding fire in *jhum* fallows for preparing *jhum* fields).
3. Trends in the availability of information on the degree of degradation of degraded areas and ecosystems.
4. Trends in rehabilitation of prioritized degraded areas and ecosystems.

6.4.3.4 Specific Actions:

1. Geographical Information System and georeferenced images has become 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 will in further conservation planning.

2. Scientific studies need to be also 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 participatory / 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 stakeholders. 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/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 benefitting agriculture etc.

8. Pollution from mines, industries, vehicles and ecological disturbances can have adverse effect of human health and wellbeing. 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.
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 to miners and general public. Aware villagers would be able to able to pressurize mine owners to use better methods of mining, better safeguard and avoid unwanted leaching and pollution. A well-structured awareness programmes should be undertake for all stakeholders. Effective mining policy should 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 also for the population living in vicinity.
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. For safeguard of environment, ecosystems and biodiversity, and human health, it should be made mandatory for mines to follow these regulations and standards. The mineral and mining department should make these assessment and clearances indispensable and adhered to before allowing

for any mining operation. Social and environment departments and NGOs should take steps to educate people on these issues as this directly affect their health, livelihoods.

12. Mining is one of the major cause of water pollution (Eugene and 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. Simsang, Myntdu, Lukha river etc. are some of the rivers, that have turned acidic blue with loss of all aquatic life due to mining discharges (Acid Mine Discharge). 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. Most of the mines in the state are being abandoned after exploitation. The collapse of mines also pose threat to life of people and wildlife living in the vicinity or abandoned area. It is thus essential to ensure that the mines are restored after extraction has stopped. 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 and 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+) for the community forests also. 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 of the state.

6.4.4 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.

The two above mentioned Aichi targets relates to this MBT and in addition the MBT also covers a part of the Aichi target 10 consisting of vulnerable ecosystems impacted by climate change.

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. Even the well know species like the *western hoolock gibbon, Asian elephant* has not been studied properly in the state. Data on distribution and status of clouded leopard, different species of macaques, *Mahseer* etc. is also not 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

Strategy 4.1: *Strengthen conservation programs for state wetlands, rivers and aquatic species.*

Action 4.1.1: Identify important wetlands, rivers, streams, river basins, lakes and catchment areas which are facing threat of destruction, pollution or anthropogenic pressures.

Action 4.1.2: Develop policies, guidelines and state laws which enable protection against anthropogenic intervention in aquatic systems and catchment areas of the state.

Action 4.1.3: Implement guidelines and policies related to conservation of aquatic ecosystems, and control of pollution through SPCB, Mining Department etc.

Action 4.1.4: Adopt policies for in-situ conservation of aquatic species e.g. several *mahseer* species in the state rivers, streams, lakes etc.

Action 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.

Strategy 4.2: *Strengthen conservation programs for the unique karst ecosystems of the state.*

Action 4.2.1: Identify and document the key karst ecosystems of the state.

Action 4.2.2: Frame guidelines for anthropogenic interventions and protection of karst ecosystems and its biodiversity.

Action 4.2.3: Prevent pollution of caves and restore caves degraded by pollution and mining.

Strategy 4.3 *Assess the impacts of climate change on biodiversity and ecosystems.*

Action 4.3.1: Develop a network of long-term climate monitoring stations for the generation of comprehensive climate data.

Action 4.3.2: Promote inter-disciplinary research on climate change, biodiversity, and ecosystems.

Action 4.3.3: Institute a national mechanism to collate and share data and information generated from research for the development and implementation of adaptation measures and policy decisions.

Action 4.3.4: Conduct systematic awareness and educational programs on the impacts of climate change on biodiversity.

***Strategy 4.4**: Strengthen climate change adaptation measures.*

Action 4.4.1: Develop a policy on climate change with special focus on food security, biodiversity and water.

Action 4.4.2: Develop appropriate long-term ecosystem-based adaptation measures to minimize impacts of climate change on vulnerable ecosystems, biodiversity and communities.

Action 4.4.3: Strengthen implementation of immediate targeted actions for prioritized ecosystems.

Action 4.4.4: Integrate long-term ecosystem-based adaptation measures into plans and programs.

***Strategy 4.5:** Enhance management effectiveness of the Protected Area System and community forests.*

Action 4.5.1: Evaluate the management effectiveness of Protected Areas and Biological Corridors.

Action 4.5.2: Complete zonation of PAs by 2018.

Action 4.5.3: Enhance local community participation in the management of PAs.

Action 4.5.4: Review the functionality of Biological Corridors for demarcation, operationalization and legal protection.

Action 4.5.5: Review and evaluate conservation reserves and CCAs.

Action 4.5.6: Monitor and assess the status and trends of biodiversity within the Protected Area System and community forests.

Action 4.5.7: Promote and support transboundary management and regional partnership initiatives.

Action 4.5.8: Encourage local communities to declare community forests as CCAs by providing schemes for improving livelihood.

Action 4.5.9: Prioritise critical areas which 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.

Action 4.5.10: Provide incentives to local communities for declaring CCAs and for biodiversity conservation.

***Strategy 4.6**: Establish sustainable financing measures for the Protected Area System and CCAs.*

Action 4.6.1: Develop and implement REDD+ activities to support conservation financing.

Action 4.6.2: Institutionalize and upscale Payment for Ecosystem Services (PES) initiatives.

Action 4.6.3: Upscale nature recreation and ecotourism programs with a financial plough back mechanism.

Action 4.6.4: Explore additional innovative financing mechanisms.

Strategy 4.7: *Assess the status of prioritized taxonomic groups and species and the factors affecting them.*

Action 4.7.1: Develop a state mechanism and evaluate the conservation status of prioritized taxonomic groups and species.

Action 4.7.2: Update the status of Red Listed species which are endemic to Meghalaya.

Action 4.7.3: Assess threats to long term survival of prioritized species.

Strategy 4.8: *Strengthen conservation programs for prioritized species.*

Action 4.8.1: Prioritize species for conservation based on nationally agreed or state criteria.

Action 4.8.2: Develop and implement species-based conservation management plans for prioritized species.

Action 4.8.3: Enhance capacity in species-based conservation and monitoring.

Action 4.8.4: Strengthen institutional and legal capacities to combat wildlife poaching.

6.4.4.3 Indicators:

1. Trends in availability of information on species and ecosystems most vulnerable to impacts of climate change.
2. Trend in implementation of Climate Change Policy in the state.
3. Vulnerability profile of the state.
4. Trends in conservation reserves and CCAs
5. Trends in the number of biological corridors operationalized
6. Trends in financial resources mobilized for PAs.
7. Type and number of transboundary-related initiatives and agreements.
8. Trends in availability of updated National Red List of prioritized taxonomic groups.
9. Trends in species-based conservation strategies and programs.

6.4.4.4 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 a 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 additions 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 km area 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. Aquatic species which are rare, threatened or endangered, their extraction should be banned by the forest department. 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. State pollution control board should implement CPCBs directives regarding affluent discharge in streams and lakes. 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. Guidelines, policies and better practices for mining, industries and vehicles should be brought out by the state pollution control board with inputs from the Central Pollution Control Board. 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. Management

plans for conservation for these priority species in PAs and community areas should be prepared. NGOs like WTI, Samrakshan Trust, WWF etc. and institutions like WII have been involved in working with species like gibbons, elephants, small carnivores and these institutions should be involved in preparation of these management plans.

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 / community forest protection squads. Local village leadership should also be involved in protection and conservation of species and its habitat in their village parameters. Incentives schemes for the villages should also be devised to motivate them to conserve these species and habitats.
17. Communities must be compensated appropriately for transferring lands to PA systems. Villages like *Mandalgre* in East Garo Hills are willing to transfer community land to Nokrek National Park, such initiatives of villages should be encouraged and compensated. However community forests managed by local communities also are equally important and such communities should also be given benefit of conserving biodiversity and ecosystems via alternative and additional livelihood schemes.
18. 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
19. In order to prevent electrocution deaths of Asian elephants, the height above the ground at the lowest point of the lowest conductor or grounding wires (i.e., at maximum sag point) of powerlines, passing through all natural areas with presence or movement of Asian elephants shall be a minimum of 20 feet (6.6 meters) above ground on level terrain (slope 20 degrees) and a minimum of 30 feet (9.1 meters) above ground on steeper terrain (slope > 20 degrees) (Guidelines for linear infrastructure intrusions in natural areas: roads and powerlines, 2011).

20. 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 (Guidelines for linear infrastructure intrusions in natural areas: roads and powerlines, 2011).
21. Tree canopy overlapping overhead above roads is an essential attribute to be retained wherever roads pass through forests with closed canopy or significant tree cover (tree density per hectare of over 50 tree stems of girth greater than or equal to 30 cm), as a low-cost, efficient and durable solution for the movement of arboreal species (Guidelines for linear infrastructure intrusions in natural areas Anon. 2011).
22. All constructions to be associated with EIA and consultation with forest department, local bodies etc. Construction of roads, build up areas etc should be done after evaluation of the benefits and negative impacts on forests, ecosystem and biodiversity.
23. Awareness programs regarding family planning etc., better child care and medical health would also help families to better plan for a child. Better family planning policies and incorporation of incentive schemes for smaller families would also benefit environment and biodiversity.
24. Rural – urban migration are responsible for negative changes in human wellbeing. Most of the rural population live in unhygienic and unhealthy surroundings of urban landscape after migration. This can be checked by providing better livelihood options and quality of life, and creating new employment opportunities in rural areas. Forest department, agriculture department, animal husbandry and rural development department should provide alternative and additional livelihood schemes, to the rural population that do not adversely affect the biodiversity of the area.
25. Joint forest management and similar practices in Himalayan region has been very effective in addressing the climate change via carbon sequestration and also of 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.

26. The community forests also can play a major role in climate change mitigation by not only providing forest related mitigation measures but also through sustainable livelihood options.
27. 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).
28. Climate change concerns to be build up in urban drainage, waste disposal, and water supply mechanisms. And increasing the water use efficiency particularly in the urban areas.
29. Various research and studies are also needed for carrying capacity mapping, mapping of the vulnerable urban poor in the state (MSCCAP, 2011).
30. 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).
31. As forests are one of the most vital carbon sinks, sustainable forestry is a very important climate change mitigation measure. Forests also play an indispensable role in maintaining ecological balance and restoration of biological diversity (MSCCAP, 2011), thus sustenance of good forests is an important climate change mitigation measure.
32. 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).
33. 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.
34. 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.
35. Develop strategies to control the populations of free ranging feral and domestic animals in the wildlife habitats.
36. 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: 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.

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 becomes 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 forests 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/ 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.

6.4.5.2 Strategies and Actions

Strategy 5.1: *Assess key ecosystem services, their flow and use by various groups.*

Action 5.1.1: Establish baseline data on key ecosystems services (ESS) from PAs, RFs, and CCAs and flows of these services.

Action 5.1.2: Document the patterns of ESS flow across various sections of society including women and poorer sections.

Action 5.1.3: Device strategies to integrate ESS into the state level development planning.

Strategy 5.2: *Safeguard health of key ecosystems so as to sustain ecosystem services.*

Action 5.2.1: Identify the major drivers affecting health of ecosystems.

Action 5.2.2: Initiate awareness programmes on ecosystem health and long term ecological security.

Action 5.2.3: Restore and augment degraded ecosystems for sustaining ecosystem services.

6.4.5.3 Indicators:

1. Assessment reports on ecosystem services from PAs, RFs, and CCAs.
2. Number of valuation studies on ecosystem services and safeguard measures/ framework in place for implementation.

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.
2. Identify all types of ecosystem services and their role in human health and well-being.
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.

6.4.6 MBT 6: 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.

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 quite susceptible 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

***Strategy 6.1**: Improve understanding on IAS and native species with high potential of invasion.*

Action 6.1.1: Complete state level/regional level inventory of IAS and native/naturalized species with potential for invasiveness along with the distribution and pathways of introduction.

Action 6.1.2: Develop modules on invasive species for incorporation in the training curricula of relevant institutions.

Action 6.1.3: Promote education and awareness on invasive species and their impacts.

Action 6.1.4: Build technical capacity on invasive species management.

Action 6.1.5: Monitor and map the spread of invasive alien species in different parts of the state and investigate the pattern of invasion.

Action 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.

Strategy 6.2: *Identify invasive species pathways and changes in areas affected by IAS.*

Action 6.2.1: Assess the damage and changes in natural systems and agricultural systems due to IAS.

Action 6.2.2: Develop mechanism for IAS monitoring and control in the state.

Action 6.2.3: Develop guidelines to prevent weeds and IAS spread and incorporate into policy documents.

***Strategy 6.3**: Develop and implement measures to protect natural and agriculture ecosystems against IAS.*

Action 6.3.1: Assess the impacts of IAS and native invasive species o agrobiodiversity and production.

Action 6.3.2: Develop management strategies for established high-risk species, taking into account the effects of climate change.

Action 6.3.3: Develop and implement guidelines to manage and regulate entry and introduction of IAS.

Action 6.3.4: Develop an institutional framework for IAS management and regional collaboration.

6.4.6.3 Indicators:

1. Baseline on the district wise spread and extent of IAS.
2. Species specific management/control programme in place
3. Annual plan of forestry operations including a chapter on control of IAS.

6.4.6.4 Specific Actions:

1. Establish baseline data on the area and spread of IAS in the state. Species specific management plan and strategies including guidelines for prevention, control and management needs to be prepared.
2. Prevention of introduction and establishment of invasive species is first line of defense and thus measures need to be taken to regulated invasion of new IAS in the state.
3. An invasive species control system should be setup by the state consisting of trained staff to address control of invasive in the state. This team needs to work in coordination with the communities to prevent the spread of invasive, which can wreak havoc on natural ecosystems and agricultural lands. Many species such as *Lantana, Eichhornia, Chromolaena, Parthenium, Ageratina, Mikania* etc. have become quite common in PAs of the state also. Rapid response teams comprising local people from the communities should be also formed in various districts.
4. Rapid response teams (RRTs) to prevent and control invasive species need to be formed within each district and RRTs should be well equipped and trained to manage various invasives. In cases total eradication is not possible the spread of invasives can be reduced and controlled. RRTs should coordinate with various departments *viz*., Agriculture, Forest and Rural Development to prioritize activities to control IAS spread.
5. Develop guidelines for management of IAS from natural areas with the help of various stakeholders including Agriculture Department and the State Forest Department. The FD also needs to establish IAS monitoring programme.
6. Take steps to control spread of invasive dwarf bamboo species in the state particularly along *jhum* cultivations.

6.4.7 MBT 7: By 2026, 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 belong 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

Strategy 7.1: *Strengthen information base, institutional and technical capacity in the conservation and sustainable utilization of fish and aquatic biodiversity.*

Action 7.1.1: Identify a lead agency to coordinate inventory of aquatic biodiversity.

Action 7.1.2: Conduct a state wide inventory and documentation of fish and other aquatic species diversity.

Action 7.1.3: Strengthen institutional and technical capacity in fish and aquatic biodiversity conservation and sustainable utilization.

Action 7.1.4: Strengthen local and traditional fish conservation practices with incentives e.g. Fish sanctuaries etc.

