DYNAMICS OF BIODIVERSITY AND ITS' IMPACT ON ENVIRONMENT IN MOKOKCHUNG DISTRICT, NAGALAND

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CERTIFICATE

This is to certify that the thesis submitted by Ms. Tiakumla towards the degree of Doctor of Philosophy (Ph.D.) in the Department of Geography title **"Dynamics of Biodiversity and its' impact on Environment in Mokokchung district, Nagaland",** embodies the result of her own work. To the best of my knowledge the data and facts recorded in the study are based on her own research work.

I, therefore, recommended that this thesis may place before the examiners for evaluation for the award of the Ph.D of this University.

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Declaration

I, Ms. Tiakumla, do hereby declare that this thesis entitled **"Dynamics of Biodiversity and its' impact on Environment in Mokokchung district, Nagaland",** submitted for the award of the Degree of Doctor of Philosophy in Geography comprises the results of my own research work carried out in the Department of Geography, Nagaland University. The contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else and that the thesis has not been submitted by me for any research degree in any other university.

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CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION

In the recent years the concept of Biodiversity occupies the centre stage of the global conservation scenario. This development has been largely attributed to the change in the notion of conservation, perception of man from hunting to game preservation.

Biodiversity and its resources have provided all the essential needs and wants of mankind. In other words, Biological Diversity forms support systems not only for our survival but also for sustainable growth and development. 'Biodiversity has ethical, social and economic values distinct from Bio-resources. The social, ethical, cultural and economic values of Biodiversity have long been recognized in religion, art and literature.'[1]

Human society depends on Biological Diversity for almost all the food supply, half of its medicines, much of its fuel, building materials and for mental and spiritual welfare. Of all the gifts of nature, none is more indispensable to man than Biodiversity. It is recognized as one of the most valuable, life supporting natural resources on whose proper use depend the life supporting systems and the social and economic development on a regional and global scale. Biodiversity in wild and domesticated forms serves the basic assets for our survival. It is without doubt, the very basis of human being.

Biological Diversity is also essential from both environmental and ecological point of view. The production of oxygen, reduction of carbon dioxide, maintaining the water cycle, and protecting soil are some important services. It also helps in the ecological

1. H. J. Chowdhery, S.K. Murti: Plant Diversity and Conservation in India - An overview; 2000, page 7

processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support system, maintaining the water balance within ecosystems, watershed protection, erosion control and local flood reduction.

It is now being acknowledged globally that the loss of Biodiversity has a direct link to the most debated global climatic change. Consequences of greenhouse effect are the occurrences of more hurricanes and cyclones and early snow melts in mountains causing more floods during monsoon. It is obvious that the preservation of Biological resources is essential for the well-being and the long-term survival of mankind. 'Science has attempted to classify and categorized the variability in nature for over a century. This has led to an understanding of its organization into communities of plants and animals. This information has helped in utilizing the earth's biological wealth for the benefits of humanity and has been integral to the process of development.'[2]

The concept of Biodiversity, its importance and Conservation in the academic parlance cannot be disputed. The need for sustainable development is a key to the future of mankind. The degradation of biological resources is also linked to continuing problems of pollution, increasing levels of global warming, the depletion of ozone layer which are caused due to direct or indirect loss of forests have also made everyone aware of the growing environmental concerns. Therefore Conservation and management of Biodiversity and its resources have become an urgent need.

2. Erach Bharucha:Textbooks of Environmental Studies (For Undergraduate courses); 2005, Page79.

Despite the deteriorating status of the Biodiversity, its importance, conservation and management approach is yet to receive adequate attention in academic domain. Keeping into consideration of all these facts it has become imperative for geographers to focus its attention on the study of ecosystems. The increasing interest of geographers on Biodiversity is also due to the result of concerns regarding species extinction, depletion of genetic diversity due to natural calamities, faulty development models and anthropogenic factors.

The rapid depletion of organic material and the increasing modification of the biosphere by man have led to a serious complexity of the existing ecological problem. Hence, it is vital for geographers to promote public awareness and education about its importance, the measures required for the management and conservation aspects and the inclusion of these topics in educational programmes with respect to sustainable use of Biodiversity.

Such studies would undoubtedly motivate the researchers and geographers interest in unfolding the intricacies of various ecosystems. Besides, it would also impart a better understanding of ecological functions and processes and of the nature of ecological interrelationships.

In order to understand the nuances of the concept further, there is a need to look at various definition of Biodiversity given by different authors from different perspectives. 'Biodiversity' may be defined as the sum total of species richness including plants, animals and micro-organisms occurring in a given habitat. It refers to the extent of genetic, taxonomic and ecological diversity over all spatial and temporal scales.'(Harper and Hawksworth, 1995). Mayhew (2004) defined 'Biodiversity as the varied range of

flora and fauna.' MC. Kinney (1998) defined 'Biodiversity dynamics refers to the turnover of biological units across all temporal and spatial scales'.

In the Convention of Biological Diversity (1992), 'Biodiversity has been defined as the variability among living organisms from all sources including inter alias, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.' Thus, Biodiversity in short 'is the totality of genes, species and ecosystems in a given region'.

In fact, Biodiversity is composed of four essential elements namely genetic diversity, species diversity, ecosystem diversity and human cultural diversity. In addition to the above elements, Biodiversity is also closely controlled by the physical factors like terrain, topographical, slope altitude, climate, sunshine, soils etc that are quite vital determinants of Biological diversity. It is therefore imperative that maintaining all these types of diversity is fundamental to the functioning of ecosystems which has an effect on human welfare. These elements are interwoven and integrated which serves an ecosystem as a very efficient instrument which ensures optimum utilization of both organic and inorganic resources. In spite of the numerous merits and advantages attached with Biological Diversity and its resources, Biodiversity is declining resulting to ecological catastrophes faced globally.

Biological extinction resulting from natural processes and causes cannot be neglected but destruction caused due to human intervention and its activities have taken a high toll. 'The earth is subjected to many human-induced and pressures, which include pressures

from increased demand for resources; selective exploitation, destruction / exploitation of species, land use and land-cover change…' [3]

Destruction of habitat, hunting, poaching, and over-exploitation, collection for zoo and research, introduction of exotic species, control of pets and predators, pollution, deforestation and other social economic activities has speeded up extinction. This loss of Biodiversity has immediate and long term effects on human survival as the majority of the world's population are still dependent on it for their daily sustenance.

Under developmental works and over exploitation of resources have made its living resources most vulnerable. Not only that, over exploitation has resulted in shortage of various materials and also left Biodiversity exposed to various ecological threats.

Timber trade has cause the most maximum damage to the rainforest. Logging has a direct impact on Biodiversity and indirect damage is caused by timber companies opening up large scale areas of forest to invasion by settlers and shifting cultivators. Such activities have also leads to large scale destruction of forests and aquatic ecosystems which have a significant implication on human health as well as the entire global ecosystem.

This investigative study deals with special aspect which is connected with the welfare of human society. The study is more concerned with the immediate and long range necessity of man with the cultural aspects of man, his demands on Biological Diversity and its resources to satisfy his wants and aspiration.

3. Avelino Su`arez, H. Gitay, R. T. Watson, D. J. Dokken: Climatic change and Biodiversity, Intergovermental Panel on climate change, 2002, page 3.

The natural biological system is the outcome of the unique combination of several factors which makes it so different in different regions. The activities of man generally lead to changes in the basic characteristics of the biosphere.

High decennial growth rate of population, urbanization, industrialization, use of non-biodegradable substances are a few activities of man which disturb the balance that exists between living and non-living components of the environment generally causing damage to the nature.

The disturbances by man on environment are badly affected to Biodiversity and even in return to the human being for their physical, social, cultural growth and development. Most of these events are triggered by man's action on Biological Diversity. Man with his gradual dominance on ecosystem has developed several methods to combat these forces leading to produce early mortality of its off-springs, at the same time man continues to over produce. This has resulted in the demand on land for settlement, urbanization, industrialization, agriculture as well as to meet various socio-economic amenities. All these are to be taken into account that leads to the destruction of ecological balance and having an adverse effect to the natural cycle of ecosystem.

It is of paramount importance that the concept of conservation should be implemented both in theory and practice. This should be the fundamental nature, that involves the practice of allocating natural and man-made resources so as to make optimum use of the environment in satisfying basic human needs at the maximum and more as far as possible for an indefinite future and at the same time preventing deflections and deprivation of Biological diversity and its resources.

Besides, there are numerous ways in which ecological knowledge can be applied for human welfare; the major aspects are conservation of different types of ecosystem for yielding economically useful materials over a long period of time at a fairly high rate. Conservation of such is an important part of environment. Biologically rich natural areas is now being increasingly appreciated as source of human survival but on the other hand, the current rate of deforestation and land degradation in different regions of the world, many species could be lost before they are even known.

The loss of Biological Diversity has become an important process of environmental change and it is totally irreversible that we are unaware that we are losing it in our quest for higher standard of living and claiming human superiority over all the creatures on the planet. Man has begun to overuse or misuse most of these natural ecosystems. The current destruction of the remaining large areas of wilderness habitat, especially in the marvelous diverse tropical forests and coral reefs is the most important threat to Biodiversity worldwide.

With the realization of the vitality of Biodiversity for survival and progress of humankind its conservation would supply and imply as an insurance policy for a prosperous future for mankind which will lead to the ultimate conservation of essential ecological diversity as well as life nutrient pool. Genetic diversity of plants and animals would be preserved which ensures the sustainable utilization of natural resources. Through the conservation of Biodiversity, vast source of knowledge for potential use to the scientific community will be provided. Such an approach would also benefit the society by providing means of recreation and tourism.

In order to achieve long-term conservation of Biodiversity and its resources, its conservation need to be integrated and be given appropriate consideration at the wider landscape level. The scope for Biodiversity conservation can be accelerated by incorporating processes and categories of activities which have or are likely to have significant positive impacts on the conservation and sustainable development and use of Biological resources and diversity.

India is located at 8^0 4'N to 37^0 6'N Latitudes and 68^o 7'E to 97^o 30' E longitudes with a total area of 32 million hectares is rich in Biodiversity and is pertinent mutually to the wellbeing of the biosphere in common and to the nurturing of crops, animal husbandry, fisheries, forestry and pharmaceutical industry in particular.

The region has about '40,000 species of flora and 89,000 species of fauna and equally rich marine life found along the shelf zone of over 45 million hectares, and as a result India ranks amongst one of 12 mega-Biodiversity Countries of the world.'[4] 'The country has over 1,15, 000 species of plants and animals already identified and described…In flora, the country can boast of 45,000 species which accounts for 15% of the known plants of the world, approximately 15,000 species of flowering plants, 35% are endemic and located in 26 endemic centers.' [5]

North -East India located between 20^0 N to 29^0 30' N latitudes and 84^0 46' E to $97^0$30' East longitudes is very rich in Biodiversity. 'The region is recognized as one of the 8^{th} hotspots of the world and is the meeting place of at least three main streams of flora and fauna, namely the Indian mainland stream from the west, the China-Japanese stream from North and North-East and Malaya stream from South and South-East… approximately 95 plant genera is endemic to the region, about 10 dominant plant

families are represented by 2,300 species, about 7,000 flowering plants, 6,000 pteridophytes and about 650 orchid species are found. There are as many as 14 species of non- human primates, 1200 bird species of Asia, 958 are found in Assam alone.' [6]

The state of Nagaland one of the easternmost parts of north-east India is endowed by nature with enormous Biodiversity. The rich Biological Diversity of the region is undoubtedly the result of the inter-play of combinations of various factors namely; edaphic, climatic and topography. Nagaland situated on the north-east of India covers an area of 16,579 km sq and is located between 25^0 6' N to 27^0 4' N latitude and 93^0 20' E to 95^0 15' E longitude. The climatic conditions in the state ranges from the Alpine in the higher reaches of its mountains to moist, hot tropical conditions in the foot hills adjoining the plains of Assam.

The forest type varies from alpine to moist tropical types. The arrangement of the mountain ranges is such that it creates rain shadow areas where the conditions are dry and hot supporting even the species of desert region. These conditions made Nagaland to harbors rich biodiversity and hence can be termed as a state of true Mega-Biodiversity. The state houses the confluence of flora and fauna of the neighboring regions. Out of the state's total geographical area of 16,579 kms^2, very dense forest accounts to 1,274 kms^2, moderately dense forest to 4,897 kms^2 and open forest to approximately 13,464 kms^2 making to a percentage of approximately 81.21% of the forest area **(FSI Report, 2011)**.

4. H. J ChowDhery, S.K. Murti: Plant Diversity and Conservation in India-An overview, 2000, page 1
5. K. C Agrawal: Biodiversity; 1998, page 5, 6
6. Narendra Nath Bhaattacharyya: Biogeography; 2003 page 111, 114

Besides, Nagaland has one National Park (Intangki, 202.02 kms^2) at Dimapur district which harbours animals and birds species like the Mithun, Sambar, Barking Deer, Flying Squirrel, Sloth Bear, Elephant, Wreathed Hornbill etc; three Wildlife Sanctuaries namely Fakim Wildlife Sanctuary (6.42 kms^2) at Kiphire district particularly supporting animal and birds species like the Royal Bengal Tiger, Hoolock Gibbons, Tragopan Pheasant etc, Pulie-Badze Wildlife Sanctuary (9.23 kms^2) at Kohima district which is also the biggest wildlife sanctuary in the state having prime attraction like the Kaleej Pheasant,Tragopan etc and Rangapahar Wildlife sanctuary (4.70 kms^2) at Dimapur district, which is famous for wildlife species like the Tiger, Sloth Bear, Spotted Deer, Tragopan Pheasant etc.

Moreover, there is the Kanglutu Biodiversity Reserve (7060 hactares) at Mokokchung district and the Ghosu Bird Sanctuary which is 8 kms away from Zunheboto district is a place where migratory birds throng from the month of September is entirely maintained by the village community.

In addition to this, Nagaland is also the habitat of rare animal species such as the Asian Elephant, Gaur, Jackal, Tiger, Sambar, Leopard, Barking Deer, Wild Boar, Sloth Bear, Serow, Hoolock, Common Languor, Fruit Bat**,** Macaque, Himalayan Squirrel, Civet, Pangolins, Wolf, Porcupine, Hispis hare, Slow Loris, Otter, Wild Dog, Orange Bellied Himalayan Squirrel, Mongoose, Musk Deer, Binturong, Jungle cat, Mole Rat, Indian Hare, House Mouse, Field Mouse, Clouded Leopard, Palm Civet, Wood Cat, House Cat, Fulvous Fruit Bat, Indian Fox etc. Reptiles include Monitor Lizard, Tortoise, Python, Common Krait, Banded Krait, Viper, Common Cobra etc.

Birds like the Grey Headed Fishing Eagle, Crested Serpent Eagle, Bearded Vulture, Forest Eagle, Collared Pigmy Owlet, Collared Scope Owl, Kaleej Pheasant, Common Hill Partridge, Common Pheasants, Red Jungle Fowl, Peacock Pheasants, Pin Tailed Green Pigeons, Rufous Turtle Dove. Marrn Backed Imperial Pigeon, Emerald Dove, Himalayan Jungle Nightjar, Indian Roller, Chestnut Threaded Bee-eater, Blue Threated Barbet, Great Barbet, Great Pied Hornbill, Rufous Necked Hornbill, Golden Backed Throated Woodpecker, Darjeeling Pied Woodpecker, Blue Napped Pitta, Mrs. Gould's Sunbird, Nepal Yellow Backed Sunbird, Black Breasted Sunbird, Fire Tailed Yellow Backed Sunbird, Long Tailed Broadbill, Red Drumped Swallow, Tyflers Swallow, Black Napped Ariole, Himalayan Tree Pie, Bronzed Drongo, Large Brown Thrush, Lesser Racket-Tailed Drongo, Black Drongo, Grey Drongo and Tragopan etc.

According to Champion & Seth there are six types of forests in the state namely: Northern Tropical Wet Evergreen Forests, Northern Tropical Semi-Evergreen Forests, Northern Sub-Tropical Broad leave Wet Hill Forests, Northern Sub-Tropical Pine Forests, Northern Montana Wet Temperate Forests and Temperate Forests. These Forests are the home of 22 species of bamboo, 340 species of Orchids including rare and endangered species of orchids like the *Thunia* 1spp, *Arundinaria graminifolia* (Bamboo Orchid), *Renenthera* (Red Vanda), Rhynchostytis (Fox Tail), *Pleoni Phauis* (Ground Orchid),2 spp, *paphiopedilum* 1 spp, *cymbidium tigrinum* 1 spp etc. Besides Pinus species like the *Pinus khasyia* (indigenous), *Pinus caribiae* (exotic), *Pinus petula* and *Cryptomeria japonica* (exotic), numerous broad leaved trees like the Alps, Alder, Oaks, Teak, Uriam, Sam, Siris etc and varieties of spiders, worms, insects and bees.

Adding more lusters to the rich Biodiversity of the state, Mokokchung district is not an exception in terms of diversities of life forms. Situated at an altitude of 1398 meters above mean sea level, Mokokchung district is located at 93^0 53' E to 94^0 53' E longitude and 25^0 56' N to 27^0 40' N latitude. Out of the total area of 1,615 km sq Mokokchung has total forest coverage of about 28966.47 hectares **(Basic Fact 2011).** With all these inherent potential in the state, in which Mokokchung district forms a part of it, the current practice of agriculture is unsustainable owing to the traditional Jhum cycle mode of operation.

Although Nagaland was once rich in Biodiversity but it is soon declining now. Reckless cutting of trees and clearing of forests and a lack of concerted effort in afforestation have made it poor now in this precious resource resulting into denudating the potential forest land. In addition, the speedy developmental commotion and swift changes of societal structure of the region have caused a hurdle on the constant nourishment of this diversity. Biodiversity is fast declining and the dependence of the local community on the biomass in their locality to gather many of their day by day requirements is in danger. It is therefore vital that conservation of this rich natural heritage is needed to carry out unanimously.

In order to ameliorate the situation, it is important that immediate steps needed not only to conserve but also to protect all the places of plants and animals occurrences both in-situ and ex- situ conservation is necessary. People should be made conscious of the fact that indiscriminate destruction of Biodiversity will upset the balance of nature and will bring dreadful consequences for the future generation.

These approach can further be reinforced by adopting alternative means of sustainable and community centered progress which can be achieve in the course of the empowerment of the people and provision of opportunity for bigger partaking of women in societies resolution making procedure. Besides various steps and techniques of scientific based research and strategy for effective Biodiversity conservation and management in the district with special priorities to population control, conservation of natural resources, biomass use, mining and quarrying control, haphazard and illegal settlement should be streamlined for better Biodiversity conservation and management.

Besides support policies and systems that would strengthen institution and legislation, natural resources accounting, training and orientation programme, promoting environmental awareness, role of women and NGO's are highly helpful to serve the needful purpose. All these aspects needs extraordinary consideration as efforts of logical institutions will meet authentic accomplishment simply when general citizens are encourage to involve in such ventures.

The second chapter **'Geo-physical framework of Mokokchung district, Nagaland'** with special reference to physiographic, geology, drainage system, soil, climate and natural vegetation, its interplay contributing towards a rich Biodiversity in the district will be discussed in the subsequent chapter.

1.2 STUDY AREA

Mokokchung district has a total geographical area of 1615 km 2 and is located at 93^0 53' E to 94^0 53'E longitude and 25^0 56' N to 27^0 40'N latitude. The district has six physiographic divisions namely Ongpangkong Range, Asetkong Range, Langpangkong Range, Changkikong Range, Japukong Range and Tzurangkong Range.

The forest type in the region is of Deciduous to Evergreen forests and the area under forest cover is approximately 28966.47 Hectares (**Basic Facts 2011**). Mokokchung district has three government protected forests namely Minkong (275.32), Chubi (134.68) and Longsa (18.00) Hectares.

Mokokchung district is situated at an average altitude of 1398 meters above mean sea-level. Summer temperature varies from 28^0-30^0C and winter temperature varies from 10^0-15^0C. The amount of precipitations received in the district is 1600 mm to 2500 mm approximately. The important rivers of the region are Milak, Tzurang, Tsurong, Nanung. Menung, Dikhu/Tsula and Tsumok.

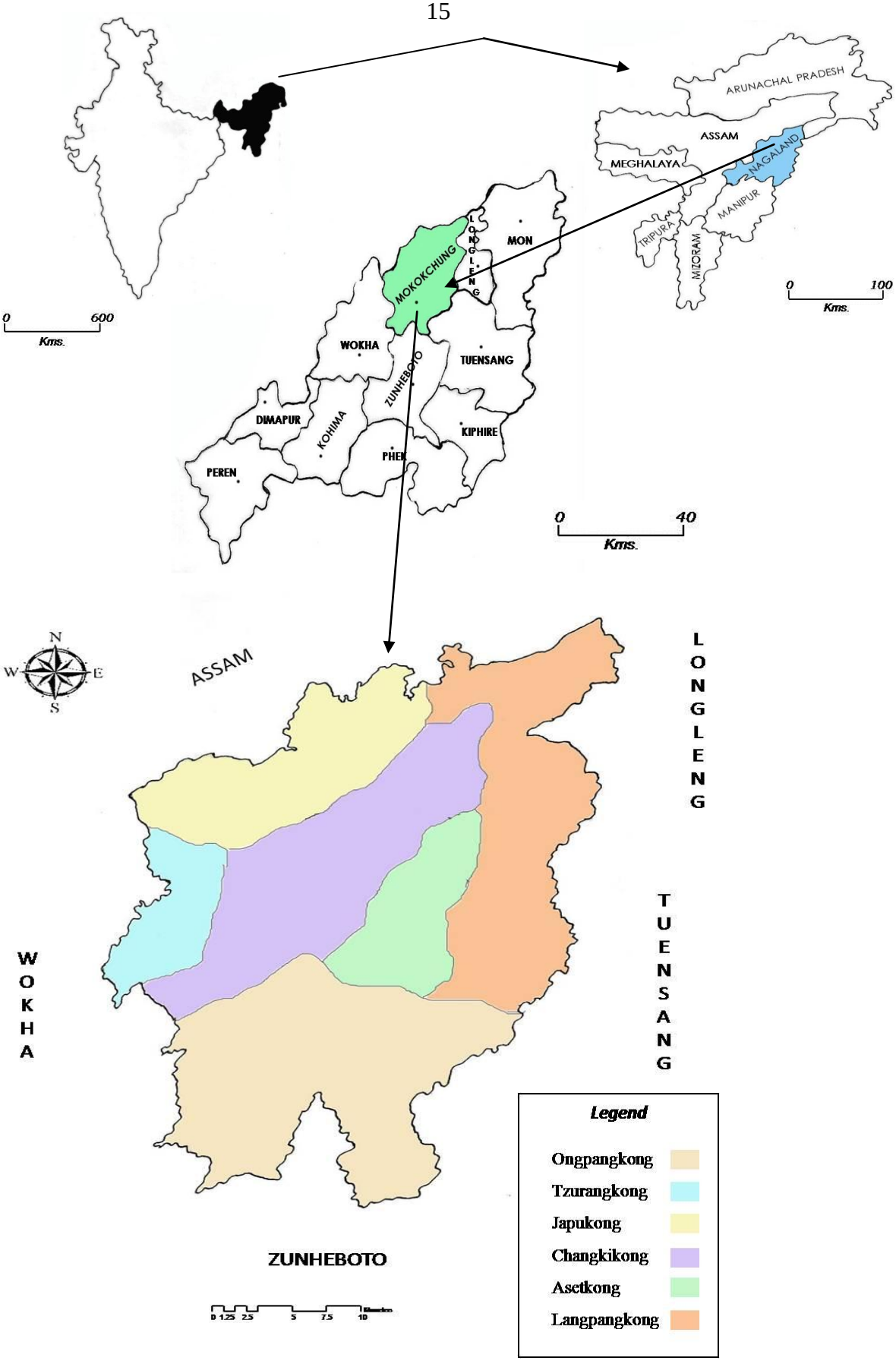


FIGURE 1.1 MAP OF THE STUDY AREA- MOKOKCHUNG DISTRICT, NAGALAND.

The selected study areas from all the six ranges of Mokokchung district are given on the following tables.

Table 1.1 ONGPANGKONG RANGE

Name of the village	Total geographical area (Km^2)	Altitude (meter)	No. of household (2011 census)	Total population (2011 census)	Total forest cover (Hectare)	Total cultivated area (Hectare)
ALIBA	29	1050	304	1044	1250	1595
CHUCHU YIMPANG	27	1352	458	3776	20	2410
LONG KHUM	80	1601	448	3809	150	3709

(Source: Basic Facts 2011)

Table 1.2 ASETKONG RANGE

Name of the village	Total geographical area (Km^2)	Altitude (meter)	No. of household (2011 census)	Total population (2011 census)	Total forest cover (Hectare)	Total cultivated area (Hectare)
MOPUNG CHUKET	22	450 to 1220	741	2965	245	1728
LONGJANG	51	835	945	3481	420	4493

(Source: Basic Facts 2011)

Table 1.3 LANGPANGKONG RANGE

Name of the village	Total geographical area (Km^2)	Altitude (meters)	No. of household (2011 census)	Total population (2011 census)	Total forest cover (Hectare)	Total cultivated area (Hectare)
CHANG TONGYA	85	850	509	2238	7060	1300
WAMEKEN	35	450	214	750	1517	1833

(Source: Basic Facts 2011)

Table 1.4 CHANGKIKONG RANGE

Name of the village	Total geographical area (Km^2)	Altitude (meters)	No. of household (2011 census)	Total population (2011 census)	Total forest cover (Hectare)	Total cultivated area
CHANGKI	149	1100	700	2484	9700	1610
DEBUIA	41	200 to 1204	174	538	2600	1050

(Source: Basic Facts 2011)

Table 1.5 JAPUKONG RANGE

Name of the village	Total geographical area (Km^2)	Altitude (meters)	No. of household (2011 census)	Total population (2011 census)	Total forest cover (Hectare)	Total cultivated area (Hectare)
JAPU	80	830	140	487	7385	415
SATSUKBA	10	300	63	242	824	126

(Source: Basic Facts 2011)

Table 1.6 TZURANGKONG RANGE

Name of the village	Total geographical area (Km^2)	Altitude (meters)	No. of household (2011 census)	Total population (2011 census)	Total forest cover (Hectare)	Total cultivated area (Hectare)
CHUNGTIA YIMSEN	42	210	389	1523	2500	1500
LONGPA-YIMSEN	90	260	339	1700	6000	2850

(Source: Basic Facts 2011)

1.3 STATEMENT OF THE PROBLEM

For centuries the Ao-Nagas have been dependent on the natural environment for their survival and development. Even today more than 85% of the population maintain intimate link to their forest for food, security and sustainability that has been the basis of their physical and cultural survival. However, in the recent times, the biodiversity of the district is facing serious threats due to increasing population, pressure on agriculture to bring more areas under cultivation, more seriously commercialization of forest and forest products and other developmental activities of urban oriented. Traditionally, the slash and burn system of agriculture, commercial farming and monoculture plantations is extensively followed in Mokokchung district.

The fast erosion of their long symbiotic relationship is causing a serious threat to the entire biodiversity development in Nagaland, particularly in Mokokchung district. Further lack of realization for preserving and maintaining the biodiversity is causing uncertainties for the sustainability of the rich biodiversity of Mokokchung district of Nagaland thereby affecting the entire biodiversity system of the state.

Among the present 11 district of Nagaland, Mokokchung district happens to be the one district which had experienced early contact with the outside world, British administration and development etc. Hence, history and dynamics of Biodiversity has been more apparent. Even in the present days it indicates fast changes of Biodiversity as compared to many new districts in the state. As such Mokokchung district gives wider scope for the study.

The research study therefore intends to bring forth the systematic understanding about biological diversity, their role in shaping the environment and also its management and conservation.

1.4 OBJECTIVES

(a) To study the dynamics of biodiversity pattern and to evaluate the present status of biodiversity.

(b) To analyze the factors leading to the distribution and occurrences of different levels of biodiversity.

(c) To evaluate the co-relation between changing pattern of biodiversity and environmental changes.

(d) To assess human impact on the biodiversity.

(e) To bring out a suitable strategy for preserving and sustainable development of biodiversity in Mokokchung district and the entire state in general.

1.5 HYPOTHESIS

(a) Rapid demographic development exerts pressure on the Biodiversity and as a consequence it adversely effects the environment.

(b) Lack of proper planning and implementation leads to rapid depletion of the Biodiversity which is a loss of the resource.

(c) Jhum cultivation and unethical commercialization of forest cause uncertainties for Biodiversity development in Mokokchung district and in the entire state.

1.6 SOURCE OF DATA AND METHODOLOGY

The research work is based on the methods and procedures given below:

1.6.1 FIELD STUDY

For proper understanding and perception of the study, observation of geographical facts and landscape both natural and cultural were drawn from the field investigation. The study tour has been undertaken from the six ranges of Mokokchung district. Out of which three villages from the Ongpangkong range and two villages from the remaining five ranges were selected covering 13 (thirteen) villages from Mokokchung district. The names of the selected villages are: Aliba, Chuchuyimpang, Longkhum (Ongpangkong), Mopungchuket, Longjang (Asetkong), Wameken, Changtongya (Langpangkong), Changki, Dibuia (Changkikong), Chungtiayimsen, Longpayimsen (Tsurangkong). Japu, Satsuk (Japukong).During the field tour to the selected villages, status of Biodiversity and the direct and indirect co-relationship between man and his environment were studied, besides stocks of the forests, rivers, streams and jhumlands were visited and first hand information were collected by personally visiting and staying in the villages.

1.6.2 COLLECTION OF DATA

Data and materials required for the research work were collected from both primary and secondary sources. Geographical facts and the socio-economic condition of the people living in these villages that are of paramount importance were obtained from personal observation and interviews with the local people through households survey by prepared questionnaires. Moreover, information was also collected from the village headmen, village elders, Womenfolk, Gaonboras and people with candid knowledge about the Biodiversity of the region. For mapping of the study areas, Toposheet No 83 J series was

used. Besides, various books, journals, newsletters, dissertation and Ph.D thesis, office reports and various websites were consulted for the analysis on the concern topic.

1.6.3 SAMPLE TECHNIQUES AND DESIGN

According to the nature of the problem, this study demands the stratified random sampling technique using questionnaires and interview methods. This technique was applied purposefully with a view of more in depth investigation of the problem based on primary information.

In stratified random sampling, the sampling is designed so that a designated number of items are chosen from each stratum. It is one of the methods which by using the available information concerning the population, attempts to design a more efficient sample than obtained by the simple random procedure. The procedures are given below.

(a) The universe to be sampled is sub-divided (or stratified) into groups which are mutually exclusive and include all items in the universe.

(b) A simple random sample is then chosen independently from each group.

Thirteen villages from all the six ranges were selected, **(Table 1.1, 1.2,1.3,1.4,1.5,1.6)** out of which 20% of the total household were covered by survey giving due consideration of socio-economic conditions. Thus the study of the selected households and villages adequately reflect the condition of the district.

During a reconnaissance survey it was found that most of the households are engaged on forest related activities because they are dependent on forests and Biodiversity resources for their livelihood. Other households are more or less engaged with home gardens and

orchards gardening. Village size ranges from 63 to 945 households; therefore sample of 20% of households in each village.

With structured questionnaires, a field survey was conducted in all the thirteen selected villages from 2009 to 2013. The final survey were completed with the participation and informed consent of village elders, teachers, students, village headmen, Gaonboras, womenfolk, VDB which were tabulated and counted from the prepared questionnaires and interviews schedules.

Responses to open questions were collected on a variety of demographic and socio-economic indicators: household composition, age, education, primary and secondary occupations, interaction with farmers and hunters, awareness of the benefits obtained from forests and Biodiversity linked activities, role of women in forests and Biodiversity conservation, and the expected benefits and training from government and non-governmental organizations.

1.6.4 STUDY AREA ANALYSIS

The results obtained on the opinion of the respondents with regard to Biodiversity related activities, conservation and management are given below.

Among the 260 people interviewed through prepared questionnaires, 58% were male and 42% were female.

1.6.4.1 LAND-USE PATTERN

- The major land-use pattern in the 13 villages of the study area comprises of 40% under forest, 30% under agriculture, 10% under settlement and 20% under Barren/ fallow land.

- Agriculture is the mainstay of the economy and is the source of income for most households, while day labour (both agriculture and non-agricultural wage work, for example, in stone quarries, lumbering, saw mills) were the second most important source of primary income, secondary sources of household income included poultry rearing, vegetables and fruits cultivation.
- 40% was engaged in Jhumming and 20% under wet paddy and terracing, 10% horticulture and 30% under commercial plantation (trees, crops and fruits).

1.6.4.2 FOREST AND BIODIVERSITY AS PERCEIVED BY THE LOCAL COMMUNITY

- 90% of the respondents considered forest as the sustainer of livelihood and 10% believes forests are sacred; the abode of deities who protects animals and birds. 90% considers Biodiversity and forests are related and one cannot exist without the other while 10% of the people feel that Biodiversity is the storehouse of natural resources.

1.6.4.3 LOCAL COMMUNITY ON FOREST/BIODIVERSITY RELATED ACTIVITIES

- 70% of the respondents go to forest for gathering firewood, vegetables, fruits etc, while 30% of the respondent go to forests and river for fishing and leisure.

1.6.4.4 PERCEPTION OF THE LOCAL COMMUNITY ON FACTORS LEADING TO BIODIVERSITY DECLINE

- 60% of the respondent are of the view that population is the major factor for declining biodiversity. While 40% of the respondent was of the view that

developmental activities is responsible for biodiversity loss especially around the urban concentrated areas.

- 20% of the people believes commercialization of forests like logging as the major cause; only 2% considered forest fire as the major cause of biodiversity loss in the region because while setting fire in the Jhum field utmost care and precaution is taken to prevent fire from spreading in the nearby jungle and forests.
- Only 5% believes that shifting cultivation is the main cause for biodiversity loss because many of the respondents believes that shifting cultivation had been sustaining the Ao-Naga people for generations without bringing major destruction to environment besides there are very little alternative to replaced jhumming because of steep slopes and water scarcity in almost all the district except along the foot hills and valleys like the Changki valley, Tzurang valley and Tuli valley.

1.6.4.5 PEOPLE'S OPINION ON THE IMPACT OF CLIMATIC CHANGE ON BIODIVERSITY IN THE REGION

- 90% responded that there are some changes in Biodiversity relating to weather with summer temperature increased by a few degrees thereby affecting cropping pattern, flowering and fruits etc, while 10% felt that there are very slight changes which is imperceptible.
- 70% responded that Biodiversity and environment changes have affected their socio-economic activity both directly and indirectly where access to basic resources like firewood and water have become more difficult and expensive due to deforestation and over exploitation.

1.6.4.6 PEOPLE'S OPINION ON THE PRESENT STATUS OF BIODIVERSITY IN THE REGION

- 30% of the respondent felt that the present status of biodiversity in Nagaland is going from bad to worse mainly due to human induced activities like logging, hunting and deforestation while 70% of the respondent is of the opinion that the present scenario of biodiversity can be amended with proper management and conservation through education from the grass root level with the implementation of strict laws and regulation.
- 90% responded they are directly dependent on Biodiversity and environment and 10% responded indirect dependence on Biodiversity. 70% of the respondent feel that rigid preservation of biodiversity would hamper human livelihood as most of the people are dependent on forest and its resources and therefore sustainable development and biodiversity go hand in hand and this concept should be encouraged.

1.6.4.7 AWARENESS LEVEL AND INITIATIVE TAKEN TO CONSERVE BIODIVERSITY

- 60% of the respondents considered Biodiversity as a natural asset while 10% views Biodiversity as material and 30% as nature.
- 100% of the respondent believes that biodiversity and the local community are related and 60% is conscious about the importance of biodiversity.
- 60% of the respondent has attended seminar and workshops on Biodiversity and Environment Conservation conducted under various governmental departments like the Forest department, Agriculture department, Soil & water conservation department etc and other NGO's, 99% of the respondent are aware about the

importance of biodiversity and environment through seminars and workshops conducted various government and NGO's while 1% responded in negative.

- 40% of the respondents are actively involved in conservation of biodiversity and environment through 'Community Reserved forest' or 'Reserved Forest.'

1.6.4.8 PEOPLE'S OPINION ON GOVERNMENT AND TRADITIONAL LAWS/POLICY ON BIODIVERSITY CONSERVEATION

- 70% of the respondent is of the opinion that government policies is not adequate enough to safeguard and conserved Biodiversity in Nagaland, and is of opinion that if the government is serious to safe guard and conserved biodiversity in the region, the government should provide other alternative means for their livelihood as most of the people are directly dependent on forests for their sustenance. While 45% of the respondent believes that traditional and customary laws at the grass root level would be more effective and bring more benefits towards this approach as the village community and its laws have the ultimate power to control everything relating to land and its resources in the Ao-Naga society.
- 90% responded that education is the key towards a long term progress of Biodiversity conservation in the district because if a person have a sound environmental education he/she will be automatically inclined towards pragmatic approach to protect biodiversity while 10 % feels that government policies would be more effective.
- 80% feels that integration of education, traditional and governmental policies and approach would be the best strategy to safeguard Biodiversity in the district whereas 15% of the respondent believes that 'Community Reserved Forest' is

the best strategy, 5% felt that conservation would be effective and practical by involving the Student Unions, Senso Mundang, Ao senden etc to bring more pragmatic results.

1.6.4.9 GENDER ROLE ON BIODIVERSITY CONSERVEATION

- 100% of the respondent believes that both men and women play a significant role in both agricultural and forests associated activities.

Basing on these findings from the prepared questionnaires, interviews and interactions with the village elders, teachers, students, village headmen, Gaonboras, womenfolk, VDB etc with other primary and secondary sources, the study on the succeeding chapters in the thesis was done which are discussed and analysed in detail in the succeeding chapterisations.

1.7 REVIEW OF LITERATURE

The Biodiversity crisis has had at least one positive outcome. It has forced biologists from many disciplines to interact and exchange data, which generally improves our overall understanding of ecology and evolution. **(Agarwal, 1991)** on the book '*Biodiversity and Environment*' quotes that, "Biodiversity comprises every form of life from the tiniest microbes to the mightiest beasts and the gigantic trees". The Oxford dictionary of Geography by **(Mayhew, 2004)** defined Biodiversity as "the varied range of flora and fauna". In the convention of Biological Diversity (1992), Biodiversity has been defined as the variability among living organisms from all sources including inter alias, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. **(Mc.Kinney, 1998**) in the book *'Biodiversity' Dynamics: Turnover of population, Taxa, and communities*, wrote that "Biodiversity dynamics

refers to the turnover of biological units across all temporal and spatial scales". (**Mc Ghee, 1996**) quote that "in practice, long term loss of Biodiversity can occur by decreasing origination as well as by increasing extinction. It is often argued that populations are the most basic unit of biodiversity dynamics*"*.

(Brown, 1995) in his book "*Macroecology"* summarize much of his work attempting to extrapolate abundance dynamics to large spatial and temporal scales. The current contraction of Biodiversity is a cause for alarm while complete disappearance is most serious, and other losses merit attention. **(Paulsamy,1998)** in the book *'Introduction to Environment Biology'* stresses that in the direction of environmental problem as such in human problem, every one should be given education, so that every individual citizen can make a contribution towards control of environment problem. **(Dang's, 1991)** *'Human Conflict in conservation : Protected Areas – The Indian experience'* also throws light along similar lines that in the designing development strategies that are sustainable, conservation of wilderness areas plays a special role. He elaborate further that the natural and relatively undisturbed habitats are important not only for the in-situ maintenance of genetic resources, but also for maintaining certain natural, aesthetic and cultural values in their own right.

Dang's view is also endorsed by **(Rai**, **Mohapatra and Goel**, **1992**) in the book *'Environment Management – Physio – Ecological facts' (Volume I),* where they analyses the human civilization which is at cross roads that whether man should decide to destroy themselves and all the accumulated heritage of the species over the millennia or man may decide to the reasonable empathic to our bases of sustenance and progress towards new heights. Their study also reveals that through part of a complex matrix of life

support system on this planet, the human destiny is inevitably and undeniably in his own hands.

(Hopfenberg and **Pimentel, 2007)** in their article "Human development throughout history has depended on sustainable access to natural resources", they point out the fact that the main causes of Biodiversity loss are conversion of natural ecosystems into agricultural or other land use, and the decline of species distribution and abundance in ecosystems due to degradation processes such as logging, pollution, fragmentation and disturbances. Their approach is further strengthen by **(Franceschinelli, Vasconcelas, Landau, Ono and Santos,2007)** in their article "The genetic diversity of *myrciaria floribunda* in Atlantic forest", fragmentation may cause loss of genetic diversity within population and disruption of gene flow among population or sub-population, leading to depletion of genes that may have adaptive importance.

Professor **(Trivedi, 2002)** in the book *'Encyclopedia of World Environment 3. Wild life'* questions whether apart from the ethical and aesthetic reasons, is there any reason to fear that human survival is at risk if biological diversity is not preserved or whether human can exist surrounded only by agricultural field, planted forests & the life. He also emphasis that man's capability to transform his environment that can bring the benefits of ecological development and an opportunity to enhance the quality of life. Further he asserted the point that, the same power, if incorrectly applied can also cause incalculable harm to the natural environment and consequently to human life**.**

(Naeem, Loreau and **Inchausti, 2006)** in *'Biodiversity and Ecosystem functioning (synthesis and Perspectives)'* says that while the functional significance of earths biota to ecosystem or earth – system functioning is well established, the significance of earth's

biodiversity has remained unknown until recently. They also add that the earth's biota is not a passive epiphenomenon of earth's physical conditions and geochemical processes. They also assert that at a time when Biodiversity is undergoing dramatic changes in distribution and abundance, predicting the ecosystem or earth – system consequences of such change is a critical issue.

In the article "Plant diversity assessment of *shorea robusta* dominated forest dense of Simipal Biosphere Reserve", by **(Mohanty, Mishra, Bal and Upadhyay,2005)** highlights the point that tropical forest are amongst the richest and most complex biological communities on the earth and exhibit a tremendous ability of self importance. They also lament that with the increasing population pressure over the last few decades and dependence of the people on plant products has le to the vast exploitation of natural flora and fauna in the forest.

(Kondratyev,1998) in *'Multidimensional Global Change'* reveals that Biodiversity provides goods and services essential to support human livelihoods and aspirations, and enables societies to adopt to changing needs and circumstances. He further adds that the protection of these assets and their continued exploration through science and technology offer the only means by which the nations of the world can hope to develop sustain ably. The ethical, aesthetic, spiritual, cultural and religious values of human societies are an integral part of this complex equation.

(Chowbhery and **Murti,2000)** in the book *'Plant Diversity & conservation in India – an overview'* analyzed that while the utilization of biological resources is a pre-requisite for human sustenance on this planet, at the same time it is equally essential to conserve

these resources for future generations through their sustainable utilization. *'Environmental concerns and strategies'* by **(Khoshoo, 1991)** portrays that time has come when sustainability in development has to enter in our planning process as one of the basic and permanent objectives.

(Sharma and **Khan,2003)** in the book '*Environmental Conservation depleting Resources and Sustainable Development'* says that high human and animal population exert tremendous pressure on natural Biodiversity, and due to over-exploitation many species of high economic value has entered into the category of threatened or endangered species. He further adds that indigenous people has often been victims of ethnocide. *'Perspective in Environmental Studies'* by **(Kaushik** and **Kaushik, 2004)** asserts how exponential growth of human population coupled with ways to attain high standards of living through technological advancement has resulted in widespread contamination of the environment at global level. He also throws light on how human centric approach of development has already damaged the nature to a large extent. He was strongly of the view that the objective of environmental protection cannot be achieved without the involvement of the masses at the grass root level.

Books on the North-East region were also reviewed for a better understanding of the significance, its present status of Biodiversity in the region. Some of them are *'Man and Environment in North – East India'* by **(Medhi**, **1992**) where he opines that the fast dwindling of the rich forest has posed a serious ecological problem to the region. He says that the forest area of this region is in great threat of extinction because of wanton clearance of the forest for various purposes. As a consequence, it not only threatens extinction of some of the species but also setting in an ecological imbalance in the

region. He emphasized on the importance of conservation of plant resources of the region by taking various steps and regenerates the resources by scientific cultivation and through social afforestation by involving the people.

(**Taher** and **Ahmed,2002)** in the book *'Geography of North-East India*' reveals that the region which receives the heaviest rainfalls in the world is endowed with rich Biodiversity is slowly degradating due to human interference and lack of scientific planning and management. **(Goel** and **Gopalakrishna,2000)** in *' the Geography of North-East India'* also points out the fact that the despite the region's rich Biodiversity, due to large scale deforestation and the continuing impact of traditional practices like the shifting cultivation or Jhuming have made the vegetation cover to rapidly deplete in terms of areas and variety. *'The Ferns of Nagaland'* by **(Jamir and Rao,1998)** highlights the shifting agriculture practiced by the Naga people, has greatly depleted the natural fertility of land and its valuable forest resources and also denuded the potential forest land. They also opined that the increased in human population, heavy incidence of grazing and pressure on land for agriculture have also been responsible for removal of forest cover and in turn resulting in barren or only grass and Eupatorium covered hills in the state.

Similar points were made **by (Howard, Allen, Allen** and **Gait, 2005)** in the Book *'Gazetter of Bengal and North-East India'*. Where they opined that the whole of the hills must have once been covered with forest, dense evergreen forest, but the Jhum system of cultivation necessitates the periodical clearance and as a result, an area of nearly 5 or 6 times as large as that under cultivation in any given year is very unfavorable to tree growth.

'The Economic Plants of North-East India', by **(Kumar, 1999)** also reveals that the rapid developmental activity and fast changes of societal structure of the region are bound to have an impact on the continued sustenance of this diversity and that the need for conservation of this rich natural heritage is unanimous. He also emphasized that conservation should be done on scientific basis and a data base of what actually exist today is of paramount importance. Similar view is resounded by **(Puro, 2005)** in the article "*Soil Nutrients Status of the disturb and undisturb forest ecosystem of Lumami, Nagaland*". He adds that forest ecosystem in spite of being rich in Biodiversity in highly productive are unfortunately continuously influenced by many ecological process and disturbances. One of the major disturbances caused by man is in the form of traditional agricultural practice such as slash & burn also known as jhuming which affects the overall productivity of the forest ecosystem.

Professor ***(*Ganguly, 1996*)*** *in the book 'Sustainable Human Development in the North - East region of India*' is of the view that the region's natural resources are being depleted at a fast rate, Biodiversity is being lost and the dependence of the rural and tribal masses on the biomass in their neighborhood to meet many of their daily needs is in jeopardy. He says that an alternative model of sustainable and people centered development can be achieved through the empowerment of the community and provision of opportunity for larger participation of women in the society's decision making process. In the article "Systematic, Biogeography and Diversification of Indian *Quill worts*" by (**Shrivastava**, **2005)** says that immediate steps are needed not only to conserve but also to protect all the places of plants occurrences both in-situ and ex-situ conservation are necessary.

(Salo and **Pyhala, 2007)** in their article "Exploring the gap between conservation science and protected area establishment in the AllPahuayo Mishara National reserve (Peruvian Amazonia)" adds that while many scientific priority setting approaches have been suggested that, the steep from mapping priority area for conservation based on scientific information, to formulate the practical tools for conservation Biological Diversity is less well documented. They further adds that to make both ends meet several key aspects, such as legislative framework multi-scale politics and socio economic factors have to be taken into account.

The above literature and studies are from different perspectives which are done at different levels. The authors very strongly advocate for employing both in-situ and ex-situ methods to conserve Biodiversity. This aspect needs special attention because efforts of scientific institutions will meet real success only when local people are encourageously involved in such ventures. Such aspects when applied in the present study area will certainly be successful in conservation of biodiversity on a sustainable basis.

CHAPTER-2

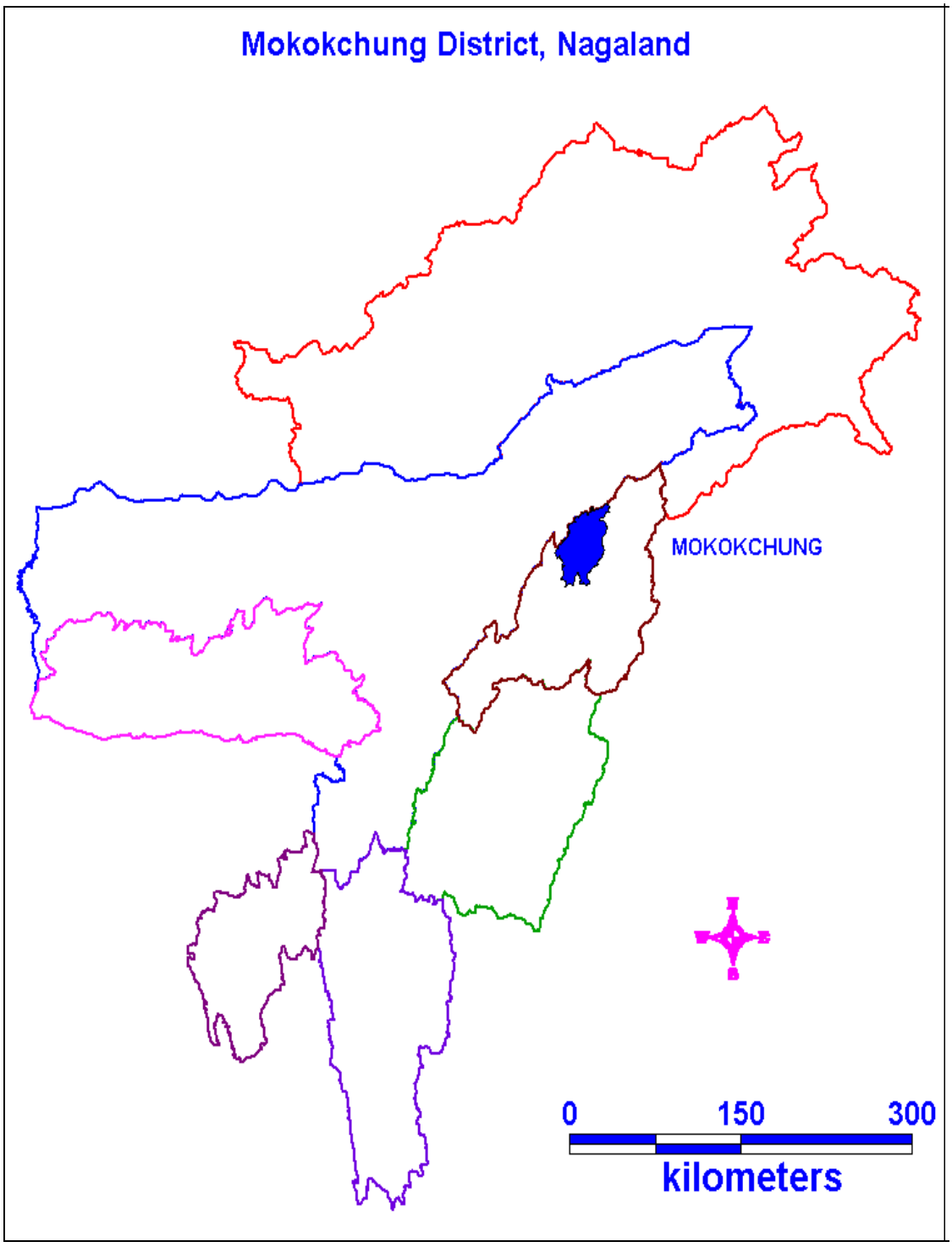
GEO-PHYSICAL FRAMEWORK OF MOKOKCHUNG DISTRICT, NAGALAND

2.1 INTRODUCTION

Nagaland is endowed with ample amount of Biodiversity due to its varied topography, soil and the climatic conditions which helps diversity of life forms to flourish. According to the recent State Report of Forest (SRF) Report 2011, out of the state's geographical area, very dense forest account for about 5,709 km square (34.4%), moderate forests for approximately 5,650 km square (34.1%) and open forests of around 7,902 km square (48%) which makes to $1/6^{th}$ of the state to be under forest cover.

Nagaland is located at $25^{o}6'$ N and $27^{o}4'$ N latitude and 93^{o} 20' E and $95^{o}15'$E longitude has a total geographical area of 16,579 km^2 out of which Mokokchung district has an area of 1,615 km square. Mokokchung district is one of the present eleven districts of Nagaland and is bounded by Assam to the North, Tuensang district to the East, Zunheboto to the West. Mokokchung district being located at an altitude of 1325 meters above mean sea level is situated at 25^{o} 56' N to 27^{o} 40' N latitude and 93^{o} 53' E to 94^{o} 53'E longitude.

In fact the diversity of flora and fauna is the product of the physical, social and cultural environment prevailing in the region. Physical factors of climate, soil, topography and biotic elements are instrumental in the formation of diversity of life forms and also their dynamism.



(Source: Ground Water Information Booklet, Mokokchung District, Nagaaland)

FIGURE: 2.1 LOCATIONAL MAP OF MOKOKCHUNG DISTRICT, NAGALAND

2.2 PHYSIOGRAPHY

The entire state of Nagaland is having rugged terrain of which Mokokchung district is comparatively less elevated. The district is characterized by high hills and ranges coupled with sharp crust ridges and narrow valleys, with a few plain lands. 'The hills vary from 1000 to 2000 meters and the average height of the district is 1500 meters. Mokokchung district being a part of the eastern Himalayas has got its mountain ranges spread from North-East to South-West, though occasionally some ranges have gone to other direction also.'[1]

The physiography of the district of Mokokchung shows six distinct hill ranges. The ranges are more or less parallel to each other and run in North-East or South-West direction. The ranges are higher on the East than in the West where it has adjoined the plains of Assam. The southern portion of the district is comparatively more rugged than the Northern parts. About 60% of the total area of the district is having elevations which were formed cutting through soft and loose geological strata by heavy rainfall resulting into numerous gorges like valleys have resulted.

Within the district the Doyang and the Milak rivers with their tributaries flowing downstream have lead to the formation of fertile flood plains known as Changki valley, Tuli valley and Bhaghty valley having an average width varying from one to two miles at an average, all of these valleys are locating on the Western side of the district adjoining the plains of Sibsagar district of Assam.

1. Mokokchung District Gazetteer (Nagaland), Government of Nagaland, Kohima; 1979, page 3

The river valleys of Tzurang, Milak and Dikhu on the South-Eastern sides are also more steeper compared towards the North-Western sides, where the average slope in the entire region varies from 30 degree to 70 degree.

Geographically, Mokokchung district is divided into six parallel ranges on the basis of terrain, climate, soil and the type of vegetation where all the six ranges display some slight variation in all these geographical factors thereby influencing the present status of Biodiversity. The six ranges are detailed below:

(a) Ongpangkong Range

(b) Asetkong Range

(c) Langpangkong Range

(d) Changki Range

(e) Japukong Range

(f) Tzurangkong Range.

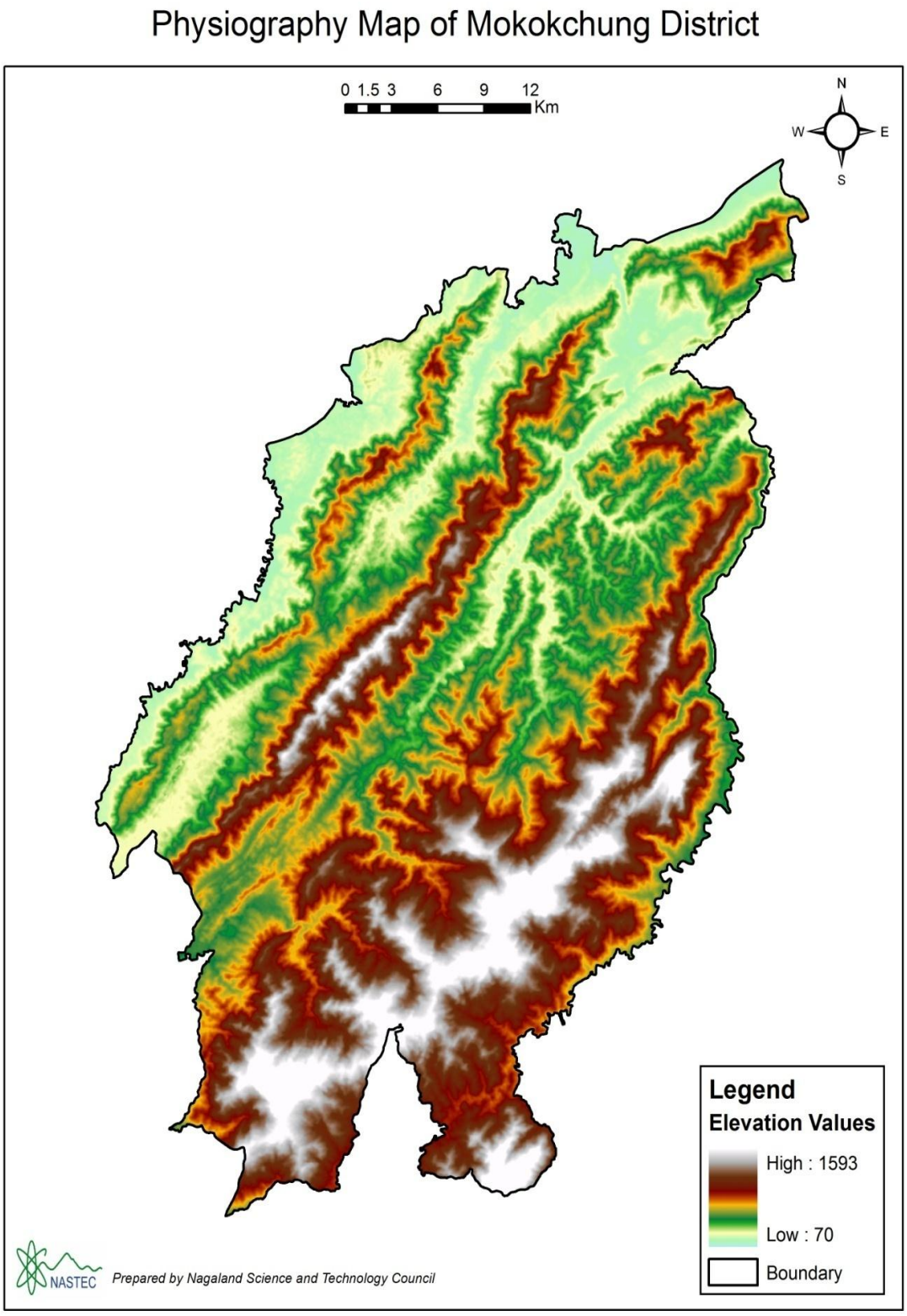


FIGURE: 2.2 PHYSIOGRAPHIC MAP OF MOKOKCHUNG DISTRICT

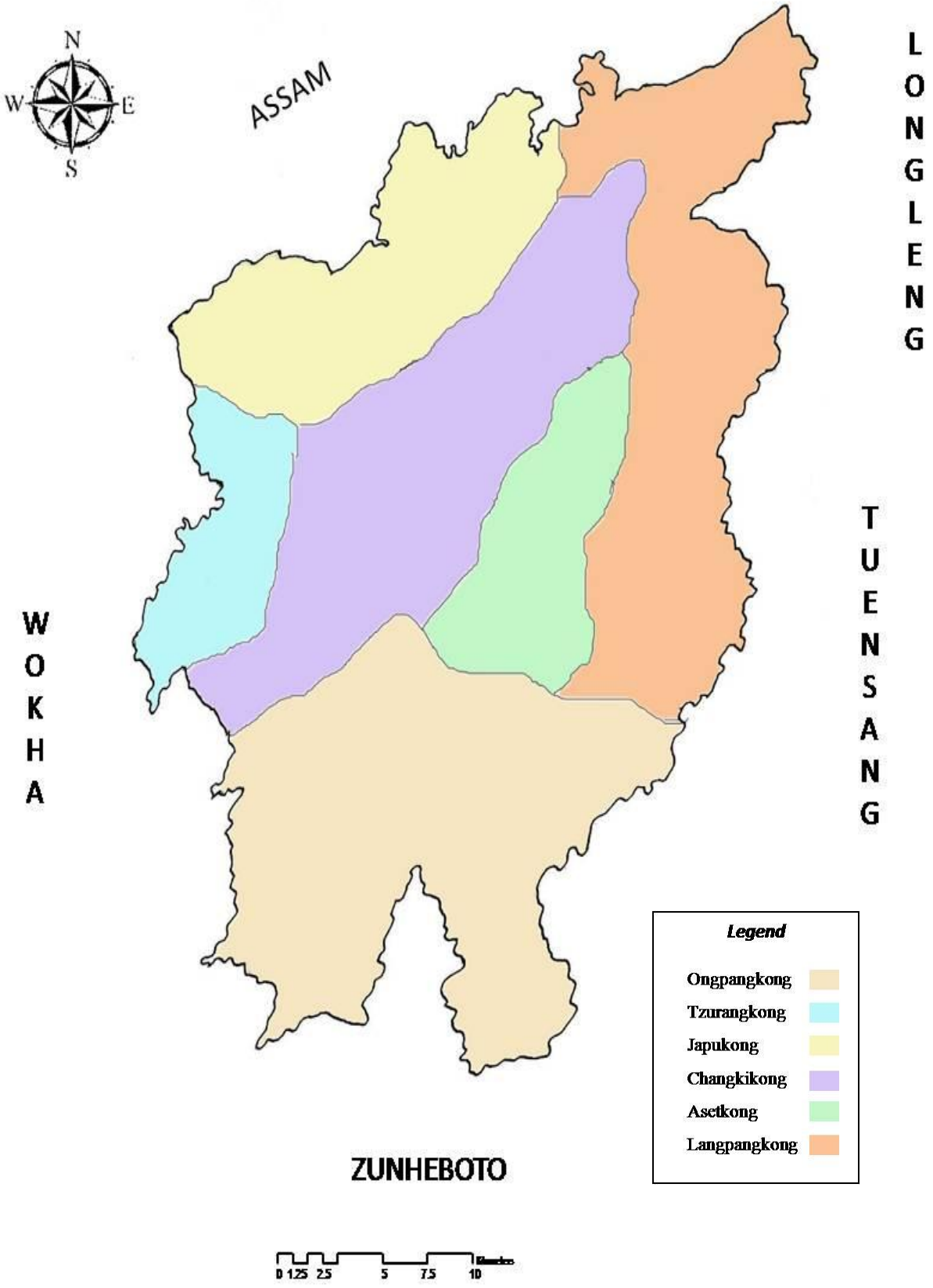


FIGURE 2.3 MAP OF MOKOKCHUNG DISTRICT SHOWING THE SIX RANGES.

2.2.1 ONGPANGKONG RANGE

Ongpangkong range is the southernmost range and is also the highest altitude and is believed to be where civilization started among the six ranges. This range forms an irregular boundary of the Ao area with that of the Lothas and the Semas on the south and with the Sangtams on the east and is colder than the other ranges and hence named as Ongpangkong. At present the range guards 17 villages and has a total population of approximately 85,667 (**2011 Census**).

