

**IMPACT OF SHIFTING CULTIVATION ON ENVIRONMENT IN
MOKOKCHUNG DISTRICT, NAGALAND: A GEOGRAPHICAL
ANALYSIS**

**Thesis Submitted to Nagaland University
in Fulfillment of the Requirements
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**DOCTOR OF PHILOSOPHY
In
GEOGRAPHY**



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CERTIFICATE

This is to certify that the thesis submitted by Ms.Brenda towards the degree of Doctor of Philosophy (Ph.D) in the Department of Geography on title **“Impact of Shifting cultivation on Environment in Mokokchung District, Nagaland: A Geographical Analysis”** 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, recommend 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.Brenda, do hereby declare that this thesis on “**Impact of Shifting cultivation on Environment in Mokokchung District, Nagaland: A Geographical Analysis**”, 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 bases 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 my research degree in any other University.

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CHAPTER: 1 – INTRODUCTION

1.1 Introduction

Shifting cultivation commonly known as Jhumming is one of the most ancient system of farming believed to have originated in the Neolithic period around 7000 B.C (Borthakur, D.N. 1992). It is also alternatively called as Slash and Burn method of cultivation. The system is regarded as the first step in transition from food gathering and hunting of food production. It is practiced in different parts of the world. It is the principal method of agricultural practice among the Naga people which consists of clearing of plot of forest land by burning the vegetation and cultivating the plot of land for one or two years. After this, the old cultivated land is then left fallow so that to regain the vegetation cover.

Shifting cultivation is described as “an economy” of which main characteristics are rotation of fields rather than crops; clearing by means of fire, absence of draught animals and manuring, use of human labour only, employment of dibbling stick or hoe; short period of soil occupancy alternating with long fallow periods (Satapathyetal,2003). It encompasses cropping system such as horticulture and annual cropping, perennial tree crops, animal husbandry, and management of forest and fallows sequential or rotational cycles (Thruppatal, 1997).

About 10 million hectare of tribal land stretched across 16 states estimated to be under shifting cultivation in India (Eswaraiah, 2003). Based on recent satellite images, it is estimated that 1.73 million hectares of land use affected by shifting cultivation in North east India (FSI, 2000). While an estimated 12% of tribal population in India still practices shifting cultivation, the number of families involved in shifting cultivation in Northeast India is estimated to be 4.5 lakhs (MOEF, 1997).

It is widely persistent among the indigenous communities, the practice continues to be the dominant land-use system and mainstay of economy of the hilly people in the south and Southeast Asia, including India's Northeastern region. It is a mode of cultivation that has evolved in response to the most difficult terrain and topography under inhospitable environments through centuries of trials, struggles and field experiments with nature. Cultivation of Jhumming seriously affects the forest cover as it destroys the vegetation and damages the resilience characteristics of the ecological environment. *Most scholars opine that the causes of continuity of this prehistoric system are largely linked up with the ecological, economic and cultural aspects of the communities practicing shifting cultivations (Sharma, 1976).*

Keeping in view, shifting cultivation will not go easily from Naga farming systems, improved fallow management practices can therefore, be an option for

improving the livelihood and food security. It continues to draw the serious attention to both policy makers and development practitioners in the world.

1.2 Objectives

The main objectives of the Study area:-

1. To promote sustainable economic development of the people living in rural areas.
2. To study the spatial distribution of land use patterns.
3. To propose management plans for its natural habitat that is usually destroyed during Jhum operations.
4. To evaluate the cropping pattern.
5. To promote environmental conservation and restoration of ecological balance.
6. To generate and adopt technologies that promotes sustainable use of resources and improve livelihood.

1.3 Hypothesis

The study postulates the following hypothesis:-

1. Increase of population leads to reduction in Jhum cycle which as a consequence causes rapid loss of forest resources.

2. Jhumming irreparably deals upon bio-diversity and depletes flora and fauna riches of the area.
3. Jhum cultivation causes pollution of the air which ultimately leads to Global warming.

1.4 Data Base and Methodology

a. Primary Methods

Apart from the collection of secondary source of data, field survey was carried out to assess the different parameters based on some sample villages under Mokokchung district. The studies covered all the farming communities, cultural groups, different agricultural land use patterns, environmental degradation so as to understand the issues and problems of shifting cultivation and the social implications of the farming communities. Data collection was also carried on through personal interviews; discussion with the farmers, as well as field survey observations with questionnaires was also carried out.

The quantative data of the study area was obtained and classified to get information from the following categories:

1. Land under shifting cultivation
2. Area under land use and land cover

3. Types of agricultural cropping and production
4. Land under permanent farming and plantation etc.,

To understand the pattern of land resource utilization, an intensive field survey of few sample villages was selected based on random sampling method.

The following data was applied to achieve the objectives:

1. Occupational structure of the village.
2. Indigenous or traditional knowledge based on land use and preservation.
3. Land ownership-private, community or Government.
4. Income of the households from the agricultural productivity.

b. Secondary Methods

Secondary sources were collected from the Central and State Government Reports, information articles from journals, magazines, books, newspapers, different libraries, relevant Government publication of Mokokchung district, Nagaland, Northeast and India, websites etc., on impact of environment, issues of land management and relevant information such as occupational structure of the people, demand and supply of the agricultural products. The data collected from various sources was systematically processed, classified and computed, some of which were computed using tables, pie-charts, graphs and also with representative maps.

a. Sample Survey

Out of the total 102 inhabited villages of the district (2001 census), 5 (five) sample villages was selected. Out of the five sample villages, area under shifting cultivation, types of agricultural cropping system and impact of environment were analyzed through conducting sample surveys.

c. Data Analysis

The data collected was thoroughly checked, assessed, tabulated and cross examined using appropriate statistical tools and techniques like contingent valuation method and regression etc.

1.5. Study Area

The study area was concentrated under Mokokchung district. It has a geographical area of 1615 Sq.km situated in the north-western part of Nagaland. The district lies between 93 53' and 94 53' East Longitude and 25 56' and 27 40' North Latitude. It is bounded by Assam in the north, Wokha district in the west, Tuensang and Longleng districts in the East and Zunheboto district to the south. It comprises of 8 (eight) circles and 6 (six) ranges. The total population of the district was 1, 93,171 (2011).

The traditional method of shifting cultivation is a rain-fed cropping system usually practiced on forest hilly terrain of mild steep slopes and Nagaland State rank first in holding this traditional method of farming. Out of the State 95550

hectares of total Jhum paddy in 2011-2012, Mokokchung district covers an area of 9770 hectares.

1.5 Statement of the Problem

Shifting cultivation has been a subject of debate and intervention since the colonial era, and has often been a victim of public misconceptions. Often the practice has been criticized by environmentalists, foresters, and developmental practitioners and policy makers as being “*Primitive, backward, destructive or wasteful*”, and as a mere precursor to more “*modern, sustainable*” and *sedentary forms of agriculture*. Contemporary critics of shifting cultivation, *pejorative terms that perpetuates misperceptions about shifting cultivators* (Thruppetal, 1997).

Nagaland which is situated in the Northeastern part of India is one of the most underdeveloped States, having its own distinctiveness and peculiarities. It covers an area of 16, 579 Sq.km. Having a population of 1,980,602 with an average density of 119 persons per Sq.km (2011 census). The Jhum paddy covers an area of 95550 hectares with a total production of 171940 metric tons (2011-12).

Land is the most basic asset among the Ao-Naga community of which the land system is based on the community ownership (Colchester, 1997). *Indigenous People ancestral territories are not just their economic base, these lands are*

intimately bound up with their cosmologies and identities as communities, and as peoples (Majid Husain 1997). In the hilly terrain of the Northeast India, Jhumming is the dominant economic activity. Over 80% of the people living in the hills are dependent on shifting cultivation.

The natural environment is tremendously affected a lot due to massive deforestation which is a direct effect by shifting cultivation. Owing to unchecked growth of population and over-exploitation of forests their ecosystems have become highly fragile and have lost them of their resident character. The narrowing down of the Jhum cycle has arise lots of consequences that has brought decline in soil fertility, decreasing agricultural crops productivity yields, increased poverty affecting environmental degradation of local environment. The Government Protected forest and also the village protected forest meant for conservation have been degraded a lot. *The area is placed under severe threat of soil erosion and de-forestations mainly due to shifting cultivation (Singh and Singh, 1981).*

Wagh, et al (1984) *have viewed that the land resource for agricultural activities should be assessed on the basis of slope, dissection index, soil and vegetation cover and land-use of a land at micro-level.*

The present environmental consequences are likely to increase in the future and it will cause hazards. So, it is therefore necessary to implement that planning strategies in conserving the environment in all the communities and

State as a whole. Many of the study reports of Government suggest liberal diversion of forest land particularly fallow forests within the USF areas for expansion of permanent agriculture or development of cash crop plantations as a possible answer to reduce the practice of shifting cultivation and to wean away the shifting cultivators. A systematic evaluation of the carrying capacity of Jhum will have to be undertaken to help the Government in formulating sustainable policies for the growing population. There are also several indigenous innovations by the shifting cultivators themselves in response to growing challenges of Jhumming. *The Indian Council of Agricultural Research (ICAR) through several viable alternative landuse models and land management practices than can be introduced in areas under shifting cultivation (ICAR, 1985; Borthakur, 1992).* The models were based on evaluation in terms of their long term runoff, production potentials, soils and nutrient losses; yield behavior, biotic and abiotic changes and so on.

1.6 Significance of the Study

The finding of the study will be very helpful and useful for the farmers as well as the Government in forming suitable and remedial measures in shifting cultivation. By promoting a sustainable development towards land use systems, cropping systems and environmental restoration and conservation. It will be relevant in understanding the role of communal ownership in the utilization of

landscape for the particular purpose such as crop land, agro-forestry, commercial agricultural production, agro- plantation crops, and the fertility of the soil content.

1.7 Review of Literature

Shifting cultivation known as Jhumming is one of the most ancient system of farming believed to have originated in the Neolithic period during 7000 B.C (Borthakur, D.N,1992).

Jhum cultivation is woven into the traditions and culture of the Nagas with major land use is under Jhum. Traditionally all the tribes in the State practice slash and burn type of cultivation. This type of cultivation has brought lots of tremendous impact on environment in the recent years. It continues to draw serious attention from policy makers, development practitioners and academicians and continues to be viewed as environmentally not sustainable. Insufficient land availability and inadequate time for the land replenishment and recovery of forest cover in the current situation suggests that options have to be found within the existing constraints for Jhum cultivation and evolving ways to ensure better forest generation. *Cultivation continues to be the mainstay of the region's economic and political choices and that turns land encroachment into a major threat to their livelihood (Melville Pereira, Walter Fernandes, 2005).* Human impact on the

environment takes in the form of unscientific method of agricultural cultivation, mass destruction of forest cover, overgrazing, and the overuse of the natural resources.

According to **(B P Maithani, 2005)** “*Shifting cultivation in Northeast India (Policy Issues and Options)*” deals about the controversial as the perceptions of the tribal farmers practicing shifting cultivation. The author has been able to reconcile these approaches by suggesting with facts and figures that increase productivity. An alternative farming system could also be developed simultaneously for the economic well being of the tribal Jhum cultivators. This balance approach tends eminently useful to the policymakers and project implementation and policies.

R.B Mandal (1990) in the book” *Land Utilization: Theory –Practice*” deals with the anthology of land utilization- the basic concept and models of land use, principal approach of study, land use classification, agricultural efficiency, land conservation and agricultural region and land use planning from various part of the globe by taking some samples. Hence, this book has at a significance of spatial analysis a developing a region for economic progress and social justices.

Anil Kumar D E, Arnab Kumar D E (2003) “*Man Nature and Environment*” – deals with the elements comprising the environment and then explain the concepts of ecosystem and ecology. It highlights the inter-dependent nature of life on the earth and the impact of population and development on the environment.

Environmental consequences like green house effect, ozone hole, desertification, deforestation are adequately explained the kinds of environmental pollution as well as strategies of development have also been highlighted and focus on environment in Northeast India also.

Books on the Northeast Region on Environmental degradation were also reviewed-

B.S.Chauhan (2001) “*Shifting cultivation in Perspective*” the book deals with the shifting cultivation related issues (Productivity, impact on eco-system, degradation, ecological losses, stability and short and long duration cycles). Proper management of natural resources are been stressed out and the consequences of degradation of natural resources. It is therefore, imperative that the impact of shifting cultivation on our natural resources in Northeast region is evaluated properly and alternative methods of cultivation are assailable within the prevailing socio-economic conditions are evaluated. For different parts of the region he also attempts to evaluate the impact of shifting cultivation particularly of short duration cycles, on the degradation of ecosystem and suggest viable alternatives to shifting cultivation.

Medhi, R (1992) “*Global Warming and its Implications for the Development World*” – he opines that the fast dwindling of forest cover had posed a serious ecological problem. It states that, forest area in this region is in great threat of

extinction due to mass clearance of forest cover. As a consequence, it not only threatens the extinction to various species but also lead to ecological imbalance in the environment. He emphasizes on the importance of conservation of plant resources of the region by taking various steps and by scientific cultivation through social Afforestation by involving the community.

(Goel , Goplakrishna, 2000) in '*the Geography of North-East India*' also points out despite the fact the region's loss of rich biodiversity is due large scale of deforestation and the continuing impact of traditional practices of shifting cultivation or Jhumming have made the vegetation cover deplete so rapidly in terms of areas and variety.

"The Ferns of Nagaland" **(Jamir, Rao (1998))** highlights the shifting cultivation 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 the increase in human population, heavy incidences in the pressure of land for agriculture has also been responsible for removal of forest cover and in turn results in barren or only grass, shrubs that covered the hills in the State.

Walter Fernades, Nafisa Goga D'Souza (2006) "*Climate Change and Tribal Sustainable Living: Responses from the Northeast*"- The book brings together some papers on issues with special reference to the tribal's in India, specially the Northeast which is rich in biodiversity but is rarely taken into consideration on justices issues. The author's contribution to an understanding of sustainable living

as alternative which will be a response from the Northeast of India to the climate changing crisis facing the world.

Vandana Shiva, Gitanjali Bedi (2002)”*Sustainable Agriculture and Food Security: The Impact of Globalization*” It deals with the concern of inter-link issues of globalization, the environment, livelihood and food security in the developing world. It also contributes to maintain that the sustainable use of natural resources such as land and water requires that their ownership lies with decentralized agricultural communities by covering a wide range of issues.

Nigel J.R, Allan (ed) (1995) on the book “*Mountain at Risk Current Issues in Environmental Studies*” deals with the changing view of mountain environment. The geo-ecology paradigm that has been the standard means of interpreting the mountain environment for many decades has now given way to a variety of contextual avenues of investigation. It demonstrate the various nature of mountain studies, the role of mountain forest, hazards and risks, wildlife habitat, global climatic change, agricultural biodiversity and protected areas.

Bhaskar Chandra Biswas (2006)” *Environmental Geography*” He stressed out the relationship between people and their habitat in the environment. It concerns about the climatic change by anthropogenic release of green house gases, notably carbon dioxide and their interactions with human uses on natural environment. It

also emphasis an overview on environmental dilemma and the factors that need to be examined in order to understand the problem.

P.R.Trivedi, Gurdeep Raj (1992)”*Environmental Problems Impact Assessment*”- It deals with the impact assessment of environmental problems which has recently gained tremendous references in our interaction with the environment due to the dangerous dimensions of environmental pollution. This is largely cause due to disruption of the natural ecosystems of the world by man activities.

William J. Bond, Brain W –Van Wilgen (1996) “*Fire and Plants – Population and Community Biology Series -14*” The book studies on the fire ecology that contributes to the areas of current research in ecology including the importance of disturbance for maintaining diversity and events that determines of community composition. An understanding of forest fire is of immediate applied importance in forestry, conservation and range management.

Lesley Head (2000) “*Cultural Landscapes and Environmental Change*” emphasized with different culture conceptualize the human role in nature is central to the way in which environmental management decisions are made. The book then moves on to discuss the relevance of the perspectives to contemporary issues through a wide variety of international case studies.

Paulsamy (1998) in the book “*Introduction to Environment Biology*” stresses out the environmental problems and everyone should be given education so that every individual citizen can make a contribution towards control of the environmental problems.

P.S.Ramakrishnan (2001) “*Ecology and Sustainable Development-Working with Knowledge Systems*” discuss the community participation in natural resource management. Policies are linked to sustainable management and human managed ecosystems with concern for sustainable livelihood of rural societies.

M.Safi (1997) The only way to preserve the rich biodiversity of the North Eastern hill areas is by giving adequate employment to the tribals, living in and around the forest area.

Majid Husain (1997) Owing to unchecked growth of population and over-exploitation of forests their ecosystems have become highly fragile and have lost them of their resident character.

Kaushik, A, Kaushik, C.P (2004), *Perspective in Environmental Studies*, asserts that how exponential increase in population coupled with ways to attained high standards through technology advancement has resulted in widespread contamination of the environment has come up the global level. He also points out how man centric approach of development has already damaged the nature to a

large extent and strongly view that the objective of environmental protection cannot be achieved without the involvement of the masses at the grass root level.

(Ronnie Vernoooy, Liz Fajber, 2006) Problems related to the sustainable management of natural resources are most critical in the uplands and coastal areas, where natural resources degradation can often lead to irreversible loss of food sources and the breakdown of ecosystem with loss of habitat.

Vengota Nakro, Chozhule Kiki (2006) Sustainable development in Nagaland depends primarily on a balanced approach that includes conservation, sustainable management of existing lands and forest, the exploitation of new forest resources, and adapting agricultural systems over time .

CHAPTER: 2 - PHYSICAL FRAMEWORK OF MOKOKCHUNG DISTRICT

2.1 Introduction

Nagaland is the homeland of the Naga tribes and of the “Seven Sisters” of the Northeast of India located between 25 6’ N and 27 4’N latitude and 93 20E and 95 15’E longitude having a geographical area of 16,579 Sq.km. Out of which Mokokchung district has an area of 1,615 Sq.km with an average density of 120 persons per Sq.km which is inhabited by the Ao-Naga tribes. In accordance with the legends and traditions says that the Aos sprung up from ‘Longtrok’ which means ‘Six Stones’. They then founded the Chungliyimti village where they settled and stayed for a considerable period of time. It is the starting point of the different aspects of development of Ao-culture. In due course of time, they crossed the Dikhu River by a cane bridge leaving other people behind. The people (Aos) who went ahead leaving others behind came to be known as ‘Aoer or Ao’ which means ‘going or gone’. First they occupied a place named as ‘Soyim’ (Ungma) under Ongpangkong range which is the southernmost range and also the highest altitude of all the ranges. In due course of time, from there they have migrated to different places and gradually as population grew it eventually spread out to different places establishing different villages. The word ‘MOKOK’ means

defiance and 'CHUNG' means the act of going apart. The Aos belong to three dialectal different groups namely Chungli, Mongsen and Changki and most comparatively among the well developed districts in Nagaland.