Action 7.1.5: Develop and implement sustainable management plans for fish and key aquatic biodiversity.

Action 7.1.6: Formulate policies for sustainable use of bio-resources in the state.

Strategy 7. 2: *Identify threats to aquatic life and fish biodiversity and take steps to ameliorate them.*

Action 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

Action 7.2.2: Prepare guidelines and policy documents to prevent detrimental fishing practices and other developmental activities, which may affect the aquatic ecosystems.

Action 7.2.3: Prevent garbage pollution of aquatic systems by formulating and implementing rules related to discharges of urban and industrial wastes into the water bodies.

Strategy 7.3: *Improve management of private forest, State Forest, and village forests for sustainable production of goods and services.*

Action 7.3.1: Identify community forests which falls outside the Forest Management Units and lack management plans; bring these forest patches progressively under sustainable management regimes.

Action 7.3.2: Review and update codes of best practices and guidelines for holistic sustainable forest management.

Action 7.3.3: Constitute a Monitoring and Evaluation mechanism to assess the efficacy of the management plans in terms of sustainability.

Action 7.3.4: Promote sustainable management practices in village grazing land.

Strategy 7.4: *Strengthen good governance for sustainable management of forests.*

Action 7.4.1: Strengthen transparency through access to information and consultative/ participatory approaches.

Action 7.4.2: Enhance institutional capacity for sustainable management of resources and effective delivery of services.

Action 7.4.3: Strengthen capacity and empower local communities for sustainable management of resources.

Strategy 7.5*: Promote sustainable agricultural practices that ensure conservation of biological diversity.*

Action 7.5.1: Assess biodiversity indices based species biodiversity in major farming systems.

Action 7.5.2: Introduce appropriate measures for conservation of biodiversity in the agricultural systems.

Action 7.5.3: Promote organic farming as per the state or National Agriculture Development Plan.

Action 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.

Action 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.

Action 7.5.6: Promote agro-forestry based farming practices.

Action 7.5.6: Provide loans and micro-finance opportunities to farmers for sustainable agriculture.

Strategy 7.6*: Major pollutants affecting environment are maintained as per the National environmental standards.*

Action 7.6.1: Strengthen implementation of environmental standards for all major pollutants.

Action 7.6.2: Strengthen monitoring and reporting mechanisms for all major sources of pollution.

Action 7.6.3: Strengthen environmental performance reporting system by industries.

Action 7.6.4: Take steps to reduce usage of plastic and declare Meghalaya as plastic-free State.

Strategy 7.7: *Strengthen research and technical capacity for documenting, monitoring and assessing the impacts of major pollutants.*

Action 7.7.1: Document and quantify major pollutants.

Action 7.7.2: Develop capacities to assess and monitor major pollutants.

Action 7.7.3: Strengthen research and technologies to assess and monitor impacts of major pollutants on environment, including biodiversity.

Action 7.7.4: Adhere to the national baseline for river water quality and develop state baselines.

6.4.7.3 Indicators:

1. Availability of consolidated information on fish and key aquatic biodiversity.
2. Number of management plans and implementation strategies for fish and key aquatic biodiversity.
3. Trends in area of state forest under sustainable management practices.
4. Trends in area under organic agriculture, including Sustainable Land Management practices.
5. Trends in level of pollution at point source.
6. Trends in pollution control initiatives and mechanisms.
7. Trend in policies regarding pollution control.

6.4.7.4 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. Conservation plan for aquatic endangered and threatened species should also be prepared for the state and implemented at various streams, rivers, lakes and pond level.
5. Organic farming should be promoted by Agriculture Department. The Meghalaya Organic Mission 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. For restoration of degraded habitat high growing trees can be planted with fruit producing low growing bushes or shrubs. Studies by FAO has identified suitable trees which can be grown in a combined growing patch rather than monocultures (http://www.fao.org/docrep/p2070e/p2070e00.HTM). Area specific native forest tree species for the state must also be studied and this information should be passed on to the farmers etc. by the agriculture department. There is a need to establish pilot sites/seed banks/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. State level empowered committee under the chairmanship of the Additional Chief Secretary has been constituted to ensure co-ordination among relevant departments and organizations. There needs to be stronger efforts to integrate and develop sustained goals for organic farmers in the purview of biodiversity conservation.

10. One of the major reasons for degradation of community forests has been a disengagement of youths from the traditional way of life. The importance of environmental conservation is overweighed by the commercial interests of mining, timber harvest and exploitative NTFP collections. This issue can only be addressed through better awareness and education to people living in villages. State Government must provide schemes for educating the rural population and their involvement in conservation programmes.
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 *jhum*s 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.

6.4.8 MBT 8: By 2026, 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

Strategy 8.1: *Strengthen conservation of agrobiodiversity and indigenous breeds of domestic livestock.*

Action 8.1.1: Develop strategies for conservation of prioritized crops and livestock species.

Action 8.1.2: Strengthen technical capacities and infrastructure for ex-situ conservation of agro-biodiversity, including crop's wild relatives.

Action 8.1.3: Identify and declare heritage sites for native crop varieties and crop wild relatives.

Action 8.1.4: Review current legal and policy framework to address agro-biodiversity conservation and sustainable use.

Action 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.

Strategy 8.2: *Strengthen national capacities in documentation and management of agrobiodiversity conservation and sustainable utilization.*

Action 8.2.1: Complete the documentation and diversity assessment of key cultivated crops and domesticated animals, including crop wild relatives.

Action 8.2.2: Develop capacity to undertake diversity studies of crops and domesticated animals.

Action 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:

1. Trends in the availability of information on the diversity and status of key cultivated crops and domesticated animals.
2. Trends in *ex- situ* conservation programmes such as gene banks, seed banks, local animal farms.
3. Trends in *in-situ* conservation programmes such as wild crop variety farms etc.

6.4.8.4 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. Agriculture department must also provide incentives to farmers for growing wild / traditional varieties with known advantages e.g. drought resistant, pest resistant crops etc. Wild / 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: 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: 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. The implementation of Convention on Biological Diversity can only happen via integration of these traditional knowledge systems and effective participation of local communities.

6.4.9.2 Strategies and Actions

Strategy 9.1: *Promote Traditional Knowledge (TK) and Customary Practices relevant to biodiversity conservation and sustainable use.*

Action 9.1.1: Inventorise and document TK and Customary Practices relevant to biodiversity conservation and sustainable use.

Action 9.1.2: Explore innovative measures to strengthen and incentivize TK and Customary Practices that promote biodiversity conservation and sustainable use.

Action 9.1.3: Strengthen measures to prevent mis-appropriation of TK associated with genetic resources and Customary Practices.

Strategy 9.2*: Build state capacities for the protection, preservation and utilization of TK and Customary Practices relevant to biodiversity conservation and sustainable use.*

Action 9.2.1: Build capacities on TK, ABS, Intellectual Property (IP), Community Protocols, documentation of Customary Practices, Negotiations, Contract Agreements, etc.

Action 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.*

Action 9.3.1: Identify and document bio-cultural heritages of the state.

Action 9.3.2: Document Cultural Ecosystem Services (CES).

Action 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.

Strategy 9.4: *Prevent destruction and degradation of bio-cultural heritage sites.*

Action 9.4.1: Prepare policies for sustainable ecotourism in and around bio-cultural heritage sites.

Action 9.4.2: Prevent pollution of bio-cultural sites via declaring these sites as no plastic and no garbage zones.

Action 9.4.3: Organize cleaning and habitat improvement drives to restore degraded and polluted sites.

6.4.9.3 Indicators:

1. Trends in documentation of TK associated with genetic resources.

2. Trends in the availability of information on Customary Practices and Community Protocols related to management of biological resources.

3. Trends in ABS agreements related to TK associated with genetic resources.

6.4.9.4 Specific Actions:

1. Meghalaya is very rich in indigenous traditional knowledge (ITK) related to bio-resource use and biodiversity conservation. However, inventories related to medicinal plants and wild edible plants are the only well documented ITKs available at present. NEHU, colleges in Meghalaya and NGOs must help in documenting TKs related to biodiversity conservation and sustainable management. Forest Department, agriculture department, ministry of tribal affairs etc. should also provide funds, permissions and technical skills in creating inventory of this information.
2. Many TKs and customary practices can also lead to innovative mechanisms of conservation in community areas. Village Reserve Forests is a customary practice in Meghalaya and it is one of the major conservation promoting practice. In Garo Hills, GHADC and NGOs like WTI are using these practices to declare legally protected village forest as community reserves for wildlife conservation.
3. General public and policy makers should be made aware of the TKs and customary practices regarding conservation. Capacity building workshop thus should be organize by state research institutions, ministry of tribal affairs, forest department, agriculture department etc., for the indigenous communities for promoting and utilizing these and for ABS mechanisms.
4. 'Living root bridges' are one of the finest example of traditional knowledge. Steps should be protect and maintain these practices. State should also try to declare these as UNESCO Heritage sites of the world.
5. Many traditional medicines and forest vegetable and fruits are being used by the communities since centauries. A proper documentation of these traditional knowledge should be done with help of various educational institutions.
6. 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.
7. 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).

8. Cultural Heritage of the indigenous tribes like indigenous festivals, landscapes and practices should be encouraged *via* related government departments.

6.4.10 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.

In Meghalaya efforts are underway by the State Biodiversity Board to establish policy and implementation mechanisms; however, no clear guidelines have been developed yet. 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

Strategy 10.1: *Develop a state policy and legal framework for the implementation of the Access and Benefit Sharing Policy.*

Action 10.1.1: Develop a state policy based Access and Benefit Sharing (ABS).

Action 10.1.2 Review and recommend for amendment/revision of the Biodiversity Acts in line with the state ABS policy.

Action 10.1.3: Develop regulations to facilitate implementation of the state ABS mechanism.

Strategy 10.2: *Strengthen the implementation of a fair and equitable ABS model.*

Action 10.2.1: Establish appropriate institutional, legal and administrative measures for the implementation of the ABS regime.

Action 10.2.2: Strengthen education and awareness on the ABS regime.

Action 10.2.3: Explore and pilot ABS ventures at local, and state levels with inputs from National ABS ventures.

Action 10.2.4: Create a state ABS fund for empowering local communities to engage in biodiversity conservation.

Action 10.2.5: Strengthen state capacities to implement the ABS regime.

Strategy 10.3: *Strict control mechanism on bio-resource and genetic resource piracy*

Action 10.3.1: Document and Inventorise genetic resources of the state.

Action 10.3.2: Prepare bio-resource collection guidelines

Action 10.3.3: Implement wildlife protection act 1972, international laws dealing with trade and extraction and bio-piracy.

Action 10.3.4: Organize awareness programmes for policy makers, state executives, police department, district councils and village councils regarding genetic resources and related laws.

Action 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.

Action 10.3.6: Provide incentives to local communities for prevention of genetic resource piracy.

Action 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:

1. State ABS policy and regulatory framework in place.
2. Trends in state ABS ventures.

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
- Establish payment for ecosystem services (PES) contracts, including carbon sales

6.4.10.4 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.
8. Experts and institutions dealing with wildlife trade and other bio-piracy control should be invited to build capacity of forest department, CCA protection squads and village committee groups.
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, *Dorbars, Nokmas, Sirdars*, Religious entities etc. It is essential that relevant check points and data repository be linked and maintained for preventing un-authorized access or bio-piracy and ensure explicit consensus on Mutually Agreed Terms (MAT).

6.4.11 MBT 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.

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 comes 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/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

Strategy 11.1: *Reform incentives affecting biodiversity negatively.*

Action 11.1.1: Review and identify incentives of various government department, institutions and NGOs that are detrimental to biodiversity.

Action 11.1.2: Reform harmful incentives as appropriate.

Strategy 11.2: *Strengthen incentives promoting conservation and sustainable use of biodiversity.*

Action 11.2.1: Review and redefine incentive-based conservation including Integrated Conservation and Development Projects considering sustainability, equity, community ownership and participation.

Action 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.

Action 11.2.3: Revisit and prioritize the Crop Promotional Program to strengthen agrobiodiversity conservation, development and management at the community level.

Action 11.2.4: Pilot Crop and Livestock Insurance Schemes for sustainable management of agro-biodiversity and to reduce the impacts of human-wildlife conflict.

Action 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-being.*

Action 11.3.1: Review effect of natural resource extraction on environment.

Action 11.3.2: Initiate study on effect of environment degradation and pathways which effect human health.

Strategy 11.4: *Strengthen science-based management of natural resources.*

Action 11.4.1: Carry out studies on ecological limits of vulnerable production and consumption sectors.

Action 11.4.2: Initiate and promote interdisciplinary research in sustainable production and consumption of natural resources for developing natural resources management plans.

Strategy 11.5*: Promote sustainable use and consumption of natural resources.*

Action 11.5.1: Carry out resource mapping of wood and NTFPs and develop sustainable management guidelines.

Action 11.5.2: Promote the use of efficient technologies for harvesting, processing and marketing of forest resources.

Action 11.5.3: Promote alternatives to timber to reduce pressure on natural resources.

Action 11.5.4: Integrate traditional use of natural resources (grazing, leaf litter, fodder) with sustainable management plans.

Action 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.*

Action 11.6.1: Assess capacity gaps in natural resource management.

Action 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.*

Action 11.7.1: Revise the BSAP in line with national and state priorities and Aichi Biodiversity Targets through a participatory and inclusive approach.

Action 11.7.2: Institute and document the process and procedure of BSAP preparation and revision.

Action 11.7.3: Adopt the BSAP as a state guiding document for all programmes of work related to biodiversity conservation and sustainable use.

Action 11.7.4: Mainstream actions prioritized in BSAP into relevant stakeholder plans and programs.

Action 11.7.5: Raise awareness on MBSAP and prioritized state targets as detailed out in the Implementation Plan.

Strategy 11.8: *Establish a state mechanism for implementation of the BSAP.*

Action 11.8.1: Establish a dedicated coordination unit for BSAP implementation and resource mobilization, including monitoring and reporting (as detailed out in chapter 7 on Institutional Arrangements).

Action 11.8.2: Develop and implement an effective monitoring and evaluation plan for the achievement of state biodiversity targets.

6.4.11.3 Indicators:

1. Number of harmful incentives identified and reformed.
2. Number of positive incentives reviewed and strengthened.
3. Availability of information on safe ecological limits of vulnerable production and consumption sectors.
4. Trends in development, adoption and implementation of sustainable management plans.
5. Updated NBSAP adopted as a national guiding document for biodiversity management.
6. National coordination mechanism for NBSAP implementation in place.
7. Trends in NBSAP actions integrated into relevant sectorial plans and programs.