As this range is having an average altitude of 1500 meters above mean sea level the type of vegetation varies from mixed deciduous forest and evergreen forest type. A considerable amount of the range is still under forest and jungles and therefore as a result there is a fair amount of flora and fauna species.

Ongpangkong range is one of the ranges in Mokokchung district with a large geographical area having considerable large tract of forest and virgin forest. For instance the forest of Aliba, Longsa, Khensa, Mangmetong, Longkhum, Mokokchung villages is immensely rich in Biodiversity. A good number of 30-40 wild elephants, tigers (*Panthera tigris)* are speculated to be present in the Aliba village alone. Many of the villages in the Ongpangkong range are having large tract of forest as 'Community Reserved Forest'- Aliba (1250 hectare), Ungma (690 hectares), Longsa (450 hectares), Khensa (320 hectare), Mangmetong (200 hectare), Longkhum (150 hectare), Chungtia (150 hectares), Mekuli (150 hectares) etc thereby supporting variety of life forms.

Table: 2.1 ONGPANGKONG RANGE

FAUNA	Spotted deer (*Axis axis*), Parking deer (*Cervulus muntjac*), Sambar (*Cerbus unicolor*), Otter (*Lutra*), Sloth bear (*Sclenarctos*), Wild boar (*Sus Crestatus*), Jungle cat (*felischaus guldenstaedt*), Tiger (*Panthera tigris*), Squirrel (*Funambus*), Pangolin (*Manis tricespis*), Dingo (*Canis Dingo*), Elephant (*Elephas maximus* Linnaeus) etc are found in moderate number. Whereas, Bat (*Rhnolophus),* Mole (*Talpa*), Porcupine (*Hystrix bengalensis*), Squirrels (*Funambus*), Flying squirrel (*Pteromyini or Petauristini),* Indian buffalo (*Bubalus arnee*), Cow (*Bos indicus,* L) etc are found in moderate number.
TOTAL	**19**
AVI-FAUNA	Red Jungle fowl (*Gallus gallus*), Jungle crow (*Cervus macroshynchos),* Kaleej Pheasant (*Cophhura leucomelonos*), Great Indian Himalayan Barbet/ Great Barbet/ Great hill barbet (*Megalaina verens*), Large green Barbet (*Megalaima Zeylanica*), Lineated Barbet (*Megalaima Lineata*), Coppersmith barbet (*Megalaina haemacephala*), Black drongo (*Decrurs macrocerus*), Racket tailed drongo (*Dicrurus paradiseus*), Crow billed drongo (*Dicrurus annectans*), Tailor bird (*Orthotomos sturius*), Hoopoe (*Lepupa epops*), Yellow billed blue Magpie (*Cissa flavirostris*), Raven (*Corvus corax),* Fairy bluebird (*Irena Puella*), Blackheaded yellow bulbul (*Pycnonotus melanicterus*), Redvented bulbul *(Pycnonotus cafer*), Whitcheeked bulbul (*Pycnonotus leucogenys*), Red whiskered bulbul (*Pycnonotus jocosus*), Black Bulbul (*Hypssipetes Madagascariensis*) Hill Myna (*Gracula religiosa*), Blue napped pitta (*Pitta Nipalensis*), Woodpecker (*Dendrocopos major*), Heartspotted woodpecker (*Hemicircus canente*), Grey Headed Woodpecker (*Picus Canus*), Black Backed Woodpecker (*Chrysocolaptes Festivus*), Great Black Woodpecker (*Dryocopus javensis),* Heartspotted woodpecker (*Hemicircus canente*)), Whitbacked Munia (*Lonchura striata),* Grey shrike (*Lanius excubitor*), Grey partridges (*Perdix perdix*), Cuckoo Summer/ Cuckoo (*Cuculus Canorus*), Indian Bay Banded Cuckoo (*Cacomantis Sonneratin*), Indian Drongo Cuckoo (*Surniculus lugubris*), Koel (*Eudynamys*

	scolopacea), Shallow (*Hirundorustica*), Bar Tailed Cuckoo Dove *(Macropygia Unchall),* Emerald or Bronzedwinged dove (*Chalcophaps indica*), Rufous Turtle dove *(Streptopelia Orientalis),* Spotted Dove *(Streptopelia Chinnensis),* Pin Tailed Green Pigeon (*Treron Apicaulda*), Nilgiri Wood Pigeon (*Columba Elphinstonii*),Green Fronted Green Pigeon *(Treron pompadora),* Blue Rock pigeon *(Columbia livia),* Ashy wood pigeon (*Columbus pulchricollis*), White spotted fantail flycatcher (*Rhipidura albicollis*), Rufous tailed finch-lark (*Ammomanes Phoenicurus*), Sand lark (*Calandrella Raytal*), Rufous bellied Babbler (*Dumetia Hyperythra),* Silver eared Mesia (*Leiothrix argentowris*), Slaty headed scimitar babbler (*Pomatorhinus horsfieldi*), White crested laughing thrush (*Garrulax leucolophus*), Rufousbellied Niltava (*Musicapa Sundara),* Ashy wren-warbler (*Prinia socialis*), Magpie-robin (*Copsychus saularis*), Yellow backed sunbird *(Aethopyga),* Purple sunbird (*Nectarinia Asiatic*), Streaked spider-hunter (*Arachnothera magna*), House sparrow (*Passer domesticus*), Common pariah kite (*Milvus migrans govinda*), House swift (*Apus affinus, cliffs),* Roller or blue jay (*Coracias benghalensis*), Tree pie (*Dendrocitta vagabunda*), Scarlet minivet (*Pericrocotus flammeus*), Pied bushchat (*Saxicola caprata*), Grey wagtail (*Motocilla cinerea*), Southern Trogan (*Harpactes Fasciatus*), Chestedheaded Bee-eater (*Meoops Leschenaulti*), Black Bittern (*Ixobry chus flavicallis*), White-eyed buzzard (*Bustator Teesa*), Common or Grey Quail (*Coturnix Coturnix*), Blue Breasted Quail (*Coturnix Chinensis*), Painted Bush Quail (*Perdicula Erythourhyncha*), Little Bustard Quail (*Turnix Sylvatica*), Curlew (*Numenius Arquata*), Barn or Screech Owl (*Tyto alba*), Indian Great Horned Owl (*Bubo Bubo*), Spot bellied eagle owl (*Bubo nepalinsis*), etc are found in moderate number due to large scale deforestation and hunting. Redlegged/Amur falcon (*Falco amurensis*), Grey peacock pheasant (*Polyplectron-bicalcaratun*) are also found.
TOTAL	**80**
PRIM-ATES	Primates like Slow loris (*Mycticebus coucang*), Assamese macaque (*Macaca assamensis*), Phayre's leaf monkey Trachypithecus (*Trachypithecus phayrei*) etc are found in sparse number due to over hunting.
TOTAL	**3**

REP-TILES	Python (*Reticulate python*), Land Tortoise (*Chelone imbricate*), lizards like the Rock Gecko (*Hemidactylus maculates*), Jerdons Calotes (*Calotes jerdoni),* Draco or Gliding Lizard (*Draco dussumieri*), Snakes like the king cobra (*Ophiophagus Hannah*), Bamboo Pit piper (*Trimeresurus gramineus*), Vine snake (*Ahaetulla nasuta*), Green keelback (*Macropisthodon plumbicolor*).
TOTAL	**9**
SKINKS	Snake skink (*Lygosoma punctatus*), Burmese glass snake (*Ophisaurus gracilis*), Common or Brahminy skink (*Mabuya carinata* Schneider), and Little skink (*Mabuya macularia* Blyth).
TOTAL	**4**
AMPHI-BIANS	Salamander (*Ambystoma maculatum*), Common Indian toad (*Bufo melanos tictus*), Malabar gliding frog (*Rhacophorus malabaricus*), Himalayan Torrent frog (*Amolops matmoratus*), Giant tree frog (*Rhacophorus maximus* Gunther), Skittering frog (*Euphlyctis cyanophlyctis* Schneider) etc are abundantly present.
TOTAL	**6**
AQUA-TIC SPECIES	*Channa orientalis, Schistura prashadi, Gara naganensis, Crossochilus latius,* Prawn *(Palaemon malcolmsoni), Mollusc, crab varieties like Rau, Pithia, Bahu, Mali, Nadani, Gagal, Chital, Barali, Ari etc* are also present.
TOTAL	**15**
FLORA	Hollock *(Terminalia myriocarpa* Huerek et Muell*),* Walnut tree (*Juglans regia*), Tanbark Oak (*Lithocarpus*), Goose berry (*Phyllanthus erispum*), Bauhinia (*Bauhinia variegate*), Mejankori (*Litsea citrate*), Poison oak (*Rhus griffithii*), Teak (*Tectona granfdis*), Uriam (*Bischofia javanica*), Sam (*Arto carpus chaplasha*), Coral tree (*Hovenia acerba),* Palmyra palm (*Borassus flabellifer*), Wild mango (*Mangifera sylvatica*), Mango tree

	(*Mangifera indica*), Dalchini (*Cinnamomum zeylanicum*), Yongchak (*Parkia roxburghii*), Ajar (*Largerstroemia flos-reginae*), Semul (*Bombax cuba*), Bogi poma (*Chickrassia tabularis*), Fig (*Ficus cunia*), Siris (*Albizzia chinensis*), Kala Siris (*Albizzia lebbeck*), Naricol sopa (*Streblus indicus*), Harra (*Terminalia chebula.* Gaertn. Retz), Dhuna (*Canarium resiniferum* Brace ex.King), Jamun (*Eugenia jambolna*), Rubber tree (*Ficus elastic var.decora*.Roxb), Gahori sopa (*Taluma phelocarpa*), Bola (*Morus laevigata Wall ex.Brandis*), Jatipoma (*Cedrella toona*), Paroli (*Stereospermum chelonoides* DC), Thubi (*Trema orientalis.* L. Bl), Bhelu (*Tetrameles nudiflora* R.Br), Champa (*Michelia champaca,* L), Jamuk (*Syzgium cumini*), Hilika (*Calamus erectus,* Roxb), Owtenga (*Dillenia indica*), Wild apple (*Docynia indica.* Wall Decne), Amla (*Embilica officinalis.*Gacerth*),* Jack Fruit tree (*Artocarpus heterophyllus.* Lam), Mundani (*Acrocarpus fraxinifolius*), Naga peanut (*Fermiana colorata*), Gogra/Needle tree (*Schima wallichi*), Nettle tree (*Trema orientalis*), Raspberry *(Rubus ellipticus*), Tita sopa (*Michelia champaca*), Nahor (*Mesua ferrea*), Gomari (*Gmelina arborea*), Sida (*Lanerstroemia parviflora*), Alder (*Alnus nepalensis)*, Amari (*Almora wallichi*), Satiana/Devil tree (*Alsstonia scholaris*), Agar (*Aquilaris agallocha*), Soap berry (*Sapindus rarak*), Khokan (*Duadanga grandiflora*), Oak (*Quercus serrata*), Ghora neem (*Melia composite),* Kadam (*Anthocephalus chinensis*), Korio (*Albittia procera),* Naga Tenga (*Rhus semialata*), Naga neem (*Axillaries spondias*), Neem tree (*Azadirachta indica*. A.Juss), Makai (*Shorea assamica*), Mundani (*Acrocarpus fraxinifolius*), Udal (*Sterculia villosa*), Hollong (*Dipterocarpous*), Bonsum (*Phoebe goalparensis*), Mechinga (*Zanthoxylum acanthopodium*) etc are present. Numerous medicinal plants species include Indian Aloe (*Aloe Vera*), Bowstring (*Marul Sanseviria Zeylanica*.Web), Poppy Plant Papaver (*Somniferum*), Sage (*Salvia Officinalis*), Dwarfnasturtum (*Tropa colum Majus*), Basil (*Ocimum Basilium*), Percian lilae (*Melia Azedarach.* Linn), Snakker Root (*Serpentaria*. Linn), Mint (*Mentaa Spicata.* Linn), Sweet flag (Acorus calamus. Linn), Mexican poppy (*Argemone Mexicana.*Linn), *Allium ampeloprassum, Distemon indicum, Hypoxis aurea*, Maiden hair fern

	(*Lantana camara*), Ginseng (*Panax Pseudoginseng*), Mulberry (*Morus nigra*), etc. Varieties of herbs and shrubs include wild tea (*camillea*), *Clerodendrum colebrookianum*, *Strobilanthus flaccidifolius*; *Ageratum conyzoides, Musa, Perilla frutescens, Colocasia esculenta, Houttuynia cordata*, Yam (*dioscorea bultifera*), Cucumber (*Cucumis sativus*), Pineapple (*Ananas comosus*), Passion fruit (*Passifforal edule*), Egg plant (*Solanum melongena),* Grapes (*Vitis vinefera), Zanthoxylum acanthopodium,* etc are found abundantly.etc are abundantly present. Varieties of bamboo species like the *Bambusa ballooa, Bambusa nutans, Bambusa pallida, Bambusa tulda, Denroclamus latiflorus, Dendrocalamus hamiltonii, Calamus floribundus, Calamus tenius, Arundo donax, Arundia hirsute, Livistonia jenkinsiana*. Griff*, Imperatacylindrica*. Beawb etc.
TOTAL	**112**

In addition to *Rhododendron arboretum* around 100 orchid species like the *Acampe papillosa, Aerides Odorat, Bulbophyllum affine, Bulbophyllum wallichi, Calanthe angusta, Dendrobium acinaforme, Dendrobium Jinkinsii, Eria bambusifolia, Vanda bicolor, Thunia marshalliana* etc. are found in Longkhum forests alone with a host of a few exotic species in the form of pinus species like the *cryptomeria japonica*.

2.2.2 ASETKONG RANGE

Asetkong range is the central range and is located between Milak and Menung rivers. The range runs in an East-West direction with Langpangkong range in the East, Ongpangkong range in the South, and Changkikong range in the North-West. As this range resemble an island and is consequently named as Asetkong. This range is comprised of 5 (five) recognized villages and small stations with a population of about 15,365 (**2011 Census**).

The average altitude of the range is 1100 meters above mean sea level, and is marked by the combination of rugged topography, soil condition, high rainfall and warm humid climate. The presence of natural vegetations which is found in relatively pristine state has been conducive in harboring numerous diversity of life forms in Asetkong range especially in Sangratsu village (1500 hectare), Longjang village (420 hectares) and Mopungchuket village (245 hectare) and having variety of numerous trees and plants species as shown in the following table.

Table: 2.2 ASETKONG RANGE

FAUNA	Sloth bear (*Sclenarctos)*, Elephant (*Elephas maximus* Linnaeus), Sambar (*Cerbus unicolor*), Indian buffalo (*Bubalus arnee*), Cow (*Bos indicus*,L), Wild boar (*Sus crestatus*), Spotted deer (*Axis axis*), Jungle cat (*Felis chaus Guldenstaedt*), Indian Porcupine (*Hystrix indica kerr*), Jackal (*Canis aureus Linnaeus*), Wolf (*Canis lupis*), Pangolin (*Manis crassicaudata*), Stag (*Carvus elaphus hanglu wagner*), Parking deer (*Cervulus muntjal*), Sloth (*Bradypus*), Leopard (*Panthera pardus*), Otter (*Lutra)*, Bat (*Rhnolophus)*, Squirrels (*Funambus*) including the Flying Squirrel (*Pteromyini or Petauristini)* etc are prominently found.
TOTAL	**20**
AVI--FAUNA	Red Jungle fowl (*Gallus gallus*), Jungle crow (*Cervus macroshynchos)*, Kaleej Pheasant (*Cophhura leucomelonos*), Great Indian Himalayan Barbet/ Great Barbet/ Great hill barbet (*Megalaina verens*), Large green Barbet (*Megalaima Zeylanica*), Lineated Barbet (*Megalaima Lineata*), Coppersmith barbet (*Megalaina haemacephala*), Black drongo (*Decrurs macrocerus*), Racket tailed drongo (*Dicrurus paradiseus*), Crow billed drongo (*Dicrurus annectans*), Tailor bird (*Orthotomos sturius*), Hoopoe (*Lepupa epops*), Yellow billed blue Magpie (*Cissa flavirostris*), Raven (*Corvus corax)*, Fairy bluebird (*Irena Puella*), Blackheaded yellow bulbul (*Pycnonotus melanicterus*), Redvented bulbul *(Pycnonotus cafer*), Whitcheeked bulbul (*Pycnonotus leucogenys*), Red whiskered bulbul

	(*Pycnonotus jocosus*), Black Bulbul (*Hypssipetes Madagascariensis*) Hill Myna (*Gracula religiosa*), Blue napped pitta (*Pitta Nipalensis*), Woodpecker (*Dendrocopos major*), Heartspotted woodpecker (*Hemicircus canente*), Grey Headed Woodpecker (*Picus Canus*), Black Backed Woodpecker (*Chrysocolaptes Festivus*), Great Black Woodpecker (*Dryocopus javensis),* Heartspotted woodpecker (*Hemicircus canente*)), Whitbacked Munia (*Lonchura striata),* Grey shrike (*Lanius excubitor*), Grey partridges (*Perdix perdix*), Cuckoo Summer/ Cuckoo (*Cuculus Canorus*), Indian Bay Banded Cuckoo (*Cacomantis Sonneratin*), Indian Drongo Cuckoo (*Surniculus lugubris*), Koel (*Eudynamys scolopacea),* Shallow (*Hirundorustica*), Bar Tailed Cuckoo Dove *(Macropygia Unchall),* Emerald or Bronzedwinged dove (*Chalcophaps indica*), Rufous Turtle dove *(Streptopelia Orientalis),* Spotted Dove *(Streptopelia Chinnensis),* Pin Tailed Green Pigeon (*Treron Apicaulda*), Nilgiri Wood Pigeon (*Columba Elphinstonii*),Green Fronted Green Pigeon *(Treron pompadora),* Blue Rock pigeon *(Columbia livia),* Ashy wood pigeon (*Columbus pulchricollis*), White spotted fantail flycatcher (*Rhipidura albicollis*), Rufous tailed finch-lark (*Ammomanes Phoenicurus*), Sand lark (*Calandrella Raytal*), Rufous bellied Babbler (*Dumetia Hyperythra),* Silver eared Mesia (*Leiothrix argentowris*), Slaty headed scimitar babbler (*Pomatorhinus horsfieldi*), White crested laughing thrush (*Garrulax leucolophus*), Rufousbellied Niltava (*Musicapa Sundara),* Ashy wren-warbler (*Prinia socialis*), Magpie-robin (*Copsychus saularis*), Yellow backed sunbird *(Aethopyga),* Purple sunbird (*Nectarinia Asiatic*), Streaked spider-hunter (*Arachnothera magna*), House sparrow (*Passer domesticus*), Common pariah kite (*Milvus migrans govinda*), House swift (*Apus affinus, cliffs),* Roller or blue jay (*Coracias benghalensis*), Tree pie (*Dendrocitta vagabunda*), Scarlet minivet (*Pericrocotus flammeus*), Pied bushchat (*Saxicola caprata*), Grey wagtail (*Motocilla cinerea*), Southern Trogan (*Harpactes Fasciatus*), Chestedheaded Bee-eater (*Meoops Leschenaulti*), Black Bittern (*Ixobry chus flavicallis*), White-eyed buzzard (*Bustator Teesa*), Common or Grey Quail (*Coturnix Coturnix*), Blue Breasted Quail (*Coturnix Chinensis*), Painted Bush Quail (*Perdicula Erythourhyncha*), Little Bustard Quail

	(*Turnix Sylvatica*), Curlew (*Numenius Arquata*), Barn or Screech Owl (*Tyto alba*), Indian Great Horned Owl (*Bubo Bubo*), Spot bellied eagle owl (*Bubo nepalinsis*), Common Pea Fowl (*Pavo cris Tatus*), Rosecringed Parakeet *(Psittacula Krameri),* Alexandrine or large Indian Parakeet *(Psittacula Eupatria)* etc are found in moderate number due to large scale deforestation and hunting. Redlegged/Amur falcon (*Falco amurensis*), Grey peacock pheasant (*Polyplectron-bicalcaratun*) are also found.
TOTAL	**83**
PRIM-ATES	Slow loris (*Mycticebus coucang*), Assamese macaque (*Macaca assamensis*), Phayre's leaf monkey Trachypithecus (*Trachypithecus phayrei*) etc are found in sparse number due to over hunting.
TOTAL	**3**
REP-TILES	Land Tortoise (*Chelone imbricate*), lizards like the Rock Gecko (*Hemidactylus maculates*), Jerdons Calotes (*Calotes jerdoni),* Draco or Gliding Lizard (*Draco dussumieri*), Snakes like the King cobra (*Ophiophagus Hannah*), Bamboo Pit piper (*Trimeresurus gramineus*), Vine snake (*Ahaetulla nasuta*), Green keelback (*Macropisthodon plumbicolor*), Blind snakes (*Typhlops),* Indian python (*Python molurus*), common kukri snake (*Oligodon Arnensis*), Indian cobra *(Naja naja)* etc.
TOTAL	**12**
SKINKS	Snake skink (*Lygosoma punctatus*), Burmese glass snake (*Ophisaurus gracilis*), Common or Brahminy skink (*Mabuya carinata* Schneider) and Little skink (*Mabuya macularia* Blyth).
TOTAL	**4**
AMPHI-BIANS	Salamander (*Ambystoma maculatum*), Common Indian toad (*Bufo melanos tictus*), Malabar gliding frog (*Rhacophorus malabaricus*), Himalayan Torrent frog (*Amolops matmoratus*), Giant tree frog (*Rhacophorus maximus* Gunther), Skittering frog (*Euphlyctis cyanophlyctis* Schneider) etc are abundantly present.
TOTAL	**6**

AQUA-TIC SPECIES	*Channa orientalis, Schistura prashadi, Gara naganensis, Crossochilus latius,* Prawn *(Palaemon malcolmsoni), Mollusc, crab varieties like Rau, Pithia, Bahu, Mali, Nadani, Gagal, Chital, Barali, Ari etc* are also present.
TOTAL	**15**
FLORA	Betel nut tree (*Areca catechu*), Hollock *(Terminalia myriocarpa* Huerek et Muell*),* Walnut tree (*Juglans regia*), Tanbark Oak (*Lithocarpus*), Goose berry (*Phyllanthus erispum*), Bauhinia (*Bauhinia variegate*), Mejankori (*Litsea citrate*), Poison oak (*Rhus griffithii*), Teak (*Tectona granfdis*), Uriam (*Bischofia javanica*), Sam (*Arto carpus chaplasha*), Coral tree (*Hovenia acerba),* Palmyra palm (*Borassus flabellifer*), Wild mango (*Mangifera sylvatica*), Mango tree (*Mangifera indica*), Dalchini (*Cinnamomum zeylanicum*), Yongchak (*Parkia roxburghii*), Ajar (*Largerstroemia flos-reginae*), Semul (*Bombax cuba*), Bogi poma (*Chickrassia tabularis*), Fig (*Ficus cunia*), Siris (*Albizzia chinensis*), Kala Siris (*Albizzia lebbeck*), Naricol sopa (*Streblus indicus*), Harra (*Terminalia chebula.* Gaertn. Retz), Dhuna (*Canarium resiniferum* Brace ex.King), Jamun (*Eugenia jambolna*), Rubber tree (*Ficus elastic var.decora*.Roxb), Gahori sopa (*Taluma phelocarpa*), Bola (*Morus laevigata Wall ex.Brandis*), Jatipoma (*Cedrella toona*), Paroli (*Stereospermum chelonoides* DC), Thubi (*Trema orientalis.* L. Bl), Bhelu (*Tetrameles nudiflora* R.Br), Champa (*Michelia champaca,* L), Jamuk (*Syzgium cumini*), Hilika (*Calamus erectus,* Roxb), Owtenga (*Dillenia indica*), Wild apple (*Docynia indica.* Wall Decne), Amla (*Embilica officinalis*.Gacerth*),* Jack Fruit tree (*Artocarpus heterophyllus.* Lam), Mundani (*Acrocarpus fraxinifolius*), Naga peanut (*Fermiana colorata*), Gogra/Needle tree (*Schima wallichi*), Nettle tree (*Trema orientalis*), Raspberry *(Rubus ellipticus*), Tita sopa (*Michelia champaca*), Nahor (*Mesua ferrea*), Gomari (*Gmelina arborea*), Sida (*Lanerstroemia parviflora*), Alder (*Alnus nepalensis),* Amari (*Almora wallichi*), Satiana/Devil tree (*Alsstonia scholaris*), Agar (*Aquilaris agallocha*), Soap berry (*Sapindus rarak*), Khokan (*Duadanga grandiflora*), Oak (*Quercus serrata*), Ghora neem (*Melia composite),* Kadam

	(*Anthocephalus chinensis*), Korio (*Albittia procera)*, Naga Tenga (*Rhus semialata*), Naga neem (*Axillaries spondias*), Neem tree (*Azadirachta indica*. A.Juss), Makai (*Shorea assamica*), Mundani (*Acrocarpus fraxinifolius*), Udal (*Sterculia villosa*), Hollong (*Dipterocarpous*), Bonsum (*Phoebe goalparensis*), Mechinga (*Zanthoxylum acanthopodium*) etc are present. Numerous medicinal plants species include Indian Aloe (*Aloe Vera*), Bowstring (*Marul Sanseviria Zeylanica*.Web), Poppy Plant Papaver (*Somniferum*), Sage (*Salvia Officinalis*), Dwarfnasturtum (*Tropa colum Majus*), Basil (*Ocimum Basilium*), Percian lilae (*Melia Azedarach.* Linn), Snakker Root (*Serpentaria*. Linn), Mint (*Mentaa Spicata.* Linn), Sweet flag (Acorus calamus. Linn), Mexican poppy (*Argemone Mexicana.*Linn), *Allium ampeloprassum, Distemon indicum, Hypoxis aurea*, Maiden hair fern (*Lantana camara*), Ginseng (*Panax Pseudoginseng*), Mulberry (*Morus nigra*), etc. Varieties of herbs and shrubs include wild tea (*camillea*), *Clerodendrum colebrookianum*, *Strobilanthus flaccidifolius*; *Ageratum conyzoides, Musa, Perilla frutescens, Colocasia esculenta, Houttuynia cordata*, Yam (*dioscorea bultifera*), Cucumber (*Cucumis sativus*), Pineapple (*Ananas comosus*), Passion fruit (*Passifforal edule*), Egg plant (*Solanum melongena)*, Grapes (*Vitis vinefera)*, *Zanthoxylum acanthopodium*, etc are found abundantly.etc are abundantly present. Varieties of bamboo species like the *Bambusa ballooa, Bambusa nutans, Bambusa pallida, Bambusa tulda, Denroclamus latiflorus, Dendrocalamus hamiltonii, Calamus floribundus, Calamus tenius, Arundo donax, Arundia hirsute, Livistonia jenkinsiana*. Griff, *Imperatacylindrica*. Beawb etc.
TOTAL	**113**

In addition to this, approximately 100 Orchids species like (*Dendrobium densiflorum*), Cymbidium orchid (*Cymbidium longifolium*), Blue vandal (*Vanda coerula*) etc are present abundantly.

'Community Biodiversity Reserve' in almost all the villages of Asetkong range especially in Mopungchuket village like the `Yangermanglupok' (Core zone), `Nashimer', `Aidang' and `Shirkimong' (Buffer zone) as Reserved Forests. Besides `Shengtakba Lopok' (10,000 acres) and 'Yimlipang Ba' (500 hectares) as the Community Biodiversity site and the inaccessible thick forest of 'Longpak sep' near the bank of Milak river and `Salangtemok' a pristine thick forest which makes up to a total of approximately 10600-10800 acres in Longjang village. Moreover villages like Longpha (28 hectares) and Chami (90 hectares) in the Asetkong range are having substantial amount of forest cover supporting variety of Biodiversity.

2.2.3 LANGPANGKONG RANGE

Langpangkong range is the easternmost range and is spread like a bed in resemblance and the name is known as Langpangkong (bed like range). This range dodging with the course of the Dikhu River forms a natural boundary line of the Mokokchung district with Tuensang and Mon district. It has 18 villages and has a total population of about 22,444 (**2011 Census**). The National Highway No.61 stretches through almost the entire length of the range covering about 85 kms. The Langpangkong range of Mokokchung district has large dense forest cover supporting rich diversity of flora and fauna. Some of the important fauna, avi-fauna, primates, reptiles, skinks, amphibians, aquatic species and floral species are shown in the following table.

Table: 2.3 LANGPANGKONG RANGE

	Sloth (*Bradypus*), Sambar (*Cerbus unicolor*), Pangolin *(Manis tricespis*), Squirrel (*Funambus),* including the Flying Squirrel (*Pteromyini or Petauristini),* Mithun (*Bos frontalis*), Porcupine *(Hystrix bengalensis*), Mole(*Talpa*),Lemur (*Lemur catta*),Fox (*Vulpes Vulpes*),Bat (*Rhnolophus*), Wolf (*Canis lupus*), Dingo (*Canis Dingo*), Otter *(Lutra*), Mongoose

FAUNA	(*Herpester bengalensis),* Wildboar (*Sus crestatus*), Leopard (*Panthera pardus*),Tiger (*Panthera tigris*),Sloth bear(*Sclenarctos),*Elephant (*Elephas maximus* Linnaeus), Spotted deer (*Axis axis*), Jungle cat (*Felis chaus Guldenstaedt*), Jackal (*Canis aureus Linnaeus*), Stag (*Carvus elaphus hanglu wagner*), Parking deer (*Cervulus muntjal*), Wild Goat (*Capra hircus Linnaeus*), Indian buffalo (*Bubalus arnee*), Cow (*Bos indicus,*L) etc are prominently found.
TOTAL	**28**
AVI-FAUNA	Pink-head duck (*Netta caryophyllacea*), Geese, Duck, Snipe (*Gallinago delicata*), Wood cock (*Scolopax minor*), Plover hawks, Magoie, Hoopoe (*Lepupa epops*),Nightingale (*Luscinia megarhynchos*), Tailor bird (*Orthotomos Sutorius*), Spotted munia (*Longchura punctulata*), White peck munia (*Longchura striata*), Crimsonbreasted barbet/Coppersmith barbet (*Megalaima haemacephala*), Barn or Screech Owl (*Tyto alba*), Indian Great Horned Owl (*Bubo Bubo*), Spot bellied eagle owl (*Bubo nepalinsis*), Red Jungle fowl (*Gallus gallus*), Common Pea Fowl (*Pavo cris tatus*), Jungle crow *(Cervus macroshynchos),* Kaleej Pheasant (*Cophhura leucomelonos*), Great Indian Himalayan Barbet/ Great Barbet/ Great hill barbet (*Megalaina verens*), Large green Barbet (*Megalaima Zeylanica*), Lineated Barbet (*Megalaima Lineata*), Blue napped pitta (*Pitta Nipalensis*), Black drongo (*Decrurs macrocerus*), Racket tailed drongo (*Dicrurus paradiseus*), Crow billed drongo (*Dicrurus annectans*), Hill Myna (*Gracula religiosa*), Yellow billed blue Magpie (*Cissa flavirostris*), Raven (*Corvus corax*), Fairy bluebird (*Irena Puella*), Blackheaded yellow bulbul (*Pycnonotus melanicterus*), Redvented bulbul (*Pycnonotus cafer*), Whitcheeked bulbul (*Pycnonotus leucogenys*), Red whiskered bulbul (*Pycnonotus jocosus*), Black Bulbul (*Hypssipetes Madagascariensis*), Woodpecker (*Dendrocopos major*), Heartspotted woodpecker (*Hemicircus canente*), Grey Headed Woodpecker (*Picus Canus*), Black Backed Woodpecker (*Chrysocolaptes Festivus*), Great Black Woodpecker (*Dryocopus javensis*), Rufous tailed finch-lark (*Ammomanes Phoenicurus*), Sand lark (*Calandrella Raytal*), Rufous bellied Babbler (*Dumetia*

	Hyperythra), Silver eared Mesia (*Leiothrix argentowris*), Slaty headed scimitar babbler (*Pomatorhinus horsfieldi*), White crested laughing thrush (*Garrulax leucolophus*), Rufousbellied Niltava (*Musicapa Sundara*), Ashy wren-Warbler (*Prinia socialis*), Magpie-robin (*Copsychus saularis*), Yellow backed sunbird (*Aethopyga*), Purple sunbird (*Nectarinia Asiatic*), Streaked spider-hunter (*Arachnothera magna*), House sparrow (*Passer domesticus*), Common pariah kite (*Milvus migrans govinda*), House swift (*Apus affinus*, cliffs), Roller or blue jay (*Coracias benghalensis*), Tree pie (*Dendrocitta vagabunda*), Scarlet minivet (*Pericrocotus flammeus*), Grey shrike (*Lannius excubitor*), Pied bushchat (*Saxicola caprata*), Grey wagtail (*Motocilla cinerea*), Southern Trogan (*Harpactes Fasciatus*), Chested headed Bee-eater (*Meoops Leschenaulti*), Black Bittern (*Ixobry chus flavicallis)*, White-eyed buzzard (*Bustator Teesa*), Common or Grey Quail (*Coturnix Coturnix*), Blue Breasted Quail (*Coturnix Chinensis),* Painted Bush Quail (*Perdicula Erythourhyncha*), Little Bustard Quail (*Turnix Sylvatica*), Curlew (*Numenius Arquata*), Pin Tailed Green Pigeon (*Treron Apicaulda*), Nilgiri Wood Pigeon (*Columba Elphinstonii*), Green Fronted Green Pigeon (*Treron pompadora*), Blue Rock pigeon (*Columbia livia*), Ashy wood pigeon (*Columbus pulchricollis*), Bar Tailed Cuckoo Dove (*Macropygia Unchall*), Emerald or Bronzedwinged dove (*Chalcophaps indica*), Rufous Turtle dove (*Streptopelia Orientalis*), Spotted Dove (*Streptopelia Chinnensis*), Rosecringed Parakeet (*Psittacula Krameri*), Alexandrine or large Indian Parakeet (*Psittacula Eupatria*), Grey wagtail (*Motocilla cinerea*), Scarlet Minivet (*Pericrocotus flammeus*), Hooded or Greenbreasted Pitta (*Pitta sordida*), Longtailed broadbill (*Psarisomus dalhousiae*), Brown headed storkbilled kingfisher (*Pelargopsis capensis*), Large green billed malkoha (*Rhopodytes tristis*), White-eye (*Zosterops palpebrosa*), White spotted fantail flycatcher (*Rhipidura albicollis*), Grey partridges *(Francolinus pondicerianus*), Cuckoo Summer/ Cuckoo (*Cuculus Canorus*), Indian Bay Banded Cuckoo (*Cacomantis Sonneratin*), Indian Drongo Cuckoo (*Surniculus lugubris*), Koel (*Eudynamys scolopacea*), Shallow (*Hirundorustica*). Besides Great Indian bustard (*Choriotis mgriceps*), Imperial Eagle (*Aquila Heliaca*), Black or King

	Vulture (*Sarcogyps Calvus*), Indian Griffon Vulture (*Gyps Fulvus*), Laggar Falcon (*Falco Biarmicus Jugger*), Malabar Grey Hornbill (*Tockus griseus*), Indian Pied Hornbill (*Anthracoceros Malabaricus*), Great Pied Hornbill (*Buceros bicornis*), Wreathed hornbill (*Rhyticeros undulates*) etc are found in sparse number due to large scale deforestation and hunting. Migratory bird like Redlegged/Amur falcon (*Falco amurensis*), Grey peacock pheasant (*Polyplectron-bicalcaratun*) are also found.
TOTAL	**107**
PRIM-ATES	Howling monkey *(Mycetes*), Slow loris (*Loris taroligradus*), Stump-tailed Macaque (*Macaca arctoides*), Macaque (*Macala mulatta*), Assamese Macaque (*Macaca assamensis*), Golden Languour (*Trachypithecus or Trachypithecus geei*), Capped Languour (*Trachypithecus or Trachypithecus pileatus*), Phayre's leaf monkey Trachypithecus (*Trachypithecus, phayrei).*
TOTAL	**8**
REP-TILES	River crocodile (*Crocodylus palustris*), Monitor lizard (*Varanus*), Rock gecko (*Hemidactylus maculates*), Flying lizard (*Droco volans*), House lizard (*Hemidactylus*), Southern forest gecko (*Hemidactylus anamallensis*), Jerdon's calotes (*Calotes jerdoni*), Draco or Gliding lizard (*Draco dussumieri*), Garden lizard (*Calotes Vessicolor*) etc. Besides, Turtle (*Eretmochelys imbricate*), Python *(Python reticulates*), Indian python (*Python molurus, Linnaeus*), Common worm or blind snake (*Ramphotyphlops braminus*), Blind snake or Diard's worm (*Typhlops diardii, Schlegal*), Common kukri snake (*Oligodon arnensis, Shaw*), Golden tree or Glidding snake (*Chrysopelea ornate, Shaw*), Green keelback (*Macropisthodon plumbicolor*), Common green whip snake or Vine snake (*Ahaetulla nasuta, Lacepede*), Albino Indian cobra or Indian cobra (*Naja naja, Linn*), King cobra or Hamadryad (*Ophiophagus Hannah, Cantor*), Green or Bamboo pit piper (*Trimeresurus gramineus*), Chameleon

	(*Ehamaeleo Oustezeti*), Batagur Terrapin or River Terrapin (*Batagur baska*), Land Tortoise (*Chelone imbricata*), Olive Ridley Turtle (*Lepidochelys olivacea, Eschscholte*) etc are abundantly present.
TOTAL	**25**
SKINKS	Little skink (*Mabuya macularia, Blyth*), Snake skink (*Lygosoma punctatus*), Common or Brahminy skink (*Mabuya carinata, Schneider*), Burmese glass skink (*Ophisaurus gracilis*), Himalayan skink (*Asymblepharus ladacensis Himalayanus, Gunther)*
TOTAL	**5**
AMPHI-BIANS	Salamander (*Ambystoma maculatum*), Common Indian toad (*Duttaphrynus melanostictus, Schneider),* Malabar Gliding frog (*Rhacophons malabaricus, Jerdon*), Giant tree frog (*Rhacophorus maximus, Gunther*), Himalayan torrent frog (*Amolops marmoratus, Blyth*), Skittering frog (*Euphlyctis cyanophlyctis, Schneider*) etc.
TOTAL	**6**
AQUA-TIC SPECIES	*Channa orientalis, Schistura prashadi, Gara naganensis, Crossochilus latius,* Prawn *(Palaemon malcolmsoni), Mollusc, crab varieties like Rau, Pithia, Bahu, Mali, Nadani, Gagal, Chital, Barali, Ari etc* are also present.
TOTAL	**15**
FLORA	Tea (*Camellia sinensis*), Rubber (*Fiscus elastica*) and Coffee (*Coffea Arabica*). Betel nut tree (*Areca catechu*), Coconut tree (*Cocos nucifera*), Walnut tree (*Juglans regia*), Tanbark Oak (*Lithocarpus*), Goose berry (*Phyllanthus erispum*), Poison oak (*Rhusgriffithii*), Nanga tenga (*Rhus semialata*), Teak (*Tectona granfdis*), Uriam (*Bischofia javanica*), Sam (*Arto carpus chaplasha*), Coral tree (*Hovenia acerba),* Palmyra palm (*Borassus flabellifer*), Wild mango (*Mangifera sylvatica*), Mango tree (*Mangifera indica*), Dalchini (*Cinnamomum zeylanicum*), Yongchak (*Parkia roxburghii*), Ajar (*Largerstroemia flos-reginae*), Semul (*Bombax cuba*), Bogi poma (*Chickrassia tabularis*), Fig (*Ficus cunia*), Siris (*Albizzia chinensis*), Kala Siris (*Albizzia lebbeck*), Naricol sopa (*Streblus indicus*), Harra (*Terminalia chebula (Gaertn) Retz*), Dhuna (*Canarium*

	resiniferum Brace ex.King), Jamun (*Eugenia jambolna*), Gahori sopa (*Taluma phelocarpa*), Bola (*Morus laevigata Wall ex.Brandis*), Jatipoma (*Cedrella toona*), Paroli (*Stereospermum chelonoides DC*), Thubi (*Trema orientalis (L.) Bl*), Champa (*Michelia champaca, L*), Jamuk (*Syzgium cumini*), Hilika (*Calamus erectus,Roxb*), Owtenga (*Dillenia indica*), Wild apple (*Docynia indica (Wall)Decne*), Amla (*Embilica officinalis,Gacerth),* Jack Fruit tree (*Artocarpus heterophyllus,Lam*), Mundani (*Acrocarpus fraxinifolius*), Naga peanut (*Fermiana colorata*), Gogra/Needle tree (*Schima wallichi*), Raspberry *(Rubus ellipticus*), Tita sopa (*Michelia champaca*), Nahor (*Mesua ferrea*), Gomari (*Gmelina arborea*), Sida (*Lanerstroemia parviflora*), Alder (*Alnus nepalensis),* Amari (*Almora wallichi*), Satiana/Devil tree (*Alsstonia scholaris*), Agar (*Aquilaris agallocha*), Walnut (*Juglans regia*), Soap berry (*Sapindus rarak*), Khokan (*Duadanga grandiflora*), Oak (*Quercus serrata*), Ghora neem (*Melia composite),* Kadam (*Anthocephalus chinensis*), Korio (*Albittia procera),* Naga Tenga (*Rhus semialata*), Bonsum (*Phoebe goalparensis*), etc are present. Varieties of bamboo species like the *Bambusa ballooa, Bambusa nutans, Bambusa pallida, Bambusa tulda, Dendrocalamus hamiltonii, Calamus floribundus, Arundo donax, Arundia hirsute* etc and numerous herbs and medicinal plants like Ginseng, Indian Aloe (*Aloe Vera*), Mulberry (*Morus nigra*), Maidenhair fern (*Adiantum capillus veheris*), Lantana (*Lantana camera*) etc are found in the region. Besides smaller plant species like Cucumber (*Cucumis sativus*), Pineapple (*Ananas comosus*), *Colocasia esculenia*, Yam (*Dioscerea bulbifera),* Passion fruit (*Passifforal edule*), Egg plant (*Solanum melongena),* Grapes (*Vitis vinefera), Zanthoxylum acanthopodium*, *Clerodendrum colebrookianum* etc are found abundantly.
TOTAL	**84**

Most of the villages in this range have earmarked certain portion of their forest land as Community Biodiversity and forest reserve such as the 'Kanglutu Biodiversity Reserve' (7060 hectare) at Changtongya village, where there is total prohibition on hunting and poaching. Such ventures have become a natural sanctuary for numerous wild animals and migratory birds especially the Amur falcon (*Falco amurensis*) migrating from Mongolia and Germany which have become a haven for bird watchers.

In addition, many of the villages like the Merangkong (500 hectare), Wamaken (1517 hectare), Kilingmen (700 hectare), Yaongyimsen (162 hectare), Chuchuyimlang (100 hectare), Mongsenyimti (510 hectare), Chakpa (216 hectare) in the Langpangkong range are having large tract of reserved forests.

2.2.4 CHANGKIKONG RANGE

It is a parallel range east of Japukong, which lies between two big rivers namely Milak in the East and Tzurang in the Western wide. The range comprises of nine villages. The basic statistics of 2011 census, shows the range have a population of approximately 7,316. Changkikong range is one of the richest spot of Biodiversity in Mokokochung district where many of the villages like Changki (9700 hectares), Dibuia (2600 hectares), Waromong (2100 hectares), Molongkimong (500 hectare), Mongchen (150 hectares), Khar (140 hectares), Alongkima (165 hectare) and Chungliyimsen (116 hectares) etc are reserving large tract of forest.

The type of vegetation found in the range is of mixed deciduous and evergreen forest; some of the common tree species are given in the table below. Inaccessible Reserve forest covers at `KaloMang' and `Tsurong valley', `Shamangla and Tenemtsuyong' at the Tzurong River have supported varieties of life forms. Changkikong range is known

for different kinds of rare birds and mammals, especially the presence of thick forests cover especially between Milak and Tsuzrong Rivers attract numerous fauna and avi-fauna in bulk to inhabit the forests. This kind of ambience provides a unique ecological balance in the region.

In addition to all the floral and faunal wealth, the forest of Changkikong range harbors various mineral resources such as coal - the principal mineral found in the region which is found in good amount at `Aleptoi', Jorbenna forest, Ani-yong and `Tsusu-yong pang' of Debuia village. Besides, calc-tufa, oil and gas seepages are also found in the western part of Dibuia.

Table: 2.4 CHANGKIKONG RANGE

FAUNA	Spotted deer (*Axis axis*), Parking deer (*Cervulus muntjac*), Wild boar (*Sus crestatus*), Lemur *(Lemur catta*), Pangolin (*Manis crassicaudata*), Dingo (*Canis dingo*), Howling monkey (*Mycetes*), Jungle cat (*Felischaus guldenstaedt*), Wolf (*Canis lupus*), Macaque (*Macala mulatta*), variety of squirrel *(Funambus*), Flying Squirrel (*Pteromyini* or *Petauristini),* Mole (*Talpa*), Pangolin (*Manis tricespis*), Porcupine (*Hystrix bengalensis*), Otter (*Lutra),* Mongoose *(Herpester bengalensis*) are found in huge number. Sloth (*Bradypus*), Sambar (*Cerbus unicolor*), Mithun (*Bos frontalis*), Fox (*Vulpes Vulpes*), Sloth bear (*Sclenarctos),* Jackal (*Canis aureus Linnaeus*), Stag (*Carvus elaphus hanglu wagner*), Wild Goat (*Capra hircus Linnaeus*), Indian buffalo (*Bubalus arnee*), Cow (*Bos indicus,* L) etc are prominently found. Leopard (*Panthera pardus*), Tiger (*Panthera tigris*) and Elephant *(Elephas maximus Linnaeus*) are also found in sparse numbers which are migrated from Assam. Bat (*Rhnolophus*) are found in ample amount in the

	thick Jungles and forests of the region.
TOTAL	**31**
AVI-FAUNA	Pink-head duck (*Netta caryophyllacea*), Geese, Duck, Snipe (*Gallinago delicata*), Wood cock (*Scolopax minor*), Plover hawks, Magoie, Hoopoe (*Lepupa epops*), Nightingale (*Luscinia megarhynchos*), Tailor bird (*Orthotomos Sutorius*), Spotted munia (*Longchura punctulata*), Whitepeckmunia(*Longchurastriata*),Crimsonbreastedbarbet/coppersmith barbet (*Megalaima haemacephala*), Barn or Screech Owl (*Tyto alba*), Indian Great Horned Owl (*Bubo Bubo*), Spot bellied eagle owl (*Bubo nepalinsis*), Red Jungle fowl (*Gallus gallus*), Common Pea Fowl (*Pavo cris Tatus*), Jungle crow (*Cervus macroshynchos*), Kaleej Pheasant (*Cophhura leucomelonos*), Great Indian Himalayan Barbet/ Great Barbet/ Great hill barbet (*Megalaina verens*), Large green Barbet (*Megalaima Zeylanica*), Lineated Barbet (*Megalaima Lineata*), Blue napped pitta (*Pitta Nipalensis*), Black drongo (*Decrurs macrocerus*), Racket tailed drongo (*Dicrurus paradiseus*), Crow billed drongo (*Dicrurus annectans*), Hill Myna (*Gracula religiosa*), Yellow billed blue Magpie (*Cissa flavirostris*), Raven (*Corvus corax*), Fairy bluebird (*Irena Puella*), Blackheaded yellow bulbul (*Pycnonotus melanicterus*), Redvented bulbul (*Pycnonotus cafer*), Whitcheeked bulbul (*Pycnonotus leucogenys*), Red whiskered bulbul (*Pycnonotus jocosus*), Black Bulbul (*Hypssipetes Madagascariensis*), Woodpecker (*Dendrocopos major*), Heartspotted woodpecker (*Hemicircus canente*), Grey Headed Woodpecker (*Picus Canus*), Black Backed Woodpecker (*Chrysocolaptes Festivus*), Great Black Woodpecker (*Dryocopus javensis*), Rufous tailed finch-lark (*Ammomanes Phoenicurus*), Sand lark (*Calandrella Raytal*), Rufous bellied Babbler (*Dumetia Hyperythra*), Silver eared Mesia (*Leiothrix argentowris*), Slaty headed scimitar babbler (*Pomatorhinus horsfieldi*), White crested laughing thrush (*Garrulax leucolophus*), Rufousbellied Niltava (*Musicapa Sundara*), Ashy wren-Warbler (*Prinia socialis*), Magpie-robin (*Copsychus saularis*), Yellow backed sunbird (*Aethopyga*),

	Purple sunbird (*Nectarinia Asiatic*), Streaked spider-hunter (*Arachnothera magna*), House sparrow (*Passer domesticus*), Common pariah kite (*Milvus migrans govinda*), House swift (*Apus affinus*, cliffs), Roller or blue jay (*Coracias benghalensis*), Tree pie (*Dendrocitta vagabunda*), Scarlet minivet (*Pericrocotus flammeus*), Grey shrike (*Lannius excubitor*), Pied bushchat (*Saxicola caprata*), Grey wagtail (*Motocilla cinerea*), Southern Trogan (*Harpactes Fasciatus*), Chestedheaded Bee-eater (*Meoops Leschenaulti*), Black Bittern (*Ixobry chus flavicallis*), White-eyed buzzard (*Bustator Teesa*), Common or Grey Quail (*Coturnix Coturnix*), Blue Breasted Quail (*Coturnix Chinensis*), Painted Bush Quail (*Perdicula Erythourhyncha*), Little Bustard Quail (*Turnix Sylvatica*), Curlew (*Numenius Arquata*), Pin Tailed Green Pigeon (*Treron Apicaulda),* Nilgiri Wood Pigeon (*Columba Elphinstonii),* Green Fronted Green Pigeon (*Treron pompadora*), Blue Rock pigeon (*Columbia livia),* Ashy wood pigeon (*Columbus pulchricollis),* Bar Tailed Cuckoo Dove (*Macropygia Unchall*), Emerald or Bronzedwinged dove (*Chalcophaps indica*), Rufous Turtle dove (*Streptopelia Orientalis*), Spotted Dove (*Streptopelia Chinnensis*), Rosecringed Parakeet (*Psittacula Krameri*), Alexandrine or large Indian Parakeet (*Psittacula Eupatria*), Grey wagtail (*Motocilla cinerea*), Scarlet Minivet (*Pericrocotus flammeus*), Hooded or Greenbreasted Pitta (*Pitta sordida*), Longtailed broadbill (*Psarisomus dalhousiae*), Brown headed storkbilled kingfisher (*Pelargopsis capensis*), Large green billed malkoha (*Rhopodytes tristis*), White-eye (*Zosterops palpebrosa*),White spotted fantail flycatcher (*Rhipidura albicollis*), Grey partridges (*Francolinus pondicerianus*), Cuckoo Summer/ Cuckoo (*Cuculus Canorus*), Indian Bay Banded Cuckoo (*Cacomantis Sonneratin*), Indian Drongo Cuckoo (*Surniculus lugubris*), Koel (*Eudynamys scolopacea*), Shallow (*Hirundorustica*). Besides Great Indian bustard (*Choriotis mgriceps*), Imperial Eagle (*Aquila Heliaca*), Black or King Vulture (*Sarcogyps Calvus*), Indian Griffon Vulture (*Gyps Fulvus*), Laggar Falcon (*Falco Biarmicus Jugger)* are present in good number. Rufous Necked Hornbill (*Aceros nipalensis*), Malabar Grey Hornbill (*Tockus griseus*), Indian Pied Hornbill (*Anthracoceros Malabaricus*),

	Great Pied Hornbill (*Buceros bicornis*), Wreathed hornbill (*Rhyticeros undulates*) etc are found in sparse number due to large scale deforestation and hunting. Migratory bird like Redlegged/Amur falcon (*Falco amurensis*), Grey peacock pheasant (*Polyplectron-bicalcaratun*) are also found.
TOTAL	**108**
PRIM-ATES	Howling monkey *(Mycetes*), Slow loris (*Loris taroligradus*), Stump-tailed Macaque (*Macaca arctoides*), Macaque (*Macala mulatta*), Assamese Macaque (*Macaca assamensis*), Golden Languour (*Trachypithecus or Trachypithecus geei*), Capped Languour (*Trachypithecus or Trachypithecus pileatus*), Phayre's leaf monkey Trachypithecus (*Trachypithecus, phayrei).*
TOTAL	**8**
REP-TILES	River crocodile (*Crocodylus palustris*), Monitor lizard (*Varanus*), Rock gecko (*Hemidactylus maculates*), Flying lizard (*Droco volans*), House lizard (*Hemidactylus*), Southern forest gecko (*Hemidactylus anamallensis*), Jerdon's calotes (*Calotes jerdoni*), Draco or Gliding lizard (*Draco dussumieri*), Garden lizard (*Calotes Vessicolor*) etc. Besides, Turtle (*Eretmochelys imbricate*), Python *(Python reticulates*), Indian python (*Python molurus, Linnaeus*), Common worm or blind snake (*Ramphotyphlops braminus*), Blind snake or Diard's worm (*Typhlops diardii, Schlegal*), Common kukri snake (*Oligodon arnensis, Shaw*), Golden tree or Glidding snake (*Chrysopelea ornate, Shaw*), Green keelback (*Macropisthodon plumbicolor*), Common green whip snake or Vine snake (*Ahaetulla nasuta, Lacepede*), Albino Indian cobra or Indian cobra (*Naja naja, Linn*), King cobra or Hamadryad (*Ophiophagus Hannah, Cantor*), Green or Bamboo pit piper (*Trimeresurus gramineus*), Chameleon (*Ehamaeleo Oustezeti*), Batagur Terrapin or River Terrapin (*Batagur baska*), Land Tortoise (*Chelone imbricata*), Olive Ridley Turtle (*Lepidochelys olivacea, Eschscholte*) etc are abundantly present.
TOTAL	**25**

SKINKS	Little skink (*Mabuya macularia, Blyth*), Snake skink (*Lygosoma punctatus*), Common or Brahminy skink (*Mabuya carinata, Schneider*), Burmese glass skink (*Ophisaurus gracilis*), Himalayan skink (*Asymblepharus ladacensis Himalayanus, Gunther).*
TOTAL	**5**
AMPHI-BIANS	Salamander (*Ambystoma maculatum*), Common Indian toad (*Duttaphrynus melanostictus, Schneider),* Malabar Gliding frog (*Rhacophons malabaricus, Jerdon*), Giant tree frog (*Rhacophorus maximus, Gunther*), Himalayan torrent frog (*Amolops marmoratus, Blyth*), Skittering frog (*Euphlyctis cyanophlyctis, Schneider*) etc.
TOTAL	**6**
AQUA-TIC SPECIES	*Channa orientalis, Schistura prashadi, Gara naganensis, Crossochilus latius,* Prawn *(Palaemon malcolmsoni), Mollusc, crab varieties like Rau, Pithia, Bahu, Mali, Nadani, Gagal, Chital, Barali, Ari etc* are also present.
TOTAL	**15**
FLORA	Betel nut tree (*Areca catechu*), Hollock *(Terminalia myriocarpa* Huerek et Muell*),* Coconut tree (*Cocos nucifera*), Walnut tree (*Juglans regia*), Tanbark Oak (*Lithocarpus*), Goose berry (*Phyllanthus erispum*), Bauhinia (*Bauhinia variegate*), Mejankori (*Litsea citrate*), Poison oak (*Rhus griffithii*), Teak (*Tectona granfdis*), Uriam (*Bischofia javanica*), Sam (*Arto carpus chaplasha*), Coral tree (*Hovenia acerba),* Palmyra palm (*Borassus flabellifer*), Wild mango (*Mangifera sylvatica*), Mango tree (*Mangifera indica*), Dalchini (*Cinnamomum zeylanicum*), Yongchak (*Parkia roxburghii*), Ajar (*Largerstroemia flos-reginae*), Semul (*Bombax cuba*), Bogi poma (*Chickrassia tabularis*), Fig (*Ficus cunia*), Siris (*Albizzia chinensis*), Kala Siris (*Albizzia lebbeck*), Naricol sopa (*Streblus indicus*), Harra (*Terminalia chebula.* Gaertn. Retz), Dhuna (*Canarium resiniferum* Brace ex.King), Jamun (*Eugenia jambolna*), Rubber tree (*Ficus elastic var.decora*.Roxb), Gahori sopa (*Taluma phelocarpa*), Bola (*Morus laevigata Wall ex.Brandis*), Jatipoma (*Cedrella toona*), Paroli

	(*Stereospermum chelonoides* DC), Thubi (*Trema orientalis.* L. Bl), Bhelu (*Tetrameles nudiflora* R.Br), Champa (*Michelia champaca,* L), Jamuk (*Syzgium cumini*), Hilika (*Calamus erectus,* Roxb), Owtenga (*Dillenia indica*), Wild apple (*Docynia indica.* Wall Decne), Amla (*Embilica officinalis.*Gacerth*),* Jack Fruit tree (*Artocarpus heterophyllus.* Lam), Mundani (*Acrocarpus fraxinifolius*), Naga peanut (*Fermiana colorata*), Gogra/Needle tree (*Schima wallichi*), Nettle tree (*Trema orientalis*), Raspberry *(Rubus ellipticus*), Tita sopa (*Michelia champaca*), Nahor (*Mesua ferrea*), Gomari (*Gmelina arborea*), Sida (*Lanerstroemia parviflora*), Alder (*Alnus nepalensis),* Amari (*Almora wallichi*), Satiana/Devil tree (*Alsstonia scholaris*), Agar (*Aquilaris agallocha*), Soap berry (*Sapindus rarak*), Khokan (*Duadanga grandiflora*), Oak (*Quercus serrata*), Ghora neem (*Melia composite),* Kadam (*Anthocephalus chinensis*), Korio (*Albittia procera),* Naga Tenga (*Rhus semialata*), Naga neem (*Axillaries spondias*), Neem tree (*Azadirachta indica*. A.Juss), Makai (*Shorea assamica*), Mundani (*Acrocarpus fraxinifolius*), Udal (*Sterculia villosa*), Hollong (*Dipterocarpous*), Bonsum (*Phoebe goalparensis*), Mechinga (*Zanthoxylum acanthopodium*) etc are present. Numerous medicinal plants species include Indian Aloe (*Aloe Vera*), Bowstring (*Marul Sanseviria Zeylanica*.Web), Poppy Plant Papaver (*Somniferum*), Sage (*Salvia Officinalis*), Dwarfnasturtum (*Tropa colum Majus*), Basil (*Ocimum Basilium*), Percian lilae (*Melia Azedarach.* Linn), Snakker Root (*Serpentaria*. Linn), Mint (*Mentaa Spicata*. Linn), Sweet flag (Acorus calamus. Linn), Mexican poppy (*Argemone Mexicana*.Linn), *Allium ampeloprassum, Distemon indicum, Hypoxis aurea*, Maiden hair fern (*Lantana camara*), Ginseng (*Panax Pseudoginseng*), Mulberry (*Morus nigra*), etc. Varieties of herbs and shrubs include wild tea (*camillea*), *Clerodendrum colebrookianum*, *Strobilanthus flaccidifolius*; *Ageratum conyzoides, Musa, Perilla frutescens, Colocasia esculenta, Houttuynia cordata*, Yam (*dioscorea bultifera*), Cucumber (*Cucumis sativus*), Pineapple (*Ananas comosus*), Passion fruit (*Passifforal edule*), Egg plant (*Solanum melongena),* Grapes (*Vitis vinefera), Zanthoxylum acanthopodium*, etc are found abundantly.etc are abundantly present.

	Varieties of bamboo species like the *Bambusa ballooa, Bambusa nutans, Bambusa pallida, Bambusa tulda, Denroclamus latiflorus, Dendrocalamus hamiltonii, Calamus floribundus, Calamus tenius, Arundo donax, Arundia hirsute, Livistonia jenkinsiana*. Griff, *Imperatacylindrica*. Beawb etc.
TOTAL	**114**

2.2.5 JAPUKONG RANGE

Japukong range is the outermost regular range stretching from north-east to south-west lying to the interior (south) of the Tzurangkong. It lies at a stretch of approximately of 70 kms in length and its altitude varies from 150 to 950 meters above mean sea level. The name arises from the fact that a certain man was found drying cooked rice in the sun probably for preparing rice-bear or preserving as food. Japu, in mongsen dialect means drying rice. Thus the range is known as Japukong. At present this range has 18 villages.

The hilly tracts of dense Japukong forests particularly in the following villages are having large amount of pristine forests; Japu (7385 hectare), Yajang 'A' (200 hectare), Yajang 'C' (200 hectare), Lakhuni (136 hectare), Lirmen (600 hectare), Akumen (400 hectare), Changdang (128 hectare), Longjemdang (900 hectares), Changdang (128 hectares) etc.

The climate of the Japukong range is of warm-humid sub-tropical type resulting in the formation of dense and thick jungles supporting abundant diversity of flora, fauna and avi-faunal species. The presence of thick forest like 'Satsu Tangen' and 'Retongkong' (100 acres approximately) harbours numerous life forms especially elephant, leopard

(*Panthera pardus*) and tiger which are moderately present mostly migrated from Kaziranga Forest of Assam. The important perennial rivers like the Tzurang and Tzuyong supports large diversity of aquatic organisms.