Before the coming of the Britishers the present site of the Mokokchung was a thick forest. The British administrative Headquarters was established there since February 28th 1890 as a Sub-Divisional headquarters till the formation of Naga Hills Tuensang Area (NHTA). On 1st December 1957 when it became a district of NHTA it remained a district even after Nagaland attained its statehood in 1963 with Wokha and Zunheboto as its sub-divisions. Later in 1973, it was demarcated into three districts namely-Mokokchung, Wokha and Zunheboto. The district lies between 93 53' and 94 53' East Longitude and 25 56' and 27 40' North Latitude. It is bounded by Assam in the north, Wokha district in the west, Tuensang and Longleng districts in the East and Zunheboto district to the south (Fig. 2.3). It comprises of 8 (eight) circles i.e. Longchem, Alongkima, Tuli, Changtongya, Chuchuyimlang, Kobulong, Mangkolemba and Ongpangkong and with (six) ranges- Ongpangkong, Langpangkong, Asetkong, Japukong, Tzurangkong and Changkikong ranges which is inhabited by 102 villages (2001 census). The total population of the district was 1, 93,171 (2011 census) of which there was a change of -16.77% in the population compared to population as per 2001. Having a sex ratio of 927 females for every 1000 males and a literacy rate of 92.68% with rural population comprises of 1, 37,517 followed by urban 55,654 (2011 census).

NORTHEAST REGION IN INDIA, NAGALAND IN THE NORTH EAST

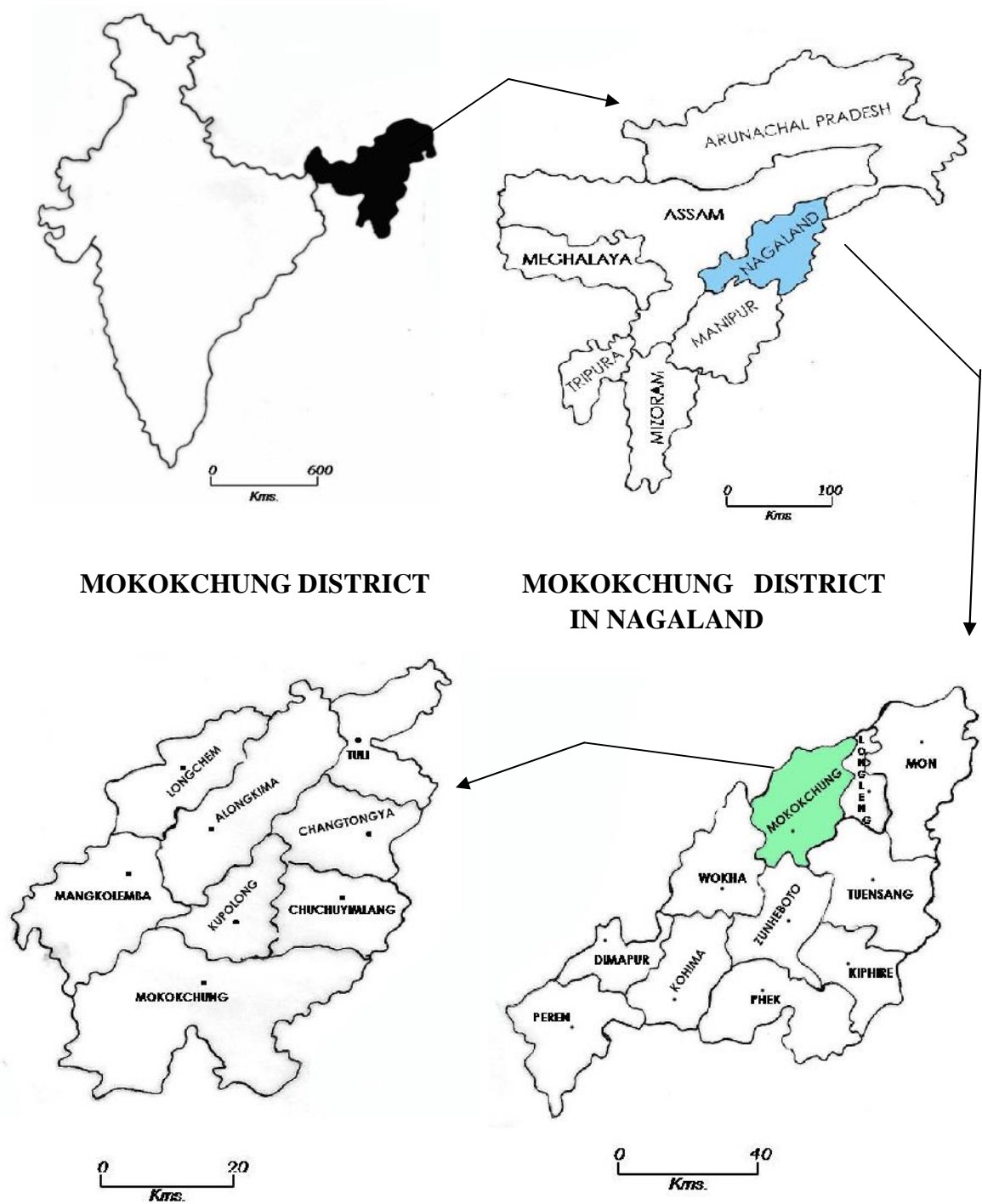


Fig: 2.1 Location Map of the Study Area viz. Mokokchung District of Nagaland

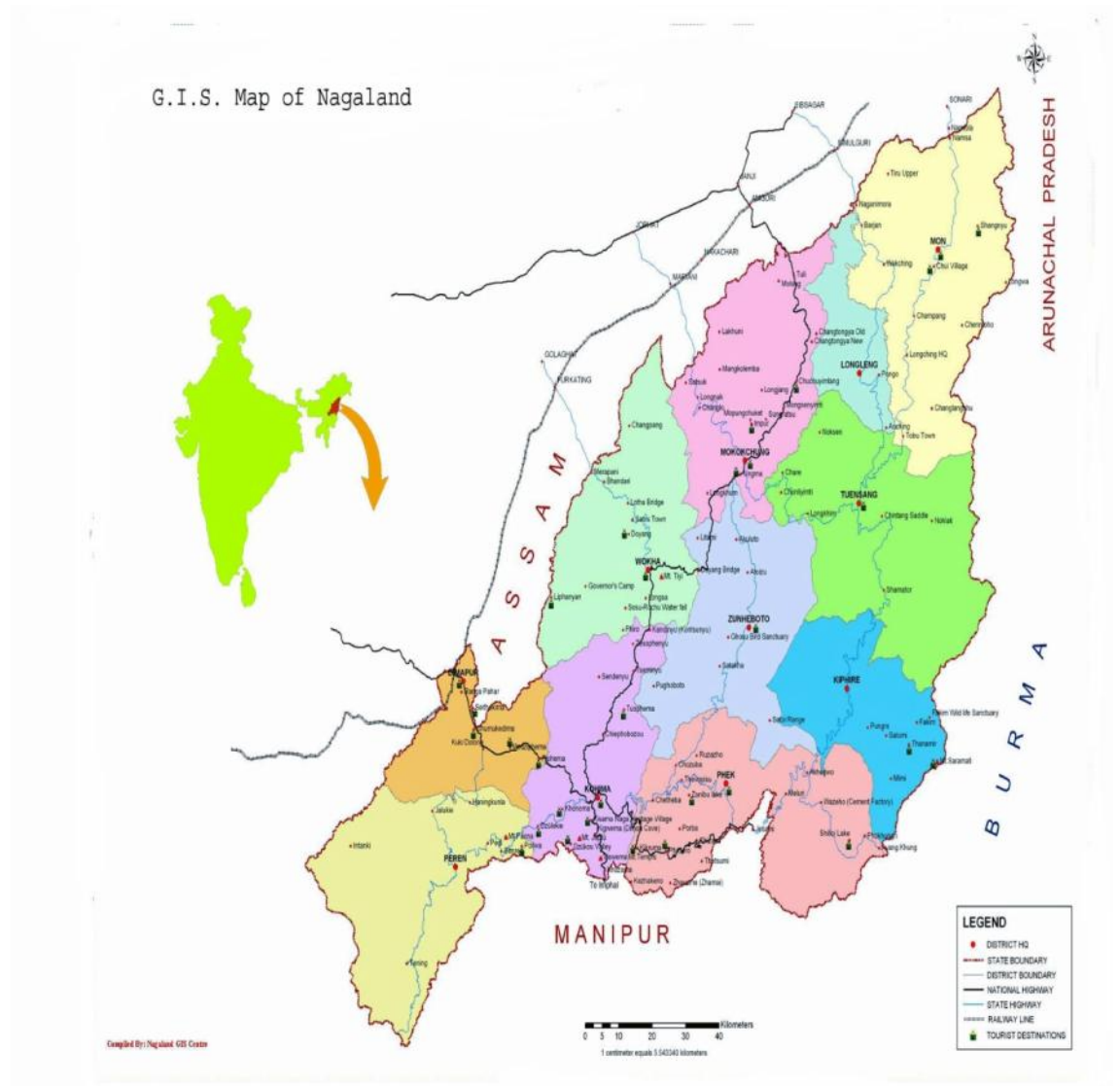


Fig: 2.2 Map of Nagaland



Fig: 2.3 Mokokchung District, Nagaland

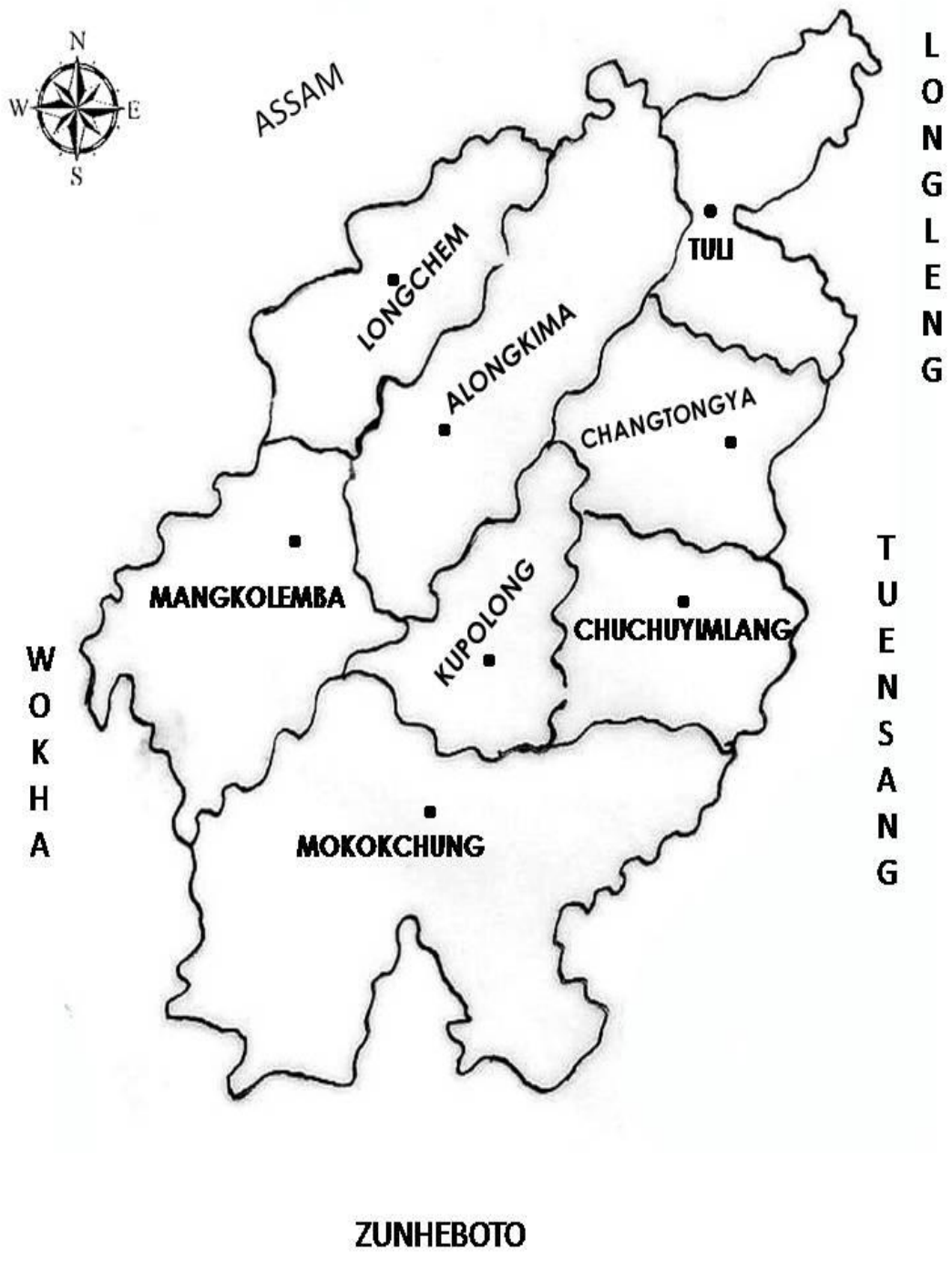


Fig: 2.4 Map of Mokokchung District showing eight circles

Physiography Map of Mokokchung District

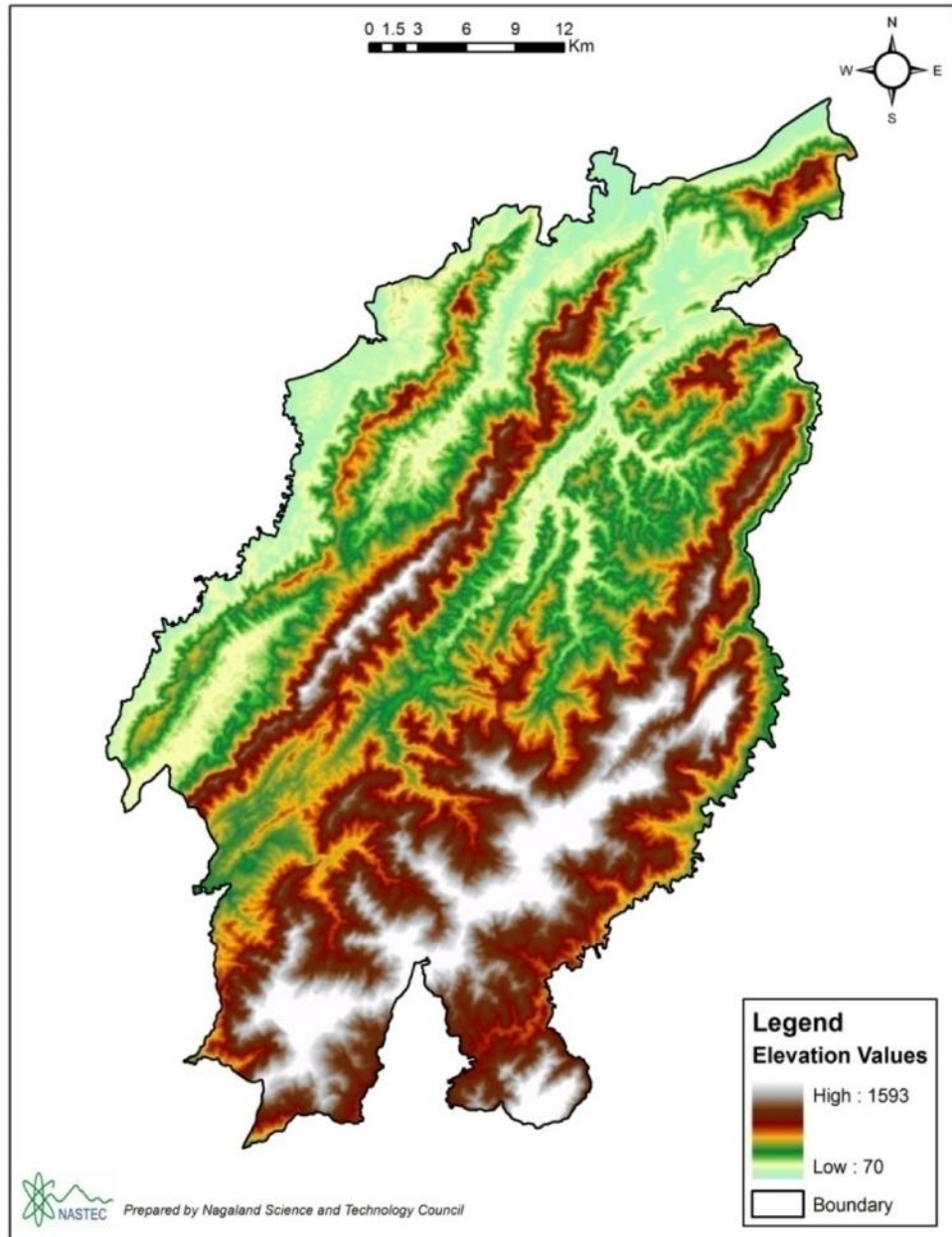


Fig: 2.5 Physiography Map of Mokokchung District

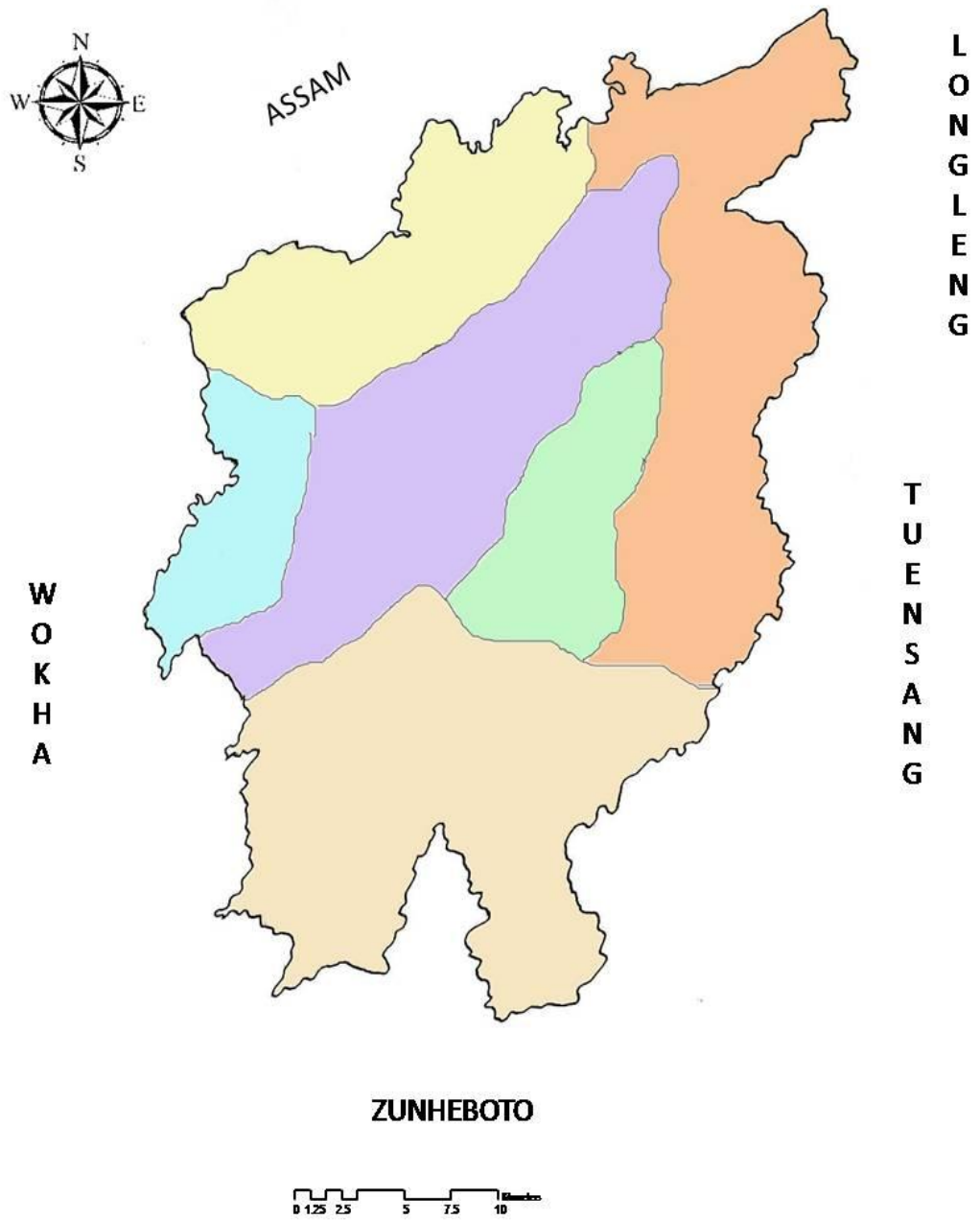


Fig: 2.6 Map of different ranges under Mokokchung District

2.2 Physiography

The entire State of Nagaland comprises of rugged terrain of which Mokokchung district is comparatively less elevated. It is a part of Naga Hills which are dismembered branch of Eastern Himalayas. The region is situated in the hills and has got a number of mountain ranges coupled with sharp crust ridges and narrow valleys with few plain lands. It spread out mostly from north- east and south-west. The hills vary attitudinally between 1000-2000 meters and the average height is 1500 meters. The ranges are higher on the east than in the west where they merge with the plains of Assam (Fig. 2.6). Between the ranges there are glens and gorges through which streams flow. Out of 1,615 Sq.km nearly half portion of the area is having elevations which were formed cutting through soft and loose geological strata cause by the heavy rains resulting into numerous gorges like valleys. Within the district Milak and Tsurang Rivers with their tributaries flows down the downstream leading to the formation of fertile flood plains i.e. Changki, Tuli and Bhaghty valleys having an average width varies from 1-2 miles.

