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# NORTH-EAST ECOREGION BIODIVERSITY STRATEGY AND ACTION PLAN

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# CHAPTER 1
# INTRODUCTION

## 1.0 BACKGROUND TO THE NORTH-EAST ECOREGION BIODIVERSITY STRATEGY AND ACTION PLAN (NEEBSAP)

This North-Eastern Ecoregional Strategy and Action Plan (NEEBSAP) is prepared as a part of the National Biodiversity Strategy and Action Plan (NBSAP) being prepared by the Ministry of Environment and Forests, Govt. of India, New Delhi with support from the Global Environment Facility (GEF). At the national level, the execution of NBSAP Process is being done by a Technical and Policy Core Group (TPCG), comprising of experts from various fields and is headed by 'Kalpavriksh', a Pune based NGO. The administrative part of the NBSAP process is being co-ordinated by the Biotech Consortium India Ltd. (BCIL), New Delhi.

## 1.1 THE NORTH-EAST ECOREGION

The North-East Ecoregion covers eight states viz., Arunachal pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim.

## 1.2 OBJECTIVES

The NEEBSAP aims to suggest certain strategies and action plans required for halting and mitigating the ongoing loss of biodiversity in the north-eastern region and promoting its conservation at regional level. While addressing the biodiversity conservation at all the three levels i.e. ecosystem, species and genetic levels, the NEEBSAP also emphasizes the conservation issues pertaining to the cultural diversity of north-east. The NEEBSAP covers wide range of natural as well as man-made terrestrial and aquatic ecosystems, wild plant and animal diversity, and domesticated biodiversity. The strategies have been formulated and actions are prioritized which are required to be taken up in the next 5 to 15 years in a phased manner in order to conserve the rich biological diversity of the region. The specific objectives of NEEBSAP are:

1. To collate and compile information on various aspects of biodiversity in north-east India.
2. To analyse the steps and initiatives taken for conservation of biodiversity in the region.
3. To assess the gaps in information and initiatives/actions.
4. To outline various strategies required for conserving the rich biological diversity of the region.
5. To present an action plan prioritizing the actions in a phased manner to achieve the broader goal of biodiversity conservation.
6. To involve various stakeholders in the biodiversity conservation planning process.

## 1.3 CONTENTS OF THE NEEBSAP

The NEESAP is divided into 8 chapters. Following this introductory chapter, which provides the background and objectives of the Strategy and Action Plan and also its preparation process, chapter 2 gives the profile of the area under the NEEBSAP. Chapter 3 summarises the range and status of biodiversity in north-east and problems relating to biodiversity have been identified in chapter 4. Chapter 5 describes the major actors and their current roles relevant to biodiversity and the on-going biodiversity related initiatives are summarized in chapter 6. Analysis of gaps pertaining to information on biodiversity and initiatives for its conservation has been made in chapter 7. Chapter 8 suggests strategies and action plans for biodiversity conservation in north-east. References and Bibliography habe been cited at the end. The list of species (including those belonging to "Threatened" category), and individuals, institutions and organizations involved in NEEBSAP process have been listed in Annexures.

## 1.4 METHODOLOGY USED IN THE PREPARATION OF NEEBSAP

### ❖ Constitution of an Ecoregional Working Group

An Ecoregional Working Group involving 20 expert members representing NGOs, Academicians, Scientists, Government Organisations and other professionals was constituted. The names of the Working Group members are given in Annexure I.

❖ **Working Group Meeting**

A meeting of the members of the Ecoregional Working Group and the Coordinators of the state steering committees and sub-state sites was organised for experience sharing on 29 May, 2001.

❖ **Literature Survey and Compilation of Information from Secondary Sources**

The literature available in the field of biodiversity was surveyed and information on various aspects were compiled to describe the range of biodiversity, its threats and conservation initiatives taken so far. The literature included published articles, reports and unpublished theses.

❖ **Field Visits and Consultation with Local Knowledgeable Persons**

In order to have specific information on certain aspects of biodiversity, short field visits were made to specific areas. During the field visit, interactions with local knowledgeable persons and other stakeholders were made to collect adequate information and to solicit their views on biodiversity conservation.

❖ **Inputs from experts**

The experts on identified themes relevant to the ecoregion were identified and inputs were invited in a structured format. The coordinators of the state and sub state sites within the ecoregion were also contacted and necessary inputs were received from them.

❖ **The Core Committee**

A Core Committee consisting of Professor R.S.Tripathi and Dr. S.K. Barik was constituted to finalise the draft strategy and action plan. The draft action plan was

discussed and finalised in a meeting of the core committee and the identified experts.

## 1.5 MAJOR DIFFICULTIES FACED DURING THE PROCESS

The following were the difficulties faced during the preparation of Biodiversity Strategy and Action Plan for north-eastern ecoregion.

- ❖ Scarcity of data on biodiversity of north-east
- ❖ Hesitation of the workers to part with information on biodiversity
- ❖ Poor transport and communication network, difficult terrain and insurgency
- ❖ Non-availability of adequate trained personnel.

# CHAPTER 2

# PROFILE OF NORTH-EAST INDIA

## 2.0 THE NORTH-EAST INDIA

The northeast region of India comprising eight states viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura has a geographical area of 2,62,382 sq. km that accounts for about 8% of the total area of India. The region lies between 22° N and 29° 5′ N Latitudes and 88° 00' E and 97° 30′ E longitudes, and shares international border with four countries viz., Bhutan, China, Myanmar and Bangladesh. Therefore, the entire region is strategically important. According to 1991 census, the total population of the region is about 31,954,000. The region is predominantly mountainous interspersed with valleys and river plains. The altitudinal variation ranges from flood plains of Brahmaputra to high Himalayan peaks attaining a height of about 8, 585 m above sea level. Associated with altitudinal variation, a wide range of climatic condition is experienced in the region. In general, the region may be characterised by heavy precipitation, rich forest cover and biodiversity, fragile mountain ecosystems, high seismicity, a drainage pattern marked by valleys dissected by three major rivers viz., Brahmaputra, Teesta and Barak and their tributaries, and low population density. The northeastern region forms a distinct geographical unit in the country and unique in many ways. Being home to more than 225 tribal communities, it is a treasure house of biological and cultural diversity, has high ethnic plurality and contains rich indigenous knowledge systems. The region still has more than 64% of the total geographical area under forest cover and continues to be a forest surplus region.

## 2.1 CLIMATE

The tropic of cancer passes through the north-eastern region i.e. just south of Aizawl in Mizoram. Except the southern half of Mizo hills, the entire region lies within the subtropical belt. As a part of south-east asia, the climate of north-east India is obviously south-east asiatic monsoon (Table 1). However, due to the

peculiar physiographic controls, local influences and ineffective north-east monsoon, the climate of different parts of north-east region has assumed regional characters. The factors responsible for distinct climatic types in various parts of the north-east are, (i) location, (ii) physiography, (iii) alternating pressure cells in northwest, northeast and Bay of Bengal, and their periodic oscillations, (iv) predominance of maritime tropical air masses, (v) local mountain and valley winds, (vi) influence of easterly jet streams and upper air westerlies, and (vii) supply of enormous moisture from the local sources. The climatic characteristics of the region can be described under the following three distinct climatic types:

(i) the cold humid monsoon climate of the frontier hilly region (above 2000 m altitude)

(ii) wet subtropical monsoon climate (covering southern Arunachal Pradesh, western Nagaland, Manipur and Mizoram)

(iii) humid mesothermal monsoon climate with heavy monsoon showers (covering the Brahmaputra Valley, Meghalaya and the Barak Valley including Tripura).

Considering the above climatic characteristics, the region has been divided into four distinct climatic regions by Barthakur (1986), which are as follows (cited in Barik 2002):

Dfh – Humid continental severe winter, moist in all seasons and short summer

CwB – Subtropical monsoon, mild winter, partially dry winter, warm and humid summer

Cwa – Subtropical monsoon, mild and dry winter.

Cwm - Subtropical monsoon, very heavy monsoon rains.

**Table 1. Climatic data for different north-eastern states.**

| State | Name of the Station | Annual Rainfall (cm) | Temperature (°C) | |
|---|---|---|---|---|
| | | | | Maximum |
| Arunachal Pradesh | Itanagar | 348 | 7 | 30.8 |
| Assam | Guwahati | 155 | 14.0 | 35.0 |
| Manipur | Imphal | 76.9 | 3.3 | 33.3 |
| Meghalaya | Shillong | 246 (Maximum 1216 at Mawsynrem and 977 at Cherrapunjee) | 2 | 28 |
| Mizoram | Aizawl | 214 | 8 | 32 |
| Nagaland | Kohima | 250 | 10.4 | 25.7 |
| Sikkim | Gangtok | 349 | 4.5 | 18.5 |
| Tripura | Agartala | 234 | 7.0 | 36.2 |

## 2.2 PHYSIOGRAPHY AND GEOLOGY

The north-east India is physiographically and geologically extremely complex because of its location at the juncture of the Peninsular India and Yunan Shan Plateau separated by the Syntaxial bend of the Himalayan Mountain chain. In addition to these tectonic complications, the topography is further modified by heavy rainfall in lower areas and snowfall in the higher elevations. Seismic instability of the region often fastens these modifications and even locally alters the surface topography. The mighty Brahmaputra with its numerous tributaries controls the geomorphic regime of the region. Geomorphologically, the region

can be divided into the following three major and about fifteen micro units (Taher 1986):

1. The Plateaus
    1.1 Meghalaya Plateau
    1.2 Karbi Plateau
2. The Hills and Mountains
    2.1 Himalayan mountainous region
    2.2 Inner Himalayan region (Glacial and Periglacial)
    2.3 Lesser Himalayan region
    2.4 Eastern Hills
        2.4.1 Dibong-Lohit knot
        2.4.2 Patkai-Tirap-Nagaland-N.Cachar and Manipur Hills
        2.4.3 Mizoram – Tripura range and valley country
3. The Plains
    3.1 The Brahmaputra plain
        3.1.1 Bhabar – Tarai belt
        3.1.2 Northern Built-up strip
        3.1.3 Brahmaputra flood plain
        3.1.4 Southern Built-up strip
        3.1.5 Southern foot hill zone
    3.2 Intermontane and Piedmont plains
        3.2.1 Manipur basin
        3.2.2 Barak valley
        3.2.3 Tripura plain

The north-east India is divided into the following three major divisions considering the physiography, tectonic movement and structural variations:

(i) the rigid massif of the Meghalaya and Karbi Plateaus (a part of the Peninsular Gondwanaland),

(ii) the folded hills and mountains of Tertiary origin born out of the Tethyan Geosyncline, and

(iii) the narrow foreland (or rift valley) that represents the Brahmaputra plain.

## 2.3 THE SOIL

The soils of north-eastern region have developed *in situ* on many types of rocks. The dominant parent materials are gneiss and granites, underlined with chlorite-quartz and schist. Manipur valley soils have developed from the transported material formed from shales and are heavier in texture. Mizoram has arrnaeous and argillaceous rocks, granites, grey to dull yellow coloured bedded sandstone with laminated iron – stained shalesand thick zones of pelagic shales and muds. Geologically, the north-eastern region consists of sandstone, salt stone, shale conglomerates and limestones. In some places of Meghalaya and Arunachal Pradesh, granite, gneiss, phylites and quartzites are also common. Tripura has sedimentary rocks ranging from Miocene origin to loosely consolidated sediment of recent origin. The soils of Nagaland are derived from tertiary rocks belonging to Barails and Disang series. Barails consist of alternating layers of sandstones and shales with carboniferous intrusions or even coal seams. Ultrabasic intrusions are also observed in the east and south-eastern parts of the state. The underlaying Disang series represents unfossiliferous shales, slates and phylites.

The soils of the region are broadly represented by four groups, viz., Inceptisols, Ultisols, Entisols and Alfisols. Although the fertility status of these soils varies greatly, they are usually rich in organic matter and are acidic to strongly acidic in reaction. The low pH of the soil is attributed to leaching of bases under the influence of high rainfall in the hills. In general, the soils of entire Meghalaya, Tripura, Arunachal Pradesh, Manipur and over 50% of the soils of Nagaland, and 40% of the soils of Mizoram are deficient in available Phosphorus. The reason of low availability of phosphorus in the soils of north-east is high content of exchangeable aluminium. The organic carbon content of the most of the soil of the region is high. Almost all soils of Manipur, Meghalaya, major portion of Mizoram, Kameng and Siang districts of Arunachal Pradesh are medium in available Potassium. Most of the soils of Tripura (north and south districts), and Tuensang and Kohima

districts of Nagaland are low in available Potassium. The soils of Sikkim and all the districts of Arunachal Pradesh except Kameng and Siang are high in available Potassium.

Considering the wide variation in the soil types in different north-eastern states, the soils of different states are described below separately.

The soils of Assam are acidic in reaction (pH varies between 5.2 to 5.6) and are usually free from lime. The soils of the Brahmaputra and Barak valleys range from sandy to rich loam and the soils of Cachar hills vary from loam and sandy loam to fine silt and clays. In lower Assam, the plains are made up of soils, which are of alluvial origin composed mostly of silt, sand and clay with occasional pebble beds.

The soil of Meghalaya is largely of lateritic origin. It is generally deficient in phosphorus and potash contents but rich in nitogen and organic matter. In the central plateau soil is predominantly red and in the northern border areas there is a typical upland loam and old and new alluvial soils. The southern parts have sandy gravely and clayey soils.

The soil of Nagaland is generally fertile except on extreme slopes. It is acidic in reaction, pH ranging from 4.8 to 6.5. The soil is rich in organic carbon (2.94%) but poor in available phosphorus (2 kg/ha) and potassium (120 kg/ha) contents.

In Tripura the soils are of two principal types: (i) brown to dark brown, and (ii) black to grey brown. The soils in the areas covered with forests are generally sandy loam, deep and well drained. The soils are acidic in reaction, pH varies between 4.85 and 5.85. The total soluble salts vary between 0.021% and 0.063%. The organic carbon and total nitrogen are quite high. In general, the forest soils are fertile except the soil on the *tilla* lands (intermittent uplands amidst plain agricultural fields) where the soil depth is thin.

Arunachal Pradesh falls in the Eastern Himalayas and Patkoi Ranges. It is endowed with wide topographical variations. Along the greater part of the length of the territory, the

characteristic Siwalik type formation of the Himalayan Mountain is found. The Siwalik range losses its typical character at the point of valley head and is replaced by a series of low hills with easier slopes. These hills gradually merge into the Patkoi hill ranges which separate India from Myanmar (Burma). The general tendency of the hills is found sloping towards the plains of Assam. These hill ridges in Arunachal Pradesh are situated in a very haphazard manner; as soon as one ends, the other starts either in opposite or parallel direction and in between, the wide and narrow valleys are found. These hill ridges and valleys along with rivers and streams make the terrain of Arunachal Pradesh broken and variegated, which results in geographical isolation. The state can be categorised into three broad physio-agronomic zones, viz., (1) the foothills, (2) the valleys and mid-hills and (3) the higher hills. The three zones have soil with the following characteristics:

i) The soils in the foothills are sedimentary and alluvial in nature mostly loams or sandy loams mixed with pebbles.

ii) The soils in the valleys are clayey-alluminus and are rich in organic content.

iii) The soils in the higher hills lack organic content and are composed of rocks of Himalayan type, viz., shales, schists and conglomerates.

Sikkim experiences a wide variation in climate, physiography, geology and vegetation that influence the formation of soils. The soils of Sikkim have been divided into 5 broad physiographic zones, viz., Soils on summit and ridge top, Soils on moderately steep slope (<30%), Soils on moderate slope (<15%), Soil on Very steep slope (>50%), and Soils on steeply sloping side hill (33-50%).

In general, soils are acidic in nature, pH being below 5.0.

## 2.4 AGROCLIMATIC ZONES

The country has been divided into 15 agroclimatic regions based on agroclimatic factors such as soil types, rainfall, temperature, water resources etc. The north-east ecoregion has been covered under Zone II - "Eastern Himalayan Region". This region comprises of Sikkim and Darjeeling (Subzone I), Arunachal Pradesh, Meghalaya, Nagaland and North Cachar Hills of Assam (Subzone II), Manipur, Tripura and Mizoram (Subzone III), Assam south (Subzone IV), and the most of Assam, Jalpaiguri and Cooch Bihar districts of West Bengal (SubzoneV).

There has not been serious attempt at micro level for delineation of the north-eastern region into specific agroclimatic zones. However some attempts have been made to divide the hills region and Assam separately into agro-climatic zones. As for the states, excluding Assam, the classification of agro-climatic zones have been based on altitude, rainfall pattern, temperature variations, topography, soil etc. According to these criteria six distinct agro climatic zones have been identified for these six states excluding Assam. These agro-climatic zones are:

(1) Alpine zone
(2) Temperate and subalpine zone
(3) Subtropical hill zone
(4) Subtropical plains zone
(5) Mild tropical hill zone
(6) Mild tropical plain zone

Although the above groups show distinct differences in broad agro-climatic characteristics, yet it is difficult to draw a clear line of demarcation between any two zones. There is a considerable scope of overlapping in various features including the agricultural practices being followed. This is because variations of climate are present even within a small area as already indicated. However for the purpose of planning for research and development, the above delineation will serve the primary objectives.

Similarly based on rainfall, terrain and soil characteristics the state of Assam has also been broadly classified into six agro-climatic zones. These are:

(1) North bank plains
(2) Upper Brahmaputra valley
(3) Central Brahmaputra valley
(4) Lower Brahmaputra valley
(5) Barak valley
(6) The hills zone.

Some of the important areas covered by the abovementioned twelve agro-climatic zones are indicated below:

**(i) Alpine Zone:**

Gorichen, Upper Tawang, Tulungla, Bumla, Shela Pass areas of West Kameng district, Jidu and adjoining areas of Northern Siang in Aruanchal Pradesh.

**(ii) Temperate and Sub Alpine Zone:**

**Arunachal Pradesh-** Tawang, Dirang, Bomdila, Shergaom areas of West Kameng district, Dibang Valley, Northern part of East Siang, Upper Subansiri district , part of West Siang around Anini and North Eastern part of Lohit district.

**Manipur-** Mao and Maran areas of North district Ukhrul and adjoining areas of east district Laithang areas of central district.

**Meghalaya-** Upper Shillong, Mawphlang and Mairang of East Khasi Hills district.

**Mizoram-** Blue mountain, Halikhan, Tuipang, Nauzuarzo, Tiang.

**Nagaland-** Tuensang and Zunheboto district, Vangkong area of Wokha district, higher areas of Mokochung district.

**(iii) Sub Tropical Hill Zone:**

**Arunachal Pradesh-** Changyak, Naga and Khonsa areas of Tirap district, Basar area of Siang district.

**Meghalaya-** Jowai sub-division of Jaintia Hills, part of Nongstoin sub-division, Nokrek and Kailash areas of West Garo Hills and Western part of East Garo Hills.

**Mizoram-** Whole state except lower valleys of Northern and Western part, area adjoining cachar district and lower parts of Chhimtuipuii district.

**Nagaland-** Mokochung district, lower part of Kohima, Wokha district and Mon district.

**(iv) Sub Tropical Plains Zone:**

**Manipur-** Imphal valley

**Meghalaya-** Umkiang area of Jaintia hills.

**Nagaland**- Bhaghti and Longnak valley.

**(v) Mild Tropical Hill Zone:**

**Arunachal Pradesh-** Southern part of Subansiri district.

**Manipur-** Manipur West District including Juiban area, Churachandpur and Thanlon of South district, Morena of Central district.

**Megahalaya-** Southern part of Jowai Sub-division adjoining Karimganj, Cachar and North Cachar district of Assam, Southern part of Nongpoh sub-division of Khasi hills, Eastern part of East Garo hills and West Khasi hills.

**Mizoram-** Lower valley of Northern and Western parts and Chhimtuipuii district.

**Nagaland-** Medziphema area of Dimapur sub-division.

**Tripura-** Jampui hills.

**(vi) Mild Tropical Plain Zone:**

**Arunachal Pradesh-** Pasighat area, Singphow area of Tirap district and lower parts of Lohit district.

**Megahalaya-** Lower part of West Garo hills district.

**Mizoram-** Areas adjoining Cachar districts of Assam and North Tripura district.

**Nagaland-** Southern part of Dimapur sub-division excluding Medziphema area.

**Tripura-** Major part of Tripura excepting Jampui hills.

**(vii) North Bank Plains Zones:**

Lakhimpur, Sonitpur and Mongoldoi districts of Assam.

**(viii) Upper Brahmaputra valley Zone:**

Dibrugarh, Sibsagar and Jorhat district including Majuli island.

**(ix) North Brahmaputra valley Zone:**

Nowgong district of Assam.

**(x) Lower Brahmaputra valley Zone:**

Kamrup, Borpeta, Kaokrajhar and Goalpara districts of Assam.

**(xi) Barak valley Zone:**

Cachar district of Assam.

**(xii) Hills Zone:**

Karbi Anglong and North Cachar Hills districts of Assam.

## 2.5 LAND USE

The land use pattern among different north-eastern states varies widely. Except in Brahmaputra and Barak valleys of Assam where substantial areas are under agriculture, major portion of north-east are under forests and least area is available for settled cultivation. According to 1958-60 Survey Operation and the Gazetteer of Sikkim, the total geographical area of Sikkim under different utilization categories is 7299 sq. km. The land use of Sikkim and the seven other states is shown in Table 2.

**Table 2. Land Use Classification of North-Eastern States.**

**A. Land use classification of Sikkim (1958-60 Survey Operation)**

| Land use Pattern | Area In '000 ha | Percentage of Area |
|---|---|---|
| Barren Land | 209.01 | 28.28 |
| Land put to Non- Agricultural Use | 69.96 | 9.58 |
| Permanent pastures and grazing land including cultivable waste | 102.49 | 14.40 |
| Land under miscellaneous tree crops and grasses | 4.17 | 0.57 |
| Forest Land | 265.21 | 36.34 |
| Land under operational holdings | 79.06 | 10.83 |
| Total | 729.90 | 100.00 |

**B. Land Use Classification ( Area in sq. km) of the seven North-Eastern States (1994-95)**

| State | Geogra-phical area | Reported area of land utilization | Area not available for cultivation | | | Other uncultivated land excluding fallow land | | | Fallow land | | Net area sown |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Forest Area | Area put to non-Agricult u-ral uses | Barren and uncultiv-able land | Permanent pastures and other grazing land | Cultiva-ble wasteland | Others | Current fallows | Fallow land other than current fallow | |
| Arunachal Pradesh | 8374 | 5495 | 5154 | a | 48 | b | b | 44 | 28 | 36 | 185 |
| Assam | 7844 | 7850 | 2012 | 1022 | 1429 | 158 | 91 | 214 | 74 | 70 | 2780 |
| Manipur | 2233 | 2211 | 602 | 26 | 1419 | b | b | 24 | - | - | 140 |
| Meghalaya | 2243 | 2241 | 938 | 84 | 142 | - | 484 | 160 | 66 | 166 | 201 |
| Mizoram | 2108 | 2085 | 1599 | - | 47 | - | 174 | - | - | 162 | 109 |
| Nagaland | 1658 | 1549 | 863 | 47 | - | - | 82 | 137 | 117 | 97 | 206 |
| Tripura | 1049 | 1049 | 606 | 133 | c | b | 1 | 27 | 4 | 1 | 277 |
| **Total** | **25,509** | **22,480** | **11, 774** | | | | | | | | **3898** |

Note: a - included under 'Barren and uncultivable land';

b - included under 'Miscellaneous tree crops and groves etc.'

c - included under 'Area put to nonagricultural uses'

Source: Modified from North-Eastern Council Statistics, 2000.

## 2.6 AGRICULTURE

Shifting cultivation or slash and burn agriculture, locally called as jhum is the main form of agriculture in the hills of north-east. In view of the mountainous terrain, settled cultivation constitutes only a small portion of the total cultivated land, which is mostly confined to the valley lands. Considering the high cost, labour and energy input involved in terrace cultivation, and in absence of other viable alternatives to shifting cultivation, the majority of the population of the north-eastern hill states continues to depend on shifting cultivation for their subsistence livelihood.

Shifting cultivation involves clearing of vegetation, and then slashing and burning the plant parts including debris. After 2-3 years of cropping, the land looses its fertility and the farmer shifts to another piece of virgin forested land for cultivation. The vegetation in the fallow land regenerates during the fallow period. After certain number of years, which varies from 3 to 15 years, depending upon the place, population and land ratio, and tribe, the farmer again comes back for farming to the same piece of land, which he left fallow a few years back. Thus, the cycle of cropping and fallow continues. The period between slash and coming back again to the same plot after completion of intervening fallow period constitute one jhum cycle. With rising population, the jhum cycle in most areas, which used to be 10 – 15 years earlier is now reducing to 2-3 years only.

Area affected by shifting cultivation in north-east India as estimated by various agencies differs significantly (Table 3). According to these estimates, the area under shifting cultivation is between 2.80 million ha and 7.40 million ha.

**Table 3. Area under shifting cultivation in north-east India as estimated by different agencies.**

| Agency | Year | Area (million ha) |
|---|---|---|
| North-Eastern Council | 1975 | 2.80 |
| FAO | 1975 | 7.40 |
| Task Force on Shifting cultivation, Ministry of Agriculture | 1983 | 3.81 |
| Forest Survey of India | 1999 | 1.73 |

Shifting cultivation has been the main source of livelihood for most tribes of north-eastern hills and a substantial portion of the total hill population exclusively depends on it for survival (Table 4). On an average, 3,869 sq. km area is put under shifting cultivation every year and an estimated 4,43,336 households earn their livelihood from shifting cultivation. It is not only the source of livelihood but also has high cultural importance among the people of northeast. The extent of area under shifting cultivation is maximum in Nagaland followed by Mizoram and Manipur (Table 5)

**Table 4. Shifting Cultivation in North-Eastern Region as reported by the Task Force on Shifting cultivation, Ministry of Agriculture (1983).**

| State | Annual area under shifting cultivation (sq.km) | Fallow period (in years) | Minimum area under shifting cultivation one time or other (sq. kms) | No. of Families practising Shifting cultivation |
|---|---|---|---|---|
| Arunachal Pradesh | 700 | 3-10 | 2,100 | 54,000 |
| Assam | 696 | 2-10 | 1,392 | 58,000 |
| Manipur | 900 | 4- 7 | 3,600 | 70,000 |
| Meghalaya | 530 | 5- 7 | 2,650 | 52,290 |
| Mizoram | 630 | 3- 4 | 1,890 | 50,000 |
| Nagaland | 190 | 5-8 | 1,913 | 1,16,046 |
| Tripura | 223 | 5- 9 | 1,115 | 43,000 |
| **Total** | **3,869** | | | **4,43,336** |

**Table 5. Area affected by shifting cultivation in different north-eastern states as per the estimate of Forest Survey of India (1999).**

| State | Cumulative area (million ha) of shifting cultivation (1987 to 1997) |
|---|---|
| Arunachal Pradesh | 0.23 |
| Assam | 0.13 |
| Manipur | 0.36 |
| Meghalaya | 0.18 |
| Mizoram | 0.38 |
| Nagaland | 0.39 |
| Tripura | 0.06 |
| **Total** | **1.73** |

# CHAPTER 3

# CURRENT RANGE AND STATUS OF BIODIVERSITY

## 3.0 RANGE OF BIODIVERSITY

The North-East India is rich in biological diversity and contains more than one-third of the country's total biodiversity. In view of its importance from biodiversity conservation point of view, the region is one of the 18 hot-spots of the world. The region has at least 7,500 flowering plants, 700 orchids, 58 bamboos, 64 citrus, 28 conifers, 500 mosses, 700 ferns and 728 lichen species. The region is equally rich in faunal diversity. An estimated 3,624 species of insects, 50 molluscs, 236 fishes, 64 amphibians, 137 reptiles, 541 birds and 160 mammalian species have been so far described (Anonymous 1998b). The region is also rich in terms of genetic and ecosystem diversity. Some of the important gene pools of citrus, banana and rice have been reported to be originated from this region (Anonymous 1996). The ecosystem diversity of the region ranges from tropical ecosystems to alpine ecosystems in the Himalayan ranges and also includes diverse types of wetland, flood plain, riverine and aquatic ecosystems along the Brahmaputra-Barak river systems. Mountain Peaks and Glaciers in high Himalayan ranges of Arunachal Pradesh and Sikkim constitute another group of unique ecosystems. Besides, a variety of man-modified ecosystems such as jhum agro-ecosystem, wet rice agroecosystem and alder-based agroecosystem contribute towards rich ecosystem diversity. All these ecosystems are home to a large variety of indigenous wild as well as cultivated crops, plants and animals. An estimated 33% of the total biological diversity of the region is endemic.