Table: 2.5 JAPUKONG RANGE

FAUNA	Spotted deer (*Axis axis*), Parking deer (*Cervulus muntjac*), Wild boar (*Sus crestatus*), Lemur *(Lemur catta*), Pangolin (*Manis crassicaudata*), Dingo (*Canis dingo*), Howling monkey (*Mycetes*), Jungle cat (*Felischaus guldenstaedt*), Wolf (*Canis lupus*), Macaque (*Macala mulatta*), variety of squirrel *(Funambus*), Flying Squirrel (*Pteromyini or Petauristini),* Mole (*Talpa*), Pangolin (*Manis tricespis*), Porcupine (*Hystrix bengalensis*), Otter (*Lutra),* Mongoose *(Herpester bengalensis*) are found in huge number. Sloth (*Bradypus*), Sambar (*Cerbus unicolor*), Mithun (*Bos frontalis*), Fox (*Vulpes Vulpes*), Sloth bear (*Sclenarctos),* Jackal (*Canis aureus Linnaeus*), Stag (*Carvus elaphus hanglu wagner*), Wild Goat (*Capra hircus Linnaeus*), Indian buffalo (*Bubalus arnee*), Cow (*Bos indicus,*L) etc are prominently found. Leopard (*Panthera pardus*), Tiger (*Panthera tigris*) and Elephant *(Elephas maximus Linnaeus*) are also found in sparse numbers which are migrated from Assam. Bat (*Rhnolophus*) are found in ample amount in the thick Jungles and forests of the region.
TOTAL	**31**
AVI-FAUNA	Pink-head duck (*Netta caryophyllacea*), Geese, Duck , Snipe (*Gallinago delicata*), Wood cock (*Scolopax minor*), Plover hawks, Magoie, Hoopoe (*Lepupa epops*), Nightingale (*Luscinia megarhynchos*), Tailor bird (*Orthotomos Sutorius*), Spotted munia (*Longchura punctulata*), White peck munia (*Longchura striata*), Crimsonbreastedbarbet/coppersmith

	barbet (*Megalaima haemacephala*), Barn or Screech Owl (*Tyto alba*), Indian Great Horned Owl (*Bubo Bubo*), Spot bellied eagle owl (*Bubo nepalinsis*), Red Jungle fowl (*Gallus gallus*), Common Pea Fowl (*Pavo cris Tatus*), Jungle crow (*Cervus macroshynchos*), Kaleej Pheasant (*Cophhura leucomelonos*), Great Indian Himalayan Barbet/ Great Barbet/ Great hill barbet (*Megalaina verens*), Large green Barbet (*Megalaima Zeylanica*), Lineated Barbet (*Megalaima Lineata*), Blue napped pitta (*Pitta Nipalensis*), Black drongo (*Decrurs macrocerus*), Racket tailed drongo (*Dicrurus paradiseus*), Crow billed drongo (*Dicrurus annectans*), Hill Myna (*Gracula religiosa*), Yellow billed blue Magpie (*Cissa flavirostris*), Raven (*Corvus corax*), Fairy bluebird (*Irena Puella*), Blackheaded yellow bulbul (*Pycnonotus melanicterus*), Redvented bulbul (*Pycnonotus cafer*), Whitcheeked bulbul (*Pycnonotus leucogenys*), Red whiskered bulbul (*Pycnonotus jocosus*), Black Bulbul (*Hypssipetes Madagascariensis*), Woodpecker (*Dendrocopos major*), Heartspotted woodpecker (*Hemicircus canente*), Grey Headed Woodpecker (*Picus Canus*), Black Backed Woodpecker (*Chrysocolaptes Festivus*), Great Black Woodpecker (*Dryocopus javensis*), Rufous tailed finch-lark (*Ammomanes Phoenicurus*), Sand lark (*Calandrella Raytal*), Rufous bellied Babbler (*Dumetia Hyperythra*), Silver eared Mesia (*Leiothrix argentowris*), Slaty headed scimitar babbler (*Pomatorhinus horsfieldi*), White crested laughing thrush (*Garrulax leucolophus*), Rufousbellied Niltava (*Musicapa Sundara*), Ashy wren-Warbler (*Prinia socialis*), Magpie-robin (*Copsychus saularis*), Yellow backed sunbird (*Aethopyga*), Purple sunbird (*Nectarinia Asiatic*), Streaked spider-hunter (*Arachnothera magna*), House sparrow (*Passer domesticus*), Common pariah kite (*Milvus migrans govinda*), House swift (*Apus affinus*, cliffs), Roller or blue jay (*Coracias benghalensis*), Tree pie (*Dendrocitta vagabunda*), Scarlet minivet (*Pericrocotus flammeus*), Grey shrike (*Lannius excubitor*), Pied bushchat (*Saxicola caprata*), Grey wagtail (*Motocilla cinerea*), Southern Trogan (*Harpactes Fasciatus*), Chestedheaded Bee-eater (*Meoops Leschenaulti*), Black Bittern (*Ixobry chus flavicallis*),

	White-eyed buzzard (*Bustator Teesa*), Common or Grey Quail (*Coturnix Coturnix*), Blue Breasted Quail (*Coturnix Chinensis*), Painted Bush Quail (*Perdicula Erythourhyncha*), Little Bustard Quail (*Turnix Sylvatica*), Curlew (*Numenius Arquata*), Pin Tailed Green Pigeon (*Treron Apicaulda),* Nilgiri Wood Pigeon (*Columba Elphinstonii),* Green Fronted Green Pigeon (*Treron pompadora*), Blue Rock pigeon (*Columbia livia),* Ashy wood pigeon (*Columbus pulchricollis),* Bar Tailed Cuckoo Dove (*Macropygia Unchall*), Emerald or Bronzedwinged dove (*Chalcophaps indica*), Rufous Turtle dove (*Streptopelia Orientalis*), Spotted Dove (*Streptopelia Chinnensis*), Rosecringed Parakeet (*Psittacula Krameri*), Alexandrine or large Indian Parakeet (*Psittacula Eupatria*), Grey wagtail (*Motocilla cinerea*), Scarlet Minivet (*Pericrocotus flammeus*), Hooded or Greenbreasted Pitta (*Pitta sordida*), Longtailed broadbill (*Psarisomus dalhousiae*), Brown headed storkbilled kingfisher (*Pelargopsis capensis*), Large green billed malkoha (*Rhopodytes tristis*), White-eye (*Zosterops palpebrosa*),White spotted fantail flycatcher (*Rhipidura albicollis*), Grey partridges (*Francolinus pondicerianus*), Cuckoo Summer/ Cuckoo (*Cuculus Canorus*), Indian Bay Banded Cuckoo (*Cacomantis Sonneratin*), Indian Drongo Cuckoo (*Surniculus lugubris*), Koel (*Eudynamys scolopacea*), Shallow (*Hirundorustica*). Besides Great Indian bustard (*Choriotis mgriceps*), Imperial Eagle (*Aquila Heliaca*), Black or King Vulture (*Sarcogyps Calvus*), Indian Griffon Vulture (*Gyps Fulvus*), Laggar Falcon (*Falco Biarmicus Jugger)* are present in good number. Rufous Necked Hornbill (*Aceros nipalensis*), Malabar Grey Hornbill (*Tockus griseus*), Indian Pied Hornbill (*Anthracoceros Malabaricus*), Great Pied Hornbill (*Buceros bicornis*), Wreathed hornbill (*Rhyticeros undulates*) etc are found in sparse number due to large scale deforestation and hunting. Migratory bird like Redlegged/Amur falcon (*Falco amurensis*), Grey peacock pheasant (*Polyplectron-bicalcaratun*) are also found.
TOTAL	**108**

PRIM-ATES	Howling monkey *(Mycetes*), Slow loris (*Loris taroligradus*), Stump-tailed Macaque (*Macaca arctoides*), Macaque (*Macala mulatta*), Assamese Macaque (*Macaca assamensis*), Golden Languour (*Trachypithecus or Trachypithecus geei*), Capped Languour (*Trachypithecus or Trachypithecus pileatus*), Phayre's leaf monkey Trachypithecus (*Trachypithecus, phayrei).*
TOTAL	**8**
REP-TILES	River crocodile (*Crocodylus palustris*), Monitor lizard (*Varanus*), Rock gecko (*Hemidactylus maculates*), Flying lizard (*Droco volans*), House lizard (*Hemidactylus*), Southern forest gecko (*Hemidactylus anamallensis*), Jerdon's calotes (*Calotes jerdoni*), Draco or Gliding lizard (*Draco dussumieri*), Garden lizard (*Calotes Vessicolor*) etc. Besides, Turtle (*Eretmochelys imbricate*), Python *(Python reticulates*), Indian python (*Python molurus, Linnaeus*), Common worm or blind snake (*Ramphotyphlops braminus*), Blind snake or Diard's worm (*Typhlops diardii, Schlegal*), Common kukri snake (*Oligodon arnensis, Shaw*), Golden tree or Glidding snake (*Chrysopelea ornate, Shaw*), Green keelback (*Macropisthodon plumbicolor*), Common green whip snake or Vine snake (*Ahaetulla nasuta, Lacepede*), Albino Indian cobra or Indian cobra (*Naja naja, Linn*), King cobra or Hamadryad (*Ophiophagus Hannah, Cantor*), Green or Bamboo pit piper (*Trimeresurus gramineus*), Chameleon (*Ehamaeleo Oustezeti*), Batagur Terrapin or River Terrapin (*Batagur baska*), Land Tortoise (*Chelone imbricata*), Olive Ridley Turtle (*Lepidochelys olivacea, Eschscholte*) etc are abundantly present.
TOTAL	**25**
SKINKS	Little skink (*Mabuya macularia, Blyth*), Snake skink (*Lygosoma punctatus*), Common or Brahminy skink (*Mabuya carinata, Schneider*), Burmese glass skink (*Ophisaurus gracilis*), Himalayan skink (*Asymblepharus ladacensis Himalayanus, Gunther)*
TOTAL	**5**

AMPHI-BIANS	Salamander (*Ambystoma maculatum*), Common Indian toad (*Duttaphrynus melanostictus, Schneider),* Malabar Gliding frog (*Rhacophons malabaricus, Jerdon*), Giant tree frog (*Rhacophorus maximus, Gunther*), Himalayan torrent frog (*Amolops marmoratus, Blyth*), Skittering frog (*Euphlyctis cyanophlyctis, Schneider*) etc.
TOTAL	**6**
AQUA-TIC SPECIES	*Channa orientalis, Schistura prashadi, Gara naganensis, Crossochilus latius,* Prawn *(Palaemon malcolmsoni), Mollusc, crab varieties like Rau, Pithia, Bahu, Mali, Nadani, Gagal, Chital, Barali, Ari etc* are also present.
TOTAL	**15**
FLORA	Betel nut tree (*Areca catechu*), Hollock *(Terminalia myriocarpa* Huerek et Muell*),* Coconut tree (*Cocos nucifera*), Walnut tree (*Juglans regia*), Tanbark Oak (*Lithocarpus*), Goose berry (*Phyllanthus erispum*), Bauhinia (*Bauhinia variegate*), Mejankori (*Litsea citrate*), Poison oak (*Rhus griffithii*), Teak (*Tectona granfdis*), Uriam (*Bischofia javanica*), Sam (*Arto carpus chaplasha*), Coral tree (*Hovenia acerba),* Palmyra palm (*Borassus flabellifer*), Wild mango (*Mangifera sylvatica*), Mango tree (*Mangifera indica*), Dalchini (*Cinnamomum zeylanicum*), Yongchak (*Parkia roxburghii*), Ajar (*Largerstroemia flos-reginae*), Semul (*Bombax cuba*), Bogi poma (*Chickrassia tabularis*), Fig (*Ficus cunia*), Siris (*Albizzia chinensis*), Kala Siris (*Albizzia lebbeck*), Naricol sopa (*Streblus indicus*), Harra (*Terminalia chebula.* Gaertn. Retz), Dhuna (*Canarium resiniferum* Brace ex.King), Jamun (*Eugenia jambolna*), Rubber tree (*Ficus elastic var.decora*.Roxb), Gahori sopa (*Taluma phelocarpa*), Bola (*Morus laevigata Wall ex.Brandis*), Jatipoma (*Cedrella toona*), Paroli (*Stereospermum chelonoides* DC), Thubi (*Trema orientalis.* L. Bl), Bhelu (*Tetrameles nudiflora* R.Br), Champa (*Michelia champaca,* L), Jamuk (*Syzgium cumini*), Hilika (*Calamus erectus,* Roxb), Owtenga (*Dillenia indica*),

	Wild apple (*Docynia indica.* Wall Decne), Amla (*Embilica officinalis.*Gacerth*)*, Jack Fruit tree (*Artocarpus heterophyllus.* Lam), Mundani (*Acrocarpus fraxinifolius*), Naga peanut (*Fermiana colorata*), Gogra/Needle tree (*Schima wallichi*), Nettle tree (*Trema orientalis*), Raspberry *(Rubus ellipticus*), Tita sopa (*Michelia champaca*), Nahor (*Mesua ferrea*), Gomari (*Gmelina arborea*), Sida (*Lanerstroemia parviflora*), Alder (*Alnus nepalensis)*, Amari (*Almora wallichi*), Satiana/Devil tree (*Alsstonia scholaris*), Agar (*Aquilaris agallocha*), Soap berry (*Sapindus rarak*), Khokan (*Duadanga grandiflora*), Oak (*Quercus serrata*), Ghora neem (*Melia composite)*, Kadam (*Anthocephalus chinensis*), Korio (*Albittia procera)*, Naga Tenga (*Rhus semialata*), Naga neem (*Axillaries spondias*), Neem tree (*Azadirachta indica*. A.Juss), Makai (*Shorea assamica*), Mundani (*Acrocarpus fraxinifolius*), Udal (*Sterculia villosa*), Hollong (*Dipterocarpous*), Bonsum (*Phoebe goalparensis*), Mechinga (*Zanthoxylum acanthopodium*) etc are present. Numerous medicinal plants species include Indian Aloe (*Aloe Vera*), Bowstring (*Marul Sanseviria Zeylanica*.Web), Poppy Plant Papaver (*Somniferum*), Sage (*Salvia Officinalis*), Dwarfnasturtum (*Tropa colum Majus*), Basil (*Ocimum Basilium*), Percian lilae (*Melia Azedarach.* Linn), Snakker Root (*Serpentaria*. Linn), Mint (*Mentaa Spicata.* Linn), Sweet flag (Acorus calamus. Linn), Mexican poppy (*Argemone Mexicana.*Linn), *Allium ampeloprassum, Distemon indicum, Hypoxis aurea,* Maiden hair fern (*Lantana camara*), Ginseng (*Panax Pseudoginseng*), Mulberry (*Morus nigra*), etc. Varieties of herbs and shrubs include wild tea (*camillea*), *Clerodendrum colebrookianum, Strobilanthus flaccidifolius*; *Ageratum conyzoides, Musa, Perilla frutescens, Colocasia esculenta, Houttuynia cordata*, Yam (*dioscorea bultifera*), Cucumber (*Cucumis sativus*), Pineapple (*Ananas comosus*), Passion fruit (*Passifforal edule*), Egg plant (*Solanum melongena)*, Grapes (*Vitis vinefera), Zanthoxylum acanthopodium*, etc are found abundantly.etc are abundantly present. Varieties of bamboo species like the *Bambusa ballooa, Bambusa*

	nutans, Bambusa pallida, Bambusa tulda, Denroclamus latiflorus, Dendrocalamus hamiltonii, Calamus floribundus, Calamus tenius, Arundo donax, Arundia hirsute, Livistonia jenkinsiana. Griff, *Imperatacylindrica*. Beawb etc.
TOTAL	**114**

2.2.6 TZURANGKONG RANGE

These are actually pimples of hillocks thrown at random adjoining the plains of Assam mostly along the valley of Dissai and the Jhanzi Rivers just before they debouch into the plains of Assam. The range borders with Assam and stretches for 15 kms from Tzurang River to Tzutapela police check gate. Tzurangkong derives its name from Tzurang River which not only demarcates but also flows downstream all along the Range towards Assam. The range is bordered with Japukong range on the East, with Wokha district on the west, with Assam on the North and with Japukong range on the South. The range enjoys a warm and humid climate with the hilly tracts of Japukong range looming on the East, besides the range is also blessed with scenic valleys and serpentine Tzurang River which flows downstream.

Tzurangkong range have huge territory of jungles and forests reserved in most of its villages; namely Moayimti (1051 hectare), Aokum (100 hectare), Medemyim (258 hectare), Chungtiayimsen (2500 hectare), Longpayimsen (6000 hectare), Molungyimsen (500 hectare), Molungkima (870 hectare) etc.

Tzurangkong forests are immensely rich in fauna and avi-faunal kingdom, perhaps because of its adjoining border with the forests of Assam. It is during floods in the neighboring parts of Assam, animals take refuge in the forests, besides the large tracts

of thick jungle and forests attract wild animals and birds to migrate from Nampha Forest in Solinijang district of Assam and also from Kaziranga National park. The presence of numerous perennial rivers; Wangtak, Tangyong, Linjayong, Dzesu etc has been conducive for the rich growth of aquatic plants and animals. Hornbill (*buceros biconis*) thought not extinct is very rarely found because of destruction of habitat and illegal hunting for its beautiful feathers threatening the species to live under severe threat of extinction

Table: 2.6 TZURANGKONG RANGE

FAUNA	Spotted deer (*Axis axis*), Parking deer (*Cervulus muntjac*), Wild boar (*Sus crestatus*), Lemur *(Lemur catta*), Pangolin (*Manis crassicaudata*), Dingo (*Canis dingo*), Howling monkey (*Mycetes*), Jungle cat (*Felischaus guldenstaedt*), Wolf (*Canis lupus*), Macaque (*Macala mulatta*), variety of squirrel *(Funambus*), Flying Squirrel (*Pteromyini or Petauristini),* Mole (*Talpa*), Pangolin (*Manis tricespis*), Porcupine (*Hystrix bengalensis*), Otter (*Lutra),* Mongoose *(Herpester bengalensis*) are found in huge number. Sloth (*Bradypus*), Sambar (*Cerbus unicolor*), Mithun (*Bos frontalis*), Fox (*Vulpes Vulpes*), Sloth bear (*Sclenarctos),* Jackal (*Canis aureus Linnaeus*), Stag (*Carvus elaphus hanglu wagner*), Wild Goat (*Capra hircus Linnaeus*), Indian buffalo (*Bubalus arnee*), Cow (*Bos indicus*,L) etc are prominently found. Leopard (*Panthera pardus*), Tiger (*Panthera tigris*) and Elephant *(Elephas maximus Linnaeus*) are also found in sparse numbers which are migrated from Assam. Bat (*Rhnolophus*) are found in ample amount in the thick Jungles and forests of the region.
TOTAL	**31**
	Pink-head duck (*Netta caryophyllacea*), Geese, Duck, Snipe (*Gallinago delicata*), Wood cock (*Scolopax minor*), Plover hawks, Magoie, Hoopoe

AVI-FAUNA	(*Lepupa epops*), Nightingale (*Luscinia megarhynchos*), Tailor bird (*Orthotomos Sutorius*), Spotted munia (*Longchura punctulata*), White peck munia (*Longchura striata*), Crimsonbreastedbarbet/coppersmith barbet (*Megalaima haemacephala*), Barn or Screech Owl (*Tyto alba*), Indian Great Horned Owl (*Bubo Bubo*), Spot bellied eagle owl (*Bubo nepalinsis*), Red Jungle fowl (*Gallus gallus*), Common Pea Fowl (*Pavo cris Tatus*), Jungle crow (*Cervus macroshynchos*), Kaleej Pheasant (*Cophhura leucomelonos*), Great Indian Himalayan Barbet/ Great Barbet/ Great hill barbet (*Megalaina verens*), Large green Barbet (*Megalaima Zeylanica*), Lineated Barbet (*Megalaima Lineata*), Blue napped pitta (*Pitta Nipalensis*), Black drongo (*Decrurs macrocerus*), Racket tailed drongo (*Dicrurus paradiseus*), Crow billed drongo (*Dicrurus annectans*), Hill Myna (*Gracula religiosa*), Yellow billed blue Magpie (*Cissa flavirostris*), Raven (*Corvus corax*), Fairy bluebird (*Irena Puella*), Blackheaded yellow bulbul (*Pycnonotus melanicterus*), Redvented bulbul (*Pycnonotus cafer*), Whitcheeked bulbul (*Pycnonotus leucogenys*), Red whiskered bulbul (*Pycnonotus jocosus*), Black Bulbul (*Hypssipetes Madagascariensis*), Woodpecker (*Dendrocopos major*), Heartspotted woodpecker (*Hemicircus canente*), Grey Headed Woodpecker (*Picus Canus*), Black Backed Woodpecker (*Chrysocolaptes Festivus*), Great Black Woodpecker (*Dryocopus javensis*), Rufous tailed finch-lark (*Ammomanes Phoenicurus*), Sand lark (*Calandrella Raytal*), Rufous bellied Babbler (*Dumetia Hyperythra*), Silver eared Mesia (*Leiothrix argentowris*), Slaty headed scimitar babbler (*Pomatorhinus horsfieldi*), White crested laughing thrush (*Garrulax leucolophus*), Rufousbellied Niltava (*Musicapa Sundara*), Ashy wren-Warbler (*Prinia socialis*), Magpie-robin (*Copsychus saularis*), Yellow backed sunbird (*Aethopyga*), Purple sunbird (*Nectarinia Asiatic*), Streaked spider-hunter (*Arachnothera magna*), House sparrow (*Passer domesticus*), Common pariah kite (*Milvus migrans govinda*), House swift (*Apus affinus*, cliffs), Roller or blue jay (*Coracias benghalensis*), Tree pie (*Dendrocitta vagabunda*), Scarlet minivet (*Pericrocotus flammeus*), Grey shrike (*Lannius excubitor*), Pied bushchat (*Saxicola caprata*), Grey wagtail (*Motocilla*

	cinerea), Southern Trogan (*Harpactes Fasciatus*), Chestedheaded Bee-eater (*Meoops Leschenaulti*), Black Bittern (*Ixobry chus flavicallis*), White-eyed buzzard (*Bustator Teesa*), Common or Grey Quail (*Coturnix Coturnix*), Blue Breasted Quail (*Coturnix Chinensis*), Painted Bush Quail (*Perdicula Erythourhyncha*), Little Bustard Quail (*Turnix Sylvatica*), Curlew (*Numenius Arquata*), Pin Tailed Green Pigeon (*Treron Apicaulda),* Nilgiri Wood Pigeon (*Columba Elphinstonii),* Green Fronted Green Pigeon (*Treron pompadora*), Blue Rock pigeon (*Columbia livia),* Ashy wood pigeon (*Columbus pulchricollis),* Bar Tailed Cuckoo Dove (*Macropygia Unchall*), Emerald or Bronzedwinged dove (*Chalcophaps indica*), Rufous Turtle dove (*Streptopelia Orientalis*), Spotted Dove (*Streptopelia Chinnensis*), Rosecringed Parakeet (*Psittacula Krameri*), Alexandrine or large Indian Parakeet (*Psittacula Eupatria*), Grey wagtail (*Motocilla cinerea*), Scarlet Minivet (*Pericrocotus flammeus*), Hooded or Greenbreasted Pitta (*Pitta sordida*), Longtailed broadbill (*Psarisomus dalhousiae*), Brown headed storkbilled kingfisher (*Pelargopsis capensis*), Large green billed malkoha (*Rhopodytes tristis*), White-eye (*Zosterops palpebrosa*),White spotted fantail flycatcher (*Rhipidura albicollis*), Grey partridges (*Francolinus pondicerianus*), Cuckoo Summer/ Cuckoo (*Cuculus Canorus*), Indian Bay Banded Cuckoo (*Cacomantis Sonneratin*), Indian Drongo Cuckoo (*Surniculus lugubris*), Koel (*Eudynamys scolopacea*), Shallow (*Hirundorustica*). Besides Great Indian bustard (*Choriotis mgriceps*), Imperial Eagle (*Aquila Heliaca*), Black or King Vulture (*Sarcogyps Calvus*), Indian Griffon Vulture (*Gyps Fulvus*), Laggar Falcon (*Falco Biarmicus Jugger)* are present in good number. Rufous Necked Hornbill (*Aceros nipalensis*), Malabar Grey Hornbill (*Tockus griseus*), Indian Pied Hornbill (*Anthracoceros Malabaricus*), Great Pied Hornbill (*Buceros bicornis*), Wreathed hornbill (*Rhyticeros undulates*) etc are found in sparse number due to large scale deforestation and hunting. Migratory bird like Redlegged/Amur falcon (*Falco amurensis*), Grey peacock pheasant (*Polyplectron-bicalcaratun*) are also found.
TOTAL	**108**

PRIM-ATES	Howling monkey *(Mycetes*), Slow loris (*Loris taroligradus*), Stump-tailed Macaque (*Macaca arctoides*), Macaque (*Macala mulatta*), Assamese Macaque (*Macaca assamensis*), Golden Languour (*Trachypithecus or Trachypithecus geei*), Capped Languour (*Trachypithecus or Trachypithecus pileatus*), Howling Monkey (Mycetes), Phayre's leaf monkey Trachypithecus (*Trachypithecus, phayrei)*
TOTAL	**8**
REP-TILES	River crocodile (*Crocodylus palustris*), Monitor lizard (*Varanus*), Rock gecko (*Hemidactylus maculates*), Flying lizard (*Droco volans*), House lizard (*Hemidactylus*), Southern forest gecko (*Hemidactylus anamallensis*), Jerdon's calotes (*Calotes jerdoni*), Draco or Gliding lizard (*Draco dussumieri*), Garden lizard (*Calotes Vessicolor*) etc. Besides, Turtle (*Eretmochelys imbricate*), Python *(Python reticulates*), Indian python (*Python molurus, Linnaeus*), Common worm or blind snake (*Ramphotyphlops braminus*), Blind snake or Diard's worm (*Typhlops diardii, Schlegal*), Common kukri snake (*Oligodon arnensis, Shaw*), Golden tree or Glidding snake (*Chrysopelea ornate, Shaw*), Green keelback (*Macropisthodon plumbicolor*), Common green whip snake or Vine snake (*Ahaetulla nasuta, Lacepede*), Albino Indian cobra or Indian cobra (*Naja naja, Linn*), King cobra or Hamadryad (*Ophiophagus Hannah, Cant*or), Green or Bamboo pit piper (*Trimeresurus gramineus*), Chameleon (*Ehamaeleo Oustezeti*), Batagur Terrapin or River Terrapin (*Batagur baska*), Land Tortoise (*Chelone imbricata*), Olive Ridley Turtle (*Lepidochelys olivacea, Eschscholte*) etc are abundantly present.
TOTAL	**25**
SKINKS	Little skink (*Mabuya macularia, Blyth*), Snake skink (*Lygosoma punctatus*), Common or Brahminy skink (*Mabuya carinata, Schneider*), Burmese glass skink (*Ophisaurus gracilis*), Himalayan skink (*Asymblepharus ladacensis Himalayanus, Gunther)* etc.
TOTAL	**5**

AMPHI-BIANS	Salamander (*Ambystoma maculatum*), Common Indian toad (*Duttaphrynus melanostictus, Schneider),* Malabar Gliding frog (*Rhacophons malabaricus, Jerdon*), Giant tree frog (*Rhacophorus maximus, Gunther*), Himalayan torrent frog (*Amolops marmoratus, Blyth*), Skittering frog (*Euphlyctis cyanophlyctis, Schneider*) etc.
TOTAL	**6**
AQUA-TIC SPECIES	*Channa orientalis, Schistura prashadi, Gara naganensis, Crossochilus latius,* Prawn *(Palaemon malcolmsoni), Mollusc, crab varieties like Rau, Pithia, Bahu, Mali, Nadani, Gagal, Chital, Barali, Ari etc* are also present.
	15
FLORA	Betel nut tree (*Areca catechu*), Hollock *(Terminalia myriocarpa* Huerek et Muell*),* Coconut tree (*Cocos nucifera*), Walnut tree (*Juglans regia*), Tanbark Oak (*Lithocarpus*), Goose berry (*Phyllanthus erispum*), Bauhinia (*Bauhinia variegate*), Mejankori (*Litsea citrate*), Poison oak (*Rhus griffithii*), Teak (*Tectona granfdis*), Uriam (*Bischofia javanica*), Sam (*Arto carpus chaplasha*), Coral tree (*Hovenia acerba),* Palmyra palm (*Borassus flabellifer*), Wild mango (*Mangifera sylvatica*), Mango tree (*Mangifera indica*), Dalchini (*Cinnamomum zeylanicum*), Yongchak (*Parkia roxburghii*), Ajar (*Largerstroemia flos-reginae*), Semul (*Bombax cuba*), Bogi poma (*Chickrassia tabularis*), Fig (*Ficus cunia*), Siris (*Albizzia chinensis*), Kala Siris (*Albizzia lebbeck*), Naricol sopa (*Streblus indicus*), Harra (*Terminalia chebula.* Gaertn. Retz), Dhuna (*Canarium resiniferum* Brace ex.King), Jamun (*Eugenia jambolna*), Rubber tree (*Ficus elastic var.decora*.Roxb), Gahori sopa (*Taluma phelocarpa*), Bola (*Morus laevigata Wall ex.Brandis*), Jatipoma (*Cedrella toona*), Paroli (*Stereospermum chelonoides* DC), Thubi (*Trema orientalis.* L. Bl), Bhelu (*Tetrameles nudiflora* R.Br), Champa (*Michelia champaca,* L), Jamuk (*Syzgium cumini*), Hilika (*Calamus erectus,* Roxb), Owtenga (*Dillenia indica*), Wild apple (*Docynia indica.* Wall Decne), Amla (*Embilica officinalis.*Gacerth*),* Jack Fruit tree (*Artocarpus heterophyllus.* Lam), Mundani (*Acrocarpus fraxinifolius*), Naga peanut (*Fermiana colorata*),

	Gogra/Needle tree (*Schima wallichi*), Nettle tree (*Trema orientalis*), Raspberry *(Rubus ellipticus*), Tita sopa (*Michelia champaca*), Nahor (*Mesua ferrea*), Gomari (*Gmelina arborea*), Sida (*Lanerstroemia parviflora*), Alder (*Alnus nepalensis),* Amari (*Almora wallichi*), Satiana/Devil tree (*Alsstonia scholaris*), Agar (*Aquilaris agallocha*), Soap berry (*Sapindus rarak*), Khokan (*Duadanga grandiflora*), Oak (*Quercus serrata*), Ghora neem (*Melia composite),* Kadam (*Anthocephalus chinensis*), Korio (*Albittia procera),* Naga Tenga (*Rhus semialata*), Naga neem (*Axillaries spondias*), Neem tree (*Azadirachta indica*. A.Juss), Makai (*Shorea assamica*), Mundani (*Acrocarpus fraxinifolius*), Udal (*Sterculia villosa*), Hollong (*Dipterocarpous*), Bonsum (*Phoebe goalparensis*), Mechinga (*Zanthoxylum acanthopodium*) etc are present. Numerous medicinal plants species include Indian Aloe (*Aloe Vera*), Bowstring (*Marul Sanseviria Zeylanica*.Web), Poppy Plant Papaver (*Somniferum*), Sage (*Salvia Officinalis*), Dwarfnasturtum (*Tropa colum Majus*), Basil (*Ocimum Basilium*), Percian lilae (*Melia Azedarach.* Linn), Snakker Root (*Serpentaria*. Linn), Mint (*Mentaa Spicata.* Linn), Sweet flag (Acorus calamus. Linn), Mexican poppy (*Argemone Mexicana.*Linn), *Allium ampeloprassum, Distemon indicum, Hypoxis aurea*, Maiden hair fern (*Lantana camara*), Ginseng (*Panax Pseudoginseng*), Mulberry (*Morus nigra*), etc. Varieties of herbs and shrubs include wild tea (*camillea*), *Clerodendrum colebrookianum, Strobilanthus flaccidifolius*; *Ageratum conyzoides, Musa, Perilla frutescens, Colocasia esculenta, Houttuynia cordata*, Yam (*dioscorea bultifera*), Cucumber (*Cucumis sativus*), Pineapple (*Ananas comosus*), Passion fruit (*Passifforal edule*), Egg plant (*Solanum melongena),* Grapes (*Vitis vinefera), Zanthoxylum acanthopodium,* etc are found abundantly.etc are abundantly present. Varieties of bamboo species like the *Bambusa ballooa, Bambusa nutans, Bambusa pallida, Bambusa tulda, Denroclamus latiflorus, Dendrocalamus hamiltonii, Calamus floribundus, Calamus tenius, Arundo donax, Arundia hirsute, Livistonia jenkinsiana*. Griff, *Imperatacylindrica*. Beawb etc.
TOTAL	**114**

2.3 GEOLOGY

The geology of the district belongs to 'the Himalayan orogeny, where the Himalayan mountain system terminated in sharp acute syntaxial bend along Burmese area'[2].

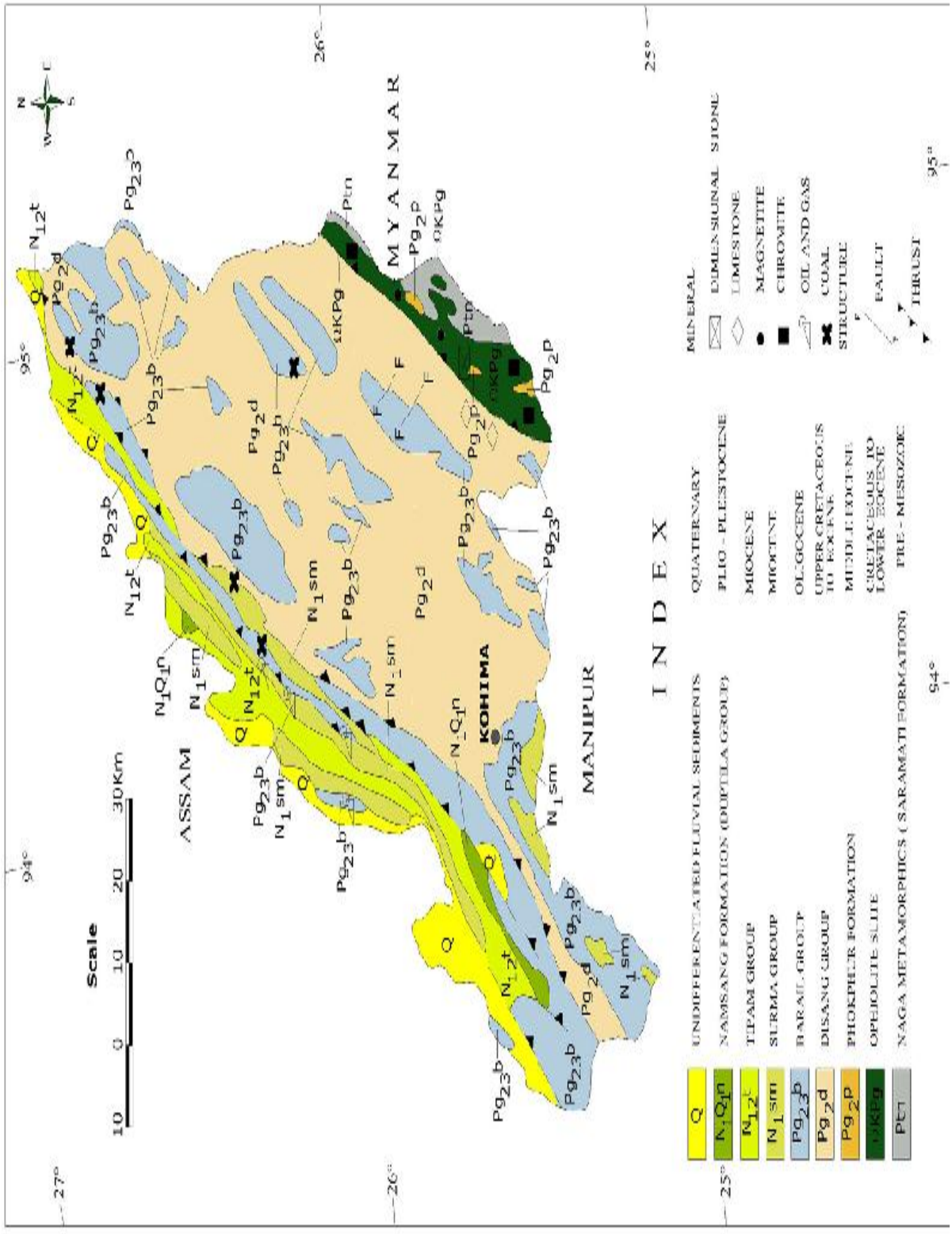
Tertiary sequence of rocks belonging to a fairly young mobile belt of the earth is found in the district. The Disang series (Eocene) and the Barial series (Oligocene) of rocks cover a majority of the district. The lower and middle Eocene age is represented by the Disang Group, upper Eocene and Oligocene age by the Barial Group, Miocene by the Surma and the Tipam Group, Miopliocene age by the Namsang beds.

Table 2.7 General Stratigraphic Sequence of Geological Formation

Geological Age	Geological sediments of Nagaland (and as such of Mokokchung district)	Thickness in meters
Recent & Pleistocene	Alluvium & high level terraces	----------
	Unconformity	
Pliocene	Dihing Group	400
	Unconformity	
Mio-Plefocene	Namsang beds	800
	Unconformity	
Miocene	Tipam Girujan clay Group Tipam sandstones Surma Group	2300 900
	Unconformity	
Oligocene	Barial Tilak Parbat Group Baragolai Naogaon	600 2300 2200
Eocene	Disang Group	3000

(Source: Mokokchung District Gazetteer)

2. Development Plan of Mokokchung Sub-Division and Mokokchung Urban Area (1971-1991) page 3, 4



(Source: Geological Survey of Nagaland)

FIGURE: 2.4 GEOLOGICAL MAP OF NAGALAND

The general geological sequence of the area is as follows:

Older Alluvium Deposit	clay, coarse sand, gravel & boulder
Tipam Group	Tipam sandstones formation Girujan clay formation
Surma Group	Surma sandstones formation
Barial Group	Barial sandstones formation
Disang Group	Disang shale formation

(Source: Mokokchung District Gazetteer)

Younger rocks belonging to the Tipam series borders the plains of Assam. In the foothills of the district, the Tertiary rocks are dispersed in parallel direction like an individual thrust shell within a system of imbricating strike fault known as "Belt of Schupen". Highly disturbed rocks are found within this, which have been sliced by cross-faults resulting into blocks pushing southward due to varying degree of faulting.

The oldest group of rocks represented by the Disang Group, is made up of a splintery shales, from grey to dark grey iron stained shales which has been inter bedded with fine grained sandstones towards the top of the series. The Disang series comprising of metamorphosed rocks increased southward from Mokokchung town to Kohima. Along the base of the hill, West of Changtongia village roughly following the Milak River,

this series overrides the Barial sandstones in the North East –South West along a thrust fault. Barial series of rocks consists mostly of well bedded sandstones with shale intercalations. This series are made up of medium grains ferruginous sandstones with partings of shale, mudstones and clay marked by thick coal seams. The Surma Group presents alteration of shale and sandstones occasionally with conglomerates. The Tipam sandstones crop out as a number of north eastern parallel strips within the "Belt of Schupen" and also as a prominent hill range locally known as Japukong range.

The Tipam Group in the upper unit consists of sandstones, grits, with bands of sandy clays with grained clay formation. It covers a vast area of the Desia Reserved Forest forming flat-topped low mounds. This clay occupies the low lying areas below the sharp falls in Tsung and Tzurang valleys.

The Namsang beds comprising of loosely packed gritty sandstone with fragments of coal cemented sand are found in the region. In the northern part around Tuli and Desai valley, good exposure is found. The formation of Girujan clay overlying the Tipam is composed of typical blue and mottled clays and argillaceous sandstone beds. This Girujan clays also occupies the broad Desai river valley, west of Changki coupled with conglomerates, grits etc.

……

Belt of Schuppen: Narrow belt of parallel to sub-parallel thrust slices trending NE-SW bounded by the Naga thrust in NW and Disang thrust in the SE.

The Disang series occurring in Mokokchung district is estimated to be around 54 million years. Majority of the structured units in the area is composed of a number of sub-parallel thrusts arranged in an imbricate manner dipping in a South-Easterly direction.The parallel traverse faults have affected the entire sequence resulting in a North-Westerly shift of the Barial coal measures and the overlying Tipam. Sub-parallel minor reversed faults are also observed parallel to the crest of the hills affecting the Tipam sandstones.

'The entire area lying close to the most strategic Eastern Himalayan syntaxial bend is having evidences of large scale earth movements. The area is detached from the Brahmaputra basin by the main boundary fault (Naga Thrust) running all along the western boundary of the district and therefore further eastward the district is sliced by a series of faults running NE-SW direction. This area is affected by minor shocks and occasional big earthquakes. Due to prolonged erosion, the hardest strata are exposed and the occurrence of landslides is frequent, particularly on the road connecting Mokokchung with Mariani. The Amguri-Mokokchung road is less disturded by landslides except beyond Tuli where the upper strata are composed of loose debris of conglomerates.'[3]

The diversity of geologic features and processes of the district provides an almost vast arrangement of habitat types to sustain life wherein the soil composition and chemistry are directly related to the underlying bedrock displaying the link between the biotic and abiotic elements.

3. Development Plan of Mokokchung Sub-Division and Mokokchung Urban Area (1971-1991) page 3, 4

Consequently the distribution of many plant taxa is dependent upon the mineralogical and chemical composition of the soil type existing in the region. Climate which is an indispensable element influencing the existing Biodiversity of the region is influenced locally by geologic features and processes. For instance the impact of mountains and hilly ranges on the wind speed and directions as well as the rain shadow areas thereby having a direct and indirect bearing on the Biodiversity.

The drainage system, watersheds, aquifers, seeps and springs of the region is also largely controlled by the present geology and geomorphology linked to lithologic and stratigraphic contacts and geomorphic features. The geology of the region is indeed fundamental for providing a rich variety of flora and fauna where the basic foundation of the geo-diversity concept reveals that there is an intrinsic relationship between biological diversity and geological diversity. In principle, the geologic bedrock is viewed as the foundation of the ecosystem.

The relationship between Biodiversity and geology have an important effect on the landscape of the district creating an appropriate landscape scale, habitat mosaic and network that are reflected in the integration at the ecosystem, community, species, organism, and cellular and genetic levels. In fact the existing geologic bedrock is viewed as the foundation of the ecosystem and the Biodiversity; besides the geographic range and migration route of the species is defined by geologic and geomorphic features. The presence of high and rugged terrain and few plains, drainage system, soil, climate and vegetation are examples of geologic processes which may influence the distribution and movement of biotic resources. Indeed the geological diversity of

Mokokchung district is one of the fundamental building blocks of landscape and all its associates geographical elements resulting into diversity of life forms.

2.4 SOIL

Soil is the natural gift for all living beings on earth, and its resource is a pre-requisite for all kinds of production. Soil is a fix asset which needs to be conserved to meet social priorities like food, cloth, shelter and communication facilities and other activities related to human welfare. Soil is a basic natural resource having much significance to mankind and therefore occupies a vital place in the biosphere.

'Soils, in its traditional meaning, is the natural medium for growth of land plants, whether or not it has developed discernible soil horizons… in this sense soil has a thickness that is determined by the depth of rooting of plants.'[4] Naturally soils consists of both organic and inorganic components coupled with mechanical mixtures and chemical compounds found in the surface of the earth.

Soils of Nagaland are derived from Tertiary rocks belonging to Barial and Disang series. 'Soils of Mokokchung district belongs to Barial series which is characterized by alternating layers of sandstones and shale with carboniferous intrusions or even coal seams.' [5]

4. R.W. Miller and R.L.Donahue: Soils, An Introduction to Soils and Plant Growth; 1992, page 1
5. O.P Singh, B, K. Tiwari: State Level Biodiversity Strategy and Action Plan for Nagaland (NBSAP0; 2002, pg.3.

Soil formation in the district is heavily influenced by the physical and chemical nature of the parent rocks, physiographic, altitude, climatic condition and plants and animals of the surrounding region. In general, it is interplay of the passive factor of parent material and the active factor of climate. The role of plants and animals organisms (Biodiversity) in soil formation should not be overlooked. Soil in the region is acidic in nature with an average PH content varying from 5.61 to 5.83. Acidity is found to be higher around the Changki area followed by Ongpangkong and Changtongia-Tuli area. In the higher altitude of the district, organic content of carbon is higher whereas in the foothills, content of organic carbon is slightly lower due to continuous cultivation in the region.

In spite of the region being hilly coupled with large area under jhumming, has thick top-soil in its land. Porosity (porous nature) of the soil is responsible for this character where rainfall sinks underground without any surface flow or water current besides the tremendous speed with which the plants cover up any bare area of the soil surface.

Three major types of soils are found in the district; viz Alluvial soil, Forest soil, and Non- Laterite soils. **Alluvial soil**s are confined along the foothills and mostly along the Tuli valleys and Plains which is located on the right bank of Milak River. Such soils are transported soil largely made up of silt, sand, and clay. Alluvial soil is usually deficient in nitrogen & humus content and requires regular addition of manure and fertilizers. **Forest soil**s are generally found at a heights varying from 900 meters to 1,800 meters and are mostly found around deciduous forests. Such soils are rich in humus and deep but slightly acidic in reaction. It is a fertile soil and is extensively used for raising a variety of crops. **Non-Laterite Red soils** are formed due to alteration of the moist and

dry seasons. This type of soil is commonly found in the hilly slopes and hill tops of the district except in the higher altitudes. It has ample content of organic matter due to the presence of high humus, and the degree of porosity is also high. The red colour of the soil is due to the presence of iron–oxide and aluminum, they are acidic and have less quantity of potash and phosphate, such soil is hard when dry and sticky when wet and are regarded as residual soil. Fertility of the soil in the district is due to its minerals and humus content as well as the prevailing climatic condition. Overall the soil in the region is boggy and loose because it has been formed by falling of leaves and branches and decayed annual undergrowth and shrubs.

Soils in Mokokchung district are prone to erosion particularly due to the extensive practice of slash & burn system of agriculture and deforestation. In order to avoid soil erosion, uses of physical & biological barriers are being carried out for soil conservation. As such, realizing the importance of soil resource, traditional system of checking heavy soil erosion is practiced in the region, where people put stumps of wood as embankment especially at delicate and loose portions.

Besides, placing of stones and boulders along the contour of the field are done; use of whole bamboo and split bamboo by making a mat like frame are laid across the slope are found to be effective to control soil erosion. Plantation of miscellaneous crops closely in line across the slopes also conserves and preserves the soil from erosion. Plantation of trees bordering the jhum field is also being carried out as it encouraged its roots to help and promote in retaining the soft soil from erosion in rainy season.

It is therefore essential that soil conservation should be emphasized with all methods aiming at reducing the amount and velocity of surface run- off and of the erodibility of the soil. Vegetation cover including both aforestation and reforestation and changes in agricultural practices should be implemented which are needed more specifically on slopes where trees retard the surface run-off and bind the soil. Undertaking of such ventures will contribute towards Biodiversity preservation.

2.5 DRAINAGE SYSTEM

'The naturally occurring channeled flow formed by streams and rivers which removes water from the land surface'[6] is defined as drainage system. Mokokchung district have numerous river both perennial and non-perennial. Though there are many streams, it has very few important rivers. The rivers are not navigable as it is shallow with numerous stones and boulders on the banks. Notable rivers found in the district are Milak, Dikhu, Tsurang or Desai, Tsumok and Menung, which runs parallel to the chains of the ridges acting as water dividers either northward or southward.

Milak: Of all the rivers, 'Milak River which is the longest is the principal river. Its source being at the heart of Mokokchung town right at the Deputy Commissioner Residence situated at an altitude of 1,300 meters.'[7]

Tsurong: 'It is an important tributary of Milak River. It rises east of Lakhuni village, then flows between Yachang and Lirmen village on one side and Molung village (Old& new) on the other.'[8]

6. Susan Mayhew: Oxford Dictionary of Geography; 1997, page 138

Tsurang or Desai: 'This river rises from the west of Chungliyimsen village and is an important tributary of Doyang river.The river assumes a crescendic bend by flowing southward, cutting through the hills of the district of Mokokchung and Lotha area on the northern part; it also bends towards the westward and northward direction.Before leaving for the plains west of Changtang village, the river flows further northward.'[9]

Dikhu: 'It emerges near the Sema area from the northern flanks. From there the river is known as Tsula which flows westward and enters west of Longsa village. It flows northward further which forms a traditional boundary like between the Ao on the one hand, and the Sangtam, the Phom and the Konyaks on the other. Its total length before merging into the Brahmaputra River is 200 kms. In the Langpangkong range of Mokokchung district its main tributary is called Nanung.'[10]

Tsumok: 'This River rises from Changtongia area and flows through Asangma and Merangkong villages and then joins Milak River.'[11]

Menung 'This River has its source at Minkong forest. Before joining the Milak river, it flows in between Sangratsu and Longjang villages on one side and Mongsenyimti and Chuchuyimlang villages on the other.' [12]

These rivers do not hold much importance from the irrigational point of view, 'as the basins through which these rivers flow are narrow and do not support stable or spacious cultivation; however terracing and plantation of fruits along the banks of the river Tsula and Tsurang shows promising results.'[13]

7-13. Mokokchung District Gazetteer (Nagaland), Government of Nagaland, Kohima; 1979, page 4, 5

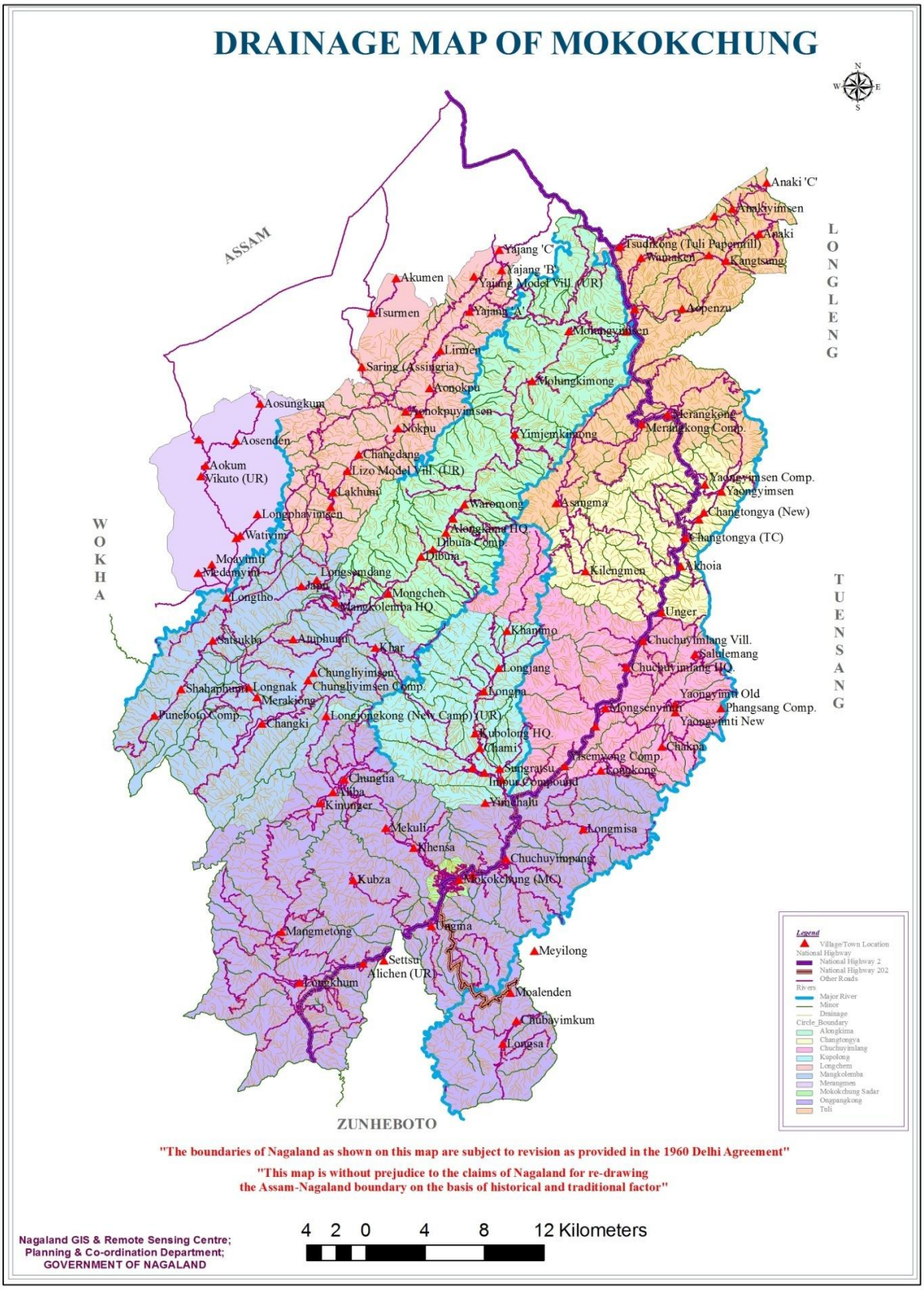


FIGURE: 2.5 DRAINAGE MAP OF MOKOKCHUNG DISTRICT

These rivers and streams is a source of great wealth, and as the riverine system are owned by the community making it accessible to all, it can serve as a means for aesthetic, economy and sustenance with proper attention and management.

2.6 CLIMATE

'Climate is the summary of mean weather conditions over a time period usually based on thirty years of records.'[14] There is no denying the fact weather and climate are dynamics feature of the physical environment and they affect the human activities to a great or lesser degree.

North-East India being located at 20^0 N to 29^0 30' N latitude and $84^0$46' E to $97^0$30' E longitude. The tropic of cancer passes across its southern part, and it essentially provides a tropical type of climate. At the same time, it is located within the monsoon belt of the south and South-East Asia, and that makes the region to be located within the tropical monsoon climate. The situation and alignment of the hills, plateaus and mountains in the region is one of the factors in influencing the climate.

Nagaland enjoys a typical monsoon climate with variants varying from tropical to temperate conditions. The mountains and hill ranges with the foothills, plains, and sheltered valleys are marked with climatic contrasts which determines to a great extent in rainfall distribution. Climatic factors in the likes of temperature, humidity, precipitation, high intensity rain and wind are the most influential for the ample distribution of Biodiversity in the region.

14. Susan Mayhew: Oxford Dictionary of Geography; 1997, page 79-80

The district of Mokokchung has a sub-tropical humid and extreme type of climate with monsoon being the dominating factor. The region enjoys a bracing and healthy climate whereas the lower ranges and valleys adjoining the plains of Assam experience a warmer climate.

Summer temperature in the district varies from 28^0 C to 30^0C and winter temperature varies from 10^0 C to 15^0 C. The annual range of temperature which is the difference between in temperature of the hottest and the coldest month of the year varies from 15^0 C to 18^0C. The temperature in the district varies locally with the variation of altitude, where the low lying valleys are warmer. July is the hottest month, but due to ample amount of showers the heat is neutralized while the hottest days appear in months of July, August and September during sunny days. Winter starts by November and the month of December to the early part of February are the coldest months in the year.

The amount of rainfall received in the district varies from 1600 mm to 2500 mm with the amount of precipitation varying greatly from year to year. Most of the rainfall received in the region is orographic in nature where warm humid air strike the hill ranges and rises up. When it rises up, the temperature falls resulting into condensation to take place. Heavy rainfall in the district is frequently received from the month of May to August while occasional rain usually begins from September to November and dry season from December to April. Rainfall is caused by the South-West monsoon which generally sets in the middle of June and continues up to the middle of September. The onset of South-West monsoon in March-April and the North-East monsoon in September-October also caused occasional storms. In general regions

experimenting heavy rainfall are dominated by dense-evergreen forests than those receiving a light or moderate precipitation.

Windy season typically takes place from February to March, during this season the wind generally blows from the South-West and at times the velocity rises up to 100 km/ hr, the wind dies out gradually during the month of April. During the rainy season the average relative humidity which is the amount of saturation value expressed in percentage is 80 percent but at times it goes up to 90 percent to 100 percent and at such it is very damp. It has being claimed that people living in areas of high and very low relative humidity is not conducive to good health whereas relative humidity of 60 percent is most suitable for human health, so it directly or indirectly effects the capacity of human being for work. Frost fall is common at higher elevation, and its fall is recorded at Longkhum village often from the first week of January to early part of February which is located at an altitude of 1601 meters, incidentally the highest located village in the entire district. These favourable environmental conditions in the region have given rise to different species of plants and animals, wherein alteration of life forms are resulted by the symbiotic affinity among variety ofgeographic factors.

2.7 NATURAL VEGETATION

Soil and climatic condition of Nagaland reflect a perfect harmony with the relief, resulting in the rich variety of flora and fauna. It is estimated that Nagaland alone has more varieties of plants than any other country in the world, making Nagaland botanically one of the richest spots in the world of which Mokokchung district forms a part.

The state of Nagaland along with the other North-Eastern states falls under Indo-Burma Biodiversity hotspots. Out of the state's total geographical area of 16,579 kms sq, forest cover in the state has approximately 86,2930 ha (**Basic Facts 2011).** Mokokchung district has a share of about 49,708 hectares under forest, out of which virgin forest accounts for 13,864 hectares and degraded forest for 24,035 hectares approximately.

'The district also have three government protected forest viz Chubi (134, 68), Minkong (275.32), and Longsa (18.00) amounting to a total of about 428.00 Ha.'[15] The nature of vegetation in the state does not only determine the ecosystem of the region but of the whole of North-East India, and as a result, 'any marked shift in forest vegetation system of the state, therefore, many bring about wide diversity and spell disaster to other surrounding region.'[16]

Natural vegetation is the primeval plant cover unaffected by man either directly or indirectly. It also plays an important role in the maintenance of ecological balance in the region. Climatic factors particularly temperature, wind, humidity, and precipitation, high intensity rain to a great extent is conducive for the luxuriant vegetation in the region.

Mokokchung district with an average altitude of 1500 meters has a cool temperature throughout the year, making it rather cold in winter. The hilly condition does not allow water to stand; also the power of retention is low because of the porosity of the earth.

15. Department of Forest, Ecology, Environment And Wildlife Nagaland: Kohima (Annual Administrative Report) 2007-2008; page 11
16. D.T Zimba: Geography of Meghalaya; page 57

Besides the vegetation could not stand the cold which fails to keep the vegetation green forever. Vegetation covers determine the physical environment to a great extent in the region. The variation in topography, soil and climate has created special biotic ambience in the region suitable for the existence of different animals and birds and so they create local niches in which biotic life can feed and live.

Under these circumstances, the district of Mokokchung consists of both deciduous and evergreen forests, most of the trees being deciduous. To be precise, mixed forest of both evergreen and deciduous trees are present, the latter being more in number and area. Evergreen trees are found at a lower altitude. 'Forest type found in the district consists of:

(a) Evergreen up to the altitude of 1000 meters

(b) Mixed deciduous and Evergreen from 1000 to 2000 meters'[17]

'The state of Nagaland harbours a variety of plant species, about 22 bamboo species, 396 orchid species' (Deb & Imchen,2008). Adding to the lists of rich bamboo species in the state, a rare and unique bamboo species known as *Phylostachy* is also found along the belt of Tizu River under Kiphire district. Similarly, Mokokchung district is not an exception, the Biodiversity of the district show a wide range of floral species, approximately 15 bamboo species, around 100 species of orchids besides a variety of animals, birds, reptiles, fishes etc.

Some prominent tree species like Teak (*Tectona granfdis*), Sam (*Artocarpus chaplasha*), Badam (*Mansonia dipika*), Hollock (*Terminalia myriocarpa*), Pine *(Pinus*

17. Mokokchung District Gazetteer (Nagaland), Government of Nagaland, Kohima; 1979, page 12

khasiya), Aamari (*Amoora wallichii*), Alder (*Alnus nepalensis*), Kadam (*Anthocephalus chenensis*), Naga Neem (*Spondias axillaries*), Rhodondendron, Urium (*Bischofia javanica*), Koroi (*Albizzia procera*), Sida (*Lanerstroemia parviflora*), Jaipoma (*Linnea grandis*), Hilika (*Terminalia chebula*), Bogipoma (*Chickrassia tabularis*), Dhuna(*Canarium resiniforum*), Sal (*Shorea robusta*), Khokan (*Duabanga sonneroides),* Agar (*Aquilaria agallocha*), Naga Tenga (*Rhus semialata*), *Bambusa Balcooa, Hamiltonii, B.Nutans,* Bonsum (*Phoebe goalparensis*), Outenga (*Dillenia indica),* Simul (*Bombax malabaricum*), Gogra (*Schima wallichii*, *B.Tulda), Dendrocalamus* and so on are found in the region. A considerable amount of the district is still under forest and jungles and as a result there is a fair amount of animal life. However, with the advent of modern civilization, a great number of animals and birds have been killed indiscriminately.

Among the faunal Kingdom found in the district are jungle Crow (*Cervus macroshynchos*), Spot bellied eagle (*Bubo nepalensis),* Wreathed hornbill (*Aceros undulates*), Grey Patridges, Grey Peacock Pheasant (*Polyplectron-bicalcaratun*), Red Jungle fowl (*Gallus gallus*), Kaleej Pheasant (*Cophhura leucomelenos*), Pin tail green Pigeon (*Teron opicanda),* Great Indian bustard, Hornbill (*Buceros biconis*), Spotted dove *(Streptopelia chinensis*), Copper-Smith barbet (*Megalaima haemacephala*), Great hill barbet (*Megalaina verens*), Ashy wood pigeon *(Columba pulchricollis*), Tailor bird (*Orthotomos sutorius*), Black Drongo *(Decrurs paradisues*), Hoopoe (*Lepupa epops*), House sparrow (*Passer domesticus)* etc besides a hosts of frogs, fishes, land tortoise, python, crabs and lizards. Mammals like Sloth (*Bradypus*), Pangolin (*Manis tricespis),* Squirrel (*Funambus*), Porcupine (*Hystrix bengalensis*), Mole (*Tulpa),* Jungle Cat (*Felix chaus.*Guldenstaedt), Wild Goat (*Capra hircus*.Linnaeus), Bat (*Rhnolophus),* Lemur

(*Lemur catta*), Howling monkey (*Mycetes*), Macaque (*Macala mulatta*), Royal Bengal Tiger (*Panthera tigris*), Wolf (*Canis lupus*), Dingo (*Canis dingo*), Otter (*Lutra)*, Slot Bear *(Sclenarctos)*, Mongoose (*Herpester bengalensis*), Leopard (*Panthera pardus*), Wild boar (*Sus crestatus*), Spotted deer (*Axis axis*), Parking deer (*Cervulus muntjac*), Elephant (*Elephas maximus*.Linnaeus), Stag (*Carvus elaphus hanglu*.Wagner), Jackal (*Canis aureus*.Linnaeus) etc to name a few are present in fair amount. In addition to this, there is also abundance of edible wild fruits and mushrooms.

In addition to this, there is also abundance of edible fruits and mushrooms. Medicinal plants and herbs which is believed to have certain healing power for the treatment of diverse diseases and ailments are *Achyranthes aspera, Ageratum conyzoides, Centella asiatica, Cissampelos pareire, Costus speciosus, Curculigo capitulatea, Datura, Eupatorium adenophorum, Mikania micrantha, Houttuynia cordata* etc are also present. Tea, which is one of the most popular drinks of today was also discovered first in Nagaland by the Britishers. The favourable climatic conditions in the region have favoured the plantation of certain economic and climatic crops like tea, coffee, herbal plants and rare flora.

All these variety of flora and fauna are partially or wholly interdependent. Such diversity of life is found only in a particular area under special physical conditions whose existence may or may not be possible under any other environmental state. All life forms influence each other and live in symbiotic relationship. Any disturbance found in their existence would hamper the ecological balance and extreme care should be implemented to maintain perfect harmony in the environment.

Despite the fact that Mokokchung district being richly endowed with diversity of flora and fauna their survival is at risk mainly because of human interference. In order to avoid unwanted catastrophe resulting due to massive destruction of Biodiversity, education and awareness at the grass root level is needed to be envisaged. This should be strengthened with rigid customary laws and regulation against illegal hunting and killing animals, felling of trees and gatherings by rewarding befitting punishment to the trespassers.

Revival of various Acts and Amendments like the Nagaland Forest Act (1968), Wild life Protection Act (1972), Nagaland Jhumland Act (1970), Forest Conservation Act (1980), Writ Petition (Public interest litigation, civil No 202/1995), Nagaland Tree Felling Regulation Rules (2002), Biodiversity Act (2002) etc should be endorsed and carried out sincerely and consciously which as a result would mitigate in solving the problem of rampant Biodiversity destruction in the region.

The topography of the district composed largely of foothills and high mountain ranges of the eastern Himalayan range with steep slopes, dissected with elevations ranging from 1000 meters to more than 2000 meters above mean sea level synchronize with the geology belonging to the Himalayan orogeny characterized by the young mobile belt of the earth of the Disang and Barial series covering a major portion of the district.