6.4.11.4 Specific Actions:

1. The MBB holds the privilege and responsibility for implementation of this plan with involvement of key institutions such as Forest Department, local communities, educational institutions etc.
2. 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. Such detrimental incentive schemes must be identified and stopped.
3. Infrastructure development have also fragmented forests and destroyed connectivity. Careful planning of infrastructure development needs to be done with involvement of Forest Department, District Councils, and local institutions.
4. A state mechanism involving various stakeholders should implement the New BSAP. The BSAP must also outline which organization will implement various parts of the BSAP. The state forest department is the major stakeholder, the other state departments, ministries, research and educational institutions, colleges, NGOs and other public department along with the communities living close to forests are also stakeholders who must be also consulted and involved in implementation of the BSAP.
5. State government department needs to initiate incentive schemes for better land use planning around critical wildlife habitats and ecosystems.
6. Community based natural resource management needs to be encouraged by incentives *via* state Forest, Fisheries and Agriculture Departments.
7. Human – Elephant conflict and resulting crop depredation and casualties is a major source of negative perception of wildlife in the state. The studies by Samrakshan Trust suggest measures like chasing away herds by bursting crackers or beating drums and firing blanks for decreasing the conflict. Use of departmental *koonkie* elephants to chase away wild elephants is suggested as a last resort. Plans are also outlined to start two 'anti-depredation squads' in the state at Williamnagar and Nongstoin.
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 in 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 tools like occupancy based assessment for 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. In Garo Hills Gibbon reserves in community forests, fish sanctuaries and sacred groove is looked upon with pride by the villagers, which also encourages them to manage and maintain these areas.
12. Many local communities make handicraft items from NTFP etc. from the forest areas, or handicrafts from waste 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: 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.

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 a 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

Strategy 12.1: *Strengthen evidence-based policy and decision-making.*

Action 12.1.1: Analyze existing biodiversity data and information gaps.

Action 12.1.2: Strengthen research to generate biodiversity information and expand knowledge base.

Action 12.1.3: Promote accessibility and sharing of biodiversity information and knowledge.

Action 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.*

Action 12.2.1: Support and promote inter and intra-disciplinary research on biodiversity and related technologies.

Action 12.2.2: Strengthen state mechanisms to coordinate, promote and review transfer and adoption of appropriate technologies (e.g: HWC management, Forest fire management).

Action 12.2.3: Promote sustainable procurement initiatives such as Green Public Procurement.

Strategy 12.3: *Strengthen institutional mechanisms and good governance to coordinate fund mobilization for Meghalaya state BSAP implementation.*

Action 12.3.1: Adopt the Meghalaya state BSAP as a guiding document for biodiversity management in the state.

Action 12.3.2: Establish the MBC as the state coordination agency for MBSAP implementation and resource mobilization.

Action 12.3.3: Establish a funding window for Meghalaya state BSAP implementation with innovative funding mechanisms.

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Strategy 12.4: *Mobilize financial resources to support implementation of the Meghalaya state BSAP.*

Action 12.4.1: Review the financial gap for implementation of the Meghalaya state BSAP.

Action 12.4.2: Implement BIOFIN process for assessing state finance for biodiversity conservation.

Action 12.4.3: Develop and implement Resource Mobilization Plan.

Action 12.4.4: Allocate funds as per the Resource Mobilization Plan.

Action 12. 4.5: Monitor effective and efficient utilization of available funds.

Strategy 12.5: *Mainstreaming of biodiversity conservation and sustainable development.*

Action 12.5.1: Generate awareness on biodiversity conservation and sustainable development.

Action 12.5.2: Develop programmes for participatory planning and biodiversity conservation.

Action 12.5.3: Coordinate and harmonize among sectoral plans.

6.4.12.3 Indicators:

1. Trends in new biodiversity information generated.
2. Existence of an accessible central repository on biodiversity data and information.
3. Trends in evidence-based decision-making.
4. Trends in adoption of technologies related to biodiversity management.
5. Trends in funds sourced to implement the Meghalaya state BSAP.

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 so as to reduce the effect of these development on biodiversity. The state pollution control board must also collaborate with CPCB and other state boards for getting latest technologies for effective pollution control.
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. UN also funds BSAP implementation *via* The Environment and Energy Thematic Trust Fund. Other mechanisms involve Payment for Ecosystem services, biodiversity offsets, environmental fiscal reforms, markets for green products, biodiversity in climate change funding and biodiversity in international development finance.

The responsibility of implementing these strategies and action plans rests on various state, national and non-governmental institutions, Appendix 23 lists the action plan and the responsible institutions. The implementation mechanism is discussed in subsequent chapter 7.

Chapter 7

Implementation Plan and Resource Mobilization

7.1 Introduction

The success of the state BSAP 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 effect 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 favorable 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 and 2.3), lists the national, state and DC's natural resource management policies, and the review by Barik and 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 fulfills commitment to these conventions. Table 7.1 lists the synergies existing between the MBTs and international treaties and conventions.

Harmony between 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 links several international biodiversity related agreements into the state biodiversity targets which forms 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 fulfills 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 follows 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, ecosystems 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 MBT target of safeguarding natural habitat (MBT 3) aims to safeguards both life on land (SDG 15) and below water (SDG 14), safeguards clean water access (SDG 6) and makes communities sustainable (SDG 11). Such synergies exists 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 lists 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 fulfills the targets of the SDGs. It must also be realized that for achieving the SDGs, the MBTs can be a very strong mechanisms 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.

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

The primary responsibility of implementing the coordinating the activities listed in the BSAP lies with the Meghalaya State Biodiversity Board (MBB), its district level coordination committees and BMCs. Each target is further assigned to one or more relevant Departments / 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 20 state government departments (including Forest Department, Agriculture and allied Departments etc.), 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 (Appendix 23).

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

Table 7.2 Linkages between 12 MBTs and 17 SDGs

Meghalaya Biodiversity Targets	Sustainable Development Goals 2030								
Biodiversity awareness	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	4 QUALITY EDUCATION	5 GENDER EQUALITY	8 DECENT WORK AND ECONOMIC GROWTH				
Biodiversity valuation and poverty alleviation	1 NO POVERTY	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	4 QUALITY EDUCATION	8 DECENT WORK AND ECONOMIC GROWTH	10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES	13 CLIMATE ACTION	17 PARTNERSHIPS FOR THE GOALS
Safeguarding natural habitats	6 CLEAN WATER AND SANITATION	11 SUSTAINABLE CITIES AND COMMUNITIES	14 LIFE BELOW WATER	15 LIFE ON LAND					
Protected areas	6 CLEAN WATER AND SANITATION	11 SUSTAINABLE CITIES AND COMMUNITIES	14 LIFE BELOW WATER	15 LIFE ON LAND					
Ecosystem services	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	4 QUALITY EDUCATION	5 GENDER EQUALITY	6 CLEAN WATER AND SANITATION	11 SUSTAINABLE CITIES AND COMMUNITIES	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	14 LIFE BELOW WATER	15 LIFE ON LAND
Managing invasive species	11 SUSTAINABLE CITIES AND COMMUNITIES	13 CLIMATE ACTION	15 LIFE ON LAND						

Sustainable landscapes	2 ZERO HUNGER	7 AFFORDABLE AND CLEAN ENERGY	14 LIFE BELOW WATER	15 LIFE ON LAND					
Maintaining genetic diversity	2 ZERO HUNGER	15 LIFE ON LAND							
Protecting traditional knowledge	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING							
Access and benefit sharing	8 DECENT WORK AND ECONOMIC GROWTH	10 REDUCED INEQUALITIES	15 LIFE ON LAND						
Inclusive governance	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	17 PARTNERSHIPS FOR THE GOALS							
Resource mobilization	4 QUALITY EDUCATION	7 AFFORDABLE AND CLEAN ENERGY	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	14 LIFE BELOW WATER	15 LIFE ON LAND	17 PARTNERSHIPS FOR THE GOALS			

Modified from UN Poster on Synergies between NBTs and SDGs

A number of NGOs also work in the state of which WWF, WTI, NEFAS are the major civil organization and agencies working toward biodiversity management and conservation. The MBSAP action plan and responsible agencies 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.

7.4 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) and classified as one benefitting either natural resource management, protection, etc. 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 7.3, Fig. 7.3). Contribution to sectoral mainstreaming, restoration, and has been declined in the state over last four years (Table 7.3, 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 (7.3 and 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 7.3, Fig. 7.1, 7.3).

However, these BioFin 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 7.3 BioFin expenditure in 326 schemes of Meghalaya state during 2011-15 (000,000 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	190.0	202.9	210.7	228.9
Enhancing Implementation	211.8	110.2	205.8	150.6
Access and Benefit sharing	100.0	75.0	50.0	50.0
Natural resource use	887.7	981.7	264.7	216.1
Others	52.3	40.0	48.2	51.2
Multiple Category*	483	400.5	725.5	998
Total expenditure in BioFin	2208	2005	1650	1783

**refers to schemes categorized in more than one of the above mentioned categories*

Figure 7.1 BioFin Expenditure in BioFin Categories during 2011 -2015

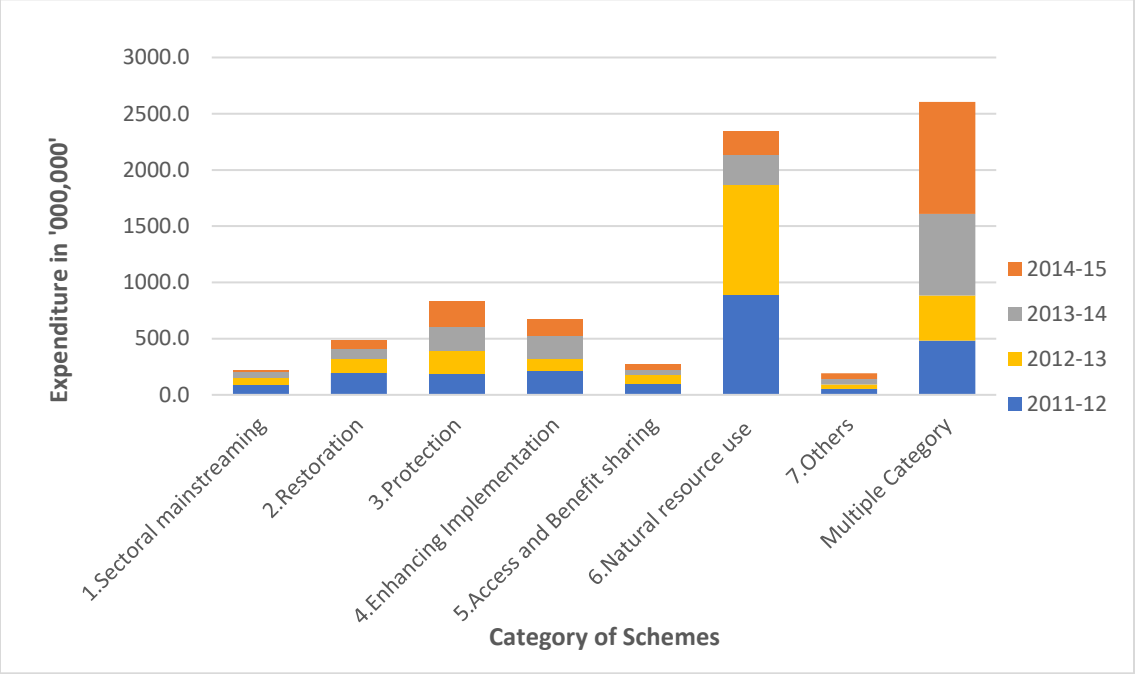


Figure 7.2 Details of BioFin Expenditure in Multiple Category Schemes during 2011 -2015