## 3.1 ECOSYSTEM DIVERSITY

- **Forest ecosystems**

  The north-eastern region has the most diverse types of forest ecosystems in the country that range from Tropical forest ecosystems in the floodplains to Subtropical, Temperate and Alpine forest ecosystems in the high mountains. Besides, Riverine ecosystems with varying species composition are scattered through out the region at different elevations along the Brahmaputra and Barak rivers and their tributaries.

- **AquaticEcosystems**

Although mountainous, the region is very rich in aquatic ecosystem diversity. The large number of rivers and streams flowing across the region represent the diversity in the lotic ecosystems. The high altitude lakes situated along the elevational gradient and large number of *bheels*, ponds and marshlands in the lowlying and floodplain areas of Assam, Arunachal Pradesh and Tripura represent the diversity in lentic ecosystems of north-east. The Loktak lake, a RAMSAR site and one of the most unique and important wetlands of the country is situated in the north-eastern ecoregion.

- **River island**

The largest river island of the country Majuli is also situated in the north-eastern ecoregion. The unique island ecosystem is situated in the river Brahmaputra and is home to many endemic and threatened elements of biodiversity. Unfortunately, due to frequent change in the course of the river and many other anthropogenic and natural causes, the island ecosystem itself is under threat. Therefore, conservation of such unique ecosystems is of high importance from biodiversity conservation point of view.

- **Agroecosystems**

The agroecosystem diversity in the north-east region ranges from the ecosystems under shifting cultivation practices in the mountains to settled and intensive cultivation practices in the valleys and plain lands. The variety and variability in shifting cultivation (e.g. tribe specific variabilities, *Boon* and Alder *jhum*) and terrace land cultivation (e.g. irrigated terrace and bench terrace with stone wall) practices make the agroecosystem diversity of north-east quite rich.

- **Alpine meadows**

The Eastern Himalayan alpine meadow ecosystems are situated in the high altitude areas (above 3700 m altitude) of north-eastern ecoregion. Such ecosystems are found in Sikkim and Arunachal Pradesh, where a large number of floral and faunal elements are endemic, threatened and commercially useful (e.g. rare medicinal plants). As such the Himalayan alpine meadows are one of the most fragile ecosystems and the

livelihood of millions of people living in these areas is directly dependent on the sustainable management of biodiversity in these ecosystems.

## 3.2 FOREST ECOSYSTEMS

In north-east India (Sikkim statistics not included), 54% of the total geographical area of the region is recorded as forest area. The forest cover of the region (163,799 sq. km) is much higher than the recorded forest area and constitutes about 64% of the total geographical area (Forest Survey of India 1999). The forest cover of the region is more than three times higher than the national average of 19.4%. The forests of the region comprise 25.7% forest cover of the country. The region is forest rich and per capita forest cover in northeast region (0.52 ha) is much higher than the national average (0.076 ha). The forests are very rich in biodiversity and the region is one of the 18 biodiversity hotspots of the world. Because of wide altitudinal, climatic and edaphic variations, a variety of forest ecosystems ranging from tropical evergreen to alpine scrub are found in north-eastern region.

### 3.2.1 Forest Types of the North-Eastern States

Depending upon the local climatic and edaphic conditions, forest types of states vary. Wide variation in these factors among different northeastern states results in formation of a large number of forest types each differing in species composition and forest structure. Major portion of each north-eastern states is characterised by mountainous terrain and altitudinal variation is an important determinant of the local climate and soil characteristics in all the state. Therefore, it is possible to consider altitudinal variation as a factor for classifying forests in the region in a broader sense. Such a classification scheme along with the important species found in each broad forest type is given in Table 6. The forest types of north-east as classified by Champion and Seth (1968) is given in Table 7.

**Table 6. Broad Forest types of North-east based on altitudinal ranges**

| **Forest type** | **Altitudinal ranges (m)** | Important species |
|---|---|---|
| Alpine | Above 3500 | *Rhododendron* spp., *Arenaria* spp. , *Saxifraga* spp. |
| Temperate | 1800-3500 | *Acer* spp., *Castanopsis* spp., *Populus* spp., *Tsuga* spp., *Abies* spp., *Cupressus* spp., *Pinus* spp. |
| Subtropical Pine | 1000-3500 | *Pinus roxburghii, P. merkusii, P. wallichiana* |
| Subtropical broadleaved | 900-1900 | *Castanopsis* spp., *Quercus* spp., *Michelia* spp., *Alnus nepalensis, Schima* spp. |
| Tropical wet evergreen | Up to 900 | South bank:<br>*Dipterocarpus macrocarpus, Shorea assamica*<br>North bank:<br>*Mesua ferrea, Altingia excelsa* |
| Tropical semi-evergreen | Upto 600 | *Terminalia myriocarpa, Bombax ceiba, Canarium strictum, Ailanthus grandis* |

**Table 7. Forest types of north-east as classified by Champion and Seth (1968)**

| | |
|---|---|
| 1B/C1. | Assam valley tropical wet evergreen forest |
| 1B/C2(a,b). | Upper Assam valley tropical wet evergreen forest |
| 1B/C3. | Cachar tropical wet evergreen forest |
| 1/E1. | Cane brakes |
| 1/E2. | Wet bamboo brakes |
| 1/2S1. | Pioneer Euphorbiaceous scrub |
| 2B/C1(a,b). | Assam valley semi-evergreen forest |
| 2B/C1/1S1. | Sub-Himalayan high alluvial semi-evergreen forest |
| 2B/C1/1S2. | Syzygium parkland |
| 2B/C1/2S2. | Eastern alluvial secondary semi-evergreen forest |
| 2B/C/2S3. | Sub-Himalayan secondary wet mixed forest |
| 2B/$C_2$. | Cachar semi-evergreen forest |
| 2/$E_3$. | Moist bamboo brakes |
| 2/2S1. | Secondary moist bamboo brakes |
| 3C/C1(a,b,c) | Very moist sal forest |
| 3C/C2(d) | Moist plains sal forest |
| 3C/C2/DS1 | Moist sal savannah |
| 3C/$C_3$(b). | East Himalayan moist mixed deciduous forest |

| | |
|---|---|
| 3C/$C_3$/2S1. | Northern secondary moist mixed deciduous forest |
| 3C/$C_3$/2S2. | Secondary Euphorbiaceous scrub |
| 3/1S1. | Low alluvial savannah woodland |
| 3/1S2(a,b). | Eastern hollock forest |
| 4C/$FS_2$. | Sub-montane hill valley swamp forest |
| 4C/$FS_3$. | Creepers swamp forest |
| 4D/SS1 to $SS_5$. | Tropical seasonal swamp forest |
| 4D/2S2. | Eastern wet alluvial grassland |
| 4E/RS1. | Riparian fringing forest |
| 5/1S2. | Khair-sissu forest |
| 8B/C2. | Khasi sub-tropical hill forest |
| 8B/DS1. | Assam sub-tropical hill savannah woodland |
| 9C1b | Himalayan chir pine forest |
| 9/C2/DS1. | Assam sub-tropical pine forest |
| 9/C2/DS1. | Assam sub-tropical pine savannah |
| 11B/C1(a,b,c). | East Himalayan wet temperate forest |
| 11B/C2. | Naga hills wet temperate forest |
| 12/C3(a,b) | East Himalayan moist temperate forest |
| 12/E1. | Cypress forest |
| 12/DS1. | Montane bamboo brakes |
| 12/1S1. | Alder forest |
| 12/2S1. | Low level blue-pine forest |
| 13/C6. | East Himalayan dry temperate coniferous forest |
| 13/C6/E1. | Larch forest |
| 13/C7. | East Himalayan dry juniper/birch forest |
| 13/1S1. | Hippophae/Myricaria scrub |
| 13/1S2 | Populus-Salix forest |
| 14/C2. | East Himalayan sub-alpine birch/fir forest |
| 14/C2/2S1. | Sub-alpine blue pine forest |
| 14/DS1. | Sub-alpine pasture |
| 15/C1. | Birch/Rhododendron scrub |
| 15/C2 | Deciduous alpine scrub |
| 15/C2/E1. | Dwarf Rhododendron scrub |
| 16/C1. | Dry alpine scrub |
| 16/E1. | Dwarf juniper scrub |

### 3.2.2 Forest cover

Forest cover of different north-eastern states as assessed by Forest Survey of India (FSI) every two years is given in Table 8. Except in Arunachal Pradesh and Tripura, the forest cover in all the states are declining. The region is forest rich with high forest-man ratio (Table 9). The forest cover in all the states of the region is much higher than the recorded forest area except in Assam and Tripura

(Table 10). This is due to non-recording of a part of the council, community, clan and private forests, most of which are not surveyed, demarcated and settled properly. In Assam and Tripura, substantial recorded forest areas are encroached, degraded and diverted for non-forestry purposes. Hence, the actual forest cover is significantly less than the recorded forest area in these two states.

**Table 8. Change of forest cover (in sq. km) in north-eastern states since 1991 FSI assessment**

| State | 1991 | 1993 | 1995 | 1997 | 1999 |
|---|---|---|---|---|---|
| Arunachal Pradesh | 68,757 | 68,661 | 68,621 | 68,602 | 68,847 |
| Assam | 24,751 | 24,508 | 24,061 | 23,824 | 23,688 |
| Manipur | 17,685 | 17,621 | 17,558 | 17,418 | 17,384 |
| Meghalaya | 15,875 | 15,769 | 15,714 | 15,657 | 15,633 |
| Mizoram | 18,153 | 18,697 | 18,576 | 18,775 | 18,338 |
| Nagaland | 14,321 | 14,348 | 14,291 | 14,221 | 14,164 |
| Tripura | 5,535 | 5,538 | 5,538 | 5,546 | 5,745 |
| **Total** | **1,65,777** | **1,65,142** | **1,64,359** | **1,64,043** | **1,63,799** |

**Table 9. Status of forests and forest-man ratio in north-eastern states**

| State | Population | Geographical Area '000 ha | Total Forest '000 ha | | Dense Forest (> 40% Canopy Cover) '000 ha | Open Forest (10-40% Canopy Cover) '000 ha | Per Capita Forest Cover in ha |
|---|---|---|---|---|---|---|---|
| | | | Recorded | Cover | | | |
| Arunachal Pradesh | 864558 | 8374 | 5154.0 (61.54) | 6885 (82.21) | 5776 | 1109 | 7.96 |
| Assam | 22414322 | 7844 | 3070.0 (39.15) | 2369 (30.20) | 1452 | 917 | 0.11 |
| Manipur | 1837149 | 2233 | 1515.4 (67.87) | 1738 (77.86) | 593 | 1145 | 0.95 |
| Meghalaya | 1774778 | 2243 | 949.6 | 1563 | 592 | 971 | 0.88 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | (42.34) | (69.70) | | | |
| Mizoram | 689756 | 2108 | 1593.5 | 1834 | 379 | 1455 | 2.72 |
| | | | (75.59) | (86.99) | | | |
| Nagaland | 1209546 | 1658 | 862.9 | 1416 | 514 | 902 | 1.17 |
| | | | (52.04) | (85.43) | | | |
| Sikkim | 406457 | 730 | | | | | |
| Tripura | 275 7205 | 1049 | 630.9 | 575 | 223 | 352 | 0.21 |
| | | | (60.01) | (54.79) | | | |
| **N.E. States** | **31953771** | **26239** | **13776.3** | **16380** | **9529** | **6851** | **0.52** |
| | | | **(54.00)** | **(64.00)** | | | |
| **India** | **838583988** | **328726** | **765210** | **63729** | **37736** | **25506** | **0.076** |
| | | | **(23.28)** | **(19.39)** | | | |

Figures in parentheses represent the forest area as percentage of the total geographical area

### 3.2.3 Forest ownership and Legal Classification of Forests

The legal classification of forests in different north-eastern states is shown in Table 10. It can be seen from the table that unlike in the rest of the country where forests are mostly owned by the state and managed by the state forest department, in most north-eastern states substantial forest areas are under the unclassed category, and are owned by private individuals, clans, village councils, district councils and other traditional community institutions. In some states like Arunachal Pradesh, the ownership of such forests is not clear and the people enjoy traditional usage rights and the government has adequate control over the land and trees.

**Table 10. Classification of forest areas in north-eastern states based on legal status**

**(Area in sq. km)**

| States | Geographical area (sq. km) | Reserved | Proposed Reserve | Protected | Unclassed | Total Recorded Forest |
|---|---|---|---|---|---|---|
| Arunachal Pradesh | 83743 | 19673.52 | - | - | 31866.48 | 51540.00 |
| Assam | 78438 | 17588.85 | 3933.63 | - | 9185.09 | 30707.57 |
| Manipur | 22327 | 1463.00 | - | 4171.00 | 9520.00 | 15154.00 |
| Meghalaya | 22429 | 981.00 | - | 12.00 | 8503.00 | 9496.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Mizoram | 21081 | 7127.00 | - | 3568.00 | 5240.00 | 15935.00 |
| Nagaland | 16579 | 86.00 | - | 507.00 | 8036.00 | 8629 |
| Tripura | 10486 | 3588.18 | 509.03 | - | 2195.47 | 6292.68 |
| **Total** | **255083** | **50507 (37%)** | **4443 (3%)** | **8258 (6%)** | **74546 (54%)** | **1, 37, 754 (100%)** |

Figures in parentheses represent the percentage of total recorded forest

About 54% of the total forest area of the region are unclassed and are not covered by any scientific management plan. In Assam, out of total 30707.57 sq. km of forest area, 3589 sq. km of Reserved Forest and Proposed Reserved Forest are managed by two district councils and the rests are managed by the state forest department. In Tripura, Tripura Tribal Area Autonomous District Council controls 143.17 sq. km of forests (2.27%) and the rests are managed by the state forest department. In Mizoram, 1776 sq. km of forest (11.14%) is under the control of three district councils and the state forest department manages the remaining areas. In Meghalaya, the three autonomous district councils control the unclassed forests of 8503 sq. km (96%). In Nagaland, unclassed forests (93%) are owned by the clans, village councils and individual families. In Manipur, all unclassed forest land of 9520 sq. km is under the control of hill areas council.

### 3.2.4 Important Forest Resources

The north-eastern states have vast natural forest resources. Besides timber, a number of non-timber forest produce including cane, bamboos, broomgrass, mushrooms, orchids, commercially important grass species, oil yielding trees, honey and wax are extracted from the forests every year in large quantities. Important medicinal plants such as *Taxus baccata, Tinospora cordifolia, Vinca rosea, Strychnos nux-vomica, Dichora febrifuga, Hodgsonia hiteroclita, Scutellaria discolour, Smilax* sp., *Solanum khasianum, Dioscorea deltoides, Dioscorea prazerai, Dioscorea bulbifera, Holarrhena antidysenterica* etc. are also found in these forests. Gums, resins, edible wild fruits and tubers and a number of spices such as Cinnamomum, Lichi (*Illicium griffithii),* Large Cadamum are other important non-timber forest resources of the region contributing substantially to the livelihood and economy of the people.

### 3.2.5 Bamboo and Rattan diversity

The north-east ecoregion contains about 46% of bamboo and 33% of rattan species found in India (Table 11). Most of these are endemic and are exclusively found in this ecoregion.

**Table 11. Bamboo and Rattan diversity of north-east India as compared to India and World.**

| Geographic Region | Bamboo | | Rattan | |
|---|---|---|---|---|
| | Genera | Species | Genera | Species |
| North-East | 16 | 58 | 5 | 23 |
| India | 23 | 125 | 5 | 70 |
| World | 75 | 1250 | 13 | 600 |

## 3.3 AGROECOSYSTEMS

The agrobiodiversity of north-east ecoregion is not only rich (Table 12) but also important from many angles. The region is center of origin/ speciation for many agricultural and horticultural crops/varieties such as citrus, paddy, maize and cucurbits.

**Table 12. Diversity of major crops in North-East India (after Hore, 2001)**

| Crop | Estimated diversity | Diversities collected till 2000 |
|---|---|---|
| Rice | 9650+ | 4300 |
| Maize | 15 races and 3 subraces –1200+ | 760 |
| Taros | 300 | 272 |
| Yams | 230 | 200 |
| Citrus | 17 species and 52 varieties | 80 |
| Banana | 16 species | 120 |
| Orchids | 700 species | |
| Sugarcane | 19 | |
| Bamboo | 78 species | |

### 3.4 FLORAL DIVERSITY

The floral diversity of north-east is quite rich and approximately one third of the flora is endemic. Some of the important floral elements including the endemic and threatened category are listed in Annexure II.

### 3.5 FAUNAL DIVERSITY

The north-east ecoregion is one of the richest region of the country having high faunal diversity (Annexure III ). The region is also home to a large number of endemic, rare and endangered animal species, which are being increasingly threatened due to habitat destuction, illegal poaching, trade and unrestricted hunting. Some of these species have been listed under Annexure III.

#### 3.5.1 Avifauna

The north-eastern ecoregion is quite rich in avifauna having more than 540 bird species, of which several are endemic to the region . The Eastern Himalayas and Assam plains are the two endemic bird areas among the 7 such areas identified in the country (Supriya Jhunjhunwala, 2002). The list of restricted range bird species in the abovementioned two endemic bird areas of north- east is given in Table13.

**Table 13. List of restricted range bird species in the two endemic bird areas of north-east (after Supriya Jhunjhunwala, 2002).**

**A.Eastern Himalayas**

| | | |
|---|---|---|
| 1. | Dark-rumped Swift | *Apus acuticauda* |
| 2. | Ward's Trogon | *Harpactes wardi* |
| 3. | Chestnut-breasted Partridge | *Arborophila mandellii* |
| 4. | Blyth's Tragopan | *Tragopan blythii* |
| 5. | Sclater's Monal | *Lophophorus sclateri* |
| 6. | Beautiful Sibia | *Heterophasia pulchella* |
| 7. | Broad-billed Warbler | *Tickelli hodgsoni* |
| 8. | Brown-capped Laughingthrush | *Garrulax austeni* |
| 9. | Grey Sibia | *Heterophasia gracilis* |
| 10. | Hoary-throated Barwing | *Actinodura nipalensis* |

| | | |
|---|---|---|
| 11. | Ludlow's Fulvetta | *Alcippe ludlowi* |
| 12. | Rufous-throated Wren-babbler | *Spaeleornis caudatus* |
| 13. | Rusty-bellied Shortwing | *Brachypteryx hyperythra* |
| 14. | Rusty-throated Wren Babbler | *Spelaeornis badeigualris* |
| 15. | Snowy-throated Babbler | *Stachyris oglei* |
| 16. | Streak-throated Barwing | *Actinodura waldeni* |
| 17. | Striped Laughingthrush | *Garrulax virgatus* |
| 18. | Tawny-breasted Wren-babbler | *Speleornis longicaudatus* |
| 19. | Wedge-billed Wren-babbler | *Sphenocichla humei* |
| 20. | White-naped Yuhina | *Yuhina bakeri* |
| 21. | Yellow-vented Warbler | *Phylloscopus canator* |

## B.Assam Plains

| | | |
|---|---|---|
| 1. | Manipur Bush Quail | *Perdicula manipurensis* |
| 2. | Blackbreasted Parrotbill | *Paradoxornis flavirostris* |
| 3. | Marsh Babbler | *Pellorneum palustre* |

# CHAPTER 4
# PROBLEMS RELATING TO BIODIVERSITY CONSERVATION

## 4.0 Threats to species and ecosystem diversity

Although the factors threatening the species and ecosystem diversity of north-east (Box 1 and 2) are more or less similar to those operating elsewhere such as habitat fragmentation, poaching and trade in wild flora and fauna, introduction of exotics etc. (Box 3), certain crucial factors causing problems in biodiversity conservation specific to north-easstern region are described in the following paragraphs.

| **Box 1. Components of species diversity under threat** |
|---|
| • Forest flora and fauna<br>• Agricultural crops<br>• Horticultural crops<br>• Domesticated livestock<br>• Biodiversity in aquatic ecosystems (e.g. Fish, aqatic flora and fauna)<br>• Insect diversity (e.g. butterfly) |

| **Box 2. Ecosystems under threat** |
|---|
| • Forest (Sacred forests, RFs, PAs, CFs)<br>• Aquatic (River, Lake, Bheels, Ponds, wetlands)<br>• River island<br>• Agroecosystems (Intensive cultivation)<br>• Alpine meadows |

| Box 3. Factors causing threat to Biodiversity |
|---|
| • Shifting cultivation<br>• Deforestation and habitat destruction<br>• Invasive species<br>• Introduction of exotics<br>• Popularisation of hybrid varieties<br>• Poaching<br>• Trade in wildlife including wildplants and insects<br>• Over exploitation of biodiversity beyond sustainable limit<br>• Change in food habit due to subsidized food grain distribution |

### 4.1 Problems relating to biodiversity conservation

#### 4.1.1 Land tenure issues

- Land tenure systems vary widely among different north-eastern states, which are quite different from the rest of India. The ownership pattern and tenurial rights over land also vary among the districts and tribes within a state. The complexity in land ownership and tenurial rights makes it difficult for survey, demarcation and consolidation of land. Therefore, cadestral survey and land demarcation are completely absent in the hill areas of northeast.

- Most clan-owned forests are over-exploited as there is hardly any management system or any restriction on resource use. The forests under the control of Village Councils, Anchal Samitees and other traditional institutions such as Syiemship, Sirdarship, Doloiship and Nokmaship are usually managed by customary laws. The District Council Acts wherever applicable to these forests are too weakly enforced. With the weakening of the influence of these traditional institutions over the land and people, the usage right of the people in these forests is now almost unrestricted. As a result, baring a few, all these forests are now severely degraded.

### 4.1.2 Dichotomy in Forest Administration

Most of the forests in Arunachal Pradesh, Manipur, Meghalaya and Nagaland are owned by private individuals, communities and clans. The ownership rights over land and resources are further protected by the sixth schedule of Indian Constitution (Table 14). The acts and rules framed by the state and national governments are therefore not applicable to such forests to ensure their protection. The district council acts are too weakly enforced as there are not adequate forest personnel in the district council to enforce them. Hence, most community forests in north-east are virtually under no management and do not come under the effective enforcement of any of the forest laws. This necessitates the framing of appropriate policies and laws to effectively manage these forests.

**Table 14. Administrative structure and Special Constitutional Provision for Tribal areas of North-East India**

| State | Special Constitutional Provision | Autonomous (District) Councils |
|---|---|---|
| Arunachal Pradesh | Article 371 H | No Autonomous Councils but the state has Elective Village Councils and Anchal Samitis (Panchayats) |
| Assam | Sixth Schedule Read with Article 371 B (for Scheduled Areas only) | Karbi-Anglong, North Cachar Hills, Bodoland, Rabha-Hasong, Tiwa, Mishing |
| Manipur | Article 371C | Ukhrul, Tamenglong-Senapati, Sadar Hills |
| Meghalaya | Sixth Schedule | Khasi Hills, Jaintia Hills and Garo Hills |
| Mizoram | Sixth Schedule Read with Article 371G | Pawi, Lakher, Chakma |
| Nagaland | Article 371A | No Autonomous Councils but each village has a Village Council |
| Tripura | Sixth Schedule | Tripura Tribal Area Autonomous District Council, Khumulwang |

### 4.1.3 Gender and Equity issues in natural resources and biodiversity management

Traditionally, the usage rights of all the community members over the community lands were well-recognized and based on the eqitable land utilization pattern, the societies were more or less homogeneous. However, of late, certain types of community lands are increasingly being privatized and the landlessness within the tribal society is increasing. Such unequal distribution of land resources is responsible for increasing dependence on forests by certain sections of the society leading to forest degradation. With exception of Meghalaya, where a woman becomes the custodian of the family land, woman has hardly any decision making power in the matter of natural resource management in the entire north-east. Even in Meghalaya, women cannot take part in the traditional village *darbars,* which is the main decision making body at village level. Thus, resolving the gender and equity issues concerning natural resource management is equally important in north-east as in the other parts of the country.

### 4.1.4 Inter-departmental coordination

Strengthening of the traditional village level institutions and capacity building of the communities for natural resources management are two important steps that can help conserving community/private forest resources. The forests being the main stay of the region's economy, development and management of forests have to be viewed in a wholistic manner. Thus, community development programmes and other land-based activities such as agriculture, horticulture, fisheries etc. have to be complementary to the forestry activities. This needs a close inter-departmental coordination to address various developmental and livelihood issues of the people that in turn, will ensure the sustainable management of forests. Besides, non-forestry sector policies, institutions and activities can have significant forestry implications. Therefore, coordination among different sectoral departments is a must for the development of forests in the region.

### 4.1.5 Effective management of private and community forests

- There is a need to work out a regulatory mechanism to control over-exploitation of forests, where the land owners themselves will be legally bound to sustainably harvest and manage their own forests. This may perhaps be achieved through

strengthening and empowering the existing traditional institutions with adequate legal back up and generating awareness among the forest owners regarding the importance of sustainable forest management in the region. There is a need to strike a balance between the enabling and controlling functions of the legal instruments.

- This may also include the capacity building measures among the forest owners for scientific management of the forests. Unless the forests are converted to productive forests and sufficient financial return is ensured through the principle of sustained yield, the perpetuation of community forests and other unclassed forests is highly constrained.

- In addition to PFM, other forms of key partnerships need to be evolved for better management of community/ private forests. Some of the following partnerships have been successfully tried in different parts of the north-east, which need to be replicated and adapted suitably. (i) Government – Forest owner-Industry (ii) Government – Private forest owners (iii) Government-Community forest regulating bodies (iv) Partnership between Government agencies and (v) NGO-Govt.- Community partnerships.

### 4.1.6 Smuggling of Timber across the international border

The illicit felling of trees and timber smuggling across the international borders has been the most important cause of forest degradation in border areas irrespective of the ownership of the forests. The efforts to prevent timber theft either through Border Security Force or through State Forest Protection Forces have not been successful. Empowering the local people through constituting forest protection committees and giving the total responsibility of protection to them seem to be the only possible solution to this problem.

### 4.1.7 Shifting cultivation

Unregulated shifting cultivation by the local tribal populations has been a major threat to sustainable forest management particularly in unclassed and community forests of the region. In the absence of any alternative livelihood source, shifting cultivation continues to be the main stay of sustenance for a vast majority of the forest dwellers. In spite of the efforts by many agencies of the state and national governments, a viable landuse option to shifting cultivation is yet to be found.

### 4.1.8 Inter-state border dispute

There exist a lot of inter-state border disputes among the north-eastern states. Most of these border areas are forest lands and because of boundary disputes, such lands are often declared as 'no man's land' and hence, does not come under any form of management. This leads to the degradation of forests in such areas.

### 4.1.9 Insurgency

The long insurgeny problem in some states such as Assam and Tripura has considerable impact on forest conservation. Large tracts of plantation forests in the entire state of Tripura are being destroyed in absence of any watch and guard either by the forest department or by the JFM committees due to insurgency. Similar situation prevails in Manas National Park of Assam.

### 4.1.10 Gregarious flowering of bamboo

Besides over-extraction and no management plan for bamboo forests, the gregarious bamboo flowering (Box 4) has been a threat to conservation of bamboo diversity in the region.

**Box 4. Gregarious flowering of Bamboo – a threat to forest biodiversity**

Some urgent steps need to be taken by the north-eastern states to mitigate the consequences of the 'gregarious flowering of bamboo' predicted to occur during 2005-2007. Scientists have predicted that gregarious flowering of bamboo will occur in an estimated area of 18,000 sq. km in the states of Mizoram, Tripura, Manipur and parts of Assam and Meghalaya during 2005-2007. The epicentre of bamboo flowering will be

Mizoram. It is calculated that about 26 million tons of bamboo will be available for harvest before flowering takes place in those areas. Out of these, 10 million tons of bamboo will be available in inaccessible areas. The last such gregarious flowering of bamboo was recorded in Mizoram, Tripura and Barak Valley of Assam in 1959 which was followed by a severe famine in those areas that left a fear psychosis in the minds of the people.

The gregarious flowering of bamboo begins in September-October just after the rainly season. Initially there are many young inflorescences and within a few weeks whole clumps get transformed into huge flowering cluster. Then starts the seed-shed in December and by January, there is a thin layer of seeds on the forest floor below the bamboo stands. The seed-shed attracts seed predators, mostly rat species. As there is a increase in seed-shed in the following months, by the end of summer there are enough seeds on the forest floor and a large number of rats relishing on the abundant food supply. With the onset of rains in the rainy season, bamboo seeds germinate in a few days and the layer of the bamboo seeds on the forest floor gets converted into a lush green carpet of bamboo seedlings. All of a sudden there is no food for the seed predators (rats). Therefore, the rodents in millions come out of the bamboo forests in search of food and land in farms in the vicinity. These then play havoc with the standing crop, devour the grains stored in granaries resulting in famine in the aftermath of bamboo flowering.