The river valleys of Tsurang, Milak and Dikhu on the south eastern sides are steeper compared to the North-western sides. Numbers of perennial streams flow through the district before joining the Brahmaputra River. The district is agriculturally and industrially among the most progressive districts in the State along with Kohima and Dimapur. The major agricultural regions cultivating Jhum cultivation is located in the hilly slope areas being cultivated in different ranges

with the maximum cultivators under Ongpangkong range. The terrace cultivation is cultivated in the low-lying areas of Changki-Longnak, Tsurang, Milak and Dikhu valley regions. Tuli-Milak and Changki-Longnak valleys are also the major small industrial areas. The physiography of the district shows parallel ranges basing on different climate, soil, terrain and characteristics of different vegetation. The six ranges under the district are Ongpangkong, Langpangkong, Asetkong, Changkikong, Japukong and Tzurangkong ranges (Fig 2.6).

1. **Ongpangkong Range**

It is the highest altitude and also the southernmost range which is bounded by Sema and Lotha on the south and Sangtams on the east. It has an average altitude of 1500 msl having types of vegetations varies from evergreen forest to mixed deciduous forest types. It present, the range consists of 17 villages by having a population of 85,667 (2011). The range has a large tract of virgin forests and forest by adopting ‘**Community Reserved Forests**’.

2. **Langpangkong Range**

It is the eastern most range and the terrain is spread out like a bed. The range dodging with the course of Dikhu River by forming a natural boundary line between Tuensang and Mon districts. It has a total population of 22, 44 (2011) with 18 villages. National Highway No: 61 stretch through the entire length of

the range which covers about 85 kms. Large tracts of community biodiversity and forest reserve are located in this range of which '*Kanglutu Biodiversity Reserve*' has 7060 hectares at Changtongya village.

3. Asetkong Range

This range is located between Menung and Milak Rivers and based as the central range of all the ranges. It runs in an east-west direction with range of Langpangkong in the east, Ongpangkong in the south and Changkikong range in the north-west which resembles an island. Average altitude msl (mean sea level) is 1100 meters above mean sea level which is marked by distinct warm humid, high rainfall, rugged topography and soil types. It has five recognized villages and small stations by having a population of 15,365 (2011).

4. Changkikong Range

It is located between Milak and Tzurang River in the west, which comprises of 09 villages with 7,316 (2011) approximately. The range has a vegetation of mixed deciduous and evergreen forest which has an accessible Reserved Forest covers at Tsurong valley and Kalomang. It is said to be one of the richest spot of biodiversity under the district with the presence of thick forest covers. Geographically, it consists of various mineral resources mainly the deposits of coals in the area.

5. **Japukong Range**

This range is the outer most range which stretches from the north to east and south to west lying to the interior (south) of Tzurangkong region. It has 18 villages and altitude varies from 150-950 meters msl having an approximate of 70 kms in length. The range enjoys a warm-humid and sub-tropical type with formations of dense and thick forests. Retongkong and *Satsu Tangen* are some of the well known reserved forests.

6. **Tzurangkong Range**

The range borders with Assam and stretches about 15 km from Tzurang River to Tzutapela area. It consists of hillocks randomly which adjoins the plains of Assam mostly along the valleys of Desai and Jhanzi Rivers before debouching into Assam plains. Wangtak, Tangyong, Dzesu are some of the perennial rivers by having a warm and humid climatic conditions.

2.3 Geology

The geological characteristics are of great influence on the nature due to the process of aggradations and degradations are in no way insignificant in shaping of the topographic evolution and landform of any place. The geology of

the district belongs to the Himalayan Orogeny, where the Himalayan mountain system terminated in sharp acute syntaxial bend along Burmese area.¹

Major portion of the district is covered by Disang series (Eocene) and then Barail series (Oligocene) rocks and Tipam series of still younger rocks occur in the areas bordering the plains of Assam. The lower and middle Eocene age is represented by the group of Disang, upper Eocene and Oligocene age by the Barail group, Miocene by Surma and the Tipam group, Miopliocene age by Namsang beds.

The younger rocks belonging to the Tipam series borders the Assam plains. In the foothills of the district tertiary rocks are dispersed in parallel direction like an individual thrust shell within a system of imprecating strike faults as known the '*Belt of Schupen*'. High rocks are found with disturbed being sliced by cross-faults which results into blocks that have pushed southward due to varying degrees of faulting with fine grained sandstones towards the top of the series.

The Disang group of rocks represents the oldest rocks which is made up of splintery hard shales, from grey to dark iron stained shales has been inter-bedded with fine grained sandstones towards the top of the series. The Disang series consists of metamorphosed rocks and the metamorphism increases southward

¹ *Development Plan of Mokokchung Sub-Division and Mokokchung Urban Area (1971-1991) pp.3, 4*

from Mokokchung to Kohima. Along the base of the hill, west of Changtongya village roughly follows the Milak River. This series overrides the Barail sandstones in the northeast-southwest along a thrust fault. Rocks of Barail series consists mostly well bedded sandstones with shale intercalations. It is made up of medium grains ferrogeneous sandstone with partings of shale, mudstones and clay marked by thick coal seams. The Surma group presents alternations of shale and sandstones occasionally with conglomerate. The Tipam sandstones crops out a number of northeastern parallel strips within the '*Belt of Schupen*' and also as a prominent hill range which is known as the Japukong range.

The upper unit of Tipam group is represented by sandstones, grits with bands of sandy clays and grained clay formation. It covers an area of 'Desai Reserved Forest' which forms a flat-topped low mounds. In Tsurang and Tsurong valleys this clay occupies the low-lying areas below the scrap falls.

The Namsang beds in this area comprise of loosely packed sandstone with fragments of coal cemented sand. A good exposure is found in the northern part around Tuli and Desai valley. Girujan clay formation overlying the Tipam is composed of typical blue and mottled clays and argillaceous sandstone beds. This Girujan clay also occupies the broad Desai River valley, west of Changki coupled with conglomerates grits etc. The Disang series occurs in the 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 north-westerly shift of Barail coal measures and the overlying Tipam. Sub-parallel minor reversed faults are also observed parallel to the crest of hills which affects the Tipam sandstones.

The entire district which lies close to the most strategic eastern Himalayan syntaxial bend is having evidences of large scale earth movements. As a result prolonged, the hardest strata are exposed and the occurrence of landslides is frequent particularly the road connecting Mokokchung and Mariani (Fig: 2.8). The Amguri-Mokokchung road is less disturbed by landslides except beyond the Tuli region where the upper strata are composed of loose debris of conglomerate. All these diversity of geologic features and process has brought impact on the environment. And this has further been destabilized by prolonged Jhum cultivation which leads to deforestation and loss of soils.

Geomorphology Map- Mokokchung

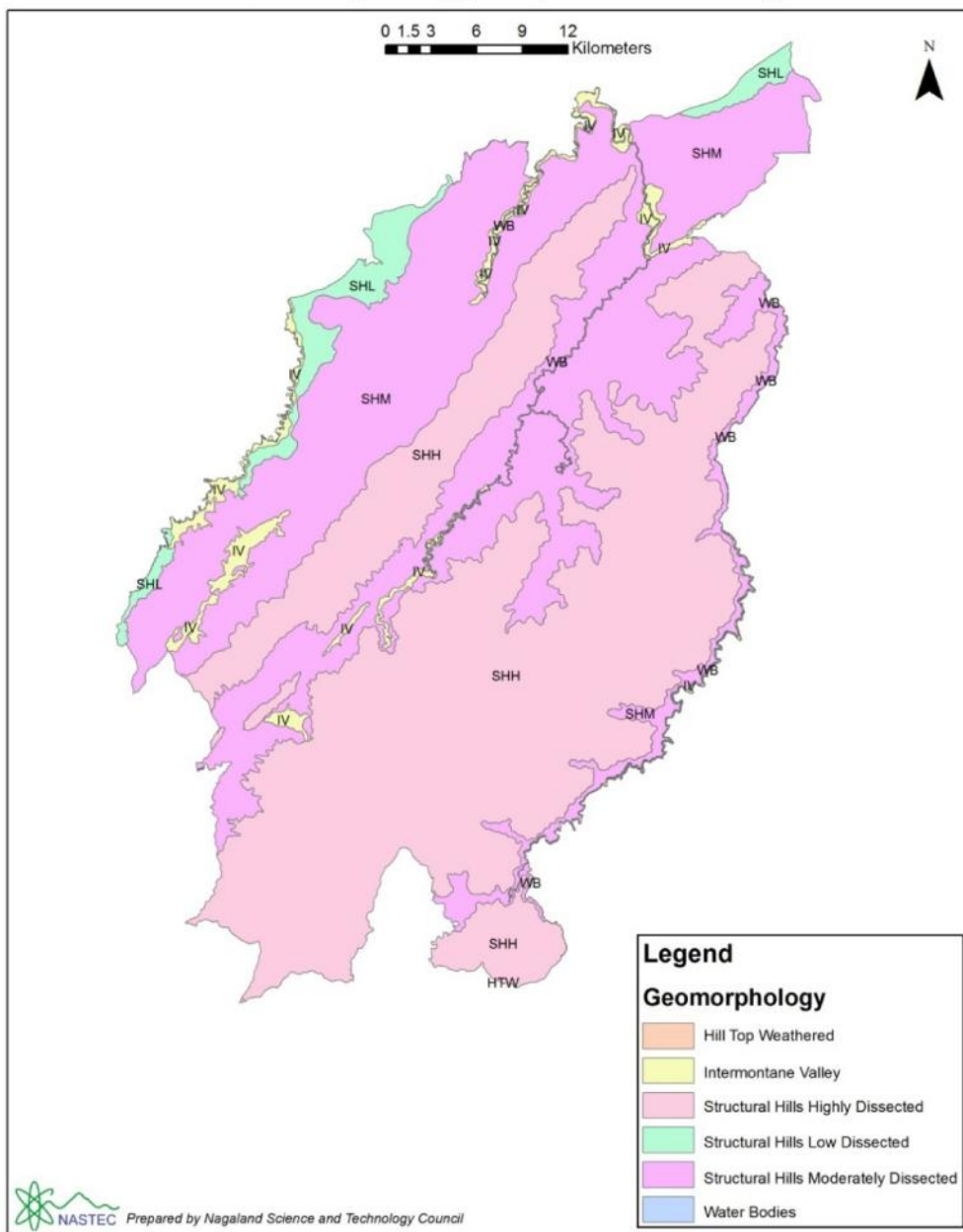


Fig: 2.7 Geomorphology Map of Mokokchung District

Road Information System of Mokokchung District

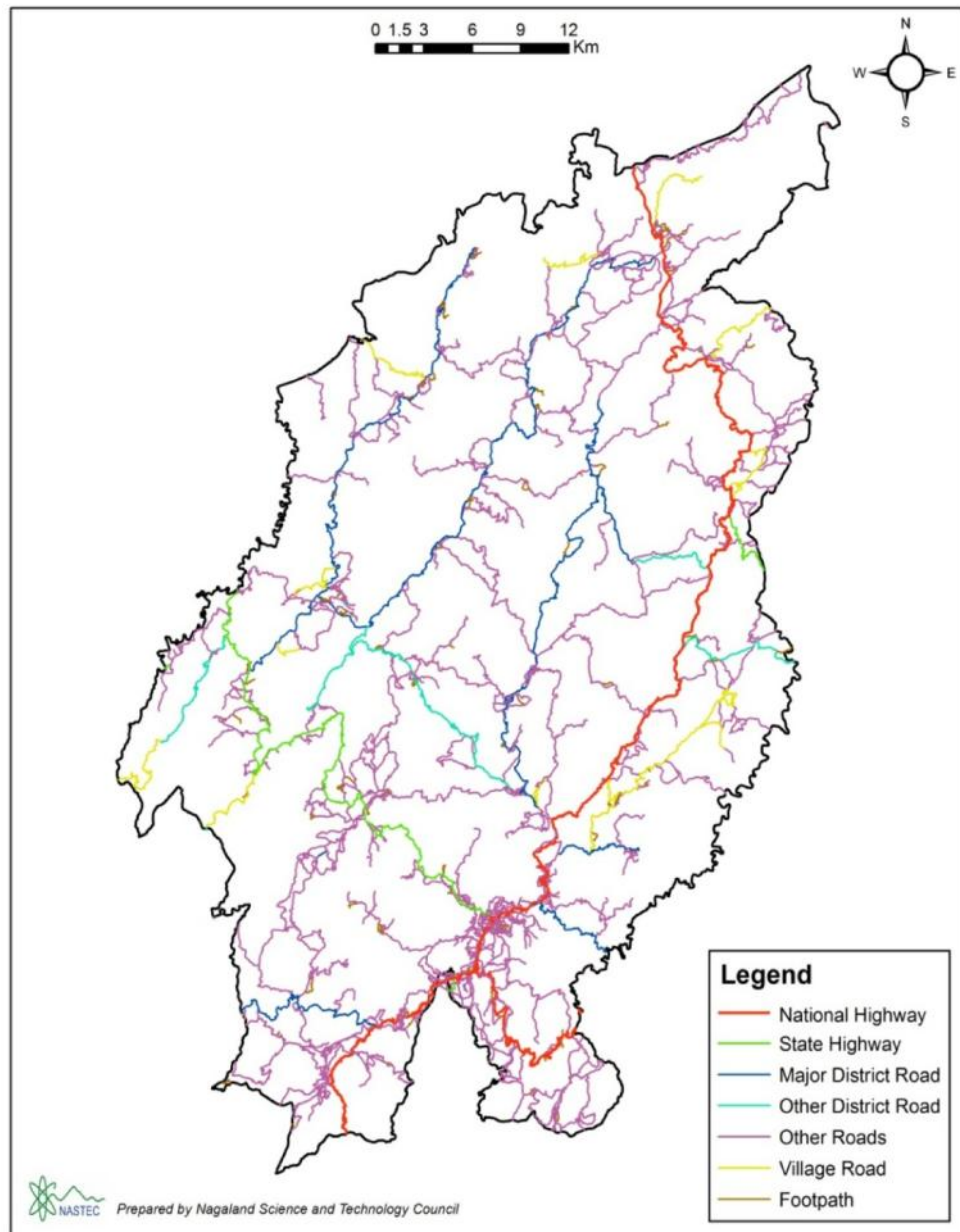


Fig: 2.8 Mokokchung District Road Network

2.4 Drainage Pattern

Streams flowing over a surface are influenced by the structure of surface which leads to the emergence of different patterns. In other words, drainage patterns get adapted to the structure of land and apart from the structure other factors also affect the shape of the drainage pattern. Among them the endogenic forces are important.

The important rivers which are found in the district are Desai or Tsurang, Dikhu, Milak, Tsumok, and Menung. They run parallel to the ridges which act as water dividers either northward or southward except Doyang which cuts across the middle chain. Direction of tributaries is from south to north in accordance with its varying nature of topographic conditions. The main rivers are perennial in nature but volume of water reduces during dry season and often rivers become almost dry.

Main rivers which make significant drainage system are as follows:

1. Milak

It is the main longest river which flows across the Ao region and known as Jhansi in Assam. Its source is found in Mokokchung town itself at an altitude of 1300 meters. It flows northward until it leaves the hills and turns westward near Amguri plains. The river is a bounded line between east of Alongkima, west of

Kobulong and west of Changtongya and Tuli circle and in plains it flows through Sibsagar district (Assam). A notable tributary of Milak is Tsurong that runs in the east of Longchem and Alongkima circle in the west.

2. Dikhu

This River rises from northern flanks near Sema known as Longa or Nanga which flows westward and enters Ao region of Longsa village known as Tsula. Then, it flows northward forming a traditional boundary line between the Ao and Sangtam on one hand, and Phom and Konyak on the other. Its total length before emerges into Brahmaputra River is 200 km. On the west this river acts as a boundary line for Chuchuyimlang, Ongpangkong, Changtongya and Tuli circles. The main tributary which falls in Chuchuyimlang circle is Nanung which rises from northwest of Longkong village and after flowing across the east of Mongsenyimti, Chuchuyimlang, Salulemang villages and flows into Dikhu.

2. Tsurang or Desai

This River rises from the west of Chungliyimsen village and it is an important tributary of Doyang River. It flows southward with a crescendo bend through the hills of Mokokchung district and northern part of Lotha area. It also passes through the western part of Mangkolemba and south of Longchem circle and continues to run further northward until it leaves the hills for the plains in the west of Changdang village.

3. **Menung**

This River has its source at Minkong forest that is located between extreme north of Ongpangkong and south of Kobulong circles. It flows in between Sungratsu and Longjang villages on one side and Mongsenyimti and Chuchuyimlang villages on the other.

4. **Tsumok**

It rises from Changtongya and flows through Asangma and Merangkong villages and finally joins Milak River.

The rivers of the district run through the ridges as well as it crosses the softer landscapes taking a round course and sometimes making abrupt bends. Therefore, it does not support a stable cultivation, however terrace and fruit plantation are cultivated on the banks of Tsula and Tsurang.