These geological factors heavily influence the climate in the distribution of ample amount of precipitation especially during the raining season from May-August resulting in the most significant climatic aspects on the soil. The percolation of rainwater through soil acts upon unconsolidated rock bits and lower bedrock layers, exerting a chemical

weathering influence and forces of mechanical weathering like repetitive freeze/thaw during the cold season and exfoliation during the warmer season providing the soil with erratic chunks of rocks.

As Mokokchung district enjoys a sub-tropical and humid climate with monsoon being the dominating factor, it provides rapid release of nutrients from such rock detritus into the soil making it (soil) more conducive to various micro-organisms in the soil like the nematodes, protozoa, earthworm and other burrowing animals which have a significant effect on soil composition, mineralogy, chemical composition and fertility through their tunneling, excrement and nutrient transfer. Moreover the soil in the district is having high porosity where rainwater sink without any surface flow or water current besides the remarkable speed with which the plants cover up any bare area of the soil surface thereby reflecting the composition of vegetation and animal communities.

Consequently the ample Biodiversity of the region has been made possible from the wide range of existing conditions; altitude, slope, geology, climate, soil etc in the absence of which it would affect the livelihood of the people. These conditions have been a key factor in sustaining a rich and generous Biodiversity for several millennia eventually contributing towards food security, socio-economic, cultural and spiritual enlistment for the people.

The succeeding chapter on **"Status and dynamics of Biodiversity of Mokokchung district"** discusses about the current Biodiversity condition in the study area giving a more accurate and authentic insight on the current scenario.

CHAPTER-3

STATUS AND DYNAMISM OF BIODIVERSITY IN MOKOKCHUNG DISTRICT

3.1 INTRODUCTION

India ranks amongst one of the 12 mega-diversity centers of the world in which Nagaland is recognised as a major contributor. Nagaland is located in one of the 8th hotspots of the world in terms of biodiversity. A few areas of the state are still pristine and harbour wide variety of endemic species of plants, animals and micro-organisms. The immense permutation of the topography, climate, altitudinal variation, heavy rainfall and soil conditions have supported to the diversity of life forms in Nagaland, in which Mokokchung district is a part.

Nagaland along with the other north-eastern states is the meeting ground of at least three mainstreams namely, the Indian mainstream from the mainland India, the Chinese-Japanese stream from the north and the east, and the Malayan stream from the south has been responsible for the generous variety of Biodiversity in Mokokchung district. Nagaland is a part of Biodiversity hotspots – An area with high species richness and high species endemism. On this basis, Nagaland is rich not only in the floral wealth and endemic species of plants but is also equally rich in terms of mammals and avi-fauna.

Out of the 1250 species of orchids found in India, Nagaland has 340 species of orchid species. Most of the orchids are epiphytes or lithophytes with few being terrestrial. Nagaland also boost of having the world's hottest chilly variety known as 'Naga Jolokia' or 'Bhut Jolokia' **(Guinness Book of World Records, 2007)**, world's tallest Rhododendron tree measuring 30.79 meters and 2.41 meters in girth found in Jafu Mountains of Kohima district **(Guinness Book of World Records)**.

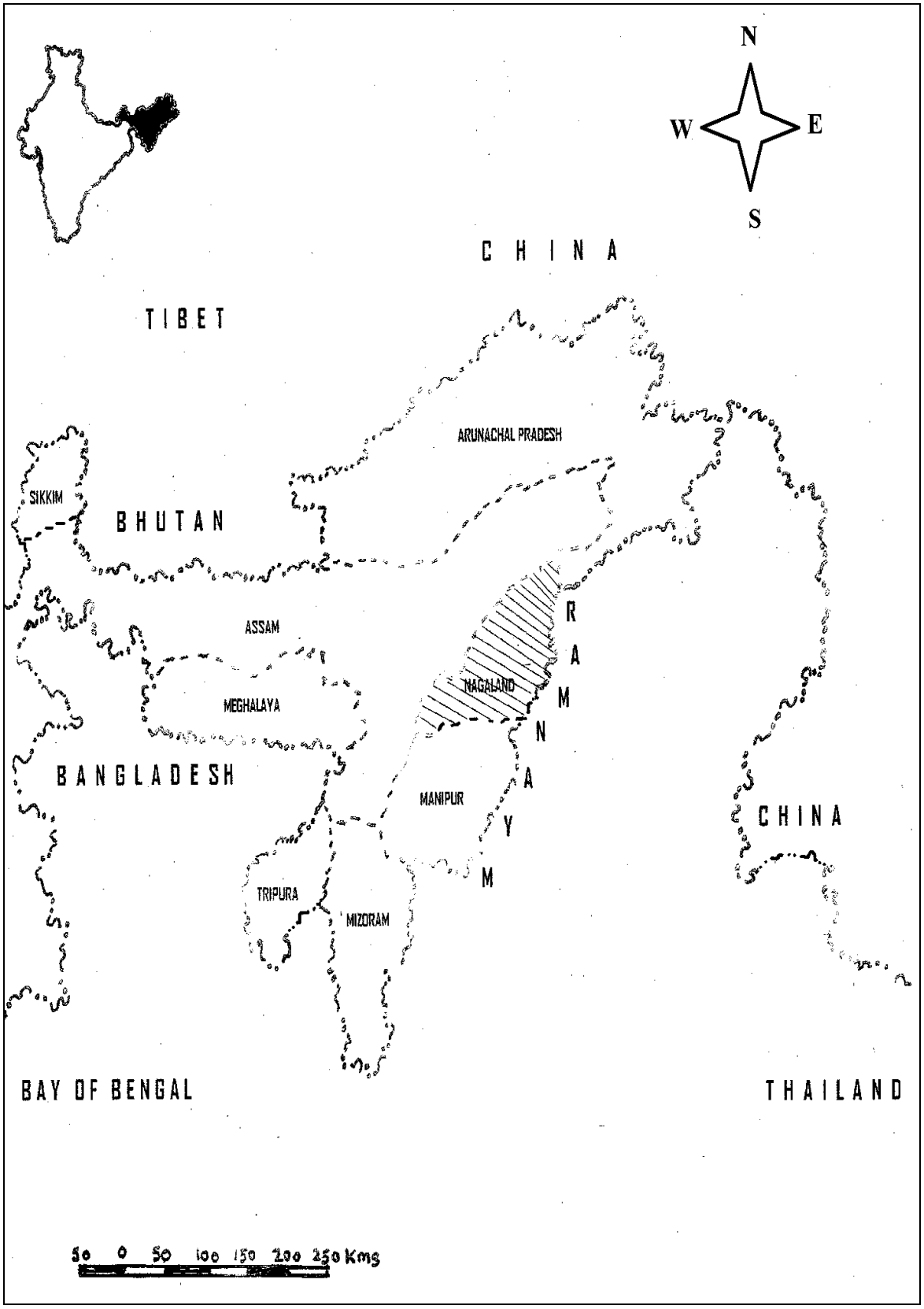


FIGURE: 3.1 LOCATIONAL MAP OF NAGALAND, CONFLUENCE OF INDO-BURMAN BIODIVERSITY HOT SPOT

The variety of flora and fauna flourishing in the multi-climatic and soil condition as well as the topography dominated by hilly mountainous terrain is extremely rich from ecological perspectives having rich blanket of forests many of which is yet to be explored and exploited. Mokokchung district is situated at an average altitude of 1398 meters above mean sea level and is located at 93^{o} 53' E to 94^{0} 53' E longitude and 25^{0} 56' N to 27^{0} 40' N latitude. The topography of Mokokchung district is made up of mountains and hills, coupled with foothills, plains and valleys is blessed with eco-climatic conditions varying from place to place.

Out of the total geographical area of 1,615 square kilometers, Mokokchung district has total forest coverage of about 28966.47 hectares **(Basic Facts 2011)**. The characteristics of the forests of Mokokchung district ranges from deciduous to evergreen forests with moderate to ample rainfall is endowed with rich Biodiversity. It is observed that high rainfall and moderate temperature in the region provides wider opportunity to favour plants and animals existence with the experience of the sub-tropical humid climate permitting the trees and vegetation to grow throughout the year. The area under forest cover (in km^2) and government protected forests in the district is shown in the tables below:

Table: 3.1 AREAS UNDER FOREST COVER IN MOKOKCHUNG DISTRICT

Total Geographical Area	Very dense	Moderately dense	Open	Total	%	Change	Scrub
1,615	1	458	966	1425	88.2	-18	1

(Source: The State of Forest Report 2011, Forest Survey of India, Kawlagarh Road Dehradun, Uttarankhand)

Table: 3.2 GOVERNMENT PROTECTED FOREST IN MOKOKCHUNG DISTRICT

District	Government Protected Forest	Areas (in HA)	Total
Mokokchung	Chubi Minkong Longsa	134.68 275.32 18.00	428.00

(Source: The State of Forest Report 2011, Forest Survey of India, Kawlagarh Road Dehradun, Uttarankhand)

3.2 CONCEPT OF FOREST ACCORDING TO THE LOCAL COMMUNITY

A forest is more than an area covered by trees because it includes smaller plants, animals, soils and water. A forest as defined by Allen and Sharp as 'a community of trees and associated organisms covering a considerable area: utilizing air, water and minerals to attain maturity and to reproduce itself; and capable of furnishing mankind with indispensable products and services.' [1]

A forest as perceived by the local people in the district is a 'means for providing sustenance, fodder for animals, medicines, timber etc which provide ground for hunting, gathering and farming. It is conceived as a sacred place, protecting or protector of wildlife, their habitat for breeding. It is also understood as the abode of trees where wildlife is preserved. Moreover, it is perceived as a store house of wealth, generating financial source, as a blessing for mankind, having great aesthetic value pleasing one's body, mind and soul. Overall, it is realized as the sustainer of our livelihood'.

1. An Introduction to American Forestry, page 68

As interpreted from these definitions given by the locals, it is appreciated that forests plays an integral role in the everyday life of the tribal people. In fact, Ao-Naga's social norms, cultural, physical and economy are interwoven very closely with forests and their Biodiversity. Forest and Biodiversity 'the source of energy' holds a great place of importance among the Naga society. Nagas have known the importance of forests over the centuries and the interconnection between forest and Biodiversity including man. Biodiversity has helped their pursuit of everyday needs and wants, and this has asserted the relationship between them and Biodiversity since time immemorial.

Nagas completely depends upon the forest and its Biodiversity for the food requirements; it has served as the rich hunting ground for wild animals and birds as most Nagas are non-vegetarian by nature. There has always been a direct and indirect contribution of Biodiversity in the form of food supplies and other necessity towards human progress. It has given so much for better productivity of farming purpose, for clothing, fuel, timber, shelter, medicines etc to meet all the basic essentials of living. Ao-Nagas are closely related to forests and Biodiversity as it has created a niche for its existence; its role in agriculture is more recognized as Nagas are mostly farmers, it provide scope for understanding any forms of cultivation be it jhumming, terracing or wet- paddy field which are predominant type of farming practiced in the region.

The role of Biodiversity in the environment like increasing soil fertility in the region is well ascertained. Trees in the surroundings firmly enclosed the soil, reducing soil erosion; speed of water is also reduced thereby increasing ground water supply as much water is retained in the soil. As agriculture is an important part of every Naga life, Biodiversity conservation and preservation is therefore fundamental.

It is without doubt that Biodiversity is a rain making force; trees seize moisture bearing clouds thus creating abundant rainfall to agricultural field. Its role in purifying the air and water in the region is also well ascertained. Biodiversity the veritable storehouse of hundreds of biological products in various manifestations could also change the lifestyle of the indigenous community by alleviating poverty and enhancing wealth for the community directly through bio-resources. As Biodiversity and its resources provides the intrinsic demand for the Ao-Nagas, it is rightly legitimize that it is essential for their survival and in no way be isolated from each other, as man derives its resources from the Biodiversity, he is a part of environment.

3.3 CULTURAL ROLE IN CONSERVATION OF BIODIVERSITY

Even in the past, Nagas had always regarded and reverend forests and jungles as 'Sacred', it was in fact held as a tradition to respect the diversity of life forms as it had ever been sustaining for generations for physical, socio-economic and spiritual enlistment. 'Sacred groves are defined as small patches of native vegetation that are protected by traditional communities on the basis of cultural/ religious beliefs' (Ramakrishnan 1992). 'The inhabitants of the areas especially, living in the remote forest have certain beliefs and myths regarding the surrounding vegetation.' [2]

Ao-Naga ancestors have indigenous spiritual beliefs and they regard certain forests as the 'place of worship' and were considered as taboo to carry out cultivation in such forests. There are still many people in most of the villages in the district who have faith in the metaphysical power regarding the surrounding forests and vegetation; these forests are apprehended as 'sacred' or 'Ait' in the local vernacular of Ao language.

2. Sudhir Kumar: Medicinal Plants of North-East India; 2002, page 197

In the traditional belief of the Ao-Nagas, ‘Ait’ is believed to be vested with supernatural beings or spirits. Ait is characterized by their unique quality of micro-climate, aquifers, nutrient cycle, preventing soil erosion and shows a unique in-situ conservation process, is often the last refuges for threatened species along with medicinal plants. In the earlier days ‘Ait’ used to be the place where people perform rites and rituals to appease the deity and wishes for their well-being. In such groves, resource exploitation is strictly prohibited.

There are many instances where specific forests well spread all over the district are conceived as ‘Ait’, but the ‘Ait’ at ‘Lakuni forest,’ ‘Changtang Lushi’ is overshadowed by legendary tales. ‘Ait’ is the place ‘where birds and animals take shelter’ or a ‘place of drinking water’. It is believed that in certain solemn days, it is impossible to hunt any kind of creatures within the ‘Ait’ territory, in fact it is a taboo to hunt birds and animals while drinking water or grazing within the ‘Ait’. It is also believed that even the injured creatures could get healed supernaturally when they entered the territory of ‘Ait’.

There are also superstitions associated with certain birds and animals which were forbidden to killed or eat them; for instance Black python (*Python molurus*) is considered as a curse even to encounter them, it is supposed to bring bad luck and misfortune. There are some individuals who believed that killing of certain animals like an elephant (*Elephas maximus*), tiger (*Panthera tigris*), leopard (*Panthera pardus*), crocodile (*Crocodylus palustris*); pangolin (*Manis tricespis)* often brings misfortune like sicknesses, immediate dead in the family, relatives or near friends. These beliefs and superstitions have positively contributed towards Biodiversity preservation in many villages of the district.

Due to the vast portion of the district being entirely composed of pristine and inaccessible jungles and forests, wild animals and birds were abundant and roaming freely in the wilderness. There were also incidents of encroachment made on the human habitat areas; in order to avoid such menace, the village authorities imposed strict laws and regulations to mandatory slash and burn the forest land for cultivation. It is also said that one family would cultivate two or three forest land in a year because of the urgent need to prevent wild beasts from invasion, this was practiced till the late 1960's and was done with the belief that as wild animals dominate human habitation, forest areas should be degraded to put off animals from intruding.

These evidences show that the district has absolute storehouses of Biodiversity, which have been preserved in its natural habitat for centuries, mainly because of inaccessibility. In the present scenario, however, the forest areas of the region which once constitute numerous variety of flora and fauna are changing at a fast pace. The unethical practiced like the deforestation, hunting, poaching, unethical gathering and over exploitation has lead many of the biotic species to become endangered. It is observed that many are at the risk of becoming extinct.

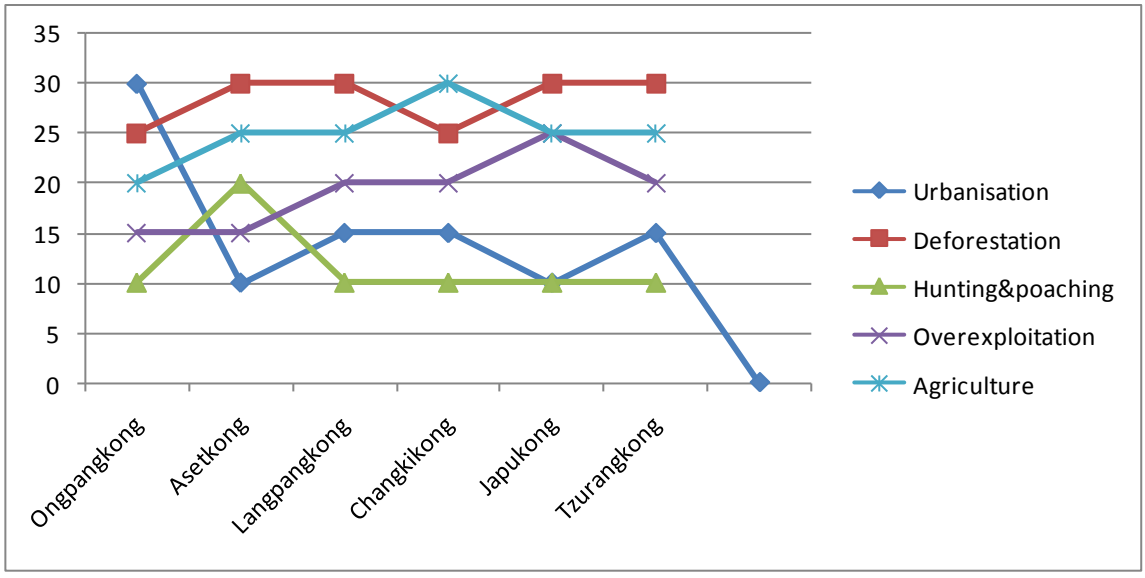
Wreathed Hornbill (*Rhyticeros undulates*), Indian Pied Hornbill(*Anthracocerus malabaricus*), Leopard *(Panthera pardus*), Tiger (*Panthera Tigris),* Howling Monkey (*Mycetes)* etc to name a few which were once abundantly found till the 1980's has noticeably reduced in number. With the depletion of forest- the habitat of flora, fauna and avi-fauna and also the source of life system, the local Biodiversity has also diminished along with it.

A major part of the district of Mokokchung was under the cover of dense jungles and forests till the late 1960's.With the approaching of modern civilization, which has introduced more sophisticated guns and weapons to the region, is partially responsible for the indiscriminate killing of animals and birds.

3.4 DYNAMISM OF BIODIVERSITY

The inception of modern civilization and increase population pressure has been continuing in bringing changes in the environment. Physical alteration of forest and jungles is one of the sole factors for the great loss of Biodiversity. Mokokchung district has witnessed a massive change where natural forest areas were slash and burn for cultivation, settlement, road construction and other developmental works of urban oriented.

FIGURE: 3.2 SHOWS THE CAUSES FOR THE DECLINE OF BIODIVERSITY IN MOKOKCHUNG DISTRICT (RANGEWISE)



(**Source: Field survey 2009-2013**)

It is of common experienced that in Mokokchung district, with the felling of trees and forests, permanent damage is incur upon their habitat, besides disturbing the migration of migratory birds like the Amur Falcon (*Falco amurensis*) and animals like the Elephant

(*Elephas maximus*), Tiger (*Panthera tigris*), Leopard (*Panthera pardus*) etc. The degree of loss is prominent in the case of indigenous plant species *Rhododendron Arboretum* which once abundantly embellishes the forests of Longkhum village of Mokokchung district has reduced expressively. Diminishing of these species, which is well adapted at the higher altitude with moderate to heavy rainfall, is due to the negligence on the part of the locals to protect against indiscriminate exploitation and deforestation.

Moreover deforestation has discouraged migratory birds like the Grey Peacock Pheasant (*Polyplectron bicalcaratun*) at Longkhum village under Ongpangkong range which is believed to migrate from Indonesia. Golden Languor Trachypithecus (*trachypithecus geei*), Capped Languor Trachypithecus (*trachypithecus pileatus*) etc once found in abundance in the entire district is no more seen for the past 20 years time in some forests like the Aliba, Chuchuyimpang, Mopunchuket and Dibuia villages because of disappearance of forests and excessive hunting and poaching as these animals are believed to served medicinal purpose for treating certain diseases like kidney stone etc.

Larger carnivores like the Tiger (*Panthera tigris*) and Leopard (*Panthera pardus*) which were found in good numbers till the mid 1990's are not found within a span of 10 years in many parts of the district. Porcupine (*Hystrix bengenlensis),* Spotted Deer (*Axis axis*), Barking Deer (*Cervulus muntjal*) etc and birds species like the Great Pied Hornbill (*Buceros biconis*), Indian Pied Hornbill (*Anthracocerus malabaricus*), Malabar Grey Hornbill (*Tockus griseus*) etc are present only in sparse number.

Logging is a major factor for the decline of forests and eventual loss of Biodiversity in the district. The area of closed-canopy forest which once covers more than 40% has declined.

It has reduced from 42.8% in 1972–1975 to 21% by 1995 (NRSA 1983, FSI 1997). The effects of logging are not always as direct as the absence of trees because since the 1970's about 7% of the virgin forests are destroyed in the Changkikong region alone thereby promoting more landslides which has destroyed vast acres of natural forests once filled with diverse plants and animals.

Moreover, logging does not simply remove a few trees from the forest. When canopy trees are cut, many smaller forest trees and plants dependent upon them for shade or support or moisture vanish. Animals dependent upon trees or other vegetation for food, shelter, water, and breeding sites also disappear. Only those animals (generally the larger ones) which can migrate to contiguous forest areas survive. This is one of the major reasons for the loss of Biodiversity in the district where larger animals like elephants, tigers and leopards, diverse species of hornbills are practically very sparse in their population.

Logging and deforestation activities affect pollination as plants in cut-over areas often cannot be pollinated, or if they are, their seeds fall upon unsuitable open areas where they cannot survive. In addition, many rainforest species are restricted to relatively small areas and are found nowhere else consequently when the areas in which these species reside are logged or burned, they will disappear.

Logging activities also press on roads into previously untouched forest. Various government aided fund has undertaken more than 50 agricultural link road projects in the State covering approximately 405.00 km (**Agri Land Newsletter, 2011)** to provide road connectivity of the villages with agricultural potentials areas putting a serious toll on Biodiversity. Even if logging is selective, the logging roads and tracks made to pick up the

cut trees cause damage to soil and plant life; moreover erosion is common along these roads. And since roads create openings where none previously existed, the forest now has a long "edge," where conditions are very different from a normal forest interior (there is more light, temperatures are higher, humidity is lower). It is also observed that species adapted to the conditions within a forest interior cannot survive along the newly-formed edges and when forest areas are clear cut, the problems are exacerbated. The open land that remains after an area is clear cut allows for the direct impact of raindrops, which then fill the pores and channels within the mineral soil once protected by trees. The presence of water in these channels traps nutrients within the clay layers of the ground. With nutrients unable to reach new growth, restoration of a flourishing vegetation and tree growth is greatly burdened. Thus, animals that rely on these unique habitats to survive are left with nowhere to go.

Additionally, the loggers hunt animal populations previously untouched and the roads act as conduits into the forest where people can penetrate relatively easily. People follow the logging roads in search of agricultural or grazing lands, and they deforest more areas along these roads and they too hunt for subsistence and for sale of "bush meat" in the local market. Secondary consequences of deforestation are common like the pollution, silting and other damage which results from logging leading to declines in biodiversity. In Mokokchung district, varieties of river fish species have diminished after logging activities under the multiple stresses of habitat loss, land slide, pollution etc.

In the recent years there has been a significant change in the total number of species, but some species, such as the Elephant (*Elephas maximus*), Sloth Bear (*Melurses ursinus*), Spotted Linsang, Tiger Civet (*Prionodon pardicolor*), Tailed Pig (*Macaca assamensis)*

which are endangered species all over Nagaland have decline more apparently in their quantity. Besides, primates and hornbills (despite their protected status) have significantly become lower as hunting of many of these animals and birds is far above sustainable levels. Plants and tree species too are threatened to extinction with the demolition of forests by jungle fires. Floral species like the Agar (*Aquilariia agallocha*), Hollong (*Dipterocarpous*), Makai (*Shorea assamica*), and Nahar (*Mesua ferra*) are rare and endangered species in the district.

The moist deciduous and evergreen forests adorning the entire district of Mokokchung were the abode of these magnificent creatures, but due to reckless destruction of forests and jungles, their population has considerably reduce, threatening their survival. If proper preservation and conservation with effective implementation are not initiated, they are nigh on the verge of extinction. 'There are many plants that do not exist anymore and no effort was made to revive and preserve them….In some cases, plants do not even have local names probably because of limitation of local dialect'[3]

This further asserts that loss of natural habitat results in a proportional decrease in the population of biotic life. Such disastrous effects on the present Biodiversity of the region has meet with mutilation effects at an alarming rate, more so because of unscrupulous destruction of wild life habitats. This experienced has proven that the decrease in the primary forest cover in the district are disturb by various anthropocentric activities, like increase population, deforestation, expansion of agriculture, developmental activities, commercialization of forests, hunting and poaching and unethical exploitation of resources etc which shall be discussed in detail in the succeeding chapters.

3. Adding Value to Shifting Cultivation in Nagaland, India NEPED; 2007, page 39

Biodiversity reckon as ‘an asset, the greatest wealth serving all the needs and wants for safe drinking water, firewood, timber, traditional medicine etc by the local people in the region is at a critical condition especially due to increase of population, deforestation and over-exploitation. Biodiversity in the region has undergone a drastic change within a span of 50 years (dating from 1960 till the present day). Natural processes are always involved in the elimination and evolution of species although its mechanism is imperceptible but the rate of extinction is slow in contrast to the present extinction caused due to human impact.

‘Loss, fragmentation or transformations of habitats have been mainly due to changes in land use such as urbanization, industrialization, agricultural development, vegetation manipulation, shifting cultivation, introduction of exotic species etc…..Wildlife habitats are getting destroyed at an alarming rate with disastrous effects on the Biodiversity.’ [4]

This can be supplemented with rapid developmental activities, construction of roads, making easy accessible to forests and jungles, increased urban areas which are mostly unplanned are widely spread over these ranges have made to minimized the Biodiversity of the region. The splendid Biodiversity in the region which is fast deteriorating in the district of Mokokchung is due to the lack of scientific knowledge and awareness about the role of Biodiversity welfare, unplanned development, and blatant exploitation of Biodiversity and its resources which have made it dangerously vulnerable. Apart from disintegration in the forest area, plants and tree species, fauna, avi-fauna and fish species are seriously depleted in the region. Over exploitation, use of lime, chemicals, batteries and pollution caused by dumping of inorganic wastes into the rivers and streams is most responsible in making our river ecosystem most exposed.

4. U.Kumar, M.Asija: Biodiversity, Principles & Conservation (2nd edition); 2009, page 55

3.5 POLLUTION OF BIODIVERSITY DUE TO MINING RELATED ACTIVITIES

The practiced of mining especially along the Tuli, Anaki, Waromong, Debuia, Mongkolemba and Changki areas of the district has caused irreversible damage to animals, birds, vegetation and the aquatic ecosystem through the release of toxic chemicals. Previously buried metal sulfides are exposed during mining activities which when comes into contact with atmospheric oxygen gets converted into strong sulphuric acid and metal oxides.

Such compounds are released into the nearby water bodies causing water pollution. When they are leaked they slowly percolate through ground water and pollute it, surface runoff from the mining pit also pollutes the soil and rock debris making it poisonous and harmful for the vegetation of the surrounding areas, the soil becomes unsuitable for plants to grow and the organisms that live in the soil find the polluted environment hostile for their survival. Besides the water accumulated in the mining pit becomes a stagnant pool of water making it a breeding ground for water borne disease causing insects and organisms like mosquitoes to flourish.

This may also result into a phenomenon, called bio-magnification, through the process of which unknowingly some harmful chemicals enter our bodies through food chain. When these chemicals are washed down into the soil, plants absorb them along with water and minerals. Similarly, from the water bodies, aquatic plants and animals consume these chemicals. This is one of the ways in which chemicals enter the food chain. As these chemicals are not degradable, these get accumulated progressively at each trophic level. Thus, the amount of chemicals increases in each of the trophic levels resulting in a serious implication on the food chain.

PLATE NO: 3.1 MINING AT TULI REGION.

PLATE NO: 3.2 MINING AT CHANGKI REGION.

PLATE NO: 3.3 MINING AT WAMEKEN REGION.

3.6 DISTURBANCE IN THE ECOSYSTEM DUE TO VARIOUS UNETHICAL PRACTICES

Food chains and webs or food networks describe the feeding relationships between species to another within an ecosystem where the organisms are connected to the organisms they consume. It is the relationship between various components of an ecosystem on the basis of who eats what. For example, grasshopper eats green plants and frog consumes grasshopper and snake eats frog and carnivorous bird finally eats snake.

Ecosystems are maintained in perfect balances in nature due to complex relationships between the producers (plants, photosynthetic bacteria and algae), herbivores (which feed on plants), predators (which feed on herbivores) and the decomposers (which feed on the dead animals and plants).When this balance is altered; it can destabilize the entire ecosystem and trigger alterations in it.

In Nagaland the main motivations for hunting are for food, cultural and economic demands. The meat of wild birds and animals are considered as an expensive delicacy for most Nagas. Economic reasons that are driven by cultural demand is also influential particularly for the current decline in the tiger, elephant and primates population as many traditionally believes that consumption of their meat can cure cancer, asthma, tuberculosis etc.

Ecosystems are so interconnected; the loss of prey animals within a food chain will eventually have the same effects as the loss of an apex predator will have. Hunting of deer for food and elephants for their ivory eventually produces adverse effects within their respective ecosystems as all are prey animals. Hunting and poaching is a serious issue that

cannot be diminished overnight in Mokokchung district. It will require cooperative efforts locally at the community level, tougher legal sanctions on perpetrators and the education of the public on the effects that hunting and poaching has on the health of ecosystems.

The health of the ecosystems is paramount, as all forms of biotic and abiotic activities depends on them from socio-economy to general human welfare. Environment will continue to be degraded in Mokokchung district through poaching and illegal wildlife trade, unless action is taken now. The loss of such endangered species resulted from hunting and poaching will have a significant impact on the ecosystems in which these animals live because in the event of complete species extinction, these effects pose the threat of being highly detrimental and irreversible.

For instance one of the reasons for the declining number of tiger in the district is that herbivores animals are hunted down for meat and economic needs exacerbated by deforestation adversely affecting their food chain. Likewise the loss of endangered species like the python in the region is also related to food chain, though Ao's do not take its meat, this reptile are found in very few number since most of the herbivorous animals like the Spotted Deer (*Axis axis),* Barking Deer (*Cervulus muntjac),* Otter (*lutra),* Pangolin (*Manis tricespis*), Squirrel (*Funambus),* Mole (*Talpa)* etc on which pythons would feed are very sparsely found due to hunting; amphibians like Malabar Gliding Frog (*Rhacophons malabaricus),* Giant Tree Frog (*Rhacophorus maximus),* Himalayan Torrent Frog (*Amolops marmoratus),* Skittering Frog (*Euphlyctis cyanophlyctis)* etc which would otherwise serve as food for pythons have become scarce due to loss of habitat through deforestation and over exploitation of bio-resources by human actions.

Mokokchung district due to its unique location at the confluence of the Palaeo-arctic and Indo-Malayan Biogeographically realm has great biological significance. The vegetation comprising of evergreen forest to mixed deciduous evergreen forest covering over a wide altitudinal range from 1000 m to over 2000 m with diverse habitats provides numerous diversity of species among which snake variety like the Common Worm or Blind Snake (*Ramphotyphlops braminus),* Blind Snake or Diard's Worm (*Typhlops diardii),* Indian Python *(Python molurus*), Common Kukri Snake (*Oligodon arnensis*), Golden Tree or Glidding Snake (*Chrysopelea ornate*), Green Keelback (*Macropisthodon plumbicolor*), Common Green Whip Snake or Vine Snake (*Ahaetulla nasuta*), Albino Indian Cobra or Indian Cobra *(Naja naja),* King Cobra or Hamadryad (*Ophiophagus Hannah*), Green or Bamboo Pit Piper (*Trimeresurus gramineus*) etc are found.

Unfortunately most of larger snake species like the Pythons and other snake species in the district have decline as they are killed with the pretext that they emit poisonous venom. But venoms in snakes is produced only when the snakes are extremely healthy, so they are very judicious in using their venom and are capable of modulating and controlling their venom in their bites. Snakes are killed because of such misconceptions in the district ignoring the knowledge about their importance in the ecosystem. Snakes plays a vital role in maintaining the balance in the ecosystem, for instance controlling the menace of rodents and save the paddy field; snakes like Keel Back (*Macropisthodon plumbicolor*) helps in controlling spread of malaria by eating mosquito's larvae's etc.

In addition to the decline of Biodiversity in the district due to such reasons, shortage of space is rapidly becoming the top concern for wildlife especially for larger animals like elephants, tigers and leopards etc, naturally the predominant species will occupy the land

and as such human population continues to expand despite lack of resources while the animals are forced to negotiate on their habitat.

Farming and development has lead to vast areas of natural forest being burned, chopped down or otherwise destroyed making the soil infertile for crops and vegetations. The lack of viable forests areas means less oxygen production and massive soil erosion as tree plays an important role in anchoring soil. Elephants and tigers need vast areas of fertile land and forests to graze and hunt their prey, while in the absence and scarcity of space they tear and push down trees and begin to exacerbate the man-made problems as there are insufficient resources.

3.7 IMPACT OF WEATHER AND CLIMATE CHANGE ON THE LOCAL COMMUNITY

There are massive changes encountered by the people of the district, be it in the form of weather and climate, food chain, cropping pattern, flowering and fruiting, trees, animals and insects etc. Climatic change is most noticeable in the region. Felling of trees have deprived the soil of its fertility promoting soil erosion, it has induced delay in rain, inciting more thunderbolt and increase of temperature.

Discussion and direct interaction through prepared questionnaires including village councils, farmers and womenfolk clearly pointed out that in the past especially “During the 1960’s, when the forest was thickly concentrated, there used to received heavy rainfall at all seasons, there were hardly any drier season, but now it has changed drastically due to felling of trees. Climate has become warmer and unpleasant”. Farmers have also faced untold miseries in their cropping pattern yielding less quantity of juice in vegetables and fruits especially citrus fruits like oranges; some do not bear any seeds.

Alteration in the weather and climate is more noticeable in the Langpangkong range, where the local people testify that unlike the former days whereby from the month of January to May which then used to experienced colder season, has been reversed at present, its alteration leading to the prevalence of more sicknesses and diseases like spread of malaria, headache, cold etc.

Climatic changes have its adverse impact causing “delay in rainfall, restraining dew formation, which inhibits bees to collect nectar from flowers thus affecting pollination, thereby affecting the economy of the locals who are cultivators”. Pollination is essential for the provision of plants, animals and all life forms. Almost all the fruits and vegetables require pollinators, and this service is at a critical condition to the production of considerable portion of vitamins and minerals in the human diet.

Such valuable service of Biodiversity is earnestly felt at present as we suffered in quintuple ways due to scarcity of Biodiversity and its resources. Such an incident has made everyone aware about the significance of the tiniest organisms playing a crucial role in the ecosystem thus affecting human welfare. It is to be acknowledgeable that destruction of an insignificant looking insect species or a butterfly or a bee species through excessive use of pesticides and insecticides may lead to failure of crops as it aids pollination.

Another side effect is the burgeoning of pests due to the loss of these species. It is observed that in almost all the villages spreading over all the six ranges, unethical exploitation of forest has lead to scarcity of vital Biodiversity and its resources; it has severally polluted the air, water and soil encouraging various pestilences and diseases.

As quoted from the questionnaires, “Forests which once used to provide edible wild food, raw materials and medicinal purpose in abundance have depreciated at present”, “unlike the former days, all the rivers have been dried up due to excessive deforestation, resulting in acute water scarcity in the villages”. In the past, “birds like cuckoo and swallow were conspicuously everywhere, and when they sang ,it was reckon as the time to sow seeds and thus were taken as an bio-indicator for sowing and harvest seasons.”

Changes in Biodiversity and environment also affect the economy of the local people, as “economic condition has been badly affected, for getting access to attaining essentials needs like water and firewood have become more expensive and difficult due to injudicious use of bio-resources” These evidences certainly shows that the extent of dependence on Biodiversity by the local community is unconditional.

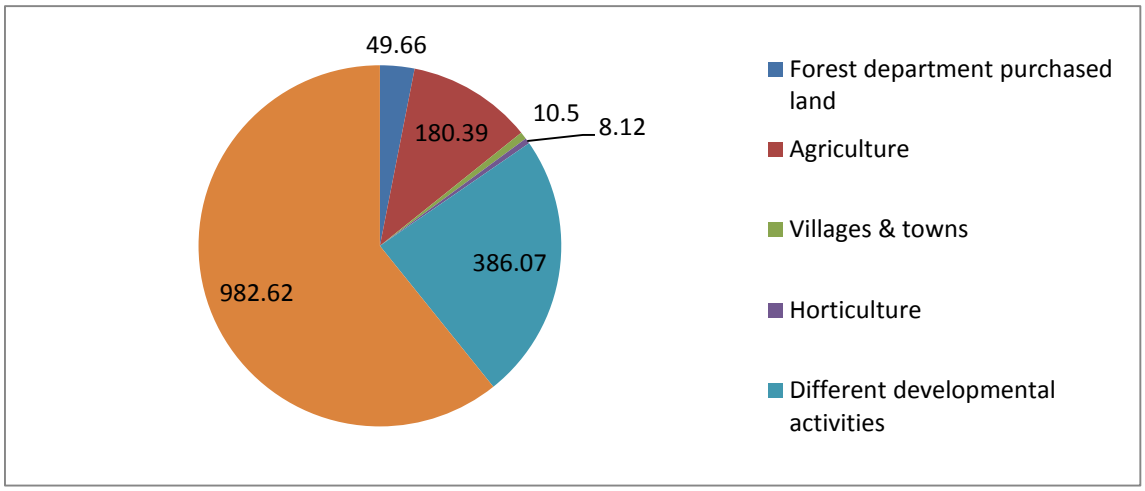
3.8 CURRENT STATUS OF JHUMMING

Land is the most basic asset in the Naga community. Traditionally, land is categorized as village land, community land, and clan/family land. The land owned by the community dominants in the Ao-Naga community. In the recent years many land are purchased and owned by individuals. Jhumming is the traditional practice which has its roots deep in the socio-cultural life among the Nagas.

For generations, jhumming has proved to be the sustainer of livelihood, with its lifestyle, festivals, songs and dances revolving around it. The practice of jhumming can be conserved for the time being in its traditional forms rather than being eliminated because shifting cultivation, when still practiced using traditional methods, is significantly less destructive than current practice of monoculture plantation and commercial farming.

Despite repeated attempts to eradicate shifting cultivation, it has persisted because majority of the Naga population are dependent on this form of cultivation for their subsistence.

FIGURE: 3.3 LAND-USES PATTERN OF MOKOKCHUNG DISTRICT



(Source: Land Use Statistics, Ministry of Agriculture, GOI, 2011)

As observed in many of the villages in Mokokchung district where jhumming are predominantly practiced, the central reason is associated with the concern for the biophysical limitations of the land form, geology, climate and edaphic conditions of the mountainous terrains of the district, which are not favourable for the expansion of cultivated areas.

Moreover the acute shortage of drinking water sources has restricted the expansion of sedentary agriculture with very limited opportunities to expand irrigation and the land area available for permanent cultivation is not enough even for subsistence living for the majority of farmers. In fact, of the total cultivated land in the district 50 percent is under shifting cultivation representing up to 75 percent of the annual family food requirements for greater part of the farmers.

It is also a matter of experience that this practice restricts the intensity of land use, reducing the rate of environmental degradation in situations where capital and land management capability are low. In situations where conservation practices on sloping, permanently cultivated land are restricted due to shortage of labour, shifting cultivation has in fact helped minimize erosion. It is observed that Naga farmers strictly follow traditional norms for fertility regeneration resulting in lesser environmental impact. Hence it is an ecologically more stable form of cultivation than existing permanent and commercial cultivation practices.

It is undeniable that jhumming is partially responsible for depredating forest area in the district, as it is marked by slash and burn method before being cleared ultimately leading to loss of habitat of plants and animals and hence a loss to diversity, but at the same time jhum has its own cycle (10-15 years). In fact a larger section of the forest cover in the district is made up of jhum fallow land, the process of leaving the land fallow incite the re-growth of trees and vegetation giving rise to rejuvenate secondary forests.

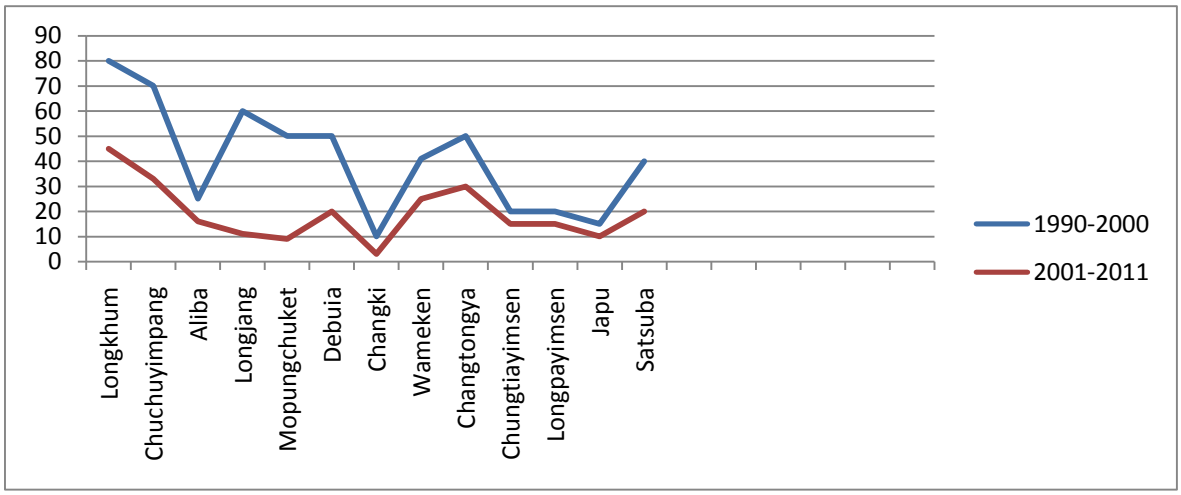
The table below shows the total land use under Jhumming and T.R.C paddy in Mokokchung district.

Table: 3.3

CULTIVATION	**1990**	**2000**	**2011**
JHUMMING	14,500	13,600	13,400
T.R.C	6750	6800	6850

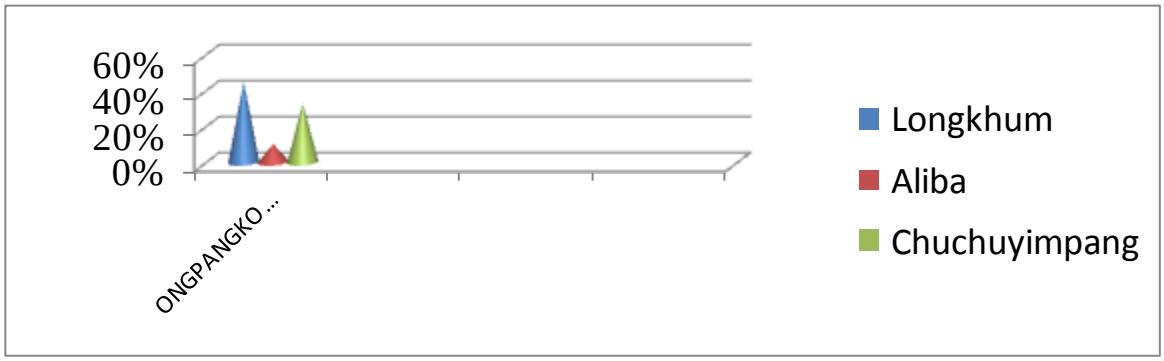
(Source: Basic Facts 2011)

FIGURE: 3.4 SHOWS THE % OF HOUSEHOLD PRACTICING JHUMMING IN THE SELECTED STUDY AREA UNDER MOKOKCHUNG DISTRICT



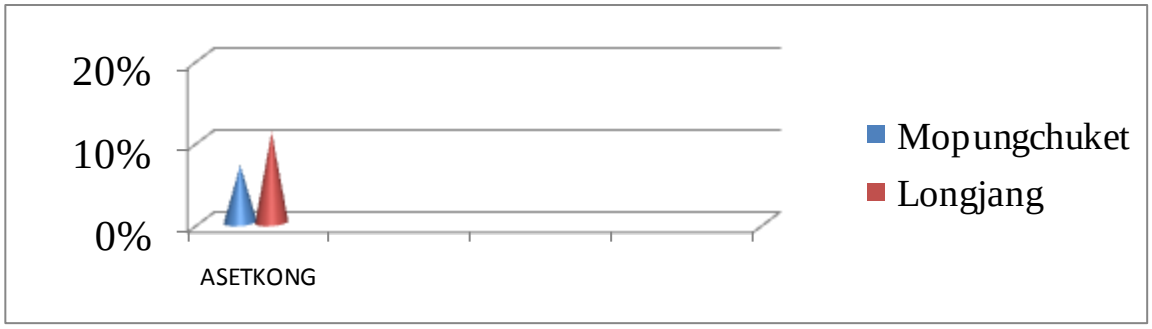
(Source: Field survey 2009-2013)

FIGURE: 3.4.1 ONGPANGKONG RANGE



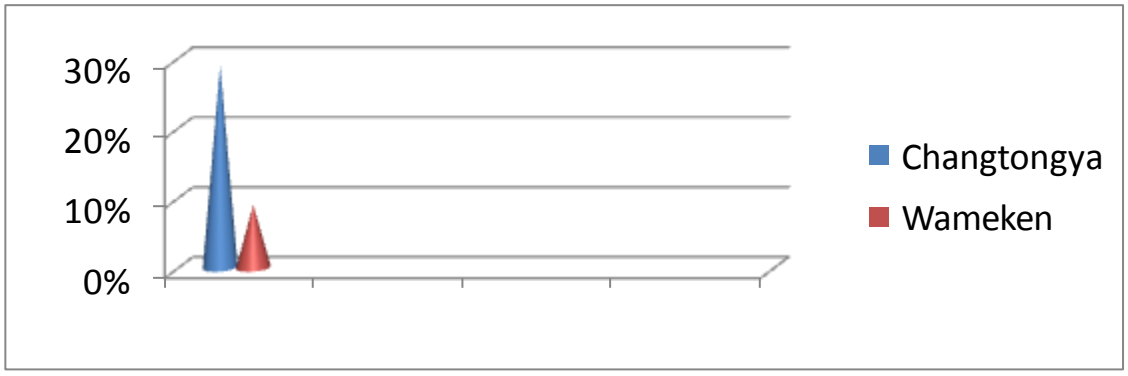
(Source: Field survey 2009-2013)

FIGURE: 3.4.2 ASETKONG RANGE



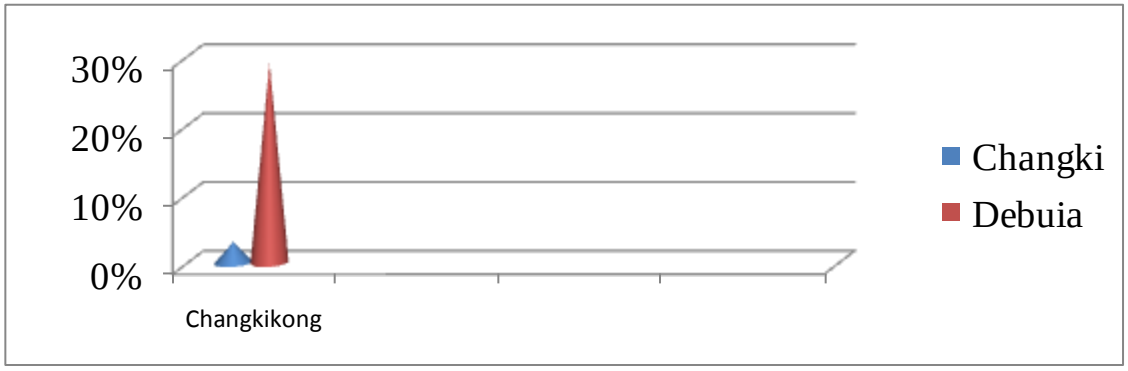
(Source: Field survey 2009-2013)

FIGURE: 3.4.3 LANGPANGKONG



(Source: Field survey 2009-2013)

FIGURE: 3.4.4 CHANGKIKONG

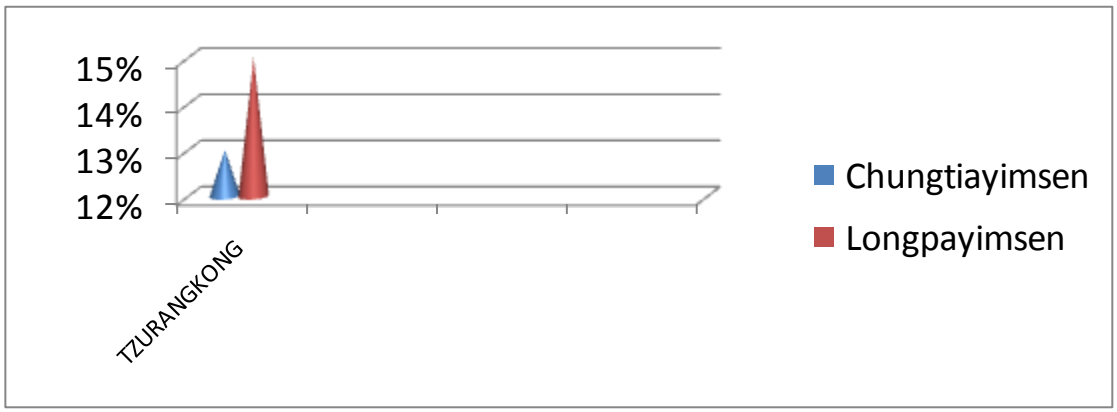


(Source: Field survey 2009-2013)

FIGURE: 3.4.5 JAPUKONG

(Source: Field survey 2009-2013)

FIGURE: 3.4.6 TZURANGKONG



(Source: Field survey 2009-2013)

This shows that during the last decade in Mokokchung district, jhumming has slightly reduced paving the way for other alterative method of farming. Shifting cultivation has drastically reduced because of low productivity and returns on one hand and better standard of living and other alternative farming such as orchards farming, animal farming etc on the other hand. The number of families which practiced only jhumming has also declined considerably in almost all the villages of the district, and as a result there is a decline of areas under jhum which in turn has helped in restoring the forest area in a substantial way.

Therefore instead of recommending the complete and immediate abolition of shifting cultivation, attention need to be given to achieve community participation in an effort to promote and maximize the implementation of appropriate new land use strategies to create more productive agricultural systems while simultaneously conserving the forest wealth. Furthermore the consequences of a sudden abolition of shifting cultivation would be extremely negative as many families depending on this practice would no longer be able to sustain their own food needs. As such, changes should begin moderately and shifting cultivation practices should be replaced gradually.

Despite all these hurdles incurring against the progress of Biodiversity in the district, still the following birds, animals and vegetation are found in the region, thought the figures may vary from forests to forests and range to range, depending on the implementation of laws and regulations by the village authority against hunting, poaching and gathering of bio-resources.

Table: 3.4 LARGE AND MEDIUM TREE SPECIES

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Teak	Teak sung	Tectona granfgis
Tita sopa	Ari sung	Michelia champaca
Nahor	Mangi sung	Mesua ferrea
Gomari	Eikung sung	Gmelina arborea
Sida	Arongtsubasung	Lanerstroemia parviflora
Alder	Mokokchung sung	Alnus nepalensis
Amari		Almora wallichi
Satiana/Devil tree	Eiku sung/Lazarongpang	Alsstonia scholaris, Wall
Korio	Moang sung	Albizzia procera
Sam	Sulem sung	Arto carpus chaplasha
Agar	Sungi/Sungya tong	Aquilaria agallocha
Uriam	Jali/Sensir tong	Bischofia javanica
Semul	Ali tong	Bombax cuba
Bogi poma	Aichangtong	Chickrassia tabularis
Coral tree	Settsu/Jeje	Hovenia acerba
Walnut	Akha tong	Juglans regia
Wild mango	Pongen su	Mangifera sylvatica
Soap berry	Soap berry	Sapindus rarak
Oak	Oak	Quercus serrata
Malabar neem/ White Cedar	Ghora neem	Melia composite,Melia azederach
Khokan	Khokan	Duadanga grandiflora
Kadam	Kadam	Anthocephalus chinensis
Fig	Mongozuno	Ficus auriculata,Ficus cunia
Fig	Akho	Ficus cunia
Naga Tenga	Tangmoh/Naga Tenga	Rhus semialata
Bonsum	Bonsum	Phoebe goalparensis
Naga neem	Naga neem /Hog plum	Axillaries spondias
Siris	Siris	Albizzia chinensis
Kala Siris	Siris	Albizzia lebbeck

Naricol sopa	Naricol sopa	Streblus indicus
Hollock	Awa	Terminalia myriocarpa Huerek et Muell
Harra	Lingkha	Terminalia chebula (Gaertn) Retz
	Sungkup tong	Artocarpus lakoocha Roxb
Betal nut palm	Salidong	Areca catechu,Linn
	Ontong/Entsung	Betula alnoides Bush.Ham ex.D.Don
	Pachet/Chelo	Callicarba arborea Roxb
Dhuna	Liangmesen	Canarium resiniferum Brace ex.King
	Kozu	Castanopsis indica A D C
	Tsupena/Sungamerem/Majeblam	Elaeocarpus floribundus Bl
	Pekang	Elaeocarpus sp
	Waza tsungi/Merr-sung	Engelhardtia spicata Bl
Jamun	Longchen tong	Eugenia jambolna
Rubber tree	Ngissa tong	Ficus elastic var.decora.Roxb
	Jelok/Sulok	Helicia nilagirica Bedd
	Koya laksetla	Gynocardia odorata R.Br
	Amendong	Macropanax dispermus (Bl.) O.Ktze
Gahori sopa	Lakhup	Taluma phelocarpa
Bola	Asentsu sung/Asen sung/Hatsuh	Morus laevigata Wall ex.Brandis
Mulberry	Metiyong	Myrica esculenta Buch,Ham.ex D.Don
	Rin/Aren	Persea fructifera Kost
	Charak	Rhus acuminate DC
	Pako	Spondias pinnata (L.f) Kurz
	Ok-ko-rong	Sterculia hamiltonii (O.Ktze)Adelb
Jatipoma		Cedrella toona
Paroli	Sungpet	Stereospermum chelonoides DC
	Ozhi/oyei	Styrax serrulatum Roxb
	Longchensu	Syzgygium kurzii (Duthie) Balak
Bhelu	Achen tong	Tetrameles nudiflora R.Br
Thubi	Tosu	Trema orientalis (L.) Bl
	Sarang	Quercus griffithii Hk.f & Th

	Sarang	Quercus dealbata Hk.f &Th
	Sarang	Lithocarpus dealbatus (Miq)Rehder
	Sarang	Lithocarpus elegans (Bl.)Hatus
Champa	Ripang	Michelia champaca, L
Am	Tete tong	Mangifera indica
Jamuk	Along dong/Longchin dong	Syzgium cumini
Hilika	Terminalia citrine	Calamus erectus,Roxb
Owtenga		Dillenia indica
	Injang kirosu	Calamus erectus,Roxb
Wild apple	Arem apple	Docynia indica (Wall)Decne
Amla	Lozu/lolosu	Embilica officinalis,Gacerth
	Surajang	Livistonia jenkinsiana,Griff
	Okti-jang	Zalacca secunda, Griff
	Dimetsulasu	Roydsia suaveoden,Roxb
	Asang tong	Caryota urens,Linn
	Asatong	Hodgsonia heteroclite,Hk.F
	Atitong	Entada scandense,Benth
	Charangsujang	Sapindus mukorossi, Gaerth
Jack Fruit tree	Bolung tong	Artocarpus heterophyllus,Lam
	Metoksuben	Datura fastuosa,Linn
	Charaktong	Rhus griffithii,Hk.F
	Akolongkokusu	Solanum khasianium, Clarke
	Masaktong	Strobilanthes flacculifolius,Nees
Eucalyptus	Eucalyptus	Eucalyptus sp, L.Herit
Neem tree	Neem tong	Azadirachta indica,A.Juss
Mundani	Mundani	Acrocarpus fraxinifolius
Hollong	Hollong	Dipterocarpous
Makai	Nguprung	Shorea assamica
Ajar	Ajar	Largerstroemia flos-reginae
Gogra/Needle tree	Mejangsung	Schima wallichi
Pine	Pine sung	Pinus khasiya
Yongchak	Yongchak tong	Parkia roxburghii
Naga peanut	Metangtong	Fermiana colorata
Raspberry		Rubus ellipticus
Dalchini	Sungshe tong	Cinnamomum

		zeylanicum
Bauhinia	Biangnok	Bauhinia variegata
Yew		Cephalotaxus griffithii
Mejankori	Anget	Litsea citrata
Udal	Ajunem	Sterculia villosa
Nettle tree	Tosu	Trema orientalis
Dudhi		Wrightia tomentosa
Mechinga	Jangpet	Zanthoxylum acanthopodium
Wild Rhea		Debregesia longifolia
Pula		Kydia calycina
Adhatoda		Adhatoda vasica
TOTAL		**104**

(Source: Field survey 2009-2013)

Table: 3.5 MEDICINAL PLANTS

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Aloe	Tanula O	Aloe Vera
Wool flower	Alosangtsung	Celoses Argentines-Linn
Mugwort	Antsukna	Artemisia Vulgaris-Linn
Wild yum	Arem shi	Dioscorea Villosa-Linn
Tapioca	Ali shi	Manihot Utetssima poh
Chrysanthemum	Ansu naro	Chryanthemum
Sun flower	Anu naro	Hellanthus annuus-Linn
Soyabeans	Azungkenyih	Glycine Max Merril
Redamarnath	Arotemeremla	Amaranthus
Blessed Thistle	Ayih naro	Cnicus benedicus-Linn
Couch Grass	Azu yih	Agropyron Repens-Linn
Lentil	Ahar Dal	Cajanus Cajans-Linn
Larkspur	Atsuk Remtsu	Delphinium Ajacis
Blackberry	Aroklashi	Morusigra-Linn
Curry Leaf	Aoun Sungo	Murraya-Linn
Dandelion	Ayisen	Taraxacun Officinaee
Sensitive Plant	Aakmesen naro	Mirabilis Jalapa-Lin
Oats	Atah	Anena Sativa
Bread Fruit	Bangsem	Artocarpus
Bowstring	Bertong	Marul Sanseviria Zeylanica.Web
Sponge Gourd	Bento	Luffaclendrica-Linn
Yellow Oleander	Ber naro	Thevetia Peruviana-Pers
Autumn crocus	Biaz naro	Colchicum Autumnale
Jackfruit	Bolong	Artocarpus Heterophyllus
Onion	Biaz	Allium capa-L
Chaulmongra	Chidemratong	Hydnocarpus Wightiana.B
Coffee	Capy	Coffea Arabica-Linn

Poinsettia	Chuba naro	Euphorbia Pullherrima
Pomegranate	Charimtong	Punica Granatum-Linn
Traingular Milk Wort	Dakrah	Euphoria Antiguoron
Stinging Nettle	Demongtsu	Urtica Dioica
Meadow Sweet	Doklo	Filipendulaulmaria.L
Corriander	Donia	Corindrum Sativum.L
Yellow Nights	Entsu Likok	Solanum Xanthcarpun
Eucalyptus	Eucalyptus (menemtsu.O)	Eucalptus Globulus Labill
Passion Fruit	Entsulashi	Passiflora Edulis.Sin
Ginseng	Ginsing	Panax Ouiguefulius-Linn
Poppy Plant	Ghanitong	Papaver Somniferum
Cardamom	Ilaichi	Ellittariacardamomum-Maton
Four O'Clock	Jemdang naro	MeraBillsJalapa-Linn
Black Mustard	Jibi Tanakla	Brassica Juncea-Linn
Pineapple	Jero	Ananas Comosus-Linn
Cocoa	Jambolashi	Theobrona Cacao-Linn
Great Burdack	Kumenatsu	Arctium Lappa-Linn
Cotton	Kumba	Gossypium Herbaceum-Linn
Sweet Gum	Komtong	Liquidambar Herbaceum-pLinn
Live Forever	Kutanga Masuba Yi	Bryophyllum Pinatum-Linn
Chestnut	Kazujang	Castanea Sativa-Linn
Bengal Quinine	Likok	Aegle Marmelos-Linn
Indian Pennyworth	Longsugoruk	Bacopa Cente-Umlla Jalneem
Garlic	Lasung	Alium Sativum
Spiked ginger lily	Lasung	Hedychium spicatumj
Gooseberry Amla	Lozu	Emblica Officinalis Gaertn
Chillies	Mersu	Capsicum Fruit
Maize	Menti	Zee Mays
Sugar Cane	Moji	Saccharum Officinorum-Linn
Sage	Mejensanger naro	Salvia Officinalis
Cow Hage Velvet Bean	Mesemerh	Hewach Mucuna Purita
Fig	Munguzuno	Ficus Glomerata
Hyacenth Bean	Matsulakshi	Dolic Hos Lab Lab
Black Mulberry	Menaklakshi	Morusnigsa
Wild Apple	Medoklashi	Feronia Lemonia-Linn
Pumkin	Mapu	Cucurbita Pepo
Papaya	Mamazu	Carica Papaya
Madasgagar periwinkle	Mozunaro	Catha Ranthus
Coconut	Narikol	Cocos Nucifera-Linn
Dwarfnasturtum	Nupang naro	Tropa colum Majus
Mexican Butterfly	Noklangsang naro	Asclepias curassavia

weed or Blood flower		
Basil	Nangpera	Ocimum Basilium
Chamomile	Narosen	Anthenisnobites
Percian lilae	Nangajang	Melia Azedarach-Linn
Snakker Root	Nokna	Serpentaria-Linn
	Nokna	Houttuynia cordata, Thunb
Banyan Tree	Ngisahtong	Decorative Bar
Holy plant	Ongjenaro	Alex Aquifolium
Alder	Ongpangsulem	Bhamnus Frangula
Marigold	Petshi naro	Tagettes Erecta Linn
Mountain Ebony	Penuk	Bauchinia Variegata
Blue Flag	Pisong	Iris Versicollor Linn
Angelica	Pangpanglao	Angilica Archangelica L
Century Plant	Pudotong	Agava Americana
Platains	Sanglem	Plantago Major
Pansy	Shinunaro	Viola Tricolor
Whiteoak	Surangtong	Querus Alba
Ginger	Sungmok	Curcumadomestica.Val
Palmyra Plant	Suratong	Borassue
Banana	Somomo	Musa Paradisiaca
Tumeric	Sungsung	Curcuma longa-Linn
Sacret lotus	Tzu naro	Nelumbium Speciosum
Okra/Lady's finger	Tetsur meyong	Abelmoschus
Bitter Sweet	Tanur likok	Solanum Dulcamara
	Sungerlikok	Solanum myriocanthum Dunal
Gingue Foil	Tanurarokolashi	Potentilla reptans
Flame of forest	Tzubennaro	Butea Frondesa
Grapes	Tsukmenatsu	Citrus maxima.burn
Lemon	Hasu	Citrus Maxima.Burn
Orange	Naring	Citrus sinensis
Stone apple/ Bengal Quince	Bel	Aegle marmelo
Watermelon	Tzuzunyi	Citrullus Valgarisseh
Phyllanthus	Tanur lozu	Phyllanthus Fratemus Web
Vervaiijn	Tanur Mendi	Verbena Officinalis
Celery	Tanur napa	Apium Graveolens
Siliry	Teronemtong	Apium Graveolens Linn
Woodsorrel	Waroyisu	Oxalis Acetosella linn
Willow	Yimjepangnaro	Acetyisalicylic Acid
Mint	Yimra Mozu	Mentaa Spicata Linn
Hibiscus	Yimpangnaro	Hibiscus
Indian Spinach	Zua Aobaonu	Basellar Alba linn
	Zaklo	Distemon indicum
	Tinulemba	Hypoxis aurea
	Tsungrempangmozu/Tempokruzu	Cissampelos pareire L.