Besides the famine due to rat menace, bamboo flowering has a direct negative impact on the forest biodiversity. Following the bamboo flowering, the bamboo plants die and get dried. Because of its low utility value, people put fire to these dried bamboos in the months of March and April causing extensive damage to the forest flora and fauna as well as to the regeneration of bamboo itself as substantial amount of bamboo seeds get burnt in the process.

**Proposed Activities**

Certain recommended measures focussing on extraction and utilisation of bamboos before they get to flower are as follows:

- Detailed survey and mapping of bamboo resources in the N-E in collaboration with Forest Departments and Forest Survey of India (FSI).
- A bamboo flowering database is to be prepared involving International Bamboo and Rattan Research Institute (INBAR), Beijing, RFRI, FSI and Forest Departments.
- To facilitate timely extraction and transport of bamboos that are set to flower after three year from now, it is required to improve the conditions of State and National Highways in the region. Feasibility of transporting bamboos by waterways through Bangladesh needs be explored for making the resource available for users in Orissa and Andhra coast. The Railway Ministry has been suggested to work out concessional rates for transportation of bamboos from the N-E. The experts call for modification of the present 'mahal' system for extraction of bamboos and formulation of effective and workable transit rules on uniform basis for all the States.
- The Hindustan Paper Corporation Limited (HPCL) should first consume the flowered stock of mulli bamboos of the N-E region by suspending consumption of other species during period of flowering.
- Other recommendations on resource utilisation include; setting up of mini-mechanical pulping mills at strategic locations and the pulp to be compressed into high-density pulp sheets and blocks in the small scale industry sector for long-term space effective storage and economic transportation. It is suggested to form village clusters and supply appropriate machinery to utilize the available resources. This will besides generating employment, reduce the cost of bamboo transportation.
- Suitable technology be developed to convert bamboo into high value products like laminated board, composite boards, railway sleeper board etc.

- It is also suggested that possibility of using flowered fruit seed of bamboo for animal feed through collection just before maturity be explored.
- Regarding regeneration of bamboo of logged over area, the experts suggest that the steep and inaccessible areas should be left to regenerate naturally while in accessible areas 50 per cent will be taken up for regulated natural regeneration, 30 per cent for mixed bamboo plantation and the balance 20 per cent for the tree plantation. The bamboo resources in forest areas needs be stocked quickly by increasing investments, using better planting material and silvicultural practices. The HPCL is suggested to take up large captive plantation in the degraded forest areas and wasteland on long-term lease.
- Research institutes like the RFRI are suggested to introduce improved planting stocks having shorter rotation period and germ plasm bank should be maintained in RFRI, Jorhat for the entire region.

# CHAPTER 5
# MAJOR ACTORS AND THEIR CURRENT ROLES RELEVANT TO BIODIVERSITY

## 5.0 MAJOR ACTORS IN CONSERVATION OF BIODIVERSITY

Although there are not many agencies/organizations working exclusively for biodiversity conservation in north-east *per se*, the activities taken up by many organizations including non-governmental and traditional institutions, government departments and scientific institutions have direct or indirect implications for biodiversity conservation. Some of these organizations are listed below. However, it may be mentioned here that most of these organizations are yet to make biodiversity conservation as the focus of their activities.

## 5.1 STATE GOVERNMENT AGENCIES

Most state government departments having land-based activities such as departments of Forest, Agriculture, Sericulture, Horticulture, Fisheries, Veterinary and Animal & Husbandry implement many schemes that involve the breeding and introduction of many new as well as exotic species aiming to increase the productivity in their respective sectors. Such activities invariably affect the biodiversity conservation initiative adversely. However, of late, many state agencies are now involved in such biodiversity conservation activities as establishment of germplasm banks for selected agricultural and horticultural crops, medicinal plants, botanical gardens and other *ex situ* conservation measures.

## 5.2 CENTRAL GOVERNMENT AGENCIES

Many central government agencies such as Rubber Board, Spice Board and National afforestation and Ecodevelopment Board undertake plantation of various plant species that contribute positively to biodiversity conservation. Many central ministries also support the state governments on project basis to take up such activities that contribute to biodiversity conservation. Botanical Survey of India, Zoological Survey of India, Indian Council of Agricultural Research, National Bureau of Plant Genetic Resources and many other central government organizations are directly involved in inventorization, conservation and propagation of biodiversity.

## 5.3 AGENCIES INVOLVED IN DEVELOPMENTAL ACTIVITIES

Public and private sector companies involved in developmental activities such as power generation (e.g. NHPC, NEEPCO, NTPC and AEC), road construction (e.g. NHA and PWD/CPWD), establishing refineries (e.g. IBP, IOC, BP) and drilling of oil and natural gases (e.g. ONGC), mining (by private companies) etc. have both positive and negative impacts on biodiversity. They contribute positively through compensatory afforestation of areas more than that actually damaged and negatively by destroying the endemic and threatened flora and fauna and their habitats.

## 5.4 JUDICIARY AND LEGAL PRACTITIONERS

Of late, the judiciary and legal practitioners have become important stakeholders of biodiversity. For example, the Supreme court order dated 12 December, 1996 and subsequent interventions/orders have saved the unique and precious tropical evergreen Dipterocarpus forest ecosystem on the south bank of the Brahmaputra. Besides, the moratorium on tree felling has contributed substantially towards biodiversity conservation in north-east.

## 5.5 NON-GOVERNMENTAL ORGANISATIONS

Many non-governmental organizations are now working for the conservation of biodiversity in north-east. Although most of them are local and grassroots level, certain national level NGOs such as TERI and CEE, and international NGO such as WWF-India have been working in the region for more than two decades now for the cause of biodiversity conservation. A list of local NGOs actively engaged in Biodiversity related works is appended as Annexure.

## 5.6 TRADITIONAL COMMUNITY/ VILLAGE LEVEL INSTITUTIONS

***Village Durbars***

The Village Durbars play a very important role in the running of the day-to-day administration of the villages in Meghalaya. It is composed of elderly men folk. The ladies are restricted by tradition to take part in the deliberations of the durbar. All issues pertaining to the village are discussed, debated and decided by the durbar. Therefore, if anything is to be implemented for the benefit of the community at large, it is the durbar

which decides on it. The village durbar is represented by the *Tymmen Shnong* or *Waheh Chhnong* (Village Headman) in the Khasi and Jaintia Hills respectively and the *Nokmas* in Garo Hills. In many villages in the state, specific forest areas are earmarked as village forests or community forests where fuel wood extraction, thatch grass collection and materials for house construction are permitted. Certain village durbars are also the custodian of sacred groves and community forests.

***Durbar Raid***

In Khasi Hills of Meghalaya, a *Raid* is a conglomeration of not less than four villages. It also has a durbar and it is represented by the *Syiem Raid* (Chief), *Basan* (representatives of clans), *Lyngdoh* (Priest) and the headmen of the constituent villages. While in Jaintia Hills, the *Doloi* is the equivalent of the *Syiem Raid* and in Garo Hills by the *Nokma* who is assisted by the *Laskars*. The functions of the Durbar Raid is more or less like the Village Durbar except for the area of operation and involvement of ceremonies and rituals pertaining to the welfare of the *Raid,* administration of local markets, reservation of forest areas as sacred groves and community forests and allotment of land for cultivation and jhumming.

*Village Development Councils*

The Village Development Councils (VDCs) are the traditional institutions constituted at village level in Nagaland. These are equivalent to the Village durbars of Meghalaya. The VDCs manage the natural resources of the village and henece, are major stakeholders of the biodiversity. The Government of Nagaland effect the required interventions through these VDCs.

*Village Councils*

The village councils are the traditional village level institutions responsible for the administration of villages in Mizoram, Arunachal Pradesh, Assam and Tripura. These Councils have final say on the common property resources within the jurisdiction of the concerned village. Hence, they have important bearing on biodiversity conservation and its uses.

*Anchal Samitis*

Anchal Samitis are the panchayat equivalents in Arunachal Prades and are constituted by taking a cluster of villages. Substantial portion of the undisturbed natural community forests in Arunachal Pradesh are under the control of such Anchal Samitis.Therefore, these are one of the most important stakeholders of biodiversity in Arunachal Pradesh.

*Panchayats*

Like rests of the country, Assam, Sikkim and Tripura in north-east follow panchayati raj system. Substantial portion of the common property resources are governed by the panhayats and hence, panchayats play an important role in biodiversity conservation within their respective domain.

## 5.7 RESEARCH ORGANISATIONS

Many state and central government research organizations including universities of the region are engaged in research, inventory and conservation of biodiversity in the region. A list of such organizations is presented in Box 5.

**Box 5. Organisations and Universities in north-east engaged in research, inventory and conservation of biodiversity**

Botanical Survey of India, Shillong

Zoological Survey of India, Shillong

GB Pant Institute of Himalayan Environment and Development, North-East Unit, Itanagar

Indian Council of Agricultural Research for North-Eastern Hill Region, Barapani, Shillong with campuses through out the north-east

State Forest Research Institute, Itanagar

NBPGR, Shillong

North-Eastern Hill University, Shillong

Nagaland University, Kohima

Mizoram University, Aizawl

Arunachal University, Itanagar

| |
|---|
| Tripura University, Agartala |
| Assam University, Silchar |
| Tezpur University, Tezpur |
| Gauhati University, Guwahati |
| Assam Agricultural University, Jorhat |
| Regional Research Laboratory, Jorhat |
| Dibrugarh University, Dibrugarh |

## 5.8 AUTONOMOUS DISTRICT COUNCILS

Most north-eastern states except Arunachal Pradesh, Nagaland and Sikkim have Autonomous District Councils (Table 15). Under the Sixth Schedule of the Constitution of India, most of these District Councils enjoy legislative, executive and judicial powers.

**Table 15. Autonomous District Councils of north-east.**

| State | Autonomous (District) Councils |
|---|---|
| Arunachal Pradesh | No Autonomous Councils but the state has Elective Village Councils and Anchal Samitis (Panchayats) |
| Assam | Karbi-Anglong, North Cachar Hills, Bodoland, Rabha-Hasong, Tiwa, Mishing |
| Manipur | Ukhrul, Tamenglong-Senapati, Sadar Hills |
| Meghalaya | Khasi Hills, Jaintia Hills and Garo Hills |
| Mizoram | Pawi, Lakher, Chakma |
| Nagaland | No Autonomous Councils but each village has a Village Council |
| Sikkim | No Autonomous Councils but each village has a Village Council |
| Tripura | Tripura Tribal Area Autonomous District Council, Khumulwang |

## 5.9 NEWLY EMERGING COMMUNITY INSTITUTIONS

Under the initiatives of many central sector schemes and donor agency funded projects, specialized community institutions have been constituted. Such community institutions now exist through out the region. For instance, with the initiatives from the state forest departments and Central government sponsored schemes, Village Forest Protection Committees have been constituted in all the states of north-east.

Similarly, under IFAD funded project, which is being implemented in 6 upland districts of north-east viz., Senapati and Ukhrul of Manipur, Karbi Anglong and North Cachar Hills of Assam, and West Khasi Hills and West Garo Hills of Meghalaya, Community institutions and Self-help groups have been constituted for implementation of the project.

## 5.10 INTERNATIONAL DONOR AGENCIES (IFAD, CIDA)

International Donor Agencies such as IFAD in Meghalaya, manipur and Assam, and CIDA in Nagaland (NEPED project) have been playing crucial role in conserving the biodiversity through their respective projects. Although biodiversity conservation is not the main objective of these projects, the projects have been contributing substantially towards the cause of biodiversity conservation directly or indirectly.

## 5.11 INTERNATIONAL AND NATIONAL POLICIES AND CONVENTIONS

All the international treaties and national policies have significant impact on the conservation of biodiversity in the north-east.

## 5.12 ACADEMIC INSTITUTIONS INCLUDING SCHOOLS AND COLLEGES

The educational curriculua in the universities, colleges and schools have an important role to play in biodiversity conservation. Creation of general awareness and imparting specialized training on biodiversity conservation are two most important functions that the educational institutions have the potential to perform.

## 5.13 BIORESOURCE- BASED INDUSTRIES

The industries, which are dependent on bioresources are one of the most important stakeholders that can contribute substantially towards conservation of biodiversity. For instance, pharmaceutical industries can conserve medicinal plants by entering into suitable arrangements with the farmers so that the required medicinal plants could be cultivated to meet their needs. Today, such industries are viewed as destroyer of biodiversity as they extract the required plants from the wild without ensuring their regeneration.

## 5.14 TRADITIONAL MEDICAL PRACTITIONERS

The traditional medicinal practitioners are often viewed as one of the threats to biodiversity conservation as they over-extract certain elements of biodiversity for medicine. The cultivation of medicinal plants in herbal gardens by the traditional medical practitioners is an example to show how they can play a positive role in biodiversity conservation.

## 5.15 SHIFTING CULTIVATORS AND OTHER FARMING COMMUNITIES

The shifting cultivators and other traditional farming communities of north-east have played a key role in conserving the rich agricultural crop germplasm of the region. In spite of the availability of many hybrid and high yielding varieties these farmers have been cultivating the traditional varieties for generations. Therefore, they may be considered as the most important stakeholders in agrobiodiversity conservation.

# CHAPTER 6

# ONGOING BIODIVERSITY CONSERVATION INITIATIVES

## 6.0 BIODIVERSITY CONSERVATION INITIATIVES

The biodiversity conservation initiatives in the north-eastern region may be discussed under the initiatives from (i) village communities, (ii) NGO supported, (iii) Government, and (iv) Donor agency driven.

## 6.1 COMMUNITY INITIATIVES

A large number of well-managed isolated forest patches under private and community ownership exist in different parts of the north-east that stand as testimony to the success of community initiatives in forest management. Most of these management systems were conceived by the indigenous societies themselves and evolved through ages of practice. The people of north-east have been innovative, in many ways, in conserving and managing their rich biodiversity through evolving various systems/ approaches, some of which are traditional and have been practised since time immemorial, while others are being tried in recent years. These systems seem to be the most viable conservation options in a given geo-physical and socio-economic environment. Some of these biodiversity conservation initiatives are described below.

### *6.1.1 Sacred forests*

Sacred forests of Meghalaya i.e. *Law Lyngdoh, Law Niam* and *Law Kyntang* and sacred groves of Manipur, including *Nag Vans* are the examples of forest management practices based on the traditional religious beliefs. An estimated area of 1000 sq km forests are under sacred forests of Meghalaya (Annonymous, 1984). A unique feature of sacred forests of Meghalaya is in their size. Unlike in other parts of the country and abroad, where the sacred groves are very small, the sacred forests of Meghalaya are as big as 900 ha and the average size is more than 50 ha. Conservation of such big patches of forests provide a variety of ecosystem services such as protection of water sources, enhancing

the quantity and quality of ground water, conserving soil and maintaining homeostasis of the ecosystem, besides providing the habitats for a wide range of flora and fauna. These sacred forests are 'home' to more than 514 plant species, representing 340 genera and 131 families and offer habitat to at least 50 rare and endangered plant species of the state (Tiwari *et al.*, 1998). A number of taxonomically and ecologically important plant species are now only confined to these sacred forests (Haridasan and Rao, 1985).

The sacred forests are intimately linked with the cultural practices of the respective tribes. Traditional rituals are being performed regularly either within the sacred groves or at adjacent sites and thereby making these sacred forests as repository of rich cultural diversity in the region. However, a recent study reveals that only 1% of the total sacred forests in Meghalaya are undisturbed (Tiwari *et al.*, 1998).

*6.1.2 Village safety and supply reserves*

The concept of safety and supply reserves in Mizoram dates back to as early as 1872 (Singh, 1996). The safety reserves are usually maintained by most Mizo villages to protect the water source of the village. No extraction of product of any kind is allowed from such forests and therefore, these forests are very rich in both plant and animal diversity. In order to meet the bonafide need of the villagers, a supply reserve is invariably maintained and both the types of reserves function complementary to each other. Since the product extraction is regulated and the regeneration of species is ensured, the supply reserves have so far been sustainable, in spite of product extraction from these forests. Both these practices are examples of sustainable forest management by the community. As many as 2,648 sq km of forests are reported to be under village safety and supply reserve (SFAP, Mizoram 1997).

*6.1.3 Asha Van*

Asha Van of the Jamatias of Tripura had an origin from the resource needs of the villagers. Earlier each Jamatia village was maintaining a forest surrounding its village as a protective barrier from their enemies. As time passed, the management of these forests were oriented towards meeting the needs of the villages and extraction of product for

fuelwood, small house construction and other miscellaneous needs was allowed. These Asha Vans are now well maintained in certain villages and are sustainably utilised through community regulations (Barik and Darlong 2001).

### *6.1.4 Anchal Forest Reserves and Village Forest Reserves of Arunachal Pradesh*

Large tracts of rich forests of Arunachal Pradesh are owned by the various tribes of the state. Unable to manage for higher returns due to lack skill and requisite resources, the chiefs of Nocte tribe approached the government to manage the forests owned by the tribe on a partnership basis and accordingly a 'deed' was signed between the Government and the Chiefs of Borduria and Namsang (the then Tirap District) in 1948.

Namsang village forests and Borduria village forests covering an area of 108.88 and 38.5 sq km respectively were declared as Village Reserves Forests (VRFs) under Assam Forest Regulation in 1962 and have been scientifically managed as per the working plans prepared for such purpose. Estimated annual timber yield from these forests is about 9,500 cu m and generates a net revenue of about Rs. 2 crores. The Namsang-Borduria Trust Fund is now supporting two educational institutions and providing quality education to boys and girls in Tirap District. A referral hospital and nursing school had also been constructed under the Trust Fund at Pullong village. The present corpus fund of the Trust is more than Rs. 10 crores.

This success story of partnership forest management in Namsang-Borduria forests prompted the Arunachal Pradesh government to initiate and promote similar arrangements for unclassed state forests (USFs), wherein traditional rights of individuals and communities are respected and recognised. Existence of Panchayati Raj institutions at the village, anchal and district level as per the Panchayati Raj Act and Rules made thereunder, further encouraged and facilitated introduction of Arunachal Pradesh Anchal Forest Reserve (Constitution and Maintenance) Act in 1975. The Act provides for sharing of net revenue between the government and Anchal Samitis on 50:50 ratio.

Attracted by the possible monetary gain out of managing the hitherto unmanaged high forests (USFs) in their respective jurisdiction, many Anchal Samitis came forward to constitute Anchal Forest Reserves(ARFs). Till 1996, there were at least 11 ARFs covering an area of 325.12 sq km spread over in 8 districts of the state. Subsequently, the need of involving individual villages rather than anchal was felt and accordingly the Village Forest Reserves Act (VRFs Act) was adopted. Till date, 12 VRFs have been constituted in 4 districts covering an area of 279.26 sq km. There is however increasing demand for constitution of VRFs in commercially timber-rich USFs areas. The area of the smallest ARF/VRF is 0.63 sq km and the largest is 119 sq km. The Tafragram ARF (99.84 sq km) has a trust fund of about Rs. 10 crores and supports various welfare activities for the local people.

### *6.1.5 Apna van in Arunachal Pradesh*

Some of the local tribes of Arunachal Pradesh have a tradition of maintaining forests for fuelwood, timber and other forest produce on their own private land. Beautiful bamboo and pine forests maintained by the Apatani tribes in Ziro plateau in Lower Subansiri district are the examples of such practices. Taking clue from such practices and in order to rehabilitate the degraded jhum fallows of the state, the government of Arunachal Pradesh introduced a subsidy scheme called *Apna van* in 1986-87. The Apna Van scheme notified in 1986 and subsequently revised in 1991 and 1997 envisages to raise plantations on abandoned private and community Jhum lands of Arunachal Pradesh. The scheme has been renamed as "Assistance for raising Apna Van" in 1997. Considering the vast area of the state under unclassed forest which are valnerable to unscientific exploitation and jhum cultivation, the Apna Van scheme has been quite popular among the local people and has helped in regenerating the degraded jhum fallows and deforested areas and also reducing pressure on the existing forests.

Essentially, the scheme was developed as an alternative to shifting cultivation, under which the farmers are encouraged to plant trees alongwith the crop plants on their jhum lands so that the effect of jhum on the land could be minimized. The officials of the forest department extend technical support for the scheme and the people cultivate

a variety of agri - horticultural crops with tree species as per their own requirement. Most of these plots contain local varieties of crop plants and native tree species, contributing substantially towards preservation of local gene pool. The farmers have been showing keen interest for this scheme and a large number of successful Apna van plots can be seen in many parts of Subansiri districts, Siang districts and the districts on the southern bank of Brahmaputra. Till 1997-98, about 16000 ha of plantations have been raised under Apna van scheme in 13 districts of the state. An amount of Rs 349 lakh has been spent under the scheme till the year 1996-97.

## 6.2 NGO SUPPORTED BIODIVERSITY CONSERVATION INITIATIVES

### *6.2.1 Involvement of NGO in management of forests*

NGOs involvement in forest management has been identified as one key element in forest management. A number of collaborative programs are going on in field. The NGOs help in creating awareness, people's motivation, organisation of training programmes and conflict resolution.

### *6.2.2 Awareness programs*

A big drive has been launched to create awareness among stakeholders especially those living in and around forest areas. All kinds of mass media and public contact methods are being used. Literature is distributed, meetings with public are held and rallies have been organised.

## 6.3 INITIATIVES TAKEN BY THE GOVERNMENTS FOR BIODIVERSITY CONSERVATION

### *6.3.1 Protected Areas*

As an *in situ* conservation measure of fauna and flora, and to protect the areas of biological importance, 13 national parks and 42 wildlife sanctuaries have been constituted in the region under the Wildlife Protection Act (1972). In addition, 5 biosphere reserves have also been notified in the region, each representing unique

ecosystems identified on the basis of their biodiversity, naturalness and effectiveness as a conservation unit (Table 16). The total area under national parks and wildlife sanctuaries in the region is 14,989.75 sq. km, which constitutes about 5.71% of the total geographical area of the region (Table 17).

**Table 16. Biosphere Reserves, National Parks and Wildlife Sanctuaries in different northeastern states.**

| States | Biosphere Reserves | National Parks | Wildlife Sanctuaries |
|---|---|---|---|
| Arunachal Pradesh | Dehang Dibang | Namdapha | Pakhui |
| | | Mouling | D'Ering Memorial |
| | | | Itanagar |
| | | | Mehao |
| | | | Eaglenest |
| | | | Kane |
| | | | Kamlang |
| | | | Sessa Orchid Sanctuary |
| | | | Dibang valley |
| | | | Tale valley |
| Assam | Manas | Kaziranga | Barnadi |
| | Dibru Saikhowa | Manas | Dipor Beel |
| | | | Garam pani |
| | | | Lao khowa |
| | | | Manas |
| | | | Wameri |
| | | | Orang (Rajib Gandhi) |
| | | | Pabha |
| | | | Pobitora |
| | | | Sonai Rupai |
| | | | Dibru Saikhowa |
| Manipur | | Keibul Lamjao | Yangoupokpi Lokchao |
| | | Sirohi | |
| Meghalaya | Nokrek | Balphakram | Baghmara Pitcher Plant Sanctuary |
| | | Nokrek | Nongkhyllem |
| | | | Siju |
| Mizoram | | Murlen | Ngenpui |
| | | Phawngpui | Khawnglung |
| | | | Lengteng |
| | | | Dampa |
| Nagaland | | | Fakim |
| | | | Intanki |
| | | | Puliebadze |
| | | | Ranga pahar |
| Sikkim | Khangchendzonga | Khangchendzonga | Moenam |
| | | | Shingba Rhododendron |

| | | | |
|---|---|---|---|
| | | | Kyongnosla Alpine |
| | | | Fambonglah |
| Tripura | | | Gumti |
| | | | Roa |
| | | | Sepahijola |
| | | | Trishna |

**Table 17. Area under National parks and Wildlife Sanctuaries in north-east India.**

| State | Area under National Park (sq.km) | Area under Wildlife Sanctuary (sq. km) | Total (sq. km) |
|---|---|---|---|
| Arunachal Pradesh | 2468.23 | 7114.45 | 9582.68 |
| Assam | 1173.71 | 939.88 | 2113.59 |
| Manipur | 81.80 | 184.85 | 266.65 |
| Meghalaya | 267.48 | 34.20 | 301.68 |
| Mizoram | 250.00 | 634.00 | 884.00 |
| Nagaland | 202.02 | 24.41 | 226.43 |
| Sikkim | 850.0 | 161.1 | 1011.1 |
| Tripura | 0 | 603.62 | 603.62 |
| **Total** | **5293.24 (2.02%)** | **9696.51 (3.70%)** | **14989.75 (5.71%)** |

Figures in parentheses represent the area as percentage of the total geographical area

### *6.3.2 Livestock related initiatives*

The state departments of Animal Husbandry and Livestock have taken up several schemes for increasing/maintaining livestock and bird population of the State. Some of these programmes are, Cattle and buffalo development, Poultry development, Sheep and goat development, Piggery development, Feeds and fodder development, Rabbit, Quail, Duckery, Veterinary services and animal husbandry, and Extension training programmes. For implementation of these schemes, Gram Panchayats/ village councils are being involved. The Departments have also undertaken farmers' awareness programmes from time to time although direct programme on biodiversity was lacking.

### *6.3.3 Initiatives in Agriculture sector*

The plant Breeding Divisions of the Agriculture Departments are doing the work of collection, evaluation, documentation and maintenance of different local varieties existing in their respective states for future breeding purposes. Some state departments (e.g. Tripura and Manipur) have collected local varieties of rice found in their respective states and maintain them in the gene banks. Some states also have established the facility to develop bio-fertilisers and bio-control of crop diseases (e.g. Tripura). The ICAR research complex for north-eastern Hill region along with its research centers spread through out the north-east has identified a number of phenotypes of rice, maize, jackfruit and few vegetables found in the region. It is also developing a germplasm bank for such phenotypes.

### 6.3.4 *Initiatives in Horticulture sector*

Efforts have been taken for collection and maintenance of germplam of fruits such as citrus, banana, lichi, and vegetables, ginger, and medicinal and aromatic plants by the state departments of Horticulture and Soil Conservation.

### 6.3.5 *Initiatives in Fisheries sector*

The Fisheries Departments have taken initiatives to propagate threatened and endangered species of fish and some other aquatic fauna. For example, in Tripura a policy has been formulated to train the rural masses for sustainable aquaculture with rational use. The Department has taken up re-establishment of Giant Prawn, Magor, Pabda and fresh water turtle.

### *6.3.6 Biodiversity conservation in Notified Forest Areas*

The government owned forests have been classified into Reserved Forests (RF), Protected Forests (PF) and Proposed Reserve Forests (PRF) to protect and control their

management and rational exploitation. Activities harmful to forest flora and fauna have been prohibited in these areas.

### *6.3.7 Policies and legislation*

For forest areas, the National Forest Policy of 1988 has been adopted in the region. To ensure policy implementation, appropriate forest legislations and instructions have been brought in. The central legislations such as Indian Forest Act, 1927; the Wild Life (Protection) Act, 1972; the Forest (Conservation) Act, 1980; and the Environment (Protection) Act, 1972 have been enacted in the region. Besides, a large number of state legislations are in force in each state for regulation of forest extraction.

### *6.3.8 Education for Biodiversity conservation*

In addition to *in-situ* conservation efforts, each state has at least one zoo for *ex-situ* conservation, wildlife education along with other objectives. Captive breeding programme on selected animals such as leopard cat, binturong, spotted deer and primates along with awareness promotion efforts have been by and large successful.

### *6.3.9 Specialised Projects for biodiversity conservation*

Many projects with specific objectives of biodiversity survey and conservation were undertaken in different north-eastern states to survey and identify biodiversity rich locations referred as 'Conservation Hot Spots (CHS)' in the region with funding support from WWF – India and other funding agencies. The effort of certain state forest departments (e.g. Tripura) in this regard which undertook such activities with the help of JFM Committee members, NGOs and officials of the Forest Department through a participatory process is worh mentioning.

### *6.3.10 Medicinal plants resource*

Documentation and identification of medicinal plants in different north-eastern states have been initiated. So far, more than 400 medicinal plant species have been identified and documented in the region and the process is going on. The list of some medicinal plant species of north-east is annexed. Under the Centrally Sponsored Scheme of 'Non-Timber Forest Produce including medical plants' is being implemented in all the states since 1989 – 90. Attempts are also being made to establish medicinal plant gardens as gene banks in different localities.

### *6.3.11 Joint Forest Management (JFM)*

The programme of JFM has been adopted in 7 states (except Meghalaya) of the ecoregion to regenerate, protect and manage the degraded forest lands with the involvement of local communities with or without the help of NGOs. The thrust of the programme is management of the forests on benefits sharing basis. The local communities and the Forest Department work together as partners and co-managers. The programme is implemented through formulation of microplans of the selected areas. The microplans take care of the natural resources and prescribe sustainable utilisation of biological resources for the welfare of the community.