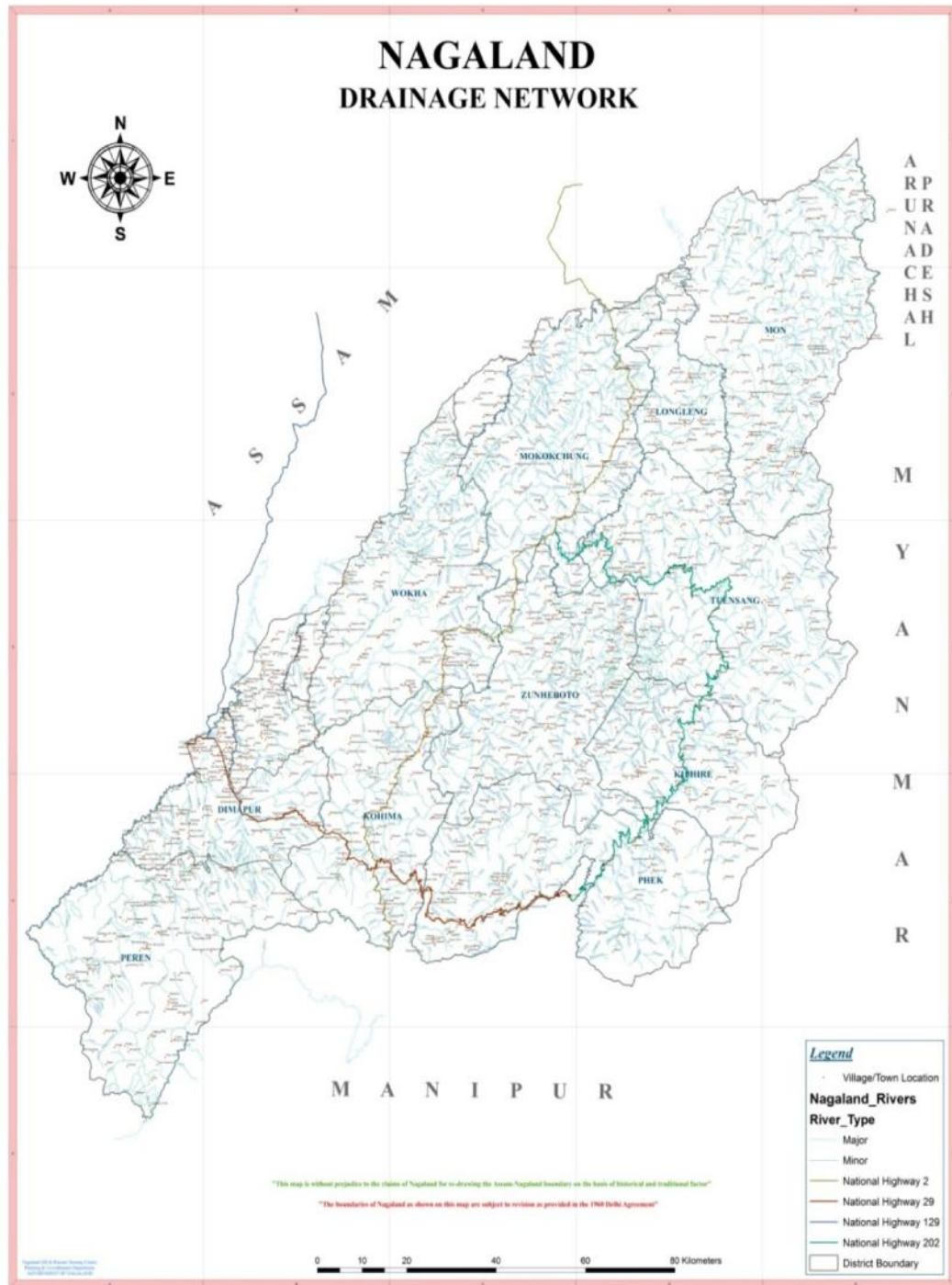


Fig: 2.9 Nagaland Drainage Network

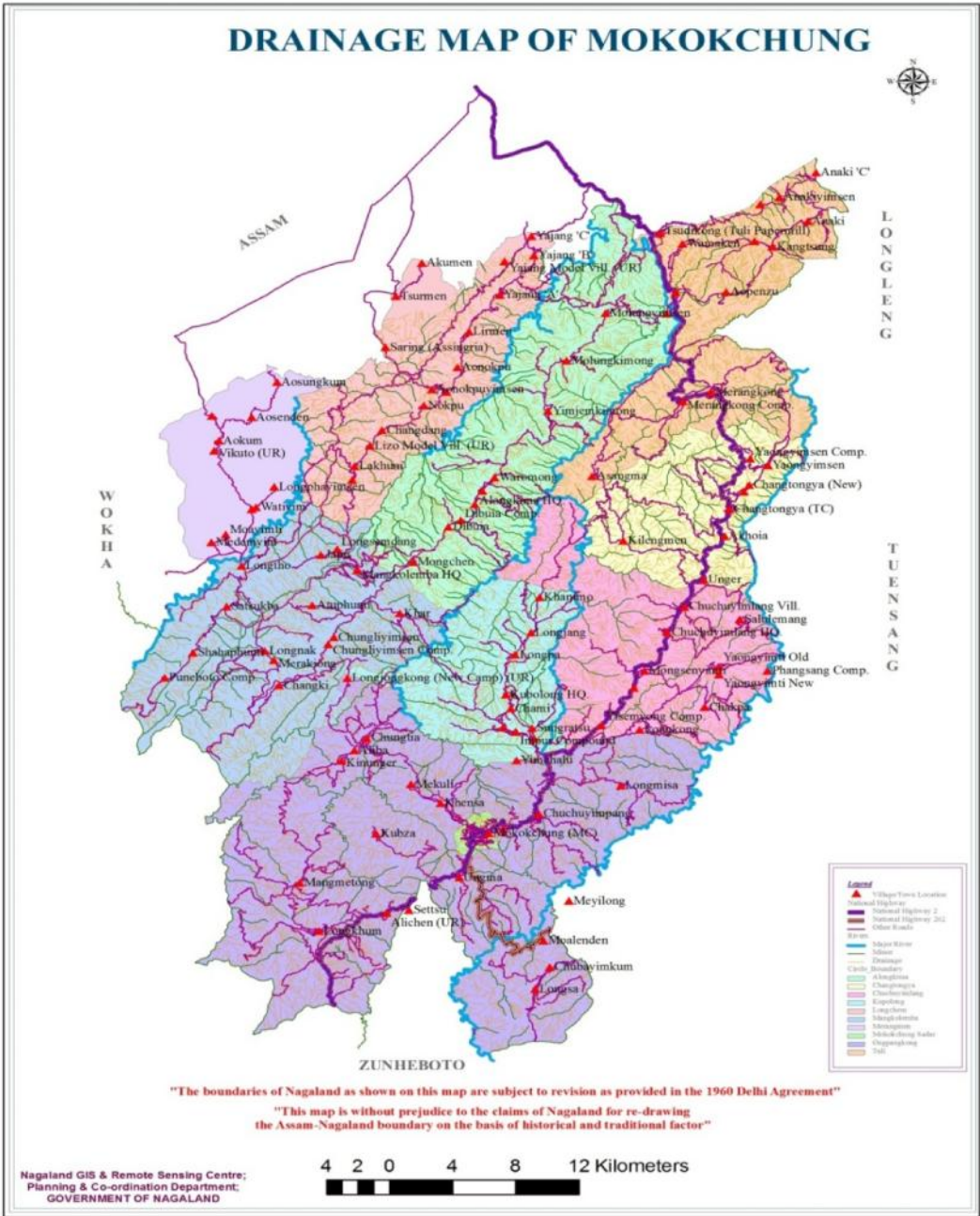


Fig: 2.10 Mokokchung District Drainage Network

2.5 Soil

Soils are the most valuable life supporting natural resource for the society since they produce food, fiber and fodder which are basic to our very existence.² For a sustained utilization of soil resource, it is imperative to know the nature, characteristics and extent of different soils, their qualities, produce capacity and suitability for all alternative landuse. Soil formation increase about 8mm per century and 8mm per century (or might be higher) in formation under agriculture due to ploughing – it aerates the soil and increases the rate of leaching.³

The ecosystem significantly influences the process of soil formation. In Nagaland, large altitudinal variations have given rise to diversity in climate and vegetation. The soil has been developed on shales and sandstones. Soils of Nagaland are derived from tertiary rocks belonging to Barail and Disang series. They are generally acidic, rich in organic carbon but poor in available of phosphate and potash content except in the valleys and in the foothills with comparatively level land and gentle gradients.

The State has identified 72 soils families and was mapped into 36 soil units. The area wise distribution of different soils (order, suborder, great group and sub

² *Soils of Nagaland (Their kinds, distribution, characterization and interpretations) for optimizing Landuse-Dept. of Soil & Water Conservation, Government of Nagaland, Kohima. pp.8*

³ *The Environment (Principles of Applications), Chris Park. pp.611.*

groups). The Soils of Nagaland belong to four orders, seven suborders, 10 great groups and 14 subgroups. (Fig: 2.11). It is also observed that Inceptisols is the dominant soils followed by Ultisols, Entisols and Alfisols.

The soils of Mokokchung district belongs to Barail series mostly acidic in nature. The PH content varies from 5.6 to 5.8 on an average. Acidity is found higher around Changki area followed by Ongpangkong and Changtongya –Tuli area. Soils found in foothills are rich in deposits and is fertile which is good for cultivation. Organic carbon content is high in higher altitudes while foothills which are continuously cultivated lands have low content of organic carbon. The soils are poor in phosphate (P O) excluding some patches adjoining Mokokchung town, Tuli-Merangkong and Waromung village areas. Three major type of soils are found in the district-

1. Alluvial soil (Recent alluvium soils –Entisols), Old alluvium (oxizol and ultisols) and Mountain valley soil (Entisols).
2. Forest soil and
3. Non-lateriate soils.

Alluvial soils are confined along the foothills in the valleys of Tuli, Changki, Bhaghty, Tzurang and plains located on the right bank of Milak River. These soils are transported largely made up of silt, sand and clay. Content of the soil is usually deficient in nitrogen and humus content requires regular addition of fertilizers and manures.

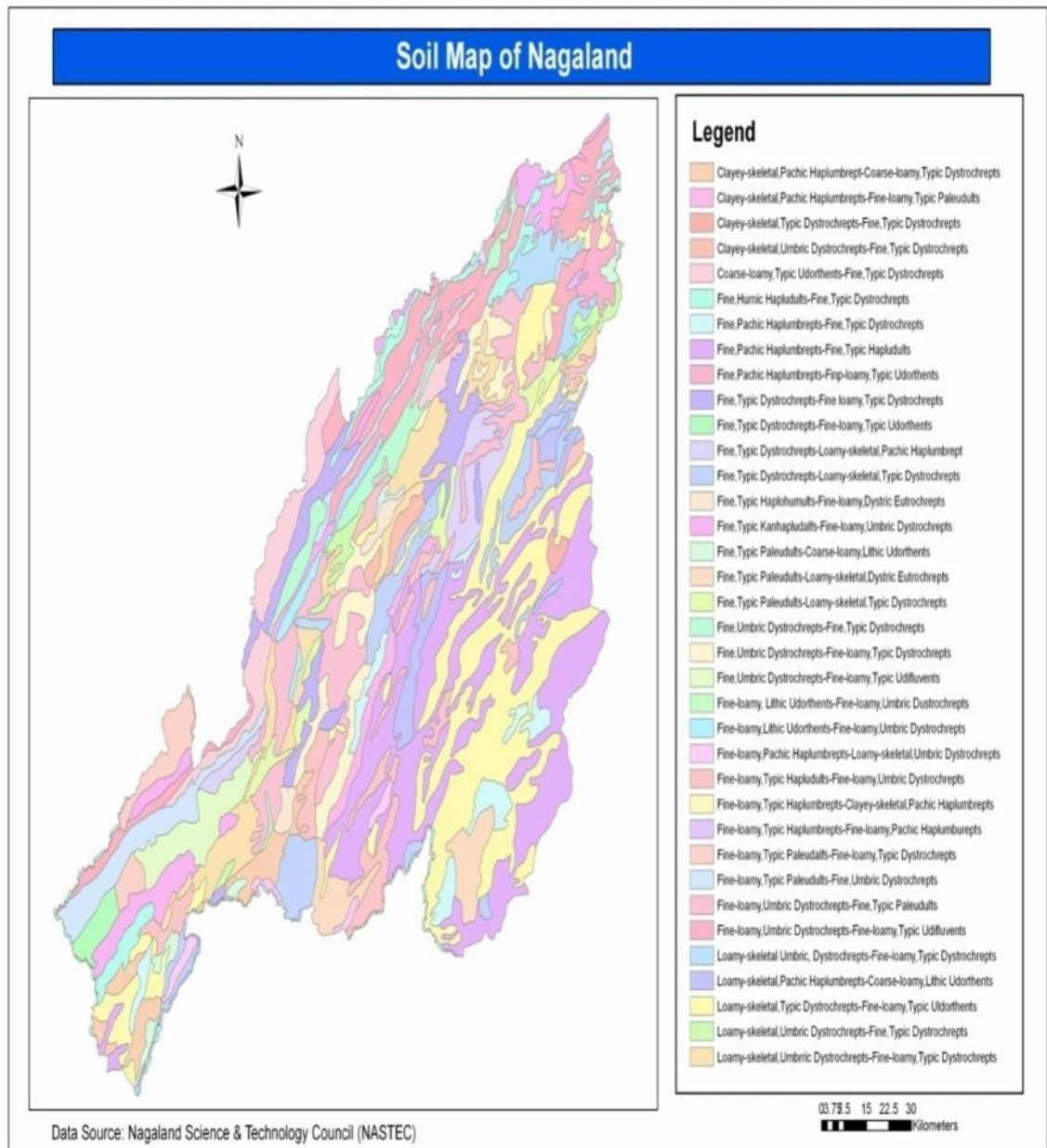
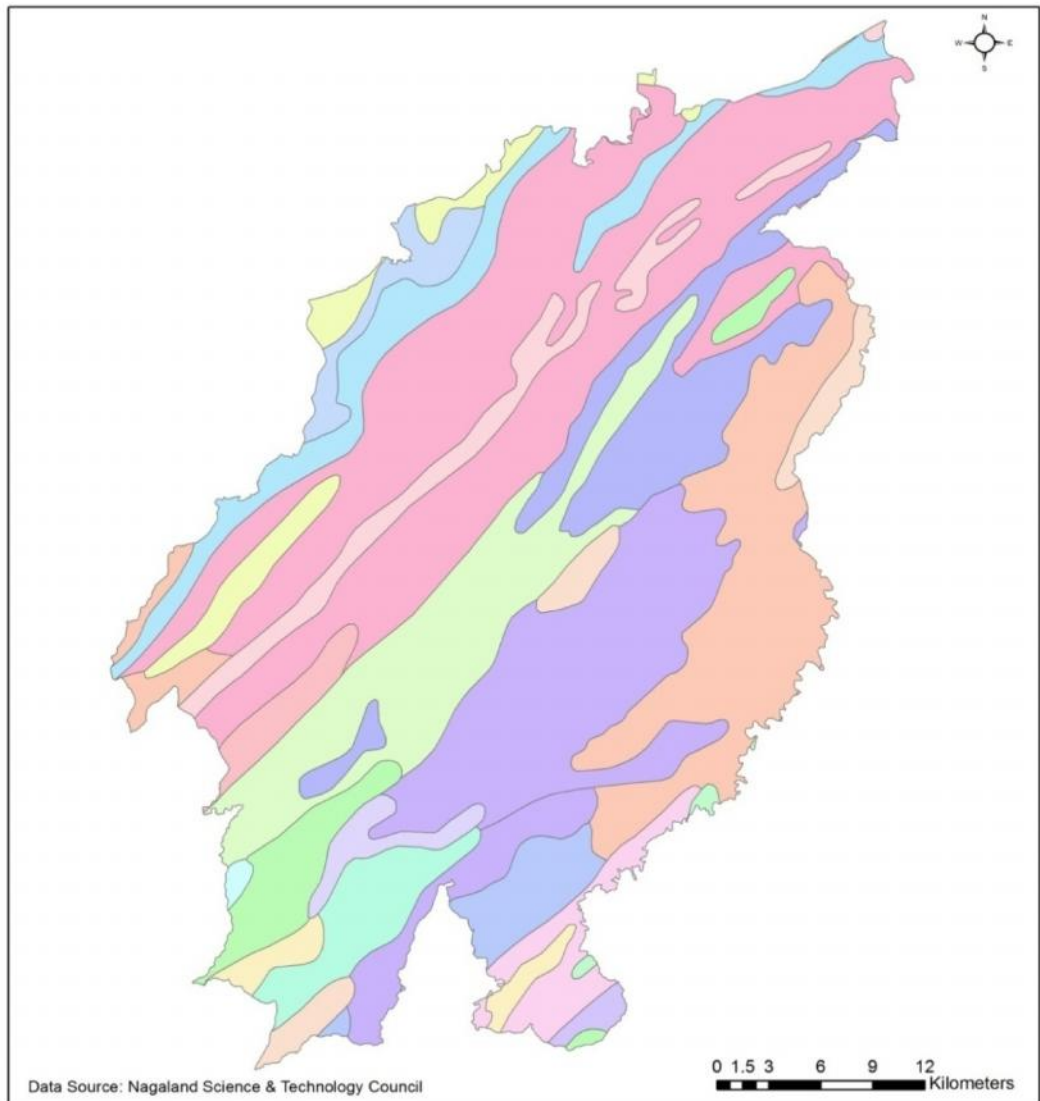


Fig: 2.11 Soil Map of Nagaland

Soil Map of Mokokchung District



Legend

DESCRIPTION

TAXONOMY

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Fig: 2.12 Soil Map of Mokokchung District

Forest soils are generally found at a height which varies from 900 meters to 1800 meters and are found mostly around deciduous forests. Such kind of soils is rich in humus and deep but slightly acidic in reactions which are fertile for growing variety of crops. Non-laterite Red soils are formed due to alteration of moist and dry seasons. This type of soil is found in the hilly slopes and hilly tops except in higher altitudes. It contains organic matter due to presence of high humus and degree of high porosity. The color red soil is due to presence of iron-oxide and aluminum which contains acidic and have less quantity of phosphate and potash. Such soils are hard when dry and sticky and when it gets wet, it is regarded as residual soil. The fertility of the soil in the district is due to content of minerals and humus as well as with the prevail of climatic condition. Overall the soil in the region is loose and boggy because it is formed by falling of leaves, branches and the decayed annual undergrowth and shrubs.

The inherent problem of soil erosion is further aggravated due to extensive practice of slash and burn or shifting cultivation and deforestation. This ultimately leads to rapid run-off on steep slopes and less vegetation cover and the deposition of materials in the valleys and in the low-lying areas. To avoid soil erosion, use of physical and biological barriers is being carried out for soil conservation.

2.6 Climate

Climate is a complex of meteorological conditions. It exists in any given area and imparts individuality to the landscape of that area.⁴

The most important among the numerous meteorological elements are precipitation, temperature, relative humidity and evaporation. Weather and climate are the dynamic features of a physical environment. Indian climate forms a part of climatic patterns of South East Asia. Northeast India has been located at 20 N to 29 30'N latitude and 84 46 'E to 97 30' E longitudes. It passes the tropic of cancer across the southern part by providing a tropical type of climate. The climate of Nagaland is controlled by its terrain features varying from tropical to temperate conditions. The hill ranges and mountains with the foothills, plains and sheltered valley marked with climatic variations which determines to a great extent in rainfall distribution. Mokokchung district has a sub-tropical humid type of climate while valleys and the lower range adjoining the Assam plains experience a warm climate. The temperature of the district varies from 28 C – 30 C and winter temperature varies from 10 C – 15 C.