Lantana	Anitong	Lantana camara,Linn
	Rin/Aren	Persea fructifera Kost
Crab's eye	Asang naro	Abrus precatorius,Linn
Indian Acalypha	Wally naro	Acalypha indica,Linn
Sweet flag	Rangpang	Acorus calamus,Linn
Century plant	Entsumerem	Agave Americana, Linn
Rain Tree	Tsunglu naro	Albizia lebbek,Benth
Red Amaranth	Aru/Rowa	Amaranthaus gangeticus, Linn
Mexican poppy	Aeng naro	Argemone Mexicana,Linn
Mountain ebony	Merem naro	Bauhinia variegate,Linn
	Tsumenemli	Paederia foetida,Berth
Basella alba,Linn	Poi wa	Indian spinach
	Emrem	Clerodendrum colebrookianum
Tree tomato	Pento tong	Cyphomandra betacea
	Asong	Garcinia pedunculata Roxb
	Longchokorok	Centella asiatica (L) Urban
TOTAL		**126**

(Source: Sungomozu by Meyisongla)

Table: 3.6 ORNAMENTAL PLANTS

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Bauhinia	Yimpang naro	Bauhinia purpurea, Linn
Mountain ebony	Merem naro	Bauhinia variegate,Linn
Periwinkle	Etsuk naro	Catharanthus roseus,G.Bom
Wooiflower (Cock's comb)	Aluentsung naro	Celosia argentea,Linn
Chrysanthemum	Entsuk pen naro	Chrysanthemum,indicum,Linn
Thorn apple	Mangaben naro	Datura innoxia,Mill
Poinsettia (Christmas star)	Benchong naro	Euphorbia pulcherrima,Willd
Sunflower	Anu naro	Helianthus annuus,Linn
Hisbiscus	Yampang naro	Hibiscus rosa-sinensis,Linn
Four O'clock plant	Jemdang naro	Mirabillis jalapa,Linn
Sacred lotus	Tsutsung naro	Nelumbium speciosum,Willd
Marigold	Kitsung naro	Tagetes erecta,Linn
	Inchentong	Cynthea brununiana,Wall,Clarks
Rhododendron	Metsuben naro	Rhododendron arboretum,Sm
TOTAL		**14**

(Source: Field survey 2009-2013)

Table: 3.7 PLANTS USED AS FLAVOUR AND SPICES

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Onion	Piyas	Allium cepa,Linn
Chinese onion/ Chinese scallion	Piyas	Allium Chenense G.Don
Garlic	Lasung	Allium sativum,Linn
Tumeric	Haldi	Curcuma domestica,Val
Cardamom	Mngozuno	Elettaria cardamomum,Maton
Black pepper	Tsumar mersu	Piper nigrum,Linn
	Alo-lasung	Allium anpeloplasum,Linn
	Mongmong/Mongsu	Zanthoxyllum. Edgew
Tes-pata	Tes pata	Cinnamomum zeylanicum,Breyn
TOTAL		**9**

(Source: Field survey 2009-2013)

Table: 3.8 BAMBOO/CANE

LOCAL NAME	SCIENTIFIC NAME	USES
Awah	Dendrocalamus hamiltonii	Making ropes, handy crafts
Longmi	Bambusa tulda	House construction,fencing
Warok	Bambusa ballooa,Roxb	House Construction
Arr	Calamus floribundus Griff	Handicrafts,binding materials
Arang	Arundo donax L	House construction
Meri warok	Arundina hirsuta	
Sura	Livistonia jenkinsiana, Griff	Leaf used as roof in thatch house
Azu	Imperatacylindrica,Beawb	Dried leaf used as roof in thatch house
Sungkem	Bambusa vulgaris,Schrad	
Sura dong	Borassus flabellifer,Linn	Used as roof construction,dried leaf used as broom
	Denroclamus latiflorus	Making furniture
Rattan cane	Calamus tenius	Used for basket making, furniture frames, walking stick, also used as substitute for ropes and cables for suspension bridges.
TOTAL		**12**

(Source: Field survey 2009-2013)

Table: 3.9 ORCHID FLORA

Mokokchung district have approximately 143 orchid species belonging to about 50 genuses.

ORCHID SPECIES	PLACE/ LOCALITY
Acampe multiflora (LindI)Lindl	Meinkong forest
Acampe papillosa (LindI)	Mokokchung
Acanthophippium Striatum LindI	Mokokchung
Aerides Crassifolium Par & Reichb.f.	Mokokchung
Aerides fieldingii Jenkins	Mokokchung
Aerides Odorato Lour	Longkhum , Chungtia village
Agrostophyllum callosum Reichb	Changtongya village
Agrostophyllum khasianum Griff,	Meinkong forest
Anoectochilus brevilabris LindI	Meinkong forest, Longkhum village
Anoectochilus roxburghii(Wall) LindI,	Meinkong forest, Longkhum village
Anthogonium gracile	Longkhum village
Aphyllorchis prainii	Mokokchung
Appendicula cornuta	Changki village
Arachnis labrosa	Longkhum village
Arundina graminifolia (D.Don)Hochr	Meinkong forest, Chungtia village
Ascocentrum ampullaceum	Mokokchung
Bulbophyllum affine LindI	Longkhum village
Bulbophyllum caryanum (Hook)Spreng	Longkhum village
Bulbophyllum dyeraneum (King&Pantl)Seidenf	Mokokchung
Bulbophyllum elatum (Hook.f.)J.J.Sm	Mokokchung
Bulbophyllum gamblei Hook.f	Meinkong forest, Longkhum village
Bulbophyllum hirtum LindI	Longkhum village
Bulbophyllum hymenanthum Hook.f	Meinkong forest, Longkhum village
Bulbophyllum leptanthum Hook.f	Changtongya
Bulbophyllum odoratissimum LindI	Meinkong forest
Bulbophyllum ornatissimum (Reichb.f)	Meinkong forest, Longkhum village
Bulbophyllum piluliferum King&Pantl	Changtongya
Bulbophyllum polyrhizum LindI	Mangkolemba, Changtongya
Bulbophyllum reptans (LindI).LindI	Mokokchung

Bulbophyllum rigidum. King& PantI	Mangkolemba
Bulbophyllum rotschildianum(O'Brien)J.J.Sm	Longkhum, Longsa village
Bulbophyllum secundum Hook.f	Longkhum village
Bulbophyllum viridiflorum (Hook.f)Shltr	Longkhum village
Bulbophyllum wallichii (LindI), Reichb	Meinkong forest, Longkhum village
Calanthe angusta LindI	Longkhum village
Calanthe foerstermannii Reichb.f	Tuli
Calanthe mannii LindI	Changki village
Calanthe masuca(D.Don)LindI	Longkhum village
Calanthe puberula LindI	Meinkong forest
Calanthe triplicate(Willem)Ames	Mokokchung
Calanthe vaginata LindI	Mokokchung
Cleisostoma appendiculatum(LindI.)Benth &Hook	Mokokchung
Cleisostoma filiforme(LindI).Garay	Mokokchung ,Longkhum village
Cleisostoma racimeferum(LindI).Garay	Mokokchung
Cleisostoma simondii(Gagnep)Seidenf	Mokokchung
Cleisostoma striatum (Reichb.f)Garay	Mokokchung
Cleisostoma williamsonii (Reichb.f)Garay	Mokokchung
Coelogyne corymbosa LindI	Longkhum village
Coelogyne elata LindI	Longkhum village
Coelogyne flavida Wall. ex LindI	Longkhum village
Coelogyne griffithii Hook.f	Mokokchung, Changtongya, Longjang village
Coelogyne ovalis LindI	Longkhum village
Coelogyne suaveolens Hook.f	Longkhum village
Coelogyne viscosa Reichb.f	Longkhum village
Cymbidium aloifolium (L)Sw	Longkhum, Tuli and Tzurang
Cymbidium iridioides D.Don	Longkhum village
Cymbidium lancifolium Hook	Longkhum village
Cymbidium macrorhizon LindI	Meinkong forest
Dendrobium acinaforme Roxb	Longkhum village
Dendrobium anceps sw	Longkhum village
Dendrobium aphyllum (Roxb) Fischer	Changtongya, Longkhum village

Dendrobium chrysanthum Wall.ex.LindI	Mokokchung, Longkhum village
Dendrobium Chrysotoxum LindI	Longkhum , Changki village
Dendrobium crepidatum LindI & Paxt	Longkhum village
Dendrobium densiflorum (LindI) Wall	Longkhum , Changki village
Dendrobium farmeri Paxt	Longsa
Dendrobium fimbriatum Hook. Var, Oculatum Hook	Mokokchung, Longkhum
Dendrobium gibsonii LindI	Longkhum , Changki village
Dendrobium heterocarpum Wall.ex LindI	Longkhum village
Dendrobium Jinkinsii Wall.ex. LindI	Longkhum village
Dendrobium lindleyi Steud	Mokokchung
Dendrobium lituiflorum LindI	Longkhum village
Dendrobium moschatum Sw	Longkhum village
Dendrobium ochreatum Wall.ex. LindI	Longkhum village
Dendrobium primulinum LindI	Longkhum , Changki village
Dendrobium terminale Par & Reichb.f	Longkhum village
Dendrobium thyrsiflorum Reichb.f	Longkhum , Changki village
Dendrobium wardianum Warner	Longkhum village
Epigeneium amplum (LindI)	Mokokchung
Epipogium indicum Chowdhery, Pal & Giri	Mongsenyimti village
Eria acervata LindI	Longkhum village
Eria bambusifolia LindI	Longkhum village
Eria Bractescens LindI	Mangkolemba
Eria dasyphylla Par & Reichb.f	Changtongya
Eria pannea LindI	Meinkong forest, Longkhum village
Eria spicata (D.Don) Hand & Mazz	Mokokchung
Eulophia emilianae saldanha	Meinkong forest
Eulophia nuda LindI	Mokokchung
Flickingera fimbriata A.D. Hawkes	Changki, Longjang village
Gastrochilus acutifolius (LindI)Kze	Meinkong forest
Gastrochilus calceolaris (Buch- Ham ex. Sm)D.Don	Longkhum village
Gastrochilus pseudodisticus (King & Pantl) Seidenf	Meinkong forest
Goodyera viridiflora (BL) B.L	Meinkong forest, Longkhum village

Habernaria digitata LindI	Meinkong forest
Habernaria furcifera LindI	Meinkong forest, Longkhum village
Liparis bistriata Par & Reichb.f	Mokokchung
Liparis caespitosa (Lam) LindI	Changtongya
Liparis longipes LindI	Longkhum village
Liparis plantaginea LindI	Longkhum village
Luisia brachystachys (LindI) Bl	Changtongya
Luisia psyche Reichb.f	Longkhum village
Luisia trichorhiza (Hook) Bl	Mokokchung
Malaxis acuminate D.Don Var. biloba Hook.f	Mongsenyimti , Longkhum village
Malaxis cylindrostachya (LindI) Kuntze	Longsa village
Malaxis khasiana (Hook.f) Kuntze	Ungma village
Malaxis latifolia Smith	Mokokchung
Monomeria barbata LindI	Tzurang, Mangkolemba
Neogyne gardneriana (LindI) Reichb.f.ex.Pfitz	Longkhum village
Oberonia acaulis Griff	Longkhum village
Oberonia clarkei Hook.f	Mokokchung
Oberonia ensiformis (Sm.ex.Rees) LindI	Meinkong forest
Oberonia griffithiana LindI	Longkhum village
Oberonia iridifolia (Roxb) LindI	Mokokchung
Oberonia longilabris King & Pantl	Meingkong forest
Oberonia orbicularis Hook.f	Mokokchung
Oberonia pyrulifera LindI	Meinkong forest, Longkhum village
Oberonia recurva LindI	Meinkong forest, Longkhum village
Oreochis foliosa (LindI)LindI	Meinkong forest, Longkhum village
Otochilus fusca LindI	Ungma village
Papilionanthe teres (Roxb) Schltr	Changki village
Phaius mishmensis Reichb .f	Longkhum, Mongsenyimti village
Pholidota articulate LindI	Longkhum village
Pholidota griffithii Hook.f	Longkhum village
Pholidota imbricate (Roxb) LindI.Var.coriaceae Hook	Mokokchung , Longkhum village
Pholidota imbricate (Roxb) LindI .Var. imbricate	Longkhum village

Pholidota watti king & Pantl	Longkhum village
Phreatia elegans LindI	Longkhum village
Pleione maculate (LindI) LindI	Meinkong forest, Longkhum village
Pleroceros suaveolens (Roxb). Holtt	Mokokchung
Rhynchostylis retusa BI	Longkhum village
Robiquetia succisa (LindI) Seidenf.& Garay	Mokokchung
Schoenorchis gemmata (LindI) J.J. Sm	Longkhum village
Smitinandia micrantha (LindI) Holtt	Changki village
Spathoglothis pubescens LindI	Meinkong forest
Taenia latifolia Benth.ex Hook	Longkhum, Mongsenyimti village
Thunia marshalliana Reichb.f	Mokokchung
Trichotosia dasyphylla (Par & Reichb.f) Kranzl	Mokokchung
Tropidia curculigoides LindI	Mokokchung
Tylostylis discolor Hook.f	Longkhum village
Uncifera obtusifolia LindI	Mokokchung
Vanda alpine LindI	Longkhum village
Vanda bicolor Griff	Longkhum village
Vanda coerulea Griff. Ex. LindI	Ungma, Longkhum village
TOTAL	**143**

(Source: Orchid Diversity of Nagaland by Deb & Imchen)

Table: 3.10 ANIMALS

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Sloth	Soiza	Bradypus
Pangolin	Kulep	Manis tricespis
Squirrel	Changngen	Funambus
Flying Squirrel		Pteromyini or Petauristini
Porcupine	Tsukpera/Jepju	Hystrix bengalensis
Mole	Boor/Fija	Tulpus
Bat	Laa/Napo	Rhnolophus
Lemur	Sou	Lemur catta
Wolf	Tsungi/Tsunu	Canis lupus
Dingo	Shirong/Tsulong	Canis dingo
Fox		Vulpes Vulpes
Jackal		Canis aureus Linnaeus
Otter	Jirem	Lutra
Sloth bear	Shim/Ereem	Sclenarctos

Mongoose	Zoktsu	Herpester bengalensis
Leopard	Jangrang ki/Moruk ki	Panthera pardus
Wild boar	Pongzu/Pongi	Sus crestatus
Spotted deer	Shitsu/Suvi	Axis axis
Parking deer	Mesu/Metsu	Cervulus muntjac
Royal Bengal Tiger	Tsuyim ki	Panthera tigris
Jungle cat	Aong tanu/Arem tanu	Felix chaus Guldenstaedt
Elephant	Aong shiti/Arem shiti	Elephas maximus Linnaeus
Wild Goat		Capra hircus Linnaeus
Mithun	Su/Atsu	Bos frontalis
Sambar	Tsangsa	Cerbus unicolor
Indian buffalo	Jang	Bubalus arnee
Stag		Cervus elaphus
Cow	Nashi	Bos indicus,L
TOTAL		**28**

(Source: Field survey 2009-2013)

Table: 3.11 BIRDS

ENGLISH	**LOCAL NAME**	**SCIENTIFIC NAME**
Rufous Necked Hornbill	Kongsong ozu	Aceros nipalensis
Malabar Grey Hornbill	Wapo	Tockus griseus
Indian Pied Hornbill	Changaza	Anthracoceros Malabaricus
Great Pied Hornbill	Tenem	Buceros bicornis
Wreathed hornbill	Tuchi	Rhyticeros undulates
Heart spotted Woodpecker	Tsung olen	Hemicircus Canante
Grey Headed Woodpecker	Sungmetsutsu	Picus Canus
Black Backed Woodpecker	Olen	Chrysocolaptes Festivus
Great Black Woodpecker	Olenja	Dryocopus javensis
Large green Barbet	Olow	Megalaima Zeylanica
Great Indian Himalayan Barbet/Great Barbet	Ongu	Megalaima Verens
Lineated Barbet	Oloo	Megalaima Lineata
Blue napped pitta	Saso	Pitta Nipalensis
Rufous tailed finch-lark	Aliosung	Ammomanes Phoenicurus
Sand lark	Lela	Calandrella Raytal
Jungle Crow	Waro	Cervus Macrorhynchos
Swallow	Zenik	Hirundo Rustica

Racket-tailed drongo	Oyeem/Yim/Yimyu/Oyim	Dicrurus Paradiseus
Crow billed drongo	Mere	Dicrurus Annectans
Black drongo /King crow	Meri	Dicrurus Adsimilis
Hill Myna	Oching	Gracula Religiosa
Bank Myna	Shingro	Acridotheres Ginginianus
Yellow billed blue Magpie	Ochak	Cissa flavirostris
Raven	Waro	Corvus Corax
Fairy bluebird	Chungpoongyhu	Irena Puella
Black headed yellow Bulbul	Chukchuriben	Pycnonotus Melanictterus
Red vented Bulbul	Tsukpu/Onet	Pycnonotus cayer
White cheeked Bulbul	Imti onet	Pycnonotus Leucogenys
Red whiskered Bulbul	Tengkoling	Pycnonotus Jocosus
Black Bulbul	Shangmelang	Hypssipetes Madagascariensis
Rufous bellied Babbler	Pintsu ozu	Dumetia Hyperythra
Silver eared Mesia	Whocha ozu	Leiothrix argentowris
Slaty headed scimitar babbler	Aok pokpok	Pomatorhinus horsfieldi
White crested laughing thrush	Phiya	Garrulax leucolophus
Rufousbellied Niltava	Oshirem	Musicapa Sundara
Ashy wren-Warbler	Eniberep	Prinia socialis
Magpie -robin	Jongkicharang	Copsychus saularis
Yellow backed sunbird	Jempangmejempang	Aethopyga
Purple sunbird	Jempangmejempang	Nectarinia Asiatic
Streaked spider-hunter	Tekopintsu/Lachen-tsuyongo	Arachnothera magna
House sparrow	Opereb/Ochi/Alushijak	Passer domesticus
White-eye	Chinen	Zosterops palpebrosa
Forest eagle-owl/spot bellied eagle owl	Pokpu/Bokbo	Bubo nipalensis
Grey peacock pheasant	Otsu	Polyplectron-bicalcaratun
Grey partridge	Otsu-u/Oki	Francolinus pondicerianus
Kaleej pheasant	Orek/Ovi	Cophhura leucomelenos
Great Indian bustard	Poken	Choriotis mgriceps
Crimson breasted barbet or coppersmith	Olo	Megaliana haemacephala
Common pariah kite	Orja	Milvus migrans govinda
House swift	Enuk	Apus affinus (cliffs)
Roller or blue jay	Chakta	Coracias benghalensis
Tailor bird	Motong ozu	Orthotomos sutoris
Tree pie	Longikakak	Dendrocitta vagabunda
Scarlet minivet	Resowa/Arishi ozu	Pericrocotus flammeus
Grey shrike	Chempangwa	Lannius excubitor
White spotted fantail flycatcher	Jungkisara	Rhipidura albicollis
Pied bushchat	Akasa	Saxicola caprata

Grey wagtail	Lila	Motocilla cinerea
Spotted munia	Feje	Longchura punctulata
White backed munia	Olongza	Longchura striata
Barn or Screech Owl	Watilong	Tyto alba
Indian Great Horned Owl	Pokpu	Bubo Bubo
Redlegged orAmur falcon	Melolem	Falco amurensis
Southern Trogan	Mamawah	Harpactes Fasciatus
Chestedheaded Bee-eater	Tsumeleh	Meoops Leschenaulti
Hoopoe	Orokentempong	Upupa Epops
Black Bittern	Tsuolo	Ixobry chus flavicallis
White –eyed buzzard	Orrecha	Bustator Teesa
Imperial Eagle	Oreja	Aquila Heliaca
Black or King Vulture	Okemara Senertsur	Sarcogyps Calvus
Indian Griffon Vulture	Oken	Gyps Fulvus
Laggar Falcon	Monzu	Falco Biarmicus Jugger
Common or Grey Quail	Opeya	Coturnix Coturnix
Blue Breasted Quail	Ongmuk	Coturnix Chinensis
Painted Bush Quail	Osu/Okhi	Perdicula Erythourhyncha
Little Bustard Quail	Ongmok	Turnix Sylvatica
Red Jungle Fowl	Ometsu/Obela	Gallus Gallus
Common Pea Fowl	Toteozu	Pavo cris Tatus
Curlew	Youngchureri	Numenius Arquata
Pin Tailed Green Pigeon	Changya/Orak/Olusapong	Treron Apicaulda
Green Fronted Green Pigeon	Hile	Treron pompadora
Blue Rock pigeon	Alutemtem	Columbia livia
Ashy wood Pigeon	Alutemtem	Columbia Pulchricollis
Bar Tailed Cuckoo Dove	Uoyu	Macropygia Unchall
Rufous Turtle dove	Alutemtem	Streptopelia Orientalis
Nilgiri Wood Pigeon	Poso/Kimetsu)	Columba Elphinstonii
Spotted Dove	Posu/Kimetsu	Streptopelia Chinnensis
Roseringed Parakeet	Oru/Oro	Psittacula Krameri
Alexandrine or large Indian Parakeet	Oru	Psittacula Eupatria
Cuckoo Summer	Zui Pangrep	Cuculus Canorus
Indian Bay Banded Cuckoo	Pakupaku	Cacomantis Sonneratin
Indian Drongo Cuckoo	Angowa	Surniculus lugubris
Shallow		Hirundorustica
Koel	Ophinak	Eudynamys Scolopacea
Grey wagtail	Titiwaza	Motocilla cinerea
Scarlet Minivet	Sangmen nang	Pericrocotus flammeus
Hooded or Greenbreasted Pitta	Oyee	Pitta sordida
Longtailed broadbill	Kilingli	Psarisomus dalhousiae
Brown headed storkbilled kingfisher	Tongto	Pelargopsis capensis
Large greenbilledmalkoha	Chena	Rhopodytes tristis

Emerald or Bronzedwinged dove	Menze	Chalcophaps indica
TOTAL		**101**

(Source: Field survey 2009-2013)

Table: 3.12 PRIMATES

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Slow Loris	Shenemongmong/Sooy	Mycticebus coucang
Stump-tailed Macaque	Makup/Maket	Macaca arctoides
Macaque	Mekut	Macala mulatta
Assamese Macaque	Jangti/Chantee	Macaca assamensis
Golden Languour	Shomi/Shimi	Trachypithecus or Trachypithecus geei
Capped Languour	Milango/Shinu	Trachypithecus or Trachypithecus pileatus
Howling Monkey	Sangpu sanga	Mycetes
Phayre's leaf monkey Trachypithecus	Shaki	Trachypithecus,phayrei
TOTAL		**8**

(Source: Field survey 2009-2013)

Table: 3.13 REPTILES

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Batagur Terrapin or River Terrapin	Kera	Batagur baska
Land Tortoise	Kera	Chelone imbricata
Olive Ridley Turtle	Chano	Lepidochelys olivacea(Eschscholte)
River crocodile	Tzurang	Crocodylus palustris
TOTAL		**4**

(Source: Field survey 2009-2013)

Table: 3.14 LIZARDS

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
House lizard	Sangpila	Hemidactylus
Common Garden lizard		Calotes vessicolor
Flying lizard		Draco volans
Monitor lizard		Varanus
Rock gecko	Kitsungtetsu	Hemidactylus maculates
Southern forest gecko	Sayanu	Hemidactylus anamallensis
Jerdon's calotes	Sangken	Calotes jerdoni
Draco or Gliding lizard	Ongleang	Draco dussumieri
TOTAL		**8**

(Source: Field survey 2009-2013)

Table: 3.15 SKINKS

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Little skink	Intesangken	Mabuya macularia (Blyth)
Snake skink	Intesangken	Lygosoma punctatus (Beddome)
Common or Brahminy skink		Mabuya carinata (Schneider)
Burmese glass skink	Asangper	Ophisaurus gracilis
Himalayan skink		Asymblepharus ladacensis Himalayanus (Gunther)
TOTAL		**5**

(Source: Field survey 2009-2013)

Table: 3.16 SNAKES

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Common worm or blind snake		Ramphotyphlops braminus
Blind snake or Diard's worm	Kieper/Tsulafe	Typhlops diardii (Schlegal)
Indian python	Ngum	Python molurus (Linnaeus)
Python	Ngum	Python reticulates
Common kukri snake	Mekumper	Oligodon arnensis (Shaw)
Golden tree or Glidding snake	Chuchungba	Chrysopelea ornate (Shaw)
Green keelback	Sungkemper	Macropisthodon plumbicolor
Common green whip snake or Vine snake	Lemyangtsu per	Ahaetulla nasuta (Lacepede)
Albino Indian cobra or Indian cobra	Ongyangper	Naja naja (Linn)
King cobra or Hamadryad	Umnak	Ophiophagus Hannah (Cantor)
Green or Bamboo pit piper	Sungkemper	Trimeresurus gramineus
TOTAL		**11**

(Source: Field survey 2009-2013)

Table: 3.17 AMPHIBIANS

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Common Indian Toad	Kangrang	Bufo melanostictus (Schneider)
Malabar Gliding frog	Suanga ki	Rhacophons malabaricus (Jerdon)

Giant tree frog	Kodok	Rhacophorus maximus (Gunther)
Himalayan torrent frog	Yongkhi	Amolops marmoratus (Blyth)
Skittering frog	Yarangki	Euphlyctis cyanophlyctis (Schneider)
Salamander		Ambystoma maculatum
TOTAL		**6**

(Source: Field survey 2009-2013)

Table: 3.18 AQUATIC SPECIES

ENGLISH	LOCAL NAME	SCIENTIFIC NAME
Ceylon Snakehead	Alopongko/ Kodilla	Channa oreintalis
Schistura prashadi	Rutong/ Mesetja	Schistura prashadi
Naga Garra		Gara naganensis
Gangetic Latia		Crossochilus latius
Prawn		Palaemon malcolmsoni
Chub Mackerel	Rau	Scomber Japonicus
	Pithia	
	Chital,	
	Nadani	
	Gagal	
	Barali	
	Ari	
	Mali	
Rohu/Rohi	Labeo Rohita	
TOTAL		**14**

(Source: Field survey 2009-2013)

3.9 RANGE WISE DISTRIBUTION OF THE STUDY AREA OF MOKOKCHUNG DISTRICT

In order to get more accurate and balanced profile of the status of Biodiversity, as well as the awareness level and extent of conservation programmes on Biodiversity in the district, thirteen villages have been selected from all the six ranges under Mokokchung district. The names of the selected villages are Aliba, Chuchuyimpang & Longkhum (Ongpangkong); Mopungchuket & Longjang (Asetkong); Dibuia & Changki

(Changkikong); Wameken & Changtongya (Langpangkong); Japu &Satsukba (Japukong), Chungtiayimsen & Longpayimsen (Tzurangkong) which are discuss below.

The following table reveal the dynamics of Biodiversity status in the selected study areas of Mokokchung district during the last 50 years from 1960-2013 (Present day).

Table: 3.19 ONGPANGKONG RANGE

NAME OF THE VILLAGE	STATUS OF BIODIVERSITY		
	1960-1980	**1980-1990**	**1990-2013**
LONGKHUM	**VERY RICH**	**DECLINE** Due to Jhumming, hunting & logging.	**INCREASE** Due to restriction on logging, hunting, decrease in jhumming.
ALIBA	**VERY RICH**	**DECLINE** Due to Jhumming, hunting & logging	**SUBSTANTIAL INCREASE** Due to declining jhumming, restriction on animal husbandry and logging.
CHUCHUYIMPANG	**VERY RICH**	**DECLINE** Due to Jhumming, hunting, Commercial farming.	**DECLINE** Due to Commercial farming.

(Source: Field survey 2009-2013)

Table 3.20 ASETKONG RANGE

NAME OF THE VILLAGE	STATUS OF BIODIVERSITY		
	1960-1980	1980-1990	1990-2013
MOPUNGCHUKET	VERY RICH	MINOR DECLINE Due to hunting, logging, stone quarries, commercial farming and jhumming	SUBSTANTIAL INCREASE Due to declining jhumming and community approach on conservation of Biodiversity.
LONGJANG	VERY RICH	MINOR DECLINE Due to jhumming, hunting.	DECLINE Due to hunting, commercial farming and plantations.

(Source: Field survey 2009-2013)

Table 3.21 LANGPANGKONG RANGE

NAME OF THE VILLAGE	STATUS OF BIODIVERSITY		
	1960-1980	1980-1990	1990-2013
CHANGTONGYA	VERY RICH	DECLINE Due to commercial farming, Jhumming and logging.	SUBSTAINTIAL INCREASE Due to community approach on conservation of Biodiversity.
WAMEKEN	VERY RICH	MINOR DECLINE Due to logging, hunting, plantation of cash crops, and mining activities.	DECLINE Due to logging, plantation of cash crops, stone quarries and mining activities.

(Source: Field survey 2009-2013)

Table 3.22 CHANGKIKONG RANGE

NAME OF THE VILLAGE	STATUS OF BIODIVERSITY		
	1960-1980	1980-1990	1990-2013
DEBUIA	**VERY RICH**	**MINOR DECLINE** Due to logging and hunting.	**STATIC** Due to low developmental activities, ban on logging and hunting but practiced of mining continues to destroy forests.
CHANGKI	**VERY RICH**	**DECLINE** Due to logging, hunting, mining.	**STATIC** Due to declining jhumming and ban on hunting but still mining activities pollutes the forests and aquatic ecosystem.

(Source: Field survey 2009-2013)

Table 3.23 JAPUKONG RANGE

NAME OF THE VILLAGE	STATUS OF BIODIVERSITY		
	1960-1980	1980-1990	1990-2013
JAPU	**VERY RICH**	**MINOR DECLINE** Due to logging and hunting.	**SUBSTANTIAL INCREASE** Due to poor road connectivity between urban areas and pristine jungle, ban on animal husbandry, logging, hunting and illegal gathering.
SATSUKBA	**VERY RICH**	**MINOR DECLINE** Due to jhumming and hunting.	**SUBSTANTIAL INCREASE** Due to low population concentration and poor infrastructure development.

(Source: Field survey 2009-2013)

Table 3.24 TZURANGKONG RANGE

NAME OF THE VILLAGE	STATUS OF BIODIVERSITY		
	1960-1980	**1980-1990**	**1990-2013**
LONGPAYIMSEN	**VERY RICH**	**MINOR DECLINE** Due to logging and hunting.	**SUBSTANTIAL INCREASE** Due to community approach on Biodiversity conservation, ban on logging, hunting and minimal practiced of jhumming.
CHUNGTIAYIMSEN	**VERY RICH**	**MINOR DECLINE** Due to logging and hunting.	**SUBSTANTIAL INCREASE** Due to minimal practiced of jhumming and community participation on Biodiversity conservation.

(Source: Field survey 2009-2013)

3.10 RANGE WISE STATUS OF BIODIVERSITY IN MOKOKCHUNG DISTRICT

The ancient and virgin forests of all the six ranges under Mokokchung district harbours diversity of flora and fauna. Mokokchung district is blessed with mountains and hill ranges as well as deep gorges. The presence of meandering rivers like Milak, Tsurang, Tsurong, Menung, Tsula and its tributaries provides a congenial climate throughout the year with a summer temperature of 27^0 C – 30^0 C and winter temperature of 10^0 C -15^0 C is supporting a rich Biodiversity. Villages like Changki, Debuia, Aliba, Longkhum, Longjang, Longpayimsen, Japu and Wameken etc are the richest spots of Biodiversity in the entire district of Mokokchung,

The forest type found in the study areas is of lush evergreen sub-tropical forest which provides a relatively pleasant cooler air during warmer days. The topography

in the entire district of Mokokchung district is wholly hilly expect for small pocket of valley in the embankment of Milak and Tsurang rivers. Precipitation is mostly received during summer season and winter is relatively dry. The atmospheric elements in the form of thick moisture and laden clouds dominate the hillocks and mountains, these conditions have favoured the growth of mosses, lichens, epiphytes that embellish the trees of the forest in the foot hills.

The forests especially of Changki and Dibuia villages are known for different kinds of rare birds and mammals. The presence of thick forests cover especially between Milak, Tsurang and Tsurong rivers attracts numerous fauna and avi-fauna in bulk to inhabit the forests. This kind of ambience provides a unique ecological balance in the region.

The presence of important rivers like the Milak, Tsurang, Tsurong, Tsuong, Tsueet, Tsumeet, Aitsu and Jalem etc along the Changkikong range; Tzushi, Wangnak, Lisemyong, Korayong, Wangtak, Tangyong, Linjayong, Dzesu etc along the Tzurangkong range; Tsurang and Tzuyong in the Japukong range; Milak and Menung with its numerous rivulets like the Kanglayong, Tsusa, Elang, Junghtsu, Mangsentsu, Tsurur, Tsuden nala etc along the Asetkong range, Milak, Tsula and its tributaries at the Ongpangkong range has favour the splendid biodiversity especially in the riverine ecosystems.

Varieties of aquatic resources are found in the region like the *channa oreintalis, schistura prashadi, gara naganensis, crossochilus latius,* prawn *(palaemon malcolmsoni*), varieties of crab like the *Rau, Pithia, Bahu, Mali, Nadani, Gagal. Chital, Barali, Ari* etc; varieties of lizards like the Monitor lizard (*varanus*), Flying lizard (*Draco vessicolor),* Garden lizard *(calotes vessicolor),* House lizard *(hemidactylus)* etc are abundantly present.

River crocodile (*Crocodylus palustris*) measuring 3 feet in length, Turtle (*Lepidochelys olivacea*), Land tortoise (*chelone imbricata*), Chamelions (*Chamaeleo ousteleti*) and snakes like the *Ohiphagus, Lamprepeltis* and *Hannahare* present in good number. Besides, all species of genus Python (*reticulate python*) is also found in moderate number. Leopard (*panthera pardus*), Royal Bengal tiger *(panthera tigris*) and Elephant *(elephas maximus Linnaeus*) are also found in sparse number which are migrated from Assam. Bat (*Rhnolophus*) are found in ample amount in the thick Jungles and forests along 'Longpak sep' and 'Salangtemok' (Longjang village), 'Aleptoi' (Debuia village) and 'Tsurong valley' (Changki-Debuia forests) of region.

The study areas are also rich in terms of minerals resources; there is a spot in the Tsula River near Changtongya village where crude oil pops up which the locals called 'menemtsu' is used as midnight lamp oil and other useful purposes. Thick coal seams, calc-tufa, oil and gas seepage are present in abundance at 'Aleptoi', 'Jorbenna', 'Ani-yong' and 'Tsusu-yongpang' (Debuia village). This evidence indicates a history of rich biodiversity even in the distant past as these resources are formed from the decayed flora and fauna species which had been buried for thousands of years under high pressure and temperature.

These villages being immensely blessed with rich Biodiversity, however over the last few decades, there is a considerable decline of forest cover mainly because of unplanned and unscientific exploitation of forest resources and recent trend in farming system mainly monoculture and commercial farming. It is also observed that plantation of tea, coffee and rubber have also contribute towards the loss of Biodiversity in the region as large tract of jungles and forests are cut down and cleared to make way for

plantation. Even private plantation is practicing in an area of 50 km^2 in Changki village alone.

The rich biodiversity of the forest have however been disturb and threatened by hunting, poaching and illegal gathering. Deforestation and habitat destruction has lead to massive disappearance of inaccessible virgin forests. Since the inception of loggings and timber trade which continued actively till the late 1980's has been an important factor which destroys biodiversity in the region. As a result, the rich variety of Biodiversity in these villages has been destroyed reducing to a minimal strength of flora and fauna. Such unwanted destruction is mainly caused by human intervention and its related activities.

From the study area, it is observed that vast scales of once inaccessible forests are widely demolished with the inception of logging and its activities since the 1970's. This has already reduced around 7% of the rich forest in the region particularly in Changki, Japu, Wameken, Merangkong, Changtongya, Longjang, Chungtiayimsen and Longpayimsen villages. During the period of 1970's–1990's commercial logging was a common practiced in these parts of the region which had wiped out a considerable portion of the forest land thereby destroying Biodiversity. But in the present scenario logging is completely restricted for the last ten years especially in Longkhum village under Ongpangkong range, Mopungchuket village under Asetkong range and Japu village under Japukong range helping in the restoration of the lost Biodiversity.

It is also been observed that most of common land management in the study areas are dominated by shifting cultivation. As the slash and burn system of agriculture involved the

clearing of forests, it ultimately leads to loss of habitat of plants and animals, hence loss of Diversity. The pressure of population on the other hand plays an important role in deciding the status and dynamism of Biodiversity causing innumerable quality of birds and animals to be lost due to fragmentation of forests, habitat loss and indiscriminate exploitation by human activities.

In order to ameliorate the present status of Biodiversity in the study areas, the village authority in all the selected study areas are trying its level best to conserve and manage forest and Biodiversity under its jurisdiction for better maintenance of environment stability through preservation and where necessary restoration of the natural heritage in a sustainable manner. For making this kind of venture more effective and pragmatic the village council has set aside a portion of their erstwhile forest area converting into Biodiversity conservation site. Reserved Forests in the selected study areas are 'Sungadin Min', 'Anungmeyong Min', 'Osaknuyong Min', 'Amalongpang Min', 'Mongsen Yimlu Min', 'Chaok Yimlu Min' of Longkhum village; 'Serani Lenden Forest' and 'Kongyung Forest' of Chuchuyimpang village; 'Yangermanglupok', 'Nashimer', 'Aidang', 'Shirkimong' of Mopungchuket village; 'Yimlipang Ba', 'Shengtakba Lopok' of Longjang village; 'Kanglutu Biodiversity Reserve' of Changtongya village; 'Aleptoi' of Debuia village and 'Yimkup' of Longpayimsen village.

One positive development is that, this site is becoming a natural sanctuary particularly for wild elephants, wild cats and numerous migratory birds especially Grey Peacock Pheasant (*Polyplectron-bicalcaratun*) at Longkhum forests of Ongpangkong range. Various workshop and seminar under different department have been conducted within the premises of these villages, which have immensely help the villagers to be conscious

and respect their rich Biological diversity and also promoted the villagers to protect, reserved and managed forest and Biodiversity by envisaging rigid customary laws by rewarding befitting punishment to the trespassers.

With these entire ample resources present within the village jurisdiction, the villagers in general and the village council in particular are trying to safeguard against illegal exploitation and prevent mismanagement of these valuable resources. Restriction on the use of dynamite, light batteries and lime in the riverine system is also prohibited within their territory, coupled with heavy imposition of fine as high as 50,000 rupees especially in 'Dikhu Green River Project' commonly owned by Ungma and Longsa villages.

In order to preserve biodiversity and to take this approach to another level, practiced of animal husbandry have been prohibited in Japu village under Japukong range and Aliba village under Ongpangkong range as it lead to overgrazing. As forest serves as a boundary, defense and provider for food, fodder, medicinal, raw materials and domestics needs, the villagers are encourage to thrive under the control of the regulation; those finding trespassing the laws are to pay penalty as high as Rs.5000. It is interesting to observe that whoever reports the matter of such malpractice to the village authority will be rewarded with half of the fined money.

With an aim to preserve the rich biodiversity the village council and the villagers are consciously and actively involved by implementing laws and regulations against hunting and poaching especially during the month of March-April (breeding season).In order to discouraged poaching especially elephants, a penalty of Rs 1 lakh has been already imposed particularly at Longpayimsen village under Tzurangkong range. However the

laws are flexible during the month of November-December with the permission of the village councils, the forests is also open for gathering during these months.

Of late, the people of these villages are making an effort for conserving Biodiversity. One such instance is the releasing of domesticated fowls, rabbits, hare etc as part of the conservation programme initiated by the 'Lanuzunga' in Chuchuyimpang village under Ongpangkong range. The village authority has also earmarked two forest areas namely 'Serani Lenden Forest' and 'Kongyung Forest' covering approximately 80 acres and100 acres respectively for the conservation programme. Chuchuyimpang village is the first amongst the entire Ao village to undertake such positive venture. This aspect is further reinforced by the village authority with strict imposition of laws to ban hunting animals and birds, illegal gathering along with certain afforestation programmes which will help towards conservation and management of Biodiversity in the long run.

Moreover the Changtongya villagers with the objective to conserve Biodiversity within their territory have reserved a large tract of forest known as the 'Kanglutu Biodiversity Reserve' (7060 hectare). The major attraction of 'Kanglutu Biodiversity Reserve' is the Amur Falcon migrating from Germany and Mongolia which fly to this forest and the neighbouring forests of Yaongyimsen village under Langpangkong range in tens of thousands from the 2nd week of October to the month of November. It is a major tourist centre attracting both local and national tourist with scores of ornithologists arriving here in the hibernal season. It was declared a Community reserve in 2001 and is acknowledged as a 'No hunting Zone Area'.

This status have also encourages and promote liberal habitat for diversity of fauna particularly in the likes of Spotted Deer (*Axis axis*), Barking Deer (*Cervulus muntjac*), Wild Boar (*Sus Crestatus*), Jungel Cat (*felischaus guldenstaedt*), Tiger (*panthera tigris*), Squirrel (*Funambus*), Pangolin (*Manis tricespis*), River Crocodile, Dingo (*Canis Dingo*), Bat (*Rhnolophus)*, Mole (*Talpa*), Otter (*Lutra*), Howling monkey (*Mycetes*), Porcupine (*Hystrix bengalensis*) etc in large quantity.

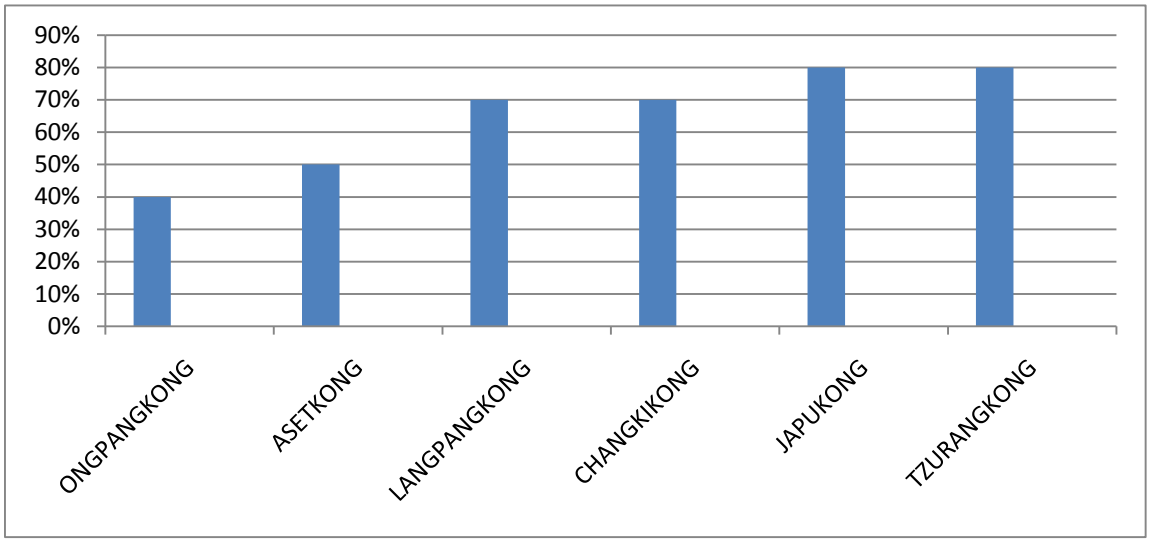
It is also observed in the study areas that the tussle between the Ao-Naga and the Assamese to claim ownership over the lower Tsurangkong region has created condition discouraging strict and firm imposition of laws and regulation against poaching and hunting. In spite of all these hassles and hurdles coming against conservation and preservation of biodiversity in the region, Tsurong River and the surrounding forests at the Tsurangkong range has been completely protected against the use of lime, batteries and dynamite. In order to augment step towards Biodiversity conservation, the Longpayimsen village authority has delineate a reserved forest 'Yimkup' (approximately 200 acres) and has already started tree plantation on an area of approximately 10 acres.

Besides, proposal has been made at the 'Tsukong (Range) meeting' that trespassers will be forced to pay compensation in the form of pigs and cattle. It is also encouraging to observed that the practiced of shifting cultivation is also partially discouraged as it promotes deforestation, and jhum cycle has been made mandatory to increased by at least 10 years. Seminars presented by NGO's and various governmental departments like the Horticulture department and Forest department have also spread a positive message towards biodiversity conservation in these villages. In addition to this splendid diversity of life, there are ample scopes for augmenting these valuable resources by encouraging

people's participation to mobilized and tapped these resources in a sustainable manner which would provide opportunity for promoting eco-tourisms and wild life sanctuary for the entire district of Mokokchung.

It has further being reinforced by development professionals who create awareness on Biological Diversity Conservation among the village community. It is to be noted that this aspect needs special attention because efforts for Biodiversity conservation and management with meet real success only when local people are encourageously involved in such ventures. Through interviews and direct interaction conducted with the village authorities GBS, pastors, teachers, students and farmers of the above mentioned villages, it is learned that these villages under the study area have taken initiatives to conserve Biological Diversity in the land within the jurisdiction and the territorial control of a particular village.

FIGURE: 3.5 STATUS OF BIODIVERSITY IN MOKOKCHUNG DISTRICT (RANGEWISE IN PERCENTAGE)



(Source: Field survey 2009-2013)

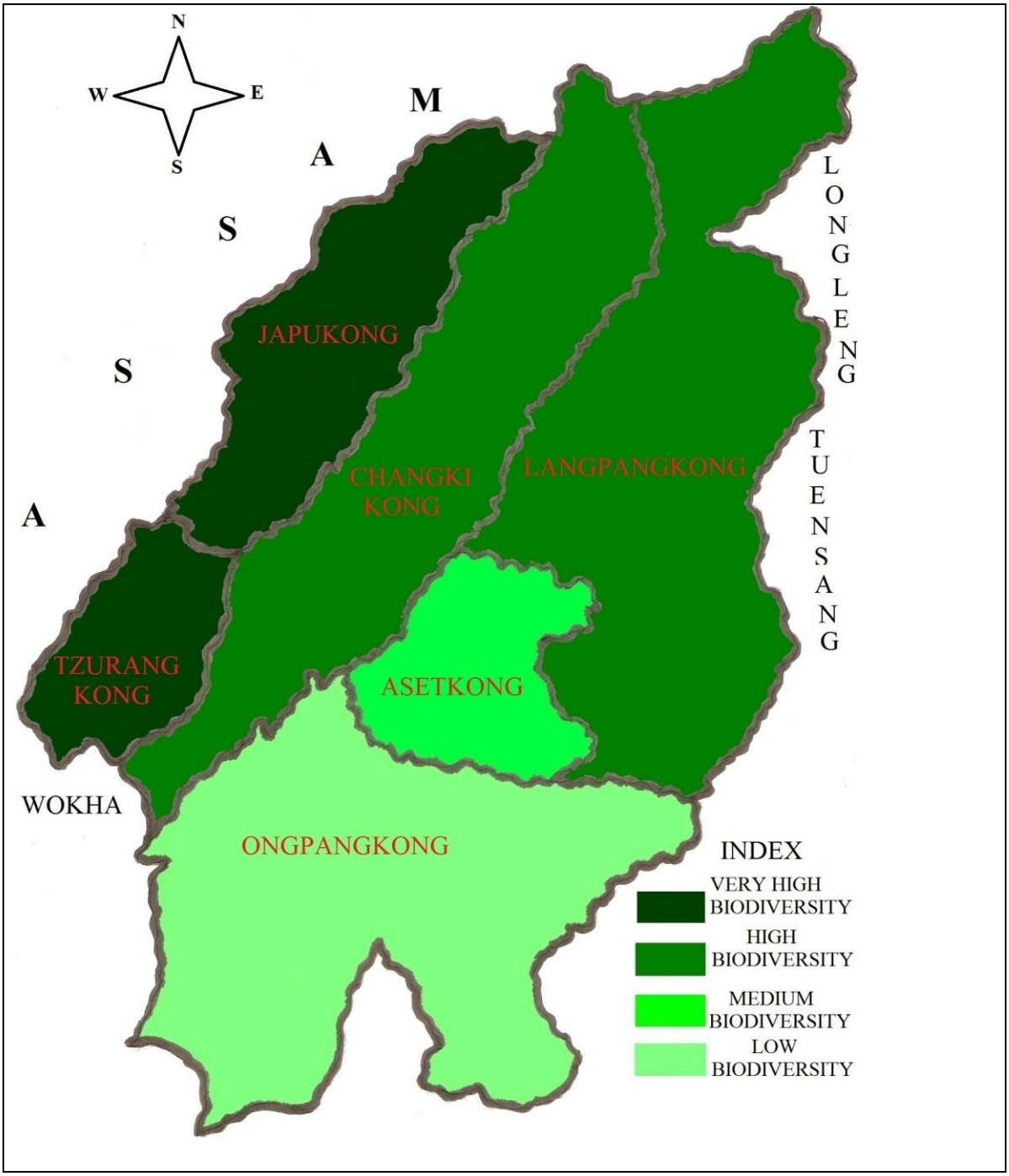


FIGURE: 3.6 MAP SHOWING THE RANGEWISE STATUS OF BIODIVERSITY UNDER MOKOKCHUNG DISTRICT

From the observations obtained through field work, interview and direct interactions with different sources, it is found that Mokokchung district is rich in Biodiversity and its resources. Amongst the six ranges, Changkikong, Japukong, Tzurangkong and Langpangkong ranges are extremely rich in Biodiversity mainly because of its large geographical extent having thick jungles and forests, complement by warmer climate as in the case of Japukong, Tsurangkong and Langpangkong ranges with proximately to the border of Assam bounded by thick inaccessible forests which incite upon the migration of birds and animals from the warmer region.

Another factor is that shifting cultivation is drastically diminishing in these ranges compared to Ongpangkong and Asetkong ranges, where shifting cultivation though it has considerably reduced but is more commonly practiced because of its steeper slopes and water scarcity discouraging other alternative method of farming like terracing and wet-paddy field.

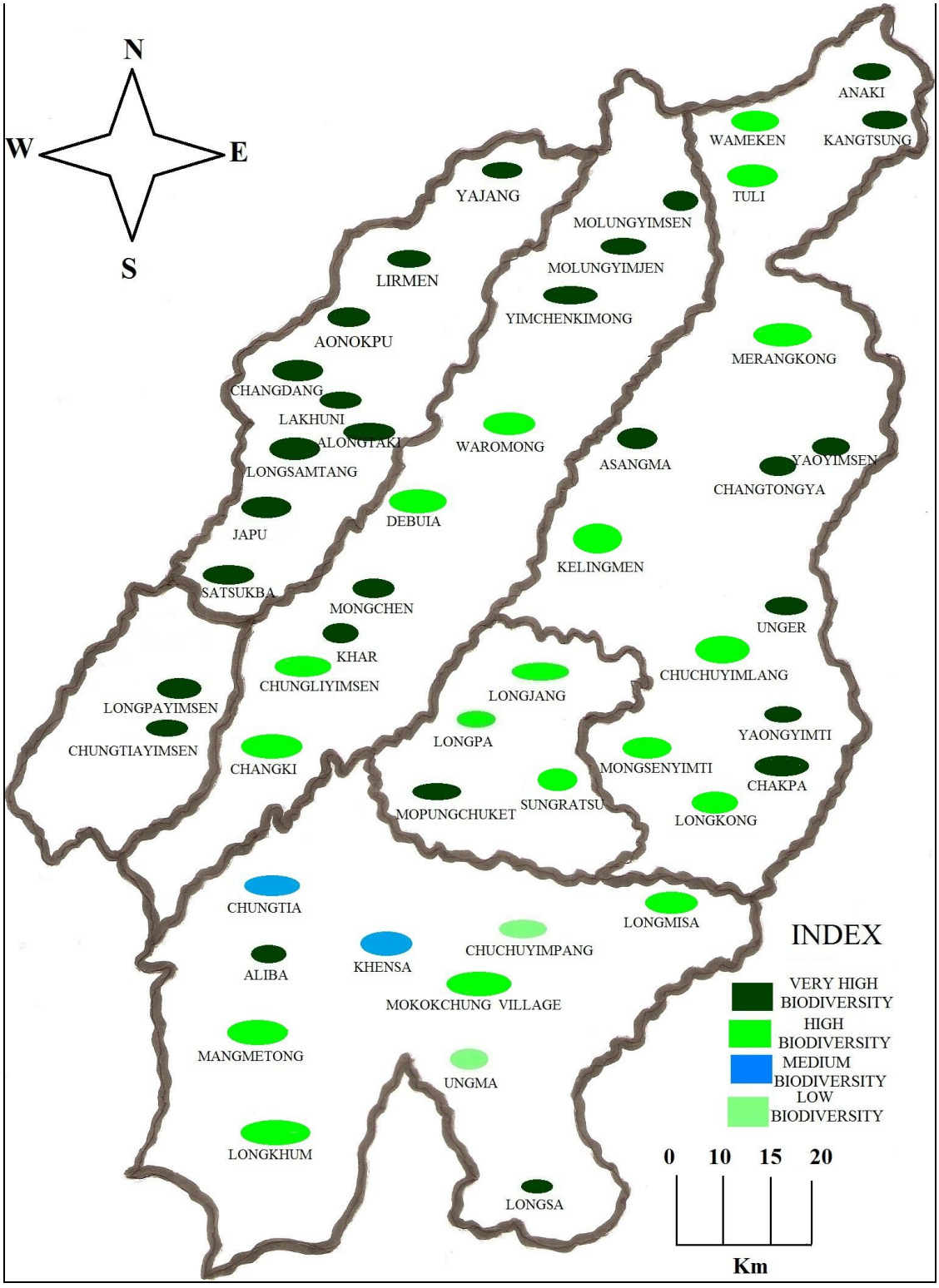


FIGURE: 3.7 MAP SHOWING THE LEVEL OF BIODIVERSITY STATUS IN DIFFERENT VILLAGES OF MOKOKCHUNG DISTRICT

PLATE: 3.4 Forest eagle-owl/spot bellied eagle owl (*Bubo nipalensis*) at Longpayimsen village

PLATE: 3.5 Laggar Falcon (*Falco Biarmicus Jugger*) at Japu village

Tzurangkong, Japukong, Changkikong and Langpangkong ranges are comparatively less elevated; these ranges also comprise of fertile plains and valleys like: the Changki, Baghty and Tuli valleys adjoining the plains of Sibsagar district of Assam. Moreover, the hills on the Western sides are less elevated and these ranges are more or less confined in the western side. Milak, Tsurang, Tsumok and Tsurong Rivers which passes through many of the villages falling under these ranges have provided ample opportunity to support terrace cultivation and wet-paddy farming.

Though, there are numerous perennial rivers and rivulets in the Ongpangkong range, this range being of more steeper slope and of higher altitude which do not favour other options of terracing and wet-paddy field; besides, terrace cultivation have certain criteria to be meet with, it can be accurately practiced on a much gentler slope supported with ample water sources to irrigate the fields; the more rugged topography of these ranges acts as a detrimental factor for making way for other substitute farming. Besides, habitat destruction for agriculture, settlement, construction of roads and other related urban activities particularly on the Ongpangkong range where it has also witness high population concentration of approximately 85,667 **(2011 census).** Close proximity of most of the villages like Mokokchung, Chuchuyimpang, Longsa, Ungma, Khensa, Mekuli, Aliba and Chungtia with rich forest resources sold variety of forest resources like timber, firewood and other edible resources to Mokokchung town and surrounding urban centers where there is great demand on forest and bio-resources.

Asetkong range adjoining the Ongpangkong range is located in the hearth of the district and experienced a warm and humid climate giving rise to dense forests and vegetations but its strategic central location posed a problem as animals, birds and other aquatic resources

has been exploited especially by the people coming from urban areas as this range is located near the urban center. Besides the good road connection- National Highway No.61 passes through this range providing access to remote forests have played an important role in Biodiversity decline; the people made use of its facility by taking their vehicles into the interior jungle and forest to make maximum exploitation. Villages like Sungratsu, Mopungchuket and Longjang falling in this range are in close proximity to Mokokchung town, these villages have large tract of pristine forests, rivers and streams that are exploited to meet the demands of the increasing population in the urban centers. These reasons are responsible for the decline in Biodiversity in this range.

'As all our Biodiversity resources are connected, it is important that ways and measures should be adopted to exploit these resources without depleting those.' [5] 'It is women who virtually sustain the families and feeding the livestock…the rural and tribal women have an attachment in their management. They never see these resources just in terms of their commercial value. For them, the natural resources essentials elements for the sustenance of the home and community.'[6]

There is also a conflict between conservation and development, as initiating development activities will obviously hamper Biodiversity conservation, sustainable utilization and development of the available resources can solve the problem with the active participation of women.

5. Karen Arms: Environment Science; 1990, page 230
6. M.Balakhrishnan, R.Borgstrom, S.W.Bie: Tropical Ecosystem: A synthesis of Tropical Ecology & Conservation; 1994, page 362

3.11 ROLE OF NAGA WOMEN IN MAINTAINING A SUSTAINABLE BIODIVERSITY

Naga women have a very strong appreciation of the value of forest and Biodiversity, it has been observed that women spend as much time in the forest as men and they are the first to feel the impact of any shortage of forest produce. It has also observed that Naga women has been consistently in close contact with forest and environment through their jhum land and other related works thereby orientating and acquiring themselves with the need to preserve Biodiversity for the future generation. Obviously they have better practical indigenous knowledge on Biodiversity.

The role of women in traditional management practices has increasingly been appreciated globally as a strong incentive for Biodiversity conservation. Moreover the role of women is having good potentiality in enhancing conservation and sustainable use of natural resources, including home garden and therefore as a remedy for numerous forest conservation problems. Naga women have an intense interaction with forests through their heavy involvement in collecting and producing food, fuel, timber and medicinal remedies besides their interest and motivating character in forest conservation. Their role can be used as an entry point to build an economically viable and ecologically sustainable forest and Biodiversity management system.

Biodiversity is essential for security, livelihood and reducing poverty and how gender can determine people's role in the use, conservation and management of Biodiversity. Women especially in the rural areas have an intense interaction with natural resources, given their heavy involvement in collecting and producing food, fuel, medicinal remedies and necessary raw materials. With knowledge passed down through many generations, Naga

women frequently acquire a profound understanding of their environment and of Biodiversity in particular, yet their contribution to conservation go unrecognized. Biodiversity loss and bio-piracy now endanger their knowledge and resources including through the erosion of their diverse resource base. Lack of ownership and control over land and resources along with limited access to education and services impose major constraints.

To encourage women's role in effective Biodiversity conservation, it is imperative to achieve full and active participation of women in decision making and assure their access to services including environmental education and resources. It can further be reinforced through equal sharing of benefits and open the door to an essential primary step by adopting the approach on collection of gender- specific information and data, while awareness on the potential wealth of women's conservation should be raised in all forums and institutions dealing with Biodiversity. This should be supplemented with all conservation efforts drawn from all the principles of social justice, equity and equality.

The fallout in the Biodiversity of the region can be assuaged with the promotion of more seminars and workshop to make the awareness more effective. A Chinese proverb says "If you want to plan for one year plant rice, if you want to plan for ten years plant trees and if you want to plant for 100 years educate people". It is of paramount importance that encouraging the people to be environmentally educated is the best strategy to protect our fragile Biodiversity in the region. 'This will intend to make the people conscious about Biodiversity, its physical, social, aesthetic values and their link with ethno biology'[7]

In most Naga society, management of natural resources is vested with the village community as the land and its resources are considered as community property, it is necessary to strengthen the traditional practices and mechanisms through coordinated efforts of various governmental departments and NGO's involving the local community in the management process and ensuring their livelihood security in a sustainable manner. As rigid measures for preservation threatens people's livelihood, who are mostly dependent on forest and its resources, it is of utmost importance that judicial utilization of the available bio-resources and Biodiversity preservation be envisaged and emphasized.

Sustainable development, which is defined as 'the use of components of Biological Diversity in a way and at a rate that does not lead to the long term decline of Biological Diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations'[8]

This should be implemented as an addendum to fortify the approach towards Biodiversity conservation and management. Sustainable utilization can abate the exploitation of Biodiversity and its resources for the future well-being of the people as all living resources have a limit of growth, therefore it is vital to educate the masses to conserve Biodiversity for their fullest use.

The government also on their part should stiffen to conserve Biodiversity and its resources by providing encouragement in the form of incentives and subsidies for the Protected Areas, tree plantation and management of Biodiversity related activities.

7. U.Kumar, M.Asija: Biodiversity, Principles & Conservation (2nd edition); 2009, page 55
8. Convention on Biodiversity-Article 2

As the government policies and traditional laws complement each other, the Ao senden and Senso Mundang should enforce various strategies to bind all the Biodiversity and its resources within its territory and jurisdiction with the imposition of heavy fine and punishment specifically against hunting, poaching and gathering etc to bear more effective results.

Farmers should be educated and made aware about the kind of trees, plants species to be planted according to the type of soil, topography and climate to bring out the best result in their land use which will be conducive towards Biodiversity conservation in the region. Permanent farming with various technical aid, fertilizers and manures could be another alternative.

Conservation of forests within a particular territory and boundary between or among various villages could favour towards Biodiversity preservation. As animals and birds are mobile and moving from one territory to another territory, when a particular village implements very lenient laws and regulation, it will disturb the Biodiversity conservation in the counterpart region. Therefore it is vital to equally consider implementing of such acts from both ends.

This kind of innovation can be included in protecting the river ecosystem through co operations between and among villages which are delineated by a common rivers and streams they share. One such positive venture which has come up recently is the joint declaration of Dikhu Green River Project by Longsa and Ungma village councils.

As the forests of all the six ranges of the district are adjoin to one another, the continuity and maintenance of the ancient and virgin forest in tune with the conservation programmes undertaken in these villages will definitely open an ample scope for a successful Biodiversity conservation in the district.

Human impact on Biodiversity particularly with regard to developmental induced activities, deforestation, hunting and poaching and over-exploitation and its effect on the climate of the region will be discussed on the succeeding chapter entitled **"HUMAN IMPACT ON BIODIVERSITY."**

CHAPTER-4

HUMAN IMPACTS ON BIODIVERSITY

4.1 INTRODUCTION

Biodiversity encompasses both land and water and has been badly affected by man and his mechanisms with an unprecedented pace over the last few decades in the region. Man as an active agent of change has threatened many important profit to humans that go beyond than providing daily sustenance.