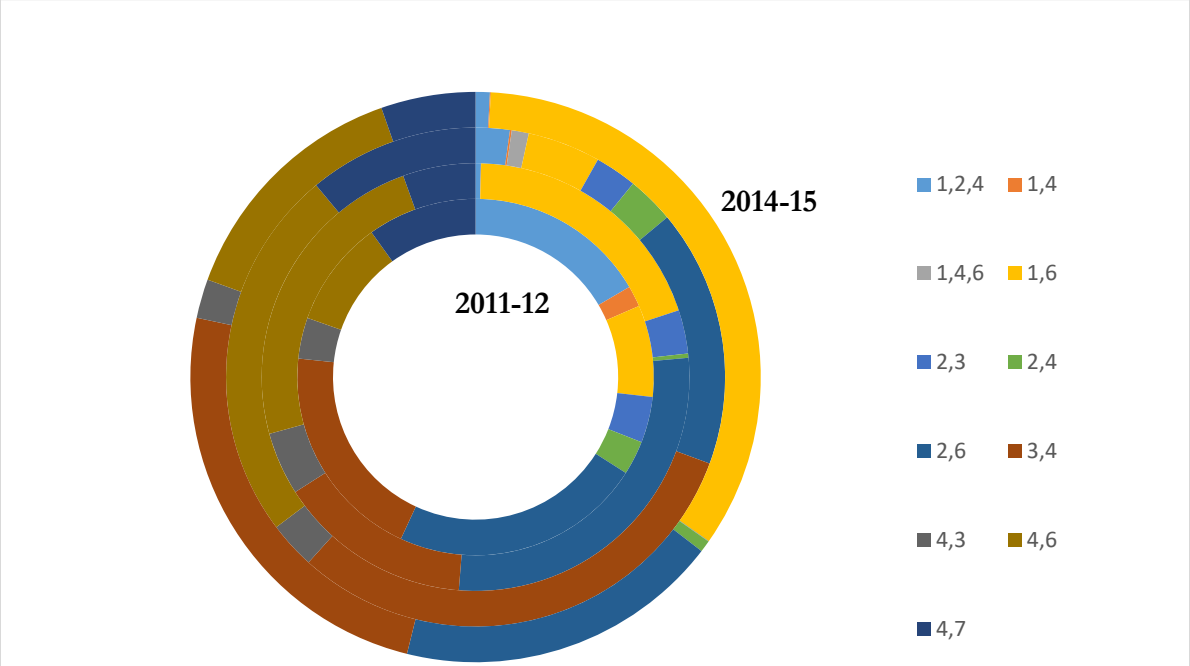
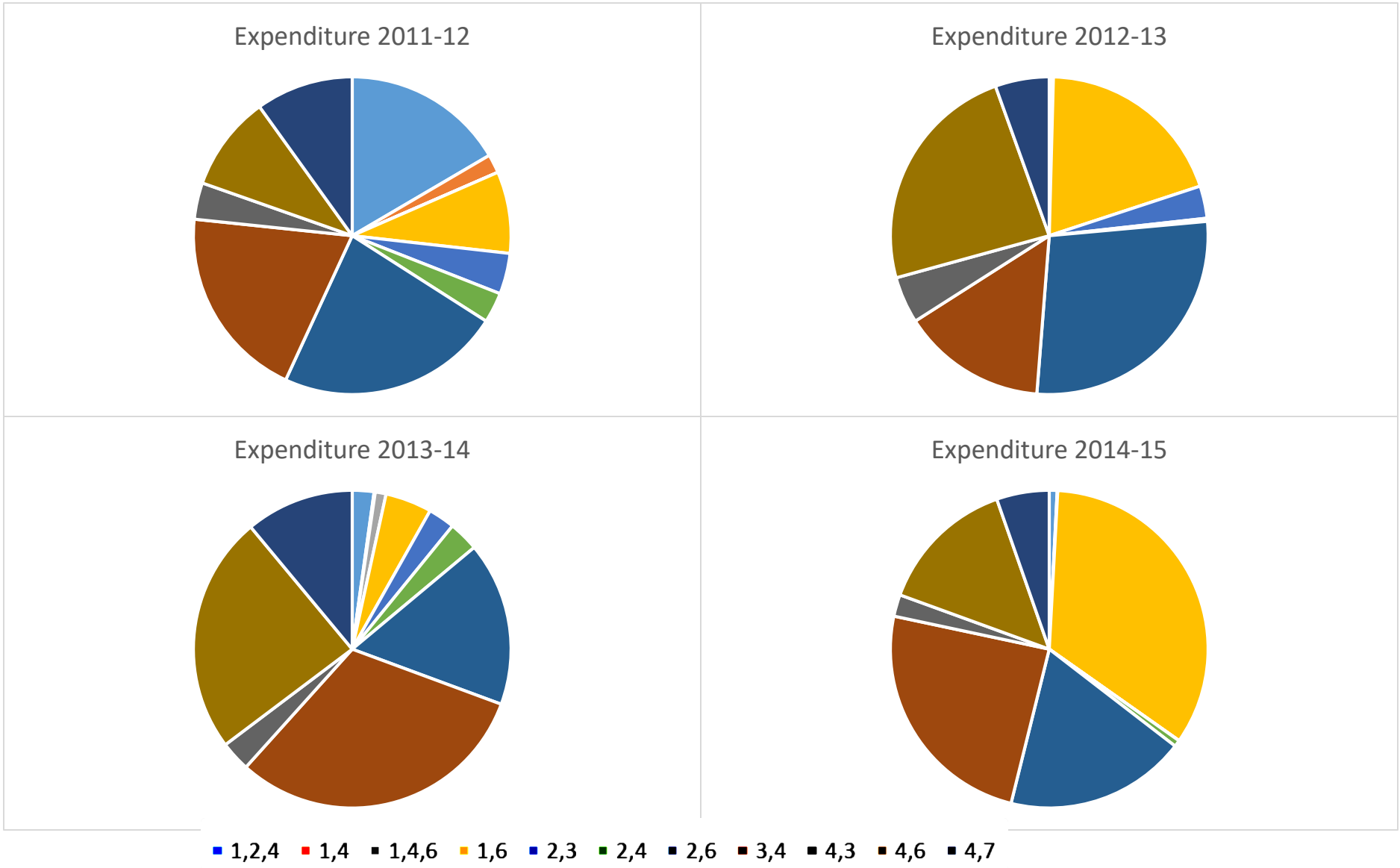
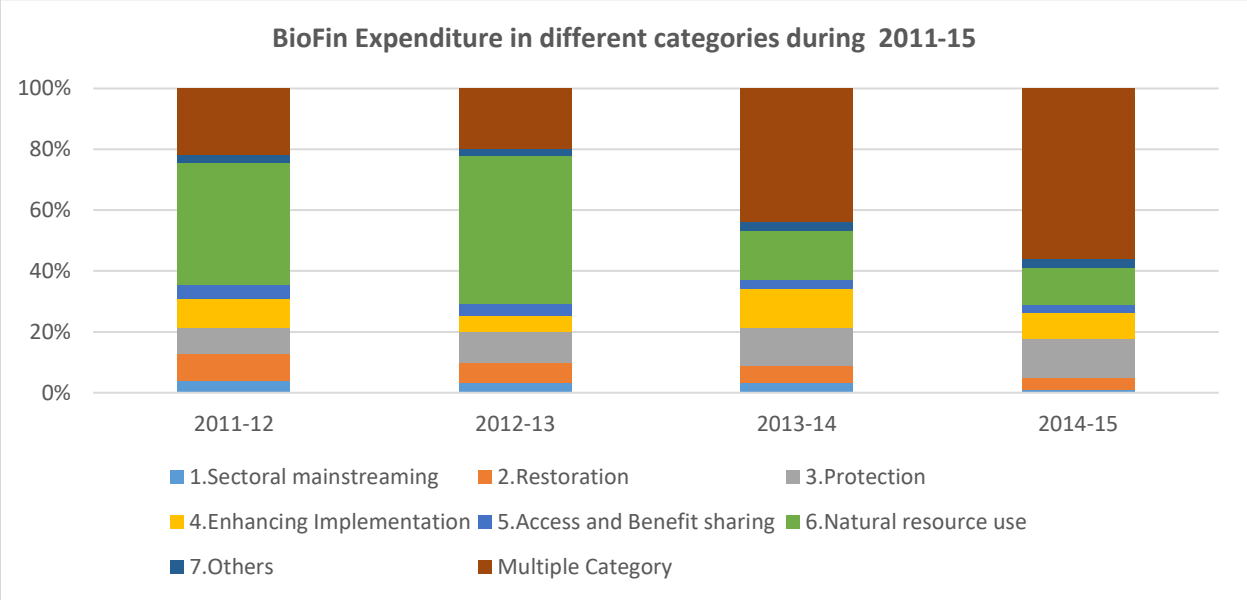


Figure 7.2 Details of BioFin Expenditure in Multiple Category Schemes during 2011 -2015



1. Sectoral mainstreaming, 2. Restoration, 3. Protection, 4.Enhancing Implementation, 5. Access and Benefit sharing, 6.Natural resource use, 7.Others

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



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, capacities 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 ecotourism 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.

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 has 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. 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 25; Table 7.4). 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 change some policies which are not working well.

The MBB needs to identify their own time frame for quarterly, mid-term and final assessment of the MBTs for ecological, social and economic impact of implementation. And to assess progress in achieving MBTs, related Aichi targets, SDGs and the multilateral agreements to which India is a signatory.

Table 7.4 Snapshot of Monitoring and Evaluation Plan

State / National Biodiversity Targets	Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
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.*	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	Gov. of Meghalaya Department of Education, Meghalaya Board of Secondary Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department etc	2 years
			Number of schools enrolled in the National Environment Awareness Campaign, National Green Corps-Eco Clubs Programme, Paryavaran Mitra Programme, Global Learning and Education, Gyan Vigyan Vidyalaya, birdwatching clubs, DNA clubs (DBT's Natural Resource Awareness Club) etc	Meghalaya MHRD, MoEFCC, Department of Education, Centre for Environment Education NE, CPR Environmental Education Centre, Meghalaya Board of Secondary Education, Department of Biotechnology	2 years

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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**	

*ENVIS WII http://www.wiienvis.nic.in/Database/; Meghalaya Forest Department (Gazette notification refs)

Appendix 2

List of Sacred Groves in Meghalaya

Sl.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
58	Diengliengbah	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

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

*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**

*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	*Hedychium 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	*Paramignya micrantha* Kurz **Rutaceae**
44	*Pantlingia serrata* N.C.Deori **Orchidaceae**
45	*Pennilabium proboscidcum* A.S.Rao et J.Joseph **Orchidaceae**
46	*Phlogacanthus wallichii* C.B.Clarke **Acanthaceae**
47	*Photinia cuspidata* (Bertol.) N.P.Balakrishnan **Rosaceae**
48	*Photinia polycarpa* (Hook.f.) N.P.Balakrishnan **Rosaceae**
49	*Pogostemon strigosus* Benth. **Lamiaceae**
50	*Pteracanthus nobilis* (C.B.Clarke) Bremek **Acanthaceae**
51	*Pteracanthus rubescens* (T.Anders.) Bremek **Acanthaceae**
52	*Pteracanthus urophyllus* (Nees) Bremek **Acanthaceae**
53	*Rhynchospora griffithii* Boeck. **Cyperaceae**
54	*Rubus khasianus* Cardot **Rosaceae**
55	*Salix psylostigma* Anders. **Salicaceae**
56	*Senecio jowaiensis* N.P.Balakrishnan **Asteraceae**
57	*Sympagis maculata* (Nees) Bremek **Acanthaceae**
58	*Taeniophyllum khasianum* Joseph et Yoganarasimhan **Orchidaceae**
59	*Tarphochlamys affinis* (Griff.) Bremek **Acanthaceae**
60	*Tetrastigma obovatum* Gagnep. **Vitaceae**
61	*Trachyspermum khasianum* H.Wolff **Apiaceae**
62	*Thrixspermum musciflorum* A.S.Rao et J.Joseph **Orchidaceae**

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

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**
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**

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

Appendix 7

Common Flora of Meghalaya

Sl. No	Botanical Name	Family
	Trees	
1.	*Acacia mearnsii*	Leguminosea
2.	*Azadirachta indica*	Meliaceae
3.	*Albizia procera*	Leguminosae
4.	*Albizia lebbek*	Leguminosae
5.	*Albizia stipulata*	Leguminosae
6.	*Alstonia scholaris*	Apocynaceae
7.	*Aquilaria khasiana*	Thymeliaceae
8.	*Alstonia sp.*	Apocynaceae
9.	*Amoora rohituka*	Meliaceae
10.	*Allasanthus lanceolata*	Euphorbiaceae
11.	*Alstonia scholaris*	Apocynaceae
12.	*Acquillaria agallocha*	Thymeliaceae
13.	*Acquillaria khasiana*	Thymeliaceae
14.	*Artocarpus heterophyllus*	Moraceae
15.	*Artocarpus integrifolia*	Moraceae
16.	*Alnus nepalensis*	Betulaceae
17.	*Amoora wallichii*	Meliaceae
18.	*Betula alnoides*	Betulaceae
19.	*Phanera (Bauhinia) purpurea*	Leguminosae
20.	*Phanera (Bauhinia) variegata*	Leguminosae
21.	*Bombax ceiba*	Malvaceae
22.	*Bombax insigne*	Malvaceae
23.	*Baccaurea sapida*	Euphorbiaceae
24.	*Cassia fistula*	Leguminosae
25.	*Cinnamomum tamala*	Lauraceae
26.	*Cinnamomum camphora*	Lauraceae
27.	*Castanopsis indica*	Fagaceae
28.	*Cassia sp.*	Leguminosae
29.	*Cryptomeria japonica*	Pinaceae
30.	*Cupressus torulosa*	Pinaceae
31.	*Cinnamomum cecicodaphne*	Lauraceae

Sl. No	Botanical Name	Family
32.	*Cordia dichotoma*	Boraginceae
33.	*Careya arborea*	Lecythidaceae
34.	*Calastrus sp.*	Celastracae
35.	*Dysoxylum binectariferum*	Meliaceae
36.	*Dillenia indica*	Delleniaceae
37.	*Dillenia pentogyna*	Delleniaceae
38.	*Dalbergia sissoo*	Leguminosae
39.	*Dysoxylon racamona*	Meliaceae
40.	*Diospyros montana*	Ebonaceae
41.	*Derris ferruginea*	Caesalpiniaceae
42.	*Euginia khasiana*	Myrtaceae
43.	*Erythrina variegata*	Leguminosae
44.	*Erythrina stricta*	Leguminosae
45.	*Exbucklandia populnea*	Hamamelidaceae
46.	*Phyllanthus emblica*	Euphorbiaceae
47.	*Elaeocarpus floribundus*	Elaeocarpaceae
48.	*Ficus elastica*	Moraceae
49.	*Ficus bengalensis*	Moraceae
50.	*Gmelina arborea*	Verbenaceae
51.	*Eugenia tetragina*	Myrtaceae
52.	*Ficus cunea*	Moraceae
53.	*Ficus hispida*	Moraceae
54.	*Ficus hirta*	Moraceae
55.	*Gmelina arborea*	Verbenaceae
56.	*Garuga pinnata*	Burseraceae
57.	*Gynocardia odorata*	Achariaceae
58.	*Melia azedarach*	Meliaceae
59.	*Pinus kesiya*	Pinaceae
60.	*Ilex godojam*	Aquifoliaceae
61.	*Mangifera indica*	Anacardiaceae
62.	*Mangifera sylvatica*	Anacardiaceae
63.	*Myrica esculenta*	Myricaceae
64.	*Magnolia champaca*	Magnoliceae
65.	*Magnolia oblonga*	Magnoliaceae
66.	*Prunus sp. (nepalensis)*	Rosaceae

Sl. No	Botanical Name	Family
67.	*Prunus persica*	Rosaceae
68.	*Prunus communis*	Rosaceae
69.	*Podocarpus latifolius*	Podocarpaceae
70.	*Pyrus pashia*	Rosaceae
71.	*Parkia timoriana*	Leguminosae
72.	*Quercus griffithii*	Fagaceae
73.	*Quercus serrata*	Fagaceae
74.	*Quercus glauca*	Fagaceae
75.	*Quercus semiserrata*	Fagaceae
76.	*Rhododendron arboreum*	Ericaceae
77.	*Sterculia villosa*	Sterculiaceae
78.	*Pterygota alata*	Malvaceae
79.	*Firmiana colorata*	Malvaceae
80.	*Sapindus mukorossi*	Sapindaceae
81.	*Schima khasiana*	Ternstroemiaceae
82.	*Schima wallichii*	Ternstroemiaceae
83.	*Senegalia catechu*	Leguminosea
84.	*Syzygium cumini*	Myrtaceae
85.	*Shorea robusta*	Dipterocarpaceae
86.	*Tamarindus indica*	Leguminosae
87.	*Taxus baccata*	Taxaceae
88.	*Sapium baccatum*	Euphorbiaceae
89.	*Styrax serulatum*	Styracaceae
90.	*Sarcandra glabra*	Chloranthaceae
91.	*Trewia nudiflora*	Anacardianceae
92.	*Tertameles nudiflora*	Anacardianceae
93.	*Terminalia myriocarpa*	Combretaceae
94.	*Terminalia bellirica*	Combretaceae
95.	*Terminalia chebula*	Combretaceae
	Shrubs	
96.	*Litsea salicifolis*	Lauraceae
97.	*Antidesma sp.*	Phyllanthaceae
98.	*Trevesia sp.*	Araliaceae
99.	*Clerodendron sp.*	Theaceae
100.	*Clerodendrum colebrookianum*	Verbenaceae

Sl. No	Botanical Name	Family
101.	*Euphorbia hirta*	Euphorbiaceae
102.	*Solanum torvum*	Solanaceae
	Herbs	
103.	*Amomum sp.*	Zingiberaceae
104.	*Malotus phillipenisis*	Euphorbiaceae
105.	*Alocasia sp.*	Araceae
106.	*Peliosanthes sp.*	Amaryllidaceae
107.	*Zingiber sp.*	Zingiberaceae
108.	*Mimosa pudica*	Mimosaceae
109.	*Scoparia dulsis*	Scrophulariaceae
110.	*Centella asiatica*	Apiaceae
	Climbers	
111.	*Dioscorea bulbifera*	Dioscoriaceae
112.	*Alchornea sp.*	Euphorbiaceae
113.	*Desmodium sp.*	Populanaceae
114.	*Cleistanthus stipitatus*	Euphorbiaceae
115.	*Riphidophora sp.*	Araceae
116.	*Piper spp.*	Pipraceae
117.	*Trichosanthes sp.*	Cucurbitaceae
118.	*Argyreia spp.*	Convolvunceae
119.	*Lycopodium spp.*	Lycopodiaceae
120.	*Piper betle*	Piperseae
121.	*Cleorodendrum spinosum*	Verbenaceae
122.	*Entada scandens*	Mimosoideae
123.	*Halbolia latifolia*	Berbenaceae
124.	*Euphorbia hirta*	Euphorbiaceae
	Ferns	
125.	*Osmunda sp.*	Osmundaceae
126.	*Pteris sp.*	Pterisaceae
127.	*Diplazium esculentum*	Pterisaceae
128.	*Adiantum sp.*	Adiantaceae
Source: NEBRC, NEHU (*updated binomial nomenclature*)		

Appendix 8

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 ne soh myndong	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 myrsiang	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

Appendices

Sl. No	Scientific name	Local name	Colour of dye
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 9

Wild Edible Plants of Meghalaya

Sl.	Scientific name	Local name	Family	Mode of Utilization
1.	*Acanthopanax trifoliatus*	Kenbut (Mk)	Araliaceae	Young shoots are cooked and eaten
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 and considered to be medicinal
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. Eaten raw
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 offseason
20.	*Cardamine macrophylla*	-	Brassicaceae	Leaves are used as vegetable

Sl.	Scientific name	Local name	Family	Mode of Utilization
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 off 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.