⁴*Geography of India-Balbir Singh Negi, U.B Singh (1998-1999) pp.17*

**Table: 2.1 Sum-up of Meteorological data of Mokokchung District from
2007-2013**

Particular	YEAR						
	2007	2008	2009	2010	2011	2012	2013
Ave.Max.Temp (C)	292	304.6	306	302.6	302.8	302	306.2
Ave.Min. Temp (C)	181.5	186.7	198	203.2	206	174.4	175.2
Ave. Dew Point (C)	195.5	189.7	190.6	202.3	196.6	159.7	158.7
Ave.R/H (%)	903.1	866.9	879.6	902.6	887.8	807.1	884.4
Rainfall in (mm)	1788.4	2518.3	2267.5	2675.1	2586.9	2133.5	2115.9
No. of Rainy days	126	147	130	157	152	137	112

Source: Soil and Water Conservation Department, Nagaland

(Table: 2.1) shows the sum-up of meteorological datas of 7 years starting from 2007-2013. It includes Average Maximum Temperature, Average minimum Temperature , Average Dew Point, Average Relative Humidity (R/H), Rainfall and No: of Rainy days. The amount of rainfall varies from 1600mm to above 2500mm, the total rainfall from (2007 to 2013) of which the amount of highest rainfall was recorded in 2010 with 2675.1 mm and the lowest with 1788.4mm in the year 2007. The total number of rainy days was recorded highest in the year 2010 with 157 days and the lowest was recorded 112 days in the year 2013. The average maximum temperature was recorded in 2013 with 306.2 C. This shows drastic changes in climatic variation within a span of seven years in the district. Mokokchung district rainfall is cause by southwest monsoon and generally sets in

during the middle month of June till the half of September with heavy rainfall. During rainy season the average the amount of saturation value expressed in percent (%) is 80% but sometimes goes upto 90%. Temperature in the district varies according to the variation of altitude to different ranges. July is the hottest month but due to ample amount of showers heat is neutralized while hottest days start from the month of July, August and September. While the winter starts from November-December to the early part of February are the coldest months. The dry season starts from December till April month. With the start of southeast monsoon from March to April month and September to October month of Northeast monsoon goes occasional storms. A high velocity hail storms that lash on March, 2010 damaged nearly 21 houses in Changtongya and even Akhoya villages under Mokokchung district. The normal windy season starts from February to March month which blows from the southwest and sometimes the velocity raises upto 100 km/hr and slows down gradually on April month.

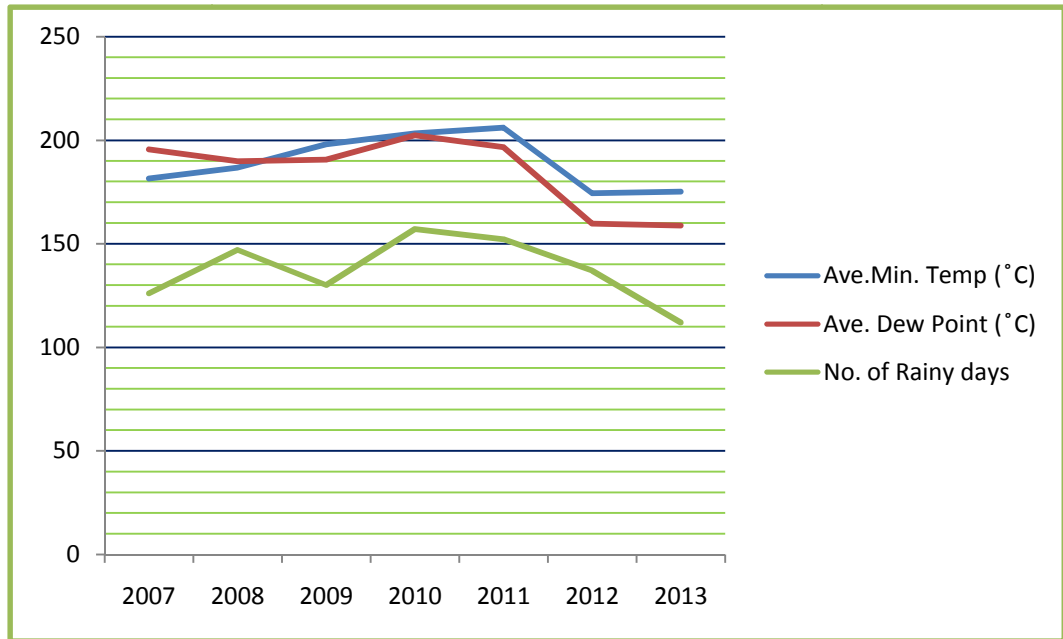


Fig: 2.13 Average Minimum Temperature (C), Average. Dew point (C) and No. of Rainy days

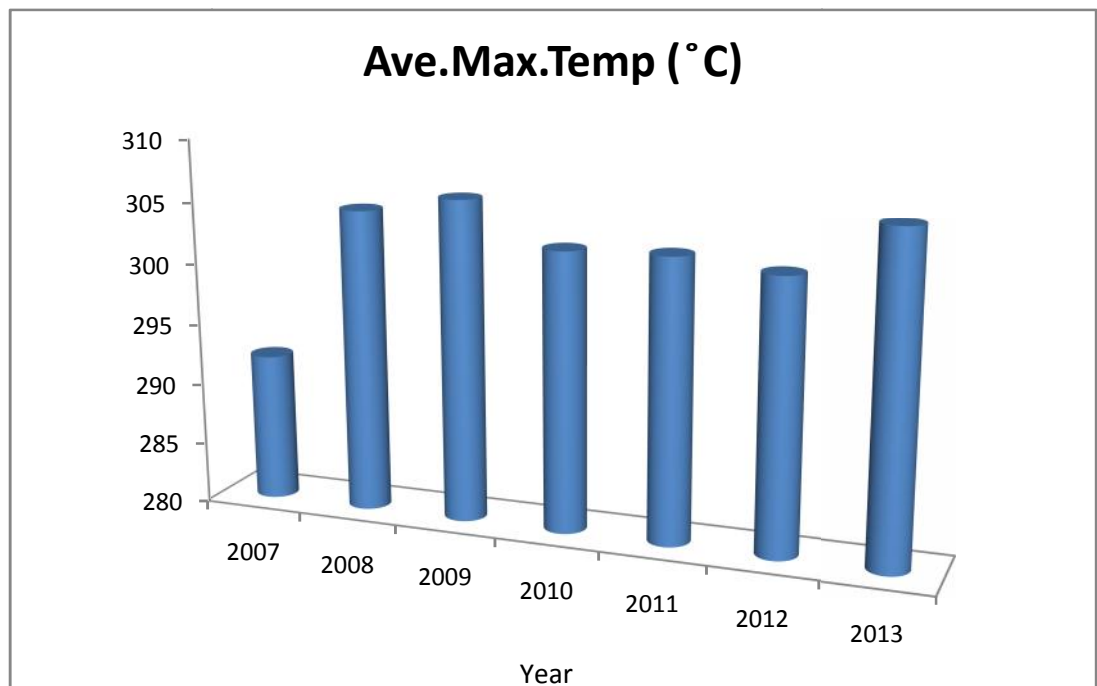


Fig: 2.14 Average Maximum Temperatures from 2007 to 2013

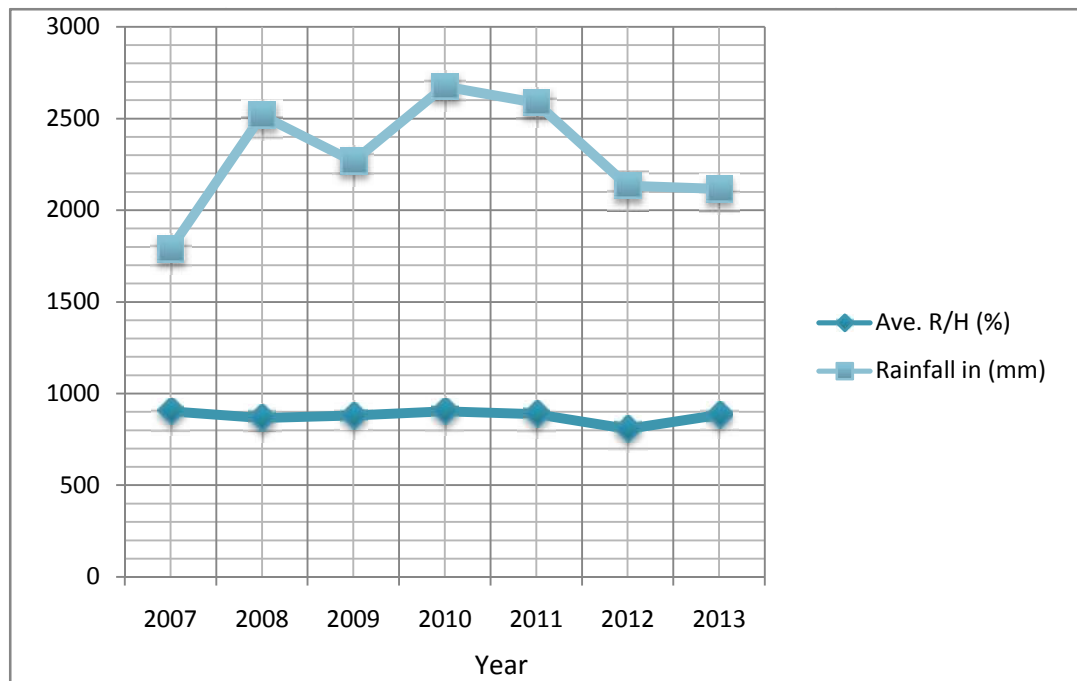


Fig: 2.15 Average Relative Humidity (in %) and Rainfall in (mm)

2.7 Natural Vegetation

The characters of vegetation of a place depend upon its temperature, rainfall, interference by man and soil.⁵ Nagaland along has a wide variety of vegetation which falls under Indo-Burma Biodiversity Hotspots. Out of the District geographical area of 1615 Sq.km, forest covers an area of 28976.79 hectares (in 2011).

⁵Gopal Singh (1979): *Geography of India*, pp.53

Most of the virgin forests are found in Tsurang forest that lies in Changkikong and Japukong range and near Milak of Tuli areas respectively. It has three Government Protected Forest i.e. Chubi (134.8 hectares), Minkong (275.32 hectares) and Longsa (18.00 hectares) which comes upto 428.00 hectares.

The district of Mokokchung with its hilly topography and few patches of plains has an average altitude of 1500 meters well suited to support dense natural vegetation. With the due course of time practice of shifting cultivation by the people for centuries has however destroyed much of the luxuriant exotic forest canopy which leads to soil erosion. The region consists of both deciduous and evergreen forests being deciduous most part of the trees found in lower latitude. Mixed forest of both evergreen and deciduous trees is present.

The type of forest which is found in the district consists of:

1. Evergreen (Upto an altitude of 1000 meters)
2. Mixed deciduous and evergreen forest (From 1000- 2000 meters)

Forest intake vegetation covers provide lots of essential items for the people. People in this region under study have been living in adjustment with the environment though the perfect and orderly co-existences with the forest and vegetation zone seems to be missing. Plantation of various crops and fast growing species and small patches are also being cultivated.

1. Arbore- culture – trees like Chakranta, Eucalyptus etc.
2. Citrus and non-citrus fruits like pears, oranges, guava and pineapple etc.
3. Economic plantation like Sal, Teak etc.

The region is richly endowed with wide diversity of flora and fauna their survival is at risk due to human interference. So any disturbance found in their existence would hamper the ecological balance and extreme care should be implemented to maintain a perfect harmony towards the awareness and protection of the environment to safeguard the rich natural biodiversity.

CHAPTER: 3- SOCIO-ECONOMIC DETERMINANTS OF THE EXISTING LANDUSE

3.1 Introduction

Land is the basic resources of human society and there has been a relationship between man and land since time immemorial. Human environment relationship changes through time with the development of society and activities. The relationship is infact, based on the basic principles of ecology which is the mutual interaction between organisms and physical environment and also interaction among the organisms in a given ecosystem. Thus, man is considered as an integral part in shaping up the environment as well as in the utilization of environment.

Naga Hills is one such mountainous region manifesting numerous smaller hill ranges with considerable rivers, valleys, gorges and streams. The prevailing topography naturally affects cultural, social and economic settings. Such a different settings demand certain adoption of the people seeking to wrest livelihood from it. Such variety of topographic features makes the basic determinants of ecosystem. Nagas traditional life revolves around the village. The family, clan, khel and the village represents the extent of a Nagas concern and there was a very little inter-village and even less inter-tribe interaction. The village is the highest political unit and the sameness of culture and shared among together. Within this concept, the Nagas have adopted their culture and their livelihood to the norms of the natural environment.

For centuries they have been dependent for the survival and livelihood they have also developed a unique relationships with the ecological environment mainly through their indigenous and traditional method of cultivation. *A holistic understanding of the ecological setting and village ecosystem of the traditional societies becomes essentially important (U.A.Shimary, (2007).* Land use system revolves around the basic question of how land is used by the community and members. It includes all the different types of land utilization in a given area or territory having two main land use system categories i.e. land tenure system and the other is the method of cultivation of land with customary laws. The customary laws also differ from one village to another or tribes. Land is the use actual made of any parcel of land. The factors such as rainfall, temperature and soil all together contribute to the basis of agriculture and determine the limit of both the cultivability and productivity of the land. Land use mainly relates to the optimum use of the limited land between the alternative major types of land use. The primary use of land are paddy fields, cash crops, forest, pasture, transport, gardening, residential areas, mining, industrial, commercial and uncultivable waste barren and fallow land etc. The customary land as well as ownership of land use has undergone lots of changes in course of time. Today, the land use system and the tenure faced immeasurable threats to the environment. These are due to the increase in population, massive destruction of forest cover on the onset of Jhum cultivation, loss of biodiversity status etc., all these consequences tend to disturb the environment in many ways.

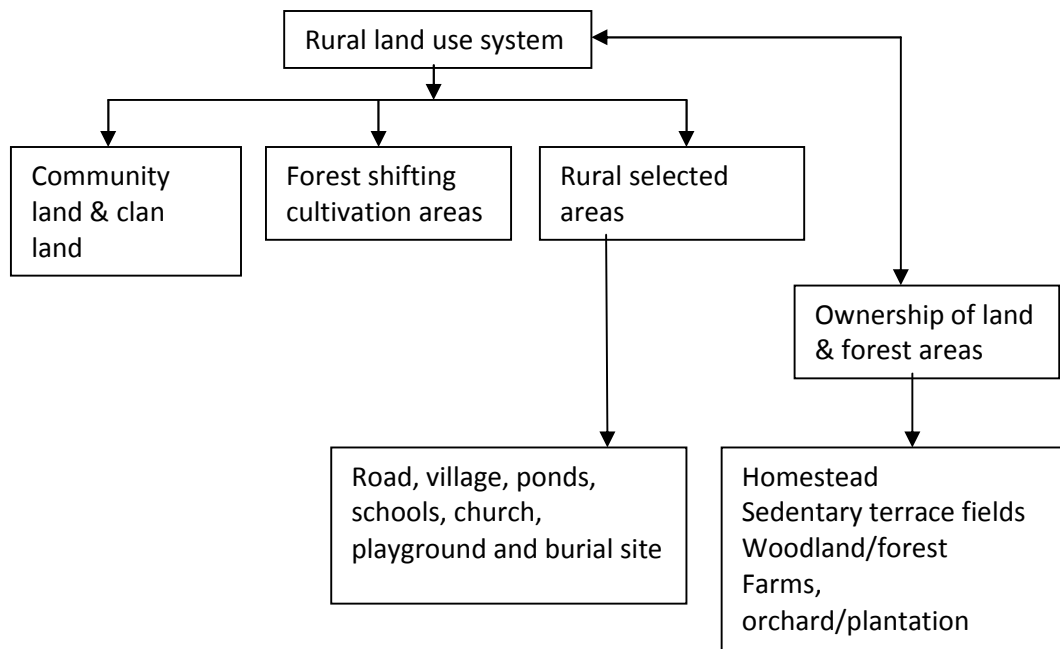


Fig: 3.1 Rural Land use system

3.2 Socio-Economic Set up of the District

The main land use system in the district is under agriculture of which area under shifting cultivation predominately occupies the region while the terrace (TRC) cultivation occupies the land in low-lying areas. Jhum or shifting cultivation type of cultivation mainly depends upon the monsoon as the rain provides for the seasonal crops. But with the headquarter being located in the Ongpangkong range it has expanded a lot due to rural people migrating to town for education and employment and for the business. This has brought tremendous change from rural to urban sectors in the socio-economic status.

The town has also emerged as one of the most important trading places for the people living in other district as the main State Highway passes through the town which connects the other districts of Tuensang, Wokha, Zunheboto and Longleng.

3.3 Economy

The main economy of the district is solely based upon on agriculture for their livelihood. An important corollary of shifting cultivation has been community or clan ownership of the basic resources of land and forest which is significant for maintaining equity of economic, social status and security of livelihood of the members of the community. However, with due course of modernization, occupational structure is fast changing mainly in the non-agricultural sectors. While the mining of coal is also a lucrative business activity being carried out in the district. Though the government does not undertake any mining activity, the rural people themselves get explored and exported to the nearby states. It is quietly disorganized and the rural people sell off without knowing the real market prices which brought in with great loss. The coal mining activities is largely carried out in Changki, Mongchen, Molungkimong, Lakhuni, Anaki, Merangkong etc., However, the mining activities are unscientific, unplanned and uneconomical which affects the topographic features and also brought drastic negative changes in the environment.

3.4 Population Characteristics

From time immemorial the people of the district has maintained their cultural integrity by having a socio-economic barrier with the people from the plain areas. However, with the advent of modernity the once closed Naga village society has now being opening to the outside world. Likewise, the Ao society has also taken up a cosmopolitan nature where people from different communities and villages freely and openly interact by living in relationship with harmony. With the momentum of raising migration from other communities it has greatly affected the socio-economic and environment of the people in the town.

Table: 3.1 Nagaland District wise Population of 2011 census

Sl.no	District	Population
1	Mon	250671
2	Mokokchung	193171
3	Zunheboto	141014
4	Wokha	166239
5	Phek	163294
6	Tuensang	196801
7	Longleng	50593
8	Kiphire	74033
9	Kohima	270063
10	Peren	94954
11	Dimapur	379769
	Total	1980602

Source: Directorate of Economic & Statistics, Government of Nagaland, Kohima, Statistical Handbook, 2012

Mokokchung district is known to be one of the most developed districts and considered as one of the major metropolitan towns in the State. It has recorded the highest literacy rate in the State. The State having an area of 16,579 Sq.km with eleven districts has diverse population patterns based on the size and location of every district. The State has greatly affected by the population explosion. The State total population according to 2011 census is 19, 80,602 (Table 3.1) with a population density of 119 per Sq.km and a decadal rate (%) of - 0.47. It has witnessed unprecedented rise of population since 1971 with record of highest in the country from 39.9% to 64.4% in 2001. As revealed in the above, Dimapur district stands as the highest population of 379769 followed by Longleng district with a total population of 50593 as the lowest. While Mokokchung district 5th with 193171 population. The district has witnessed a drastic population shift in the past few decades with the rate of infant mortality and birth rate attributed to the growth of population. The district overall demographic change and numerous problems such as large numbers of influx of illegal immigrants both in urban and rural areas creates haphazard situation for the development of the district as well as in land use affecting the environment.

Table: 3.2 Population Growth rate of Mokokchung District

Year	Total Population	Density (Per.Sq.km)	Decadal Growth rate (%)
1981	1,04,193	65	+25.84
1991	1,58,374	98	+52.00
2001	2,27,239	141	+43.48
2011	1,93,171	120	-16.77

Source: Directorate of Economic & Statistics Department, Kohima: Nagaland Handbook of 2009 & 2012

The district is also dominated by large majorities of tribal population and other communities from the neighboring States do comfortably stay with the local people. The growth rate of population in the district is steadily growing from 1981-2001 which is considered as the transaction period of the movement of people from other States mostly illegal immigrants and apart from the census 2011 the population growth has decline to -16.77 % (Table: 3.2). This shows the low growth in birth rate also the influx of migrants both legally and illegal has been reduced to a large extent due to the amendment of ‘Survival 2007’ under the active part of AKM in the district.