The recent slaughter of Biodiversity and other connected changes in the environment are now faster than ever before with the commencement of modern civilization, and there is no indication of this course slowing down. Many animals, birds and plants populations including micro-organisms have declined in numbers, geographical extend, or both. Though species extinction is a natural part, which is inevitable, yet human action have enlarged the extermination rate by manifold.

Generally in all scenarios, human induced developmental activities, unethical commercialization, agricultural lands have swelled to meet the demand of the ever growing population making the forest cover to shrink. This has lead to a long-term decline in the local Biodiversity, mainly as a result of habitat loss. River Biodiversity and specific fish populations too have decline due to factors such as overharvesting and pollution. Biodiversity is waning rapidly in Nagaland, obviously connected to direct factors like habitat loss, they are also linked to indirect factors like increase human population, agriculture increase resulting in the large scale conversion from forest cover, overfishing, over hunting, over exploitation of resources etc.

The following factors have been critically important for influencing Biodiversity loss in the region over the last 50 years.

4.2 POPULATION DYNAMICS AND BIODIVERSITY

Human centric approach have encouraged the unsustainable use of Biodiversity and its resources in various manifestations like habitat fragmentation, environmental pollution, introduction of alien species and genes through genetically modified organisms to fulfilled the burgeoning population growth. These have resulted in the severe loss of Biodiversity causing rapid climate change and devastation of the natural environment affecting the local food security as well. As human health and well-being directly reflect the health of Biodiversity of a region, human impact on Biodiversity have caused higher pollution levels in the environment resulting to asthma, lung cancer, constriction of blood vessels and increase incidence of heart disease and other cardio pulmonary diseases etc.

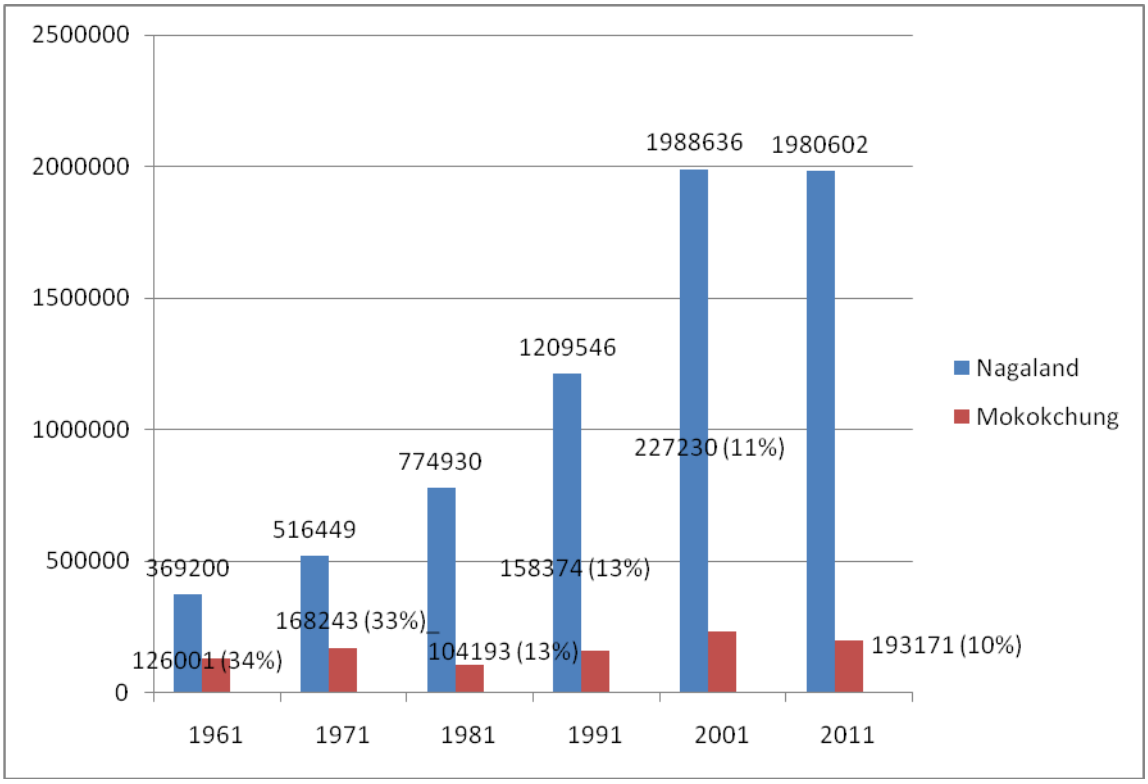
Currently the most alarming environmental issue of global climatic change due to global warming has led to severe natural calamities like landslides and heavy incessant rainfall in Nagaland. In the last few years, the Himalayan Range has witnessed an increased in rainfall during the monsoon season resulting from global warming thus leading to global climatic change **(National Institute of Disaster Management, New Delhi).** Nagaland being located in the Himalayan Range had also experienced an increase in rainfall. In the year 2010, the State had experienced an increased in the average intensity and quantum of discharge with an increase in rainfall quantum though there had been no increase in the average annual rainfall. The month of July 2010 have received 8.45% of more rainfall above normal **(Directorate of Soil & Water Conservation, Nagaland)**. Such recurring

phenomenon of heavier rainfall is becoming common in the State triggering natural calamities.

4.2.1 POPULATION GROWTH AND URBANISATION

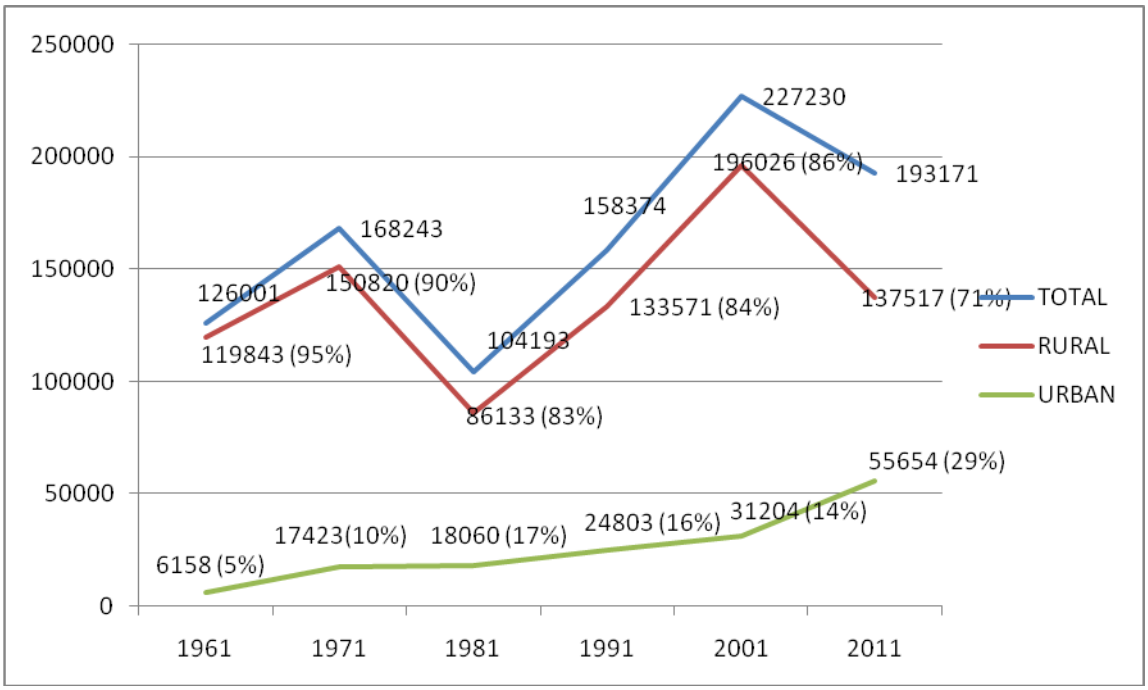
The progress of Biodiversity in Mokokchung district as well as the entire state of Nagaland has been greatly affected by the high population explosion. The total population of the state as per the 2011 census is 19, 80,602 with a population density of 119 persons per km^2 which in fact indicate a decline in the overall population growth in Nagaland. However, the state of Nagaland has experienced unprecedented rise of population since 1971 with a record of highest growth of population in the country from 39.9% to 64.4% in 2001.

FIGURE: 4.1 SHOW THE CONTRIBUTION OF MOKOKCHUNG DISTRICT IN TERMS OF POPULATION CONCENTRATION TO THE STATE.



(Source: Basic Facts 2011)

FIGURE: 4.2 SHOW THE URBANISATION TRENSD IN MOKOKCHUNG DISTRICT.



(Source: Basic Facts 2011)

Mokokchung district has recorded a population of 193,171, where there was a change of -16.77 percent in the population compared to population as per 2001 but still has an impact on the Biodiversity because urbanization trend continues to progress. In the previous census of India 2001, the district has recorded an increase of 0.00 percent to its population compared to 1991.

The main reason for the increase is the high population growth is the migration from rural to urban areas and the transformation of rural areas to urban areas. Urban areas and urbanisation affect biodiversity in many ways; one of the most important consequences of urbanization is habitat loss, habitat fragmentation and isolation or habitat alteration (Antrop 2000, McDonnell &Pickett 1990, McKinney 2002). Another characteristic of urban areas is the high number of exotic, invasive or accidentally

introduced species (Rebele 1994). If these non native species replace the native species, they reduce biological uniqueness of a local ecosystem.

4.2.2 IMPACT OF ILLEGAL IMMIGRANTS

The overall demographic change in the state is the result of numerous problems such as large number of influx of illegal immigrants both in urban and rural areas creating haphazard situation for the development process as well as for the Biodiversity and environment. Illegal immigration has taken place prior to 1970's. By 1980's it had created various social, economic and environmental problems drastically affecting the entire demographic process of the State.

Illegal immigration has been taking place in Nagaland, especially in areas bordering Assam, who were assumed to have prospects for better employment for manual labour have significantly contributed to the influx of immigrants, with the immigrants easily finding work, be it in the agricultural fields, in homes or as manual labourers. As Nagaland faces a labour shortage, certain sections of Naga society also encouraged immigrants by providing them shelter, land for settlement and cultivation etc are engaged in agricultural activities. They are employed in the paddy fields and after staying in the areas for a few years become like a native making encroachment into forestland which is a serious threat to forests and their conservation. The situation is alarming in some villages of the district like the Tsuremmen village, Lirmen village (Tzurangkong range) and Aosungkum village and Aosenden village (Japukong range) that needs strong political will to address the problem, which has caused loss of forest area and created a means for perpetual degradation of forest resources with many unsuccessful efforts to evict encroachers from a reserve forest areas.

The problem with illegal immigrants in Mokokchung district started with the inception of logging trade that were spread to the deep interior of the forest region having thick concentration of forests where the immigrants have started to dominates the land use and the economy in forested areas. Logging has damage 10-20 per cent of the forest resources significantly changing the forest ecology. Furthermore, logging and construction of logging roads bring immigration into formerly remote areas, opening up the interior to use, stimulating the development of cash economies, and allowing access to distant markets.

4.2.3 IMPACT OF CLIMATIC CHANGE

Apart from such population related problems the most severe effect caused by population explosion in the district is the climatic change. In general global warming is not just a single issue, but a compilation of numerous environmental issues which are threatening the basic existence of various life forms in the region. Mokokchung district which usually have a cool pleasant climate has temperature risen by a few degrees Celsius undergoing a slight changes in the climatic condition. This slight alteration in degrees has its effect on Biodiversity as plants and animals are sensitive to fluctuation in temperature and climate. Even the past records show evidences from fossils and palaeo-biological studies indicates that rapid climatic change has been associated with mass extinction.

In Mokokchung district, the year 2009 was the warmest year which nearly brought drought like situation as the rainfall during this year was very scarce badly affecting the cultivation, cropping pattern, fruiting, flowering, tree, birds, insects etc which are the sole source of our livelihood The district which usually received heavy rainfall is facing deficient in rainfall over the last few decades, which contributes to global warming.

The consequences of climate change to Biodiversity in the district of Mokokchung, have inconclusive results. There are evidences of damage caused to agricultural crops, changes in blooming season of several of plants and flowers, reduction of resources etc. For instance, there were drastic fluctuation on the weather and climatic elements prevailing in the region, incurring more hailstones and thunderbolts, even the frost formation are seldom found in Longkhum village which experienced snowfall and frost formation in winter days in the past.

Rainfall has become lesser and erratic causing acute water shortage in the entire district, higher temperature creating conditions for prevalence of more diseases and sicknesses. Farmers irrespective of their cultivation type have been the most affected as they have bear the brunt of climate change where the vegetables and fruits yield lesser quantity of juice and the fruit borne are seedless. Besides, the production and reproduction patterns too have change with the changing climate. Mokokchung district have witnessed an increase in the number of pests like locust in the fields, large insects, mosquitoes. Due to erratic rainfall farmers face delay in sowing or non germination of seeds, crop diseases which could not be managed through traditional measure resulting in unpredictable harvest.

Delay in rainfall in the region also constrains dew formation, thereby affecting pollination by bees and insects etc. Besides, due to changes in the occurrences of seasons even the traditional method of forecasting have become undependable as farmers cannot depend on the forecasts to sowing time and harvesting and all that goes in between. It has also risk of losing traditional and cultural knowledge on wild species of plants and

animals having unique adaptations and genetic makeup which are capable of coping with a rapidly changing climatic condition which holds the key to survival. Monsoon have become unpredictable as the spatial and temporal patterns of precipitation have changed frequently; the average temperature in the district have soared due to the increase intensity effect of El Nino causing heavy to very heavy rainfall increasing during summer season and rainfall intensity is decreasing in drier season causing disruption to normal agriculture.

As a result of such seasonal shifts in weather, it has worsened the severity of events like floods and droughts in the region. Due to climate change, the district has also faced various natural calamities like landslides, as Mokokchung district is a landslide prone region and is vulnerable to such calamities. The landslides that occurred on 22nd June 1992 and on 26th May 2005 was the worst case ever witnessed by the district which was caused by incessant rainfall measuring more than 170.7 mille-meters, costing the lives of 14 people and lost of properties was the worst case the district had ever witnessed. The district is also frequented by flood and drought like situation especially along Mangkolemba, Longchem (Changkikong range), Kubolong (Asetkong range), Changtongya (Langpangkong range) and northern and southern parts of Ongpangkong range caused by climatic change related problems.

Large scale forest depletion leads to climate change in Mokokchung district thereby affecting the composition of species and their dominance. Changes in the forest composition have a negative impact on the economy of the tribal communities, as forests provide all means of sustenance. Majority of the indigenous community is still depending

on the Biodiversity for fire fuel, fodder, raw materials, medicinal plants, shelter, clothing etc, therefore, any reduction in the density and species richness in the region will definitely affect the economy of the local population, however slow and intangible it may seem.

During the last few decades, population increased was largely due to high birth rate and low death rate and illegal immigration leading to illegal development which fails to provide a permanent and sustainable development. In addition population growth has resulted in more important social impacts like lack of bio-resources, acute shortage of drinking water, encroachment on forest land for agriculture, settlement, developmental projects etc. Its impact on the Biological and the physical environment is manifold, which has caused in the misuse and over use of biological resources.

Various such outcome is the poaching and killing of wild birds and animals, overexploitation, and the expansion on more cultivable land and advancement in agriculture by clearing the large tract of jungles and forests with the excessive application of pesticides, insecticides, fungicides, weedicides etc causing pollution in the air, water, and soil.

The population explosion in the recent years in Mokokchung district has stressed most of the biological systems, where Biological Diversity is the most affected. Population pressure has forced to expand more cultivable land exposing the forests leaving it dry and naked, and to make matter worse habitat destruction through illegal timber trade and local

pressure for firewood have depleted the forest resources. These destructive activities have driven away many species of wild animals, birds and have caused near extinction up to a considerable level. This has paved the way for frequent water crisis in all parts of the district, causing failure of agriculture products which is the sole sustainer as more than 90% of the Naga population is dependent on it.

4.3 HABITAT DESTRUCTION

‘The major threat to Biodiversity is loss of habitat, and the most important means of protecting Biodiversity is habitat preservation. Habitat loss includes habitat destruction as well as habitat fragmentation. Habitat loss is known to be the primary threat to the majority of plants and animals currently facing extinction, with the negatives effects of alien species and over exploitation being other important factors’ [1]

Destruction of habitat or loss of habitat in various semblances is the single most common factor leading to Biodiversity loss in the region. In the last few decades’ massive scale of forests were destroyed to bring about agriculture, settlement, highway construction, drainage, buildings and other urban oriented activities. These have brought about an uncomplimentary consequence on the elimination of plants and animals and various lower level organisms creating an undesirable effect on the air, water and land which in turn affects our wellbeing for our survival as it also had an ill effect on our cropping pattern, fruiting, flowering etc which are our means of sustenance.

1. Richard B Primack: A Primer of Conservation Biology (Second Edition); 2000, page 77

Habitat loss has put a heavy pressure on the food requirements resulting into conversion of forest land into agricultural land with the introduction of cash crops like rubber, coffee and tea plantation especially along Mokokchung and Dimapur districts at random phase without considering the viability of local condition, environmental viability, market viability and farmer friendly have put a strain on Biodiversity. Commercial farming on pineapples, passion fruit, banana and citrus fruits like oranges etc which is a new trend in many parts of the state were taken up on an area of approximately 3000.0 ha in the year 2007-08 alone **(Agri Link 2008)**.

Development of spices and medicinal and aromatic plants like ginger, cardamom, aloe Vera, black peeper etc cultivated along the Changki valley (Mokokchung), Zunheboto. Phek, Longleng, Kohima, Kiphire, Tuensang, Peren, Mon and Wokha have converted 100's and 1000's of forest land into a literally new agricultural trend. Habitat destruction has given rise to habitat fragmentation leading to subdivision of a particular habitat and the corresponding increase in other habitats in the landscape. Many virgin and inaccessible forest in the district have suffer habitat fragmentation of stable areas which contributes towards a significant impact on the Biodiversity of the region particularly affecting forests thus leading to Biodiversity loss. This is the result of clearing of natural vegetation and conversion of habitat of the wild into agriculture land, settlement, construction of roads and development etc posing a grave threat to Biodiversity in the region.

Habitat fragmentation caused large population of Biodiversity to be broken into smaller population which may be isolated from one another as removal of an organism from its

environment can have irreversible impacts on the environment itself. These sub population may be too small to be viable or, if local extinction of species occur, fragmentation cuts off the potential for reproduction since there are no intact population nearby.

As such many species cannot adapt to the unfavorable environment resulted from habitat loss, forcing them to succumb to predation, starvation or diseases. Habitat destruction has also discouraged the seasonal migration of birds and animals from the neighboring state like Assam, Asian and other European countries. It has directly affected the larger animals like the tiger, elephant, leopard etc which requires larger geographical allocation for breeding and feeding. Birds like the Grey Peacock Pheasant (*Polyplectron bicalcaratun*), Roseringed Parakeet (*Psittacula Krameri)*, Large Indian Parakeet (*Psittacula eupatria*),Common Peafowl (*Pavo cristatus)* etc which are mostly confined in the dry and moist- deciduous biotype are badly been intruded upon due to habitat destruction in the district. Many species of plants and animals are destroyed today in the district because of habitat loss, as a particular species cannot live anywhere, they find it difficult to adapt to the changes in the environment.

Especially those species which requires larger space for feeding and hunting are most vulnerable to this kind of situation as these organisms has been interfere and disturbed upon by this activity resulting in inadequate food supply. Rufous Necked Hornbill *(Aceros nipalensis*), Wreathed Hornbill (*Rhyticeros undulates*), Malabar Pied Hornbill (*Anthracoceros coronatus*), Indian Pied Hornbill *(Anthracoceros malabaricus*) etc which once were abundantly found in many forests of the district have come down to a critical

number, this is caused due to habitat destruction for carrying out cultivation as these creatures made most of their abode on the tall gigantic trees of the evergreen and moist-deciduous forest up to 1800 meters above mean sea level. Primates like Slow Loris (*Nycticebus coucary*) are also affected as "they prefer forest edges, which have more supports and insects preys." [2]

Mithun (*Bos frontalis*) often reared at an altitudes ranging between 300 to 3,000 meters above the sea level need large geographical area for feeding. In Nagaland, Mithun is a highly traditionally prized unique animal and has important place in economic, social and cultural life of tribal people. Owning of Mithun is considered to be an indication of social economic superiority of an individual in the society. Despite all these status associated with this animal which once roamed freely in many forests of Nagaland including Mokokchung district is declining. It is disheartening that rampant environmental degradation due to encroachment of forest land and unabated felling of trees and poaching has become a serious threat to this animal in the region reducing mithun (*Bos frontalis*) population to 33,385 in Nagaland **(Census 2011).**

Similarly, the decline in elephant population in Mokokchung district is mainly due to reduction of forest cover. In the wild habitat, elephants range over tens or hundreds of square kilometers, larger space are needed for bigger breeding herds, which complement the ultimate elephant enrichment activity like giving birth to offspring and caring for them but most of the original habitat are lost from logging, forest clearance for

2. Srivastava: Primates of North-East India; 1999, page 121

agriculture, and the killing of elephants as pests, ivory poaching and forest fires etc. In some case elephant-human conflict were also observed as in Aliba village, Debuia village, and the areas along Changki valley and Tzurang valley of Mokokchung district which often happens when the matriarchs of a herd are killed, the teenage orphans are left without supervision and become very aggressive. Moreover elephants are losing their forest habitats from conversion to tea, rubber plantation and other commercial farming especially along the Tuli in the Langpangkong range, Changki and Tzurang range.

Stump-Tailed Macaque (*Macaca arctoides*), Assamese Macaque (*Macaca assamensis*) is the most severely hit due to the loss of its habitat not only in the district of Mokokching but in India and elsewhere due to habitat destruction. As 50% of their diet is composed of fruits, seeds, young leaves, flowers, buds etc, removal of forests have severely affected their food habits. Similarly many species of plants, herbs and scrubs having potential for medicinal purposes have met the same fate. For instance the Maiden hair fern (*Adiantum capillus-veneris*), Crab's eye (*Abrus precatorius*, Linn), Asparagus (*Asparagus officinalis*, Lin), Sprout-leaf plant (*Bryophyllum pinnatum*, Lam), Ballon vine (*Cardiospermum halicacabum*), Country Borage (*Coleus aromaticus*,Beth), Sanka weed (*Euphorbia hirta*, Linn), Sensitive plant (*Mimosa pudica*, Linn), Prickly pear (*Opuntia dillenii*, Haw), Purslane (*Portulaca oleracea*, Linn), Bowstring Hemp (*Sansevieria zeylanica*, Wild), Sage (*Salvia officinalis*, Linn) etc which once grow abundantly in the district were considered as troublesome weeds as it makes farmers difficult to cultivate land making these species at the point of extinction.

Habitat destruction or loss caused by man's interference on nature for acquiring his wants in several genre like over-exploitation, illegal gathering, unethical commercialization of Biodiversity resources in the guise of collection of fruits, vegetables, honey, gum, resin, medicinal herbs and plants, or cutting of trees for firewood and cultivation, for construction of roads, buildings, dams for irrigating the field etc. which effect the diet and surroundings of a particular species as its habitat and food supply are destroyed.

Habitat destruction have hamper many migratory animals and birds especially the Red legged or Amur Falcon (*Falco amurensis)* which is believed to migrate from Europe, these birds migrate in large number in terms of millions and rest in Changtongya and Yaongyimsen forests under Langpangkong range before they set for their destination. Habitat destruction manifested in the likes of cattle grazing, encroachments on the forest land and the unplanned developmental activities which is a common practiced in the region still continues to demolish many plants and animals habitat. Loss of habitat or destruction which is a result of increasing human population in the region has put a heavy pressure on the food requirements. In order to fulfill this, area under forest covers in the region have reduced, where large tracts of forest areas are converted into agricultural land. As loss of habitat directly contributes to the loss of Biodiversity in the region, it has severally upset the natural ecological balance affecting the delicate food chain.

4.4 DEFORESTATION

For centuries, forests have influence the Ao-Naga lifestyle, society, economy, and culture. Forest with its multipurpose characteristics has executed the function of the ecological, aesthetic, productive and religious role of the Naga society. Forests have defended, sustain and maintain all forms of well being. The forest in the district is

distributed unevenly and the thickness or the presence of dense jungle in an area depends upon the imposition of strong traditional laws and regulations against illegal felling of trees and timber logging.

Over the past three decades the states have experienced unabated exploitation of forest and minerals resources, for instance developmental induced projects such as Doyang Hydro Electric Project (DHEP) with its capacity of 75mw undertaken by the government of Nagaland and North East Electric Power Corporation (NEEPCO). Under this project the total catchment areas is about 2,60,600 hectares which is entirely falling within the community land is directly affecting 22 neighboring villages causing submergence of forests and agricultural land displacing the local people since its inception. Villages like the Seluku, Old Riphyim, New Riphyim, Old Changsu and New Changsu are the worst affected where there are evidences in the sudden climate change; erratic rainfall sometimes receiving heavy rain falls and at other times drought like situations having an impact on the cropping pattern and the entire biodiversity of the region.

Besides, there are other such developmental activities causing direct environmental impact. Among many are the mining in the foothills of Nagaland particularly in Anaki, Tuli, Mongchen, Yimjenkimong, Japu and Changki valley where unregulated and unscientific rat- hole mining is being carried out. The mined wastes are dumped on the open jhum land and forest thereby exposing the sulphurous coal dust creating serious environmental hazards. These wastes are carried downstream by the rain water destroying the entire biodiversity especially the aquatic life in the rivers.

Apart from the ecological destruction large number of hamlets and human settlements has emerged in many obscure forest regions. Many such new settlers are unaware of the indigenous Nagas who had intimate relations with the biodiversity of the region, their sole motive being the profit maximization, hence wanton depletion of Biodiversity and environment where such settlements takes place. Pristine forest and jungles of the district are confined mostly in the remote interior areas of the Changkikong, Japukong and Tzurangkong ranges where the means of transport and communication are not well-develop in comparison to other ranges in the district. These dense jungles and forest are the abode of diversity of birds, animals, reptiles and amphibians including the much floral diversity.

Forest of Mokokchung district are embellish by strong and tall tree species like the Babul Acacia *(Acacia Arabica*), Alder (*Alnus Nepaiensis*), Christmas tree (*Cryptomeria japonica*), Teak (*Tectona Grandis),* Champaca *(Michelia Champaca),* Pine *(Pinus Patula*), Rose Gum *(Eucalyptus Camaldulensis*), Silver Oak (*Grevillea Robusta*), Walnut (*Juglans Regia*), Jackfruit tree (*Artocarpus Integrifolia*), White Popinac (*Leucaena Leucocephala*), Gumbar/Gmelina (*Gmelina Arborea*), Siris/Khoka (*Albizzia Lebbeck*), Lampati (*Duabanga Sonneratoides*), Bonsum (*Phoeba Goalparensis*), Bllue gum(*Eucalyptus Globulus*), Deodara (*Cedrus Deodara*), Sal tree (*shorea Robusta*), Hollock (*Terminalia Myrio Carpa*), Kadam *(Anthocephalus Chinensis*), Ghora neem (*Melia Composita*), Hog-Plum (*Spondias Axillaris*), Hill Toona (*Cedrela Serrata*),Koroi (Albizzia procera), Agar (Aquilaria agallocha), Uriam (Bischofia javanica), Semul (Bombax ceiba), Bogi poma (Chickrassia tabularis), Coral tree (Hovenia acerba) and so on. However it is a hard fact that large portion of trees has been cut down recklessly to bring about development, urbanization and agriculture. In reality forest begin to shrink in

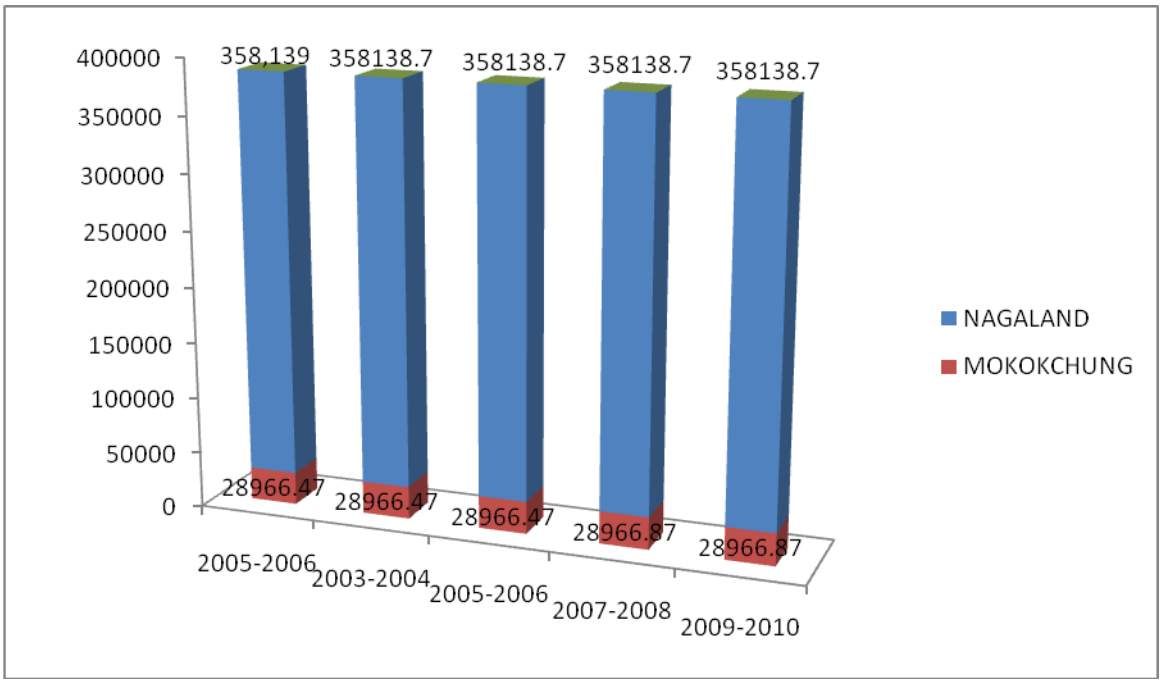
the district with the commencement of commercialization of trees for timber and plywood. This malpractice actively took place since the late 1970's to 1990's making the inaccessible dense jungles to be devastated at a high rate leading to a major threat to the rich Biodiversity of the region and the surrounding environment.

TABLE: 4.1 SHOW THE STATUS OF FOREST (HECTARE) IN MOKOKCHUNG DISTRICT.

GEOGRAPHICAL AREA	FOREST AREA	FOREST COVER	VILLAGE WOODLAND	FOREST COVER AVAILABLE FOR TREATMENT (PVT PERSONS)	PROTECTED FOREST	PURCHASED FOREST BY THE DEPARTMENT
161500	57067.11	12373.91	945.00	29121.75	428.00	4548.79

(Source: Annual Administrative Report 2010-2011; Department of Forests, Ecology, Environment & Wildlife Nagaland)

FIGURE: 4.3 SHOW THE AREA UNDER FOREST (IN HECTARE).



(Source: Statistical Handbook of Nagaland 2011)

4.4.1 LOSS OF BIODIVERSITY DUE TO LOGGING

Logging and its related activities have wiped out a massive portion of forests area in the Langpangkong, Tzurangkong, Japukong and Changkikong areas. These ranges have larger geographical extent under forest cover and are the strongholds of thick and dense inaccessible forests areas of Mokokchung district. Likewise, Ongpangkong and Asetkong ranges are also severally damage by logging activities though very strong customary laws are implemented with heavy fine and punishment in the recent years. The selective logging of a few large trees creates openings in the crown cover leading to better grass production, which invites cattle and goats. Their browsing makes regeneration difficult, and then the area is invaded by exotic, non palatable weed species.

Logging has severe effects on soil, nutrients, forest structure, and biodiversity (Ernst et al., 2006), and causes appreciable damage to uncut trees, especially in poorly planned operations (Johns et al., 1996; Johns, 1997). Moreover logging is one of the main causes of declining bat (*Rhnolophus)* population in the district due to degradation of forests as they are primary agents of pollination and seed dispersal for many pioneer plants represent important components of biodiversity.

4.4.2 DEMAND ON FIREWOOD

Another cause of deforestation in Mokokchung district is the unabated demand on firewood. Dependence on fuel wood is likely to continue for a long time to come as it is consistent with cultural patterns and living habits and least expensive form of fuel compared to LPG where its supply is not sufficient to meet even urban demand and also not easily available to villagers. Since firewood is obtained almost free of cost in the villages there is no encouragement for the rural folks to substitute fire fuel completely. In addition, due to lack of economic income the poor people are driven to cut down trees

and sold in the urban areas where there is greater demand for the use of logs and larger branches resulting in the fair sized trees to cut, possibly in large patches, thus having a more degrading effect on the forest than may be the case with cutting for village needs, which can be met more often from pruning or pollarding the branches of trees or even bushes in a limited area. Thus collection of fuel wood for sale in urban areas is the cause of much destruction and degradation of forests.

4.4.3 DEFORESTATION TO MEET COMMERCIAL PURPOSES

Tree species like the Hollong (*Dipterocarpus macrocarpus*), Walnut (*Juglans regia*), Makai (*Shorea assamica*) and Bonsum (*Phoebe goalparensis*) etc are faced with severe destruction due to its importance as timber and plywood which fetch as high as Rs. 678/- per cubic meter. Kala siris (*Albezzia lebbec*), Koroi (*Algezzia procera*), Amari (*Amoora wallichii*), Sam (*Arctocarpus chaplasha*), Bogipoma (*Chikrasia tabularis*), Jatipoma (*Cedrella toona*), Nahor (*Mesua ferrea*), Gogra (*Schima wallichi*), Gahori sopa (*Talumaa phelocarpa*), Pine (*Pinus khasiya*) etc are also meet with similar consequences which are cut down in large number for constructional and decorative timber, as these tree species are expensive as well and fetch as high as Rs. 94/- per cubic meter.

Deforestation has resulted in the loss of Biodiversity in the region, as trees are the abode of not only birds but animals takes refuge as well. With the felling of a tree, the entire being of life including the micro-organisms which derives its nutrients from it are destroyed as well. A very well known experience relating to deforestation face in almost all the forest of the district is the disappearance of numerous diversity of hornbill viz Rofousnecked hornbill (*Acenos Nipalensis*), Wreathed Hornbill (Rhyticeros Undulatus), Malabar Hornbill (Tockus Griseus), Indian Pied Hornbill (Anthrecoceros Malabarius), Great Pied Hornbill (Buceros Bicornis) etc in the last 20 years is partially due to

destruction of evergreen and moist-deciduous forest as these birds make their abode on the tall trees as these birds feed mostly on fruits particularly (do in seeds), the felling of these tree species have had an impact on hornbill population. Primate species is also diminished to the point of extinction because of deforestation leading to habitat loss besides hunting and poaching. As primates mostly feed on fruits, leaves, buds and berries of specific tree species like the Ajar (*Lagerstroemia flos- reginae*), Tita sopa (*Michelia champaca*), Moria or Kothia koroi (*Albizzia lebbek*), Paroli (*Stereospermum chelonoides*), Am (*Mangifera indica*), Satiana (*Alstonia scholaris*),Outenga (*Dillenia indica*), Sam (*Artocarpus chaplasha*), Gomari (*Gmelina arborea*), Amari (*Amoora wallichi*) etc, the felling of these trees have threatened their survival as their means of sustenance has been diminished.

Unlike the present days, where forests and vegetation are killed indiscriminately to bring about development and other related human welfare. Our ancestors times were often shrouded with certain gena or taboo associated with thick jungles and forests. It is believed that the place or the forest where a man was killed by a tiger, that particular forests or plot of land is regarded as ‘unholy’ or ‘polluted’, it was a taboo, as well as a bad omen to gather even a leaf from such forests, while hunting and cultivation were forbidden, as it was believed to bring severe sicknesses as ‘sungra’ known as cancer and severe misfortune. This kind of forest were left untouched for a 100 years and only after completion of these years, cultivation and other related works can be carried out. Such a practiced has also indirectly and directly leaded to preservation of large areas of forests. But today such beliefs and superstitions have no place and forests are cut down recklessly. Forests are destroyed without considering the future consequences in the district, as massive destruction of forests can reduce the rainfall in an area, as plants have

the capacity to hold large quantities of water that they have taken up from the soil. This water evaporates from the plants into the air and may fall to earth as rain while deforestation force the soil to drain immediately the little water it holds.

The extraction and the indiscriminate removal of major and minor forest production by illegal means have already affected the Bio-diversity wealth in various ways. It has resulted in deteriorating the physical environment as any alteration in Biodiversity would definitely result in alteration of climate, soil, water, air etc. Deforestation in the region have influence the prevailing micro-climate, it has disturb the stable temperature, humidity, wind, precipitation, radiation etc. This recent changes in climate have already had a significant impact on Biodiversity and ecosystem in the region, causing severe and harmful impacts on ecological aid and provision in the framework of long growing season, increase the risk of extinction, decline in population size, floods, droughts and disease outbreak and epidemic etc.

Forest-the mother of diversity of all life forms and Biodiversity is the foundation of all essential benefits to the well-being of humanity and therefore need to be conserved. Realizing its importance, the village authorities in almost all the district have laid down numerous tree plantation, afforestation and reforestation activities. Logging is completely prohibited in many jurisdiction and territories among the Ao villages, as this unethical practice has deprived all the bio resources, valuable birds and animals along with the disappearance of many rare and exotic plant species. One of the main reasons of deforestation prevailing in the district is for agriculture purpose.

PLATE NO: 4.1 LOGGING AT TULI REGION

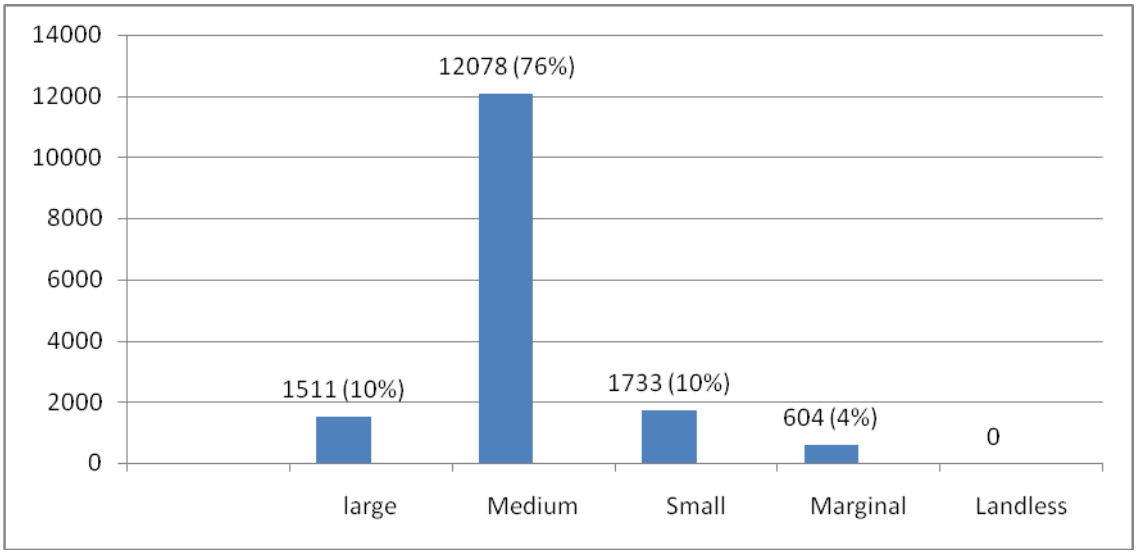
PLATE NO: 4.2 LOGGING AT WAMEKEN FORESTS.

PLATE NO 4.3 LOGGING AT TZURANGKONG AREAS

4.5 AGRICULTURE

Agriculture is a way of every Naga life practiced by 1, 49,171 households in Nagaland (**Census 2011**); it is a tradition which for centuries has sustained their livelihood. It had, have and will continue to be the central to all strategies for planned socio-economic development of the region. As the economy of the State is largely dependent on agriculture which still occupies a significant place as 30.15 (GSDP) of the State Domestic Product in 2004-2005 was generated by agriculture sector and any changes in the production of food grains affect the economy significantly.

FIGURE: 4.4 SHOW THE AGRICULTURAL LAND HOLDING PATTERN (AREA IN HECTARE) IN MOKOKCHUNG DISTRICT.



(Source: Nagaland Science & Technology Council (NASTEC)

4.5.1 JHUMMING

Nagaland often known for pre-dominantly jhumming practices is in many ways interwoven in their culture, the mode of life, festivals, songs, marriages etc which revolves around jhum cultivation. Jhumming which is predominantly practiced by almost all Naga tribes with the exception of few tribes such as the Angami and Chakesang tribes

which practiced terrace settled cultivation is partially responsible for the rapid deforestation in many parts of the state. As Nagaland is often known for pre-dominant practice of shifting cultivation, Mokokchung district is not an exception. This practiced of agriculture has made the land barren and naked virtually eliminating every possible creature from the area. The hills and mountains which were garnish with virgin and inaccessible jungles are no longer to be found in the present scenario.

"In their natural state these hills were clothed with evergreen forest, but this has retreated before the torch and dao of husbandman until all but the most precipitatous hillside are slowly being dueled. The Jhum system of cultivation which is in vogue, is very unfavourable to the growth of trees, because it demands such extensive areas, when the field are abandoned, they grow up with tall grasses, reeds, and scrub bamboo, but before the trees could retain any growth the torch is applied and the land is again put under the plough" [3]

Since time immemorial, the land use is dominated by agriculture mainly shifting, where forest are cleared by within down the jungle, and allow it to dry up for several months in the dry season and then clean up the area by burning up the dried jungle, this slash and burn method have caused vast devastation to the rich biodiversity status in the region, under this system, even the shrubs and undergrowth are not spared.

3. M.M Clark: A Corner in India; 1978, page 37, 29

PLATE NO: 4.4 JHUMMING ONE OF THE PRE-DOMINANT FORM OF FARMING IN MOKOKCHUNG DISTRICT.

Jhumming has had a significant effect on Biodiversity because of its prevalence over the region; it has generated the greatest impact on the environment because of the degree of habitat loss and alteration taking place on a large geographical scale. One important side effect resulting from deforestation and subsequent jhumming is the increase erosion of the top soil, where removal of natural agents like the surface H_20 and winds, to carry them away along its nutrients and beneficial micro-organisms.

Mokokchung district is known to practice Jhum in the entire district except in the foothills bordering Assam which comprises of 15 percent of the geographical area. Centuries of shifting cultivation has created a scenario where only about 15 to 20 percent of the village forest is ancient or old forest and the rest are all young forest of about 10 to 20 years covered under jhum cycle. Therefore many endemic species of flora and fauna have drastically declined in the district over the past many decades. Instances are Nahor (*Mesua ferrea*), Tita sopa (*Michelia champaca*), Hollong (*Dipterocarpous),* Makai (*Shorea assamica),* Wild Apple (*Feronia Lemonia*. Linn), Madasgagar Periwinkle (*Catha Ranthus*), Holy plant (*Alex Aquifolium*), Blue Flag (*Iris Versicollor.* Linn), Century Plant (*Agava Americana*), Hibiscus (*Hibiscus*), Sweet flag (*Acorus calamus*. Linn) etc has declined especially in some villages of Chuchuyimpang, Mopungchuket, Ungma, Aliba (details in **Table 4.14 and Table 4.15**).

Bush fire and accidental jungle burning is also closely related to jhum practice. During the burning of Jhum field accidental fire in the unintended forest occurs either due to human error or unpredictable wind direction. Such accidental fire cause immense loss of forest, bamboo grooves and Biodiversity in general. Sometimes the uncontrolled fire burns many acres of forestland even beyond the jurisdiction of one village thereby

affecting neighbouring village forest. Such incident of forest fire often creates misunderstanding between the villages however such accidental jungle burning is either mutually settled or a nominal fine is imposed on the defaulter. Such accidental forest fire is frequent in the areas where jhum is commonly practiced often resulting into huge losses of forest Biodiversity and even a well settled farms.

It is undeniable that jhumming is partially responsible for depredating of forest area in the district, as it is marked by slash and burn method before being cleared ultimately leading to loss of habitat of plants and animals and hence a loss to diversity. In fact a larger section of the forest cover in the district is made up of jhum fallow land which allows rapid growth of young forest that the process of leaving the land fallow incite the re-growth of trees and vegetation giving rise to rejuvenate secondary forests.

4.5.2 MONOCULTURE AND COMMERCIAL FARMING

Currently there is a rapid change in the land use pattern from a traditional based jhumming to a money driven commercial farming system under which large tracts of forests and agricultural lands are owned by few individual or otherwise community lands are converted into a monoculture commercial forests, plantation of crops like tea, coffee, rubber, commercialization of fruits like oranges, banana, pine-apples, etc. This unregulated unplanned emerging system of land use has multi dimensional impact on the Biodiversity and its resources which in turn adversely affect the livelihood of the general mass due to shift in agricultural pattern.

PLATE 4.5 TEA PLANTATIONS AT MOPUNGCHUKET VILLAGE.

PLATE 4.6 TEA PLANTATIONS AT LONGJANG VILLAGE.

PLATE NO: 4.7 NURSERIES AT MOPUNGCHUKET VILLAGE.

PLATE NO: 4.8 RUBBER (*Hevea brasiliensis*) PLANTATIONS AT LONGPAYIMSEN VILLAGE.

PLATE NO: 4.9 AGAR (*Aquilaria agallocha)* NURSERY AT LONGPAYIMSEN VILLAGE.

Plantation of monoculture trees mainly Teak, Agar, Gomari, etc for commercial resources use have caused loss of habitat and species of tropical, alpine, and evergreen forests as these forest types are predominant in the state. Modern farming practice which include the use of genetically modified varieties, introduction of alien species, use of chemicals fertilizers etc have resulted in encountering numerous problems like introduction of diseases, pests, accumulation of salts due to rampant use of salts as weedicide, reduction in yield etc affecting the cropping pattern and its productivity. There is a kind of ecological imperialism with the introduction of new and fast propagating trees and grasses which diminishes the indigenous plants.

TABLE: 4.2 SHOW THE PARTICULARS UNDER MONOCULTURE IN MOKOKCHUNG DISTRICT

PARTICULARS UNDER PLANTATION	AREA IN (HA)	AREA IN %
Gamari	2544.11	50%
Teak	938	18%
Alder	667.70	13%
Hollock	526.50	10%
Pine	402.57	8%
Others	5	1%
TOTAL	**5078.88**	

(Source: From the respondents, interview and discussion with the village elders)

TABLE: 4.3 SHOW INCREASE IN TREE SPECIES USED FOR CONSTRUCTIONAL AND DECORATIVE TIMBER SINCE THE LATE 1990's

SCIENTIFIC NAME	COMMON NAME	LOCAL NAME (AO –NAGA)
Tectona granfdis	Teak	Teak sung
Michelia champaca	Tita sopa	Ari sung
Morus lavaegata	Bhola	Asentsu sung/Asen

		sung
Gmelina arborea	Gamari	Eikung sung
Phoebe goalparensis	Bonsum	Bonsum
Mansonia dipika	Badam	Badam
Dalbergia sissoo	Sissoo	Sissoo
Shorea robusta	Sal	Sal
Terminalia myriocarpa	Hollock	Awa

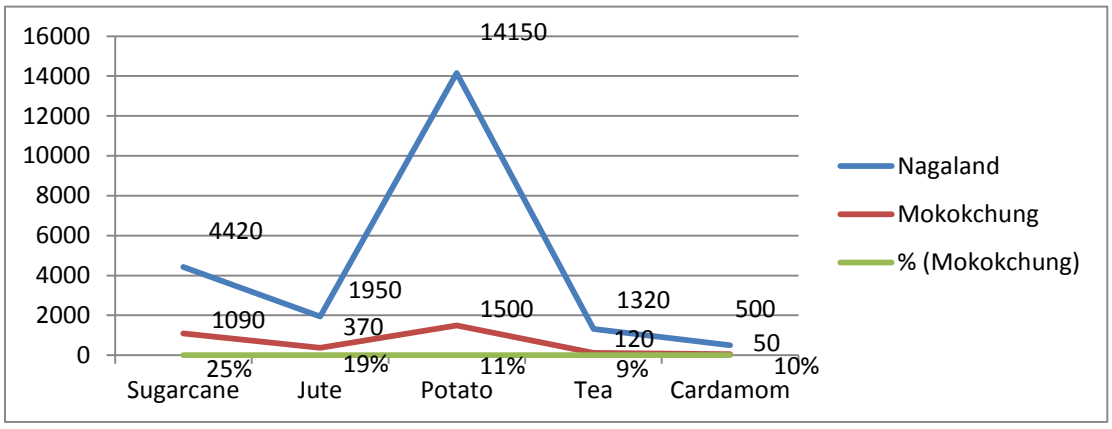
(Source: From the respondents, interview and discussion with the village elders)

TABLE: 4.4 SHOW INCREASE IN TREE SPECIES USED FOR PLYWOOD TIMBER SINCE THE LATE 1990's

SCIENTIFIC NAME	COMMON NAME	LOCAL NAME (AO –NAGA)
Diupterocarpus macrocarpus	Hollong	Hollong
Juglans regia	Walnut	Akha tong
Shorea assamica	Makai	Nguprung
Phoebe goalparensis	Bonsum	Bonsum

(Source: From the respondents, interview and discussion with the village elders)

FIGURE: 4.5 SHOW THE AREA IN HECTARE UNDER VARIOUS COMMERCIAL CROPS IN MOKOKCHUNG DISTRICT



(Source: Statistical Handbook of Nagaland 2010-2011)

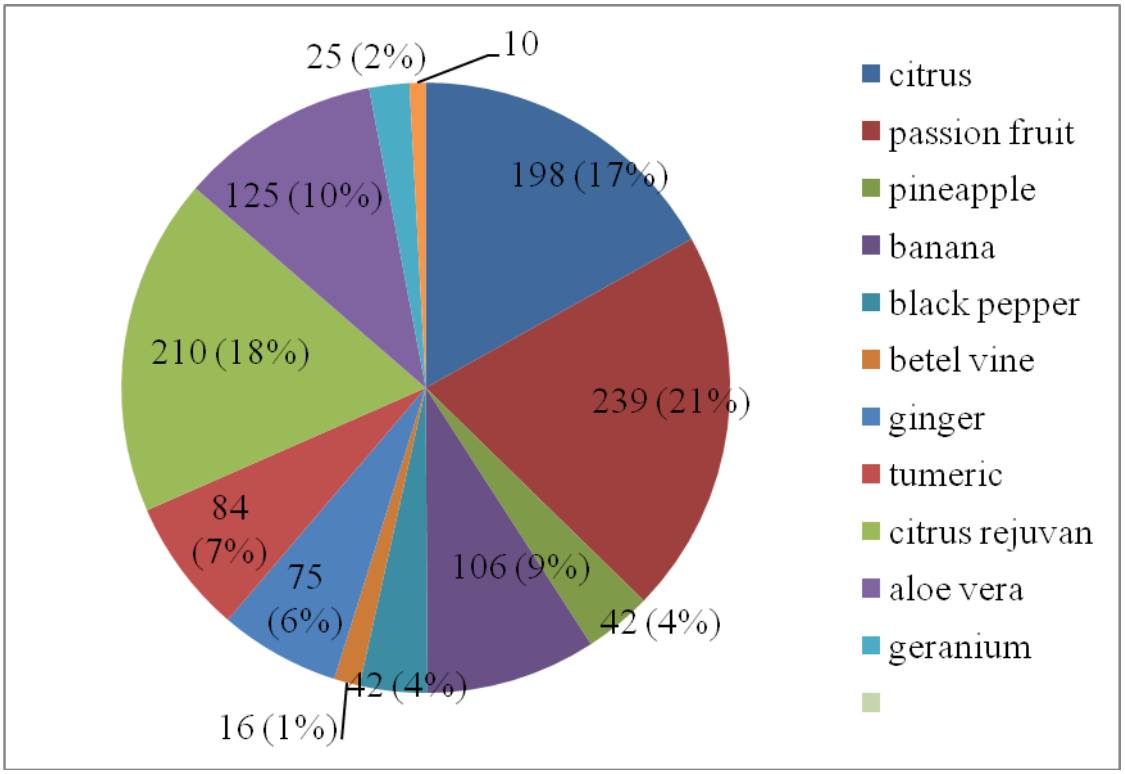
Introduction of cash crops like rubber, coffee and tea plantation have been introduced at random phase without considering the viability of local condition, environmental viability, market viability and farmer friendly, which has been cultivated at the expense of subsistence crops like paddy rice. Its contribution in achieving self-sufficiency in the food and in avoiding food shortage is significant but at the same time the impact of Biodiversity degradation in its sporadic expansion should not be overlooked.

Mokokchung district have 2035 hectares under Tapioca cultivation, besides commercialisation of crops like tea, Agar (*Aquilaria agallocha*), rubber (*Hevea brasiliensis*) etc are rapidly increasing in the district where areas of tropical evergreen forests have replaced these plantations especially along the foot hills of Longpayimsen, Chuntiayimsen (Tzurangkong range), Changki valley (Changkikong range), Tuli valley (Langpangkong range), Mopungchuket and Longjang villages (Asetkong range). Commercial plantations have replaced the original vegetation and flora bringing damage and pollution to forests through the large quantities of chemicals, fertilizers, and pesticides applied in the plantations. Such monoculture plantation and commercial cultivation on a large scale is taking place currently without being aware of its implication. Tree plantation of pure crop no doubt alleviate the destruction caused by heavy deforestation but at the same time it disturb the ecological balance by degrading soil fertility because of identical rooting depths of the crops.

Many Naga farmers have switch into commercial farming allured by the money derived governmental schemes and plans which offers loans, subsidies and other incentives such as free saplings, free seeds and financial assistance that are irresistible for the poor farmers. This emerging trend has created waves of large scale transition from traditional

jhum cultivation to commercial and permanent farming. Agriculture in the form of jhumming, terracing, wet-paddy field and other substitute method of farming in the district has had a significant effect on the Biodiversity because of its prevalence over the landscapes which no doubt plays an important role in diminishing the vegetation cover as such a practiced demands large tract of jungles and forests to cut down.

FIGURE: 4.6 SHOW THE AREA EXPANSION IN HECTARE UNDER DIFFERENT COMMERCIAL CROPS IN MOKOKCHUNG DISTRICT.



(Source: The Annual Administration Report 2010-2011.The department of Horticulture Government of Nagaland)

It can be said that increased population has a negative impact on Biodiversity as the effect of it is evidently observed in the expansion of agricultural practiced as more than 80% of the Naga population is dependent on agriculture. Besides agriculture, there are other various developmental activities which have been brought about by increased population and as a result much damage has been made at the expense of Biodiversity. These factors have dominated the environment to suit the increasing population welfare

and aspiration, and have largely converted the natural landscape beyond recognition. Physical factors like climate (temperature and precipitation), landforms, soils etc which affect the spatial distribution of Biodiversity in the region has been badly affected upon.

Various government aided fund has undertaken more than 50 agricultural link road project in the state covering approximately 405.00 km to provide road connectivity of the villages with agricultural potentials areas putting a heavy toll on biodiversity. Large acres of land which otherwise could have cultivate by two to five families are replaced by monoculture particularly Teak, Agar, Gomari etc. One pull factor for practicing commercial and monoculture by Naga farmers is the good market potentials, promise of loans, subsidies and other incentives such as free saplings, free seeds and other irresistible financial assistance.

With efforts from the local government and other policy makers to discourage the age old traditional practiced of jhumming have actually contributed to deforestation, loss of biodiversity, and reduction in carbon storage. In fact, shifting cultivation, often perceived as the destroyer of tropical forest may be ecologically appropriate, culturally suitable in Mokokchung district, and under certain circumstances the best means for preserving biodiversity in the region. The real threat to these tropical forests is posed by the steady advance of large-scale permanent and commercial agriculture.

The hilly and mountainous terrain of Mokokchung district harbors exceptionally diverse wealth of natural resources in the likes of evergreen forests up to an altitude of 1000

meters and mixed deciduous evergreen forests varying from 1000 meters to 2000 meters have a good potential of biological diversity and is the home to a rich heritage of indigenous cultures which stems and revolves around shifting cultivation. For generations indigenous Ao-Naga farmers manage this system in ways that integrate production from both cultivated fields and diverse secondary forests, including everything from grass and bushes in its early stages, to young open-canopy trees, to mature closed-canopy tree communities.

The greatest threat caused by monoculture and commercialization of crops in the local Biodiversity is the permanent elimination of complex forests and replacing them with crops of a single species such as tea, rubber, coffee, ginger, maize etc over shifting cultivation. With the need for cash and increasing opportunities to earn it, farmers are pushed away from traditional shifting practices toward permanent agriculture with the consequences of devastating the potential ecosystem. If this trend continues in the region, extensive deforestation causing maximum Biodiversity loss will take place in the district.

TABLE: 4.5 SHOW THE CONVERSION OF FORESTS AREA INTO COMMERCIAL FARMING.

PARTICULARS OF COMMERCIAL CROPS	AREA IN HECTARE	AREA IN %
Oil seeds (Soya bean, Ground nut, Sesame, Mustard, Linseed, Sunflower)	30,092	71%
Maize	48300	12%
Tea	13600	3%
Cereals	2,85,890	68%
Pulse	41,800	10%
Ginger	95	0.02%
TOTAL	**4,19,777**	

(Source: The Annual Administrative Report 2010-2011)

In contrast to this, shifting cultivation has a significant advantage over permanent agriculture because in jhumming the vegetation that are felled in patches of forest during the dry season is burned before the onset of the rainy season to open the site and release nutrients. The cleared fields are cultivated and harvested for one or more years, and then left to lie fallow for varying periods allowing soil to stabilize and give forest vegetation an opportunity to re-grow providing a home for a variety of life forms.

Shifting cultivation promotes greater carbon sequestration because when the plant grows they absorb and store carbon and keep carbon which is a major contributor to greenhouse gases out of the atmosphere. When a plant sprouts and matures it absorbs carbon dioxide from the atmosphere, breaks it down chemically and uses carbon as construction material for roots, stems, branches, flowers, and leaves and when the plant dies, some of the carbon goes back into the atmosphere and some are released into the soil thereby promoting biodiversity conservation than permanent agriculture.

In fact only about 30 to 40 percent of the land-cover changes in the district resulted from conversion of areas under shifting cultivation (including secondary forest) into permanent and commercial agriculture. In Nagaland secondary forest vegetation covers majority of the forest area and it is found that it remained fairly stable despite continuous shifting cultivation. In Mokokchung district 77 to 95 percent of the total landscape of each of the five sites remained under secondary vegetation. Thus land use changes from forest cover in the district results primarily from further expansion of agriculture and secondarily with the expansion of urbanization and infrastructure caused due to increase population and its associated economic growth and changing consumption patterns. Biodiversity loss is caused by either natural or human induced factors causing a change in an ecosystem in

both direct and indirect ways. These events have trigger changes in climate and also the dominant cause of Biodiversity lost.

4.6 HUNTING & POACHING

Over hunting and poaching is another threat to Biodiversity and its resources in the district of Mokokchung. Despite various acts and regulations which has been laid down by the government of India to curb these activities, in many cases it has proved to be futile as trade on many products of endangered species continues unabated. Hunting of birds and animals for game, skin, ivory or horn is the main reason for wildlife population erosion.

Hunting of wild animals and birds in the region took place since time immemorial and for variety of reasons, mostly for food as the meat of wild animals and birds are considered as a delicacy. Besides, they are also hunted for medicines, ornamentation, pets and also hunted as pests. Varieties of birds, species especially Rufousnecked Hornbill (*Aceros Nipalensis)*, Wreathed Hornbill (*Rhyticeros Undulatus*), Malabar Grey Hornbill (*Tockus Griseus*), Indian Pied Hornbill (*Anthracoceros Malabarius*), Great Pied Hornbill (*Buceros Bicornis*) etc have been placed to the near point of extinction in the entire district of Mokokchung which are mainly hunted for their beautiful feathers used for traditional ceremonies and festivals like Moatsu and Tsuremmong.

In addition, primate species are the most severely hit amongst all the wild life, mainly because of overhunting and poaching. Primate species like Stump-tailed Macaque

(*Macaca Arctoides),* Golden Langur Trachypithecus (*Trachypithecus Gei*), Capped Langur Trachypithecus *(Trachypithecus*) Pileatus, Phayre's leaf monkey Trachypithecus (*Trachypithecus)* Pheyrie etc have been hunted to the point of extinction in many parts of the district. Primates are hunted for medicinal purpose, where certain body parts are supposed to have medicinal value for treating body pain, fever, asthma and abnormal blood pressure, in few case, they are hunted as pets but could not survive in the captivity.

Many animals especially the elephants and the primates' species are killed as they are forced into crop raiding because of loss of normal habitat to agriculture. This uncontrolled hunting and poaching has caused maximum damage to various Biodiversity in the region resulting in numerous species to become endangered and threatened. Tigers (*Panthera Tigris*), Leopard (*Panthere Pardus*), Elephant (*Elephas Maximus*) Sloth Bear (*Sclenerctos*) etc have been critically reduced in their population on the entire district of Mokokchung, which have been poached and hunted for their bones, hides, skins and tusks.

4.6.1 HUNTING FOR TRADITIONAL HEALING AND MEDICINE AND OTHER USES

Hunting has caused more direct negative effects to the declining and sparse number of tigers and leopard population, because its bones, with almost all its body parts including even the whiskers are use for treating toothache are highly valued for the medicinal purpose. Deer are hunted for meat and trophies, besides deer species like the Barking Deer and Spotted Deer have meet the ill fate as they are now placed in the category of vulnerable species list, they are hunted indiscriminately as the male organ are used for overall medicinal purpose. The fetus of deer is allegedly used as a tonic during child birth

and is also used as a charm in witchcraft. Bats are hunted for treating asthma and tuberculosis, the meat of Dingo is used as an overall medicines. Also the stomach of Porcupine is dried along with its excreta to treat stomach disorder, The blood of smaller Mole (*Talpa*) is used for treating asthma and tuberculosis, Sloth Bear is hunted for its gall which is allegedly believe to treat variety of diseases like stomach disorder. Otter is also eaten as it is believe that eating its meat prevents fish bones from sticking in the throat, its toes and nails are dried over fire place to treat the same.

Many animals are hunted for variety of reason for instance Squirrels (*Funambus*) for its fluffy tail used as a key chain, Leopard for food and for its beautiful skin, Boar's teeth is also used for ornament, ceremonies and its skin is used to decorate hands and feet during dancing, the feathers of Porcupine were used by women folk as a comb, Mongoose are also eaten as meat where they are trapped by using indigenous method of burning bones of animals near their habitat.