### *6..3.12 Afforestration programs*

Large scale plantation programmes for developing vegetation cover over degraded forestlands have been taken up in a big way. The sate forest departments have also been emphasizing on Aided Natural Regeneration in which the natural vegetation is allowed to come up with supplementation from outside to fill up the vacant spaces. There are state-specific programmes for bringing the vacant and Jhum fallow lands belonging to small and marginal farmers under vegetation cover. Such schemes include, the 'Apna van scheme' in Arunachal Pradesh and 'Angan Ban Prakalpa' in Tripura. Under these

schemes, the beneficiaries are given incentives in the form of cash and kind to afforest their vacant and jhum lands.

### *6.3.13 Soil and Moisture Conservation Programmes and Biodiversity Conservation*

Conservation of soil and moisture programme in the region has been taken up by the state departments of Soil conservation and other agencies. River Valley Projects for catchment areas of major rivers is one such big initiative, where a large variety of tree species are planted. Besides conserving the soil and moisture, the tree species also help in conserving the biodiversity.

## 6.4 DONOR AGENCY-DRIVEN BIODIVERSITY CONSERVATION INITIATIVES

### *6.4.1 NEPED Experience in Nagaland*

The Nagaland Environment Protection and Economic Development (NEPED) is a unique experiment of adopting multi-disciplinary approach for sustainable development keeping people at the centre-stage of traditional jhumland management. The project was conceived and designed on realisation of the fact that agro-forestry can be the economic mainstay of the people of Nagaland. The project was launched in 1994 through establishing test plots with a target of 1000 villages. The project was designed to introduce tree plantation into jhum fields keeping in mind the cultural sensitivity and the acceptability by the Naga farmers. Based on the observation and interaction with the farming communities, the most promising systems for the economic and environmental sustainability of Nagaland are being identified. One of the ideas that NEPED propagated was to integrate trees into jhum cultivation and it was accepted by the people readily. Till date about 60 native tree species have been introduced to the shifting cultivation plots during fallow period. In addition, an alternate option for shifting cultivation is being advocated by the NEPED, i.e., the Alder based jhum system that has been practised for hundreds of years by the Angamis, Chakesang, Sema, Konyaks and other tribes of Tuensang district. However, the practice of the farmers at Khonoma village of Kohima district, which is unique in many ways, is being popularised by the NEPED Project Operation Unit (POU). The POU considers it as a perfect system of jhum intensification

and terms as "localised jhum". The alder base system of jhum allows intensification of food related agricultural activities in specific plots, and sparing the trees in other plots which would have been otherwise slashed and burnt for jhum (Barik and Darlong 2001).

### *6.4.2 IFAD Project in six districts of north-east*

Under IFAD funded project, which is being implemented in 6 upland districts of north-east viz., Senapati and Ukhrul of Manipur, Karbi Anglong and North Cachar Hills of Assam, and West Khasi Hills and West Garo Hills of Meghalaya, Community institutions and Self-help groups have been constituted for implementation of the project. Biodiversity conservation with a focus on conservation of six sacred groves in Meghalaya is one of the project's important work components. Besides, other activities under the project also contribute indirectly towards the conservation of biodiversity in the region.

# CHAPTER 7
# GAP ANALYSIS

## 7.0 GAP ANALYSIS FOR BIODIVERSITY CONSERVATION

The depletion of biodiversity and inadequacy in actions to conserve the biodiversity of the region may be attributed to several factors, which range from inadequate knowledge about biodiversity and its components to adoption of wrong and inappropriate policies by the concerned stakeholders. Such inadequacies have been analysed in this chapter.

## 7.1 GAPS IN KNOWLEDGE AND INFORMATION

- Information on urban biodiversity is scanty
- Works on aquatic ecosystems of north-east are too meager
- Species inventory in inaccessible areas of Arunachal Pradesh, Nagaland, Karbi Anglong and North Cachar hills of Assam, and parts of Mizoram and Manipur is yet to be made.
- Poor information on Biosphere Reserves
- Information on genetic diversity is extremely poor
- Very little information on microbial diversity
- Unique ecosystems such as River Islands e.g. Majuli need to be studied.
- A large portion of insect, fish, mammalian and avian diversity remains underexplored.
- Cultural diversity of more than 250 tribes of north-east is yet to be adequately described
- Information on wild ornamentals and aromatic plants is scanty

## 7.2 GAPS IN VISION

Most of the programmes and activities being undertaken by the state governments are shortsighted. They are directed to fulfill the immediate needs of the people such as creating space for agriculture, settlement and other developmental activities. There has also been little coordination among various agencies of the government. Cooperation with research and academic institutions does not exist to the desired level. Long-term planning based on sustainable development strategies and integration of biodiversity conservation issues with development planning is the need of the hour.

- **Monoculture Plantations**

In order to increase the revenue generation, the State Forest Departments pursue the policy of raising plantations of commercially important species by clearing and burning the natural forests. In the process, large areas of forests were converted into monoculture plantations and a large number of native species were lost.

- **Introduction of High Yielding Varieties of crops**

The Agriculture Departments are introducing various high yielding varieties of rice and vegetables. This is associated with increasing use of inorganic fertilizers and chemicals for plant protection. Such policies not only ignore the indigenous species and varieties but also have adverse effects on existing flora and fauna. In fact, the people agree that many varieties of small fish found earlier in agriculture fields have disappeared now mainly because of the use of chemicals in agricultural fields.

- **Introduction of exotic livestock species**

Most agencies involved in the rural development through land-based activities and through development of biological resources do not take adequate measures for the propagation of indigenous varieties. For instance, exotic varieties of cow, cattle, foul and goat with single-minded pursuit of increasing productivity are being introduced and the local breeds are being totally ignored. The result has been further reduction in population size of the indigenous animals.

- **Conversion of natural vegetation areas into cash crops**

Cash crops such as tea, coffee, rubber, cadamum, ginger and broom grass are being encouraged by several agencies throughout the north-east. Many shifting cultivation rehabilitation programmes introduce these cash crops as alternatives to shifting cultivation These plantations are obviously taken up on lands with natural vegetation (in past or present) at the cost of biodiversity. These agencies are pursuing rehabilitation keeping in view short-term gains. They are unable to visualize the long-term sustainability of such plantations.

## 7.3 GAPS IN POLICIES AND LEGAL STRUCTURE

- The wrong afforestation policies with focus on economically important species such as teak, gamari and pine, have been harmful to biodiversity. Such policies as adopted in Tripura, Mizoram, Nagaland and Meghalaya has not only decreased the species diversity in natural/ rehabilitated forests but have also resulted in accelerated soil erosion and loss of soil moisture.

- The policy of rehabilitation of *jhumias* through rubber plantation as has been done in Tripura may prove to be a disaster for other floral and faunal species in such areas.

- The schemes for increasing the productivity of crops, livestock and fish single mindedly at the coast of local species and by using inputs have affected the biodiversity. The policy of promoting high yielding varieties and assessment of progress and success on the basis of consumption of fertilizer and plant protection chemicals has led to ignoring the indigenous varieties. The government subsidy and credit policy is instrumental in adopting these schemes.
- Through the Public Distribution System, only HYV food grains are distributed. There is a need to include distribution of indigenous varieties too.

- The policies of institutional finance have not recognised the social and ecological role of traditional cropping patterns. There should have been emphasis on

ecological implications while providing credit for different cash crops such as tea, coffee and rubber cultivation.

- The planners have not considered the role and value of biodiversity in preparing developmental plans. Such ignorance has been responsible for taking no efforts to conserve and enhance biodiversity.

- Most of the problems are related to increase in population. The rate of population growth in the north-east is unusally high. This causes tremendous strain on the natural resources and adoption of certain policies that are not very friendly to conserve biodiversity. No population policy has been adopted for future planning.

- Education policy does not include teaching on biodiversity conservation. The school curriculum should be able to mould the young minds in favour of biodiversity conservation.

- Disposal of forest products particularly extraction and transportation procedures are cumbersome and discouraging to the private growers of timber.

- No policy as such to create awareness among masses for biodiversity.

## 7.4 GAPS IN INSTITUTIONAL AND HUMAN CAPACITY

- The number of trained taxonomists in the region is grossly inadequate. This is one of the most important bottlenecks for completing the inventorization of biodiversity. The school and college teachers should be adequately trained and motivated to undertake such responsibilities.

- Harvesting, storage and distribution/marketing of various products such as timber, NTFPs, foodgrains, horticultural products etc. are not yet streamlined. There is need to evolve mechanisms for their orderly transactions by involving people.

- Not all persons concerned with management of biological resources understand the concept of biodiversity in proper perspective. Many of them suffer from biased attitudes. So it is imperative that those who plan, decide and implement the developmental programmes are adequately trained and educated in favour of biodiversity conservation.

- There are a number of institutions - PRIs, departments, colleges, universities, NGOs, local community groups such as JFM Committees and Fish Cooperatives that follow certain programmes having bearing on biological resources. While framing their programmes, these agencies are motivated to pursue their own goals in watertight compartments without considering their impact on other programmes or existing resources. There is no institution, which can make them sit together and discuss the programmes in a holistic manner.

## 7.5 GAPS IN BIODIVERSITY RELATED RESEARCH AND DEVELOPMENT

- Regeneration and cultural practices for many species need to be researched and standardized for their cultivation. Threatened species need immediate action for ensuring their continued existence.
- Identification of different ecosystem types and their structure, function and processes need to be understood to ensure their conservation. The information on different ecosystems is lacking particularly in the Eastern Himalayan states of Arunachal Pradesh and Sikkim, where ecosystem diversity is very high.
- Identification and Classification of Threatened species need to be done.
- Sustainable harvest/ extraction level for various bioresources needs to be determined for different areas.
- Richness of agrodiversity such as cultivars of rice, maize, millet and other cereal crops, diversity of horticultural (e.g. *Citrus, Cucurbita* etc.), and vegetable crop species is yet to be fully inventorized and documented.

- There is a serious gap between research and field needs. The established formal institutions like university departments, departmental research stations and others rarely consult the farmers and local communities about their problems while pursuing research. Need-based research needs to be encouraged.

## 7.6 SHARING MECHANISM OF THE EXISTING INFORMATION AND KNOWLEDGE

- Documentation on all the aspects of biodiversity of north-east in general is poor. The documentation is required to disseminate the information.
- Available grey literature such as unpublished theses, reports and other documents need to be compiled and published for wider dissemination of knowledge.
- Documentation of disappearing ITK systems and ethnobiological knowledge
- Documentation of the customary laws needs to be undertaken.

## 7.7 GAPS IN ACTIONS

- Little work on IPRS and patenting of bioresources/ ITKS
- Biopiracy issues are yet to be a concern of the biodiversity conservation
- Transboundary problems are not adequately addressed
- Conservation efforts for fragile areas are yet to be initiated
- Integration of biodiversity concerns into five year and other developmental plans of GOI (including NEC) and State Governments has never been done.

# CHAPTER 8
# STRATEGIES AND ACTION PLANS

**STRATEGY I**

**EXPANDING AND IMPROVING KNOWLEDGE ON BIODIVERSITY AND IDENTIFYING THREATS TO BIODIVERSITY**

**ACTION I A: Inventory and documentation of biodiversity in many unexplored/ underexplored areas**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : BSI, ZSI, NEHU and other Universities, SFRI, ICAR

**ACTION IB: Monitoring of biodiversity**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : BSI, ZSI, NEHU and other universities, SFRI, ICAR

**ACTION I C: Identification of ecosystem types, their mapping and status**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : IIRS, SRSACs, FSI, Universities

**ACTION I D: Identification of critical and fragile areas**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : IIRS, SRSACs, FSI, Universities

**ACTION I E: Documentation of Traditional Knowledge System (TKS)**

TIME FRAME: 2 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE : Universities

**ACTION I F: Studies on ethnomedicine, ethnobotany and ethnozoology , and documentation of traditional healers**

TIME FRAME: 3 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE : Universities

**ACTION I G: Identification of biodiversity rich areas outside the government protected areas such as sacred forests and other community conserved areas**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : Universities, State Forest and Agriculture Departments, Traditional Community Institutions, District Councils

**ACTION I H: Studies on trends and forces driving biodiversity change**

TIME FRAME: 2 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : Universities and other academic institutions, FSI, IIRS, SRSAC

**STRATEGY II: STRENGTHENING *IN SITU* AND *EX SITU* BIODIVERSITY CONSERVATION EFFORTS**

**ACTION I I A: Identifying the strengths and weaknesses of the ongoing conservation efforts**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : BSI, ZSI, SFRI, NEHU and other universities, ICAR, and State Forest, Agriculture, Horticulture and Fisheries Departments

**ACTION II B: Identifying threatened and endemic taxa and economically valuable wild species for *in situ* conservation**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : BSI, ZSI, SFRI, NEHU and other universities, ICAR, and NBPGR

**ACTION I I C: *In situ* conservation of identified taxa and their natural habitats**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : State Forest, Agriculture, Horticulture and Fisheries Departments

**ACTION II D: *Ex situ* conservation of identified taxa**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : BSI, ZSI, NEHU and other universities, SFRI, ICAR and NBPGR, Colleges

**ACTION II E: Integration of *in situ* and *ex situ* conservation measures**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : R& D Institutions and State Forest, Agriculture, Horticulture and Fisheries Departments

**ACTION II F: Conservation of fragile and critical ecosystems**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE : Concerned Ministries/ Departments of GOI/ State Governments and Community Institutions

**ACTION I I G: Ecorestoration of degraded/ damaged ecosystems**

**ACTION I I G1: Ecorestoration of mining sites**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Departments of Forest, Mining, Agriculture, Horticulture, and Private/ Public sector companies dealing with mining activities

**ACTION I I G2: Ecorestoration of flood affected areas**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Departments of Forest, Fisheries, Flood control and Irrigation, Brahmaputra Board

**ACTION I I G3: Ecorestoration of vanishing wetlands**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Departments of Forest, Fisheries, Flood control and Irrigation, Brahmaputra Board

**ACTION I I G4: Ecorestoration of river islands**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Departments of Forest, Fisheries, Flood control and Irrigation, Brahmaputra Board

**ACTION II H: Conservation of biodiversity rich areas out side the government protected areas**

**ACTION II H1: Conservation of sacred forests**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Forest Department, GOI, District Council and concerned Community Institutions

**ACTION II H2: Conservation of village/community forests**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Forest Department, GOI, District Council and concerned Community Institutions

**ACTION II I: *Ex situ* conservation of NTFPs, medicinal plants and important tree species**

- Increasing the production and availability of Non-timber Forest Produce (NTFP) and medicinal plants through large-scale cultivation.
- *Ex situ* conservation of important medicinal plants by planting them in suitable habitats in different parts of the ecoregion.
- *Ex situ* conservation of important tree, bamboo and rattan species by setting up of arboretum, bambusetum and canetum at suitable places.

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State Forest Department, GOI, District Council and concerned Community Institutions

**ACTION II J: Addressing the transboundary issues (inter-state and international)**

**ACTION II J1: Eviction of encroachment by illegal immigrants/ refugees causing the destruction of natural habitats**

TIME FRAME: 2 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Concerned Ministries/ Departments of GOI, State Governments and Community Institutions

**ACTION II J2: Poaching, illegal timber trade, theft of rare medicinal plants near international boundaries**

TIME FRAME: 2 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Concerned Ministries/ Departments of GOI and State Governments and Community Institutions

**ACTION II J3: Arresting the destruction of biodiversity and habitats caused due to inter-state border dispute**

TIME FRAME: 2 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Concerned Ministries/ Departments of GOI and State Governments and Community Institutions

**ACTION II K: Reviving the eroded cultural values relevant to biodiversity conservation**

TIME FRAME: 2 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Concerned Ministries/ Departments of GOI and State Governments and Community Institutions

**STRATEGY III: PROMOTING SUSTAINABLE USE OF BIODIVERSITY**

**ACTION III A: Documenting quantum and kind of uses of biodiversity**

TIME FRAME: 3 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: NEHU and other academic and research institutions along with the Community Institutions

**ACTION III B: Determining the level of sustainable harvest in time and space for different components of biodiversity**

TIME FRAME: 5 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Departments of state governments, Community

Institutions and research institutions including universities

**ACTION III C: Regulation for achieving sustainable use of biodiversity**

TIME FRAME: 3 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Departments of state governments, community institutions

**ACTION III D: Value addition and promoting alternate sustainable livelihood options such as floriculture, pisciculture, apiculture, sericulture, mushroom cultivation, cultivation of medicinal plants, spices and aromatic plants**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Departments of state governments, private entreprenures and community institutions with support from GOI

**ACTION III E: Incentives and rewards for sustainable use of biodiversity**

TIME FRAME: Continuous

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Departments of state governments, private entreprenures, community institutions and GOI

**ACTION III F: Adoption and development of appropriate technology for value addition of biodiversity**

TIME FRAME: 5 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Private entreprenures, community institutions and R& D institutions

**STRATEGY IV: ACHIEVING EQUITY IN ACCESS, USE AND BENEFITS OF BIODIVERSITY**

**ACTION IV A: Providing secure access rights to biodiversity for traditionally dependent communities**

TIME FRAME: Continuous

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Departments of state governments, community institutions and GOI

**ACTION IV B: Tackling inequities in the access to and benefits from use of biodiversity**

TIME FRAME: Continuous

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Departments of state governments, community institutions

**STRATEGY V: ADDRESSING THE POLICY AND LEGAL ISSUES RELATED TO BIODIVERSITY CONSERVATION AND USE**

**ACTION V A: Aanalysing existing laws and policies from biodiversity point of view and identifying points of amendments**
**ACTION V A1: District council laws**
**ACTION VA2: State laws**
**ACTION VA3: Central laws/policies**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Departments of state governments, professionals and GOI

**ACTION V B: Compilation of traditional and customary laws and their analysis from biodiversity point of view**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Departments of state governments, professionals and Community Institutions

**ACTION V C: Amending current laws and policies to make them compatible with biodiversity goals**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: District councils, state governments and GOI

**ACTION V D: Formulating and enacting new policies and laws for enhancing the conservation, sustainable use and equitable distribution of biodiversity**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: District councils, state governments and GOI

**ACTION V E: Adequate legal back up to the appropriate customary and traditional laws**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: District councils, state governments and GOI

**ACTION V F: Revising the EIA guidelines for north-east and prescribing stringent EIA procedure for assessing the impact of developmental projects on biodiversity and more compensatory activities to mitigate the loss of biodiversity**

TIME FRAME: 1 year

PRIORITY: Top

AGENCY TO BE RESPONSIBLE : Ministry of Environment and Forests, Government of India

**ACTION V G: Valuation of biodiversity of north-east including the ecosystem services provided by it**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: NEHU and other Universities of the region with funding support from the Ministry of Environment and Forests, Government of India

**STRATEGY VI: ADDRESSING THE LAND TENURE ISSUES FOR ENSURING CONSERVATION AND EQUITABLE USE OF BIODIVERSITY**

**ACTION VI A: Survey and demarcation of private, clan and village/ community lands**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: District councils, state governments and community institutions including clan councils

**ACTION VI B: Ensuring the access to biodiversity for all the stakeholders in clan and village/ community lands**

TIME FRAME: 3 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: District councils, state governments and community institutions including clan councils

**ACTION VI C: Need to demarcate land for different uses at village level**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: District councils, state governments and community institutions including clan councils

**STRATEGY VII: INSTITUTIONAL ARRANGEMENT AND CAPACITY BUILDING FOR CONSERVATION AND EQUITABLE USE OF BIODIVERSITY**

**ACTION VII A: Establishment of an Ecoregional Biodiversity Conservation Authority**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Ministry of Environment and Forests, Government of India

**ACTION VII B: Establishment of State and District level Biodiversity Boards**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Ministry of Environment and Forests, Government of India and State Governments

**ACTION VII C: Utilizing the existing traditional village level institutions for biodiversity conservation programmes**

TIME FRAME: 3 years

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: District councils, state governments, GOI and community institutions

**ACTION VII D: Capacity building of traditional institutions for conservation and equitable use of biodiversity**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI, NGOs and community institutions

**ACTION VII E: Facilitating flow of funds for conservation and sustainable utilization of biodiversity directly to traditional village institutions**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: District Councils, State governments, GOI, Donor agencies and community institutions

**STRATEGY VIII: CONTROLLING BIOPIRACY AND PROTECTING PEOPLE'S RIGHT OVER BIODIVERSITY**

**ACTION VIII A: Evolving mechanisms to monitor and control biopiracy**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: BSI, ZSI, Ministries, State governments, Departments of Querentine/Customs

**ACTION VIII B: Creating awareness about IPR and extending the provisions of IPR to IKS/TKS**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI, community institutions, NGOs, universities, R&D institutions and PFC

**ACTION VIII C: Compilation and publication /registration of IKS for the purpose of IPR**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: BSI, ZSI, State governments, GOI, community institutions, NGOs, universities, R&D institutions and PFC

**ACTION VIII D: Ensuring the benefits to the community generated through application of IKS through suitable legislation**

TIME FRAME: 1 year

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI, community institutions, NGOs, universities, R&D institutions and PFC

**STRATEGY IX: DEVELOPING INFORMATION AND DATABASE ON BIODIVERSITY, ITS USES AND CONSERVATION**

**ACTION IX A: Creating database on biodiversity and related issues at regional level**

TIME FRAME: 5 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: NEHU

**ACTION IX B: Authenticating the information on the distribution and identification of various components of biodiversity and publication**

TIME FRAME: 3 years

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: NEHU, BSI, ZSI, R&D institutions

**STRATEGY X: AWARENESS &EXTENSION**

**ACTION X A: Awareness camps on importance, uses and conservation of biodiversity**

TIME FRAME: Continuing process

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: State government departments

**ACTION X B: Creating awareness about IPR and biopiracy**

TIME FRAME: Continuing process

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: State government departments

**ACTION X C: Inclusion of biodiversity and related issues in school books**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State government education departments

**ACTION X D: Using print and electronic media for creating awareness**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: Media agencies

**STRATEGY XI: CAPACITY BUILDING**

**ACTION XI A: Training programmes on uses and value addition for communities**

TIME FRAME: Continuing process

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: NGOs, State and central departments of industries

**ACTION XI B: Capacity building in taxonomy**

TIME FRAME: Continuing process

PRIORITY: Medium

AGENCIES TO BE RESPONSIBLE: Universities and colleges

**STRATEGY XII: GENDER**

**ACTION XII A: Involving women in protection and regeneration of biodiversity**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI and donor agencies

**ACTION XII B: Adequate women representation in committees/ institutions responsible for decision making and programme implementation at all levels**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI, NGOs and community institutions

**STRATEGY XIII: EQUITY**

**ACTION XIII A: Ensuring equitable distribution of benefits of biodiversity among all strata of people through suitable legislation and by involving community institutions**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI, NGOs and community institutions

**STRATEGY XIV: EMPOWERMENT**

**ACTION XIV A: Empowerment of weaker sections of the society and women through legislation and involvement of traditional institutions**

TIME FRAME: Continuing process

PRIORITY: Top

AGENCIES TO BE RESPONSIBLE: State governments, GOI, NGOs and community institutions

## INTEGRATING BIODIVERSITY INTO OTHER SECTORS OF DEVELOPMENT

- Conservation of biodiversity should be an essential component in all land-based development projects including rural development projects.
- Measures to conserve biodiversity to be made mandatory in EIAs/EMPs
- Financial provision for biodiversity conservation in five year plans of GOI and annuial plans of state governments
- Biodiversity in educational curriculum
- Biodiversity conservation in north-east should be one of the thrust areas of NEC
- Need to integrate ecotourism with biodiversity conservation

## Transboundary Candidate Priority Complexes in the Eastern Himalaya

## (from Sharma, 2002)

The Eastern Himalayan region extends from Khangchendonga complex in the eastern most part of Nepal through, Sikkim and North Bengal in India, Bhutan, China, Myanmar, Chitagong Hills of Bangladesh, and North-East Indian States of Assam, Meghalaya, Arunachal Pradesh, Manipur, Mizoram, Nagaland and Tripura. Along this longitudinal and latitudinal spread it includes savanna-grasslands of the foothills, sub-tropical forests, temperate forests, sub-alpine forests, alpine shrub and meadows, and cold deserts of the high Himalaya. The selection criteria for candidate priority complexes have included (a) representation of distinct habitat types, communities and assemblages, (b) conserve large areas of intact habitats and intact biotas that can support viable populations of focal species and focal ecological processes, (c) conserve keystone species, habitats and community processes, (d) conserve distinct large-scale ecological phenomena, and (e) conserve focal species and species of special concern (Wikramanayake et al., 2001). The Eastern Himalaya has several species of plants and animals that can be considered as focal species. In the lowland areas, these can include umbrella (species that require large areas for effective conservation, that will then include the ecological and spatial requirements of most of the other biodiversity) species such as tiger, greater one-horned rhinoceros, and Asiatic elephant; habitat specialists such as swamp deer or barasingha, wild water buffalo, hispid hare, pygmy hog; and keystone species such as the several hornbills in the low elevation broadleaf forests. At higher elevations, the snow leopard and its prey species, musk deer, red panda, the pheasants, partridges, tragopans, and large birds of prey like the Lammergeier and Himalayan Griffon qualify as focal species. The extreme altitudinal gradient in near-tropical latitude allows a great bioclimatic range from tropical monsoon forests of the plain and the high alpine environments above 5000 meters. This has given rise to deciduous broadleaf forests of tropical hardwoods like *Shorea robusta*, *Lagerstroemia* and *Terminalia*; evergreen broadleaf subtropical forests

dominated by *Castanopsis tribuloides* and *Schima wallichii*; evergreen broadleaf warm temperate forests dominated by oaks and laurels; winter-deciduous broadleaf cool temperate forests of maple and magnolia; evergreen broadleaf forests in cool temperate area dominated by oaks and rhododendrons; sub-alpine evergreen needle-leaf forests of hemlock, silver fir and junipers; alpine evergreen shrubs dominated by rhododendrons and junipers; alpine deciduous shrubs like rose, barberry and willow; and diverse alpine meadows. The selected transboundary candidate priority complexes may also include various protected areas either on one country or a few countries. The following are the candidate priority complexes in the Eastern Himalaya that have the transboundary sharing (Fig. 1):

1. *Khangchendzonga Complex*

This complex has an area of 11,500 $km^2$ landscape that forms the watershed of river Tista originating in Sikkim and running through West Bengal. The landscape includes the Khangchendzonga Conservation Area in Nepal, Khangchendzonga Biosphere Reserve in Sikkim, Singalila National Park in Darjeeling Gorkha Hill Council and many other smaller protected areas in Sikkim (Fambonglo, Kyongsla, Maenam, Singba and Barsey) and Darjeeling (Senchal and Mahananda). This transboundary complex extends from eastern Nepal into Sikkim and Darjeeling of India. Khangchendzonga Conservation Area in Nepal is reported to harbor 19 species of mammals and 202 bird species. Sikkim and Darjeeling serve home for 150 species of mammals, 550 species of birds, 650 species of butterflies and moths, 33 species of reptiles, 16 species of amphibians, 48 species of fishes, 350 species of ferns and allies, 9 species of conifers, and 4500 species of flowering plants including 36 species of rhododendrons, 450 species of trees and 430 species of orchids. The landscape provides north-south connectivity and includes relatively intact subtropical and temperate forests that have become highly fragmented and cleared throughout most of Nepal. There are also several floral hotspot in this complex especially of rhododendrons, orchids and medicinal plants. Focal mammals for conservation are snow leopard, red panda, serow, musk deer, marbled cat, Himalayan

thar, great Tibetan sheep, clouded leopard, Tibetan antelope, Tibetan gazelle and blue sheep, and tiger on the southernmost part in Mahananda Wildlife Sanctuary.

2. *Jaldapara-Buxa-Phibsoo Complex*

This complex comprises of 4,560 $km^2$ landscape that includes three protected areas such as Buxa Tiger Reserve and Jaldapara Wildlife Sanctuary in India and Phibsoo Wildlife Sanctuary in Bhutan. It has Terai-Duars savanna and grasslands, and smaller areas of subtropical and temperate broadleaf forests. Within this landscape Phibsoo wildlife sanctuary in southern Bhutan is connected to Manas protected area complex in Assam, and Buxa tiger reserve and Jaldapara wildlife sanctuary is connected with Garumara protected area complex in West Bengal. These connectivities are very important for conservation of focal mammals such as elephant and tiger. This complex harbors several animals of conservation significance that includes elephant, tiger, clouded leopard, golden langur, gaur, greater one-horned rhinoceros, python, Indian otter, and two Himalayan endemic animals such as the hispid hare and pygmy hog. Birds of conservation significance found in this complex are black necked crane, Bengal florican, great pied hornbill and rufous necked hornbill. There are many rare and endemic plant species in this complex.