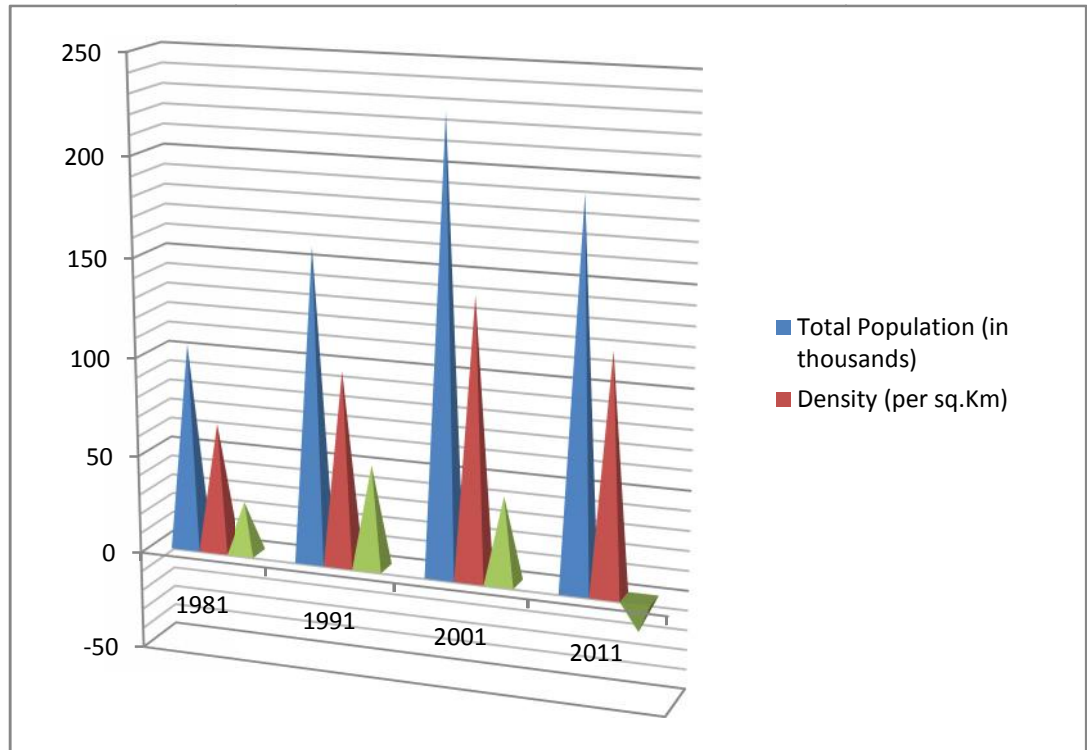


Fig: 3.2 Graph showing Mokokchung District Population

Table: 3.3 Population Growth rate of Nagaland

Year	Person	Decadal growth rate (%)	Density Per.Sq.km
1981	774930	+ 50.05	46
1991	1209546	+56.08	73
2001	1990036	+64.53	120
2011	1980602	-0.47	119

Source: Directorate of Economic & Statistics, Government of Nagaland, Kohima; Statistical Handbook 2009 & 2012

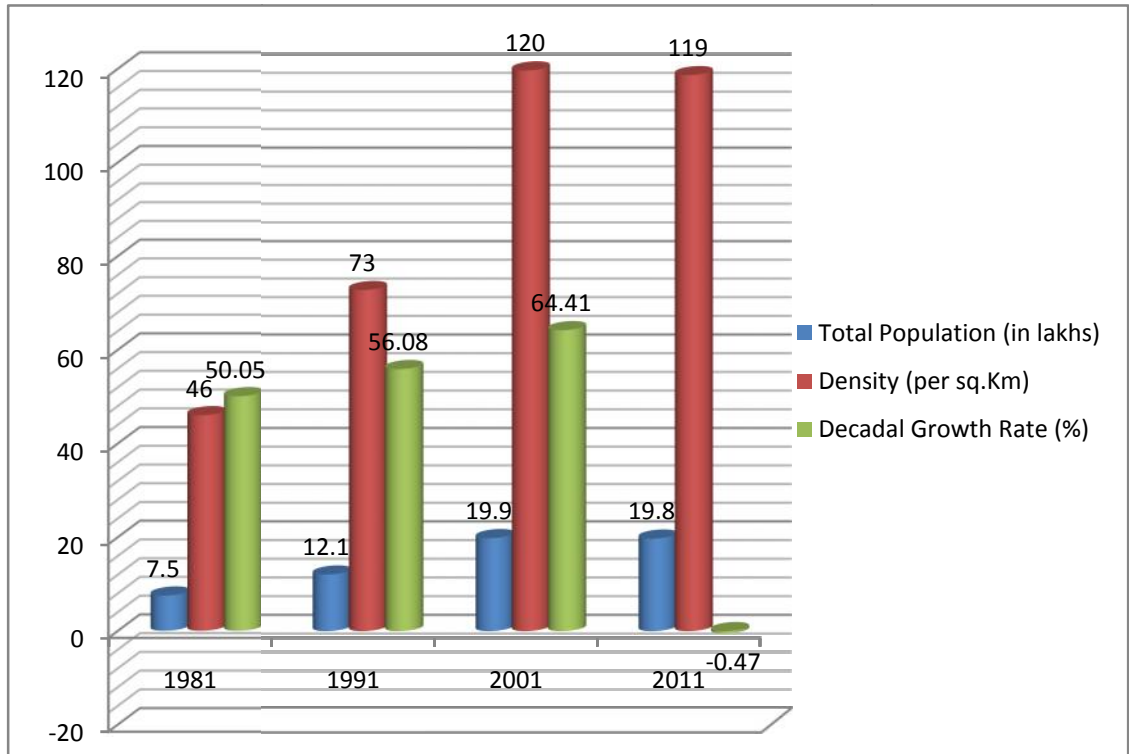


Fig: 3.3 Graph showing Population Growth rate in Nagaland from 1981-2011

3.5 Circle-Wise Population

Any region that consists of a particular tribe or clan is characterized by society, economy and political setup of a region. The district comprised of section of people comes from different districts as well as from neighboring states. The dominance populace is the Scheduled Tribe (ST) that comes up to 90% of the population in the district.

Table: 3.4 Circle-Wise Population of Mokokchung District

District/Circle	No. of village in circle 2011 census	Rural/Urban	Year			
			1981	1991	2001	2011
Mokokchung town	18	U	18060	24803	29332	34432
Ongpangkong circle	21	R	25970	38283	50868	45824
Kobulong circle	10	R	9848	14167	21112	12330
Longchem circle	16	R	5194	9151	12849	8581
Alongkima circle	10	R	8764	9618	21185	11952
Mangkolemba circle	13	R	8665	12128	20966	12950
Chuchuyimlang circle	11	R	8828	18273	23023	17790
Tuli circle	21	R	1058	19238	26603	21513
Changtongya	09	R	8278	12975	22878	7530

Source: Deputy Commissioner Office, Mokokchung, Nagaland

According to (Table: 3.4) of the circle-wise population the district is comprised of eight circles which including Mokokchung town. Over the years (from 1981-2011) Ongpangkong circle has witnessed the highest concentration of population with lowest concentration in Longchem circle but in 2011 it was taken up by Changtongya town with 7530.

3.6 Sex Composition

The term sex ratio is commonly used with reference to the proportion of women and men in total population of a country, state and district. The proportion is termed in total females per 1000 males of the area is concerned. Though it is desired that the numerical strength of male of the area and female members should be more or less equal in many instances it is not so.

Table: 3.5 Sex Composition of Mokokchung District

YEAR	MALE	FEMALE	TOTAL POPULATION	SEX%(FEMALES PER 1000MALES)
1981	54,648	49,545	1,04,193	907
1991	82,823	75,551	1,58,374	912
2001	118,428	108,802	2,27,239	919
2011	100,229	92,942	1,93,171	927

Source: Directorate of Economic & Statistics, Government of Nagaland, Kohima, Statistical Handbook, 2009 & 2012

The overall sex ratio in the district in 1981 was 907 females for every 1000 males (Table: 3.5) while in 2011 it was gone upto 927. The sex ratio tends to vary inversely with the rate growth of population which shows that the growth rate, the greater the mobility of people and greater the mobility it lowers the ratio.

3.7 Literacy

After the attainment of Statehood in 1963, schools and colleges were given priority that even students from other districts used to come to study in Mokokchung district-Impur Christian School. Mayangnokcha High school and Fazil College became the first educational institutions in the state. During 1870's American Missionaries were the one who first established the educational institutions. This shows that literacy rate has been increased tremendously.

Table: 3.6 Literacy rate of Nagaland and Mokokchung District

	2001			2011		
	Persons	Male	Female	Persons	Male	Female
Nagaland	67.11	71.77	61.92	80.11	83.29	76.69
Mokokchung	84.27	86.14	82.20	92.68	93.55	91.74

Source: Directorate of Economic & Statistics, Government of Nagaland, Kohima, Statistical Handbook, 2009 & 2012

The district indicates as one of the most literate district in the State and been declared a fully literate district in the year 2007. During the year 2001, the total literacy rate was 84.27% with male 86.14% and female 82.20%. Literacy rate in the district is still tremendously increasing with 92.68% (2011). This means that 92.68 out of 100 person of age more than 6 years are literate (Table3.6). It was ranked

first in terms of literacy rate out of eleven districts of Nagaland and 591 out of total 640 districts in India.

3.8 Rural-Urban Settlements

Mokokchung district is predominately a rural region and rural settlement is a common feature. To study the settlement patterns of the district, it is divided into three categories- predominately direction of the growth, land types and transport network. The district is hilly and most of the settlement areas are located on the hill top with various village falls into different circles. The main town is located in Ongpangkong range which is the main district Headquarter. Rural population constitute of 137,517 (2011) while urban population is 55,654.

Table: 3.7 Rural- Urban Population of Mokokchung District

Mokokchung	2001		2011	
	Rural	Urban	Rural	Urban
	196,026	31,204	137,517	55,654

Source: Statistical Handbook of Nagaland, 2004 & 2012, Directorate of Economic & Statistics, Government of Nagaland, Kohima

It is revealed that the concentration of rural –urban settlement population is more in rural areas (Table: 3.7). The ratio of rural – urban has changed and concentrated more population in urban areas from 1961 to 1971. This is primarily due to commercialization and urbanization which has lead to migration

from the rural to urban sectors. The district is pre-dominantly a rural region with a maximum settlement population below 1500 persons. The town of Mokokchung is the only urban area though there are five-sub town considered as rural settlement. Tuli, Changtongya and Mangkolemba with a population of more than 5000 persons that falls under class seven villages in India.

The patterns of settlement on the rugged terrain caused lots of constraints for the development of an area. Most of the rural settlements are of compact type with rectangular and linear shapes. Rural population is higher in all the districts in the state. The main reason of continuous increase in urban population is through industrial growth, jobs opportunities and better educational facilities also by inflows of the new migrants and directly by the natural increase of the migrants.

3.9 Cultural Ethos of Land use in Mokokchung District

3.9.1 Introduction

Land is defined as a sum total of the natural resource over which the possession of the earth's surface which covers the earth surface, building sites, soil status, forest, water resources, mineral deposits, climatic conditions and rainfall etc. It is the relationship of man to soil in the widest sense. It is laid down in native law and customs.¹

¹ *Coral Gardens and their Magic; Malniowski; B (1965), Bloomington.*

Land must be conceived in a more comprehensive manner. It is not only the prize asset but the most essential elements for human survival and development. A proper utilization and management is the key balance for the sustainable environmental development.

However, land as a free gift of nature is limited in supply and therefore beyond human control. The supply of land in its resources are extremely limited and fixed, while demand for land to provide basic needs and developmental activities of human is rapidly increasing which results in a fast decline to the land-man ratio.

The supply of land in its resources are extremely limited and fixed, while demand for land to provide basic needs and developmental activities of human is rapidly increasing which results in a fast decline to the land-man ratio. Human induced changes in land use often result in habitat fragmentation and loss the primary cause of species decline.² The problems related to land resources have further accentuated due to weakening of traditional management institutions, different ownerships of land and ill-defined rights. Relationship between the land and human activities is not only dynamic but also changes rapidly in time.

²*Environmental Geography: Bhaskar Chandra Biswas (2006), pp.90*

Land use practice is a continuing search for some acceptable balance to this change of people-land relationship.

Thus, land-man relation is expressed in two different categories.

1. Land in the individual person who used it.
2. Man and his relationship with the land can be expressed in terms of man as a social being and the land as in-exhaustible resource.

Each tribe or a village in Nagaland has a well definite territory bounded on all sides and well demarcated by land or rivulets and ridges to separate it from the territory of its neighbors. While the boundaries are marked by stones, hills, streams as well as by the other land marks which are all distinct and permanent. So, within a given village territory and land, there are different patterns of land use and land ownerships. However, land use system revolves around the basic question of how land is used by the communities and its members. In land use system, it encompasses the tenure of land as well as ownership of land in the village. The land use system includes all forms of different land utilization in the given village territory. In Nagaland, land tenure system embodies certain customary laws and under such laws and procedures the land household has the right in the use of basic resource of land and water in the community land and forest. Given below is some of the land ownership divisions commonly practice in Nagaland.

a) **Community land**

Community land consists of individual land which belongs to the village community as a whole. Any bonafide household is free to use such land for any agricultural purposes and also for the domestic consumption.

b) **Clan land**

Every clan has a land which is earmarked for the construction of houses, cultivating lands and wood lands within the territory of the villages. The eldest person of the clan is the custodian under the clan land who exercises a titular right over it. However, the senior members of the land are given the priority to use the land for cultivation. The clan members are also entitled to collect firewood from the clans land.

c) **Individual land**

Land use which are either inherited or acquired is said as the individual land. They have a right to share the produce of the land, to transfer holdings and have got the right of use to others.

d) **Government owned lands**

Majority of the land is solely owned either by the community, clan or by individuals, only a small portion of land is owned by the government. This has being used for setting up of educational institutions, medical, offices etc.

Community land as well as ownership of the land has undergone much drastic changes in course of time. Today, the land use system and tenure system faced much inevitable threats especially under the village community land and forest. This is due to the changes attributed to socio-economic transition and pressure on population. The tribal society that is supposed to be traditionally egalitarian where community ownership is the rule with large scales of land encroachment in the community land by a powerful section of the community. The emergence of elite class in the village contributes much change in the land use systems which can be traced back to the colonial period.

The other intervention that has brought changes in the land use is the inappropriate developmental schemes mainly from the State intervention. Moreover, promotions of income generation schemes is inevitable that affects land use patterns and led to competition for land resource (More commercial plantation and tertiary shifting cultivation activities operate in community land). In the village, land and forest have existed as community property, so the village land becomes the bone, which tied the members of the community. The land which belongs to the village community is administrative under the '*Putu or Tatar Menden*'.

Landuse/Landcover of Mokokchung Distrtrict 2011-2012

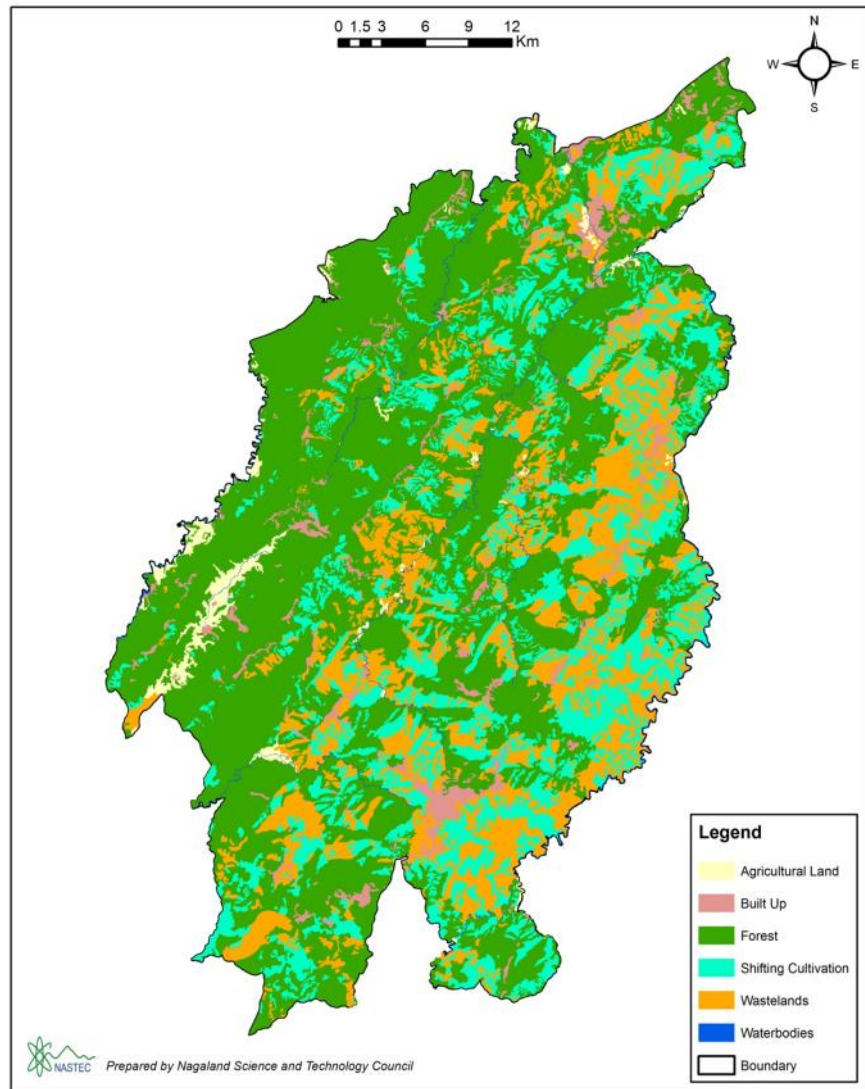


Fig: 3.4 Land use/land cover Map of Mokokchung District (2011-12)

3.9.2. Agricultural Land use and Crop Production

Land use refers to the man activities and various means of land use for different purposes. Generally, tribal economic systems are focused on their traditional land use system, particularly agriculture and forestry. The various land use system type which arise from the livelihood activities of these traditional societies are integral component of landscape mosaic. However, Naga community is one of the largest ethnic groups having several sub-ethnic communities where economic system of the people is largely dependent on the natural environment. Given the nature of the habitat and ecology, Nagas naturally depend on their land-household-production-house-hold consumption. In a Naga society, the use of land is the nucleus of all socio-activities, and the dominant land use system and traditional ecological activities is the cultivation of shifting cultivation. *The traditional farming system is closely adjusted to the local conditions (Grig, D; 1990).*

Agriculture is the mainstay of the economy and it is the source for almost all the households while day labour (both agriculture and non-agricultural wage work like lumbering, stone and quarries) are the secondary most important source of primary income while the secondary source of household income include poultry rearing, vegetables and fruit cultivation.

Mokokchung district has the dubious distinction of supporting the highest shifting cultivators in the State along. Out of the geographical area of 1615 Sq.km, land use falls under different agricultural categories actively cultivated by

the people. The district is endowed with varied climatic conditions and unique ecosystem to raise different types of crops. The different categories of agricultural land use system are as follows: (a) Jhum Paddy (b) Terrace Rice Cultivation or Wet Rice cultivation (TRC/WRC) Paddy (c) Plantation and Spices.

a. Jhum Paddy

Land use under Mokokchung district is mostly cultivated under Jhum paddy of which Ongpangkong range is the highest cultivator of all the six ranges. The district maintains an average Jhum cycle of 10-15 years but gradually it has been reduced. Beside paddy, other crops such as cereals, pulses, oilseeds, commercial crops are also cultivated. Out of the State 95550 hectares of total Jhum paddy, the district has an area of 9770 hectares.