4.6.2 HUNTING PRACTICES AND SUPERSTITIONS OF THE PAST

Hunting was practiced in the Ao community since time immemorial, as in the olden days it was one of the most important activities not only to fight wild animals for food but it was also a sort of game and amusement. During the olden times, before sophisticated weapons and guns were introduced, indigenous tools and implements were used for hunting birds and animals: where long bamboo spikes were commonly placed within the pitfalls and snares which were lightly covered with earth or dry leaves or sticks using as a decoy to ambush wild animals like elephants, bears, leopards, squirrel and small birds. Even today in some remote village of the district some farmers are equipped with tools and equipments for fighting the wild animals to protect their paddy fields and habitation

from the ravages of the wild beasts. “Corporate system of hunting big games such as tigers, deer, wild pigs, bears, etc is quite interesting. It is a system of picketing the hunting ground at respective location by groups of men. If the animals are in a cave or a hideout, dogs are essential which render valuable service in tracing out the whereabouts of the animals by their sense of smell. The picketer yells, cry and shout aloud by provocating the animals to come out from its hideout and is then speared from one position to another until it falls.” **4**

Even the larger animals like the elephants were killed in this manner by spearing or shooting till the creature accede to its wounds and injuries. However dwindle of Biodiversity during former days using such primitive tools and techniques cannot match up with the present day use of sophisticated ammunitions and weapons which have amputated Biodiversity in the region making it more conspicuous since the introduction of guns after the 2nd world war where elaborate and complicated guns have contributed in depreciating the glorious Biodiversity in the region.

In the former days, wild elephants, wild pigs which were common were hunted on as they cause damage in the rich fields as they tramp down the grain with their huge feet as in the case of elephants. As quoted from the questionnaires ‘earlier, bears wander liberally in the jungles, even parking deer were heard usually in the quietness of night’. There used to have large numbers of different varieties of monkeys like the Hoolock (*Hycobates Hoolock*) or Black Gibbon, Macaca mulatta, Macaca Assamensis, Stump-Tailed Macaque,

4. Gazetteer of Mokokchung district; 1979, page 79

Capped Langur, Golden Langur, Phayre's Leaf monkey Trachypithecus residing in the jungles and forests were hunted down as these monkeys were considered destructive to fruits and they are most persistent in entering the granaries to eat the rice that is stored. Capped Langur "have been hunted for food, but other purposes such as ornamentation, taboo, religious ceremonies and traditional medicines which are used without any restriction" [5] Trachypithecus Pheyrei are also specially hunted in areas around salt springs where the species seems to produced large gallstones from the limestone." [6] Another reason for the disappearances of larger animals like the tigers, leopards is that these animals "frequently visit the villages and feast on a cow, a pig or a goat, and sometimes they even taste human flesh." [7]

As quoted during interview with the elder people "in the former days, there were diversity of birds and animals in the jungles. Birds like the eagles were considered as pests as it carry away small piglets, cows and poultry, they were shot at or killed in large number. Moreover, the village authority would announced a reward for those who bring a head of the eagle as proof and would claim their reward, but today this practiced have stopped as there are scarcely any present in the region. Carnivorous animals like the tiger and leopard cause a great deal of anxiety about the poultry yard and the pig-sty". "Packs of Dingo in well organized raids would attack cattle and pigs, which were driven into the jungle and forests and there feasts upon them. But today the populations of Dingo have come down with the domestication of dogs" This kind of situation is encountered even in the present day in some thick concentrated forests areas like Wameken. Such problems caused by several animals including small carnivorous animal like the Jungle cat have

5. 6. Arun Srivastava: Primates of North-East India; 1999, page 165, 169

7. History of Mokokchung, Centenary Literature Committee; 1990, page 45

encouraged hunters to killed them in the guise of this alibi. In the same way, several varieties of big birds like the hawks, crows, several species of the eagle family are killed at a maximum because at times, they would carry off a small pig or goat and make raids on the cattle and poultry yards. Although Nagas had been hunting since time immemorial, yet there are certain species which were considered as taboo or gena like the Indian Python (*Python molurus*), King Cobra or Hamadryad (*Ophiophagus Hannah)* etc as they are said to bring bad omen. Killing of tiger, leopard and elephants were also believed to incur upon immediate misfortune like the death of a relative or in the family, such fears and superstitions had also forbade people from killing such creatures.

It is also said that during former days, trapping of Hornbills for their beautiful and magnificent feathers, one had to undergo certain rites and rituals by keeping himself sanctified for at least 30 days. These beliefs had forbidden and controlled against killing and hunting of animals and birds, but with the advent of modernization, superstitions have been done away and as such there is no restriction or taboo or to killed or hunt any kind of species of birds, animals or reptiles.

PLATE NO: 4.10 VARIOUS ASSETS OF ANIMALS USED FOR TROPHIES, ORNAMENTS AND DECORATIONS.

4.7 OVER EXPLOITATION OF BIORESOURCES

Loss of Biodiversity and its resources is due to the overconsumption and demands on its resources. Generally, population pressure and widespread changes in lifestyle in the region have lead to over-use of natural resources. Over harvesting or over exploitation has its tremendous effect on Biodiversity loss in the region as deforestation, habitat destruction and over-exploitation of resources are ever coinciding which evidently wipes out all the vital Biodiversity and its resources thus producing a negative irreversible impact on the existing environment.

Population explosion and its ever increasing demand on resources in the district coupled with human greed to derived maximum profit from Bio-resources have lead to the peak exploitation on many of our rare and precious species of Biodiversity. The deteriorating condition on our river ecosystem is mostly noticeable in most parts of the district where most of our indigenous fish diversity has been depleted to the point of extinction. Fishing is always a part and parcel of the Ao-Naga society as a means of sustenance.

1.7.1 INDIGENOUS METHOD OF FISHING

Since the time of our forefathers, several devices were used to catch fish; for small catches a low dam were built across the river to raise the level of water upstream or regulate its flow or an enclosure of stakes were set in a stream as a trap for fish were used. Community fishing is also very common but in the earlier days, use of temporary poisonous tuber known as ‘Merr-sung’ (*Engelhardtia spicata* Bl), ‘Arrh’ (*Diospyros undulate* Dc),’Sulee’ (*Milletia cinerea* Benth), were commonly used for catching fish, “which are thrashed and pounded and spread out in the stream thereby causing temporary loss of sense to the fishes and it compels them to come out from the depths of the rivers

and flounder above. Walnut leaves were also used to temporarily poison the river"[8]. These indigenous methods of catching fish do not incur much damage to the diversity of fish species.

Nowadays excessive use of lime, batteries, explosives etc for fishing especially in the urban areas has caused total damage to all these valuable diversity on a long term course. Use of gadgets especially batteries are harmful to aquatic ecosystem as they contain heavy metals like cadmium and mercury. When batteries are carelessly used in the rivers for fishing, the heavy metals may leak into the ground. These contributes to soil and water pollution and endanger not only the aquatic life but the entire wildlife as the animals come to the rivers for drinking, it also affects humans through food chain by consuming the poisonous fishes and other organisms found in the river ecosystem, besides people living downstream will be affected as well. One organic form of mercury like the methyl mercury is of particular concern because it can build up in certain fish. When animals and birds including man consumed the contaminated fish, they will be exposed to either inorganic or organic mercury risking permanently damage to brain, kidneys, and developing fetus.

4.7.2 LOSS OF VARIOUS BIO-RESOURCES DUE TO OVER EXPLOITATION

In addition to this, malpractised in the river ecosystem results in the loss of aquatic resources for instance marshy crocodile or the fresh water crocodile or the Muggar (*Crocodylus palustr*is), Land tortoise (*Chelone imbricata*) etc which are found especially in the Changkikong, Lanpangkong, Japukong and Tzurangkong ranges have been

8. Mokokchung District Gazetteer, Nagaland; 1979, page 79, 80

depreciated in their numeral because of over harvesting for illegal trading in the black market as they are believed to possess certain medicinal values. The growth of over-exploitation of these valuable Bio-resources in the region are due to ignorance and compulsions for survival. Mokokchung district which is known for diversities of frog species like the Malabar Gliding Frog (*Rhacophorus malabaricus*, Jerdon), Giant Tree Frog (*Rhacophorus maximus*, Gunther), Himalayan Torrent Frog (*Amolops marmoratus*, Blyth), Skittering Frog *(Euphyctis cyanophlyctis*, Scneider) is declining due to excessive exploitation.

"More than 20 species of wild plants having an actual or potential medicinal value, such as *Coptis teeta, Dioscorea deltoidea, Drosera sp, Qaphiopedilum drurui, Racevolfia serpentine* and *Saussurea lappa* are believed to be extinct or facing extinction. "Sweet Flag (*Acorus calamus*), which was found in Kashmir, Manipur and Nagaland only a few years ago is now being imported to meet the medicinal demand in the country." [9]

Our substantial Biodiversity have been abused where diversities of orchids, rhododendrons, beautifully coloured begonias, variety of tree ferns, ground ferns, mosses, creepers and vines which have potential use to serve different purposes have been depreciated in the name of overexploitation. Herbs like the 'Tsungrempang mozu' (*Cissampelos pareire* L) which is used for treating body ache, burns, stomach troubles and most importantly believed to have magical power to ward out evil spirits are also threatened due to over harvesting. Different species of hornbills, common pea fowl (*Pavo*

9. K.C. Agrawal: Wildlife of India, Conservation and Management; 2000, page 4

Cristactus), Roseringed Parakeet (*Psittacula Krameri*), Large Indian Parakeet (*Psittacula Eupaoria*), Indian Great Horned Owl (*Bubo Bubo*), Hoopoe (*Upupa Epops*), Racket Tail Drongo (*Dicrurus Paradiseus*), Crow Billed Drongo (*Dicrurus Annectans*) etc have been particularly exploited for their beautiful features used as ornaments in various ceremonies and feasts. Wild elephants, wild pigs, bears, barking deer, leopards, tigers, stags etc has been exploited for their heads as trophies and because of their related economic value fetching whopping prices in the black market. As such utilizing has often been the prelude to extinction, over harvesting has drastically reduced the population size of all species of Biodiversity. If these mechanisms are not regulated, all these valuable species will be driven to extinction.

Mokokchung district have abundant varieties of wild fruits like the wild mangoes, gooseberry (*Emblica officinalis*), crab apples, figs (*Ficus Cunia*), Fig (*Ficus Auriculata*), lime, oranges, raspberries *(Rubus Ellipticus*), strawberries, cherries etc. Wild fruits have contributed as a vitamins supplement for the rural people, and plays an important role in economic income. Besides, walnut *(Juglans Regia*), Naga Tenga (*Rhus Semialata*), Naga Peanut (*Fermiana Colorata*), Wild jackfruit or Sam (*Artocarpus chaplasha),* etc which are abundantly found and enriching the Biodiversity of the district is soon vanishing due to overharvesting.

Another reason for surplus exploitation is the prevailing ethno botanical knowledge among the Nagas. Though its practiced is highly praiseworthy but at the same time injudicious utilization of valuable herbs, shrubs and plant species and animal's product for this purpose has paid the cost of its extinction. Bio-diversity and its resources have

been or are used as wild food, agricultural crops for construction of houses, modes of transportation, or as baskets, pottery, art, as clothing, weaving as medicines and alternative methods of healing, and in the context of cultural myths and religious ceremonies, unfortunately their advantages are misused and overused in the recent years.

Since ancient times, Naga forefathers have been dependent on plants and animals for their existence and for meeting their basic amenities; they have always lived in symbiotic relationship without disturbing their ecological balance of the surrounding environment. Especially various plant species were used by the tribal people which were derived from natural plant parts or plant producers to treat and prevent illness. This form of practice has been existing since ancient times and is still flourishing today as the primary form of medicines.

Overexploitations of bio-resources have arisen because of dependence on various medicinal purposes associated with certain plants and animal's product for treating various sickness and diseases, especially herbal medicinal remedies have been in high demand because of its higher potency and because of its easy accessibility. Butea Minor, Indian Pennywort (*Centella Asiatica*), Curculigo Capitulata, Common Buckwheat (*Fago-Pyrum Esculentum*), Houttuynia Cordata, Mejanker (*Litsea Citrata*), Naga-Tenga (*Rhus Semialata),* Raspberry (*Rubus Ellipticus*), Lhinetta (*Swertia Chirayita*), Thalictrum sp, Parmar (*Zanthoxylum Alatum*), etc are some local plants which have been over exploited.

Bamboo and cane highly regarded as wealth in the Ao- Naga society is soon declining. In the recent years, bamboo grooves are destroyed to make way for cultivation, plantation of tea, coffee, rubber etc. Bamboo species particularly *Dendrocalamus Hamildonit, Arundina hirsute, Bambusa ballooa, Bambusa tulda* etc is highly favoured for its superior quality materials in different cottage industries with the coming up of agro-based industries in the region, even the young bamboo shot are over exploited for food.

Indigenous economic plants like the turmeric (*Cucurma aromatic,* L), ginger (*Zingiber officinale*), pepper (*Piper nigrum*), Cardamom (*Elettaria cardamomum,* L), lemon grass and citronella *(Cymbopogon citrates* and *Cymbopogan spp*), taro (*Colocasia spp*), yam (*Dioscorea spp),* passion fruit *(Passiflora edulis*) etc are also neglected and exploited which otherwise may proved to derived good monetary income if managed properly. Indigenous plants having high economic value like the Mundani (*Acrocarpus Fraxinifolius*), Coral Tree (*Havenia Dulcis*), Tita Chapa (*Michelia Champaca*), Bhola (*Morus Laevigata*), Bonsum (*Phoebe Goalparensis*), Needle tree (*Khuzhuli Ghas*), Rattan cane (*Calamus Tenius*) Yew *(Cephalotaxus Griffiithii*), Udal (*Sterculia Villosa*), Nettle Tree (*Trema Orientalis*) , Dudhi (*Wrightia Tomentosa*), Mechinga (*Zanthoxylum Acanthopodium*) etc are also largely harvested for timber, plywood, fire fuel, as spices, fiber, for fodder, furniture, as ornamental purposes, constructions of buildings, woodworks and wood carving from trees have been associated with the Ao-Naga people since time immemorial. All these species of Biodiversity having economic and medicinal importance are getting lost due to overharvesting by various human activities in the name of bringing welfare to the society. Sadly, the extinction of primates in many forest of the district is also due to over exploitation for their skin or other body parts, and even the blood to produce various kinds of medicines and also for ornamentation.

Trading in the bones and skins of tigers fetch whopping price in the black markets virtually putting a serious threat in their survival. Elephant (*Elephas maximus*) is mainly hunted and exploited for its tusks than meat in the region putting it in the endangered species list not only in the district but all over the country as well. Poaching for ivory is responsible for drastic decline in elephant population, though strict traditional laws and regulation had been laid down particularly against poaching of elephants where punishments with a penalty of Rs. 1 lakh are imposed in the Longpayimsen village under Tsurangkong range, and many villages in the district have followed suit to combat such illegal practices.

4.8 BIODIVERSITY STATUS OF MOKOKCHUNG DISTRICT

Unethical practices and activities has resulted the Biodiversity of the region to decline. The table given below shows the present status of Biodiversity in Mokokchung district. There are 3 endangered species and 4 extinct **primate species**; 20 vulnerable species, 29 endangered species and 5 extinct **bird species;** 7 vulnerable species and 14 endangered **animal species;** 2 vulnerable species and 2 endangered **reptiles species;** 2 vulnerable species and 2 endangered **lizard species;** 2 vulnerable species and 3 endangered **skink species;** 6 vulnerable species and 2 endangered **snake species;** 6 vulnerable species and 2 endangered **amphibian species;** 1 rare species, 14 vulnerable species and 15 endangered **floral species;** 12 rare species, 7 vulnerable species and 19 endangered **large and medium tree species.**

TABLE: 4.6 PRIMATES

ENDANGERED SPECIES	**Slow Loris** (*Mycticebus coucang*), **Assamese Macaque** (*Macaca assamensis*), **Phayre's leaf monkey Trachypithecus** (*Trachypithecus)phayrei*) etc.
TOTAL	**3**

EXTINCT SPECIES	**Capped Languour** (*Trachypithecus* or *Trachypithecus pileatus),* **GoldenLanguour** (*Trachypithecus* or *Trachypithecus geei*), **Stump-tailed Macaque** (*Macaca arctoides*), **Howling Monkey** (*Mycetes*) etc are extinct **since 1990** in the **Ongpangkong** and **Asetkong range**.
TOTAL	**4**

(Source: Field Survey 2009-2013)

TABLE: 4.7 BIRDS

VULNERABLE SPECIES	**Heart spotted Woodpecker** (*Hemicircus Canante),* **Grey Headed Woodpecker** (*Picus Canus),* **Black Backed Woodpecker** (*Chrysocolaptes Festivus*), **Great Black Woodpecker** (*Dryocopus javensis*), **Large green Barbet** (*Megalaima Zeylanica*), **Great Indian Himalayan Barbet/Great Barbet** (*Megalaima Virens*), **Lineated Barbet** (*Megalaima Lineata*), **Red vented Bulbul** (*Pycnonotus cayer*), **White cheeked Bulbul** (*Pycnonotus Leucogenys*), **Red whiskered Bulbul** (*Pycnonotus Jocosus*), **Black Bulbul** (*Hypssipetes Madagascariensis*), **Rufous bellied Babbler** (*Dumetia Hyperythra*), **Common or Grey Quail** (*Coturnix Coturnix*), **Blue Breasted Quail** (*Coturnix Chinensis*), **Red Jungle Fowl** (*Gallus Gallus*), **Common Pea Fowl** (*Pavo cris Tatus),* **Green Fronted Green Pigeon** (*Treron pompadora*), **Hooded or Greenbreasted Pitta** (*Pitta sordida),* **Emerald or Bronzedwinged dove** (*Chalcophaps indica),* **Brown headed Storkbilled kingfisher** (*Pelargopsis capensis*)
TOTAL	**20**
ENDANGERED SPECIES	**Indian Bay Banded Cuckoo** (*Cacomantis Sonneratin*), **Grey wagtail** (*Motocilla cinerea*), **Red legged or Amur falcon** *(Falco amurensis*), **White –eyed buzzard** (*Bustator Teesa*), **Chested headed Bee-eater** (*Meoops Leschenaulti*), **Imperial Eagle** (*Aquila Heliaca*), **Laggar Falcon** (*Falco Biarmicus Jugger),* **Sand lark** (*Calandrella Raytal),*

	Swallow (*Hirundo Rustica),* **Racket-tailed drongo** (*Dicrurus Paradiseus*), **Crow billed drongo (***Dicrurus Annectans***),** **Hill Myna** (*Gracula Religiosa*), **Bank Myna** (*Acridotheres Ginginianus),* **Yellow billed blue Magpie** (*Cissa flavirostris),* **Fairy bluebird** (*Irena Puella),* **Black headed yellow Bulbul** (*Pycnonotus Melanictterus),* **Forest eagle-owl/spot bellied eagle owl** (*Bubo nipalensis),* **Indian Great Horned Owl** (*Bubo Bubo),* **Grey peacock pheasant** (*Polyplectron bicalcaratun),* **Grey partridge** (*Francolinus pondicerianus),* **Kaleej pheasant** (*Cophhura leucomelenos),* **Crimson breasted barbet or coppersmith** (*Megaliana haemacephala),* **Common pariah kite** (*Milvus migrans govinda),* **House swift** (*Apus affinus*. cliffs), **Hoopoe** (*Upupa Epops*), **Pin Tailed Green Pigeon** (*Treron Apicaulda*), **Blue Rock pigeon** (*Columbia livia*), **Ashy wood Pigeon** (*Columbia Pulchricollis*), **Rosecringed Parakeet** (*Psittacula Krameri*)
TOTAL	**29**
EXTINCT SPECIES	**Rufous Necked Hornbill** (*Aceros nipalensis*), **Malabar Grey Hornbill** (*Tockus griseus*), **Indian Pied Hornbill** (*Anthracoceros Malabaricus*), **Great Pied Hornbill** (*Buceros bicornis*), **WreathedHornbill** (*Rhyticeros undulates*) etc are extinct in some forests of **Chuchuyimpang, Ungma,Mopungchuket, Longjang** and **Debuia** villages since 1990.
TOTAL	**5**

(Source: Field Survey 2009-2013)

TABLE: 4.8 ANIMALS

VULNERABLE SPECIES	**Mithun** (*Bos frontalis*), **Squirrel** (*Funambus),* **Otter** (*Lutra*), **Lemur** (*Lemur catta*), **Wild boar** (*Sus crestatus),*

	Mongoose (*Herpester bengalensis),* **Sloth** (*Bradypus)*
TOTAL	**7**
ENDANGERED SPECIES	**Elephant** (*Elephas maximus.* Linnaeus), **Royal Bengal Tiger** (*Panthera tigris),* **Leopard** (*Panthera pardus*), **Bat** (*Rhnolophus*), **Pangolin** (*Manis tricespis),* **Mole** (*Tulpus),* **Porcupine** (*Hystrix bengalensis*), **Macaque** (*Macala mulatta),* **Dingo** (*Canis dingo*), **Wolf** (*Canis lupus),* **Spotted deer** (*Axis axis*), **Parking deer** (*Cervulus muntjac),* **Jungle cat** (*Felix chaus*. Guldenstaedt), **Sloth bear** (*Sclenarctos*)
TOTAL	**14**

(Source: Field Survey 2009-2013)

TABLE: 4.9 REPTILES

VULNERABLE SPECIES	**Batagur Terrapin or River Terrapin** *(Batagur baska),* **Land Tortoise** *(Chelone imbricata)*
TOTAL	**2**
ENDANGERED SPECIES	**River crocodile** *(Crocodylus palustris),* **Olive Ridley Turtle** *(Lepidochelys olivacea. Eschscholte)*
TOTAL	**2**

(Source: Field Survey 2009-2013)

TABLE: 4.10 LIZARDS

VULNERABLE SPECIES	**Common Indian Toad** *(Bufo melanostictus.* Schneider), **Salamander (***Ambystoma maculatum)*
TOTAL	**2**
ENDANGERED SPECIES	**Malabar Gliding frog** *(Rhacophons malabaricus.* Jerdon),

	Himalayan torrent frog *(Amolops marmoratus.* Blyth), **Skittering frog** *(Euphlyctis cyanophlyctis*. Schneider)
TOTAL	**3**

(Source: Field Survey 2009-2013)

TABLE: 4.11 SKINKS

VULNERABLE SPECIES	**Little skink** *(Mabuya macularia*. Blyth), **Common or Brahminy skink** (*Mabuya carinata.* Schneider))
TOTAL	**2**
ENDANGERED SPECIES	**Burmese glass skink** *(Ophisaurus gracilis),* **Snake skink** *(Lygosoma punctatus*. Beddome), **Himalayan skink** *(Asymblepharus ladacensis Himalayanus*. Gunther)
TOTAL	**3**

(Source: Field Survey 2009-2013)

TABLE: 4.12 SNAKES

VULNERABLE SPECIES	**Common worm or blind snake** (*Ramphotyphlops braminus),* **Blind snake or Diard's worm** *(Typhlops diardii.* Schlegal*)* **Common kukri snake** (*Oligodon arnensis.* Shaw), **Golden tree or Glidding snake** (*Chrysopelea ornate.* Shaw)), **Albino Indian cobra or Indian cobra** *(Naja naja*. Linn), **King cobra or Hamadryad** (*Ophiophagus Hannah.* Cantor)
TOTAL	**6**
ENDANGERED SPECIES	**Indian python** *(Python molurus. Linnaeus),* **Python** *(Python reticulates)*
TOTAL	**2**

(Source: Field Survey 2009-2013)

TABLE: 4.13 AMPHIBIANS

VULNERABLE SPECIES	**Common Indian Toad** *(Bufo melanostictus)* (Schneider) **Giant tree frog** (*Rhacophorus maximus*) (Gunther) **Himalayan torrent frog** (*Amolops marmoratus)* (Blyth) **Skittering frog** (*Euphlyctis cyanophlyctis*) (Schneider)
TOTAL	**6**
ENDANGERED SPECIES	**Salamander** (*Ambystoma maculatum*) **Malabar Gliding frog** (*Rhacophons malabaricus*) (Jerdon)
TOTAL	**2**

Source: Field Survey 2009-2013

TABLE: 4.14 FLORAL SPECIES

RARE SPECIES	**Rhododendron** (*Rhododendron arboretum*,Sm) found at Longkhum village,
TOTAL	**1**
VULNERABLE SPECIES	**Sensitive Plant** (*Mirabilis Jalapa*. Lin), **Great Burdack** (*Arctium Lappa*. Linn), **Lantana** (*Lantana camara*. Linn), **Crab's eye** (*Abrus precatorius.* Linn), **Mountain ebony** (*Bauhinia variegate.* Linn), **Traingular Milk Wort** (*Euphoria Antiguoron*), **Four O'Clock** (*MeraBillsJalap*a. Linn), **Live Forever** (*Bryophyllum Pinatum*. Linn), **Chestnut** (*Castanea Sativa*. Linn), **Sugar Cane** (*Saccharum Officinorum*. Linn), **Sun flower** (*Hellanthus annuus*. Linn), **Mugwort** (*Artemisia Vulgaris*. Linn), **Blessed Thistle** (*Cnicus benedicus*. Linn), **Thorn apple** (*Datura innoxia*. Mill)
TOTAL	**14**
	Bowstring Marul (*Sanseviria Zeylanica*.Web), **Poinsettia** (*Euphorbia Pullherrima*), **Poppy Plant** (*Papaver Somniferum),* **Cotton**

ENDANGERED SPECIES	(*Gossypium Herbaceum*. Linn), **Sweet Gum** (*Liquidambar Herbaceum*. Linn), **Sage** (*Salvia Officinalis*), **Wild Apple** (*Feronia Lemonia*. Linn), **Madasgagar periwinkle** (*Catha Ranthus*), **Holy plant** (*Alex Aquifolium*), **Blue Flag** (*Iris Versicollor*. Linn), **Century Plant** (*Agava Americana*), **Hibiscus** (*Hibiscus*), **Sweet flag** (*Acorus calamus*. Linn), **Mexican poppy** (*Argemone Mexicana*. Linn), **Sacred lotus** (*Nelumbium speciosum*.Willd),
TOTAL	**15**

Source: Field Survey 2009-2013

TABLE: 4.15 LARGE AND MEDIUM TREES

RARE SPECIES	*Strobilanthes flacculifolius Nees***, Alder** (*Alnus nepalensis*), **Naga Tenga** (*Rhus semialata*)**, Naga neem** (*Spondias axillaries*)**,** *Engelhardtia spicata***,** *Persea fructifera Kost, Spondias pinnata, Tetrameles nudiflora, Livistonia jenkinsiana, Spondias pinnata,* Sterculia hamiltonii (*Rhus acuminate* DC*),* *Persea fructifera Kost*
TOTAL	**12**
VULNERABLE SPECIES	**Amla (***Embilica officinalis.*Gacerth**), Semul** (*Bombax cuba*)**,** **Harra (***Terminalia chebula***.** Gaertn Retz)**,** *Artocarpus lakoocha* Roxb**,** *Canarium resiniferum* Brace ex.King**,** *Castanopsis indica* A D C, **Gahori sopa** (*Magnolia griffithii* Hk.f.& Th)
TOTAL	**7**
ENDANGERED SPECIES	**Nahor** (*Mesua ferrea*)**, Tita sopa (***Michelia champaca*), **Hollong** (*Dipterocarpous)***,* **Makai** (*Shorea assamica),* **Mundani** (*Acrocarpus fraxinifolius***), Owtenga** (*Dillenia indica),* **Coral tree (***Hovenia acerba*), **Satiana/Devil tree** (*Alsstonia scholaris,*Wall*),* **Korio** (*Albizzia procera***), Sam** (*Arto carpus chaplasha*), **Walnut** (*Juglans regia*), **Soap berry** (*Sapindus rarak*), **Paroli** (*Stereospermum chelonoides* DC), **Amari** (*Almora wallichi),* **Gomari** (*Gmelina arborea*), **Ajar** (*Largerstroemia flos-reginae),* **Bonsum** (*Phoebe goalparensis*), **Bogi poma** (*Chickrassia tabularis),* **Jatipoma** (*Cedrella toona)*
TOTAL	**19**

Source: Field Survey 2009-2013

Bio-diversity status in Mokokchung district was very rich before the advent of modern civilization. This can be accounted from the writing of Mrs. Clark in her book (‘A Corner in India’ P.29). “Our route, was simply a Naga trail, first across the lowlands where grow in such profusion the tail feathery waving bamboos intertwined and interlaced, forming pretty fantastic arbours across our path and not infrequently necessitating the cutting of our way. On and on we went, up and down, through forest of stately trees, with delicate creepers entwining their giant trunks, their branches gracefully festooned with vines and orchids swaying in the breeze.” **10**

Biodiversity contributes directly or indirectly to many aspects of human well-being, for instance by providing raw materials and contributing to health. Over the past century, many people have benefitted from the conversion of natural ecosystems to agricultural land and from the exploitation of Biodiversity.

However, these changes have increased poverty among some social groups. Factors such as habitat change, climate change and a growing population and consumption will continue to cause losses in Biodiversity and changes in ecosystem service at the present pace or even faster if such activities are not checked and abated. Many of the actions that have been taken to conserve Biodiversity and promote its sustainable use have been successful in limiting Biodiversity loss.

10. M.M Clark: A Corner in India; 1978, page 37

Overall the losses are now occurring more slowly than they would have in the absence of these actions taken by communities, NGO's and various governmental departments. To achieve greater progress towards Biodiversity conservation, it is necessary to strengthen a series of actions that focus primarily on the conversation and sustainable use of Biodiversity and ecosystem services. Unprecedented additional efforts would be needed to achieve significant reduction in the rate of Biodiversity loss at all levels at the earliest.

Many of the biotic and the abiotic resources to which man have free access such as clean water, clean air, wildlife, aquatic resources etc are not to be taken for granted. Everyone has the opportunity to judiciously utilize and preserved these assets because once these valuable resources are left neglected, it can be easily overharvested or converted to non-renewable resources inviting uncalled tragedy. It is in our hands to avoid the tragedy of overconsumption and abuse of these vital resources by upholding these indispensable lives supporting system of Biodiversity by diverting our thinking from a self-centered viewpoint to broader perspectives.

The fifth chapter entitled **'Impact of Biodiversity on environment in Mokokchung district'** deals with the impact of Biodiversity on the physical, cultural and socio-economic front. This chapter reflects Biodiversity's influence particularly on agriculture, health, tourism, as well as culture, traditional knowledge and religion etc of the people in the study areas.

CHAPTER-5

IMPACT OF BIODIVERSITY ON ENVIRONMENT IN MOKOKCHUNG DISTRICT

5.1 INTRODUCTION

Biodiversity, the variety of diverse life forms is immensely vital for all life activities both in terms of physical and social environment. Its functional role in maintaining the quality of environment aiding to the essential well-being for all organisms is crucial for all lives on the earth. The impact of Biodiversity on the physical environment takes into account all the external, tangible surroundings in which an organism exists and which can influence its behaviour and development like the landforms, soil, climate, vegetation etc. Its participation in controlling of air, water and soil pollution, soil conservation, detoxification of waste, stabilization of earth`s climate, restraining flood, climate change, weather and other climatic elements etc is so important which has both material and intangible values to mankind.

On the other hand, the influence of Biodiversity on the social environment also known as the milieu is the identical or similar social positions and social roles as a whole that influence the individuals of a group. The social environment of an individual is the culture and society where an individual lives in and the institutions with whom an individual interacts. Biodiversity provides a better scope for reproduction and maturity of life forms which in return makes it capable to furnish all life forms with indispensable services. These valuable services bear a direct impact on our environment, which have proved to benefit human development in the long run.

5.2 BIODIVERSITY AND THE LOCAL COMMUNITY

The contribution of Biodiversity towards the indigenous traditional knowledge, culture, spirituality, agriculture, eco-tourism and health in the Ao-Naga society is significantly evident. Indigenous knowledge particularly on agriculture, traditional medicine and healing diffuse a wide control of the indigenous people's interest and require to construes it correctly in the context it is used. Indigenous knowledge of the Ao- Nagas on all these fields is something native evolving, persisting and practicing for centuries and had passed on orally from generation to generation. All these numerous services yielded by Biodiversity influences the local community in everyday activities in a direct and indirect way, some of which are discuss in brief.

5.2.1 BIODIVERSITY AND AGRICULTURE

Agriculture is the central activity of the Ao-Naga society. Biodiversity directly influences the food security in several ways as the local communities relies on it as an insurance even during famine and failure of harvest; Ao-Naga forefathers survived on wild indigenous yam (*Dioscorea bulbifera*), *Colocasia esculenta (*Manu/ Ami*)* as an alternative food source. The ecosystem functions rendered by Biodiversity are critically important to agriculture-the sole sustenance for the tribal Naga population. Agriculture is dependent completely on the process and functions of ecosystem, including soil formation, recycling of nutrients, maintenance of hydrological cycle, crops pollination and so on which are initiated by interactions between all the elements of Biodiversity. Biodiversity reflects the potential of sustainable agriculture aiding agriculture for the better crop diversity by enhancing the quality of nutrition by contributing more chance to fight against malnutrition and other health problems.

Most of the land-use in Mokokchung district is through agriculture. A dominant practiced since time immemorial is playing a pivoted role in the contribution and dynamism of plants and animals species. The topography of Mokokchung district is largely made up of rugged terrain, steep slopes, with high hills and ranges. More than 80% of the total cultivable land is hilly supporting mainly jhumming. Water scarcity in the district do not encourage other alternative farming like terracing and wet paddy farming except along the gentle slopes that spread over the foothills and valleys lying close the bank of Rivers Milak, Tsurang and Tsula where terracing and wet paddy cultivation are carried out.

Every farmer knows that maintenance of soil fertility is the foundation of all agriculture. Use of fertility and chemicals may enhance soil fertility and benefit for a short time but the risk of soil acidification, salinization, compaction, loss of structure (and therefore water infiltration) and soil erosion in the long term is a huge price to pay for. The bottom line of all these problems is the loss of soil Biodiversity- the loss of `free' ecosystem services that Biodiversity provides. Soil harbours millions of micro-fauna (nematodes protozoa), earth worms and termites etc which plays a vital role in contributing towards a wealthy Biodiversity. Agriculture will be almost impossible without soil, as greater part of Biodiversity in agricultural landscapes occur in the soil. The millions of organisms creating this enormous collection of thousands of diverse species are exceedingly active in burrowing, moving soil around, ingesting it and mixing it with their intestinal juices before defecating it, consuming decayed dead roots and waste absorbing hard-to- get at-phosphates and performing a multitude of additional soil farming processes. Soil pores irrespective of their sizes are all biologically determined and soil pores take part in a major role in the

water penetration properties of soils, and in determining such things as bulk density and water- logging without the soil biota nitrogen would not be mineralized, and under reduced soil biodiversity, soil fertility declines swiftly and noticeably.

Traditional agriculture practices like jhumming have significantly contributed to the loss of Biodiversity adversely affecting the natural environment. It involves the activities of massive deforestation, clearing of forests, burning and often introduction of alien species and use of chemical and common salts. Salt accumulation loosens the soil promoting soil erosion, soil organisms like earthworms, leeches and other micro-organisms which are pivotal in soil fertility are made to disappear resulting in a negative impact on the physical and socio-economic activities.

Land use in the region is undergoing massive transition which is taking place rapidly with numerous cases which were formally or currently under jhumming are being converted into other land-uses for permanent farming, commercialization of fruits, plantation of tea, coffee and rubber, forest plantation, reforestation etc which are driven by genuine needs for economic benefits, provision for livelihood, ecosystem services, Biodiversity and environment protection and preservation.

As the mainstay of the people in Mokokchung district is traditionally dependent on agriculture, it is of paramount importance on the part of the local farmers to incorporate the

traditional agricultural practices with the management and protection of species that depend on agricultural land use, like for instance, the use of leguminous cover crops (velvet bean, rice bean and soya bean) as these crops have dense foliage and are grown mainly for cover and protection of soil, nitrogen fixation, soil fertility, conservation of micro-organisms and earth worm and maintaining soil temperature etc. Undertaking of such a small step can definitely aid conservation and restoration of Biodiversity in agricultural areas.

Agriculture will always be the way of life deeply interwoven with the Ao- Naga culture and traditions. In the present scenario the rapid population growth in the district has made it indispensable for rapid expansion of agriculture not only to achieve self reliance for household food security but also to bring about equity in distribution of income and wealth resulting in reduction of poverty levels.

One recent trend of agricultural practiced in the district is the land- use transition, taking place at a fast pace where most of the forest land are transformed into other land uses particularly into plantation crops like tea, coffee and rubber etc, commercialization of fruits namely orange, banana, pineapples, crops like tapioca (Alishi). Tapioca cultivation at Mopungchuket village alone under Mokokchung district was carried out to a total area of 1885 ha in 2006 which increase to 2035 ha in 2007 (**Agri Land News letter, Nov 2007)**. These new systems of agriculture have taken place at the expense of the traditional small holding practices; most of these transitions are driven by economic interests. The impacts of this transformation are manifold wherein Biodiversity and its resources have been severely

hit upon, affecting the provision of ecosystem services and environmental maintenance thereby influencing local livelihood. At the same time the large scale conversion of forest land into plantation areas especially in the Tuli- Wameken, Longjang areas has reduced several species almost to the point of no return increasingly bringing changes in the weather and climate conditions.

The replacement of traditional agricultural system by monoculture in many parts of Mokokchung district have caused in the decline of Biodiversity. There is also a concern that replacing traditional agricultural practiced of jhumming by monoculture will lead to the extinction of indigenous wild plants and herbs like 'Mong mong' (*zanthoxylum oxyphyllum*, Edgew*)* and 'Emrem' (*Clerodendrum colebrookianum)* as these indigenous species are grown side by side with jhum crops.

Monoculture practiced carried out usually in large acres of land have threatened the traditional land management as these encouraged deforestation and unsustainable agricultural production as it evolves from capitalist economics that emphasized on money profit and market value. Moreover, practiced of monoculture normally in the likes of planting teak, gamari, agar etc for commercial resource use have caused loss of habitat and species of the deciduous and semi-evergreen forests as these forests are the predominant forests in the district. This practiced also caused the erosion of our indigenous ecological knowledge including traditional skills and practices, loss of livelihood, conflict and erosion of our cultural identity that are associated with these pristine forests.

Commercialization and monoculture could threaten the traditional practiced of agricultural management which affects the loss of traditional diet and knowledge of famine food like *Dioscorea bulbifer* (yam), *Colocasia esculenta* etc. Commercialization and monoculture normally carried out by rich individuals have reduced communal cohesion and common sense of ownership, leading to lack of local support for conservation. With this trend there is high probability of many farmers losing their land as monoculture and plantation farming are generally undertaken on large scale land where the Government is interested to provide aid only to those individual leasing large acres of land.

Introduction of alien species like eucalyptus, Lantana, water hyacinth, Goat weeds, (*Ageratum conyzoides*), Hemp weeds (*Mekania mecrantha*), Great plantain (*Plantago major)* etc do not have a balanced relationship with indigenous plants, so they may overgrow and grows out natural species. They grow and rapidly multiply upon finding favourable environment then they block the growth of endemic vegetation and reduce its cover; they inhibit the growth of useful endemic plants. There are also no natural enemies to curb their rapid growth, their roots, fruits and leaves are non edible to endemic animals. Over the years Mokokchung district have undergone drastic changes in the land use with deforestation, urbanization and its related development and agricultural intensification as the chief agents, loss of wild species is conspicuous making it very imperative and urgent to protect the local Biodiversity by keeping up pace with the dynamic socio-cultural-front.

As jhum is the dominant type of cultivation practiced in the district, it can neither be replaced by an alternative system nor can be stopped outright. Jhum is still necessary as it assures a measure of food security for most of the local populace in an economically sensitive and hilly terrain like Mokokchung district, where application of modern technologies has limitations. Jhum on the other hand, is the base for development and application of low input technologies like 'low external agricultural input technology'. This existing system can be improved to make it more productive and sustainable through intensification by introduction of cover crops and proper fallow management. Fallow period in jhum cycle can be increase by planting fast growing alder tree and multi-purpose economic and also planting of shade loving and medicinal plants under the canopy. As trees are jhum crop, planting more tree-crop will do no harm, in fact integrating of crops, trees and fodder will helped utilized different soil depths, space and light efficiently and at the same time conserve soil and water and improve site condition.

Farm forestry can also be an alternative method of farming; the practiced of sustainable land management system through forestry practices on the farmer's farm and village lands integrated with other farm operations on the same unit of land, thus increasing the yield of the land. It also encourage to make villages self sufficient in their firewood and small timber demands, gives shelter to wildlife which would improve the natural environment and thus replenished the favourable effect on agriculture. As the agricultural products and bi-products besides medicines and supplements, nutrition, bio-chemicals, cosmetics and other wants and needs relies on Biodiversity, sustainable agriculture should be encouraged which can be

brought about by preserving Biodiversity and at the same time can be conducive towards human welfare.

An indigenous traditional agricultural practice like adopting the planting of indigenous trees like Alder (Alnus nepalensis) in the jhum field is an example of sustainable measures. 'The alder based jhum system is extremely important because it provides at least 57 food crops to supplement the rice staple grown in nearby wet terrace rice cultivation,' [1] where the growth of these cereals and green leafy vegetables are not possible in the Wet Terrace Rice Cultivation (WTRC). Planting alder tree improve the soil fertility by atmospheric nitrogen fixation in the soil enhancing crop yields and reducing soil erosion. This sustainable and productive system continues to potential good quantities of timber and fire wood for the Naga farmers.

In order to make the present agricultural system into a more sustainable oriented, subsistence agriculture can be promoted into organic farming with improvement on sustainable rain-fed farming under permanently developed rain-fed conditions. Organic farming that works in harmony with nature rather than against it. Organic farming does not necessarily mean going back to traditional methods; many of the farming methods used in the past are still useful today. These knowledge, techniques (use of legumes and green manures, crop rotation, increasing genetic diversity, recycling and use of composted crop waste and animal manure, careful planning and crop choice etc), and materials available are

1. Building upon Traditional Agriculture, NEPED; 1999, page 27

allow to work with nature thus creating a balance between nature and farming where crops and animals can grow and thrive. The aim in organic farming is not to eradicate all pests and weeds but to keep them down to an acceptable level and make the most of the benefits that it may provide. Incorporating the knowledge of practicing sustainable lifestyle is one solution to amend the damage already caused to Biodiversity and environment. As agriculture had and will continue to sustain the local population which have provide a range of consumer goods from ample diversity of fruits, vegetables, roots, tubers and nuts, fibers, fuels and timber, a sustainable agricultural practice should be implemented first and foremost.

5.2.2 BIODIVERSITY AND ECO-TOURISM

Biodiversity is associated with aesthetic value which is a magical elixir to mitigate environment degradation thus encouraging environment conservation at the same time sustaining the well-being of the local people by generating income from such industry. Eco-tourism is a recent social activity that is gaining momentum in Nagaland. Culture is the foundation of the Naga-society and eco-tourism along with culture and is needed to be conducted in a sustainable manner ultimately improving to social impoverishment. As more exotic location is in much demand as a tourist destination particularly places having a high degree of Biodiversity. Mokokchung district have many places where there is relatively high concentration of Biodiversity wealth in the villages like Longkhum, Aliba, Mopungchuket, Longjang, Tuli, Changtongya, Longpayimsen, Japu, Changki, Debuia etc. These regions have many virgin forests adorned with many species of rare and exotic birds, animals and plants including orchids.

The numerous rivers, streams and rivulets like the Milak, Dikhu, Tsurang, Tsurong, Menung etc which are rich in aquatic ecosystem also aid in eco-tourism. Birds like the Grey Peacock Pheasant (*Polyplectron bicalcaratun*), Roseringed Parakeet (*Psittacula Krameri),* Large Indian Parakeet (*Psittacula eupatria*), Common Peafowl (*Pavo cristatus),* Rufous necked Hornbill *(Aceros nipalensis*), Wreathed Hornbill (*Rhyticeros undulates*), Malabar Pied Hornbill (*Anthracoceros coronatus*), Indian Pied Hornbill *(Anthracoceros malabaricus*) etc are found in many forests of Mokokchung providing scope for bird sanctuary.

Changtongya and Yaongyimsen forests and its vicinity is well known for the migration of Amur falcon in terms of millions, this bird species migrate from parts of northern Siberia and Europe and rest in these forest before they set for their destination to spend the winter. Besides, there are numerous animals' habitats and especially elephant migration route from the north bordering Assam to South-West of Mokokchung via the Changki valley. These regions could serve as an eco-tourism spot through proper management, providing standard logging and boarding, provision for sight-seeing with watch towers could greatly help to boast eco-tourism. Eco-tourism is locally practiced at Longkhum village (Ongpangkong), Mopungchuket village (Asetkong), Chuchuyimlang and Changtongya villages (Langpangkong) which are supported by the Tourism Department, Government of Nagaland.

Eco-tourism has potential for generation of income, wealth and employment and will help in the sustainable development of remote areas, for instance Mongchen, Debuia, Waromong

(Changkikong range); Tuli, Changtongya, Mongsenyimti, Chuchuyimlang, Molungyimsen (Langpangkong range); Longkhum, Longsa, Aliba (Ongpangkong); Mopungchuket, Longjang (Asetkong), Longpayimsen, Aosenden (Tzurangkong range); Changdang, Lirmem, Japu, Lakhuni (Japukong range) etc.

Progress in ecotourism creates more opportunity through proper planning for regeneration of natural resources, employment for the local community, generating awareness in the host community through minimizing the negative social influences and threats to the environment. In fact ecotourism can yield sustainable results only when the tourists, the service providers, the host community and authorities are well informed and prepared to harness tourism. A management plan for any sustainable ecotourism need to be prepared by a professional urban planner, in consultation with the local community which could also avoid inter-sectoral and cross-sectoral conflict.

With such ample potentials of untouched and authentic tourist destinations, Nagas are needed to be encouraged to maintained local traditions and developed sophisticated practices for sustainable exploitation of the environment. It is vital that sustainable approach on eco-system needed to be based on a strategy that protect and strengthen both natural and cultural diversities avoiding the clash of conservation and people influenced development. Integrating the right of the local communities to use and managed natural tourism is needed by ensuring that profits and benefits arising from eco-tourism related activities are used by the local populations and also for the conservation of Biodiversity.

Implementation of eco-tourism could provide potentials to preserve and enrich the local and indigenous cultures not only in the short term but also from a Trans generational long term perspectives. Local communities should be involved in integrating eco-tourism activities into self reliance projects by enhancing sustainable livelihood benefitting both the communities and Biodiversity. Such an approach could assess to ensure that any planned activities do not threaten or undermine the vulnerability of Biodiversity and the culture.

In order to make eco-tourism a successful industry particularly in Mokokchung district and in Nagaland in general, every individual should be sensitive towards the environment and the local traditions and needs to follow a set of guidelines for the successful development of ecotourism. Besides non-governmental organizations, scientific and research institutions could play a key role in the development of ecotourism in the region.

5.2.3 BIODIVERSITY AND HEALTH

The WHO defined health as a ‘state of complete physical, mental and social well-being not merely as absence of disease or infirmity’; hence health can be considered as wealth. Air and water are the two indispensable elements without which man cannot survive. This is an over simplification of the interrelationship with Biodiversity. We cannot imagine `health’ without a healthy Biodiversity. Health (physical, cultural and social) is greatly influenced by our surrounding environment. Any changed on Biodiversity can at the same time hamper and bring a negative impact on all forms of life including man.

When Biodiversity is destroyed or diminished, it will have an impact on the climate and weather conditions. All sources of water supply will be affected starting from rain water, springs, ponds, wells, lakes, rivers etc, badly affecting the local populous as water is the essence of life incurring upon famine and malnutrition. As everything is intertwined closely together, disturbance or changes in one element may lead to the change in another. Such conditions can put a high risk on the fundamental health conditions of Biodiversity and ecosystem.

Climate changes affect the availability of food, clean water, soil, atmosphere etc by creating conditions for the spread of infectious diseases. Climate change in the region have resulted in more heat waves (increase temperature), storms, droughts like situation etc that could lead to more accidents and death, spread of infectious diseases like malaria, filaria etc caused by high temperature and humidity besides a variety of diseases associated to respiratory systems. Illness and deaths from such diseases are expected to increase, especially in the elderly population.

Nagaland has witnessed an increased in summer temperature in the last few two decades resulting increasingly in the constant shift in weather pattern with extreme cold during winter season and warm season exacerbating the air, water and soil quality making it unsuitable for human health. Moreover, the progress of civilization, urbanization, developmental activities, and social components of man like his food habits, population growth have depleted the quality of air, water, soil etc that are essential to human health.

Numerous species of wild and domesticated plants, animals and birds along with varieties of fish species of the river ecosystem in the region are unfortunately exploited beyond the limit leading to serious decline in its quantity with serious implication on human health. Use of lime, chemicals and explosives, mining wastes carried downstream by rainwater in all the major rivers of Milak, Dikhu, Tsurang, Menung and their tributaries which flow along the district are facing severe condition as it increase the chance to proliferate the spread of vectors such as mosquitoes furthering the risk of exposing to many infectious diseases like cancer, food poisoning, dizziness though at the moment there are no official record.

Changes in Biodiversity influence all components relating to human well-being including health and as such human illness can be averted by a healthy ecosystems. To stay healthy, healthy Biodiversity is indispensable to provide food, clean water, breaking down and recycling of wastes. It is important that human health relating to Biodiversity be promoted through adequate education and motivation among the indigenous people through formally recognizing the role played by traditional medicine in primary health care provision especially for the rural and urban poor.

Biodiversity and health of the environment are intricately related and it is important that health and integrity of the local plants and animals community status be taken into account. Biodiversity and human health relationship has been manifested in the practiced of traditional medicine by using various plants and animals in the Ao- Naga culture since time

immemorial. A healthy relationship between human health and Biodiversity could be continued only through ensuring the persistent survival of the existing local Biodiversity.

Traditional medicine provides and continues to provide an important health care service to the local populace. Traditional medicine is defined as the sum total of knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures that are used to maintain health, as well as to prevent, diagnose, improve or treat physical and mental illness (WHO, 2008). The WHO estimates that 80% of the people in the world rely on traditional medicine for primary health care needs (Farnsworth, 1988).

Many of the plants and animal organisms used in traditional healing contains vital substances used as medicines like the *Butea minor, Centella asiatica, Curculigo capitulate, Fagopyrum esculemtum, Houltuynia cordata, Litsea litrata, Rhus semialata, Rubus ellipticus, Swertia chirayita, Thalictrum sp, Zanthoxylum alatum* etc to name a few, these plants are used for treating various ailments which are prepared by using mainly the decoction and infusion process. In the decoction method the herbs are boil for 15-20 minutes and the herbs are strain using a tea strainer, while in the infusion method, hot water are pour into the herbs and allow it to cool and finally strain using a tea strainer. These plants and herbs used in traditional healing are gathered from the wild and are also grown as crops in the jhum field.

Most of these plants used in traditional medicine are easily available and cheap, offering many benefits that conventional medicine lacks. The use of traditional medicine and healing has always been a way of life for the Ao-Nagas, one of its advantages is that the commonly used herbal medicines is safe and with no known side effect.

This practiced of traditional healing and medicine using varieties of diverse plant species reveal the hidden specifics reflecting the value of traditional driven indigenous knowledge. The diversity of species displaying its specific quality carries with it their functional genes for those traits, and need to be maintained at their native habitats which is associated with the Ao-Naga traditional and cultural practices since its inception. Ever since the Naga society came into being, Ao-Nagas have known the secrets of traditional healing where diversities of plants species with its herbs, tubers and barks are used for treating diseases and ailments. Even today more than 80% of the Naga community is dependent on traditional medicine and healing. Some of the examples given in the table below are used commonly even today as a panacea for treating sicknesses.

Table: 5.1 PLANTS USED IN TRADITIONAL HEALING

Local name	Scientific name	Medicinal uses
Zaklo	*Distemon indicum,Wedd*	The leaf after boiling is used for treating malaria.
Tinulemba	*Hypoxis aurea,Lour*	Tuber is used as antidote for snake bite.
Anitong	*Lantana camara, Linn*	The tender leaf is grounded into paste and is consumed.

		for treating diseases like allergic, cough, asthma, diabetic, arthritis, rheumatism etc.
Tsumenemla	*Paederia foetida*, *Benth*	The leaf is used for treating high fever and dysentery.
Rin/Aren	*Persea fructifera Kost*	Latex is used for treating boils.
Asong	*Garcinia pedunculata Roxb*	Fruit eaten for treating cough and diarrhea.
Tangmo	*Rhus semialata*	Powdered seed is used as antidote.
Sungerlikok	*Solanum myriocanthum Dunal*	Fruit used in treating toothache.
Nokna	*Houttuynia cordata, Thunb*	Whole plant eaten for skin disease, gastric, ulcer, blood purifier.
Tsungrempangmozu	*Cissampelos pareire L*	Plants used for treating burns, stomach troubles, to drive off evil spirit.
Longchokorok	*Centella asiatica (L) Urban*	Plant eaten for loose motion, blood purifier.
Nangpera	*Ocimum basilium*	Plants used for treating cold, food poisoning, stomach disorder, to drive off evil spirit
Mongozuno	*Ficus Glomerata*	Use in traditional medicine for treating cancer, piles, toothache etc.
Alo sangtsung	*Celose argentes*. Linn	Use for treating itching and tuberculosis

Kor	*Veratrum album*.Linn	Use for treating herpes, ringworm, cholera etc.
Yimra mozu	*Mentha spicata*. Linn	Use in treating cold, digestion etc.
Kutangah masupa ayi	*Bryophyllum pinnatum*.Lam	Use in treating piles, T.B and pneumonia etc.
Patio	*Piper Bettle*.Linn	Use in treating rheumatism, antiseptic etc.
Matsuklashi	*Dolic hos lablab*.Linn	Use in treating rheumatism, joint pain, stomach disorder etc.

(Source: Interview & discussions with elders, village GB's & farmers)

This knowhow of traditional medicine and healing needs to be preserved through the apprentice ship for the future generations. Health and wellness is a growing demand and it is high time to appropriately gain knowledge of age old society's connections to therapeutic ethnicity with all its answers to sustainability and harmony, environmental stewardship and environmental reverence and holistic wellbeing.

This trait can mutually benefit Ao-Naga community by providing many practical outlets for educational self-empowerment and ecological reliability. Besides, paving ways to heal ourselves as nature intended, it would rekindle to the profit and health giving resources of nature's bounty. Such awareness could help in creating an anticipated reverence for maintaining the environment that nurtures man, animals and plants and helps to develop a healthier sense of self within the purview of life; a more and more suitable idea as we progressively learn ourselves as a universal community.

PLATE: 5.1 Basil (*Ocimum basilium)* use in traditional medicine for treating cold.

PLATE: 5.2 Fig (*Ficus Glomerata*) use in traditional medicine for treating cancer,piles, toothache etc.

PLATE: 5.3 Wool flower (*Celose argentes*. Linn) use for treating itching and tuberculosis

PLATE: 5.4 Indian pennywort (*Bacopa centella*. Linn) use for treating ringworm and allergy

PLATE: 5.5 White false hellebore (*Veratrum album*.Linn) use for treating herpes, ringworm, cholera etc.

PLATE: 5.6 Mint (*Mentha spicata*. Linn) use in treating cold, digestion etc.

PLATE: 5.7 Plantains (*Plantago major.* Linn) help to stop bleeding.

PLATE: 5.8 Culantro (*Eryngium foetidum*.Linn) use in treating cold and digestion etc.

PLATE: 5.9 Snaker root (*Aristolochia serpnetaria*.Linn) use as an antidote for snake bite.

PLATE: 5.10 Live forever (*Bryophyllum pinnatum*.Lam) use in treating piles, T.B and pneumonia etc.

PLATE: 5.11 Betel leaves (*Piper Bettle*.Linn) use in treating rheumatism, antiseptic etc.

PLATE: 5.12 Hyacenth bean (*Dolic hos lablab*.Linn) use in treating rheumatism, joint pain, stomach disorder etc.

PLATE: 5.13 Jack fruit (*Artocarpus heterophylluys*) use in treating Asthma, pneumonia, bronchitis, T.B etc

PLATE: 5.14 Aloe (*Aloe vera*) used for treating cancer, asthma, jaundice etc

Traditional medicine has its source from Biodiversity, and access to traditional medicine is the most important factor when deciding the effectiveness of a traditional medical care (Pers. obs; Ellie, 2011 unpublished), and it is vital that Biodiversity conservation should have a positive impact on traditional medicine by protecting and access to the area where the primary resource is found.

It is important to state that 'social change is essential to assure that the mainstream practice of modern medicine evolves to incorporate this integral aspect of health and welfare, and this can be done through partnership with cultural leaders, elders and traditional healers.' [2] For nurturing a healthy relationship between Biodiversity, indigenous people and the land, the need of the hour is to recognize that,

- Traditional medicine and healing is the choice of the people and should be culturally acceptable and accessible.
- Culture represents an important source of health knowledge that is central to supporting small holder productivity and society safety net.
- Traditional knowledge and the holder of that knowledge merit respect and protection.
- Ensure the participation of local (indigenous) people, expert, including women and other members of the local communities in all activities related to Biodiversity and health.
- Biodiversity is the source of traditional medicine valuable to human health.

2. Todd Pesek: Healing across culture (Learning From Tradition and Healing Space), Journey to wellness, page 1

- Indigenous lands containing important Biodiversity and sources of medicinal plants need to be protected.
- Maintenance of Biodiversity with special emphasize on medicinal plant conservation need to be given much attention as it is related to health promotion as well as medical care.
- Harvesting guidelines for the sustainable collection of wild medicinal plants.
- Link between government and traditional healer's associate to support integration of traditional healing and modern medical practices.
- Education and public awareness programs that acknowledge the contribution of traditional knowledge and should be integrated with scientific research approaches.

Such an approach would pave the way for laying the foundations in providing the basis for understanding sustainability of Biodiversity, and encouraged a healthy decision-making towards sustainable management of Biodiversity and the environment. This should include the appreciation of the prevailing Biodiversity and its resources and their individual rights to existence as the fundamental needs of humanity. Appreciating the diversity of Biodiversity or natural diversity and its distinctiveness can be of great help and is the first step towards Biodiversity conservation.

5.2.4 BIODIVERSITY AND SPIRITUALITY

Biodiversity influence the everyday lives and activities and is interwoven with the surrounding environment providing multi-dimensional services including cultural and spiritual inspiration. The nature-spiritual relationship of the indigenous people is defined by the prevailing Biodiversity indirectly in a very unique means embedded locally in the territory and in return it influences the surrounding environment in which they exist. Biodiversity influence the indigenous people spiritual and traditional belief regarding the food habits, custom, lifestyle as well as the social activities. For instance, certain animals and birds are forbidden to eat, kill or even to domesticate as it might bring ill health, misfortune, or it may provoke gods or deities associated with these organisms.

Before the advent of Christianity into Nagaland, Ao-Nagas had a strong indigenous belief system. This belief strongly attached their cultural and spiritual approach towards Biodiversity and therefore upheld the view of moral value towards Biodiversity. Ao-Naga tradition has belief on the inherent spiritual link connecting human and nature. Ancient religious belief were often based on various kinds of ancient belief that have the effect of nurturing respect for plants and animals, leading to the establishment of for forest and jungle for spiritual significances.

Ancient spiritual belief of the Ao-Naga was occupied by the thought of taboo, breaking a taboo invite sickness, community banishment, or even death. Taboo often applies to certain sets of natural resources that are mainly susceptible to over exploitation. It was also

associated with totemisms a complex of ideas and practices based on the belief in a spiritual connection (often kinship) between man and certain animals especially tigers, eagle and snakes, this relationship often embrace respectful and genealogical relationship between social groups or individual and the totems. Even today, this belief is still practiced in many areas of Nagaland especially in Mon, Tuensang, Kiphire and Longleng districts. Such biophilic ethic inherent in the ancient Ao-Naga spiritualism was governed by local myths and belief systems, tending to foster a pervasive love and respect for nature. It indicates that Ao-Naga culture instill the importance on conservation of nature of biophilia, intertwined with religious ethics, and posing a unique opportunity of taking proactive measures on Biodiversity conservation.

Naga ancestors worshipped and revered nature's entities reflected in forests, and are believed to be the residents of spirits or `gods' which was also the core of the fabric of our traditional medicine and healing. These indigenous sites and groves are protected and care as sacred by respected indigenous communities.

Sacred groves are characterized by their unique quality of 'micro-climate, aquifers, nutrient cycle, preventing soil erosion and shows a unique in-situ conservation process, are often the last refuges for threatened species along with medicinal plants.' [3] Sacred groves were the place where people 'perform rites and rituals to appease the deity and wishes for their well-being. In such groves, resource exploitation is strictly prohibited.' [4]

3 & 4. Dr. Fatik Baran Mandal: Sacred grove, A unique component of Biodiversity conservation, page1

There are also restrictions on fishing and hunting at certain time of the year, often traditionally observed by many Naga communities, this is done to ensured growth of populations of various animals, birds and aquatic organism. Hunting taboos during specified season, especially on pregnant animals or female animals ensured a sustainable harvest of these populations, besides restriction on gathering of herbs and plants (for example banned on the gathering of young bamboo shoots which is a delicacy of every Naga dish) at certain important seasons also ensured the propagation of the plants.

However, sacred groves are fast degrading and losing its traditional belief and associated elements due to the loss of traditional culture, values and modernization of cultural practices. The advent of modernization caused wearing away of the traditional ethics that were very important for the conservation of sacred groves resulting in the change of belief in ancient nature worship. In today`s society market- oriented social systems do not hold any reservation towards nature and therefore nature is held as a commodity, compelling many communities to diverge from the traditions which could otherwise preserve forests and Biodiversity.

Indigenous community of the region is blessed with ecologically rich environment and they regard rivers, streams and wetlands as an inseparable part of their tradition and it is the foundation of social and economic well-being, Indigenous people's relationship with water**,** land and its resources is crucial to cultural life and spirit. While water is not viewed as a form of life, it is viewed as something sacred, in the sense that it is a basis for life, and it is a

major saver in the store of earth's resources. To the extent that the earth itself is sacred, then water too is sacred. Milak, Dikhu, Tsurang rivers and its tributaries have significant cultural and spiritual values and are a major asset for the region. Even today there are many sacred groves well spread in all the six ranges of the district having exceptionally rich Biodiversity and embrace rare species like 'Changdang lushi', 'Lakhuni lushi' and the forests along the Japukong range. Such groves indicate a meaningful fusion of religion and ecological that is traditionally maintained in many villages of the district.

Traditional beliefs of the past had played an significant role in conserving local plant diversity, where certain plants like for instance Basil (*Ocimum Basilium*), *Cissampelos Pareire*, etc are treated as sacred plants in many parts of the district especially in Longjang, Mopungchuket and Sungratsu villages. Such belief reflected in the maintenance of sacred groves has resulted in becoming important reservoirs of Biodiversity in the district. There are also ample advantages and benefits derived from native conservation policies in the likes of biomass requirements, substantial economic return and employment generation etc.