3. *Jigme Dorji-Manas–Bumdaling Complex*

This complex covering a large area of 13,700 $km^2$ forms a link of lowland grassland and savanna to alpine meadows that includes several protected areas in Bhutan and Manas Tiger Reserve in Assam, India. The connectivity in the complex is designed based on tiger as focal species that provides habitat linkage from the Manas transboundary reserve in the south to the high altitude alpine habitats in Jigme Dorji National Park and Bumdaling Wildlife Sanctuary in the north. The Black Mountain and Thrumsing La National Parks anchor the linkages at the mid-altitudes. Most of the southern part of the landscape has been included in tiger conservation units and some survey shows that tiger are found up to 3000 meter elevations in this complex (Yonzon, 2000). Thus the linkages between the large protected areas represent important habitat and dispersal routes for tigers.

The Manas reserve complex also harbors elephants. The greater one-horned rhinoceros, which is now extirpated from Manas can be re-established if poaching can be brought under control. In the north, Jigme Dorji National Park and Bumdaling provide large areas of snow leopard habitat, although snow leopard densities appear to be very low. The protected areas also harbor other large predators such as wolves and lynx. Several of the Himalayan alpine ungulates (blue sheep, serow, goral and takin) inhabit the alpine meadows, and the charismatic Himalayan endemics, red panda and musk deer inhabit old-growth sub-alpine fir forests.

4. *Tawang-Khulong Chu Complex*

This complex is spread in 8,790 $km^2$ landscape amalgamating the Sakteng-Sessa corridor linking Sakteng and Khulong Chu wildlife sanctuaries in Bhutan with Eagle's Nest and Sessa Orchid reserves in Arunachal Pradesh of India. The Khaling-Eagle's Nest corridor extends from Eagle's Nest southwestward, back into Bhutan to link with the Khaling/Neoli protected areas complex. The corridors between protected areas are meant to achieve altitudinal habitat connectivity and east-west representation of habitat types and floral assemblages. The complex includes protected areas within the larger watershed boundary of the Bhareli River. The landscape overlaps two tiger conservation units (Dinerstein et al., 1997). The southern part of the complex harbor elephants. The northern extent of the complex includes distribution of takin, serow and goral. The southern Khaling/Neoli sanctuary in Bhutan and Barnadi in India also house gaur and endemic hispid hare and pygmy hog. Complex is rich in botanical wealth.

5. *Namcha Barwa-Dibang Walong Complex*

This complex covering a large area of 27,490 $km^2$ along the India-China border includes seven protected areas such as Dibang Valley, Mo Tuo, Dong Jiu, Namcha Barwa, Mahao, D'Ering Memorial and Mouling. The boundaries of the conservation complex are based on the watershed boundaries of the Tsang Po/Brahmaputra River. The landscape extends across semi-evergreen forests of

the Brahmaputra Valley to the northeastern Himalayan sub-alpine conifer forests in the east and the alpine shrub and meadows to the north. Some of the deepest gorges in the world along the Tsang Po-Brahmaputra River provide altitudinal variations in vegetation, but within very local spatial scales. There are several floral pockets in the landscape where plant richness and endemism is high, and also contains large areas of threatened Eastern Himalayan temperate broadleaf forests. The southern extent of the landscape lies within the range of the Asiatic elephant and overlaps with tiger conservation units (Dinerstein et al., 1997). Two endemic bird areas contain several globally threatened species (Stattersfield et al., 1998). The northern landscape represents extensive areas of good snow leopard habitat and falls within the distribution ranges of blue sheep, takin, serow and goral.

6. *Namdapha-Hkakaborazi Complex*

This complex is the largest with a landscape area of 69,460 $km^2$ that has transboundary links in Myanmar, China and India. The landscape has large number of conservation significance pockets such as Hukaung-Patkoi, Namdapha extension and Hukung, Kamlang-Hkakaborazi link, Hkakaborazi-Khaunglanohu, Joypur/Upper Dihang RF, Hkakaborazi National Park, Kamlang Wildlife Sanctuary and Namdapha National Park. The altitudinal variation of this complex range from 300 to 5,000 meters. The landscape overlaps with the distribution range of Asiatic elephants. The western part of the landscape near Namdapha has overlap with tiger conservation unit (Dinerstein et al., 1997). The higher elevation area in the Golden Triangle and along the Gaolingong Shan have good snow leopard habitat and also overlaps with the distribution ranges of blue sheep, takin and serow. A very little information is available on the biodiversity and ecological integrity of this landscape.

**Strategy and Action Plan for Conservation**

Primary direct threats to the Eastern Himalaya's unique biodiversity at the transboundary candidate priority complexes are land use transformation, habitat degradation, landscape and habitat fragmentation, diminishing connectivity

between protected areas for large mammals and forest fires. Activities like grazing, road/railway track construction (recent elephant accidents in the complex corridors in Assam), deforestation, unregulated tourism, unsustainable harvest of biodiversity products and poaching in some specific areas (musk deer, elephants, greater one-horned rhinoceros etc.) are the main causes of degradation and loss of biodiversity.

The strategic approach to transboundary biodiversity conservation in candidate priority complexes in the Eastern Himalaya focuses on six key areas. Firstly, supports distinct ecological and evolutionary processes that create and maintain biodiversity. Secondly, addresses the ecological requirements, including the spatial needs necessary to maintain viable populations of focal species. Thirdly, allows a convenient assessment for representation of biodiversity that is contained in the region. Fourthly, permits the most effective conservation for long-term perspectives. Fifthly, allows to have enough scope for resilience to large-scale periodic disturbances and long-term changes. Sixthly, allows for regional and transboundary cooperation on biodiversity conservation.

**Proposed Activities**

- Participatory management of biodiversity in the protected areas of candidate priority complexes and their surroundings that will enhance conservation of the globally significant unique biodiversity of the Eastern Himalaya, which otherwise are under risk because of transboundary problems
- Restore and increase the connectivity between the protected areas within the candidate priority complex and between the complexes
- More conservation attention and efforts to focal species at the lowlands like greater one-horned rhinoceros, elephant, tiger etc., and on alpine species like snow leopard, red panda etc. Focal species of plant kingdom such as rare and endangered endemic species, and birds should also be given equal importance in the proposed candidate priority complexes

- ❖ Identification of keystone plant species and their restoration and conservation in each of the candidate priority complexes
- ❖ Transboundary issues such as grazing, poaching, unsustainable harvest of NTFPs, control of forest fires and creating new connectivity for overall conservation to be solved by regional and country-to-country cooperation basis.
- ❖ Policies and incentives conducive to participatory biodiversity conservation, complementary to the participating countries be established

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## ANNEXURE I

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# ANNEXURE II

## IMPORTANT PLANT SPECIES OF NORTH-EAST INDIA

| Botanical Name | Family |
|---|---|
| **A. TREE** | |
| *Abroma augusta* | Sterculiaceae |
| *Acacia farnessiana* | |
| *Acacia* sp. | Mimosaceae |
| *Acrocarpus fraxinifolius* | |
| *Adina cordifolia* | |
| *Aegle marmelos* | |
| *Ailanthus grandis* | Simarubaceae |
| *Albizia lebbek* | Mimosaceae |
| *Albizia lucida* | Mimosaceae |
| *Albizia procera* | Mimosaceae |
| *Albizia stipulata* | Mimosaceae |
| *Alnus nepalensis* | |
| *Alseodaphne petiolaris* | |
| *Altingia excelsa* | Hamamelidaceae |
| *Amoora rohitooka* | |
| *Amoora wallichii* | Meliaceae |
| *Anthecephalus chinensis* | Rubiaceae |
| *Aporosa roxburghii* | |
| *Aqularia agallocha* | |
| *Aralia armata* | Araliaceae |
| *Ardisia humilis* | |
| *Artocarpus chaplasha* | Moraceae |
| *Artocarpus integrifolia* | Moraceae |
| *Artocarpus lacoocha* | Moraceae |
| *Atalantia monophylla* | |
| *Averrhoa carambola* | |
| *Bauhinia purpurea* | |
| *Bauhinia varigata* | |
| *Bischofia javanica* | |
| *Bombax ceiba* | |
| *Bombax insigne* | |
| *Bombax malabaricum* | |
| *Bridelia retusa* | Euphorbiaceae |
| *Butea frondosa* | |
| *Calicarpa* sp. | Verbenaceae |
| *Calliandia umbrosa* | |
| *Callicarpa arborea* | Verbenaceae |
| *Canarium resiniferum* | Burseraceae |

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|---|---|
| *Canarium strictum* | Burseraceae |
| *Cassia fistula* | |
| *Castanopsis hystrix* | |
| *Castanopsis indica* | Fagaceae |
| *Cedrela serrata* | |
| *Cedrela toona* | Meliaceae |
| *Chukrasia tabularis* | Meliaceae |
| *Cinnamomum cecicodaphne* | Lauraceae |
| *Cinnamomum glaucescens* | Lauraceae |
| *Cinnamomum tamala* | |
| *Citrus aurantium* | |
| *Clerodendron infortunatum* | |
| *Clerodendron nutans* | |
| *Cordia fragrantissima* | |
| *Crataeva lophosperma* | |
| *Croton joufra* | |
| *Cryptocarya amygdalina* | |
| *Cynometra polyandra* | |
| *Dalbergia assamica* | Fabaceae |
| *Dalbergia pinnata* | Fabaceae |
| *Derris robusta* | |
| *Dicus religiosa* | |
| *Dillenia indica* | |
| *Dillenia pentagyna* | |
| *Dipterocarpus turbinatus* | |
| *Dryples assamica* | |
| *Duabanga grandiflora* | Sonneraticeae |
| *Duabanga sonneratioides* | |
| *Dysoxylum* sp. | Meliaceae |
| *Ehretia acuminata* | |
| *Elaeocarpus aristatus* | Elaeocarpaceae |
| *Elaeocarpus* sp. | Elaeocarpaceae |
| *Elaeocarpus sphaericus* | Elaeocarpaceae |
| *Emblica officinalis* | |
| *Entada scandens* | |
| *Erythrina stricta* | Fabaceae |
| *Erythrina suberosa* | |
| *Eucalyptus spp.* | |
| *Eugenia jambolana* | |
| *Eugenia praecox* | |
| *Euodia miliaefolia* | Rutaceae |
| *Ficus bengalensis* | |
| *Ficus cunia* | |
| *Ficus drupacea* | Moraceae |
| *Ficus elastica* | |
| *Ficus elmeri* | Moraceae |

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|---|---|
| *Ficus hirta* | Moraceae |
| *Ficus hispida* | |
| *Ficus rhododendrifolia* | Moraceae |
| *Ficus roxburghii* | Moraceae |
| *Ficus rumphii* | |
| *Ficus* sp. | Moraceae |
| *Ficus squamata* | Moraceae |
| *Garcinia turgida* | |
| *Gardenia campanulata* | |
| *Glochidian* spp. | Euphorbiaceae |
| *Glochidion cowa* | |
| *Gmelina arborea* | |
| *Goniothalamus sesquipedalis* | |
| *Gracinia anomala* | |
| *Grevillea robusta* | |
| *Grewia disperma* | Tiliaceae |
| *Grewia elastica* | |
| *Grewia microcos* | |
| *Gynocardia odorata* | Flacourtiaceae |
| *Hardwikia binata* | |
| *Heritiera acuminata* | Sterculiaceae |
| *Hiptage madablota* | |
| *Holidrana longfolia* | |
| *Hovenia acerba* | Rhamnaceae |
| *Hydnocarpus kurzii* | |
| *Hymenodictyon excelsum* | |
| *Ichnocarpus frutescens* | |
| *Jatropha curcas* | |
| *Juglans regia* | |
| *Kadsura roxburghiana* | |
| *Kydia calycina* | |
| *Kydia glabrescence* | Malvaceae |
| *Lannea grandis* | |
| *Lantana camara* | |
| *Leea indica* | Leeaceae |
| *Legerstroemia flosreginea* | |
| *Lindera* sp. | Lauraceae |
| *Litsaea polyantha* | |
| *Litsea monopetala* | Lauraceae |
| *Litseae angustifolia* | |
| *Macaranga enticulate* | Euphorbiaceae |
| *Macaranga indica* | Euphorbiaceae |
| *Machilus villosa* | |
| *Magnolia pterocarpa* | |
| *Mallotus roxburghianus* | |
| *Mangifera indica* | |

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|---|---|
| *Mangifera sylvatica* | Anacardiaceae |
| *Mansonia dipikae* | |
| *Melanorrhoea usitata* | |
| *Melia azadirachta* | |
| *Meliosma pinnata* | Sabiaceae |
| *Mellotus tetracoccus* | Euphorbiaceae |
| *Mengleitia insignis* | Magnoliaceae |
| *Mesua ferrea* | |
| *Michelia champaca* | |
| *Mimusops elengi* | |
| *Morus alba* | |
| *Morus laevigata* | Moraceae |
| *Murraya exotica* | |
| *Musa glauca* | Musaceae |
| *Musa* sp. | Musaceae |
| *Myristica linifolia* | |
| *Nephallium longana* | |
| *Nerium odorum* | |
| *Nyctanthus arbortristis* | |
| *Oreocnide integrifolia* | Urticaceae |
| *Oroxylum indicum* | Bignoniaceae |
| *Pandanus* sp. | Pandanaceae |
| *Parkia roxburghii* | |
| *Phoebe hainesiana* | |
| *Pinus kesiya* | |
| *Podocarpus neriifolia* | |
| *Premna bengalensis* | |
| *Premna spp.* | |
| *Psidium guava* | |
| *Pterospermum acerifolium* | Sterculiaceae |
| *Pyrus communis* | |
| *Pyrus laevigata* | |
| *Quercus griffithii* | |
| *Quercus* spp. | Fagaceae |
| *Rhus semialata* | |
| *Salix tetrasperma* | |
| *Sapindus mukorossi* | |
| *Sapium baccatum* | Euphorbiaceae |
| *Sarcochlamys pucherrima* | |
| *Saurauia roxburghii* | Saurauiaceae |
| *Schima wallichii* | |
| *Solanum torvum* | |
| *Spondias mangifera* | |
| *Stereospermum chelonoides* | |
| *Stereospermum chelonoides* | Bignoniaceae |
| *Syzygium cumini* | |

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|---|---|
| *Syzygium* sp. | Myrtaceae |
| *Talauma phellocarpa* | |
| *Tamarindus indica* | |
| *Tectona grandis* | |
| *Terminalia chebula* | Combretaceae |
| *Terminalia citrina* | |
| *Terminalia myriocarpa* | Combretaceae |
| *Tetrameles nudiflora* | |
| *Thevetia nerifolia* | |
| *Thevetia pterocarpa* | |
| *Toona febrifuga* | Meliaceae |
| *Tournefortia viridiflora* | |
| *Trema orientalis* | Moraceae |
| *Trewai nudiflora* | |
| *Urena lobata* | |
| *Vangueria spinosa* | |
| *Vatica lanceaefolia* | |
| *Vitex peduncularis* | Verbenaceae |
| *Vitis pedata* | |
| *Wendlandia paniculata* | Rubiaceae |
| *Zanthoxylum alatum* | |
| *Zanthoxylum budranga* | |
| *Zizyphus jujuba* | |

**B. SHRUB**

| | |
|---|---|
| *Callicarpa arborea* | Verbenaceae |
| *Capparis multiflora* | Capparaceae |
| *Casearia vareca* | Bixaceae |
| *Homonoia riparia* | Euphorbiaceae |
| *Ixora acuminata* | Rubiaceae |
| *Laportea crenulata* | Urticaceae |
| *Maesa chisia* | Myrsinaceae |
| *Mellastoma malabathricum* | Melastomataceae |
| *Morinda angustifolia* | Rubiaceae |
| *Mussaenda roxburghii* | Rubiaceae |

**C. HERB**

| | |
|---|---|
| *Ageratum conyzoides* | Asteraceae |
| *Bidens biternata* | Asteraceae |
| *Commelina* sp. | Commelinaceae |
| *Crassocephalum crepidioides* | Asteraceae |
| *Cuphea salamona* | Lythraceae |
| *Elatostema* sp. | Urticaceae |
| *Eupatorium odoratum* | Asteraceae |

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|---|---|
| *Hedychium* sp. | Zingiberaceae |
| *Phragmitis karka* | Poaceae |
| *Phrynium pubinerve* | Marantaceae |
| *Piper* sp. | Piperaceae |
| *Polygonum chinensis* | Polygonaceae |
| *Sida acutifolia* | Malvaceae |
| *Sida rhomboidea* | Malvaceae |
| *Solanum torvum* | Solanaceae |
| *Spilanthus paniculata* | Asteraceae |
| *Thysanolaena maxima* | Poaceae |
| *Urena lobata* | Malvaceae |

**D. CANE (RATTAN)**

| | |
|---|---|
| *Calamus acanthospathus* | Palmae |
| *Calamus arunachalensis* | Palmae |
| *Calamus erectus* | Palmae |
| *Calamus flagellum* | Arecaceae |
| *Calamus floribundus* | Arecaceae |
| *Calamus gracilis* | Palmae |
| *Calamus khasianus* | Palmae |
| *Calamus leptospadix* | Palmae |
| *Calamus tenuis* | Arecaceae |
| *Plectocomia assamica* | Arecaceae |
| *Demonorops jenkinsianus* | |

**E. BANANA**

| | |
|---|---|
| *Musa bulbisiana* | Musaceae |
| *Musa rosea* | Musaceae |

**F. OTHER PALMS**

| | |
|---|---|
| *Wallichia* sp. | Palmae |

**G. FERN**

| | |
|---|---|
| *Asplenium nidus* | Aspleniaceae |
| *Cyathia spinulosa* | Cyathiaceae |
| *Phagopteris auriculata* | Thlypteridaceae |

**H. EPIPHYTES**

| | |
|---|---|
| *Aeridis* sp. | Orchidaceae |
| *Aeschenanthus* sp. | Geraniaceae |
| *Asplenium* sp. | Fern |
| *Bulbophyllum* sp. | Orchidaceae |
| *Coelogyne* sp. | Orchidaceae |

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|---|---|
| *Dendrobium* sp. | Orchidaceae |
| *Lipparis* sp. | Orchidaceae |
| *Lophogramma* sp. | Fern |
| *Luisia* sp. | Orchidaceae |
| *Lycopodium* sp. | Fern |
| *Microsorum* sp. | Fern |
| *Pholidota* sp. | Orchidaceae |
| *Rhynchostylis* sp. | Orchidaceae |

**I. WILD ORNAMENTALS**

| | |
|---|---|
| *Aster* sp. | Asteraceae |
| *Begonia* sp. | Begoniaceae |
| *Chirita* sp. | Gesneriaceae |
| *Hedychium coronarium* | Zingiberaceae |
| *Hedychium gardenerii* | Zingiberaceae |
| *Hedychium greeni* | Zingiberaceae |
| *Hedychium spicatum* | Zingiberaceae |
| *Melastoma malabathricum* | Melastomataceae |
| *Musa velutina* | Musaceae |
| *Mussaenda roxburghii* | Rubiaceae |
| *Oxyspora cernua* | Melastomataceae |
| *Phlogacanthus curviclorus* | Acanthaceae |
| *Phlogancanthus guttanthus* | Acanthaceae |
| *Rhyncoglossum* sp. | Gesneriaceae |
| *Thunbergia coccinea* | Acanthaceae |

**J. CLIMBERS**

| | |
|---|---|
| *Acacia pennata* | Mimosaceae |
| *Acacia* sp. | Mimosaceae |
| *Bauhinia khasiana* | Caesalpiniaceae |
| *Dalhousea bractiata* | Fabaceae |
| *Embelia ribes* | Myrsinaceae |
| *Entada purseatha* | Mimosaceae |
| *Gnetum scandens* | Gnetaceae |
| *Mezoneurum cucullatum* | Caesalpiniaceae |
| *Mikania micrantha* | Asteraceae |
| *Pegia nitida* | Rhamnaceae |
| *Piper* sp. | Piperaceae |
| *Roydsia suaveolens* | Rubiaceae |

**K. BAMBOO**

*Arundinaria callosa* Munro.
*A. clarkei*

*A. debilis* Thwaites
*A. falconeri* Benth. & Hook.
*A. kurzii*
*A. prainii* Gamble
*A. racemosa* Munro
*A. rolloana* Gamble
*Bambusa auriculata* Kurz.
*B. balcoona* Roxb.
*B. binghami* Gamble
*B. burmanica* Gamble
*B. khasiana* Munro.
*B. kingiana* Gamble
*B. longispiculata*
*B. mastersii*
*B. nana* Roxb.
*B. natans* Wall.
*B. oliveriana* Gamble
*B. pallida* Munro
*B. polymorpha*
*B. schzostachyoides* Kurz.
*B. tulda* Roxb.
*B. vulgaris* Schrad.
*Cephalostachyum capitatum* Munro
*C.fuschisnum*
*C. latifolium* Munro
*C. pallidum* Munro
*C. pergracile* Munro
*Dendrocalamus brandisii* Kurz.
*D. flagellifer* Munro
*D. giganteus* Munro
*D. hamiltonii* Nees & Arn.
*D. longifimbriatus* Bamble
*D. hookerii*
*D. longispathus* Kurz.
*D. membranaceus* Munro
*D. sericeus* Munro
*D. strictus* Nees
*Gigantoclao macrostachya*
*Melocalamus indicus* Majumdar.R.
*Melocanna bambusoides* Trins.
*Neohouzea helferii*
*Oxytenanthera abaciliata*
*Phylloatachys bambusoides*
*Pseudostachyum polymorphum* Munro
*Schizostachyum arunachalensis*
*S. polymorphum*

*Teinostachyum dullooa* Gamble
*Teinostachyum* sp.
*T. wightii* Beddome
*Thyrsostachys oliveri* Gamble

## L. DYE YIELDING PLANTS

| Colour | Scientific name of the plant | Common name of the plant | Plant parts used |
|---|---|---|---|
| **Black** | *Pasania dealbata* Chatt.<br><br>*Strobilanthes cusia* (Nees.) Imlay | <br><br>Assam indigo | Bark<br><br>Leaves and young twig |
| **Dark brown** | *Pasania pachyphylla* Kurz. | | Bark |
| **Dark-tan** | *Prunus domestica* Linn.<br><br>syn. *P. communis* Huds. | | |
| **Green** | *Clerodendron indicum* | | |
| **Indian red** | *Solanum indicum* Linn. | | Leaves |
| **Indigo** | *Strobilanthes cusia* (Nees.) Imlay. Syn. *S. flaccidifolius* Nees. | Assam indigo | Leaves and young twig |
| **Light brown** | *Pasania dealbata* Chatt. and *Parkia javanica* Merr. Syn. *P. roxburghii* G.Donn. | Tree Bean | Bark |
| **Pale rose** | *Bixa orellana* Linn. | | Fruit |
| **Pink** | *Carthamus tinctorius* Linn. | Safflower | Flower |

## M. OTHER INGREDIENT PLANT SPECIES

*Acacia farnesiana*
*Albizizzia stipulata*
*Albizziz lebbek*
*Cajanus cajan*
*Emblica officinalis*
*Fibraurea trotterii*

*Gravillea robusta*
*Mangifera indica*
*Parkia javanica*
*Strobilanthes cusia* (Nees.) Imlay
*Trachardia lacca*

## N. SOME ENDEMIC PLANT SPECIES

*Bambussa mastersii*
*Lilium mackliniae*
*Lilium debidii*
*Lilium longifolium*
*Nepanthes khasiana*
*Calamus khasianus*

## O. THREATENED (RARE/ENDANGERED/VULNERABLE) SPECIES

*Aconitum ferox*
*Aegle marmelos*
*Aphyllorhis parviflora*
*Arundina bambusifolia*
*Arundo donax*
*Bambusa mastersii*
*Bombax ceiba*
*Bulbophyllum Wallichii*
*Bulleya yunnanensis*
*Calanthe alpina*
*Calotropis procera*
*Clitoria timatea*
*Cyathia spinulosa*
*Cymbidium riginum*
*Gossypium herbaceum*
*Habenaria geniculata*
*Habenaria susannae*
*Heritiera acuminata*
*Microstegium ciliatum*
*Piper betle*
*Scurrula atropurpurea*
*Sida rhomboidea*
*Spathoglottie pubescens*

## P. ORCHIDS

| **Scientific name** | **Flowering time/ habitat** |
|---|---|
| *Acampe longifolia* Lindl. | July-Agugust/ Epiphyte |
| *Acanthephippium sylhetense* Lindl | May-June/ Terrestrial |

| | |
|---|---|
| *Aerides multiflorun* Lindl. | June-May/ Epiphyte |
| *Aerides ordoratum* Lour. | May-June / Epiphyte |
| *Aeridus ordoratum* Var.alba (Lour) Kaamamoto&Sgarik | May-June/ Epiphyte |
| *Aeridus vandarum* Rchb.F. | March-April/ Epiphyte |
| *Anthogonium gradile* Lindl. | August to October/ Terrestrial |
| *Arundina graminifolia* (D.Don) Hochr. | April to December/ Terrestrial |
| *Ascocetru ampullaceum* Var. | April-May/ Epiphyte |
| *Bulbophyllim affine* Lindl. | March-April/Epiphyte |
| *Bulbophyllum griffithii* Rchb. F. | August/Epiphyte |
| *Bulbophyllum odoratissimum* Lindl. | June/Epiphyte |
| *Bulbophyllum pectinatum* Finst. | April-May/Epiphyte |
| *Bulbophyllum guttulatum* Wall ex Hook.F. | March-April/ Epiphyte |
| *Bulbophyllum secundum* Hook.F. | June-July/Epiphyte |
| *Bulbophyllum wallichii* Lindl. | March-April/Epiphyte |
| *Calanthe angusta* Lindl. | May-June/Terrestrial |
| *Calanthe mannii* Hook.F. | April-May/Terrestrial |
| *Calanthe triplicata* Ames. | May-June/Terrestrial |
| *Chiloschista lunifera* (Rchb.F) J.J. SM. | March-April/Epiphyte |
| *Coelogyne barbarta* Griff. | September-December/ Epiphyte or lithophyte |
| *Coelogyne corymbosa* Lindl. | March-April/Epiphyte or lithophyte |
| *Coelogyne elata* Lindl. | May-June/Epiphyte or Lithophyte |
| *Coelogyne fimbriata* Lindl. | October-December/ Epiphyte |
| *Coelogyne flaccida* Wall ex Lindl. | March-April/ Epiphyte |
| *Coelogyne fuscescens* Lindl. | October-December/Epiphyte or Lithophyte |
| *Coelogyne graminifolia* Lindl. | January-February/epiphyte or lithophyte |
| *Coelogyne longipes* Lindl. | May-June/Epiphyte or lithophyte |
| *Coelogyne nitida* (Wall ex. Don) Lindl. | April-May/Epiphyte |
| *Coelogyne prolifera* Lindl. | June/ Epiphyte or lithophyte |
| *Cymbidium aloifolium* (L) Sw. | April-May/Epiphyte |
| *Cymbidium cyperifolium* Lindl. | November-December/ Terrestrial or saprophyte |
| *Cymbidum devonianum* Paxt. | May-June/Epiphyte |
| *Cymbidium eburneum* Lindl. | March/Saprophyte or Terrestrial |
| *Cymbidium elegans* Lindl. | October-November/Epiphyte |
| *Cymbidium ensifolim* Sw. | May/Terrestrial |
| *Cymbidium giganteum* Wall. | October-November/ Terrestrial |
| *Cymbidium lancifolium* Hook.F. | June/Terrestrial |
| *Cymbidium longifolium* D.Don. | September-October/ epiphyte |
| *Cymbidium munronianum* King and Pautl. | May/Terrestrial |
| *Cymbidium tigrinum* Hook.F. | May-June/Epiphyte |
| *Dendrobium aduncum* Wall. | June-July/Epiphyte |
| *Dendrobium aggregatum* Roxb. | March-April/Epiphyte |
| *Dendrobium aphyllum* (Roxb) C.E.C. Fischer. | April/ epiphyte |