Table: 3.8 Nagaland District wise under Jhum Paddy (2011-2012)

District	Area of Jhum Paddy
Kohima	5500
Phek	1870
Mokokchung	9770
Tuensang	10550
Mon	16360
Dimapur	9510
Wokha	19570
Zunheboto	9630
Peren	6760
Kiphire	8920
Longleng	6110
Total	95550

Source: Statistical Handbook of Nagaland, 2012

Table: 3.9 Mokokchung District Area and Production of Jhum paddy (in %)

		Year				
		2007-08	2008-09	2009-10	2010-11	2011-12
A	953.5	679.2	65.3	722.6	604.9	
P	72.66	63.4	60.3	58.86	59.1	

Source: Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook, 2009 & 2012

The highest overall both in terms of area and production is from 2007-2012 as shown in (Table: 3.9). During the year 2011-12 the area under Jhum was 604.9 % but the production was low with only 59.1 % this shows a drastic change with low yield of paddy crops due to climate change and loss of soil fertility.

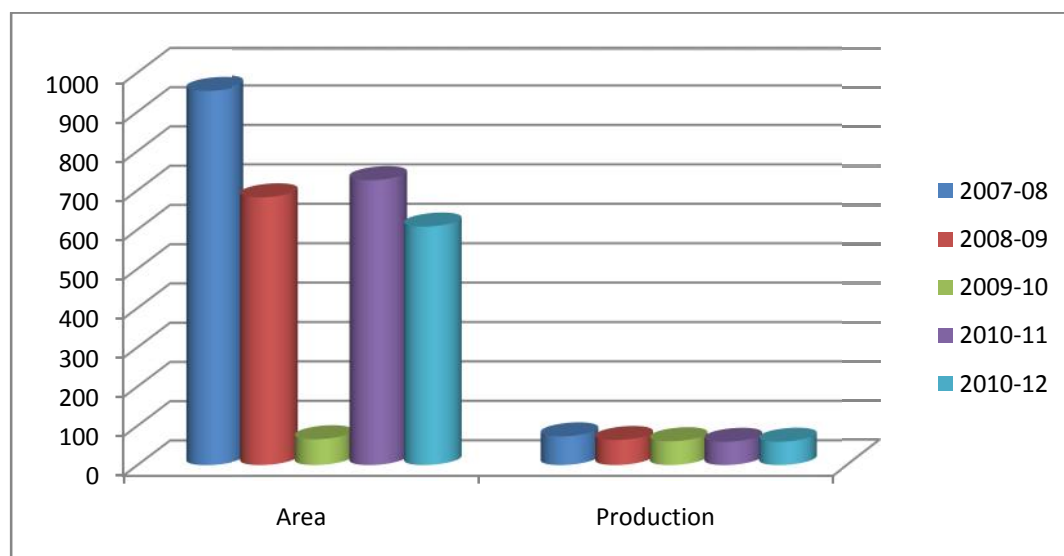


Fig: 3.5 Area and Production of Jhum paddy in Mokokchung District (in %)

Table: 3.10 Mokokchung District: Area and Production of Principal crops (in %)

Crops	Area & Prod	Year				
		2007-08	2008-09	2009-10	2010-11	2011-12
Cereals	A	1819.1	1268.73	1290.40	141.24	123.34
	P	57.42	40.53	45.88	45.92	42.46
Pulses	A	248.91	171.51	112.69	182.04	183.90
	P	5.18	3.34	3.07	3.04	3.30
Oilseeds	A	513.3	344.27	579.56	371.51	374.61
	P	7.67	5.96	13.38	5.77	6.21
Commercial crops	A	117.02	229.10	136.84	206.81	221.05
	P	29.72	50.15	37.65	45.25	48.01

Source: Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook, 2009 & 2012

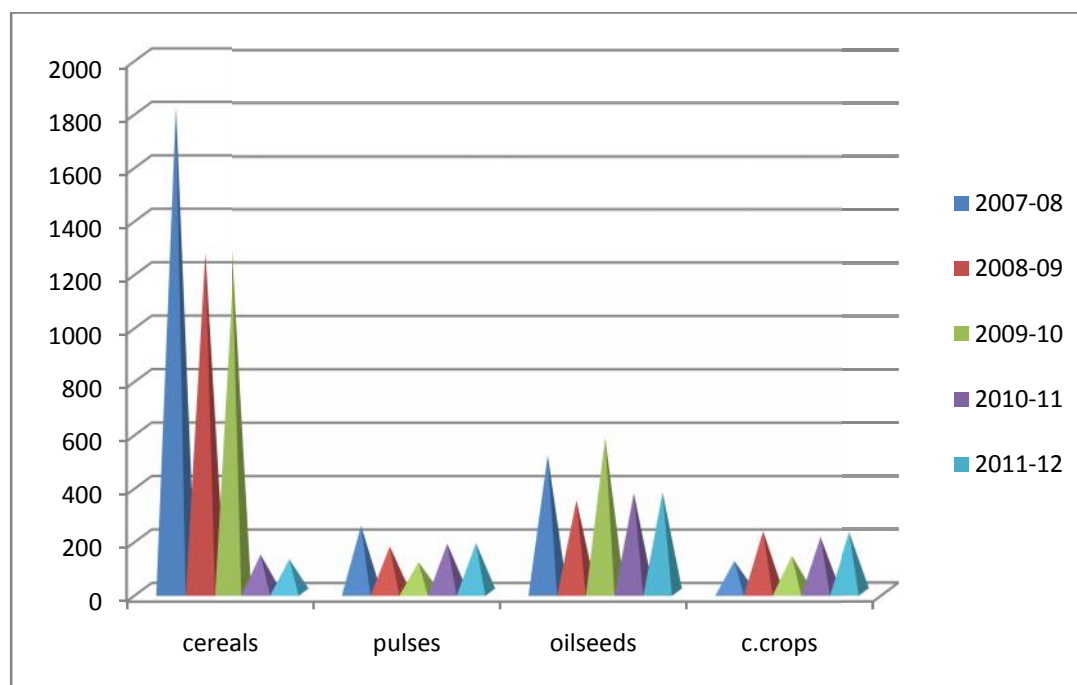


Fig: 3.6 Graph showing Area of Principal crops (in %) from 2007 to 2012

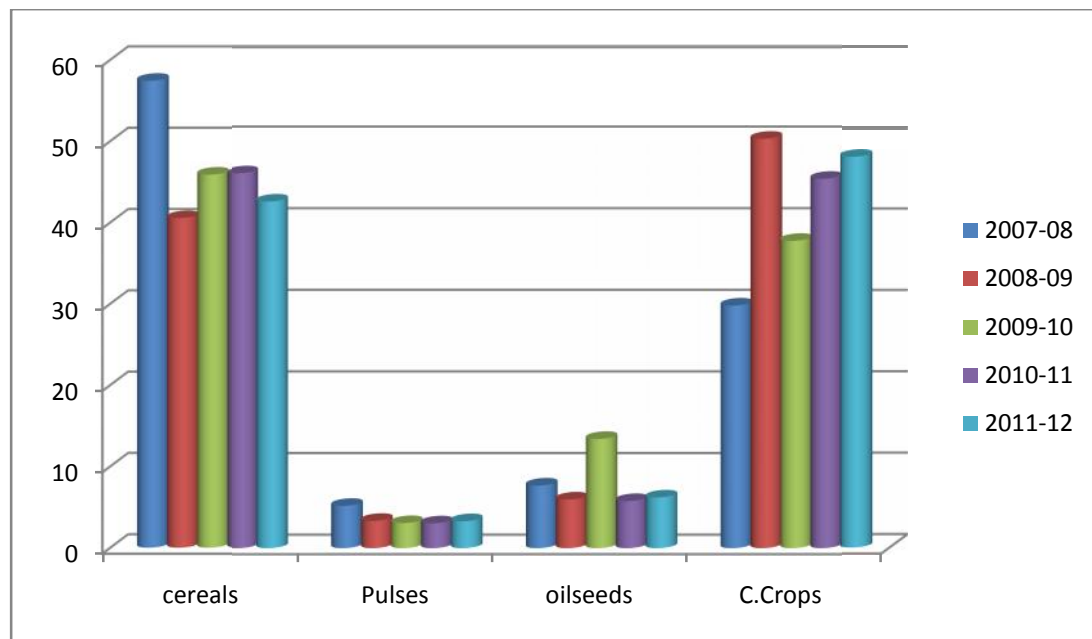


Fig: 3.7 Graph showing Production of Principal crops (in %) from 2007-2012

Many Jhum cultivators have also started cultivating cash crops like cereals, pulses, oilseeds and commercial crops. The Agriculture and Horticultural department has selected Longkhum village as the vegetable village in the year 2009. The Sungratsu village under Asetkong range has also converted an entire traditional community Jhum site into a model farming unit to sedentary farming activities. In this village Jhum cycle was only nine years which has been increased due to the change in land use pattern. As shown in (Table 3.10) cereal crops covers the highest area i.e. 29830 hectares from 2008-09 with a production of 57.42%. But in 2011-12 the area under cereals has been decreased a lot by covering an area of only 19920 hectares i.e.123.34% only.

3. Terrace Rice Cultivation or Wet Rice cultivation (TRC/WRC)

It is cultivated in the low lying areas where water is channeled into flat plots dependent on the contour and slope of the land. The field is prepared in many plot of flat land and on the side of each flat piece of land is raised above the land in order to retain water. The topography of the district which is characterized by lowland and mid slopes with varying degrees of slopes does not permit terrace cultivation or wet terrace cultivation in each in every range. It is cultivated in the valleys of Changkikong, Tzurangkong and Langpangkong ranges. Some of the permanent cultivators are Changki, Chungtiayimsen, Khar, Yajang and Merangkong villages. As per the recorded year 2011-12, the area under TRC/WRC was 4980 hectares.

Table: 3.11 Nagaland District wise Area under TRC/WRC Paddy (2011-2012)

District	Area of TRC/WRC paddy (in hectares)
Kohima	8070
Phek	11960
Mokokchung	4980
Tuensang	3520
Mon	3560
Dimapur	35970
Wokha	6450
Zunheboto	2630
Peren	7880
Kiphire	810
Longleng	200
Total	86030

Source: *Directorate of Economics & Statistics, Kohima, Nagaland Statistical Handbook of 2012*

Table: 3.12 Nagaland District wise Production under TRC/WRC Paddy (2011-2012)

District	Production of TRC/WRC paddy (in metric tons)
Kohima	19770
Phek	29310
Mokokchung	12200
Tuensang	8530
Mon	8580
Dimapur	88110
Wokha	15800
Zunheboto	6400
Peren	19290
Kiphire	1970
Longleng	480
Total	210440

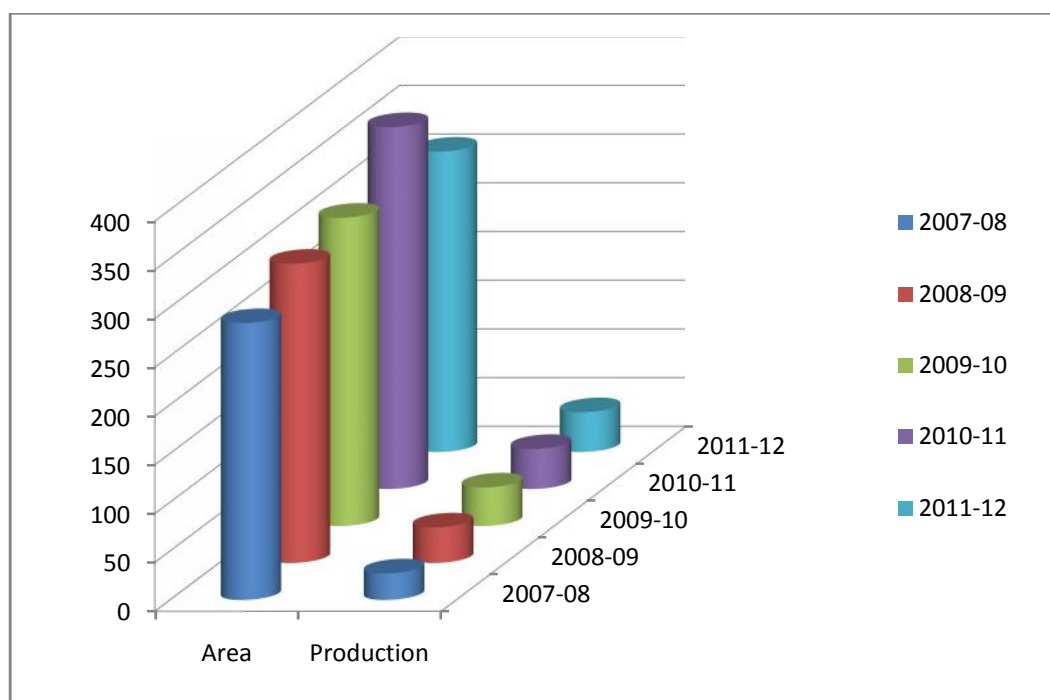
Source: *Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook 2012*

Table: 3.13 Area and Production of TRC/WRC Paddy of Mokokchung District

Year	Area (in hectares)	Production (in metric tons)
2007-2008	4590	9500
2008-2009	4960	11040
2009-2010	5110	8500
2010-2011	6000	14670
2011-2012	4980	12200

Source: Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook 2009 and 2012

Fig: 3.8 Graph Showing Area and Production of TRC/WRC under Mokokchung District (in %) from 2007-2012



Source: Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook, 2009 & 2012

According to the (Table:3.11), Dimapur district is the highest cultivator by covering an area of 35970 hectares with production of 8810 metric tons as recorded in 2011-2012. the lowest is seen in Kiphire and Longleng districts. The area under Mokokchung district was moderately increased from 2007-2010 but from 2011-2012 it was narrowed down to 4980 hectares only with production of 12200 metric tons. This is due to the climatic changes with uneven distribution in rainfall patterns.

4. Plantation and Spices

There is a rapid change in the land use pattern from traditional agricultural farming to commercial and plantation farming. Under this large tracts of forest and agricultural land are owned by individuals or community.

It is converted into monoculture, commercial forest and plantation. Plantation crops like tea, coffee, cashew nuts, rubber etc., with spices which include cardamom, black pepper, turmeric and Naga chilly etc., are cultivated. The tropical evergreen forest has been replaced into plantation along the foothills in Longpayimsen, Chungtiayimsen, Tuli, Changki, Mopungchuket and Longjang villages. Nearly 50 Sq.km of private plantation is under Changki village alone. In Merangkong village nearly 30% of the Jhum land has been converted with rubber

and tea plantations. The Schewan pepper is cultivated in Longjang village. According to (2011-2012) nearly 4564 hectares is under plantation and spices cultivation with production of 1825 metric tons.

Table: 3.14 Mokokchung District Area of Plantation and Spices (in hectares)

Crops	Year				
	2007-08	2008-09	2009-10	2010-11	2011-12
Coffee	500	500	500	500	500
Cardamom	300	315	315	200	150
Cashewnut	20	20	20	50	50
Arecanut	10	10	10	15	15
Coconut	---	---	---	05	175
Blackpepper	---	60	60	60	60
Turmeric	---	20	20	20	15
Naga Chilly	---	20	20	35	30

Source: Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook, 2009 & 2012

Table: 3.15 Mokokchung District Production of Plantation and Spices (in %)

Crops	Year				
	2007-08	2008-09	2009-10	2010-11	2011-12
Coffee	16	16	16	66.66	16
Cardamon	80	0.47	0.47	1.18	1.18
Cashewnut	02	10	9.80	16.66	16.66
Arecanut	0.2	10	9.80	16.66	16.66
Coconut	---	---	---	---	---
Blackpepper	---	0.47	0.47	1.18	1.18
Turmeric	---	18.95	18.95	18.95	16.58
Naga Chilly	---	21.32	21.32	33.17	30.80

Source: Directorate of Economics & Statistics, Kohima, Nagaland; Statistical Handbook, 2009 & 2012

3.9.3 Shifting cultivation and its Cyclic System

Mankind has inhabited the earth for over a million years before beginning to add to the resources food spontaneously brought forward by nature. It is only in the past ten thousand years that man became a producer of food by manipulating and furthering the growth of plants. There can no doubt that the initial form of agriculture was basically similar to shifting cultivation practice by many primitive as people of our days.

The origin of shifting cultivation can be traced back to the early evolutionary stage of agriculture, following hunting and gathering and preceding. The settled cultivation as the most characteristic feature of shifting cultivation and the one which has given its name is the practice of abandoning a plot after two or three seasons when its fertility begins to decline and of moving to another piece of forest and repeating the process of clearing and burning. This may be done haphazardly or on a regular cycle, which provides periods of fallow long enough to preserve the fertility of all the land and the possession of a crop. In other words, as the vegetation and soil regenerate, the land reaches a stage when it can once again be cultivated.

In the Naga Hills district there was near uniformity across the larger communities—the Lothas, Semas, Aos, the Trans-Dikhu tribes and Trans-Tizu. Certain Angami villages were also known to have practiced shifting cultivation. Though these particular tribes have a system of elaborate terracing and irrigation by which hillsides are turned into flooded rice fields. Under shifting cultivation there was virtually no cash input, no use of chemical fertilizers with no mechanization. The exclusive of manual labour, applied with digging stick or hoe, is one of the main correlates of shifting cultivation.

Shifting attracts the attention of possibly more social than physical scientists for it is not merely a set of agricultural operations strung together in sequence. Its procedure is interwoven with complex social and cultural associations between individuals, groups and the community.

Agriculture has been the major human intervention for natural resource management aimed at achieving food and livelihood security of human-kind (Binayak Rajhandari, 2006). *Shifting cultivation as a system of land use and agriculture is widespread in the mountainous areas of the Northeastern region of India (B P Maithani, 2005).*

Shifting cultivation is way of life of the people in the hilly areas, especially the people of Northeast India. Out of the total population atleast 90% of them live in rural areas and derive their livelihood directly from agriculture with the predominance of shifting cultivation in the entire region. There are nearly 600000 families of shifting cultivators in India, with more than 70% in the Northeastern States. In fact, the whole of the Northeast India can be appropriately termed as a '**The Land of Shifting Cultivators**' in the Agro-Kingdom.

This system of agriculture has played an important role in the development of human civilization. The system is regarded as the first step in transition from food gathering and hunting to food production. *It is also one of the oldest methods of resource exploitation. Shifting cultivation commonly known as Jhumming is one of the ancient system of farming believed to have originated in the Neolithic period around 7000B.C (D.N Bortakur, 2002).*

It is defined as

Shifting cultivation is described as “an economy of which mean characteristics are rotations of fields rather than crops, clearing by means of fire,

absence of draught animals and manuring, dibbling stick or hoe; short period of soil occupancy alternating with long fallow periods (Satapathyetel,2003).

Shifting cultivation is a process, which involves slashing and burning of forest (U A Shimray, 2007).

The name varies according to different regions in the world and most commonly known as rotational agriculture, slash and burn, Jhum or Swidden all the term tends to signify the same agricultural pattern of shifting cultivation. It is variously termed as Ladang in Indonesia, Caingin in Philippines, Milpa in Central America and Mexico, Ray in Vietnam, Conoco in Venezuela, Roca in Brazil, Masol by Congo and Central Africa. It is also practiced in the highlands of Manchurai, Korea and the Southwest of China. In India it is practiced in different regions across the tribal areas known by different names – Koman or Bringa in Orissa, Kumari in the western Ghats, Watra in southeast of Rajasthan, Penda, Bewar or Dahia and Deppa or Kumari in the Bastar of Madhya Pradesh. In the Northeastern region of India it is known as ‘Jhum or Podu’.