Sl.	Scientific name	Local name	Family	Mode of Utilization
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.
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)	Moringaceae	Leaves, 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

Sl.	Scientific name	Local name	Family	Mode of Utilization
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 used,
82.	*Sonchus oleraceous*	*Soh lamjew* (K)	Asteraceae	Fruits are eaten raw
83.	*Strobilanthus sp.*	Samoong (G) Sam-siphara (K)	Acanthaceae	Leaves 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 10

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 11

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 12

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 13

Orchid species of Meghalaya

S.No	Species	Locations	Locations	Locations	Locations	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		
30	*Bulbophyllum cariniflorum* Rchb.f.	Khasi Hills.				
31	*Bulbophyllum caudatum* Lindl.	Cherrapunjee	Nongstoin	Khasi Hills		
32	*Bulbophyllum cauliflorum* Hook.f.	Cherrapunjee	Dawki	Jowai		
33	*Bulbophyllum cherrapunjeensis* Barbhuiya & D.Verma	West Jaintia Hills	Chyrmang			
34	*Bulbophyllum chyrmangensis* D.Verma, S.Lavania & Sushil K.Singh	West Jaintia Hills	Chyrmang			

35	*Bulbophyllum crassipes* Hook.f.	Khasi Hills.				
36	*Bulbophyllum cylindraceum* Wall, ex Lindl.	Dawki	Mawphlang	Nongkhlaw	Pongtung	Shillong Peak.
37	*Bulbophyllum delitescens* Hance.	Khasi Hills	jaintia Hills			
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 National 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 (Loc. not known).				
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 (Loc. not known).				

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 *[Sunipia scariosa*Lindl.].	Jowai	Jarain	Kyllang rock	Markasa-Patharkhang	Nongkhlaw
74	*Bulbophyllum tortuosum* Lindl.	Nongpoh				
75	*Bulbophyllum trichocephalum* (Schltr.) T.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.	Nongstoin	Jarain	Cherrapunjee		
88	*Calanthe odora* Griff.	Cherrapunjee				

89	*Cahnthe 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	*Coelogyne cristata* 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	Cherrapunjec	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-Noonmati.
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	141. *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 iridioldes* 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	Chempunjee	Jowai	Nongpoh.		
158	*Dendrobium amoenum* Wall, ex Lindl.	Chempunjee	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			
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	Nongpoh	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
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 schlechtendaliana* 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	278. *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	285. *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	
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.				
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	395. Rhomboda *pulchra* (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	Cberrapunjec	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	*Taeniophyllhm 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

Mushroom Diversity of Meghalaya

Sl.	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 15

Medicinal Plants used by the Garo tribe

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 snakebite 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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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
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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
68.	*Parabaena sagittaria*	Chiongbom buelu	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 antidandruff.
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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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 16

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 are applied to fractured bones
4.	*Aegle marmelos**	Diengsoh bel	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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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*	Sohkymp hor	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*	Sladienglu m	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
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 make 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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
54.	*Engelhardtia spicata*	Dieng Iyba	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 don injuries
60.	*Fiscus benghalensis*	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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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
78.	*Itea chinensis*	Dieng myllong	Saxifragaceae	Decoction of leaves is applied externally for skin disease
79.	*Jatropa curcas**	Dieng songdakh ar	Euphorbiaceae	Leaf juice is used in treatment of amenorrhoea and oligomenorrhoea. Stem juice mixed with water taken oraly 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
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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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**	Diengdaw ainieh	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 stomachache 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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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 stomachache. 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.

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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.
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 o 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**	Mangkaria ng-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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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 17

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*	Batniangsoh pet	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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
15.	*Centella asiatica*	Khlein syiar	Apiaceae	Freshly eaten for dysentery and Paste of root and runners taken for stomachache. 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 infections 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.	Cu*rcuma 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
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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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

Sl. No	Scientific Name	Local Name	Family	Mode of Utilization
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 18

Common Mammals found in Meghalaya

Sl.	**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 19

Birds of Meghalaya

Sl. 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
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.	*Corvus macrorhynchos*	Jungle crow
29.	*Gracula religiosa*	Hill myna
30.	*Criniger flaveolus*	White throated bulbul

Sl. No	Scientific Name	Common Name
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

Sl. No	Scientific Name	Common Name
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

Sl. No	Scientific Name	Common Name
97.	*Streptopelia orientalis*	Oriental turtle dove
98.	*Treron curvirostra*	Thick-billed Green pigeon
99.	*Treron pompadora*	Ashy headed Green pigeon
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 20

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
	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.

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 21

Checklist of Reptiles form Meghalaya

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

6.	*Hemidactylus brooki*	Brooke's house gecko*	Gekkonidae	
7.	*Gekko gecko*	Tokay gecko*	Gekkonidae	
8.	*Cnemaspis assamensis*	Assamese day gekko$	Gekkonidae	
9.	*Hemidactylus garnoti*	Indo-Pacific gecko$	Gekkonidae	
10.	*Ptyctolaemus gularis*	Green fan-throated lizard*	Agamidae	
11.	*Calotes jerdoni*	Indo-Chinese forest lizard*	Agamidae	
12.	*Calotes emma*	Emma Gray's forest lizard*	Agamidae	
13.	*Calotes versicolor*	Oriental garden lizard*	Agamidae	
14.	*Calotes maria*	Khasi Hills forest lizard*	Agamidae	
15.	*Oriocalotes paulus*	Small forest lizard*	Agamidae	
16.	*Japalura planidorsata*	Smooth-scaled mountain lizard*	Agamidae	
17.	*Lygosoma albopunctata*	White-spotted supple skink$	Scincidae	
18.	*Sphenomorphus apalpebratus@*		Scincidae	
19.	*Sphenomorphus indicus*	Indian forest skink*	Scincidae	
20.	*Sphenomorphus maculatus*	Stream-side skink*	Scincidae	
21.	*Eutropis carinata*	Keeled Indian Mabuya*	Scincidae	
22.	*Eutropis macularia*	Bronze mabuya*	Scincidae	
23.	*Eutropis multifasciata*	Many-lined sun skink*	Scincidae	
24.	*Takydromus khasiensis*	Java grass lizard, Khasi Hills long-tailed lizard*	Lacertidae	
25.	*Takydromus sexlineatus sexlineatus*	Asian grass lizard*	Lacertidae	
26.	*Ophisaurus gracilis*	Burmese glass lizard*	Anguidae	
27.	*Varanus bengalensis*	Bengal monitor*	Varanidae	
28.	*Varanus salvator*	Water monitor*	Varanidae	
29.	*Varanus flavescens*	Yellow monitor or golden monitor*	Varanidae	
Turtles and tortoises				
1.	*Cyclemys gemeli*	Asian leaf turtle*#	Bataguridae	
2.	*Cuora mouhotii*	Keeled box turtle*#	Bataguridae	EN
3.	*Geoclemys hamiltoni*	Black pond turtle*#	Bataguridae	
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 22

Threatened Mammalian Fauna of Meghalaya

Sl	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	Insufficiently known
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	Insufficiently known
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	Insufficiently known
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 23

Action Plan and Responsible Agencies (MBSAP)

Action Plan	Agencies
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
1.2 Identify the gaps in information regarding environmental awareness among the youth and target groups	
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	
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 and biodiversity conservation awareness.	MBOSE, CBSE, ICSE, Department of Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department
1.2.3: Identify agencies involved in environmental education 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, and FD etc. as per state environmental education policy of the state and suggest modifications to streamline these programs.	Department of Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department
1.2.5: Incorporate indigenous traditional knowledge related to biodiversity conservation in the state education curricula.	Department of Education, Directorate of Higher and Technical Education
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,
1.3.2 Conduct need assessment for formal education sector and develop plan for capacity enhancement.	State Forest Department, District Council, Ministry of Tribal Affairs, Ministry of Forest and Environment, CEE,

	Autonomous District Councils, Department of North Eastern Region (DoNER)
1.3.3 Explore future possibilities and present funding for environmental capacity building *via* corporate social responsibility (CSR) initiatives.	Department of Education, Directorate of Higher and Technical Education , State Forest Department, District Council
2.1.1: Identify a lead agency to coordinate valuation of biodiversity and ecosystem services.	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)
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.	MoEFCC, State MoEF, IIFM, MBB, IEG, IIMs
2.2.1: Assess current capacity, gaps and needs for valuation of the biodiversity and ecosystem services.	MoEF&CC NEHU, State Planning Department, MBB, state colleges
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.	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)
2.3.1: Review state level policies and legislations to mainstream biodiversity and ecosystem services, with involvement of marginalized communities.	MBB, FD, all GoM departments
2.3.2: Incorporate biodiversity and ecosystem service values into relevant state documents such as the five year development plan.	All GoM departments, State Planning Department, MBB
2.3.3: Mainstream biodiversity conservation in the state level poverty alleviation programmes and strategies.	
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.	State Planning Department, MBB, FD, Ministry of Rural Development, Social Welfare Dept.

2.4.2: Integrate rural livelihoods with the Integrated Basin Development and Livelihood Promotion programme.	MBDA, Ministry of Rural Development, FD, MBB
3.1.1: Identify biodiversity rich sites and habitats outside PAs.	FSI, FD, District Councils, NRSA, Department of Space, North East Space Application Centre
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
3.1.3: Identify important localities and degraded areas for eco-restoration.	
3.2.1: Assess various drivers of environmental degradation and identify the major drivers.	
3.2.2: Access 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
3.2.3: Assess and explore linkages between positive effects of these interventions on human wellbeing.	MBDA, Ministry of Rural Development, FD, MBB, MHRD, Ministry of Health and Family Welfare
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
3.3.2: Initiate eco-restoration programmes through participatory process in highly degraded areas, especially around 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)
3.4.1: Enhance awareness on forest fire and other potential factors causing habitat loss.	FD, Universities in state, colleges, MBB
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
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.	FD, MBB, FSI, NESAC, state Universities and colleges
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,
3.4.6: Integrate Biodiversity Offset mechanisms in Management Plan of the PA, for compensation of biodiversity impacts associated with developmental projects.	FD, MBB
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, Dept. of Water Works
4.1.2: Develop policies, guidelines and state laws which enable protection against anthropogenic intervention in aquatic systems and catchment areas of the state	
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
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
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.
4.2.1: Identify and document the key karst ecosystems of the state.	FD, MBB, Meghalaya Adventure Association, Universities and colleges of state
Action 4.2.2: Frame guidelines for anthropogenic interventions and protection of karst ecosystems and its biodiversity.	
4.2.3: Prevent pollution of caves and restore caves degraded by pollution and mining.	SPCB, FD, MBB, Dept of Mines, local communities
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
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
4.3.3: Institute a national 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
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
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
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.	FD, DCs, MBB, Agriculture Department, Fisheries Department
4.4.4: Integrate long-term ecosystem-based adaptation measures into plans and programs.	
4.5.1: Evaluate the management effectiveness of Protected Areas and Biological Corridors	FD, MBB, Universities and colleges, NGOs
4.5.2: Complete zonation of PAs by 2018.	FD
4.5.3: Enhance local community participation in the management of PAs.	FD, MBB, DCs
4.5.4: Review the functionality of Biological Corridors for demarcation, operationalization and legal protection.	FD, MBB, DCs
4.5.5: Review and evaluate conservation reserves and CCAs.	FD, MBB, DCs
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

4.5.7: Promote and support transboundary management and regional partnership initiatives.	FD, DCs
4.5.8: Encourage local communities to declare community forests as CCAs by providing schemes for improving livelihood.	FD, MBB, DCs
4.5.8: Encourage local communities to declare community forests as CCAs by providing schemes for improving livelihood.	FD, MBB, DCs, MBDA, Agriculture Department, Fisheries Department
4.5.10: Provide incentives to local communities for declaring CCAs and for biodiversity conservation.	FD, MBB, DCs, MBDA, Agriculture Department, Fisheries Department
4.6.1: Develop and implement REDD+ activities to support conservation financing.	FD, MBB, DCs
4.6.2: Institutionalize and upscale Payment for Ecosystem Services (PES) initiatives.	FD, MBB
4.6.3: Upscale nature recreation and ecotourism programs with a financial plough back mechanism.	Tourism Dept, FD, MBB, DCs, Social Welfare Dept.
4.6.4: Explore additional innovative financing mechanisms.	MBB, FD
4.7.1: Develop a state mechanism and evaluate the conservation status of prioritized taxonomic groups and species.	FD, DCs, MBB
4.7.2: Update the status of Red Listed species which are endemic to Meghalaya.	FD, DCs, Universities and colleges
4.7.3: Assess threats to long term survival of prioritized species.	FD, DCs, Universities and colleges
4.8.1: Prioritize species for conservation based on nationally agreed or state criteria.	FD
4.8.2: Develop and implement species-based conservation management plans for prioritized species.	FD, DCs, MBB
4.8.3: Enhance capacity in species-based conservation and monitoring.	FD, DCs, Universities and colleges
4.8.4: Strengthen institutional and legal capacities to combat wildlife poaching.	FD, DCs, Law Dept., MBB
5.1.1: Establish baseline data on key ecosystems services (ESS) from PAs, RFs, and CCAs and flows of these services.	FD, MBB, DCs