| | |
|---|---|
| *Dendrobium arachnites* Rchb.F. | April-May/Epiphyte |
| *Dendrobium bellatulum* Rolfe. | April-May/Epiphyte |
| *Dendrobium bensoniae* Rchb.F. | May-June/Epiphyte |
| *Dendrobium boxalli* Rchb.F. | February-April/Epiphyte |
| *Dendrobium capillipes* Rchb. F. | April/Epiphyte |
| *Dendrobium clavtum* Lindl. | May-June/Epiphyte |
| *Dendrobiumcrepidatum* Lindl. | April-May/ epiphyte |
| *Dendrobium chrysotoxum* Lindl. | March-April/Epiphyte |
| *Dendrobium chrysanthum* Lindl. | September/October/Epiphyte |
| *Dendrobium dalhousieanum* Paxt. | April-May/epiphyte |
| *Dendrobium densiflorum* Wall. | March-April/Epiphyte |
| *Dendrobium devonianum* Paxt. | May-June/Epiphyte |
| *Dendrobium draconis* Rchb.F. | April-May/Epiphyte |
| *Dendrobium falconeri* Hook. | March-April/Epiphyte |
| *Dendrobium fimbriatum* Hook.F. | June/Epiphyte |
| *Dendrobium fimbriatum* Var. *Oculatum* Hook.F. | March-April/Epiphyte |
| *Dendrobium formosum* Roxb. | April-May/Epiphyte |
| *Dendrobium gibsonnii* Paxt. | July/Epiphyte |
| *Dendrobium gratiotissimum* Rchb.F. | April-May/Epiphyte |
| *Dendrobium heterocarpus* Lindl. | April-June/Epiphyte |
| *Dendrobium infundibulum* Lindl. | April-May/Epiphyte |
| *Dendrobium Jamesianum* Rchb.F. | April-May/Epiphyte |
| *Dendrobium jenkinsii* Wall ex Lindl. | March-April/Epiphyte |
| *Dendrobium litiflorium* Lindl. | March-April/ Epiphyte |
| *Dendrobium macraei* Lindl. | April-May/ Epiphyte |
| *Dendrobium moschantum* SW. | May-June/Epiphyte |
| *Dendrobium nobile* Lindl. | April-May/Epiphyte |
| *Dendrobium ochreatum* indl. | April-May/Epiphyte |
| *Dendrobium parishii* Rchb.F. | May-June/Epiphyte |
| *Dendrobium pendulum* Robx. (Syn.*Den.crasinode)* | April-May/Epiphyte |
| *Dendrobium peirardii* Roxb. | April-May/Epiphyte |
| *Dendrobium primulinum* indl. | April-May/Epiphyte |
| *Dendrobium ramosum* Lindl. | February/March/Epiphyte |
| *Dendrobium terminale* Par and Rchb.F. | September-October/Epiphyte |
| *Dendrobium thyrsiflorum* Rchb.F. | April/epiphyte |
| *Dendrobium transparens* Wall | May/Epiphyte |
| *Dendrobium wardianum* Warner. | April-May/Epiphyte |
| *Dendrobium williamsonii* Day and Rchb.F. | March-April/Epiphte |
| *Eria acrevata* Lindl. | June-July/Epiphyte |
| *Eria bambusifolia* Lindl. | October-December/Epiphyte |
| *Eria carinata* Gibs. | November-January/Epiphyte |
| *Ria coronaria* Rchb.F. | November/Epiphyte |
| *Eria pannea* Lindl. | May-Epiphyte |

| | |
|---|---|
| *Eulophia nuda* Lindl. | April-May/Epiphyte |
| *Eulophia sanguinea* Hook.F. | May-June/Epiphyte |
| *Gastrochilus bellinus* (Rchb.F) Kuntze. | February-March/Epiphyte |
| *Gastrochilus calceolaris* D.don. | March-April/Epiphyte |
| *Geodorum densiflorum* (Lam) Schltr. | April-May/Epiphyte |
| *Geodorum purpureum* R.BR. | April-May/Terrestrial |
| *Goodyera hispida* Lindl. | April-May/Epiphyte |
| *Goodyera procera* (Ken) Hook.F. | May/Terrestrial |
| *Habenaria constricta* Wall. | July/terrestrial |
| *Habenaria goodyeroides* Dos. | May-June/Terrestrial |
| *Habenaria khasianum* Hook.F. | June-August/Terrestrial |
| *Kalimpongia narajitti* Pradhan. | March-April/Epiphyte |
| *Liparis acauminata* Hook.F. | June-July/Lithophyte or epiphyte |
| *Liparis longopes* Lindl. | June-July/Epiphyte |
| *Liparis nervosa* (Thumb) Lindl. | March-April/Terrestrial |
| *Liparis viridiflora* (BL) Lindl. | November/Epiphyte |
| *Lusia antennifera* BL. | May-June/epiphyte |
| *Lusia jonesii* J.J.S. | May-June/Epiphyte |
| *Malaxis acuminata* D.Don. | August-September/terrestrial |
| *Oberonia iridifolia* Lindl. | September-October/Epiphyte |
| *Ornithochilus fuscus* Wall. | February-April/Epiphyte |
| *Otochilus alba* Lindl. | June/Epiphyte |
| *Otochilus fusca* Lindl. | December/Epiphyte |
| *Paphiopendium hirsutissimum* Lindl. Stein. | April/Terrestrial |
| *Paphiopedium spicerianum* (Rchb.F) Pfitz. | November-December/Terrestrial |
| *Pecteilis susannae* (L) Rafin. | September-October/Terrestrial |
| *Phaius flavus* (Bl) Lindl. | April-May/Terrestrial |
| *Phaius tankervilliae* Bl. | September/October/Terrestrial |
| *Phreatia elegans* Linld. | August/Terrestrial |
| *Phalaenopsis cornu-cervi* Rchb.F. | April-May/Epiphyte |
| *Phalaenopsis mannii* Rchb.F. | April-May/Epiphyte |
| *Phalaenopsis parishii* Rchb.F. | March-Arpil/Epiphyte |
| *Pholidota articulata* Lindl. | August/Epiphyte or lithophyte |
| *Pholidota imbricata* (Roxb) Lindl. | August/Terrestrial |
| *Pholodota recurva* Lindl. | August/September/Epiphyte |
| *Pleione humilis* D.Don. | September-November/Epiphyte |
| *Pleione maculata* Lindl. | October-November/Epiphyte |
| *Pleinoe praecox* D.Don. | November-December/Epiphyte |
| *Podochillus falcatus* Lindl. | June-July/Epiphyte |
| *Pogonia macroglossa* Hook.f. | March-April/terrestrial |
| *Renanthera imschootiana* Rolfe. | April-May/Epiphyte |
| *Phynchostylis retusa* (Linn) Blume. | May-June/Epiphyte |
| *Sarcanthus appendiculatus* Hook.F. | August/Epiphyte |
| *Sarcanthus filiformis* Lindl. | August-September/Epiphyte |
| *Sarcanthus insectifer* Rchb.F. | September/Epiphyte |

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|---|---|
| *Schoenorchis manipurensis* (U.C. Pradhan) | June-July/Epiphyte |
| *Spathoglothis ixiodes* (D.Don) Lindl. | August-September/Terrestrial |
| *Spathoglothis pubescens* Lindl. | September/Terrestrial |
| *Tainia hookeriana* King & Pantl. | March-April/Terrestrial |
| *Thunia alba* (Lindl.) Rchb.F. | May-June/Lithophyte or rarely epiphyte |
| *Vanda amesiana* Rchb.F. | February-March/Epiphyte |
| *Vanda alpina* Lindl. | July-August/Epiphyte |
| *Vanda coerulea* Griffex Lindl. | September-October/epiphyte |
| *Vanda coerulescence* Griff. | February-March/Epiphyte |
| *Vanda cristata* Lindl. | June-July/epiphyte |
| *Vanda parviflora* Lindl. | April-May/Epiphyte |
| *Vanda teres* (Roxb) Schltr. | May-June/Epiphyte |
| *Vandopsis parishii* (Schltr) | April-May/epiphyte |
| *Vanilla pilifera* Holtt. | April-May/Terrestrial, Lithophyte or epiphyte |

## Q. PLANTS USED AS FOOD FOR SILKWORMS

*Ricinus communis*
*Heteropanax fragrans*
*Alianthus glandulosa*
*Alianthus excelsa*
*Manihot utilissima* (Tapioca)
*Evoadia flesinofola*
*Carica papaya*
*Plumeria acutifolia*
*Quercus serrata*
*Quercus dealbata*
*Morus alba*
*Morus serrata*
*Morus indica*
*Morus migra*
*Terminalia tomentosa*
*Terminalia arjuna*
*Shorea robusta*
*Zizyphus* sp.
*Machilus bombycina*
*Litsaei polyantha*
*Litsaea citrata.*

## R. NTFP AND MEDICINAL PLANT SPECIES

| Botanical Name | Plants Parts Used | Cultivation/ Propagation methods | Other uses | Medicinal use |
|---|---|---|---|---|
| ***Abelmoschus moschatus*** | Seeds | By seeds | | Powdered seeds mixed with water taken orally for headache, carminative & as stomachic |

| | | | | |
|---|---|---|---|---|
| *Abutilon indicum* | Roots, leaves, seeds | | Fibres | Anthelmintic, laxative, aphrodisiac, gonorrhoea, inflammation of bladder, |
| *Acacia auriculiformis* | Wood | | | |
| *Acacia concinna* | Pods | | Soap for all skin diseases | Constipation, renal and vesical calculi, haemorrhoids, leucoderma, leprosy and eczema |
| *Acacia catechu* | Bark | | | Leucoderma |
| *Acalypha indica* | Whole plant | By bulb | | Laxative, jaundice, worm cases |
| *Achyranthes aspera* | Whole plant, stem | By seeds & roots | Dyes | Diuretic, appetite, asthma, skin diseases and cardiac disorder |
| *Aconitum hethophyllum* | Roots | | | As tonic, hysteria, throat infection, dyspepsia and vomiting, diarrhoea, abdominal pain and diabetes |
| *Acorus calamus* | Rhizomes | By rhizomes/roots | | Dyspepsia colic, pain, calanis remittent fever, bronchitis, asthma and dysentery |
| *Actephila excelsa* | Leaves | By seeds | | Juice of bruised leaves applied externally for tonsillitis, throat-pain |
| *Adhatoda vasica* | Leaves | | | Cough, expectorant, bronchitis, asthma |
| *Aegele marmelos* | Roots, leaves, fruits | By seeds | | Diarrhoea, dysentery, fever,opthalmia, inflammations, laxative and tonic |
| *Aeschymanthus sikimmensis* | Stem, flower, root | - | | Fever, pain, tonsilities, cureinguinal lymphodeupathy & breast cancer |
| *Ageratum conyzoides* | Leaves, roots | By seeds/roots | | Crushed juice applied externally for cuts, haemostatics, antilithic |
| *Aginata indica* | Rhizome, root, stem | By bulb | | Crushed juice applied externally on mumps, inflammatory |
| *Albizzia chinensis* | Stem-bark | By seeds | | Juice applied externally as lotion for cuts, scabies, skin diseases |
| *Albizzia odoratissima* | Stem-bark | By seeds | | Juice applied externally for ulcers,leprosy |
| *Albizzia procera* | Leaves | By seeds | | Poultice applied externally on ulcers |
| *Albizzia lebbeck* | Bark, flowers, seeds | - | Tannins, gums | Cough, skin eruption, leprosy, opthalmopathy and poisoning |
| *Aleurite fordii* | Fruits | - | Essential oils | |
| *Alocasia fornicata* | Juice | - | Vegetables | Snake bite |
| *Aloe barbadsensa* | Leaf-juice, elio | - | | Dyspepsia, skin diseases, constipation, tumours, dropsy, chronic ulcers, opthalmia |
| *Alnus nepalensis* | Wood, leaves | - | fodder | |
| *Alpinia brateata* | Rhizome | - | | Colic, cough |
| *Alpinia galanga* | Rhizomes | By rhizomes | | Cough, asthma, obesity, diabetes, fever |
| *Alstonia scholaris* | Bark, leaves, milky | By seeds | | Hypertension, fever, diarrhoea |

| | | | | |
|---|---|---|---|---|
| | exudate | | | and ulcer |
| *Aluerites fordii* | Fruits | - | Essential oils | |
| *Ambroma augusta* | Roots | - | | Tonsilitis, sore throat, gastric, fever, rheumatism |
| *Amorphophallus paeoniifolious* | Corms | By bulb | Vegetables | Tumour, cough, elephantiasis, dyspepsia, anorexia and constipation |
| *Anacardium occidentale* | Root, bark, leaves, fruits | -- | Kernels highly nutritious and concentrated food | Snake bite, leprosy, skin diseases, dysentery |
| *Anacolosa crassipes* | Leaves | - | | Small-pox |
| *Andrographis paniculata* | Whole plant | - | | Decoction taken for anti-spasmodic, diarrhoea, fever, dyspepsia, juandice |
| *Angiopteris evecta* | Root | - | | Paste on fracture |
| *Anogeisus acuminata* | Bark | - | | Cuts & wounds |
| *Anthocephalus chinensis* | Stem-bark | - | | Decoction taken orally for febrifuge, uterine complaints |
| *Aporosa octandra* | Bark | - | | Colic & stomach-ach |
| *Arenga saccharifera* | Root, flower, fruit | By seeds/suckers | | Decoction for bronchitis, & stomachic fibre string for fiddle string & trap crushed juice for fish poison |
| *Aquilaria agallocha* | Wood | - | Essential oils | |
| *Ardisia paniculata* | Root | - | | Stop bleeding at child birth |
| *Ardisia polycephala* | Root | - | | Stop bleeding at child birth |
| *Arisalma tortusum* | Tuber | - | | Pounded poultice applied externally on inflammation, skin eruptions |
| *Artemisia vulgaris* | Whole plant | By seeds/roots | Essential oils | Anthelmintic, skin disease |
| *Artocarpus lakoocha* | Stem-bark | By seeds/suckers | | Juice of crushed bark applied externally on pimples, pustules on face, acne, crack skin, |
| *Arundinaria callosa* | Whole plant | - | Constructions & vegetables | |
| *Asparagus racemosus* | Root | - | Vegetables | Diarrhoea, dysentery, aphrodisiac |
| *Aluerites Montana* | Fruits | - | oils | |
| *Averrhoa carambola* | Fruits, leaves | By seeds | Fruits edible | Eaten raw against bleeding piles & decoction taken for liver ailment |
| *Baccaurea ramniflora* | Stem-bark | - | | Juice/infusion taken orally for stomache, purgative, food allegy |
| *Baccaurea sapida* | | - | Dyes | |
| *Bambusa arundinacea* | Whole plant | By rhizomes | Constructions & vegetables | |

| | | | | |
|---|---|---|---|---|
| *Bambusa khasiana* | Whole plant | By rhizomes | Constructions & vegetables | |
| *Bambusa longispathus* | Whole plant | By rhizomes | Constructions & vegetables | |
| *Bambusa oliveriana* | Whole plant | By rhizomes | Constructions & vegetables | |
| *Bambusa vulgaris* | Whole plant | By rhizomes | Constructions & vegetables | |
| *Bauhinia purpurea* | | - | Fibres, tannins, dyes, gums | |
| *Bauhinia variegata* | Stem-bark | - | | Decoction taken orally |
| *Begonia inflata* | Whole plant | | | Straunguary |
| *Bergenia ciliata* | Root | By stem cutting | | Crushed juice applied externally on boils and decoction taken orally for dysentery, colic |
| *Bidens biternata* | Leaves | By seeds | | Juice of leaves applied externally on swollen glands & as eye drop |
| *Bischofia javanica* | | By seeds | Tannins, dyes | |
| *Bixa orellana* | Roots, bark,seeds | - | Dyes | Fever, gonorrhoea |
| *Blumea laciniata* | Root | - | | Cardiac problems |
| *Blumea lanceolaria* | Leaves | - | | Cancer & animal worms |
| *Boehmeria malabarica* | Stem | By seeds/roots | | Peeled off stem contained slimy juice applied externally on swellings, pain, sciatica |
| *Boletus edulis* | Fruiting body | - | Vegetable | |
| *Bombax ceiba* | Capsules | By seeds | Flosses | Aphrodisiac |
| *Bombax insigne* | Bark | - | | Tonsillitis |
| *Buddleja asiatica* | Flower | By seeds/stem cutting | | Powdered flower made into paste applied externally on skin diseases |
| *Bursera serrata* | Fruits, wood | - | Edible, construction | |
| *Butea monosperma* | Juice from wood, flowers | - | Tannins, gums | |
| *Butea superba* | Root | By tuber | | Juice of root in combination with *Sonchus arvensis, Vitis bifurcata* applied externally for snake bites, verrucose |
| *Byttneria aspera* | Sap | By seeds/root | | Sap of cut-stem retained in the mouth against stomatitis for children |
| *Callicarpa arborae* | Leaves, bark | - | Packing | Cuts, wounds |
| *Calotropsis giganteus* | Whole plant | By seeds | | Tonic, cough, intestinal worms, paralysis, fever,asthma & tumours |
| *Camellia kissi* | Bark | By seeds | | Decoction taken orally against kidney trouble, sciatica |
| *Canariuim* | Bark | - | | Rashes & wounds |

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| *strictum* | | | | |
| *Caraga glauca* | Root, leaves, bark | - | Tanning | Pneumonia, snake bite, headache, cholera |
| *Caryota urens* | Nut | By seeds/suckers | | Paste of crushed nut applied externally on headache, hemicrania |
| *Cassia alata* | Leaves | By seeds | | Crushed juice applied externally on ringworms |
| *Cassia fistula* | Bark | By seeds | Tannins | |
| *Cassia hirsuta* | Root | By seeds | | Infusion of root taken internally for snake-bite |
| *Cassia renigera* | Flowers | - | Ornamental | |
| *Cassia tora* | Leaves & seeds | - | | Decoction applied externally on cutaneous, ringworms, itches |
| *Catharanthus roseus* | Leaves & flowers | - | | decoction taken orally for hypertension, cancer |
| *Caulokaempferia linearis* | Whole plant | - | | Headache |
| *Cautleya gracilis* | Rhizome | - | | Cough & cold |
| *Ceiba pentandra* | Root, gum, bark | - | | Diabetes, stomach aliments, migraine |
| *Centella asiatica* | Whole plant | By stem cutting | | infusion taken orally for gastro-enteritis hypertension, fever, stomachahce and crushed juice applied externally on eye-ache, skin diseases |
| *Cephalostachyum capitatum* | Whole plant | - | Gums, vegetables & construction | |
| *Cephalostachyum fuschianum* | Whole plant | - | Vegetables & construction | |
| *Chenopodium embrosioides* | Leaves | By seeds/roots | | Crushed leaves applied externally on itches, skin diseases and infusion of leaves taken orally for intestinal worms |
| *Chikrassia tubularis* | Stem | By seeds | | Diarrhoea, dysentry |
| *Chonemorpha fragrans* | Roots | - | | Gynaecological problems |
| *Chromaalena odorata* | leaves | By seeds | | crushed juice applied externally on cuts and wounds heasmostatics |
| *Cinnamomum glaucascens* | Stem, bark | By seeds | | Juice of bark taken orally for bronchitis, pneumonia, cough |
| *Cinnamomum obtusifolia* | Stem, bark | By seeds | | Infusion taken orally against liver complaints, dyspepsia |
| *Cinnamon tamala* | Leaves | By seeds | Spices | |
| *Cissampelos pareira* | Whole plant | - | | Urinary trouble, diarrhoea, dysentery |
| *Claoxylon khasianum* | Root & bark | - | | Tumor |
| *Clerodendron* | | - | Vegetables | |

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| *glandulosum* | | | | |
| *Clerodendrum colebrookianum* | Leaves & roots | By seeds/suckers | | Intestinal worms, fever |
| *Colysis hemionitides* | Rhizome | - | | Bone fracture |
| *Cordia dichotoma* | stem-bark | - | | decoction taken internally for the removal of retained placenta in the womb, cholera |
| *Costus speciosus* | Rhizome | - | | Kidney trouble, birth control |
| *Crotolaria juncea* | leaves | By seeds | | boiled leaves and water taken orally for purgative, enumenagogue, enutic, vegetable |
| *Curculigo capitulata* | tubers | By rootstock | | juice of tuber taken orally for stomachache |
| *Curcuma aromatica* | Dry rhizomes | - | | Wounds, allergic and cough |
| *Curcumorpha longflora* | Rhizome | By rhizomes | | Diarrhoea, dysentery, gastro intestinal |
| *Curcumorpha minor* | Rhizome | - | | Diarrhoea, dysentery |
| *Dalbergia pinnata* | Root & bark | By seeds | | Stomatitis, hepatitis |
| *Datura metel* | Flower, stem, seeds | By seeds/stem | | Asthma, dandruff, hair falling and rheumatism swellings |
| *Dendrobium ariaeflorum* | Stem | - | | Stimulate hallucinogenic |
| *Dendrobium denudans* | Stem | - | | Stimulate hallucinogenic |
| *Dendrocalamus giganteus* | Whole plant | - | Vegetables & constructions | |
| *Dendrocalamus longispathus* | Whole plant | By rhizomes | Vegetables & constructions | |
| *Dendrocalamus sikkimensis* | Whole plant | By rhizomes | Vegetables & constructions | |
| *Dendrocalamus helmithonii* | Whole plant | By rhizomes | Vegetables & constructions | |
| *Dendrocalamus strictus* | Whole plant | By rhizomes | Vegetables & constructions | |
| *Dendrocnide sinuate* | Roots, leaves | - | | For swelling and blind abscesses |
| *Desmos chinensis* | Root | By seeds | | Dysuria |
| *Desmos dumosus* | Root | - | | Dysuria |
| *Desmos longiflorus* | Leaves | - | | Ulcer |
| *Dillenia indica* | stem-bark | By seeds/suckers | | decoction taken internally for diarrhoea and powdered bark applied externally on ulcers |
| *Dillenia pentagyna* | stem-bark | By seeds | | decoction of dried bark taken internally for stomach- ulcer |
| *Dioscoria bulbifera* | Tuber | - | Vegetables | |
| *Dioscorea* | Tuber | - | Vegetables | Steroidal alkaloid Diosgenin used |

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| *floribunda* | | | | by pharmaceutical industry |
| *Dioscoria alata* | Tuber | - | | Diabetes, leprosy, gonorrhoea |
| *Diospyros variegata* | Root, bark | - | | Diarrhoea, dysentery, ulcer |
| *Diplazium escunlentum* | Stem | - | Vegetables | |
| *Diplazium maximum* | Root-stock | - | | Bone setting |
| *Dipterocarpus turbinatus* | Wood oil | - | Resins | |
| *Dracaena spicata* | Root | By seeds/roots | | root chewed and juice taken for stomachache |
| *Dysoxylum gobara* | Leaves | By seeds/suckers | | Diarrhoea and as vegetable |
| *Elaeagnus cordata* | root | By seeds | | infusion taken internally for the removal of retained placenta in the womb |
| *Elsholtzia blanda* | leaves | By seeds/roots/ | | juice of aromatic leaves applied externally on inflammation and eruption of skin in children |
| *Elsholtzia crista* | flower | By seeds | | powdered flower mixed with water taken internally as antipyretic |
| *Embelia nutans* | leaves | By seeds/roots | | crushed leaves applied externally on cuts and wounds |
| *Embelia ribes* | fruit | By seeds | | cooked fruit taken internally as anthelmentic, stomachic |
| *Emblica officinalis* | Flowers | By seeds | Tannins, fruits | Laxative, cooling, dueretic |
| *Engelhardtia spikata* | | By seeds | Tannins, fruits | |
| *Entada pursaetha* | seed | By seeds | | powdered seed applied externally on inflammation, ulcer |
| *Eryngium foetidum* | whole plant | By seeds/roots | Condiment | crushed plant taken orally for stomachic |
| *Erythrina stricta* | bark | By seeds/suckers | | decoction of stem bark taken internally for stomach ulcer |
| *Eupatorium nudiflorum* | leaves | By seeds | | juice of leaves applied externally as haemostatics |
| *Eurya japonica* | Fruits | - | Edible | |
| *Ficus glomerata* | | - | Tannins, dyes, fruits | |
| *Ficus religiosa* | | - | Dyes | |
| *Ficus semicordata* | Bark & leaves | By seeds | | Liver ailments |
| *Fritillacaria cirrhosa* | Tubers | - | | Tuberculosis, asthma and bronchitis |
| *Garcinia pedunculata* | Fruits | - | | Diarrhoea |
| *Garcinia lancaeafolia* | Leaves & fruits | - | | Stomachache |
| *Garcinia sopsopia* | Branches & bark | By seeds | | Snake bite |

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| *Garuga pinnata* | Bark | - | Tannins, dyes, gums | |
| *Gelsemium elegans* | Roots | - | | Picks sickness & mange |
| *Girardinia diversifolia* | leaves | - | | decoction taken internally for anaemia, arthritis, internal bleeding |
| *Gmelina arborea* | Roots, flowers, fruits | - | | Cooling diuretic astringent fever, and urinary discharge |
| *Gnetum montanum* | Fruits | - | Edible | |
| *Goniothalamus sesquipedalis* | leaves | - | | burnt smoke inhaled against asthma |
| *Gynocardia odorata* | Seed oil | - | | Skin diseases and leprosy |
| *Haldia cordifolia* | stem, bark | - | | decoction of stem bark with that of *Vitex peduncularis* taken internally against fever, as febrifuge |
| *Hedyotis scandens* | Decoction of leaves | - | | To pulverize kidney stones |
| *Helicia excelsa* | Stem & bark | - | | Colic |
| *Hibiscus rosachinensis* | flower | By stem/cutting | | flower dipped in water taken internally for fever, febrifuge in children |
| *Hodgsonia heteroclita* | | By seeds | Vegetables | |
| *Holarrhena antidysenterica* | Bark | By seeds | | Dysenrtery |
| *Holarrhena pubescens* | Bark, fruits, seeds | - | | Diarrhoea, dysentery and piles |
| *Homalomena aromatica* | | By rootstock | | |
| *Ilex umbellulata* | Decoction of bark | - | | Tonsilitis, diarrhoea |
| *Imperata cylindrical* | Whole plant | - | Roofing and thatching Vegetables material | |
| *Jasminium nervosum* | Leaves | - | | Stomach ache and fever |
| *Jasminium dispermum* | Leaves | - | | Diarrhoea & dysentery |
| *Jatropa curcus* | stem bark | - | | juice of bark applied externally on skin diseases, eczema, ringworms |
| *Juglans regia* | Fruits | - | Edible | |
| *Lagera crispata* | Leaves | - | | Ulcer & sores |
| *Lasianthus hirsutus* | Leaves | By seeds | | Wound |
| *Lasianthus wallichii* | Leaves | - | | Hallucinogens |
| *Lepidagathis incurva* | Leaves | By roots | | Haemostatics |

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| *Lepidagathis rigida* | Leaves | - | | Remove tooth worms |
| *Lepionurus silvestris* | Leaves | By seeds | | Diptheria |
| *Leucas sp.* | Whole plant, leaves | - | | Skin diseases and fever |
| *Lindernia ruelloides* | Whole plant | - | | Cramp, sprains & spasms |
| *Lonicera macrantha* | Leaves & root | By seeds | | Diarrhoea & cancer |
| *Macaranga peltata* | Wood, leaves | - | fodder | |
| *Mallotus luecocarpus* | Root | - | | Colic |
| *Mallotus roxburghianus* | Leaves & barks | - | | Diabetes, hepatitis & hypertension |
| *Melocanna baccifera* | Whole plant | - | Vegetables & construction | |
| *Melastoma malabathricum* | Fruits | By seeds | Edible | Leaves used to stop bleeding |
| *Melocamus compactiflorus* | Whole plant | By rizomes | Vegetables & construction | |
| *Mesua ferrae* | Flowers | By seeds | Ornamentals | |
| *Michelia champaca* | Whole plants | By seeds | | Dyspepsia, nausea, skin diseases, fever, cough |
| *Milletia piscidia* | Root | - | | Infertility, fish poison |
| *Milletia pachycarpa* | Root | - | | Infertility, fish poison |
| *Mimosa invisa* | Root | - | | Dissolve calculus |
| *Morinda angustifolia* | Leaves,root | - | | Snake bite, cough |
| *Musaendra roxburghii* | Root, bark | By seeds | | Mouth ulcer |
| *Musa gluaca* | Seed | By suckers | | Convulsion |
| *Myrica negi* | Fruits | By seeds | Edible | |
| *Neohouzeaua dullooa* | Whole plant | - | Vegetables & construction | |
| *Ocimum sanctum* | Leaves | - | | Catarrh, pulmonary affection |
| *Ocimum basilicum* | Seeds, leaves and branch | - | | Gonorrhoea, aphrodisiac, chronic diarrhoea, dysentery, cold, cough, ring worm and nasal disorder |
| *Oroxylum indicum* | Barks, roots, fruits | By seeds | | Purgative, rheumatism, leucoderma, diarrhoea and tonic |
| *Osbekia rostrata* | Root | By seeds | | Renal & genito-urinal disorder |
| *Pajanela longifolia* | Leaves & shoot | - | | Fracture of bone |
| *Panax bipinnatifida* | Rhizomes | - | | Adaptogen, depression, fatique and for mental alertness |
| *Panax psedoginseng* | Rhizomes | - | | Adaptogen, depression, fatique and for mental alertness |
| *Panax sikkimensis* | Rhizomes | - | | Adaptogen, depression, fatique |