Religion is an important area which needs to be explored because the concept of religion can help in better understanding of the cultural and spiritual diversity and vulnerability as well as the belief system. All religions recognize the significance of Biodiversity and consider the earth and its inhabitants as God's creation. Religion is in fact a powerful force that shapes the viewpoint of the traditional people whose culture and spirituality are rooted in their ethnic community. The view of religion is important as it can motivate one's

appreciation of nature as God`s creation and could promote respect for the knowledge of ecological systems. Religion has a great influence on Biodiversity as it offers guidelines to the spiritual and physical connection between man and his environment. While religion offers important direction on the interconnectedness between all living and abiotic elements, all religions are characterized by a wide gap between their philosophy and the practices of the people who have acknowledged the philosophy. Religion often has had the effect of preventing excess human demands from outstripping the environmental resources that are required to sustain them.

The very nature of Biodiversity considered in it, with no regard to humanity's convenience or inconvenience, is well thought-out to give glory to the Christian God. Christianity teaches in consequence that humanity may not disorder Biodiversity or destroy God's creation, at the risk of destroying itself. Modern Christian teaching also emphasizes that need to educate and respect God's creation as reflected on Ecclesiastes 3:19, that humanity, both individually and collectively should understand the divine natural order as a sign and sacrament of God, recognizing that creatures and objects have been created for a purpose, and held a unique place in God's creation, it also encourages the need to recognized the special role of humanity within creation encouraging to support and protect natural resources. Deuteronomy 20:19 speaks about preservation of fruit trees, forbidding to destroy fruit bearing trees of an enemy even in times of war; Leviticus 25: 1-5 reveals about environmental wisdom, for instance allowing agricultural fields to go fallow for one year out of seven; Deuteronomy 22: 6-7 and Genesis chapter 9 emphasizes for wildlife preservation; Jeremiah 8: 7-8, Proverbs 6:6-8, Numbers 22:22-35 and Isaiah 1:3 shows the

impressive intelligence of wild creatures, even Noah (of the Old Testament) is a perfect example of conservationist.

Nagaland is a Christian dominated state with a percentage of about 90% and as such religious institutions in Naga community takes a certain stage, it can spearhead a social movement by preaching nature conservation as an important principles of God`s unique creation, can promote nature and Biodiversity conservation and help to provide sustainable livelihood for the local people. Religious institution can also have an immense potential of enlisting support from the masses in local movement for nature conservation in Nagaland.

God created the nature, which exists and is demonstrated in all forms of Biodiversity. God sustains, nourishes, protects it, and it exists under God's command and with God's grace. So it is in our hand to choose wisely, discouraging a conspicuous consumption and a mastery over nature but should emphasize the need to master over the self. Insensitive and irresponsible action of man towards God's creation is contrary to the divine wisdom which sustains and gives purposes to the mutually dependent harmony of the universe. In short respect for life, living in perfect harmony with other creation of God, and learning to appreciate the inter connectedness of all living beings is the key that Christian religion portrays.

5.2.5 BIODIVERSITY AND CULTURE

The diversity of flora and fauna is the foundation of the Naga social and cultural diversity where the community is based deriving all the benefits created by Biodiversity. Culture or way of life as a term, derives various meanings from the different fields of discourse related to human conditions. As a set of practices or ways of doing things, cultures shape Biodiversity through the direct selection of plants and animal and the reworking of whole landscapes (Sauer, 1965).

It is now widely recognized that both biological and cultural diversity is very much a part of diversity of life. `Nature and culture converge on many levels that span, values, beliefs, norms, livelihood, knowledge and language.' (Milton 1998; Posey 1999; Turner & Berkes 2006; Berkes, 2008). `The natural environment provides a setting for cultural processes, activities and beliefs systems to develop, and subsequently, landscapes form a diverse cultural archive of human endeavors' (Adams, 1996; Milton, 1999; Schaaf & Lee, 2006; Berkes, 2008).

Human society and community too have developed through a thorough knowledge of the surrounding natural environment and Biodiversity, which exists and is expressed in symbiotic terms and have proven now and again that Biodiversity and cultural diversity are interdependent. For thousands of generations, human society has been interacting with nature wherein Naga society is not an exception. This is well reflected in all its culture, songs, festivals, merriment etc revolving around the rich Biodiversity. In the case of the Ao-

Nagas, names, stories, chants, art and crafts, music and musical instruments, dance, ceremonies, rituals, architectural designs and forms, marriage etc reflects the interaction with Biodiversity, which in return enrich the social life by adding enjoyment and well-being.

Exposure to nature and Biodiversity is relevant in any society as it garnered a positive effect and approaches on the physical and mental well-being. Naga forefathers were interacting with nature in all aspects of life be it in the practice of agriculture, festivals, songs, decision-making etc. This relationship is more clearly reflected in the maintenance of sacred or enchanted ground which is widely spread all over the region, many of the protected areas of Biodiversity contain sacred natural sites.

Biodiversity conservation had been in practiced by the indigenous community through the system of sacred groves or enchanted land, where diversity of wild species were preserved in their habitat. Through their preservation, the most vital indigenous knowledge of flora and fauna in their original habitat were also preserved. The relationship between Biodiversity and the Naga society has historically shaped the rich diversity of culture with traditional societies interacting through adaptive and co-evolutionary processes for generations. The way of life or the Ao-Naga culture since time immemorial has constantly interacted with nature and meta-physical nature wherein all other members of the same community are involved. This constant interaction have been portrayed in the songs,

folklore, food, clothing, customs, habits, shelter, festivals etc showing indeed the relationship between natural Biodiversity and the different objects.

Naga forefathers have feel a sense of oneness with nature, with their relationship based on respect, caring and sharing, that we belong to the same unbroken holistic system. This affinity has often been depicted among the tribal and traditional community where there are still beliefs that certain plants, animals' habitats are vested with spirits and gods. This sense of oneness or belief of association with nature has evolved from a continuous and undeviating reliance upon nature. Various local communities in the Mokokchung district have selected protected areas such as `Yangermanglopok', `Nashimer', `Aidang', `Shirkimong' (Mopungchuket village), `Kalomong', `Tsurong valley', `Shamalong', `Tenemtsuyong' (Debuia village) etc for spiritual reasons results in generating high natural values.

Biodiversity and cultural diversity are intertwined and should be treated as sacred. This is verified in the designation of protected areas and nature reserves perceived as a `sacred' or `Ait' (enchanted ground) and other faith- based or sacred designation of the land spread all over the region. This reflects the people`s actions and behavior towards Biodiversity and nature, there by demonstrating in the cultural belief in the value of nature. Such belief or sacredness should be uphold to impart the lesson of mutual interdependence between man and Biodiversity to protect and prevent from misuse and over dominance of man on nature in the future.

But on the other hand, the present scenario have witnessed in the cultural diversity been manipulated and altered the local Biodiversity through modernized tradition, customs and mindset that keep on changing with time. As such traditional knowledge on Biodiversity conservation and management is rapidly declining with the pressure of modernization coming in the way. The exploitation of animals and plants species to furnish to the need of contemporary societies is causing extinction to other key species.

'Modernisation is so forceful that it dares to mould all the cultural diversities into a "single culture" based on the value of ceaseless consumption. Cultural diversities meaning fully `preserved' the environment to maintain their world view as well as their existence-material and otherwise.' [5]

The destruction of natural habitat with the advent of industries, urbanization, and mining and other developmental actions and projects have caused widespread developmental condition for survival of not only man but for all living beings. Disappearance of forests have been a great threat in wiping off numerous diversity of life, and this conditions continues to happen at a fast pace. All life forms cannot become accustomed to the changing ecological condition, for instance, rice which is the staple food of the Nagas, has cater to the diverse needs of food, nutrition, rites and rituals of the society. But recently, use of hybrid and high yielding varieties of rice such as Bahadur, Ranjit, Pankaj, Joymoti, Joyti Prasad, Pan Bera, Jay Bangla, Chinese Boro (winter paddy) which Naga farmers have already

5. Gopal Krishna Chakrabarti: 'Discourse on environment', Edited by Paharibasu (1994) on Environment and Societies; page 1

adopted in the field situation is more prominent leading to disappearance of indigenous seeds from many paddy fields. Such happening instance has risk the loss of traditional knowledge and therefore the need to conserve Biodiversity with response to indigenous traditional ethics is very important to create a sustainable environment by conserving cultural diversity.

For centuries Nagas have respected their culture, social, economic, and spiritual life and had for ages lived in isolation and had not participated in main-stream socio-economic development. But in the present scenario Naga culture have witnessed a dynamic nature influenced by westernization perhaps through language, education and religious practice. 'Culture is assuredly a perplexing phenomenon - ubiquitous in presence, complex in detail, and as such overwhelming and incomprehensible in its totality and in its intricacy. Any attempts to grasp it all in analysis will, therefore, be frustrated from the beginning to end' (Wuthnow, et al, 1987). For example, 'The Morung' or the 'Dormitory system' used to be a fortress of the village and also the cultural centre of the Nagas for unmarried boys. 'The Morung' was a recreational club during festivals like the Moatsu and Tsungremmong etc where the boys of the 'Morung' used to take leading part in all the necessary preparations. It was the place of origin of folk literature like songs, tales, riddles etc. 'Morung' was the ideal place to learn social behavior and social laws where they learned various aspects of the life in society. Life in 'Morung' used to prepare them for manhood where they are given intensive training and discipline to produced them into good a warrior which was a lifelong aspiration of every young men in those days, but in the present society it has fallen into disuse.

In the present scenario, Nagas are marching ahead towards modernity through developmental programmes and activities adopted by government agencies towards the mainstream but at the same time precautions should be taken to protect and preserved the indigenous identity of the people allowing them to come in terms with the conventional society without disturbing and alarming their colourful cultural heritage and social dimensions that are inextricably enmeshed. As the region is entangled with various developmental spheres, the need of the hour is that, every Nagas should preserve their individual identity through self awareness and pride in their indigenous traditions and culture. When the indigenous Nagas become strongly rooted in their respective societies, heritage and living culture, it can contribute towards a source to empowerment and thereby promote economic development in the region.

5.2.6 BIODIVERSITY AND TRADITIONAL KNOWLEDGE

Traditional knowledge means ‘the content or substance of knowledge resulting from intellectual activity in a traditional context’ (Tobias Kiene, 2006) which are passed from one generation to another. Traditional knowledge and traditional practices have rich roots in areas having rich Biodiversity. Maintaining of nature and Biodiversity through the guidance of traditional knowledge and traditional cultural expressions could contribute towards diversified variety of local plants and animals breed, thus promoting the growth of variety of local agricultural foodstuff, that are at the same time needing adjustment to the changing needs and wants of the local community.

Traditional knowledge and related ethics of the Ao-Nagas is the outcome of interaction with nature, conservation mentality of the people, involving local innovation and insights. It has greatly influenced the dynamic socio-cultural aspects reflecting it on the lives of the tribal people who have experienced it handed down through generations by cultural diffusion and learning through practiced. Since time immemorial, Nagas have define themselves through their own unique system of cultural expression, indigenous knowledge, practices, know-how and innovations while generating, preserving and transmitting it in a traditional and inter generational context. Rich Biodiversity in the region have aided on the increase importance of indigenous knowledge which in turn offers an economic connection.

Cultural assets like customs, tradition, indigenous medicinal knowledge and information etc hold the key to a prosperous future as it have greater value than financial assets if preserved and managed properly. Ao-Nagas are rich in terms of indigenous knowledge specifically with indigenous medicine. Biodiversity and traditional ethics including traditional knowledge and culture are the cumulative body of know-how, innovations and practices as it carry the code of survival for the indigenous and local communities. It encompasses all aspects of day to day life and is also fundamental for the existence of the Ao-Naga society including the indispensable attributes like the know-how, innovations and practices related to the conservation and sustainable use of Biodiversity, agricultural practices and how to cure ailments, making clothes, building houses and adaption to the continuous changing pattern in the society as well as the surrounding environment which are priceless and could not be afforded to loss. Indigenous traditional knowledge has taught the Ao-Naga society

about the vital services rendered by Biodiversity, one such instance is in the form of bio-indication. Some prominent indigenous knowledge on bio indicators include.

Table 5.2 BIO-INDICATORS

Indicator species	Local name (Ao-Naga)	Indication
Bamboo *(Bambusa arundinacea)*	Ashi	Chaff in rice.
Schima wallichii	Mejangsung	High soil fertility.
Embilica officinalis, Gaertn	Lozu tong	When there is plenty of this fruits in the jhum field, it indicates a bounty yield in the rice paddy.
Entada scandense, Benth	Atitong	This plant grows only in fertile soil, thus indicating soil fertility.
Dipteris wallachi, (RBr) Moore	Longchari sera	It grows in infertile soil thus it indicate soil infertility.
Helianthus anus, Wall	Jemdang naro	It blooms in the evening and is used as a time indicator.
Mirabilis Jalapa, Linn	Anu naro	This flower faces the sun and is used as time indicator.

(Source: Interview & discussions with elders, village GB's & farmers)

Bio-indicators occupied a place of great importance in the context of deepening genetic conservation and growing interest on developing indicators. With these contributions in mind rendered by Biodiversity on traditional knowledge and cultural aspects, it is of paramount necessity to develop a dynamic documentation of genetic resources through

timely alarms for regenerating or protecting the fast declining traditional and indigenous genetic wealth (IGW) by means of maintenance and conservation.

Traditional knowledge have rendered valuable service in the everyday activity of the indigenous society, like for instance, for dyeing clothes, the Ao-Nagas used indigenous plant leaves called ‘Osaak’ or ‘Mosaak’ derived from *Strobilanthus flaccidifolius*,Nees (Masaktong). The leaves are pounded and boiled and let it to become highly decomposed. It is later dried in the sun and is poured into a large pot to which is added water and ash (derived from burning good quality firewood). Later on, cotton yarn that is already boiled in white rice are poured into the ‘Osaak’ or ‘Mosaak’ which produced a light to deep blue colour, if a black colour is required, it is allow to boil again. This indigenous method was commonly used for preparing ‘Ongtsung su’ a traditional Ao-Naga shawl worn by both men and women.

There are numerous instances where indigenous traditional knowledge had guided in predicting harvest. It is said that a particular bird called ‘Ongmok’ or ‘Ongmuk’ (Blue breasted Quail /*Coturnix coturnix*), would make her nest in the paddy field, when there is a stone placed in its nest, it indicate a bounty harvest in that field and when a charcoal is found instead in its nest, it predict a poor harvest. Sometimes this same bird would give an unusual sound which predicts a misfortune like death and sickness in the family or poor harvest. Indigenous traditional knowledge of the Ao-Nagas predicts that when a snake shed

its skin at the top or near the ‘Aati’ (a rest house in the jhum field) it indicate a bounty harvest, but if it shed its skin at the bottom of the ‘Aati’ it indicate a poor harvest.

Traditional knowledge has also guided in the use of indigenous plants for appeasing gods or deities for spiritual upliftment. ’Jangpet’ (*Zanthoxyllum acanthopodium*)is used as a sacred or worshipping plant, usually for sanctifying a new jhum field, this same plant is forbidden to used after ‘Tsungremgmong’ festival. Plants like ‘Tsungrempang mozu’ (*Cissampelos pareire*) and ‘Tsungkum naro’ (*Elsholizia blanda*, Benth) is used in all sort of ceremonies. The leaf is also used to drive out evil spirits.

Besides the practiced of indigenous traditional knowledge in controlling insects and pests in the jhum field had always been helpful in the past, even today this knowledge is practiced by Ao-Naga farmers in the Jhum field. Some of the most common traditional practices are given below:

- Wild sunflower (*Tethonia diversifolia*) leaves buried under the mango tree during flowering prevents fruit borers.
- Ash mixed in potato field prevents red and white ants.
- Tobacco leaves spread in granary acts as repellents against Corcyra and other store pests.
- Sunhemp twigs spread over granary control rats and Corcyra.
- Ghora neem paste used in paddy fields especially in swampy areas control root weeds and kills larvae.

PLATE: 5.15 Wild sunflower (*Tethonia diversifolia*) leaves buried under the mango tree during flowering prevents fruit borers and also prevent soil erosion.

- Dried turmeric powder mixed with cow urine is used to control cotton semi-looper, mites, green leaf hopper, aphids etc. it also effectively control some diseases of crop plants.
- Neem leaf paste solution in water is effective for controlling leaf folder in rice.
- Solutions of Tulsi (*Ocimum sp)* leaves in soap water are used to control aphids, army worm, red cotton bug, mosquitoes, cockroach etc.
- A solution of tamarind in water is effective to control hairy caterpillars.

These practices encouraged by indigenous traditional knowledge not only increase in the crop production but it also prevents environmental degradation and ecological imbalance. Since time immemorial this knowledge were practiced and have contributed much in the Ao-Naga socio- economy, therefore the need of protecting of indigenous people's rights including indigenous knowledge, innovations and practices relating to Biodiversity is indispensable in the conundrum present scenario.

The recent trend of modernization and emerging developmental works has put adverse pressure on traditional knowledge and cultural expression of Biodiversity as these resources are over exploited and misuse threatening the cultural and social well being of the tribal masses. This will result in long-term implication as it would hamper the future potentials of valuable species which are used in traditional medicines to cure diseases. With the loss of local ecological knowledge, indigenous means of management systems are also lose simultaneously.

Haphazard development, urbanization, faulty policies etc have caused to drift away from traditional resources management, at the cost of Biodiversity. It also affects the long symbolic relationship with forest based cultures as they are physically separated from the forest wherein their beliefs and faiths are centered upon. Developmental actions and projects, urban oriented and its related activities is a continual process and cannot be brought to a halt but at the same time, these modern culture and its associates concomitant can be checked and prevented from taking shape and manipulating the natural environment, where our indigenous and traditional cultures have to a large extent succumb to its alteration.

Another reason for the lost of cultural traditional knowledge is from the interaction and increased access to other non-indigenous (Aliens) cultural groups leading to hybridization or assimilation into the more dominant culture. Assimilation with the alien culture caused the lost of folklores, community values and principles, also rites and rituals lost its meaning leading to cultural collapse.

Livelihood diversification and resource commoditization is also threatening the indigenous Biodiversity by causing a departure from cultural resource use and management practices, the loss of land-based livelihoods and the local knowledge they are based upon. Increase commoditization of natural resources have caused unsustainable management practices leading to loss of Biodiversity which in turn divert the attention from traditional resource use and management strategies.

Moreover ethno botanical traditional knowledge and conservation of native genetic resources which is a common practices of Ao-Naga culture is threatened and most affected, as it reduced the chance of deciphering the function of ethnic communities in the assortment of a particular species for carrying out such practices. This has jeopardized the local livelihood sustaining system as the original habitats are depleted beyond repair. Encroachment of the forest land and areas by agriculturalist settlers, have further depreciated the loss of habitats and species as it put a pressure on competition for basis of livelihood, conflicts, diseases and erosion of cultural identity.

There is also increasing concerns over the declining of traditional knowledge and traditional cultural expressions consequence from misappropriation and misuse by outsiders and dominance of external forces of modernization and westernization. As in the past, there were certain taboos, sentiments, belief, fear and super-natural affairs that were enmeshed in the man vis- a vis plants –animals interaction resulting in the irresistible conservation of natural resources in the form of sacred groves or enchanted land known as `Ait' in the vernacular Ao-Naga dialect. But many aspects of our tribal culture got degenerated under the influence of modernization as a results many of our relic forests have lost its original identity.

The widespread role of modern cultural activities happening in the region have altered the pristine nature, where the tag `sacred' attached to many of these forest habitats previously thought or held to be pristine are in fact an emergent property of resource dependent

livelihood practices. Keeping these facts into account, it is imperative to re-sound the ethnics-based practice of respecting and preserving of Biodiversity which is the key to the survival and sustainability of the Ao-Naga society and culture.

It has been proved that loss of one means leads to concomitant loss of the other, it is vital that community based conservation can play a pivotal role involving the relentless effort of local communities with pragmatic established practices. Co-existence between nature and cultural can be beneficial when only it allows rapid observation and adoption to change. Thereby it is understood that only a healthy traditional cultures can enable the existence of practices and skills towards respecting and conserving Biodiversity and managing ecological integrity more successfully.

As both traditional knowledge and traditional cultural expression exists in symbiotic existence, it is important to equally protect them by establishing effective actions encouraging participation and input from indigenous and local communities. Society plays a central role among the Ao-Nagas where it can impart the knowledge of nature, traditional knowledge, and eco-literacy and passed it through various means of diffusion through oral stories and narratives in the form of songs and folklore.

The Ao-Nagas have vast economic potential of traditional indigenous knowledge that could bear fruitful results if these tacit knowledge systems are capture and translated into a

codified form that is beyond oral tradition. In this way, indigenous knowledge can be share and can enhance the process through better cultural understanding and may provide a basis for problem- solving strategies for local, poor communities.

In addition to this, conservational process on traditional knowledge and traditional cultural expression should be integrated and substantiate with scientific knowledge and enquiry to understand the limits to generalizing indigenous knowledge accompanied with proper evaluation against variation in soil fertility, the climate and seasonal conditions, the impact of residual or culture acquired moisture, rainfall etc, weather parameter etc that would make cultural expressions and indigenous knowledge more valuable and provides a much more accurate merit detailed verification and validation.

Sustaining and upholding such a principle can enable the people `to live within the constraints of their environment in the long term, without the need for catastrophic learning in the event of major resource depletion. It can also generate the ability to learn from and adapt to incremental changes in the environment effectively and efficiently, and can definitely prevent the dual erosion of Biological and cultural diversity that is presently threatening the Naga society.

Integrating indigenous knowledge and scientific knowledge on Biodiversity conservation should be integrated with the recognition of women`s role would generate the need to

optimize and mobilize the potential of indigenous knowledge in habitats undergoing dynamic changes in the environment both natural and artificial, because with its lost, there will be changes in the mechanisms of knowledge transmission, devaluation of traditional knowledge, inter-generated conflicts, loss of traditional stories and folklores. It will also result in language erosion and loss, leading to changes in operation of knowledge transmission, devaluation of traditional knowledge, loss of traditional stories, folklores and traditional management strategies previously passed on orally for generations.

There is no autonomous existence; the health of the whole environment is irrevocably and inevitably linked with the health of all biotic and abiotic elements. There is compendium of examples to support the link between agriculture, human health, culture, tradition and indigenous knowledge as well as spiritual values to Biodiversity which centered on the life of the indigenous Naga people. These values upheld by the people had help to shape and preserve Biodiversity. Traditional knowledge, human health, culture and spiritual diversity cannot be separated from Biodiversity as its variation reflects the human race. But at the same time all these aspects is facing vulnerability to the advent of modernity that affects the way of life of the indigenous people and their ethnicity.

The rich cultural heritage of the Ao-Nagas is very much a part of the rich biological heritage that is inevitably ingrained in every aspects of tradition. It is unfortunate that our vast knowledge about plants and animals utilization as traditional medicine and healing of the past has fallen victim to considerable erosion at present, and a total recovery of the same is

beyond possibility since the principal matrix of preservation is seldom practice and acknowledge.

But on a high note exploitation and erosion of indigenous knowledge on medicine can be avoided and alleviated by concentrating exclusively on the protection from the problems relating to inadequacy of current legislation to protect indigenous people`s knowledge on Biodiversity and natural resources. As the indigenous knowledge are irrevocably related to the social, cultural and economy; laws and regulation providing possible solutions augmented by appropriate legislature and practical proposals based on social justice can overcome such problems.

Local knowledge and practices plays an important role in the cultural tradition in the Ao-Naga society through preserving the unique systems of knowledge especially along with the management of nature. Only through maintaining a close relationship with Biodiversity the value and usefulness of biological and genetic resources could be conserve and encourage sustainable utilization. As knowledge on traditional medicinal plants forms the basis of traditional healing practices and thus there cannot be any traditional healing practice without medicinal plants. Biodiversity is always connected to traditional cultural expression and traditional knowledge, and cannot be isolated from each other as it includes the spiritual identity, psychological aspects and the medicinal plants which forms the holistic environment both natural and cultural which is greatly connected to life as it aid the facilitation and promotion for our survival.

Religious tradition build on the inter dependence of the indigenous communities within the local Biodiversity brings positive result and can promulgate on ecological ethic. Such measure can bring potential positive environment improvement with community wants and needs. Even the indigenous cultural practices of the Nagas have revealed that hunter-gather-shifting cultivators encourage protecting the wild biota and habitats on which the tribal depend for survival. The indigenous societies of the Nagas have long realized this unity reflecting in the multitude of myths, rituals and religion. Indigenous cultures which includes protection of natural habitats in the forms of forest patches, rivers, lakes as it is considered as sacred is relevant even in the modern days.

As Biodiversity is a common property of every citizen and therefore equal benefits should be shared amongst all. An unbiased and accurate assessment of the impact of man's activity on the natural environment and Biodiversity should be made with the formulation of optimization and organizing schedules for rejuvenating the natural environment and Biodiversity at the optimal level. Emotions and sensitivity are 'the essence, the core dimension of the human being', that is involved in our first contact with reality, and "todays" great crisis is not economy, political or religion but a crisis of affect, of the capacity to feel a connection with others '(Leonardo Boff one of the founders of Liberation theology).Taking care of all living beings is indispensable and awareness and education shows that cooperation is the supreme law of the universe. Relationships amongst living and non-living world are the key for our survival. Cooperation alone has made it possible to leap from animal to humanity, and without it we are dehumanized.

CHAPTER-6

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

A summary of findings of the research work has been presented in this chapter. The research attempts to study the dynamics of Biodiversity pattern and to evaluate the present status of biodiversity. Efforts were made to analyze the factors leading to the distribution and occurrences of different levels of biodiversity and evaluate the co-relation between changing pattern of biodiversity and environmental changes. The research work carry out to assess the magnitude of human impact on the biodiversity and try to bring out a suitable strategy for preserving and sustainable development of biodiversity in Mokokchung district and the entire state in general.

Among the present 11 district of Nagaland, Mokokchung district happens to be the one district which had experienced early contact with the outside world, British administration and development etc. Hence, history and dynamics of Biodiversity has been more apparent. Even in the present days it indicates fast changes of Biodiversity as compared to many new districts in the state. As such Mokokchung district gives wider scope for the study. Geographically, Mokokchung district is divided into six parallel ranges on the basis of terrain, climate, soil and the type of vegetation. The six ranges are given below:

(a) Ongpangkong Range
(b) Asetkong Range
(c) Langpangkong Range
(d) Changki Range
(e) Japukong Range
(f) Tzurangkong Range.

Mokokchung district is rich not only in Biodiversity but the people also have a rich cultural heritage. Their traditional knowledge has a strong understanding and intimate relationship with their environment thereby have affectively protected and conserved their environment for centuries. Their indigenous socio-cultural life process is so closely linked with the ecological system that for them nature like forests, rivers, land and entire environment forms undeniable part of their socio-economic and spiritual life.

Forest and Biodiversity 'the source of energy' holds a great place of importance among the Ao-Naga society and has helped them in their pursuit of everyday needs and wants, and this has asserted the relationship between Ao-Naga community and Biodiversity since time immemorial. There has always been a direct and indirect contribution of Biodiversity in the form of food supplies, cultural and spiritual needs towards human progress.

Biodiversity plays an important role in promoting ecological and environmental services. Biodiversity the veritable storehouse of hundreds of biological products in various manifestations could also change the lifestyle of the indigenous community by alleviating poverty and enhancing wealth for the community. Its contribution to agriculture is well ascertained as it provides scope for understanding any forms of cultivation. As agriculture is an important part of every Naga life, Biodiversity conservation and preservation is therefore fundamental.

Even in the past, Ao-Nagas had always regarded forests and jungles as 'Sacred', it was in fact held as a tradition to respect the diversity of life forms as it had ever been

sustaining for generations for physical, socio-economic and spiritual enlistment. Naga ancestors have indigenous spiritual beliefs and they regard certain forests as the ‘place of worship’ and were considered as taboo to carry out cultivation in such forests. These forests are apprehended as ‘sacred’ or ‘Ait’ in the local vernacular of Ao language.

Cultural role of the Ao-Naga community is also vital for Biodiversity conservation. These beliefs, ethics and superstitions have positively contributed towards Biodiversity preservation in many villages of the district. In the present scenario, the forest areas of the region which once constitute numerous variety of flora and fauna are changing at a fast pace due to unethical practiced like the deforestation, hunting, poaching, unethical gathering and over exploitation leading many of the biotic species to become endangered. It is observed that many are at the risk of becoming extinct. Biodiversity the indispensable gift to nature provides the multi-dimensional benefits to the socio-economic sphere like agricultural and forests link activities; cultural and spiritual enlistments like the prevailing Ao-Naga custom, songs, dances, folklore, traditional knowledge, ceremonies and festivals and ways of worship.

However in the present scenario, the forests areas of the selected 13 villages covering all the six range of Mokokchung district which once constitute numerous variety of flora and fauna are changing at a fast pace due to rapid growth of population, urbanization, deforestation, hunting, poaching, agriculture, unethical gathering, overexploitation, unplanned developmental activities of urban oriented which have speeded up the loss of Biodiversity risking many to become extinct.

The following factors were observed to cause Biodiversity loss in Mokokchung district.

POPULATION DYNAMICS:

(a) POPULATION GROWTH AND URBANISATION

Mokokchung district has recorded a population of 193,171, where there was a change of -16.77 percent in the population compared to population as per 2001 but still has an impact on the Biodiversity because urbanization trend continues to progress. Urbanisation is higher at Ongpangkong range due to high population concentration of approximately 85,667 **(2011 census)** encouraging human induced activities like habitat destruction for agriculture, settlement, construction of roads and other related urban activities. Close proximity of most of the villages like Mokokchung, Chuchuyimpang, Longsa, Ungma, Khensa, Mekuli, Aliba and Chungtia with rich forest resources sell variety of forest resources like timber, firewood and other edible resources to Mokokchung town and surrounding urban centers where there is great demand on forest and bio-resources.

(b) IMPACT OF ILLEGAL IMMIGRANTS

Illegal immigration has been taking place in Nagaland, especially in areas bordering Assam, since the early 1970s or even earlier, but it has picked up since the 1980s who were assumed to have prospects for better employment and manual labour. The situation is alarming in some villages of the district like the Tsuremmen village, Lirmen village (Tzurangkong range) and Aosungkum village and Aosenden village (Japukong range) that needs strong political will to address the problem, which has caused loss of forest area and created a means for perpetual degradation of forest resources with many unsuccessful efforts to evict encroachers from a reserve forest areas.

(c) IMPACT OF CLIMATIC CHANGE

Apart from such population related problems the most severe effect caused by population explosion in the district is the climatic change. In general global warming is not just a single issue, but a compilation of numerous environmental issues which are threatening the basic existence of various life forms in the region. Mokokchung district which usually have a cool pleasant climate has temperature risen by a few degrees Celsius undergoing a slight changes in the climatic condition. This slight alteration in degrees has its effect on Biodiversity as plants and animals are sensitive to fluctuation in temperature and climate. In Mokokchung district, the year 2009 was the warmest year which nearly brought drought like situation as the rainfall during this year was very scarce badly affecting the cultivation, cropping pattern, fruiting, flowering, tree, birds, insects etc which are the sole source of our livelihood The district which usually received heavy rainfall is facing deficient in rainfall over the last few

DEFORESTATION:

A very well known occurrence relating to deforestation face in almost all the forest of the district is the disappearance of numerous diversity of hornbill viz Rofousnecked hornbill, Wreathed Hornbill, Malabar Hornbill, Indian Pied Hornbill, Great Pied Hornbill etc is partially due to destruction of evergreen and moist-deciduous forest as these birds make their abode on the tall trees as these birds feed mostly on fruits, flower buds of specific tree species, the felling of these tree species have had an impact on hornbill population. Primate species is also diminished to the point of extinction because of deforestation leading to habitat loss besides hunting and poaching. As primates mostly feed on fruits, leaves, buds and berries of specific tree species like the Ajar, Tita sopa, Moria or Kothia koroi, Paroli, Am, Satiana, Outenga, Sam, Gomari, Amari etc,

the felling of these trees have threatened their survival as their means of sustenance has been diminished.

Felling of trees and forests incur permanent damage upon their habitat, besides disturbing the migration of migratory birds like Amur Falcon and animals like the elephants, tigers etc. The degree of loss is prominent in the case of indigenous plant species *Rhododendron Arboretum* which once abundantly embellishes the forests of Longkhum village of Mokokchung district has reduced expressively. Deforestation has discouraged migratory birds like Grey Peacock pheasant which is believed to migrate from Indonesia at Longkhum village of Ongpangkong range. Golden Languor Trachypithecus, Capped Languor Trachypithecus pileatus etc, once found in abundance in the entire district is not found since the last 20 years in some forests like the Aliba, Chuchuyimpang, Mopunchuket and Dibuia villages because of disappearance of forest and excessive hunting and poaching as these animals are believed to served medicinal purpose for treating certain diseases like kidney stone, asthma, cancer etc. Larger carnivores like the Tiger and Leopard which were found in good numbers till the mid 1990's are not found within a span of 10 years in many parts of the district.

(a) LOGGING

Logging and its related activities have wiped out a massive portion of forests area in the villages like Wameken, Merangkong (Langpangkong), Longpayimsen, Chuntiayimsen (Tzurangkong), Japu (Japukong) and Changki, Debuia, Waromong (Changkikong) areas. These ranges have larger geographical extent under forest cover and are the strongholds of thick and dense inaccessible forests areas of Mokokchung district. Likewise, Ongpangkong and Asetkong ranges are also severally damage by logging

activities. The effects of logging are not always as direct as the absence of trees because since the 1970's about 7% of the virgin forests are destroyed in the Changkikong region alone thereby promoting more landslides which has destroyed vast acres of natural forests once filled with diverse plants and animals. Various government aided fund has undertaken more than 50 agricultural link road projects in the State covering approximately 405.00 km to provide road connectivity of the villages with agricultural potentials areas putting a serious toll on Biodiversity.

(b) DEMAND ON FIREWOOD

Another cause of deforestation in Mokokchung district is the unabated demand on firewood. Dependence on fuel wood continues to take both in the urban and rural areas because it is consistent with cultural patterns and living habits and least expensive form of fuel compared to LPG where its supply is not sufficient to meet even urban demand and also not easily available to villagers. Collection of fuel wood for sale in urban areas is also the cause of much destruction and degradation of forests.

AGRICULTURE:

(a) JHUMMING

It is found that most of common land management in the study areas is dominated by shifting cultivation. As the slash and burn system of agriculture involved the clearing of forests, it ultimately leads to loss of habitat of plants and animals, hence loss of Diversity. Jhumming has had a significant effect on Biodiversity especially in the Ongpangkong and Asetkong range because of its steeper slopes and water scarcity discouraging other alternative method of farming like terracing and wet-paddy field. It is undeniable that jhumming is partially responsible for depredating forest area in the

district, as it is marked by slash and burn method before being cleared ultimately leading to loss of habitat of plants and animals and hence a loss to diversity, but at the same time jhum has its own cycle (10-15 years). In fact a larger section of the forest cover in the district is made up of jhum fallow land, the process of leaving the land fallow incite the re-growth of trees and vegetation giving rise to rejuvenate secondary forests.

(b) MONOCULTURE AND COMMERCIAL FARMING

Currently there is a rapid change in the land use pattern from a traditional based jhumming to a money driven commercial farming system under which large tracts of forests and agricultural lands are owned by individual or otherwise community lands are converted into a monoculture commercial forests, plantation of crops like tea, coffee, rubber, commercialization of fruits like oranges, banana, pine-apples, etc. This unregulated unplanned emerging system of land use has multi dimensional impact on Biodiversity and its resources which in turn adversely affect the livelihood of the general mass due to shift in agricultural pattern and have caused loss of habitat and species of tropical, alpine, and evergreen forests as these tree species are planted on a large scale.

There is unaccounted unscientific process of introduction of new alien species of plants and animals under various schemes. Instances are the introduction of commercial trees and new varieties of vegetables seeds being rampantly introduced to the farmers. This posed new threat to indigenous plants and Biodiversity in the region. Modern farming practice which include the use of genetically modified varieties, introduction of alien species, use of chemicals fertilizers etc have resulted in encountering numerous problems like introduction of diseases, pests, accumulation of salts due to rampant use of salts as weedicide, reduction in yield affecting the cropping pattern and its

productivity. There is a kind of ecological imperialism with the introduction of new and fast propagating trees and grasses which diminishes the indigenous plants. Mokokchung district have 2035 hectares under Tapioca cultivation, besides commercialization of crops like tea, Agar (*Aquilaria agallocha*), rubber (*Hevea brasiliensis*) etc are rapidly increasing in the district where areas of tropical evergreen forests have replaced these plantations especially along the foot hills of Longpayimsen, Chuntiayimsen (Tzurangkong range), Changki valley (Changkikong range), Tuli valley (Langpangkong range), Mopungchuket and Longjang villages (Asetkong range).

HUNTING AND POACHING:

Hunting and poaching is another threat to Biodiversity and its resources in Mokokchung district. Despite various acts and regulations which has been laid down by the government of India to curb these activities, in many cases it has proved to be futile as trade on many products of endangered species continues unabated. Hunting of birds and animals for game, skin, ivory or horn is the main reason for declining wildlife population.

(a) TRADITIONAL HEALING AND MEDICINE

Hunting has caused more direct negative effects to the declining and sparse number of tigers and leopard population, because its bones, with almost all its body parts including even the whiskers are use for treating toothache are highly valued for the medicinal purpose. Many animals are hunted for variety of reason for instance Squirrels (*Funambus*) for its fluffy tail used as a key chain, the blood of smaller Mole (*Talpa*) is used for treating asthma and tuberculosis, Sloth bear is hunted for its gall which is allegedly believe to treat variety of diseases like stomach disorder, Deer are hunted indiscriminately as the male organ are used for overall medicinal purpose. The fetus of

deer is allegedly used as a tonic during child birth and is also used as a charm in witch craft. Bat is hunted for treating asthma and tuberculosis, the meat of Dingo is used as an overall medicines. Also the stomach of Porcupine is dried along with its excreta to treat stomach disorder, Otter is also eaten as it is believe that eating its flesh prevents fish bones from sticking in the throat, its toes and nails are dried over fire place to treat the same.

MINING ACTIVITIES:

In addition to the above mentioned human activities causing loss of Biodiversity in Mokokchung district, mining related activities is also a matter of concern. The practiced of mining especially along the Tuli, Anaki, Waromong, Debuia, Mongkolemba and Changki areas of the district has caused irreversible damage to animals, birds, vegetation and the aquatic ecosystem through the release of toxic chemicals.

OVER EXPLOITATION:

There are two reasons for over harvesting of bio-resources in Mokokchung district, firstly due to compulsions for survival and secondly due to lack of scientific knowledge and awareness on the importance of Biodiversity relating to human welfare. Overexploitations of bio-resources have arisen because of various medicinal purposes associated with certain plants and animals for treating various sickness and diseases, especially herbal medicinal remedies have been in high demand because of its higher potency and because of its easy accessibility. Butea Minor, Indian Pennywort (*Centella Asiatica*), Curculigo Capitulata, Common Buckwheat (*Fago-Pyrum Esculentum*), Houttuynia Cordata, Mejanker (*Litsea Citrata*), Naga-Tenga (*Rhus Semialata),* Raspberry (*Rubus Ellipticus*), Lhinetta (*Swertia Chirayita*), Thalictrum sp, Parmar (*Zanthoxylum Alatum*), etc are some local plants which have been over exploited. Herbs

like the ‘Tsungrempang mozu’ (*Cissampelos pareire* L) which is used for treating body ache, burns, stomach troubles and most importantly believed to have magical power to ward out evil spirits are also threatened due to over harvesting, Over harvesting in the river ecosystem have resulted in the loss of aquatic resources for instance marshy crocodile or the fresh water crocodile or the Muggar (*Crocodylus palustr*is), Land tortoise (*Chelone imbricata*) etc which are found especially in the Changkikong, Lanpangkong, Japukong and Tzurangkong ranges have been depreciated in their number as they are believed to possess certain medicinal values. Mokokchung district which is known for diversities of frog species like the Malabar Gliding Frog (*Rhacophorus malabaricus*, Jerdon), Giant Tree Frog (*Rhacophorus maximus*, Gunther), Himalayan Torrent Frog (*Amolops marmoratus*, Blyth), Skittering Frog *(Euphyctis cyanophlyctis*, Scneider) etc have been diminished due to excessive exploitation.

It is found that there are 3 endangered species and 4 extinct **primate species**; 20 vulnerable species, 29 endangered species and 5 extinct **bird species;** 7 vulnerable species and 14 endangered **animal species;** 2 vulnerable species and 2 endangered **reptiles species;** 2 vulnerable species and 2 endangered **lizard species;** 2 vulnerable species and 3 endangered **skink species;** 6 vulnerable species and 2 endangered **snake species;** 6 vulnerable species and 2 endangered **amphibian species;** 1 rare species, 14 vulnerable species and 15 endangered **floral species;** 12 rare species, 7 vulnerable species and 19 endangered **large and medium tree species** besides 143 endemic **orchid species.**

As observed in many of the villages in Mokokchung district where jhumming are predominantly practiced, the central reason is associated with the concern for the biophysical limitations of the land form, geology, climate and edaphic conditions of the mountainous terrains of the district, which are not favourable for the expansion of cultivated areas. Moreover the acute shortage of drinking water sources has restricted the expansion of sedentary agriculture with very limited opportunities to expand irrigation and the land area available for permanent cultivation is not enough even for subsistence living for the majority of farmers. In fact, of the total cultivated land in the district 50 percent is under shifting cultivation representing up to 75 percent of the annual family food requirements for greater part of the farmers.

During the last decade in Mokokchung district, jhumming has slightly reduced paving the way for other alternative method of farming. Shifting cultivation has drastically reduced because of low productivity and returns on one hand and better standard of living besides other alternative farming such as orchards farming, animal farming etc on the other hand. The number of families which practiced only jhumming has also declined considerably in almost all the villages of the district, and as a result there is a decline of areas under jhum however the current trend of commercial, monoculture and plantation has cause loss of forest covers, hence loss of Biodiversity.

It is found that the entire Mokokchung district is rich in Biodiversity and its resources, amongst the six ranges, Changkikong, Japukong, Tzurangkong and Langpangkong ranges are extremely rich in Biodiversity mainly because of its large geographical extent having thick jungles and forests, complement by warmer climate as in the case of

Japukong, Tsurangkong and Langpangkong ranges proximately to the border of Assam bounded by thick inaccessible forests which incite upon the migration of birds and animals from the warmer region.

Another factor is that shifting cultivation is drastically diminishing in these ranges compared to Ongpangkong and Asetkong ranges, where shifting cultivation though it has considerably reduced but is more commonly practiced because of its steeper slopes and water scarcity discouraging other alternative method of farming like terracing and wet-paddy field. Asetkong range adjoining to Ongpangkong experienced a warm and humid climate giving rise to dense forests and vegetations but its strategic central location posed a problem as animals, birds and other aquatic resources has been exploited especially by the people coming from urban areas as this range is located near the urban center. Besides the good road connection- National Highway No.61 passes through this range providing access to remote forests have played an important role in Biodiversity decline; the people made use of its facility by taking their vehicles into the interior jungle and forest to make maximum exploitation.

In order to ameliorate the present status of Biodiversity in the study areas, there has been an effort from the village authority and churches in all the selected study areas are trying its level best to conserve and manage forest and Biodiversity under its jurisdiction for better maintenance of environment stability through preservation and where necessary restoration of the natural heritage in a sustainable manner. For making this kind of venture more effective and pragmatic in many villages, the village council has set aside a portion of their erstwhile forest areas converting into Biodiversity conservation site.

This status have also encourages and promote liberal habitat for diversity of fauna particularly in the likes of spotted Deer (*Axis axis*), Parking deer (*Cervulus muntjac*), Wild Boar (*Sus Crestatus*), Jungel cat (*felischaus guldenstaedt*), Tiger (*panthera tigris*), Squirrel (*Funambus*), Pangolin (*Manis tricespis*), River crocodile, Dingo (*Canis Dingo*), Bat (*Rhnolophus),* Mole (*Talpa*), Otter (*Lutra*), Howling monkey (*Mycetes*), Porcupine (*Hystrix bengalensis*) etc in large quantity.

Tsurong River and the surrounding forests at the Tsurangkong range have been completely protected against the use of lime, batteries and dynamite. In order to augment step towards Biodiversity conservation, the village authority has delineate a reserved forest 'Yimkup' (approximately 200 hectare) and has already started tree plantation on an area of approximately 10 acres. Besides, proposal has been made at the 'Tsukong (Range) meeting' that trespassers will be forced to pay compensation in the form of pigs and cattle. It is also encouraging to observed that the practiced of shifting cultivation is also partially discouraged as it promotes deforestation, and jhum cycle has been made mandatory to increased by at least 10 years.

ACTION PLAN FOR SUSTAINABLE CONSERVATION OF BIODIVERSITY

The undertaken research has found out that there is a new trend of awareness on the importance of Biodiversity conservation not only as a resource but for the goodwill of the society in a holistic term. In the study area out of the thirteen (13) villages, ten (10) villages have thirty (30) number of Community Reserved Forests **(APPENDICES I,II,III,IV,V,VI).**

As discussed in the chapter **3- 3.2**, **3.3**, the Nagas have a clear perception of the human-environmental relationship and its interdependence. For the past many decades their cultural way of lives have played a crucial role for the sustainable management and conservation of the Biodiversity within their own environment. In the backdrop of the positive scenario there is also an alarming trend of rapid decline in the status of Biodiversity in Mokokchung district. Such drastic change in the Biodiversity can be attributed to various reasons cited in the preceding chapters and in the beginning of the conclusion of the chapter in particular.

Therefore, there is a need to gap up the problem by introducing a pragmatic policy which is a local and traditional friendly and sustainable in nature. Basing on the research findings following Action Plan and suggestions are put forth for a meaningful outcome towards restoration, sustainable management and conservation of Biodiversity in Mokokchung district which will be relevant for the entire state in general.

- All the Community Reserved Forests declared under the village jurisdiction such as Kanglutu Biodiversity Reserve, Sungkongtsuyong Bird Sanctuary, Serani Lenden Forest, Kongyung Forest, Tzurong Forest, Satsu Tanen, Retongkong, Yimkup etc be thoroughly studied and recognized by the department.

- Detail documentation of each species status of each of the Community Reserved Forests areas need to be ascertained and introduced a management model with scientific input to assist the traditional method.

- River ecology and conservation of important river ecology system in the major River System be studied. University, research institution and the concerned

department should work to strengthen the traditional conservation of river ecology. For example: Dikhu river ecology conservation initiated by Ungma and Longsa vilaages with the help of NEPED is a good initiative. Management of the Dikhu River falls within the jurisdiction of Ungma and Longsa villages. Such initiative can be done to Tsurang, Tsurong, Milak, Menung rivers etc which flows through numerous villages and ranges.

- Identification of migratory birds like Amur Falcon and other birds such as Grey Peacock Pheasant, Large Indian Parakeet etc and the nesting forest like the Changtongya, Yaongyimsen, Tsurong be well identified and preserves with the help of government.

- Research need to be conducted to ascertain the exact nature of the forest, presence of trees, wild fruits, landscape etc. Number of birds, direction of their coming and going, besides changing forest ecology due to such happenings. Besides research documentation and dissemination of education is needed to create local awareness.

In tune with the ongoing Biodiversity Conservation approach all over the state of Nagaland, many villages falling under the jurisdiction of Mokokchung district has follow suit to preserve Biodiversity and numerous aquatic ecosystem within their territory. It is also observed that such positive ventures can meet with high degree of success through proper consideration and adoption of the following suggestion and strategy:

- Instead of complete and immediate abolition of shifting cultivation, attention need to be given to achieve community participation in an effort to promote and maximize the implementation of appropriate new land use strategies to create more productive agricultural systems while simultaneously conserving the forest wealth. Furthermore the consequences of a sudden abolition of shifting cultivation would be extremely negative as many families depending on this practice would no longer be able to sustain when their resources of food ceases without other alternatives. As such, changes should takes place only when other better option is provided to the farmers in a sustainable manner.
- Different department and government agencies import numerous plant species for commercial purpose; this new species do not maintain a close relationship with their new partners and they may overgrow and grow out natural species. This has led to dissolution of the indigenous plants thereby adversely affecting the Biodiversity of the region. Hence government need to have a policy of first protecting the indigenous plant species before introducing of commercial trees and crops.
- There is a need to educate the farmers to encourage planting trees along with other crops in the jhum field preferably leguminous plants like velvet bean, rice bean and soya bean as these plants have dense foliage and are grown mainly to cover and protect the soil (NEPED).
- Monoculture need to be discouraged as it promotes soil erosion due to identical rooting of the same plant thus causing ecological imbalance. Terrace cultivation, organic farming, crop rotation etc should be encouraged.
- There is a need to immediately intervene in the farmer's usage of chemical fertilizers, pesticides, weedicides in farming practices. It causes soil and water

pollution, instead use of biomass, green manure, compost derived from decay and decomposed organic materials could be an alternative to substitute them.

- In Mokokchung district one of the main reasons for cutting down of trees and forests is to meet the purpose of firewood demands, therefore use of alternative source of energy like biomass derived from both plants and animals materials, solar energy, electricity etc need to be encouraged to save and conserve forest.
- Farm forestry practiced on sustainable land management can be an option for safeguarding the local Biodiversity. It also encourage the farmers to be self-sufficient in firewood and small timber demands and at the same time give shelter to wildlife thereby improving the natural environment and replenishing the favourable effect on agriculture.
- To prevent environmental pollution, requisite stipulations for mining leases need to be laid down regarding tenure, size, shape and disposition with reference to geological boundaries and other mining conditions to ensure systematic extraction of minerals along with environmental conservation.
- Government need to consider implementing laws prior to environment assessment restricting mining and quarrying activities in sensitive areas such as hill slopes, areas of natural springs and areas rich in biological diversity.
- To mitigate environmental repercussion in mining and quarrying operations, the government needs to implement proper management plans and rehabilitation concurrently with the ongoing mining operations to bring about ecological restoration in the affected areas.
- Before implementing big projects for development purpose, Environment Impact Assessment (EIA) must be done with the involvement of civic bodies so that there is accountability and minimum impact is done to various environments.

- Logging of forest for financial gains should be strictly stopped with the help of government departments. Afforestation policy should be popularized and initiated jointly with the committee region wise within a specific time frame.
- Concept of government forest management should incorporate amid habitat protection for overall conservation of Biodiversity.
- Scientific studies should be initiated before protected area/forest is earmarked.
- Scientific approaches such as documentation and computerizing databases and qualitative information from the collection of detailed inventory flora, fauna and microbial species existing in the protected areas, sacred groves and forests will be of great help in policy formulation and proper programme implementation.
- Eco-tourism and eco-development codes for Biodiversity significant areas could be promoted in harmony with the environmental conditions and without affecting the lifestyles of local people. For instance Tuli-Debuia-Japu-Tzurang-Changki-Aliba-Longkhum belt which is a rich Biodiversity zone can offer potential eco-tourism and bio-resources in the district.
- Sustainable urban development need to be endorsed by all policy makers, planners, engineers, architects and builders by treating all urban form as a habitat for both human and other organism. Locations where Biodiversity and supply of ecosystem services are concern, urban planners could also consider the wetlands, water ways, indigenous food trees, under storey plants, indigenous trees needed for nesting by birds etc. Moreover, sustainable urban development will also minimize the loss of ecosystem service and maximize the retention of local Biodiversity.
- Urbanisation trend will continue to increase in Mokokchung district eventually leading to Biodiversity loss therefore urban green space is needed to developed

in the urban centers like Mokokchung town, Changtongya town, Tuli town, Mongkolemba town etc as it would serve as a prime refuge for plants and animals in the urban towns and centers and can harbour surprisingly high species richness. For instance maintaining of green belt area like the Dikhu Green belt zone jointly by Ungma and Longsa villages which are located in proximity to Mokokchung town. This species richness can be explained by the geographic situation of the cities (Araujo 2003, Kühn et al. 2004), by the high habitat heterogeneity within urban green spaces (Hermy & Cornelis2000).

- Maintenance of corridors between jungles, forests and protected areas within a particular territory through the co-ordinate efforts between two or more villages sharing a common jungles and forests can make the conservation approach more significant and successful. For instance Minkong Forest is jointly shared by Chuchuyimpang, Sungratsu and Longmisa villages, these villages have been preserving this forest for generations where there is complete restriction on hunting and gathering of forest resources. Similarly, Mokokchung village is having large geographical area is rich in forest resources bounded by Ungma, Chuchuyimpang, Longsa and Khensa villages of the Ongpangkong range, Mopungchuket and Sungratsu villages of the Asetkong range and Chari village of Tuensang district.
- There are many strategic places for corridor maintenance such as Tuli-Anaki-Kangtsung regions; areas around Menung River bordering Longjang and Asangma villages; forest area bordering Longkum-Mangmetong-Aliba villages etc. If these villages belonging to different ranges and district implement a common law and regulations to preserved forest and Biodiversity falling in their

respective territories, then conservation approach will be more pragmatic and would yield effective results by spreading to the neighbouring territories.

- Implement strict customary and government laws against hunting, poaching, use of chemicals and poisonous substances for fishing could be supplement by meting out heavy penalty and hard punishment. Implementing such Act need to be started from the grass root level through sincere cooperation between the customary and the governmental law.
- As rigid preservation of Biodiversity would get in the way of people's livelihood, Conservation of Biodiversity should be laid down in accordance with traditions, customary laws and village councils. For instance gathering of herbs, plants, firewood, bamboo shoots etc should be open for a stipulated period of time and closed during gestation and breeding season.
- The role of NGO's can promote education and awareness by conducting seminars and workshop among the local masses to respect and protect their environment thereby strengthening the traditional practices and mechanisms in the management process and ensuring their livelihood security in a sustainable manner in the local community.
- Involvement of local people in the policy making for conserving forests and Biodiversity because village community in the Naga society is the sole custodian for the management of land and its resources. This step can bring concrete ways for devising means by which the local people can conserve and judiciously utilized the resources of the common land.
- Participation of people irrespective of gender need to be encouraged. Gender issues particularly with regard to women ownership discouraged the

implementation and progression of such Act and therefore should be critically considered.

- Respecting and appreciating the role of Naga-women in applying traditional method and practices in the jhum field, biodiversity and all forests link activities because even the two key objectives of Chapter 24 of Agenda 21 (UNCED, 1992) are to promote “the traditional methods and the knowledge of indigenous people and their communities, emphasizing the particular role of women, relevant to the conservation of biological diversity and the sustainable use of biological resources” and to ensure “participation of those groups in the economic and commercial benefits derived from the use of such traditional methods and knowledge”.
- Recognizing the value of traditional knowledge of the indigenous people, skills and practices and their right to benefit from the fruits of their labour is of paramount importance as these are “rights arising from the past, present and future contribution of indigenous farmers in conserving, improving and making available plant genetic resources, particularly those in the centers of origin/diversity”. The purpose of these rights is to "ensure full benefits to farmers and support the continuation of their contributions” (FAO, 1989).
- Providing and protecting the right to access of Biodiversity and community intellectual property right, especially with regard to the use of traditional healings, traditional medicines, indigenous knowledge system, traditional practices of Biodiversity conservation etc where they can have a stake in the continuity productivity of the resources. Because these local knowledge is highly refined and is traditionally shared and handed down between generations. Through practice, innovation and experimentation, sustainable practices are

developed to protect soil, water, natural vegetation and biological diversity. This has important implications for the conservation of plant genetic resources.

In addition to this, participation of women in Biodiversity conservation should be more emphasized because 90 percent of the planting materials used in agricultural fields are derived from seeds and germplasm that they have preserved, selected and saved by women. Furthermore, women farmers are largely responsible for the selection, improvement and adaptation of plant varieties; the selection of varieties is a complex, talented process that depends on choosing certain desirable characteristics (for instance, resistance to pest and diseases; soil and agro climatic adaptability; nutritional, taste and cooking qualities and food processing and storage properties) and these traits were acquired by Naga-women that have been handed down through generations through practical experience.

Naga women are also responsible for the management of small livestock, including their reproduction and often have a more highly specialized knowledge of wild plants used for food, fodder and medicine than men. Through their daily work, Naga-women have accumulated a unique decision-making role and intimate knowledge of their ecosystems, including the management of pests, conservation of soil and the development and use of local plant and animal genetic resources. With all these facts, gender-based differences should be discourage as both men and women have developed different expertise and knowledge about the local environment, plant and animal species and their products and uses as food in times of need, as medicines and sources of income through their different activities and management practices.

Currently In Nagaland women's involvement in formalized efforts to conserve biodiversity is slight because of wide spread cultural barriers to women's participation in decision-making arenas at all levels, on the other hand both the Convention on Biological Diversity (UNEP, 1993) and FAO's Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (1996) acknowledge the role played by generations of both men and women farmers, and by indigenous and local communities, in conserving and improving plant genetic resources. They affirm the need for women to participate fully in conservation programmes and at all levels of policy-making.

The challenge for future generations is to safeguard Biodiversity including agriculture by protecting and promoting the diversity found in integrated agricultural systems, which are often managed by women. The maintenance of plant and animal diversity will protect the ability of both men and women farmers to respond to changing conditions, to alleviate risk and to maintain and enhance crop and livestock production, productivity and sustainable agriculture. These approaches seriously needs improvement of women farmers' access to land and water resources, to education, extension, training, credit and appropriate expertise as well as participation of women as partners, decision-makers and beneficiaries.

Sharing of benefits among the concerned individuals should also be clearly stated. Land owner rights should not be sidelined and marginalized while formulating criteria and

framing guidelines for accessing, approval and licensing mechanism for commercial utilization, bio-survey and bio-utilizing, bio-prospecting and material transfer of any biological resources, because the land belongs to the people and it would directly affect the people if it fail to compliment with the traditional laws and customs.

The research work attempts to provide a measure for an effective intervention on the ongoing trend where eco-centric developmental policies like the 'Green building' and 'sustainable urban development' by using natural materials that are available locally with the common objective to reduce the overall impact of the built environment on human health and the natural environment by efficiently using water, energy and other resources, reducing waste, pollution and environmental degradation are suited best. A policy that involve the community in protecting the forest, rivers and natural resources by incorporating the traditional values, costumes and practices by effectively carrying out for managing and conserving the environment would be most successful.

For the Nagas, Biodiversity and the physical environment that surrounds them is not just an object or asset but are sacred. They have a deep sense of socio- cultural and spiritual attachment with the Biological diversity. Therefore to restore and conserve the Biodiversity of Mokokchung district in particular and the state in general, it is vital that any constructive policy for effective conservation and development of Biodiversity would require serious consideration of the socio- cultural and scientific approach.

From the undertaken research work, the scholar has carried out intensive work on human-environmental relationship from physical and cultural perspective. The researcher felt that there are many vital areas which do not come within the framework of the study but need to be studied, such as the cultural and traditional system of the Ao-Nagas for conservation of the Biodiversity and the impact of urbanization on the dynamics of Biodiversity. As such the undertaken research can only be the bases for all these above mentioned dimensions in the study of Biodiversity in the given area and the state in general. In spite of many shortfall and uncovered area of study, the strength of the undertaken research takes on the challenges pose by the emerging human environmental interface. It also opens up the scope for further research in the area for multi-dimensional studies.

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APPENDICES

APPENDICES

The following appendices show the forest conservation and distribution in all the six ranges of Mokokchung district.

APPENDICE- I ONGPANGKONG RANGE

COMMUNITY RESERVED FOREST	VILLAGES WITH LARGE FOREST COVER
Serani Lenden Forest (Chuchuyimpang village)	Aliba (1250 Hectares)
Kongyung Forest (Chuchuyimpang village)	Ungma (600 Hectares)
Sungadin Min (Longkhum village)	Longsa (450 Hectares)
Anungmeyong Min (Longkhum village)	Khensa (320 Hectares)
Osaknuyong Min (Longkhum village)	Mangmetong (200 Hectares)
Amalongpang (Longkhum village)	Longkhum (150 Hectares)
Mongsen Yimlu (Longkhum village)	Chungtia (150 Hectares)
Chaok Yimlu (Longkhum village)	Mekuli (150 Hectares)

(Source: Field Survey 2009- 2013)

APPENDICE- II ASETKONG RANGE

COMMUNITY RESERVED FOREST	PRISTINE FOREST	VILLAGES WITH LARGE FOREST COVER
Yangermanglupok- Core Zone (Mopungchuket village) Nashimer (Mopungchuket village) Aidang (Mopungchuket village) Shirkimong-Buffer Zone (Mopungchuket village) Yimlipang Ba (Longjang Village) Shengtakba Lopok (Longjang Village) Longpha Septsu (Longpha village) Ajimeyong (Longpha village) Meyong Pentong (Longpha village) Ak tsuba (Longpha village) Yangerlo (Longpha village)	Longpak Sep (Longjang Village) Salangtemok (Longjang Village)	Sangratsu (1500 Hectares) Mopungchuket (245Hectares) Chami (90 Hectares) Longjang (42 Hectares) Longpha (28 Hectares)

(Source: Field Survey 2009- 2013)

APPENDICE- III LANGPANGKONG RANGE

COMMUNITY RESERVED FOREST	VILLAGES WITH LARGE FOREST COVER
Kanglutu Biodiversity Reserve (Changtongya village) Sungkongtsuyong Bird Sanctuary (Merangkong village)	Wameken (1517 Hectares) Kilingmen (700 Hectares) Mongsenyimti (510 Hectares) Merangkong (500 Hectares) Chakpa (216 Hectares) Yaongyimsen (162 Hectares) Chuchuyimlang (100 Hectares)

(Source: Field Survey 2009- 2013)

APPENDICE- IV CHANGKIKONG RANGE

COMMUNITY RESERVED FOREST	PRISTINE FOREST	VILLAGES WITH LARGE FOREST COVER
Anujakong (Molungkimong village) Ali Rongkong (Molungkimong village) Aleptoi (Debuia village)	Kalomang (Debuia village) Tenemtsuyong (Debuia village) Tzurong Forest (Debuia village)	Changki (9700 Hectares) Debuia (8670 Hectares) Waromong (7395 Hectares) Molungkimong (500 Hectares) Alongkima (165 Hectares)

Jorbenna (Debuia village) Shamalang (Debuia village)		Mongchen (150 Hectares) Khar (140 Hectares) Chungliyimsen (116 Hectares)

(Source: Field Survey 2009- 2013)

APPENDICE- V JAPUKONG RANGE

COMMUNITY RESERV$ED FOREST	VILLAGES WITH LARGE FOREST COVER
Satsu Tangen (Japu village) Retongkong (Japu village) Changtang Biodiversity Reserve	Longjemdang (900 Hectare) Japu (800 Hectares) Lirmen (600 Hectare) Akumen (400 Hectare) Yajang A (200 Hectare) Yajang C (200 Hectare) Lakhuni (136 Hectare) Changdang (128 Hectare)

(Source: Field Survey 2009- 2013)

APPENDICE- VI TZURANGKONG RANGE

COMMUNITY RESERVED FOREST	VILLAGES WITH LARGE FOREST COVER
Yimkup (Longpayimsen village)	Moayimti (1051 Hectare) Molungkima (870 Hectare) Longpayimsen (600 Hectare) Molungyimsen (500 Hectare) Medemyim (258 Hectare) Chungtiayimsen (164 Hectare) Aokum (100 Hectare)

(Source: Field Survey 2009- 2013)