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
5.1.3 Device strategies to integrate ESS into the state level development planning.	FD, MBB, DCs, Planning Department
5.2.1: Map key ecosystems (e.g. critical watershed) providing essential ecosystem services.	FSI, NRSA, NESAC, FD, MBB, DCs,
5.2.2: Initiate awareness programmes on ESS for local communities, city dwellers and policy makers and how disruption of these ecosystem services can adversely affect human wellbeing.	FD, DCs, MBB, Universities and colleges, Ministry of Health and Family Welfare
5.2.3: Develop and implement policies to safeguard key ecosystems and vulnerable groups, including women and children.	FD, DCs, MBB, MHRD, Ministry of Health and Family Welfare
5.2.4: Restore and augment degraded ecosystems for sustaining ecosystem services.	FD, DCs
6.1.1: Complete state level/regional level inventory of IAS and native/naturalized species with potential for invasiveness along with the distribution and pathways of introduction.	FD, MBB, DCs, Universities and colleges
6.1.2: Develop modules on invasive species for incorporation in the training curricula of relevant institutions.	Department of Higher Educaiton, FD, MBB, Wetland International - South Asia, SACON, BNHS, ICFRE (Forest Invasive species cell), WII, Agriculture Department, Universities and colleges, Fisheries Dept
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 evaluating the success of IAS eradication programmes.	
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.	FD, MBB, Agriculture Department, Planning Department, Fisheries Dept., ICFRE (Forest Invasive species cell)
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.	FD, MBB, DCs, Police Dept, Agriculture Dept, Fisheries Dept, Customs, ICFRE (Forest Invasive species cell)
6.3.4: Develop an institutional framework for IAS management and regional collaboration.	FD, MBB, Agriculture Department, Planning Department, Fisheries Dept., ICFRE (Forest Invasive species cell)
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
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.	FD, DCs, village councils, , Social Welfare Dept., NBFD
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
7.1.6: Formulate policies for sustainable use of bio-resources in the state.	
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 garbage 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,
7.3.1: Identify community forests which falls 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
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),
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.
7.3.4: Promote sustainable management practices in village grazing land.	FD, DCs, village councils, Ministry of Tribal Affairs, Ministry of Rural Development
7.4.1: Strengthen transparency through access to information and consultative/ participatory approaches.	Agriculture Department, ICAR, NBPGR, IFAD, NEHU, State colleges, Community Forestry International (CFI)
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.
7.4.3: Strengthen capacity and empower local communities for sustainable management of resources.	FD, Agriculture Department, ICAR, NBPGR, IFAD, NEHU, State colleges, ICFRE
7.5.1: Assess biodiversity indices based species biodiversity in major farming systems.	Agriculture Department, , ICAR, NBPGR, IFAD, NEHU, State colleges, ICFRE
7.5.2: Introduce appropriate measures for conservation of biodiversity in the agricultural systems.	Agriculture Department, , ICAR, NBPGR, IFAD, NEHU, State colleges, ICFRE
7.5.3: Promote organic farming as per the state or National Agriculture Development Plan	Agriculture Department, , ICAR, NBPGR, IFAD, NEHU, State colleges, ICFRE
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.	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.,

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
7.5.6: Provide loans and micro-finance opportunities to farmers for sustainable agriculture.	Agriculture Department, Ministry of social welfare, Planning Dept., IFAD, NGOs, public and private banks, Rural Development Dept.
7.6.1: Strengthen implementation of environmental standards for all major pollutants.	SPCB, CPCB, State Police Department, FD
7.6.2: Strengthen monitoring and reporting mechanisms for all major sources of pollution.	SPCB, CPCB, universities, colleges
7.6.3: Strengthen environmental performance reporting system by industries.	SPCB, CPCB Universities, Colleges, NGOs
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
7.7.1: Document and quantify major pollutants.	SPCB, CPCB, Universities, Colleges, NGOs
7.7.2: Develop capacities to assess and monitor major pollutants.	SPCB, CPCB, Universities, Colleges, NGOs
7.7.3: Strengthen research and technologies to assess and monitor impacts of major pollutants on environment, including biodiversity.	SPCB, CPCB, Universities, Colleges, NGOs
7.7.4: Adhere to the national baseline for river water quality and develop state baselines	SPCB, CPCB
8.1.1: Develop and implement management plans of prioritized crops and livestock species.	Agriculture Department, Animal Husbandry Dept., Fisheries Dept.
8.1.2: Strengthen technical capacities and infrastructure for ex-situ conservation of agro-biodiversity, including crop wild relatives.	Agriculture Department, IFAD, ICAR, NBPGR, DCs

8.1.3: Identify and propose declaration of heritage sites of significant crop varieties and crop wild relatives.	
8.1.4: Review current legal and policy framework to address agro-biodiversity conservation and sustainable use.	Agriculture Department, Planning Dept., Law Dept.
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 using cryopreservation etc.	Agriculture Department, IFAD, ICAR, NBPGR,
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
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
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
9.1.1: Inventorise and document TK and Customary Practices relevant to biodiversity conservation and sustainable use.	FD, MBB, DCs, Universities and Colleges
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.	NBA, MBB, Police Department, DCs, village councils, Rural Development Dept., Tribal Affairs Dept.
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
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.	
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
9.3.2: Document Cultural Ecosystem Services (CES).	

9.3.3: Promote bio-cultural practices like traditional food, recipes, traditional medicines, and customary cultural practices	
9.4.1: Prepare policies for sustainable ecotourism in and around bio-cultural heritage sites.	
9.4.2: Prevent pollution of bio-cultural sites via declaring these sites as no plastic and no garbage zones.	CCB, SPCB, FD, DCs, Village Councils, communities
9.4.3: Organise cleaning drives to restore degraded and polluted sites.	
10.1.1: Develop a state policy based Access and Benefit Sharing (ABS).	NBA, MBB
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
10.1.3: Develop regulations to facilitate implementation of the state ABS mechanism.	
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.	Dept. of Higher Education, NBA, MBB, FD, DCs, Village Councils
10.2.3: Explore and pilot ABS ventures at local, and state levels with inputs from National ABS ventures.	NBA, MBB, FD, DCs
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.	
10.3.1: Document and inventorise genetic resources of the state.	NBA, MBB, FD, DCs, BMCs, Universities, Colleges
10.3.2: Prepare bio-resource collection guidelines	NBA, MBB, FD, DCs
10.3.3: Implement wildlife protection act 1972, international laws dealing with trade and extraction and bio-piracy.	

10.3.3: Implement wildlife protection act 1972, international laws dealing with trade and extraction and bio-piracy.	
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
10.3.6: Provide incentives to local communities for prevention of genetic resource piracy.	NBA, MBB, FD, DCs, NGOs, Village Councils
10.3.7: Provide information on states' bio-resources to airport authorities and customs officials for prevention of genetic resource piracy.	NBA, MBB, FD
11.1.1: Review and identify incentives detrimental to biodiversity.	NBA, MBB, FD
11.1.2: Reform harmful incentives as appropriate.	MBB, FD, all GoM Departments
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
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
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
11.2.4: 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.
11.2.5: Recognize and celebrate the role of the custodians of agro-biodiversity and promote conservation stewardship.	MBB, FD, DCs, Village Councils, NGOs
11.3.1: Review effect of natural resource extraction on environment.	MBB, FD, Agriculture Dept., Fisheries Dept., DCs, Universities, Colleges

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
11.4.1: Carry out studies on ecological limits of vulnerable production and consumption sectors.	MBB, FD, Agriculture Dept., Fisheries Dept., , Universities, Colleges, NGOs, ICAR, NBPGR, NBAGR
11.4.2: Initiate and promote interdisciplinary research in sustainable production and consumption of natural resources for developing natural resources management plans.	
11.5.1: Carry out resource mapping of wood and NTFPs and develop sustainable management guidelines.	FD, DCs, MBB, Universities, Colleges, NGOs, ICAR
11.5.2: Promote the use of efficient technologies for harvesting, processing and marketing of forest resources.	FD, DCs, MBB
11.5.3: Promote alternatives to timber to reduce pressure on natural resources.	FD, DCs, MBB, Universities, Colleges, NGOs
11.5.4: Integrate traditional use of natural resources (grazing, leaf litter, fodder) with sustainable management plans.	FD, DCs, MBB, Planning Dept.
11.5.5: Promote and encourage community participation in the implementation of sustainable management plans of natural resources.	FD, DCs, MBB,
11.6.1: Assess capacity gaps in natural resource management.	FD, DCs, MBB, Universities, Colleges, NGOs, ICAR, NGOs etc.
11.6.2: Strengthen capacity based on the capacity gap analysis.	
11.7.1: Revise the BSAP in line with national and state priorities and Aichi Biodiversity Targets through a participatory and inclusive approach.	MBB
11.7.2: Institute and document the process and procedure of BSAP preparation and revision.	MBB
11.7.3: Adopt the BSAP as a state guiding document for all programmes of work related to biodiversity conservation and sustainable use.	MBB, all GoM Dept.
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 as detailed out in Implementation Plan.	
11.8.1: Establish a dedicated coordination unit for BSAP implementation and resource mobilization, including monitoring and reporting (as detailed out in chapter 7 on Institutional Arrangements).	
11.8.2: Develop and implement an effective monitoring and evaluation plan for the achievement of state biodiversity targets.	
12.1.1: Analyze existing biodiversity data and information gaps.	FD, MBB, Agriculture Dept., Fisheries Dept., Animal Husbandry Dept., Planning Dept., NGOs
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.	
12.3.1: Adopt the Meghalaya state BSAP as a guiding document for biodiversity management in the state.	All GoM Dept., MBB, DCs, NGOs, Educational Institutions, ICAR, NBPGR, NBAGR etc
12.3.2: Establish the MBC as the state coordination agency for MBSAP implementation and resource mobilization.	FD, MBB
12.3.3: Establish a funding window for Meghalaya state BSAP implementation with innovative funding mechanisms.	MBB, FD, Finance Dept., Planning Dept.
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.	FD, All GoM Dept
12.4.3: Develop and implement Resource Mobilization Plan.	Finance Dept., All GoM Dept., MBB, Planning Dept.
12.4.4: Allocate funds as per the Resource Mobilization Plan.	

Appendix 24

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	Total expenditure for Biodiversity (000)			
				2011-12	2012-13	2013-14	2014-15
Peripheral Departments							
1	Land Revenue Land Ceilings	Creation of Website for Disaster Management.	4	12	17	20	20
2		Training on Disaster Management.	4	113	280	429	464
3		Establishment of Libraries.	4	20	6	6	6
4		Human Resource Support in Disaster Management	4	49	40	114	143
5		Construction of Ayurvedic/ Homeopathic Dispensaries etc.	4,6	0	0	1060	150
6	Department of Urban Development	Urban Infrastructure & Governance (JNNURM)	4	0	1745	4316	5958
7	Education Sports & Youth Affairs and Arts and Culture Department	Establishment for Textbooks Cum reference book section	4	16	11	14	16
8		Promotion of science	4	0	132	1196	120
9		Improvement of College Libraries	4	4	0	0	0
10		Youth Green Campaign Movement	4	0	5000	10000	2000
11		Adventure programme	4	8	16	8	0
12		N.SS Implementation of regular NSS activities	4	64	81	100	99
13		Holding of District & State Level Exhibition Fairs	4	0	0	0	110
14		Production of folk literature	4	2	2	2	2
15		State Sahitya Academy	4	0	0	0	8
16		Heritage Protection EW&R Dist/Ew&S Garo/Jaintia Hill	4	31	0	0	0
17		Establishment of State Archive	4	339	427	406	395
18		Strengthening and Development of State Archives	4	0	0	192	0

19		Development of State Archives	4	0	0	1066	0
20		District Library at Tura	4	0	317	288	406
21		District Library at Jowai	4	0	450	433	608
22		State Central Library Shillong	4	1739	1589	1730	1912
23		District Library at Nongstoin	4	190	199	180	215
24		District Library at Williamnagar	4	397	254	313	293
25		Raj Ram Mohan Roy Library foundation	4	15	15	30	30
26		District Library at Nongpoh	4	199	202	214	241
27		District Library at Baghmara	4	206	205	225	127
28		State museum and Archives	4	566	629	774	674
29		District Museum at Tura	4	474	473	556	738
30		District Museum at Jowai.	4	70	98	121	117
31		District Research office Tura/Shillong	4	5	11	6	11
32		Educational Research and Survey in Rural Areas	4	0	0	163	0
33		Research and Documentation in Khasi/Jaintia/Garo	4	0	0	46	0
34		Incentive Art and Culture Development Programme	4	297	300	300	300
35		International Centre for performing Arts and Culture Shillong.	4	0	0	0	10896
36		Tribal Research Institute Shillong.	4	52	54	61	76
37	Public Relations Department	Directorate of Information and Public Relation	4,7	0	0	513	608
38		Rural Broadcasting and Public Address System	4	0	0	23	17
39		Field Publicity and Information Centers		0	0	19	14
40	Planning Department	Science Technology and Environment Council	1	1300	1300	1500	2363
41		S & T Entrepreneurship Programme	1	75	0	92	0
42		Science Centre	1	360	900	549	689
43		Bio-Resources Development	1	4640	5200	5200	3356
44		Climate Change Management	1,2,4	80000	1600	16000	8000

45		Integrated Basin Development Project cum Livelihood Programme	5	100000	75000	50000	50000
46		Institute of Entrepreneurship	1	22500	750	1500	1500
47		Mission under the Integrated Basin & Livelihood Development Programme	1	60150	56340	45000	7500
48		Institute of Natural Resources	6	7500	750	7500	750
49		Promotion of Bio-Technology	7	0	40	400	200
50		Promotion of a Regional Centre for Science & Technology	7	0	100	372	0
51	Co-Operation Department	Assistance to Cooperative Union undertaking Co-operative Education programme	1,4	98	70	70	100
52		Share Capital Contribution to Livestock Coops.	6	504	906	1057	585
53		Share Capital Contribution processing for Tea/Cashewnut etc.	6	375	317	0	0
54		Share Capital Contribution to Fishery Co-operative Societies	6	1750	2948	3159	0
55		Share Capital Contribution to Tourism Cooperative Societies	1,4	9090	0	776	450
56	Schemes Under North-Eastern Council	Seed Testing Laboratories	4,7	0	0	0	4661
57		Project on Horticulture Development at Nokrek Region East Garo Hills	4	0	2376	0	0
58		Lemon Cultivation	6	0	1401	0	0
59		Integrated Development of Muga Seed Project	6	525	0	0	0
60		Don Bosco Community Information Centre	4	0	1500	450	0
61		Capacity building for Service Providers in Tourism Sector	4	362	0	0	0
62		Improvement of Marngar Lake at Marngar Village Ri-Bhoi District	4	4533	0	0	0
63	Economic Advice And Statistics	State Statistics Organizations	4,6	25615	0	0	32163
64	(Planning Department)	Improvement Primary Statistics including Agriculture C.D. Statistics and other Primary Statistics	4	8	0	0	12
65		Agricultural Statistic Division-	4	49	0	0	69
66		Directorate of Agriculture.	7	5373	5031	6267	6111

67	Agriculture And Allied Services	Directorate of Horticulture	7	1907	0	2234	1494
68		Scheme for Intensive Agriculture in selected areas	6	1094	1058	1183	1296
69		Setting up of the Seed Testing Laboratory in Meghalaya	6	0	0	150	0
70		Upper Shillong Farm	4	43	53	69	71
71		Local green manure and rural composts composition	4	15	76	17	21
72		Soil Testing Laboratory	4,6	1074	1252	1071	1173
73		State Soil Survey Organization	4	0	331	359	408
74		Bio- Control Laboratory	6	367	224	372	383
75		Development of arecanut and betel leaves including jute cotton and sugarcane for sale at subsidized rate	3	412	879	165	179
76		Development of Ginger and Turmeric including Sale of Plants at subsidized rates	6	114	152	59	160
77		Potato Development including sale of seeds at subsidized rate	6	2102	2371	2355	2691
78		Experimental Tea Plantation	4	306	249	196	192
79		Regional Centre for Training & Production of Mushrooms-	4	663	647	694	657
80		National Mission on Oilseeds and Oil Palm	4	0	0	0	749
81		Plantation Crops Development (Arecanut/Cashewnut/Coconut/Pineapple/Bamboo/Agar	6	0	0	4461	1946
82		Spices Development (Ginger/Turmeric/Large Cardamom/ Black Pepper)	6	1485	1039	1500	1922
83		Tuber Crops Development (Potato/Tapioca/Colocasia)	6	6143	6122	6317	6805
84		Regional Centre for Training and Production of Mushroom	6	455	496	613	487
85		Indigenous Crops Development	2	2421	3117	3025	0
86		Winter Cropping and Dev. of Cultivable land	6	4840	5603	2146	1435
87		Maize Development through cluster approach	6	3099	3711	3549	827
88		Organic Manure	6	18	0	1081	1109
89		Tea Development Scheme	4	282	246	358	262
90		Integrated Farming in Micro Watershed		0	0	1245	0
91		State Rice Mission	4	0	1350	14980	3000