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| | | | | and for mental alertness |
| *Parabarium hookerii* | Bark & latex, root | - | | Juandice & wounds, placental disorder |
| *Parkia roxburghii* | Pods | By seeds | Vegetables | |
| *Pentapetes phoenicea* | Roots, fruits | - | | Fever, diarrhoea, gastric problem |
| *Phlogacanthus thyrstformis* | Roots | - | | Tumors |
| *Phyllanthus airy-shawii* | Leaf juice | By seeds | | Measles |
| *Phyllanthus acidus* | Fruits, roots, bark, leaves | By seeds | | Cough,asthma, hyper acidity, skin diseases, leprosy, diabetes |
| *Phyllanthus fraternus* | Whole plant, roots, leaves | By seeds | | Jaundice, urogenital infections, ulcers, swellings and sores |
| *Picrasma javanica* | Bark | By seeds | | Used as febrifuge |
| *Pinus kesia* | Wood | - | Timber, resin | |
| *Piper diffusum* | Leaves | - | | Stomachache |
| *Pithecelobium monadelphum* | Leaves | By seeds | | Crushed leaves retained in mouth for toothache, gum-boil. |
| *Podocarpus neriifolius* | Wood | By seeds | Timber | |
| *Podophyllum hexandrum* | Rhizomes | - | | Purgative, vermiguge and cancer |
| *Polygonum cirrhifolium* | Root stock | - | | Burning sensation, ulcer, tuberculosis,bronchitis |
| *Pongamia pinnata* | Roots, bark, leaves, flowers, seeds, oils | - | | Ulcer,heamorrhoids,diarrhoea,diabetes,aneamia, leprosy |
| *Pramenthes scandens* | Leaves | - | | Urinary tract infection |
| *Prunus cerasioides* | Heart wood | By seeds | | Burning sensation, sprain, dyspepsia, diarrhoea, asthma, fever |
| *Pseudodrynaria coronans* | Rhizome | By rhizomes/stem | | Herpes |
| *Pseudostechyum polymorphum* | Whole plant | - | Vegetables & construction | |
| *Psidium guajava* | Roots and leaves | By seeds | | Abdominal pain, diarrhoea, malaria, vomiting and intestinal heamorrhage |
| *Quercus fenestrata* | Wood | - | For agricultural implements | |
| *Quercus semi-serata* | Wood | - | Construction, implements | |
| *Romaria formosa* | Fruiting bodies | - | Vegetables | |
| *Romaria holorubella* | Fruiting bodies | - | Vegetables | |
| *Rauvolfia serpentina* | Roots | - | | Blood pressure anxiety, mental troubles, sedative, tranquilizer and uterine contraction |
| *Rauvolfia tetrapylla* | Roots, bark, leaves fruits | - | | Adulterant of *Rauvolfia serpentina* |

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| *Rhaphidophora hookerii* | Stem | - | | Child birth |
| *Rhus semi-alata* | Fruits | By seeds | | Remedy for colic |
| *Rhus javanica* | Fruits | By seeds | Edible | |
| *Rubia cordifolia* | Roots and old stem | - | | Tonic astringent, anti-dysenteric, anti-septic, ulcers, skin rashes and inflammation |
| *Sacharum sponteneum* | Roots | - | | Burning sensation, dysentery, heamorrhoids, dyspepsia |
| *Sapindus mukorossi* | Nut | By seeds | | Soapnut used as local soap and as biocides |
| *Saraca asoca* | Bark | By seeds | | Gynaecological problem |
| *Saraca indica* | Bark, leaves, flowers, seeds | By seeds | | Stomachalgia, treating bone fractures, burning sensation |
| *Sarcococca saligna* | Leaves | By seeds/roots | | Boiled leaves of juice applied on sprains, swellings, sciatica, paralysis, rheumatism |
| *Schima walichii* | Sap, leaves | By seeds | | Sap applied on cuts, wounds & snake bite and leaves for intestinal tape-worms |
| *Scleroderma verucossum* | Fruiting body | - | Vegetable | |
| *Securinega virosa* | Fruits | By seeds | | Stomach ache, digestive disorder |
| *Sida cordata* | Whole plant | - | | Fever, arthritis, burning sensation |
| *Sida rhombifolia* | Roots, stem | - | | Burning sensation, diarrhoea, tuberculosis |
| *Smilax china* | Rhizomes | - | | Leprosy, epilepsy, constipation, fever, seminal weakness |
| *Smilax glabra* | Rhizome, tuber | - | | Decoction of rhizome taken internally for gynaecological problems, rheumatism, as stomachic |
| *Solanum khasianum* | Fruits | By seeds | | Steroidal and source of alkaloid solasodine, mouth wash |
| *Solena heterophylla* | Leaves | By seeds/roots | | Juice of leaves applied externally on inflammation |
| *Spondias pinnata* | Leaves | By seeds | | Diarrhoea, dysentery, vomiting, rheumatism, appetizer |
| *Stemona tuberosa* | Tuber | By tubers | | Decoction of bitter root taken internally for fever, tuberculosis |
| *Stephania hernandifolia* | Roots, leaves | - | | Boils, septic inflammation |
| *Stereospermum colais* | Roots, leaves, seeds, flowers, fruits | By seeds | | Dyspepsia, diarrhoea, wound, tonic, fever, anthelmentic |
| *Stereospernum neuranthum* | Wood vinegar | By seeds | | Chronic-ulcer |
| *Sterculia villosa* | Root, bark | By seeds | | Dysentery, applied locally for hydrosol |
| *Strobilanthes flaccidifolious* | Flowers | - | Dyes | |
| *Swertia* | Whole plant | By seeds | | Skin diseases and fever |

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| *angustifolia* | | | | |
| *Sygygium cuminii* | Fruit, seed, stem-bark | By seeds | | Infusion of root for diuretic, carminative, stomachic & decoction of stem-bark for diabetes & diarrhoea |
| *Tabemaemontana diversicata* | Roots, flowers, latex | By seeds | | Burning sensation, paralysis, inflammation |
| *Taractogenos kurzii* | Seed-oil | By seeds | | Seed-oil applied externally on leprosy |
| *Tarena odorata* | Root | - | | Snake bite |
| *Terminalia arjuna* | Stem-bark | By seeds | | Blood pressure and heart ailments & cleaning ulcerated sores |
| *Terminalia bellerica* | Stem & flower | By seeds | | Dyspepsia, dropsy, piles, diarrhoea, liver diseases, heart problems & purgative |
| *Terminalia chebula* | Bark, fruits | By seeds | | Diarrhoea, Ulcer,Tonic, astringent, laxative,Expectorant& piles |
| *Terminalia tomentosa* | Bark | By seeds | | Diarrhoea, ulcer |
| *Tetracera sarmentosa* | Bark | - | | Stomachache |
| *Tetrameles nudiflora* | Sap, bark & leaves | - | | Cuts & wounds, ottorea |
| *Thunbergia grandiflora* | Sap, root, leaves | By seeds/stem | | Sap of cut stem drop on eyes for eye-ache & juice of roots, leaves applied on wounds, sprains, burns & fracture |
| *Tinospora cordifolia* | Stem | By roots/stem | | Dyspepsia, skin diseases, jaundice |
| *Tinospora sinensis* | Stem | By roots/stem | | Infusion of taken internally for urinary tract infection, fever |
| *Toona ciliata* | Bark, flowers | By seeds | | Chronic dysentery, cough, bronchitis,leprosy |
| *Trapa natans* | Fruits | - | | Burning sensation, dyspepsia, leprosy, heamorrhages |
| *Trema orientalis* | Bark, leaves | By seeds | Fibre, fodder | |
| *Trevetia palmate* | Roots & leaves | - | | Colic & stomachache |
| *Tricholoma imbricatum* | Fruiting bodies | - | Vegetables | |
| *Tricholoma terrum* | Fruiting bodies | - | Vegetables | |
| *Uncaria sessilifructus* | Leaves | By seeds | | Leaves boiled taken for diphtheria, tonsilitis |
| *Valerina wallichii* | Roots | - | | Fever, hepatitis, skin diseases, cough, asthma, constipation, jaundice |
| *Vinca rosea* | Leaves | - | | Anti-cancer |
| *Vitex peduncularis* | Leaves | By seeds | | Rheumatism, swelling pain, headache |
| *Vitis bifurcarta* | Root | By roots | | Swelling & sciatica |

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| *Withania somnfera* | Roots, leaves | - | | Aphrodisiac,vitality, hiccup,dropsy, rheumatism, febrifuge, lesion, and painful swelling |
| *Woodfordia fruticosa* | Bark and flower | By seeds | | Malaria, fever, dysentery, skin diseases |
| *Zanonia indica* | Leaves, fruits | - | | Inflammations, spasmodic affections, cough, asthma, cuts, wounds, ulcers |
| *Zanthoxylum alatum* | Bark, fruits | - | | Tumour, dyspepsia, diarrhoea, fever, skin diseases, cough |
| *Zanthoxylum budrunga* | Leaves | - | Edible | |
| *Zingiber officinale* | Rhizome | - | | Crushed roasted rhizome mixed with water & salt as gargle against diphtheria, cough/flatulence |

## S. EDIBLE WILD PLANTS

| Name | Family | Use |
|---|---|---|
| *Alisama plantago* | Alismaceae | Cooked or fresh rhizome is eaten. |
| *Allium hookerri* | Liliaceae | The whole plant used as vegetable and spices. |
| *Allium odorum* | Liliaceae | The leaves are used as vegetable and as spices. |
| *Alocasia cullata* | Araceae | The tuber is used as raw in salad and cooked petiole is used as vegetable. |
| *Alocasia indica* | Araceae | Whole plant is used for curry. |
| *Alocasia macrorrhiza* | Araceae | The petioles are crushed along with dry small fishes and the paste is dried and eaten after cooked & the dry slices of the rhizome is used as chips. |
| *Alpinia allugha Rose.* | Zingiberaceae | The shoots with tender leaves are cooked. |
| *Asternanthera sessilis* | Amaranthaceae | The leaves with tender stems are used specially in chagempomba curry. |
| *Amarnthus sp.* | Amaranthaceae | The cooked, tender plant is used for curry. |

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| *Bambusa nutans & Bambasa tuida* | Poaceae | Young shoots from fresh plant are cooked or fermented shoots are used. |
| *Benincasa hispida* | Cucurbitaceae | Fruits are used as fresh or cooked. |
| *Brassica campestris* | Brassicaceae | Leaves are eaten as fresh or cooked, seeds are used for oil production |
| *Centella asiatica* | Apiaceae | He whole plant is cooked and used as curry |
| *Chenopodium album* | Chenopodiaceae | The leaves are used as vegetable |
| *Cissus adnata* | Vitaceae | The leaves are used as vegetable |
| *Colotasia giganatea* | Araceae | The whole plant is generally used for vegetable. |
| *Crolalaria Juncea* | Papilionaceae | The stem with young tender leaves are used in salad. |
| *Curcuma aromatica* | Zingiberaceae | The whole inflorescence head with flowers is used as vegetable. |
| *Cycas pectinata* | Cycadaceae | The young tender leaves and male cone are used as vegetable. |
| *Dendrocalamus gigantanus* | Poaceae | Young shoots & fermented young shoots are used as vegetable. |
| *Dioscorea glabra* | Dioscoreaceae | The cooked or roasted root tubers are eaten. |
| *Euryale ferox* | Nymphaceae | The young thorny leaves and petioles are used as fresh or cooked. Seeds with pulp are used as raw or cooked. |
| *Hibiscus cannabinus* | Malvaceae | The boiled leaves are used as curry. |
| *Houttuynia cordata* | Saururaceae | The fresh whole plant is used as spices for curry and salad. |
| *Ipomoea aquatica* | Convolulaceae | The whole plant is used in salads and cooked in curry. |
| *Isoetes debii* | Cucurbitaceae | The fruits are edible as vegetable |

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| *Lagenaria siceraria* | Cucurbitaceae | The fruits are edible as vegetable. |
| *Lathyrus sativus* | Pailionaceae | The young tender stems with leaves are used in salad by the people in rural areas. |
| *Lamanea australis* | Algae | The sun dried plant is fried and eaten in salted condition. |
| *Lentinellus cochleatus* | Fungi | The fruiting body is cooked and eaten. |
| *Leucaena glauca* | Mimosaceae | Tender laves, young fruits and seeds are used as raw or fry as vegetable. |
| *Momordica charantia* | Cucurbitaceae | The cooked or fry fruits is eaten as curry. |
| *Musa paradisica* | Musaceae | The stem, inflorescence and fruits are used as vegetable. |
| *Nelumbo nucifeceae* | Nymphaceae | The young stems and leaves& Rhizomes are used as vegetable. Fruits is also edible. |
| *Neptunia oleracea* | Mimosaceae | The young stems and leaves are eaten raw in salad and cooked. |
| *Nymphaea sp.* | Nymphaceae | Tubers are boiled and eaten. The fruits petioles and flowers are used as vegetable. |
| *Ocimum canum* | Lamiaceae | The leaves and whole inflorescence are used as spices for salad and curry. |
| *Oenanthe javanica* | Araceae | The plant is used in salad and cooked as curry. |
| *Pistia stratiotes* | Araceae | The young leaves are served as cooked vegetable. |
| *Parkia javanica* | Mimosaceae | The flower is used in salad. The fruits are also used as vegetable as raw or cooked. |

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| *Pisum sativum* | Papilionaceae | The young twigs and leaves are used in salad, young fruits and dried seeds are used as vegetable. |
| *Plumbago zeylanica* | Plumbaginaceae | The plant is used as vegetable by the local people. |
| *Polygonum barbatum* | Polygonaceae | The young shoot and tender leaves are used as vegetable. |
| *Sagittaria sagittifolia* | Alismaceae | The petioles are coked and eaten. The tubers also eaten as cooked or raw. |
| *Sesbania sesban* | Papilionaceae | The young leaves and fruits are used as vegetable. |
| *Spinacia oleraceae* | Chenopodiaceae | The leaves are used a vegetable. |
| *Stellaria media* | Caryophylliaceae | The young leaves and shoots are used as vegetable. |
| *Trapa natas* | Trapaceae | The leaves, stem, roots and fruits are eaten as vegetable by the people. |
| *Vulvariella esculenta* | Fungi | The plant or fruiting body is used as vegetable. |
| *Zizania latifolia* | Poaceae | The young stem with lender leaves are used as vegetable. |

## T. ECONOMICALLY IMPORTANT AND WILD CROP RELATIVES

| **Species** | **Economic importance** |
|---|---|
| *Begonia* sp. | Edible leaves |
| *Calamus flagellum* | Furniture, tender shoots edible |
| *Calamus tenuis* | Furniture |
| *Canarium strictum* | Dhona |
| *Castanopsis indica* | Wood for charcoal, nuts edible |
| *Clerodendrum colebrookianum* | Leaves used as vegetable |
| *Dendrocalamus hamiltonii* | Bamboo, shoots used as vegetables |
| *Dillenia indica* | Edible fruits |
| *Diplazium esculentum* | Young fronds used as vegetables |
| *Laportea crenulata* | Young leaves and shoots used as vegetables |
| *Laportea crenulata* | Edible leaves |
| *Litsea citrata* | Aromatic |

| | |
|---|---|
| *Livistona jenkinsiana* | Toko leaf used as roofing material |
| *Musa* sp. | Leaves as roofing material and flower spadix as vegetables |
| *Oroxylum indicum* | Bark medicinal and flowers edible |
| *Pandanus* sp. | Leves used for mat making |
| *Phlogacanthus thyrsiflorus* | Flowers used as vegetables and leaves medicinal |
| *Phrynium pubinerve* | Packaging leaf |
| *Piper* sp. | Leaves used as vegetable and fruit medicinal |
| *Poulzolzia bennetiana* | Edible leaves |
| *Sarchochlamys pulcherrima* | Edible leaves |
| *Solanum nigrum* | Tender shoots used as vegetable |
| *Solanum torvum* | Fruits used as vegetable |
| *Spilanthus paniculatus* | Leaves used as vegetable, flower head medicine for tooth pain |
| *Spondias axillaris* | Edible fruits |
| *Spondias pinnata* | Edible fruits |
| *Sterculia hamiltonii* | Fibre yielding |
| *Sterculia villosa* | Fibre yielding |
| *Terminalia chebula* | Fruits medicinal |
| *Thunbergia coccinea* | Ornamental |
| *Thysanolaena maxima* | Broom grass |
| *Trema orientalis* | Fibre yielding |
| *Wallichia* sp. | Leaves as roofing material , fibre for broom and handicrafts |

## U. PLANT SPECIES USED AS SPICES AND CONDIMENTS

| **Botanical Name** | **Family** |
|---|---|
| *Acacia catechu* (L.) Willd. | Leguninosae |
| *Allium ascalonicum* Linn. | Liliaceae |
| *Allium cepa* Linn. | -do- |
| *A. hookeri* Taw. | -do- |
| *A. odorum* Linn. | -do- |
| *A. fistulosum* Linn. | -do- |
| *A. porrum* Linn. | -do- |
| *A. sativum* Linn. | -do- |
| *A. tuberosum* Roxb. | -do- |
| *Alpinia nigra* (Gaertn.) Burtt. | Zingiberaceae |
| *Alpinia* sps. | -do- |
| *A. galanga* (L.) Willd. | -do- |

*Alternanthera sessilis* DC. Amaranthaceae

*Anisochiluscarnosus* Wall. Lamiaceae

*Anisomeles indica* (L.) O.Kuntze. –do-

*Apium graveoleps* Linn. Apiaceae

*Areca catechu* Linn Aracaceae

*Artabotrys spinosus* Kurt. Annonaceae

*Brassica capestris* Linn. Brassicaceae

*Capsella bursa-pastoris* (L.)Moench.Brassicaceae

*Capsicum annum* L. var. *Abbrevita fingarh* Solanaceae

*C. frutescens* Linn. -do-

*C. maxima* Linn. -do-

*C. minima* Roxb. -do-

*Cardamine debilis* D.Don Brassicaceae

*Chinamomum camphora* Nees. Lauraceae

*C. tamala* Nees. -do-

*C. zeylanicum* Breyn. -do-

*Citrus aurantifolia* (Christm.) Swingle Rutaceae

*C. hystrix* DC. -do-

*C. lemon* (L.) Burm. f. -do-

*C. maxima* (Burm.) Merrill. -do-

*C. sinensis* (Linn.) Osbeck. -do-

*Cocos nucifera* Linn. Arecaceae

*Coriandrum sativum* Linn. Apiaceae

*Curcuma aromatica* Salisb. Zingiberaceae

*C. amada* Roxb. -do-

*C. anguistifolia* Roxb. -do-

*C. caesia* Linn. -do-

*C. longa* Linn. -do-

*C. zedoaria* Rosc. -do-

*Curcuminum cyminum* Linn. Apiaceae

*Elsholtzia blanda* Benth. Lamiaceae

*Eryngium foetidum* Linn. Apiaceae

*Etellaria cardamomum* Maton. Zingiberaceae

*Eugenia caryophylla* Willd. Myartaceae

*Ferula asafoetida* Boiss. Apiaceae

*Foeniculum vulgre* Gaertn. -do-

*Foeniculum* sps. -do-

*Hedychium coronarium* Koeing. Snyn. *H. flavum* Roxb. Zingiberaceae

*H. spicatum* Buch. -do-

*Hibiscus cannabinus* Linn. Malvaceae

*Houttuynia cordata* Thunb. Saururaceae

*Iringonella foenum-graceum* L. Leguminosae

*Knoxia sumatrensis* DC. Lamiaceae

*Lemania australis* Akins. Rhodophyceae

*Leucas aspera* Spreng. Lamiaceae

*Litsaea citrata* Bl. Lauraceae

*Mentha arvensis* Linn. Lamiaceae

*Meriandra bengalensis* Benth.

*M. strobilifera* Benth. -do-

*Murraya koenicii* Linn. Rutaceae

*Oenanthe javanica* (Blume) DC.

*O. linearis* Wall. Ex. DC. Apiaceae

*Ocimun canum* Sims. Lamiaceae

*Ocimum* sps. -do-

*Pinus insularis* Endl.

*P. khasya* Royle. Pinaceae

*Piper nigrum* Linn. Pipreaceae

*Polygonum* sps. Polygonaceae

*Sesamum indicum* L. Syn. *S. orientale* Linn. Pedaliaceae

*Zanthoxylum acanthopodium* DC. Rutaceae

*Z. alatum* Roxb. -do-

*Z. limonella* (Dennst.) Alston. Syn. *Z. budrunga* Wall. Ex. DC. - do-

*Zingiber officinale* Rosc. Zingiberaceae

*Z. zerumbet* Smith. Syn. *Amomum zerumbet* L. Zingiberaceae

## V. MUSHROOM

**Paddy Straw Mushroom**

*Volvariella volvacea*

**Oyster Mushroom**

*Pleurotus flabellatus*
*Pleurotus cornucopiae*
*Pleurotus sapidus.*
*Pleurotus citrinopileatus.*
*Pleurotus sajor-caju.*
*Pleurotus ostreatus.*
*Pleurotus erengii.*
*Pleurotus eous.*

**Button Mushroom**

*Agaricus bisporus.*
*Agaricus bitorquis.*

## W. CULTIVATED CROPS

| Botanical Name | Family | Common English Name |
|---|---|---|
| *Avena sativa* L. | Poaceace | Oat |
| *Fagopyrum esculentum Moench* | Polygonacae | Buckwheat |
| *Oryza sativa.* L. | Poaceae | Rice, Paddy |
| *Zea mays* L. | Poaceae | Maize, Corn |
| *Sorghum vulgare* Pers. | Poaceae | Sorghum |
| *Coix lacryma-jobi* L. | Poaceae | Job's tear |
| *Echinochloa crus-galli Beauv.* | Poaceae | Barnyard millet |
| *Echinochloa frumentacea* Link | Poaceae | Barnyard or Japanese millet |
| *Panicum miliaceum* L. | Poaceae | Common, Hog, Proso, Broom corn or French millet |
| *Pasplum scrobiculatum* L. | Poaceae | Kodo millet |
| *Cajanus cajan (L.)* Millsp. | Papilionaceae | Pigeon pea |
| *Cicer arietinum* L. | Papilionaceae | Chick pea, Bengal gram |
| *Cyamopsis tetragonoloba (*L.) taub. | Papilionaceae | Cluster bean |
| *Dolichos lablab* L. | Papilionaceae | Hyacinth bean |
| *Glycine max* Merrill | Papilionaceae | Soybean |
| *Lathyrus sativus* L. | Papilionaceae | Grass pea |
| *Lens culinaris* Medic. | Papilionaceae | Lentil |
| *Mucuna utilis* Wall ex Wight | Papilionaceae | Velvet Bean |

| | | |
|---|---|---|
| *Psophocarpus tetragonolobus* DC | Papilionaceae | Goa bean |
| *Vicia faba* L. | Papilionaceae | Broad bean |
| *Vigna mungo* (L) Hepper | Papilionaceae | Black gram |
| *Vigna radiata* (L.) Wilczek | Papilionaceae | Green gram |
| *Vigna umbellate* (Thunb.) Ohwi & Ohashi | Papilionaceae | Rice bean |
| *Vigna unguiculata* (L.) Walp. | Papilionaceae | Cowpea |
| *Arachis hypogaea L.* | Papilionaceae | Groundnut or Peanut |
| *Brassica napus* L. *var glauca* (Roxb.) Schulz. | Brassicaceae | Sarson |
| *Brassica campestris* var. *toria* dutch. | Brassicaceae | Indian rape |
| *Brassica juncea* (L.) Czen. & Coss. | Brassicaceae | Indian mustard |
| *Brassica nigra* (L.) Koch | Brassicaceae | Black mustard |
| *Carthamus tinctorius* L. | Asteraceae | Safflower |
| *Cocos nucifera* L. | Asteraceae | Coconut |
| *Guizotia abyssinica* Cass. | Asteraceae | Niger |
| *Hellanthus annuus* L. | Asteraceae | Sunflower |
| *Linum usitatissimun* L. | Linaceae | Linseed |
| *Pongamia pinnata Pierre* | Papilionaceae | Pongam oil tree |
| | | |

| | | |
|---|---|---|
| *Ricinus communis* L. | Euphorbiaceae | Castor |
| *Sesamum indicum* L. | Pedaliaceae | Sesame |
| *Abelmoschus esculentus*(L.) Moench | Malvaceae | Okra |
| *Allium cepa* (L.) var. | Alliaceae | Multiplier onion |
| *Allium cepa* L. | Alliaceae | Onion |
| *Allium fistulosum* L. | Alliaceae | Welsh onion, Japanese bunching onion |
| *Allium sativum* L. | Alliaceae | Garlic |
| *Alocasia indica* (roxb.) Schott | Araceae | Taro |
| *Alocasia macrorrhiza* Schott | Araceae | Giant taro |
| *Amaranthus viridis* L. | Amaranthaceae | Amaranth green |
| *Amorphophallus campanulatus* Bl. ex Decne | Araceae | Elephant foot yam |
| *Apium graveolens* L. | Apiaceae | Celery |
| *Benincasa hispida* (Thunb.) Cong. | Cucurbitaceae | Ash gourd |
| *Beta vulgaris* L. | Chenopodiaceae | Sugarbeet |
| *Brassica caulorapa* Pasq. | Brassicaceae | Knolkhol |
| *Brassica chinensis* Juslen | Brassicaceae | Chineses cabbage |
| *Brassica rapa* L. | Brassicaceae | Turnip |

| | | |
|---|---|---|
| *Brassica napus* L. var. *napobrassica* (L.) Reichb. | Brassicaceae | Swedish tumip |
| *Brassica oleracea* L. var. *gemmifera* Zenker. | Brasicaceace | Brussels sprout |
| *Brassica oleracea* L. var. *botrytis* Prain | Brasicaceace | Cauliflower |
| *Brassica oleracea* L. convar. *capitata* (L.) var. *capitata* L. | Brasicaceace | Cabbage |
| *Canavalia gladiata* (Jacq.) DC. | Papilionaceae | Sword bean |
| *Capsicum annuum* (L.) var. *fasciculatum* (sturt.) Irish | Solanaceae | Cluster pepper |
| *Capsicum annuum* (L.) var. *longum* (DC.) Sendt. | Solanaceae | Long pepper |
| *Capsicum annuum* var. *grossum* (L.) Sendt. | Solanaceae | Bell pepper |
| *Chenopodium album* L. | Chenopodiaceae | Pig weed |
| *Citrullus lanatus* (Thunb.) Matsum. & Nakai | Cucurbitaceae | Water melon |
| *Coccinia cordifolia* Cong. | Cucurbitaceae | Ivy gourd |
| *Colocasia esculenta* (L.) Schott | Araceae | Elephant ear yam |
| *Cucumis melo* L. | Cucurbitaceae | Muskmelon |
| *Cucumis melo* L. var. momordica Duthie & Fuller | Cucurbitaceae | |
| *Cucumis sativus* L. | Cucurbitaceae | Cucumber |
| *Cucurbita ficifolia* Bouche | Cucurbitaceae | Fig leaf gourd |
| *Cucurbita maxima* Duch. | Cucurbitaceae | Winter squash |
| *Cucurbita moschata* Duch. Ex Poir. | Cucurbitaceae | Pumpkin |
| *Cucurbita pepo* L. | Cucurbitaceae | Summer squash, Vegetable marrow |
| *Cyamopsis tetragonoloba* (L.) Taub. | Papilionaceae | Culster bean |
| *Daucus carota* L. | Apiaceae | Carrot |
| *Dioscorea alata* L. | Dioscoriaceae | Greater Yam |
| *Dioscorea esculenta* Burkill | Diosciruaceae | Lesser yam |

| | | |
|---|---|---|
| *Helianthus tuberosus* L. | Asteraceae | Jerusalem Artichoke |
| *Ipomoea aquatica* Forsk. | Convolvulaceae | Water convolvulus |
| *Ipomoea batatas* (L.) Lam. | Convolvulaceae | Sweet potato |
| *Lablab purpureus* (L.) Sweet | Papilionaceae | Dolichos bean |
| *Lactuca sativa* L. | Asteraceae | Lettuce |
| *Lagenaria siceraria*(Mol.) Standl. | Cucurbitaceae | Bottle gourd |
| *Luffa acutangula* (L.) Roxb. | Cucurbitaceae | Ridge gourd |
| *Luffa cylindrica* (L.) M.J. Reem. | Cucurbitaceae | Sponge gourd |
| *Lycopersicon esculentum* Mill. | Solanaceae | Tomato |