92		Farmer's Institute		2907	2679	3016	2902
93		Demonstration in cultivator's field	4	106	92	86	98
94		Basic Agricultural Training Centre	4	297	331	357	375
95		Agri. Information Units (Hort.)	4	60	67	70	40
96		Capacity building of the Departmental Personnel(Hort.)		0	10	10	54
97		Terra Madre Conference	4	0	112	435	0
98		Training of Educated Rural Youth for Promotion of Self Employment Through Farm Based Activities (TERYPSEFA)	4	0	0	64	0
99		Land use Survey.	4	249	230	279	263
100		Implementation of E-Governance(Agri.)	4	36	36	40	28
101		Implementation of E-Governance (Hort.)	4	10	5	6	7
102		Vegetable development including sale of vegetable sed rates-	6	953	314	341	330
103		Shillong fruit Garden	4,6	562	505	458	503
104		Development in Horticulture including sale of fruit- etc. at subsidized rates	6	6846	6725	6939	7495
105		Establishment of regional Progeny Orchard cum Horticulture Nursery for Sub-Tropical Fruits(Mynkre)	6	340	273	266	302
106		Vegetable Development Scheme	6	548	605	545	248
107		Development and Maintenance of Orchard-cum-Horticulture Nurseries	6	11718	13395	13609	11039
108		Fruits Development	6	0	2175	2486	1074
109		Floriculture Development	6	4185	3595	5268	973
110		Development of Strawberry Cultivation	7	89	277	100	53
111		Horticulture Mission under Integrated Basin Development Programme 2012-2013	1,6	0	430	5065	0
112		Vegetable Garden	6	0	544	617	835
113		Maintenance of Horti-Hubs		0	1501	2386	1243
114		Central Assistance for C.S.S (Hort.)	4,6	0	0	0	41396
115		Special Plan Assistance (Hort.)		0	0	6750	0
116		State Share against Central Schemes (Hort.)		0	0	0	188
117		Special Central Assistance (Mission Organic-Hort.)		0	0	0	34500

118		National Food Security Mission	4,6	0	0	0	14437
119		Special sub-project strengthening Agriculture Extension in North Eastern States	6	0	0	0	6109
120		Support to State extension Programmes for extension reform.	6	0	0	0	10598
121		National Mission for Sustainable Agriculture (NMSA)	4	0	0	0	7459
122		Fruit Research Station	4,6	364	441	337	374
123		Agricultural Research Stations and Laboratories	4,6	4021	4516	4903	5051
124		Research project on rice	7	168	150	181	185
125		Flood Management and River Training Works	3	675	5600	626	0
126		Miscellaneous Training Programme	4	1	0	0	0
127		Provision for awareness Education & Knowledge in Water Resources	4	63	15	30	2
128		Repair Renovation & Restoration of Water Bodies	7	7500	0	0	0
129		Promotion of Water User Efficiency	6	450	73	0	0
130		Water Quality Management in Water Resources	4	42	2	0	0
131		Integrated Development of Water Resources	6	115000	160750	0	2500
132		Water Harvesting	6	25000	0	4700	910
133		Climate change study & adaptation for the water resources sector including infrastructures and procurement of equipment	4	0	1500	162	0
134		Water Resource Development Agency	6	0	1000	2500	0
135		Accelerated Irrigation Benefits Programme	6	565523	600000	0	0
136	Soil And Water Conservation	Directorate of Soil Conservation	7	3410	3256	3683	3826
137		Divisional Soil Conservation Offices	7	12655	11378	13258	16521
138		Soil Conservation Range Offices	7	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	27813	26258	28776	30981
142		Watershed Management Division	6	15677	14667	16069	16005
143		Soil Conservation Survey Schemes	4	943	863	1022	1128
144		Soil Testing Works	4	132	1006	160	163
145		Erosion Control Works	6	62	3789	814	455

146		Afforestation	2,6	601	504	723	5146
147		Water Conservation and Distribution Works	6	47	3777	292	42
148		Cash Crop Development Works	4	4100	5163	6641	8750
149		Conservation Works*in Urban Area	3	7	744	1923	9
150		Water Harvesting Works/Farm Ponds etc.	6	50	3708	250	107
151		Integrated Watershed Management Programme (IWMP)	1,6	11436	37499	0	334432
152		Conservation Training Institute	4	5156	4653	5718	7261
153		Training at Soil Conservation Centers	4	7674	7029	7925	7246
154		Extension Programmes and Information Services	4	55	48	53	71
155		Jhum Control Schemes	2	9406	9161	9555	10024
156		Watershed Management	6	1194	1176	826	1246
157		Commercial Crops Development Board	1,6	17322	2800	2800	4000
158		Soil Conservation scheme under NABARD Loan.	6	50721	60000	100902	68129
159		Integrated Wasteland Development Programme	2	142262	55029	11459	1495
160		Accelerated Irrigation Benefits Programme (AIBP)	4	94249	0	67125	0
161		Integrated Watershed Management Programme (IWMP) (State Share)	1,6	11436	37499	26482	0
162		Repair Renovation & Restoration of Water Bodies	6	0	0	0	0
163		Soil Conservation Research Centre	4	560	600	606	599
164	Animal Husbandry And Veterinary Department	Directorate of Animal Husbandry and Veterinary	4,7	3304	3438	3789	3874
165		District Offices	4,7	4039	4000	2740	7858
166		Sub-Divisional Offices	4,7	7473	7571	5404	5139
167		Veterinary Information Unit	4	1869	2080	2467	2890
168		Meghalaya State Fodder and Dairy Development Board	6	376	302	622	452
169		State Veterinary Council	4,7	15	0	0	0
170		Meghalaya State Livestock Mission under the Integrated Basin Development & Livelihood Programme	1,4,6	0	0	8000	0
171		Veterinary Hospitals and Dispensaries	4	1096	572	303	266

172		Veterinary Dispensary taken from C.D.Blocks	4	855	876	1004	1130
173		Mobile Veterinary Dispensary	4	479	446	484	511
174		Veterinary Aid Centers	4	570	628	702	751
175		Vigilance Unit	4	226	230	313	353
176		Rinderpest surveillance Containment Vaccination Programme	3	5662	5869	6466	7147
177		Animal Disease Surveillance	3	762	1055	925	896
178		Systematic Control of Livestock Disease of National Importance	4	27	33	34	35
179		Assistance to State for Control of Animal Diseases (ASCAD).	4	7	0	0	0
180		Extension of Vet. Aid Services	4	0	4	0	0
181		Scheme for establishment of new dispensaries under NABARD Loan	4,3	233	29	580	746
182		Veterinary Dispensaries	4,3	90	747	1175	1278
183		State Contribution for establishment of new Dispensaries under NABARD Loan	4,3	0	131	172	3
184		Livestock Inspectors Offices	4,3	261	255	330	320
185		Key Village Scheme	4,3	1931	1735	1945	2015
186		Cross Breeding Schemes	4,3	564	569	594	642
187		Intensive Cattle Development Project	4,3	7179	7549	8415	8555
188		Indo-Danish Project	4,3	1830	1890	2025	2075
189		Bull/Calf Rearing Farm and Breeding Centre	4,3	531	551	588	412
190		Livestock Farms Garo Hills	4,3	908	948	1066	1017
191		Cross Breed Cattle Breeding Project Kyrdemkulai /Jowai	4,3	1122	1219	1274	1200
192		Cattle Farm Jaintia Hills	4,3	890	829	896	928
193		Bufallo Farm Garo Hills	4,3	236	218	243	240
194		Poultry Farm Tura/Jowai	4,3	997	974	1239	1075
195		Poultry Farm Bhoi	4,3	899	1054	1216	1125
196		Poultry Farm Mawryngkneng	4,3	300	357	382	459
197		Central Hatchery and Chick Rearing Farm Bhoi/Garo/Jowai	4,6	633	647	709	749
198		Poultry Farm Nongstoin	4,6	292	283	323	292
199		Poultry Farm Simsangiri/Williamnagar	4,6	379	427	404	319
200		Regional Poultry Breeding Farm Kyrdemkulai	4,6	2802	1856	2312	2124

201		Poultry Farm Mairang	4,6	219	219	330	200
202		Poultry Farm Phulbari/Williamnagar	4,6	159	157	165	193
203		Poultry Development Programme under SLPP	4,6	640	702	842	845
204		Broiler Farm Kyrdemkulai	4,6	227	255	287	270
205		Distribution of Poultry Unit	4,6	176	326	326	0
206		Poultry Farm Baghmara	4,6	159	241	233	199
207		Broiler Farm (Assanangre)	4,6	286	290	349	308
208		Poultry Breeding Farm Nongpiur	4,6	300	59	212	101
209		Sheep & Goat Farm	4,6	341	354	365	392
210		Sheep Extension Unit	4,6	53	50	76	70
211		Sheep & Goat Farm Khasi Hills	4,6	173	206	186	187
212		Rabbit Farm Nongpiur	4,6	14	18	17	16
213		Pig Farm Mawryngkneng	4,6	490	508	569	562
214		Pig Farm Tura/Rongjeng	4,6	731	614	638	681
215		Pig Farm Jowai	4,6	333	328	673	549
216		Pig FarmNongstoin	4,6	279	266	286	294
217		Pig FarmBaghmara	4,6	261	223	232	263
218		Piggery Production under S.L.P.P	4,6	1738	1936	1810	1854
219		Distribution of Piggery Unit	4,6	180	330	330	0
220		Pig Farm Mairang	4,6	177	199	221	210
221		Pig Farm Dalu	4,6	422	390	442	437
222		Regional Pig Breeding Farm Kyrdemkulai	4,6	1285	1410	1757	1195
223		Pig Farm Pynursla	4,6	428	449	503	550
224		Pig Farm Sohra	4,6	81	113	158	94
225		Rural Cluster approach on Piggery Development	4,6	0	0	135	0
226		Pig Breeding Farm West Garo Hills	4,6	0	31	106	55
227		Pig Breeding Farm West Khasi Hills	4,6	127	184	167	154
228		Establishment Pig Breeding Farm Nongpyiur	4,6	154	160	300	160
229		Assistance to Self Help Group Societies on Pig Farming	4	600	600	600	0
230		Livestock Census Office	4	94	92	107	120
231		State Vet. Council	4,7	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	720	593	475	703

235		Fish Farming Centers	6	931	840	1007	1090
236		Survey and Engineering Wing for Fisheries	6	428	427	459	661
237		Fish seed Production and Demonstration Centre	3	8297	9473	10208	9230
238		Development of Reservoir and Lakes	3	3902	3867	4285	4335
239		Conservation and Legislation for protection of fish	6	14973	15166	17632	16949
240		Trout Culture	6	1194	937	1219	1315
241		Regional Fish Seed Farm Jamgei	6	1162	1166	1387	1659
242		Reclamation of Bheel Fisheries	6	1097	1175	1320	1044
243		State Aquaculture Mission	4,6	0	73943	151114	30482
244		Extension	4,6	1653	1361	1430	1635
245	Industries (Sericulture and Weaving) Department	Muga farm Centers and block plantation including Tassar.	6	5824	5799	7005	7029
246	Industries Department	Apiculture Mission under IBDP	6	0	21040	7947	1396
247	Transport (Tourism) Department	Development of Tourist Spots	4,7	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	104	0	115	208
250		13th Finance Commission Award Development of caves	2, 3	6250	0	0	0
Forest Department							
251	Forest Department	Headquarters Organization	4	19384	23974	24527	30273
252		Forest Utilization Office	4	1735	2279	2630	3835
253		Divisional Forest Officer	3,4	12003	12329	15769	25699
254		Forest ranges and beat offices	3,4	49922	44744	49716	39212
255		Strengthening of Staff in District Councils	4	800	911	960	960
256		Integrated Forest Villages Development	4	30	28	30	30
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	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	1859	4039	3901	1116
262		Studies & Training in Forest School	4	5580	5711	6264	5339
263		Mass Education and Cultural Operation for preservation of Forest	4	555	592	731	650
264		Forest Resources Survey Division	4	4437	4321	4690	5206
265		Demarcation and consolidation (excluding extension) of Forest	3	685	806	804	623
266		Working Plan Division	4,7	6464	7005	7973	8585
267		Statistical Planning and Evaluation Unit	4	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	4029	3895	4311	3158
271		Timber Treatment and Seasoning Plant	6	489	458	615	879
272		Silviculture Works (Regeneration)	2	67	67	198	95
273		Setting up of Corporation and Project Formulation Cell for Development of Forest	4	672	609	622	0
274		Forest Protection Schemes and works	3	51277	49128	55162	52003
275		Conservation of Orchids and Multiplication Project	2,4	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	6551	7036	7476	5924
278		Expenditure on Environmental Forestry and Vonomohotsava	2,6	7425	2873	3687	3570
279		Recreation Forestry	7	3565	3205	4538	3818
280		Social Forestry	2,6	80083	81972	89717	101509
281		Umbrella Project/Ecological Sohra Restoration Project	2	5815	6121	6229	5610
282		Teak wood Plantations	2	2722	2611	3710	3641
283		Plywood Plantations	2	4211	4679	7390	5777

284		Salwood Plantations	2	2212	2858	3102	4025
285		Plantation of quick growing species	2	5046	5650	5638	5506
286		Plantation of Medicinal Plants	2	7942	8524	7686	8551
287		Miscellaneous Afforestation Schemes	2	3013	3115	4096	11497
288		Preservation/Protection of Sacred Groves	3	0	0	150	0
289		Afforestation of critical catchment Areas	2	1446	11216	10921	0
290		Operation Soil Watch	4	2081	2076	2311	2036
291		Afforestation of Plan catchment area of Umiam Hydro Electric Project	2	3290	3457	3792	4046
292		Afforestation of catchment area of Kopili Hydro Electric project	2	2495	3061	2473	88
293		Ecological Restoration of Cherrapunjee	2	1378	1515	1519	1954
294		Forestry Mission under the IBDP	2	0	9998	9993	9998
295		Removal of Forest Produces by Government Agency	3	321	132	350	193
296		Removal of Forest Produce by Consumers and purchasers	3	4	2	6	27
297		Drift Waif Wood and confiscated Forest Produces	3	2	5	13	17
298		Financial Assistance to Forest Development Corporation of Meghalaya	4	236	350	350	350
299		Financial Assistance to the Meghalaya State Medicinal Plants Board	2,6	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	0	0	0	6139
302		Financial Assistance to State Environment Impact Assessment Authority (SEIAA)	4	0	0	0	435
303		Payment for compensation for depredation by wild animals	3	1020	200	1080	1500
304		Establishment of Wild Life Sanctuary	3	46001	56429	60312	51258
305		Other Wild Life Preservation Works	3	46233	48018	52740	65899
306		Ecology and Environment	2,6	13957	15315	16319	14119

307		Park's Development	3	2997	3301	3277	3335
308		Garden Superintendent Park and his Establishment	4	31	60	79	96
309		Lady Hydari Park Establishment	3,4	2018	1868	2012	1953
310		State Central Library Establishment	4	121	118	130	137
311		Wards Lake Establishment	4	889	813	942	1056
312		Pinewood Park and Other Garden	4	69	71	93	98
313		Other Gardens and Parks under Khasi Hills Division	4	59	67	67	76
314		Contribution to Eco. Development Society	4	5321	5033	5904	6298
315		Central Assistance for CSS including JFM	2,6	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	21308	440	0	0
318		Establishment of Parks and Sanctuaries (CENTRAL SECTOR SCHEMES)	3	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	500	600	600	586
322		Tree Improvement Development	4	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	13757	13182	19586	0
326		Twelfth/Thirteenth Finance Commission under Special Problem	4	22515	0	0	0
		Total		**2210950**	**2010113**	**1663128**	**1821763**

Appendix 25

Meghalaya Biodiversity Targets – Indicators and Responsible Agencies

State / National Biodiversity Targets	Corresponding Aichi 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.	**Aichi 1** ***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	Gov. of Meghalaya Department of Education, Meghalaya Board of Secondary Education, Directorate of Higher and Technical Education, ICAR, NBPGR, Forest Department etc	2 years
			Number of schools enrolled in the National Environment Awareness Campaign, National Green Corps-Eco Clubs Programme, Paryavaran Mitra Programme, Global Learning and Education, Gyan Vigyan Vidyalaya, birdwatching clubs, DNA clubs (DBT's Natural Resource Awareness Club) etc	Meghalaya MHRD, MoEFCC, Department of Education, Centre for Environment Education NE, CPR Environmental Education Centre, Meghalaya Board of Secondary Education, Department of Biotechnology	2 years
			Trend in number of government financed projects or money utilized in government projects related to biodiversity and conservation.		
			Trend in participation in non-formal training and awareness camps	ICAR, NBPGR, FD	2 years

			Trends in coverage of environment related programmes and projects with enhanced involvement of youth	Indian Youth and Climate Change Network (IYCN), South Asia Youth Environment Network (SAYEN), Directorate of Sports and Youth Affairs, Meghalaya	
			Trends in visit to Protected Areas, natural history museums and exhibitions and zoological/botanical gardens especially by schools and college students	State Forest Department (Wildlife Wing), Central Zoo Authority (CZA), CEE, ZSI, BSI	2 years
		Trend in promoting awareness at local levels	Trends in number of Biodiversity Management Committees (BMCs) constituted/operationalized	State Biodiversity Board, NBA	2 years
			Trends in number of people's biodiversity registers (PBRs) prepared		
			Trends in number of Joint Forest Management Committees (JFMCs) constituted/operationalized	State Forest Department, District Council Forest Departments, Ministry of Tribal Affairs, Ministry of Forest and Environment, CEE, Autonomous District Councils, Department of North Eastern Region (DoNER)	2 years
			Trends in number of civil society organizations/NGOs Community Forest Rights (CFR) committees, engaged in creating environmental awareness		2 years

State / National Biodiversity Targets	Corresponding Aichi Targets & Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
2  By 2026, values of biodiversity are integrated in state planning processes, development programmes and poverty alleviation strategies.	**Aichi** 2 ***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)	3 years
			Trend in number and coverage of studies related to biodiversity - TEEB etc		
			Trends in area covered by catchment area treatment plan under development projects	State Irrigation Department	
		Trend in integration of biodiversity and ecosystem service values into sectoral and development policies and programmes	Trends in reflection of biodiversity and ecosystem services in policy decisions, planning and reporting processes	MoEFCC, State MoEF, IIFM, SBB, IEG, IIMs	3 years
		Trends in policies considering biodiversity and ecosystem services in environmental impact	Trends in number of studies on biodiversity -inclusive environmental impact assessment, cumulative environmental impact assessment (CEIA) and strategic environmental assessment (SEA)	NEHU, MoEFCC, State Ministry of Environment and Forest, State Planning Department	3 years

		assessment and strategic environmental assessment	Trends in identification, assessment and strengthening of incentives that reward positive contributions to biodiversity and ecosystem services	State Ministry of Corporate Affairs	3 years

State / National Biodiversity Targets	Corresponding Aichi 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.	**Aichi 5 & 15** ***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), NESAC	3 years
		Trend in aquatic ecosystems	Changes in areas under riverine ecosystems and wetlands (terrestrial)	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	3 years
			Number of wetlands under integrated wetland management plan		
		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, CPCB, Department of Fisheries, Department of Mining, NGOs, Ministry of Water Resources, Soil and Water Conservation, North Eastern Regional Institute of Water and Land Management	2 years
		Trend in afforestation and restoration	Monitoring canopy cover, sacred forests, community conserved areas	State Forest Department, Green India Mission, North East Space Application Centre, FSI, Central Mine Planning and Design Institute (CMPDI), NEHU, NGOs like WTI, Samrakshan, Community Forestry International (CFI)	3 years
			Monitoring carbon stocks		
			Monitoring afforestation and Assisted Natural Regeneration		
			Rehabilitation of mined out areas		
		Prevention of deforestation and	Trends in slash and burn agriculture, Trends in land degradation	State Agriculture Department, State Forest Department, Ministry of	

		fragmentation of forests at mountain tops, riverine areas and conservation of critical ecosystem	conservation of hill/mountain ecosystems, conservation of river basins	Water Resources, Ministry of Rural Development, North Eastern Regional Institute of Water and Land Management	3 years
			Status and trend in water table, groundwater resources		3 years
		Species restoration after forest and water body restoration	Status of selected indicator species (gibbons, elephants, clouded leopard, *N. khasiana* etc.)	State Forest Department, District Council Forest Department, Wildlife NGOs, ZSI, BSI	3 years
		Trends in maintenance of fertility in agricultural lands using natural methods and means	Soil health records	Ministry of Agri. , State Forest Department, Minister of Water Resources, Soil and Water Conservation, North Eastern Regional Institute of Water and Land Management	3 years
			Organic carbon and humus buildup		3 years
			Trends in keeping health of near-pristine soils, being awarded titles under FRA in forest areas		

State / National Biodiversity Targets	Corresponding Aichi 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.	**Aichi 10, 11, 12** ***Strategy 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*	Trend in PA coverage under four legal categories (National Park, Sanctuary, Community Reserve and Conservation Reserve)	Change in number / area / percentage of PAs	WII, State Forest Department	3 years
		Trend in Community Conserved Areas / Village forest based conservation measures and	Area/ number of initiatives, CCAs	UNDP, WWF, ATREE, Indigenous Peoples' Community Conserved territories and Area (ICCA), District Council Forest Departments	3 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	3 years
		Trend in Wetlands brought under integrated management	Changes in area and ecological status of wetland through implementation of integrated management plans	SACON, Wetland International - South Asia, DoS, NESAC, BNHS	3 years
			Change in abundance and diversity of water bird species in wetlands over time		
			Trend in coverage of sites of International importance for migrator species under CMS convention		
		Trend in Important Bird Areas (IBAs)	Change in number / area of Important Bird Areas (IBAs) over time	Bombay Natural History Society	3 years

	factors affecting them. ***4.8:*** *Strengthen conservation programs for prioritized species.*	Status and population trend of critical endangered Terrestrial and aquatic species	Identification of state critical endangered species	State Forest Department, Autonomous Council Forest Department, BSI, ZSI	2 years
			Population trend of selected species	ZSI, BSI, WII, SACON, BNHS, NCF, WWF, WTI, IISc	5 years
		Trend in status of Indian plants and animals species included in IUCN Red Datat Book	Conservation status of species, subspecies, varities and even subpopulations at a state scale in order to highlight taxa threatened with extinction and therefore promote their conservation	IUCN- India, ZSI, BSI, WII	4 years
		Trend in air quality, water quality and noise pollution	Status and trend of ambient air quality; monitoring water quality for physio-chemical and bacteriological parameters, trace metals, pesticides at selected sites, trends in noise levels	CPCB, SPCB	Yearly
		Level of toxic contaminants in wetlands /rivers/aquatic fauna	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
			Level of toxic contaminants in rivers that provide freshwater for human use		
			Level of toxic contaminants in aquatic / terrestrial fauna		
		Status of ecosystem service of selected ecosystems	Status of ecological services of selected ecosystems including agricultural landscapes	IIFM, IIMs, IEG	5 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
		Trend in climate change measures adopted	Trends in biodiversity-inclusive climate change adaptation and mitigation measures formulated / implemented	State Climate Change Cell	

State / National Biodiversity Targets	Corresponding Aichi Targets & Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
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.	**Aichi 14** ***Strategy*** ***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 years
			Trend in number of women with access to primary/secondary/ education /health services/safe drinking water / electricity / Road connectivity		
		Extant of ground water pollution and ground water levels	Trends in groundwater levels	State Ground Water Board	2 years
			Trend in proportion of groundwater available for use		
		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	3 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 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	3 years

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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.	**Aichi** 9 ***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	Number and coverage of management plans developed for prioritized invasive species and integration with PA management plans and wetland management plans	State Forest Department, District Council, Wetland International - South Asia, SACON, BNHS, ICFRE (Forest Invasive species cell), WII, Agriculture Department	3 years
			Change in area affected by invasive species		

State / National Biodiversity Targets	Corresponding Aichi Targets & Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
7  By 2026, measures are adopted for sustainable management of agriculture, forestry and fisheries.	**Aichi 6, 7 & 8** ***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*	Trends in sustainable agriculture	Trend in area under jhum cultivation, trend in jhum cycles	Forest Survey of India (FSI), Dept. of Agriculture	3 years
			Trend in usage of agrochemical fertilizers	Dept. of Agriculture	
			Trend in use of bio-fertilizers, bio-fuels, organic manure and vermicomposts		
			Trend in energy consumption (by types / sources)in farms	Agriculture Department, Green India Mission, NEHU, State colleges, Community Forestry International (CFI)	
			Trends in increased acreage under crop production (organic/inorganic)		
			Trend in enhanced use of landraces		
			Trend in analysis of agricultural policies and programmes that adversely affect ecosystem services such as pollination	Agriculture Department, ICAR, NBPGR, IFAD	
		Monitoring agricultural extensions	Trend in awareness level of farmers	Department of Agriculture, ICAR	3 years

	of biological diversity. ***7.6**: Major pollutants affecting environment are maintained as per the National environmental standards.* ***7.7**: Strengthen research and technical capacity for documenting, monitoring and assessing the impacts of major pollutants.*		Trend in awareness level of extension service staff, scientists and agricultural research systems with relation to agro-biodiversity and associated knowledge	State Forest Department, Agriculture Department, District Council, wildlife NGOs, ZSI, BSI	
		Trend in sustainable forestry	Trend in area of degraded forests	Green India Mission, IIFM, IIMs, FSI, FRI, ICFRE	3 years
			Trend in areas of restored forests		
			Trend in proportion of products derived from sustainable sources		
		Trend in stock sizes of target and bycatch of fish species (freshwater)	Trend in catch per unit effort	Dept. Of Fisheries, Fishery Survey of India, National Fishery Development Board, NBFGR	3 years
		Trend in intensity of destructive fishing practices	Trend in over exploitative inland fishing		3 years
		Trend in sustainable fishing practices	Trend in traditional fishing practices	NBFD, Dept. of Tribal Affairs, Social Welfare Dept.	3 years

State / National Biodiversity Targets	Corresponding Aichi Targets & Strategic Actions	Composite Indicators	Description of Indicators	Indicative List of Responsible Agencies	Frequency of Monitoring
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.	**Aichi 13** ***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)	3 years
			Trend in population of domestic breeds (in situ)	Department of Animal Husbandry, Department of Agriculture,	
			Effectiveness of initiatives/measures taken to conserve indigenous animal varieties	Agricultural Universities	
			Trend in germplasm accessions in ex-situ collection	NBAGR, Agricultural Universities	
		Plant genetic diversity	Trend in number of indigenous varieties (in situ)	National Bureau of Plant Genetic Resources (NBPGR)	3 years
			Trend in area under cultivation, production/yield (in situ)	Agricultural Universities	
			effectiveness of initiatives/measures taken to conserve indigenous crop varieties and their relatives	Department of Agriculture	
			Trend in germplasm accessions in ex situ collections	National Bureau of Forest Genetic Resources, (NBFGR)	

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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 from codified system of Indian medicine	TKDL-AYUSH-CSIR Unit (Traditional Knowledge Digital Library)	3 years
			Number of transcription	NBA, SSB	
			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	3 years
			Number of patents and ABS based on TK derived from folk knowledge	Controller General of Patents, Designs & Trademark, NBA	3 years
		Trends in grass root innovations and traditional practices	Number of innovations and traditional practices documented	National Innovation Foundation (NIF), NBA, NEHU	3 years
		Trends in capacity building related to TK and PBRs	Training / Capacity building at local and community levels	NBA, SBBs and Foundation for Revitalization of Local Health Traditions (FRLHT), BSI, State Forest Service College and training centers, ICFRE	3 years
			Number of BMCs and PRI institutions trained		
		Trends in conservation and sustainable use of	Number of Medicinal Plants Conservation Areas (MPCA)established in state	MoEFCC, National Medical Plant Board (NMPB), FRLHT	3 years

		medicinal plants used by Meghalaya medical heritage	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	3 years
		Trend in bio-cultural services	Trends in documentation of cultural heritage sites	MBB, Ministry of Tribal Afairs, Ministry of Rural Development	
			Trends in incentive schemes for sustenance of cultural heritage like arts and crafts and festivals		

State / National Biodiversity Targets	Corresponding Aichi 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.	**Aichi 16** ***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	3 years
			Trends in number of cases for seeking prior approval of MBB for transferring the results of research to companies for commercial purposes		
			Trends in number of cases for seeking approval of bio-resources and associated traditional knowledge for commercial utilization		
			Trend in cases related to bio-piracy reported by communities and Forest Department	FD, MBB, District Councils, village councils	

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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.	**Aichi 3,4, 17** ***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 eg. medicinal plants, NTFP, wild edible plants, plants of traditional use.* ***11.7****: Adopt the revised state BSAP as a guiding*	Progress in implementing of State Biodiversity Action Plan	Trends in formulation and implementation of policies suggested MBSAP	SBB, State Planning Board, MoEFCC, NBA, Agriculture, Animal Husbandry Department, and Fisheries Department	3 years
		Reform incentives affecting biodiversity	Number of harmful incentives identified and reformed.		
			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, MBOS, ICAR, Agriculture Department, FD, Animal Husbandry Department, Fisheries Department	

	document for biodiversity management. ***11.8:*** *Establish a state mechanism for implementation of the BSAP.*				

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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.	**Aichi 19, 20** ***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 years
			Trend in human resource made available for implementing Aichi and State Biodiversity Targets	MBB, NBA, MoHRD (Meghalaya)	3 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 years
			Trends in assessment of gaps in biodiversity finance	NBA, MBB	3 years
			Trends in innovative finance mechanisms utilized for implementation of MBSAP	NBA, SBB, FD	3 years