| | | |
|---|---|---|
| *Manihot esculenta* Crantz | Euphorbiaceae | Tapioca |
| *Momordica charantia* L. | Cucurbitaceae | Bitter grourd |
| *Momordica dioica* Roxb. ex Willd. | Cucurbitaceae | Kakora |
| *Moringa oleifera* Lam. | Moringaceae | Drumstick |
| *Mucuna utilis* Wall ex Wight | Papilionaceae | Velvet bean |
| *Nasturtium officinale* R. Br. | Brassicaceae | Water cress |
| *Nelumbo nucifera* Gaertn. | Nymphaeaceae | Lotus |
| *Pachyrrhizus erosus* (L.) Urban | Papilionaceae | Yam bean |
| *Parkia roxburghii G. Don* | Mimosaceae | Tree bean |
| *Phaseolus lunatus* L. | Papilionaceae | Lima bean |
| *Phaseolus vulgaris* L. | Papilionaceae | French bean |
| *Pisum sativum* L. | Papilionaceae | Peas |
| *Portulaca oleracea* L. | Portulacaceae | Purslane |
| *Raphanus sativus* L. | Brassicaceae | Radish |
| *Raphanus caudatus* L. | Brassicaceae | Rat-tail radishs |
| *Rumex vesicarius* L. | Polygonaceae | Bladder dock |
| *Sechium edule* Sw. | Cucurbitaceae | Chayote |
| *Solanum melongena* L. | Solanaceae | Brinjal (Egg plant) |
| *Solanum tuberosum* L. | Solanaceae | Potato |
| *Spinacia oleracea* L. | Chenopodiaceae | Spinach |
| *Trichosanthes anguina* L. | Cucurbitaceae | Snake gourd |
| *Trichosanthes dioica* Roxb. | Cucurbitaceae | Pointed gourd |
| *Trigonella foenumgraecum* L. | Papilionaceae | Fenugreek |
| *Vigna unguiculata* (L.) Walp | Papilionaceae | Cowpea |
| *Zea mays* var. *rugosa* | Poaceae | Sweet corn |
| *Aegle marmelos* Correa ex Roxb. | Rutaceae | Bengal Quince |
| *Anacardium occidentale* L. | Anacardiaceae | Cashewnut |
| *Ananas comosus* (L.) Merrill | Bromeliaceae | Pineapple |
| *Annona atemoya* Hort. | Annonaceae | Lakshman phal |
| *Annona squamosa* L. | Annonaceae | Custard apple |
| *Areca catechu* L. | Arecceae | Arecanut |
| *Artocarpus altilis* (Park.) forsberg | Moraceae | Bread fruit |
| *Artocarpus heterophyllus* Lam | Moraceae | Jack fruit |
| *Artocarpus lakoocha* Roxb. | Moraceae | MonkeyJack fruit |
| *Averrhoa carambola* L. | Averrhaceae | Star fruit, Carambola |
| *Averrhoa bilimbi* L. | Averrhaceae | Tree sorrel |
| *Carica papaya* L. | Caricaceae | Papaya |
| *Carissa grandiflora A.DC.* | Apocynaceae | Netal plum |
| *Castanea sativa Mill.* | Fagaceae | Chestnut |
| *Citrus aurantifolia* (Christm.) Swingle | Rutaceae | Key lime |
| *Citrus grandis*(L.)Osbeck | Rutaceae | Pummelo |

| | | |
|---|---|---|
| *Citrus limettioides Tanaka (Normal)* | Rutaceae | Indian sweet lime |
| *Citrus limon* (L.) Burm.f. | Rutaceae | Lemon |
| *Citrus limonia* Osbeck | Rutaceae | CantoLemon |
| *Citrus medica* L. | Rutaceae | Citron |
| *Citrus paradisi* Macf. | Rutaceae | Grape fruit |
| *Citrus reticulata* Blanco | Rutaceae | Mandarin |
| *Citrus sinensis*(L.) Osbeck | Rutaceae | Sweet orange |
| *Citrus deliciosa* Tenore | Rutaceae | Kinnow mandarin |
| *Embilica officinalis* Gaertn. | Euphorbiaceae | Emblic myroblan |
| *Eriobotrya japonica* Lindl. | Rosaceae | Japan plum |
| *Euryale ferox* Salisb. | Nymphaeaceae | Fox nut |
| *Feronia limonia* (L.) Swingle | Rutaceae | Wood apple |
| *Ficus carica* L. | Moraceae | Fig. |
| *Flacourtia indica* (Burm.f) Merr. | Flacourtiaceae | Governor's plum |
| *Litchi chinensis* (Gaertn.) Sonn. | Sapindaceae | Litchi |
| *Madhuca indica* J.F. Gmel | Sapotaceae | Butter Tree |
| *Mangifera indica* L. | Anacardiaceae | Mango |
| *Manilkara hexandra* (Roxb.) Dubard | Sapotaceae | Khirni |
| *Morus alba* L. | Moraceae | White mulberry |
| *Morus nigra* L. | Moraceae | Black mulberry |
| *Musa paradisiaca* L. | Musaceae | Banana |
| *Musa sapientum* L. | Musaceae | Plantain |
| *Nephelium lappaceum* L. | Sapindaceae | Rambutan |
| *Passiflora edulis* Sims | Passifloraceae | Passion fruit |
| *Phoenix dactylifera* L. | Arecaceae | Date |
| *Phoenix sylvestris* Roxb. | Arecaceae | Date sugar plam |
| *Phyllanthus acidus* Skeels | Euphorbiaceae | Star goosberry |
| *Prunus armeniaca* L. | Rosaceae | Black apricot |
| *Prunus domestica* L. | Rosaceae | European plum |
| *Prunus persica* Batsch | Rosaceae | Peach |
| *Psidium guajava* L. | Myrtaceae | Guava |
| *Punica granatum* L. | Punicaceae | Pomegranate |
| *Rubus fruticosus* L. va. *discolor* | Rosaceae | Blackberry |
| *Spondias cytherea* Sonn. | Anacardiaceae | Hog plum |
| *Spondias pinnata* (L.f.) Kurz | Anacardiaceae | Indian Hogplum |
| *Syzygium cuminii (L.) Skeels* | Myrtaceae | Java plum |
| *Tamarindus indica* L. | Caesalpiniaceae | Tamarind |
| *Trapa natans*(L.) var. *bispinosa* (Roxb.) Makino | Trapaceae | Water Chestnut |
| *Vitis ninifera* L. | Vitaceae | Grapes |
| *Ziziphus jujuba* Mill. | Rhamnaceae | Chinese date |

| | | |
|---|---|---|
| *Gossypium herbaceum* L. | Malvaceae | Broach cotton |
| *Gossypium hirsutum* L. | Malvaceae | Upland cotton |
| *Hibiscus cannabinus* L. | Malvaceae | Deccan or Madras hemp |
| *Hibiscus sabdariffa* L. | Malvaceae | Jamaica sorrel or Rozelle |
| *Acacia nilotica*(L.) Delile subsp. *Indica* (Benth. ) Brenan | Mimosaceae | Indian acacia |
| *Calopogonium mucunoides* Desv. | Papilionaceae | Calopo grass |
| *Cenchrus ciliaris* L. | Poaceae | Bunch grass |
| *Cynodon dactylon* Pers. | Poaceae | Bermuda grass |
| *Dichanthium annulatum* Stapf | Poaceae | Marvel grass |
| *Medicago sativa* L. | Papilionaceae | Lucerne or Alfalfa |
| *Melilotus alba* Desr. | Papilionaceae | White sweet clover |
| *Brachiaria mutica* (Forssk.) Stapf | Poaceae | Para grass |
| *Pennisetum purpureum* Schum. | Poaceae | Napier or Elephant grass |
| *Phalaris minor* Retz. | Poaceae | Phalaris |
| *Sorghum halepense* (L.) Pers. | Poaceae | Johnson grass |
| *Vicia sativa* L. | Papilionaceae | Common vetch, Tare |
| *Curcuma angustifolia* Roxb. | Zingiberaceae | Indian Arrowroot |
| *Sapindus laurifolius* Vahl. | Sapindaceae | Sopnut tree |
| *Carum carvi* L. | Apiaceae | Caraway |
| *Cinnamomum camphora* (L.) Nees & Eberm. | Lauracae | Camphor tree |
| *Cymbopogon citratcs* Stapf | Poaceae | Lemon grass |
| *Cymbopogon nardus*(L.) Rendle | Poaceae | Citronella grass |
| *Humulus lupulus* L. | Cannabinaceae | Hops |
| *Mentha arvensis*L. | Lamiaceae | Japanese mint |
| *Ocimum basilicum* L. | Lamiaceae | Mint or basil |
| *Ocimum canum* Sims | Lamiaceae | Camphor basil |
| *Ocimum gratissimum* L. | Lamiaceae | Camphor basil |
| *Ocimum sanctum* L. | Lamiaceae | Sacred basil |
| *Pandanus odoratissimus* L.f. | Pandanaceae | Fragrant screwpine |
| *Santalum aleum* L. | Santalaceae | Sandal Tree |
| *Saussurea lappa* C.B. Clarke | Asteraceae | Costus |
| *Shorea robusta* Gaertn. F. | Dipterocarpaceae | Sal Tree |

# ANNEXURE III
# IMPORTANT ANIMAL SPECIES OF NORTH-EAST INDIA

## A. FISH

*Acanthocobitis aonalternans* (Blyth)
*Acanthocobitis botia* (Hamilton).
*Akysis* sp.
*Amblypharyngodon mola* (Hamilton- Buchanan)
*Amylyceps mangois* (Hamilton-Buchanan)
*Aorichthys aor* (Hamilton-Buchanan)
*Aplocheilus panchax* (Hamilton-Buchanan)
*Aspidoparia morar* (Hamilton-Buchanan)
*Aspidoparia ukhrulsensis* Vishwanath & Selim
*Bagarius bagarius* (Hamilton (Buchanan)
*Bagarius yarrelli* Sykes.
*Balitora brucei* Gray
*Bangana dero* (Hamilaton-Buchanan)
*Barilius barna* (Hamilton-Buchanan)
*Barilius bendelisis* (Hamilton -Buchanan)
*Barilius chatriensis* Vishwanath & Salim
*Barilius Ngawa* Vishwanath & Salim
*Barilius tileo* (Hamilton-Buchanan)
*Batasio Tengana* (Hamilton- Buchanan)
*Batasio tengana* (Hamiltong-Buchanan)
*Bodis bodis* (Hamilton-Buchanan)
C.C. *nudus Blach* (Leather Carp)
C.C. *specularis Lacepede* (Mirro carp)
*Chaca chaca* (Hamilton- Buchanan)
*Chagunius chagunio Hamilton*- Buchanan
*Chagunius micholsi* (Myers).
*Chana striatus* (Bloch)
*Chanda nama Hamilton* - Buchanan.
*Channa punctatus* (Bloch)
*Channa Stewarttii* (playtair )
*Chela laubuca* (Hamilton)
*Cirrihinus mrigala* (Mahilton-Buchanan)
*Colisa fasciatus* (Schneider )
*Colisa sota* (Hmilton-Buchanan).
*Crossocheilus latius* Hamiltong-Buchanan
*Ctenopharyngodon idellud* (Valenciennes)
*Cyprinus capio Linnaeus*
*Danio aequipinnatus* (Mc Clelland)
*Danio devario* (Hamilton-Buchanan)
*Danio yuensis* (Arunkumar & Tombi

*Erethistes pussilus* Muller & Troschel
*Esomus danricus* (Hamilton-Buchanan)
*Eutropichthys vacha* (Hamilton- Buchanan)
*Exostoma stuarti* (Hora)
*Exostoma vinciguerrae* Rega
*Gadusia chapra* (Hamilton - Buchanan)
*Gagata cenia* (Hamilton-Buchanan )
*Garra compressus* kosygin and Vishwanath
*Garra elongata* Vishwanath & Kosygin
*Garra gravelyi* (Annandale)
*Garra nasuta* (Mc Clelland)
*Glossogbius giuris* (Hamilton-Buchanan).
*Glyptothorax cavia* (hamilton-Buchanam)
*Glyptothorax manipurensis* Menon
*Glyptothorax platypogonoides* (Bleeker)
*Glyptothorax sinense* (Regan)
*Glyptothorax triliineatus* Blyth
*Hara har* (Hamilton-Buchana)
*Heteropneustes fossilis* (Bloch)
*Homaloptera modesta* (Vinciguerra)
*Homaloptera rupicula* (prasa and Mukherji)
*Hypopthalmichthys molitrix* (Valenciennes)
*Johnius coitor* (Hamilton-Buchanan)
*Labei gonius* (Hamilton-Buchana)
*Labeio pangusia* (Hamilton- Buchanan)
*Labeo bata* (Hamilton- Buchanan)
*Labeo calbasu* (Hamilton - Buchanan)
*Labeo fimbriatus* (Blotch)
*Labeo rohita* (Hamilton-Buchanan)
*Macropgnathus aral* (Bloch & Schneider )
*Mastacembelus alboguttatus* Boulenger
*Mastacembelus armatus* (Lacepede)
*Mastecembelus armatus* (Lacepede)
*Monopterius cuchia* (Hamilton-Buchana)
*Monopterus albus* (Zuiew).
*Muyersglanis jayarami* Vishwanath &Kosygin
*Mystus cavasius* (Hamilton-buchanan)
*Mystus pulcher* (Chaudhuri)
*Nandus nandus* (Hamiton-Buchanan).
*Nangra viridiscens* (Hamilton- Buchanan)
*Neolissochilus stracheyi* (Day).
*Neonoemacheilus assamensis* (Menon)
*Neonoemacheilus peguensis* (Hora)
*Notopterus notopterus* (pallas)
*Orreochromis mossambica* (peters).
*Osteobrama cotio* (Hamilton)

*Parmbassis ranga* (Hamilton-Buchanan)
*Poropuntius burtoni* (Mukerji)
*Poropuntius clavatus* (Mc Clelland)
*Pseudecheneis sulcatus* (Mc Clelland)
*Punatius sophore* (Hamilton-Buchanan)
*Puntius favanicus* (Bleeker ).
*Puntius manipurensis* Menon, Rema & Vishwanath
*Puntius stoliczkanus* (Day)
*Puntius ticto ticto* (Hamilton-Buchanan)
*Rasbora rasbora* (Hamilton-Bachanan)
*Salmostoma sladoni* (Day)
*Schistura chindwiniucus* (Bleeker )
*Semiplotus manipurensisi* Vishwanath and Kosygin
*Silurus morehensis* Arunkumar & Tombi
*Sisor rhabdohorus* Hamilton-Buchanan.
*Somileptus gongota* (Hamilton-buchanan)
*Tetraodon Cutcutia* (Hamilton- Buchanan).
*Wallago attu* (Bloch & Schneider)
*Xenentodon cancilla* (Hamilton-Buchanan)

**Threatened**

*Acantophthalmus longipinnis* (Menon)
*Acantophthalmus pangia* (Hamilton-Buchaman).
*Anabas testudineus* (Bloch).
*Anguilla bengalensis* Gray
*Bagarius bagarius* (Hamilton-Buchanan)
*Barilius barila* (Hamilton-Buchanan)
*Barilius dogarshinghi* Hora
*Botia berdmorei* (Blyth)
*Botia dario* (Hamilton-Buchanan)
*Botia histrionica* Blyth L.N.-Sareng Khoibi
*Brachydanio acuticephala* (Hora)
*Catla catla* (Hamilton- Buchanan)
*Channa orientalis* Bloch &Schneider
*Chitala chitala* (Hamilton-Buchanan)
*Cirrhinus reba* (Hamilton-Buchanan).
*Clarias batrachus* (Linngeus ).
*Crossocheilus burmanicus* Hora
*Danio naganensis* Chaudhuri
*Garra gotyla* Gray
*Garra Lissorhynchus* (Mc Clelland)
*Garra litanensis* Vishwanath)
*Garra manipurensis* Vishwanath & Sarojnalini.
*Garra naganensis* Hora
*Garra rupecula* (Mc clelland)

*Gorra Kempi* Hora
*Heteropneustes fossili* (Bloch)
*Hilsa ilisha* (Hamilton-Buchanan)
*Labeo dero* (Hamilton-Buchanan)
*Lepidocephalus berdmorei* (Blyth)
*Lepidocephalus irrorata* (Hora)
*Mystus bleekeri* (Day)
*Mystus microphthalmus* (Day)
*Ompok bimaculatus* (Bloch)
*Osteobrama cunma* (Day).
*Ostobrama belangeri* (Valenciennes)
*Psilorhynchoides homaloptera* Hora & Mukerji
*Psilorhynchus balitora* Hamilton-Buchanan
*Psilorhynchus microphtoalmus* Vishwanath & Manojkumar
*Puntius chola* (Hamilton - buchanan)
*Puntius jayarami* Vishwanath & Tombi
*Puntius sarana* (Hamilton- Buchanan)
*Raiamas guttatus* (Day)
*Raianmas bola* (Hamilton-Buchanan)
*Schistura kangjupkhulensis* (Hora)
*Schistura manipurensis* (Chaudhuri)
*Schistura nagaensis* (Menon)
*Schistura parashadi* (Hora)
*Schistura scaturigina* (Mc. Clelland)
*Schistura Sikmaiensis* (Hora)
*Schistura vinciguerrae* (Hora)
*Schizothorax richardsonii* (Gray)
*Tor putitora* (Hamilton- Buchanan)
*Tor tor* (Hamilton-Buchanan).
*Valenciennes,* P.S. Sarana (Hamilton-Buchanan)

**B. MOLLUSCS**

*Paludomus*
*Brtia costula*
*Lymnaea acuminate*
*Lymnaea andersoniana*
*Lymnaea stagnalis*
*Ferrissia ceylanica*
*Ferrissia viola*
*Camptoceras lineatum*
*Segmentina*
*Sphaerium*
*Pisidium*
*Unio manginalis*

*Bellamya bengalensis*
*Bellamya crassispiralis*
*Bellamya micron*
*Cipangopaludina lecythias*
*Angulyagra osytropis*
*Pila globosa*
*Tricula horae*
*Digoniostoma textum*
*Hippeutis*
*Parreysia*
*Trapezoideus exolescens exolescens*

**C. AMPHIBIANS**

*Ichthyophis sp.*
*Tylototriton varrucosus Anderson*
*Bufo melanostictus* Schneider
*Rana tigrina.*
*Rana timnocg aris Boic.*
*Rana breviceps schneider.*
*Kaloula pulchra* Gray.Microhyla ornat "Dumeril & Bibron"
*Micrixalus borealis* Annandale.
*Kaloula pulchra* Gray
*Microhyla ornata* "Dumeril & Biboron"
*Polypadates leucomystax* Gravenhorst
*Rhacophorous reinwardhii* Schiegel.
*Hyla annectens* Jerdon.

**Threatened**
*Hyla annectens*
*Ichthyophis* sp.
*Tylototriton varrucosus*
*Polypadates leucomystax*
*Rhacophorous reinwardhii*

**Endemic**
*Hyla annectens*
*Ichthyophis* sp.
*Tylototriton varrucosus*

**D. SNAKE**
*Ahaetula prasina* Boie
*Ahaetulla subocularis* Boulenger
*Amphiesma stolata Linn*
*Blythia raticulata* Blyth.
*Boiga multimaculata* Boie.

*Boiga ochracea* Gunther.
*Boiga tigonata* Schneider
*Bungarus caeruleius* Schneider.
*Bungarus fasciatus* Schneider.
*Claphe radiata* Schlegel.
*Cylindrophis rufus burmanus* Smith
*Elaphae taeniura*
*Elaphes radiata*
*Liopeltis frenatus* Gunther.
*Lycodon jara* Shaw.
*Naja naja*
*Naja najakaouathia* Linn.
*Oligodon arnensis* Shaw
*Oligodon dorsalis* Gray
*Opheodrys albocinctus* Cantor
*Opheodrys doriae* Boulenger
*Ophiophagus hannah* Candor.
*Pryas muscosus* Linn
*Psammodynastes pulverunlentus* Boie
*Ptyas korrs* Schlegel.
Python *molurus molurus* Linn.
*Python molusus*
*Rhabdophis himalayanus* Gunther.
*Rhabdophis subminiata* Schlegel
*Sibynophis collaris Gray.*
*Trimeresurus albolabris* Gray.
*Trimeresurus monticola* Gunther.
*Trimersurus gramineus* Shaw
Typhlops *diardi diardi* Schlegel
*Vipera russeli Shaw*
*Xenochorphis piscator* Schneider
*Xenochrophis punctulatus* Gunther.
*Zaocys nigromarginatus* Blyth

**Threatened**

*Oligodon albocunctus*
*Opheodrys doriae*
*Opheodrys albocinctus*
*Oligodon arnensis*
*Oligodon dorsalis*

**Endemic**

*Sibynophis collaris*
*Zaocys nigromarginatus*

*Amphiesma stolata*

**E. LIZARD**

*Gekho gecho* Linnaeus
*Hemidactylus bowringi* Gray
*Hemidactylus garnoti* Dumeril & Bibron
*Cosymbotus platyurus* Schneider
*Calates versicolor* Doudin
*Calotes mystaceus* Dumeril & Bibron
*Calotes jerdoni* Gray
*Calotes microplepis* Boulenger
*Draco norvilli* Aeock.
*Mabuya carinata* Schneider
*Mabuya multifaciata* Kuhi
*Mabuya macularius* Blyth
*Mabuya quadricarinata* Boulenger
*Dasia olivacea* Gray
*Lygosoma maculatum* Blyth.
*Ophisaurus gracilis* Gray
*Varanus bengalensis* Doudin
*Varanus salvator* Laurenti

**Threatened**
*Calotes jerdoni*
*Draco norvilli*
*Ophisaurus gracilis*
*Varanus bengalensis*
*Varanus salvator*

**Endemic**
*Calotes jerdoni*
*Draco norvilli*
*Ophisaurus gracilis*

## F. Bird

*Accipiter trivirgatus*
*Actitis hyoleucos*
*Alcedo atthis.*
*Alcippe nipalensis*
*Amaurornis phoenicura.*
*Anas crecca*
*Anas feleata*
*Anas Poccilorhyncha*
*Anastomus oscitans*

*Anser anser*
*Anthracoceros alburostris*
*Anthracoceros malabaricus.*
*Arachnothera longirastra*
*Arborophila torgueola*
*Arcidotheres tristis.*
*Ardea bacchus*
*Ardeola grayii*
*Argya caudate.*
*Athene blweithi.*
*Aviceda jernoni*
*Bambusicola fytchii.*
*Brachypternus bengalensis.*
*Bubulcus ibis*
*Buceros bicronis.*
*Cairina scutulata.*
*Calandrella raytal*
*Caterus wallichii.*
*Centropus bengalensis*
*Ceryle ructis*
*Chlamydotis undulata.*
*Chloropsis sonnerati*
*Choriotis nigriceps.*
*Ciconia* sp.
*Cinnyris asiaticus.*
*Collocalia brevirostris*
*Columba livia.*
*Copsychus saularis*
*Coracias bengalensis*
*Coracina melanoptera*
*Corvus macrorhynchus*
*Cuculus varius*
*Cursorius bitroquatus.*
*Cyornis banyumas*
*Cyornus rubeculoides*
*Dendrocitta formosae*
*Dendrocitta vagabunda.*
*Dendrocygna javanica*
*Dendronanthus indicus*
*Dicrurus aeneus*
*Dicrurus macrocercus*
*Dissemurus paradiseus.*
*Egretta garzetta.*
*Enicurus maculatus*
*Erithacus prunneus*
*Eudynamys* sp.

Eupodotis bengalensis.
*Falco* sp.
*Felco peregrimus.*
*Gallicrex cinerea*
*Gallinago gallinaga*
*Gallinago stenura*
*Gallus gallus*
*Garrulax leucolophus*
*Garrulax monileger*
*Grus lencogeranus.*
*Grus monacha*
Grus nigricollis.
*Gypaetus barbatus.*
*Halcyon coromanda*
*Harpactes erythrocephalus*
*Heterophasia picaoides*
*Hirundo rustica.*
*Icthyophaga nana*
*Irena puella*
*Klittacinela malabarica.*
*Leiothrix argentauris*
*Lophothorus impayanus.*
*Losterops palpebrosa.*
*Macropygia unchall*
*Manticola solitarius*
*Megalaima asiatica*
*Megapodius freycinet.*
*Mergus mergauses*
*Merops visidis*
*Metopidius indicus*
*Micropus affinis.*
*Microscelis psaroides.*
*Milvus migrans*
*Minla ignotincta*
*Motacilla alba*
*Motacilla cinerea.*
*Mydrophasianus chirurgus*
*Myophonus caeruleus*
Netta *rufina*
*Nettapus coromandelianus*
*Niltava grandis*
*Ophrysia superciliosa.*
*Orthotomus sutorius*
*Otus spilocephalus*
*Pandion haliatetus.*
*Pasrisoruus dalhousiae*

*Passer domensticus*
*Pavo cristatus.*
*Phalacrocorax* sp.
*Phodonessa caryophyllacea*
*Phoenicusus auroreus*
*Picus flavinucha*
*Pitta nepalensis*
*Ploceus philippinus.*
*Polyplectron bicalcaratum*
*Porphyrio poliocephalus*
*Ptilolaemus tickelli austeni.*
*Pycnonotus abiceps*
*Pycnonotus cafer*
*Rallina fasciata*
*Rhipidura* sp.
*Rhyacornis tuliginosus*
*Rhyticeras undulatus*
*Riparia paludicola*
*Sarcoyps calvus.*
*Saria abnormis*
*Sarkidiornis melanotus*
*Saxicola torquata*
*Spilornis cheela*
*Streptopelia chinensis*
*Sypheotides indido.*
*Syramaticus humiae.*
*Tadonrna ferruignea*
*Tadorna tadorna*
*Tephrodornis pondicerianus*
*Tetropgellus tibetanus.*
*Thamnolaea leucocephala*
*Threskiornis althiopica melanocephala*
*Treron apicauda*
*Trigna tetanus*
*Tyto alba.*
*Upupa epops*
*Urocissa erythrorhyncha*
*Vanellus indicus*
*Venelhis vanellus*
*Venellus spinosus*
*Yuhenia castaniceps*

**Endemic**

*Tragopan blithii.*

## G. WILD MAMMALS

*Aonyx cinerea* Clawless otter
*Arctonyx caltaris* F. Cuvier, Hog Badger
*Axis porcinus* Zimmemann, Hog Deert
*Bos gaurus* H. Smith, Indian Bison or Gaur
*Bubalus bubalis Linnaeus,* wild buffalo
*Capricornis umatraensis* Bechsterin Serow.
*Caprolagus hispidus* Pearson, Hispid Hare.
*Cervus duvanceli* G. Curir, Swamp Deer.
*Cervus eldi eldi* Brow antlered deer
*Cervus unicolor* Kerr Sambar
*Elephas indicus Indian* Elephant
*Felis bengalensis* Kerr, Leopard Cat
*Felis chaus* Jungle cat
*Felis marmorata* Gray, Marbled cat
*Felis temmincki* Vigors and Horsfield, Golden Cat
*Felis viverrina* Bennet, Fishing Cat.
*Funambulus sp.* Squirrel
*Helarctos malayanus* Malayan Sun Bear.
*Helarctos malyanus* Raffles, Malayan Sun Bear.
*Hylobates hoolock* Barlan Hoolock Gibbon.
*Juntiacus muntjak* Barking Deer
*Manish fentadactyla* Hodgson, Chinese Pangolin
*Martes flavigula* Boddaert, Yellow Throated Martes.
*Melursus ursinus* Sloth bear
*Nemorhaedus goral* Hardwicke Goral L.N.
*Neofelis nebulosa* Griffith, Clouded leopard
*Nycticebus coucang* Boddaert Slow Loris
*Panthera pardus* Linnaeus, leopard.
*Paradoxurus hermaphroditus* Toddy cat
*Petaurista petaurista* Pallas, Red Flying Squirrel.
*Presbytis phayrei* Blyth, Phayre's leaf Monkey
*Presbytisegei* Khajuria, Golden langur.
*Prionodon pardicolor* Hodgson, Spotted Linsang.
*Prisbytis pileatus,* Blyth, Capped Langur
*Rhinoceros unicornis* Linnaeus, Great one homed rhinocerous.
*Selenarctos tibeltanus* – Himalyan Black Bear.
*Sus corfa* Linnaeus, Wild boar
*Sus savanius* Hodgson, pygmy Hog
*Viverricula India* Dermarest, Small Indian Civet
*Viverra zibetha* Large Indian Civet

**Threatened**

All the species listed

## H. SILK WORM SPECIES

Chinese Tasar silkworm - *Antheraea pernyi.*
Eri Silk worm- *Samin Cynthia* ricinc Boiduval (earlier *Philosamia ricini)*
Indian Temperate Tasar Silkworm (Oak Tasar silkworm ) - *Antheraea proylei.*
Indian tropical Tasar silkworm - *Antheraea mylitta.*
Japanese Tasar silkworm - *Antheraea yamamai*
Muga silkworm - *Antheraea assama.*
Mulberry silkworm - *Bombyx mori.*
Wild eri silkworm - *Philosamia cynthia.*