Shifting cultivation is a type of traditional farming system adopted historically in tropical forest eco-system. It is the primitive form of soil utilization. The farmers grow food only for his family in this agricultural system. Some more surpluses, if any, are exchanged or bartered or sold for cash in the neighboring markets. The shifting population is thus self-reliant with a high degree of economic independence and the resultant economy is almost static with little chance of rapid improvement.

This system of cultivation is a way of life which revolves around agro-ecosystem of cultivation on traditional knowledge and indigenous practices. This type of agriculture has been termed as shifting cultivation because the tribal people have to go on by shifting their fields in cyclic rotation after cropping, normally two years, and on rare occasion even three years. The cultivation is traditionally an important rainfall cropping system practiced on forest land of mild to steep slopes. The cultivators of pre-historic used fire stone, axes and hoes while in the present day the cultivators used digging sticks, iron tools, iron digging sticks, daos, hoe and knives. Based on the agro-climatic and socio-cultural settings, essentially it involves clearing and burning of forest on the hill steeps followed by cultivation of paddy crops inter-mixed with different crops on the same plot. However, after one or two years of cultivation, the land is abandoned for rest and a new site is selected to repeat the process. Thus, in shifting cultivation, the farmers rotate the land rather than crops to sustain livelihoods. *Cultivation continues to be the mainstay of the region economically and politically choices and that turn land encroachment into a major threat to their livelihood (Meiville, Pereira and Walter Fernades, 2005).*

The viability of this system of cultivation once sustainable under low population density is today being threatened with unprecedented population growth and pressure on land. The Jhum cycle has also shrunk from its earlier 15-30 years period to merely 7 to 9 years now or less than that in some regions. It makes impossible for the shifting cultivators to survive any longer unless something is quickly done in the manner of improving the system. A complete

abolition is however not possible and may not be desirable as well as in view of its likely effect on socio-economic life and environment.

Shifting cultivation though a rudimentary technique of land and forest resource utilization represents an intricate relationship between ecology, economy and society of a region. It is perceived both by numerous scientists as well as the general public, as primitive, backward, wasteful, and unproductive and exploitation in the cause of widespread of environmental degradation. It is blamed for the destruction of much of the world's tropical forest, land degradation, atmospheric pollution and global climatic change.

Stages

The stages of shifting cultivation involves shifting of land on the part of cultivators by selecting the forest site by clearing the trees and turn it into field where mixed cropping is also cultivated. Under the system of Jhum areas which are selected is cleared. During the month of October and November, bushes and shrubs are felled down by taking lots of manual laboures. When slashing, large logs and bamboos are removed for the family used as fuel wood or timber. The felled trees, shrubs and slashed branches are left up to February end month. When they are dried up fire is set in the month of February and March. After then fireworks, debris of logs unburnt or half burnt is cleared by placing at orderly so that the loose earth cannot be washed away. To clear away the burnt debris lots of

intensive manual labour is needed during the time of land clearance by using simple tools such as digging sticks, hoes and machetes. After this the paddy is prepared to cultivate and sow seeds of rice and other crops like yams, maize, millet, cucumber, pumpkin etc. are sown in the Jhum land in the month of March and April depending on the pre- monsoon showers. As the plant grows weeding process is being carried out atleast three or four times till the paddy crops are fully grown while the harvesting is done during the month of August and September. The crops are generally cultivated for one year but in some areas cultivation may continue for another second year also. The field is then left fallow and the cultivator moves to another field. The first new cultivated land is called 'Ludi' while the second one is known as 'Apen' by Ao-Naga community. Initially the duration of the cycle was about (15 to 20) years or more while synchronized well with the period needed to reach the forest nutrients. Shifting cultivation on these fallow lands is practiced again and the cycles thus continue the main purpose of the fallowing period. This is to restore the fertility of the soil and simultaneously allowing the forest to grow and attain into maturity. These objectives are best achieved in longer duration fallow as compared to the short duration fallow period. Also, the soil form during longer fallow period compensates for the soil loss during cultivation. Thus, the rooting volume of the soil remains particularly unaltered and the system remains stable. *This period varies according to biophysical and agro-climatic conditions of the area usually known as critical period (Sharma, 1984).*

If the fallow period is shortened there will be less time in which the soil recovery process and vegetation succession can take place. While secondary forest may be reduced to shorter, thinner, stemmed, wood bush or jungle species, bush may be reduced to scrub and tall grasses may be reduced to short grasses.

The change in environmental conditions that happen subsequent to either a lengthening of cropping period or a shortening of the fallow period often result in crop yields. Nevertheless, even in the most favourable environment, it is likely that if the cropping period is extended beyond a certain point, the fallow conditions required for an adequate recovery of soils and vegetation will be jeopardized. The length of fallow period varies from place to place depending on the pressure of the land.

3.9.4 Status of Shifting Cultivation in Mokokchung District

Land is the most basic asset among the Ao-Naga community. Slash and burn agriculture method, popularly known as Jhum or Shifting cultivation is an old age farming practice by the Ao-Naga since time immemorial. Traditionally it is the chief form of agricultural practices among the village which involves the customary laws to regulate the practice of its cultivation. It is categorized as village land, clan land, family land and community land.

Table: 3.16 Agricultural Statistics under Mokokchung District

Total Geographical area	161500 hectares
Cultivable area	110482 hectares
Cultivate area	22433 hectares
Net-irrigated area	3944 hectares
Gross irrigated area	4003 hectares
Total Agricultural labour	6892
Total cultivator	65366
Area under Current Jhum	9770 hectares
Area under TRC/WRC	4980 hectares
Average Jhum cycle	10-15 Years

*Source: 1. District Planning & development Board, Mokokchung: Nagaland (2011-12)
2. Directorate of Economics Statistics Kohima, Nagaland, 2012.*

According to Naga Jhum Land Regulation 1946, the original inhabitants have absolute right over their Jhum land and recognized their right to practiced shifting cultivation. Like any other Naga tribes of the State, ownership and management of land in the district is governed by village council, clan and individuals. Agriculture is the most important sector and means of sustenance and livelihood for the people living in rural areas. Nearly 70% of the farmers practiced shifting cultivation. Out of the district geographical area of 161500 hectares, the total cultivable area is 110482 hectares. The current Jhum covers an area of 9770 hectares followed by terrace rice cultivation or wet rice cultivation (TRC/WRC) with 4980 hectares (Table: 3.16).

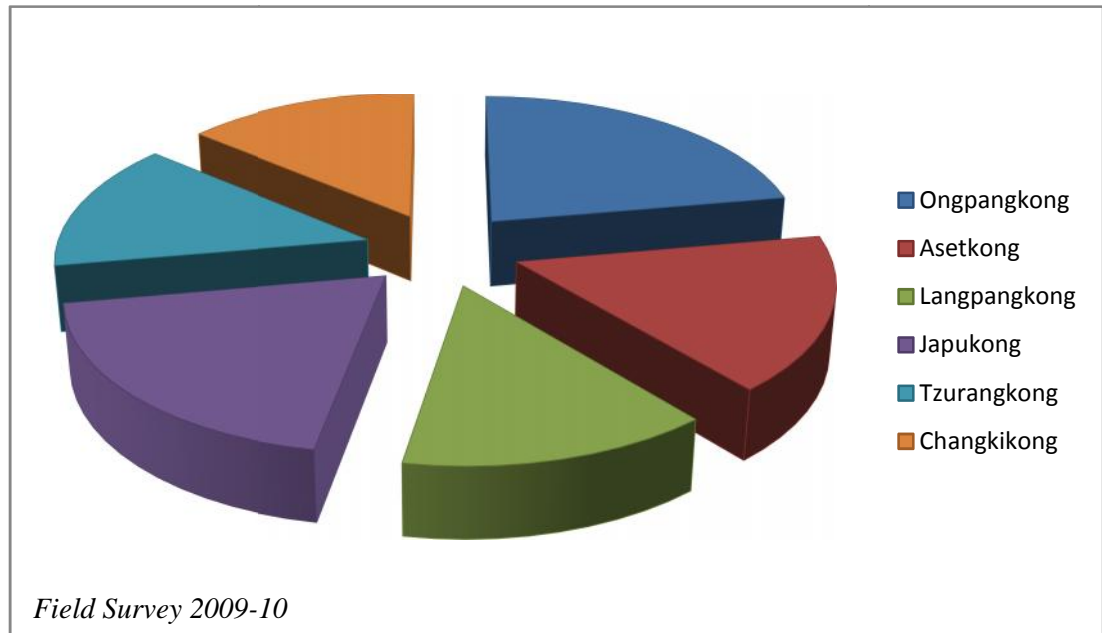


Fig: 3.9 Range wise under shifting cultivation in Mokokchung District (in %)

Area under Terrace cultivation is cultivated in the low land lying areas of Changki, Tzurang and Tuli areas. The district maintains an average Jhum cycle of 10-15 years, but now the duration of the cycle has been drastically narrowed down due to encroachment of more land. Out of 102 inhabited villages (2001 census) with six ranges, Ongpangkong range is the highest cultivator in the district (Fig: 3.9). The village of Longkhum has the highest Jhum cultivators with an area of 205 hectares under Jhum land. The villagers cultivate both Ludi (new Jhum filed) and Pentong (old Jhum field). Along with the Jhum paddy field, they also cultivate cash crops like tomato, potato and cauliflower. The village has been selected as the 'Vegetable Village' in the year 2009 by the Agriculture and Horticulture department, Government of Nagaland. The villagers are environmentally conscious as they have banned hunting in the community forests.

In the past in many of the Ao villages the Jhum cycle have been maintained within a range of 10-15 years. However, over the last few decades it has drastically narrowed down to 7 to 8 years respectively.

Table: 3.1 7 Mokokchung District Area under Forest (in hectares)

Particulars	Year		
	2008-09	2009-10	2010-11
Purchased forest	4548.79	4548.79	4548.79
Protected forest	428.00	428.00	428.00
Village forest	134523.21	24000.00	24000.00
Total	139500.00	28976.79	28976.79

Source: Directorate of Economic & Statistics Department, Kohima, Nagaland; Statistical handbook, 2009 & 2012

The total forest cover of Mokokchung district in 2008-09 was 139500.00 hectares but a large area has been decreased down during 2009-2011 with only 28976.79 as shown in (Table: 3.18). Every year more trees are cut down randomly for firewood and for Jhumming cultivation which is a great concerned for the village council. As a result, the forest cover in most of the sample villages has been depleted by becoming more or less vulnerable to grassland and shrubs. Interestingly, in the case of Merangkong and Changtongya village under Langpangkong range huge forest area under its jurisdiction converts Jhum land

into cash crops. In Merangkong village out of 60% hectares of Jhum land, 30% of the Jhum land has been converted into tea and rubber plantation and it has been flourishing to a large extent.

Expansion of terrace cultivation is also going on. The Bamboo Mission under the Government of Nagaland has also initiated by financing the Jhum cultivators for clearing up the jungles, plantation and by maintenance. This shows that, the Jhum cultivators in the village are decreasing and a shift to plantation and cash crops cultivation has been noticed. Sungratsu village under Asetkong range has an approximate area of 150 hectares under Jhum land. The village entire traditional community Jhum land has been converted into a model farming village where sedentary farming activities for production of cash crops and vegetables are being revealed. Some of the crops grown in this model farm village are passion fruit, orange, litchi and ginger. A number of enterprising farming families have started settling in this farming village. In Mopungchuket village out of 749 households (2011 census) nearly 100 households are primarily engaged in Jhum cultivation. Over the last 10 years the villagers maintained Jhum cycle at an average of 8 to 10 years, but presently it had narrowed down. This has lead to the depletion of forest cover areas and continuously creating problems for conservation of flora and fauna. Around 30 households (Field survey 2009-10) are presently engaged in tea plantation and orange projects under the supervision of Horticulture Department, Government of Nagaland. Realizing the importance of forest conservation, the village today has three protected community forest i.e.

Yangermanglupok (Core zone), Nashimer and Shrikimong. The field study reveals climatic change in the village over the last 5 years with drying up of streams and ponds.

**Table: 3.18 Nagaland classification of Forest Area
(2011-2012)**

Sl.No	Particular	Forest Area (in hectares)	Total Forest Area (%)
1	2	3	4
	LEGAL STATUS		
1	a) Reserved Forest b) Purchased Forest	6226 19247	0.72 2.23
2	Protected Forest	51679	5.99
3	Wild Life Sanctuary	3469	0.40
4	National Park	20202	2.34
5	Village Forest a) Accessible Forest b) Degraded Forest	477827 284280	55.37 32.95
	(1+2+3+4+5)	862930	100.00
	OWNERSHIP		
	a) State b) Private	100823 762107	11.68 88.32
	Total	862930	100

Source: Directorate of Economic & Statistics, Government of Nagaland: Kohima, Statistical Handbook of Nagaland, 2012

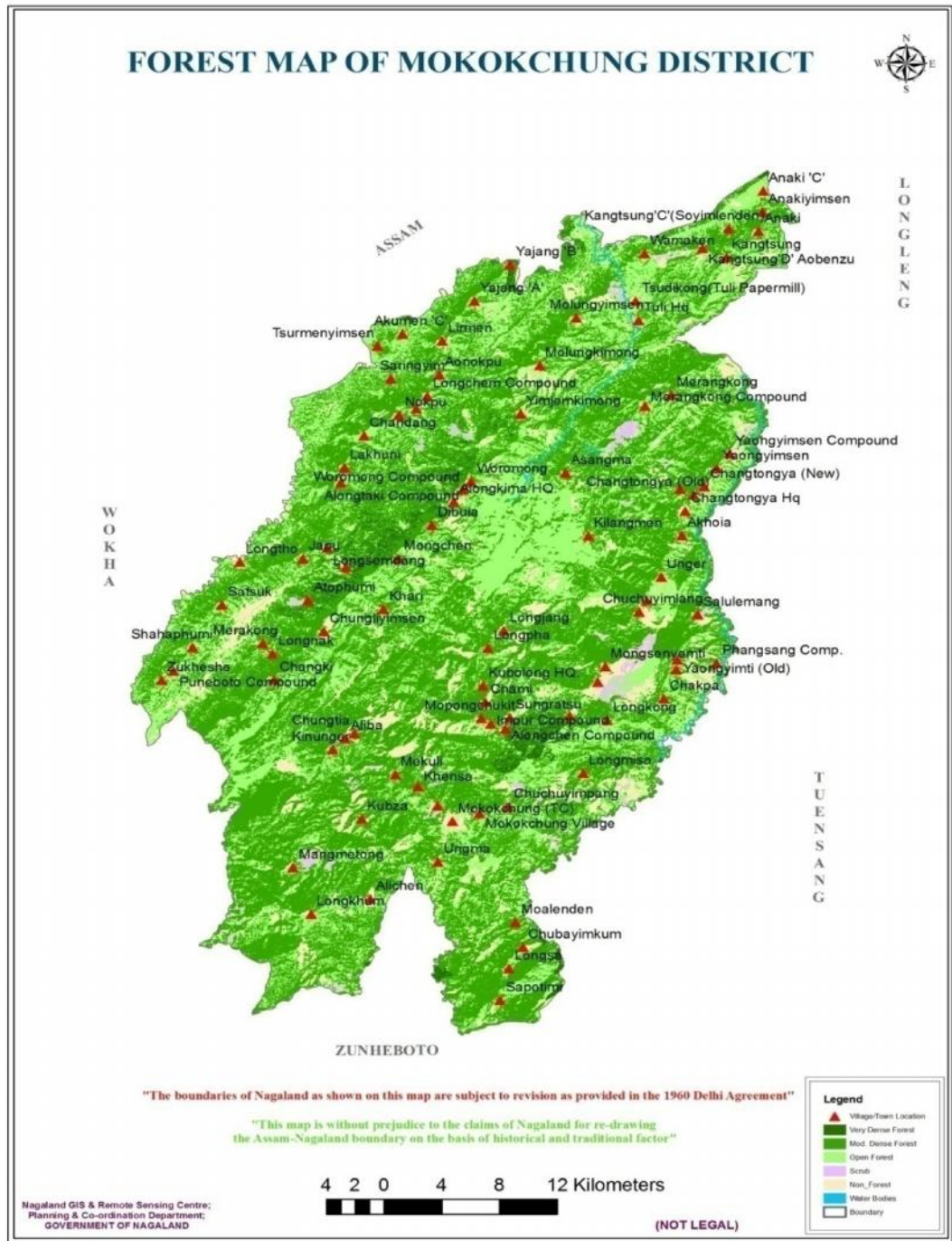


Fig: 3.10 Forest Cover Map of Mokokchung, District



Plate: 3.1 Tapioca cultivation in Sungratsu village



Plate: 3.2 Tea plantations at Mopungchuket village



Plate: 3.3 Cultivation of cash crops

Chungtiayimsen under Tzurangkong range has an approximate area of 70 hectares under Jhum paddy field. With nearly 50 households are actively involved in Jhum cultivation. The Jhum cycle has been drastically decreased over the last few years due to high pressure of population growth. Every year fresh forest land is brought into cultivation and there is a drastic reduction of forest cover. The village authority has initiated to protect forest but the result is negligible due to non-cooperation of the share holders.

Forest resources are the most important assets of the Nagas since time immemorial. The Aos have held their land, water and forest resources closely to the culture and traditions. The ownership and management of forest have been resulted into large scale of deforestation. Presently most of the forest and its products are being depleted at an alarming rate; with people remain more or less ignorant about the long term consequences. Nearly 40 hectares of forest cover i.e. Yajen, Ajen and Kupong under Khensa village were destroyed during the onset of Jhum field burning. Owing to this, many reserved forests and endangered species of both flora and fauna nestling abode were destroyed. *The loss of natural ecosystems always results in loss of biodiversity and often in a range of environmental impacts (Gordan Dickinson; Kevin Murphy, 2007).* The narrowing down of Jhum cycle also adversely affects the recovery of soil fertility and the nutrients conservation by the ecosystem. Repeated short-cycle Jhumming has created forest canopy gaps which are evident from the barren hills.

According to Hussain (1988:117) *the Jhum cycle in some parts of Nagaland is as short as 5 to 6 years, which is not sufficient for the generation of forests.* The chief methods of the exploitation of forests in Nagaland is Jhumming, extraction of firewood and raw materials, manufacture of charcoal, burning of forests and logging which all hinders the natural environmental condition in the State. The study also reveals that the Jhum cultivators in the district are constantly modifying and innovating upon their traditional practice to improve but it has still have a negative impact on the environment and their ecology. The district once known to be a rich biodiversity today has been exploited due to population pressure on agricultural land. These activities has resulted causing drastic fluctuation on weather causing acute water shortage and low yield of paddy crops in the entire district. **According to the Eastern Mirror Report (May 21, 2009)** changing weather pattern is playing havoc with agricultural activities of the rural community in and around Mokokchung district. Among the worst hit have been the cultivators of the famous cucumber cultivation especially those in the major farming villages of Aliba and Chungtia (under Ongpangkong range).



Plate: 3. 4 Forest canopy gaps



Plate: 3.5 Destruction of forest due to logging of firewood



Plate: 3.6 Forest cover



Plate: 3.7 View of the slashed areas of Forest Cover



Plate: 3.8 Felled Forest on the site of Shifting cultivation



Plate: 3.9 Burning of Jhum fields



Plate: 3.10 Jhum Field after burned



Plate: 3.11 View of Community Shifting cultivation



Plate 3.12 Jhum Paddy Fields



Plate: 3.13 Fallow Land after Shifting cultivation

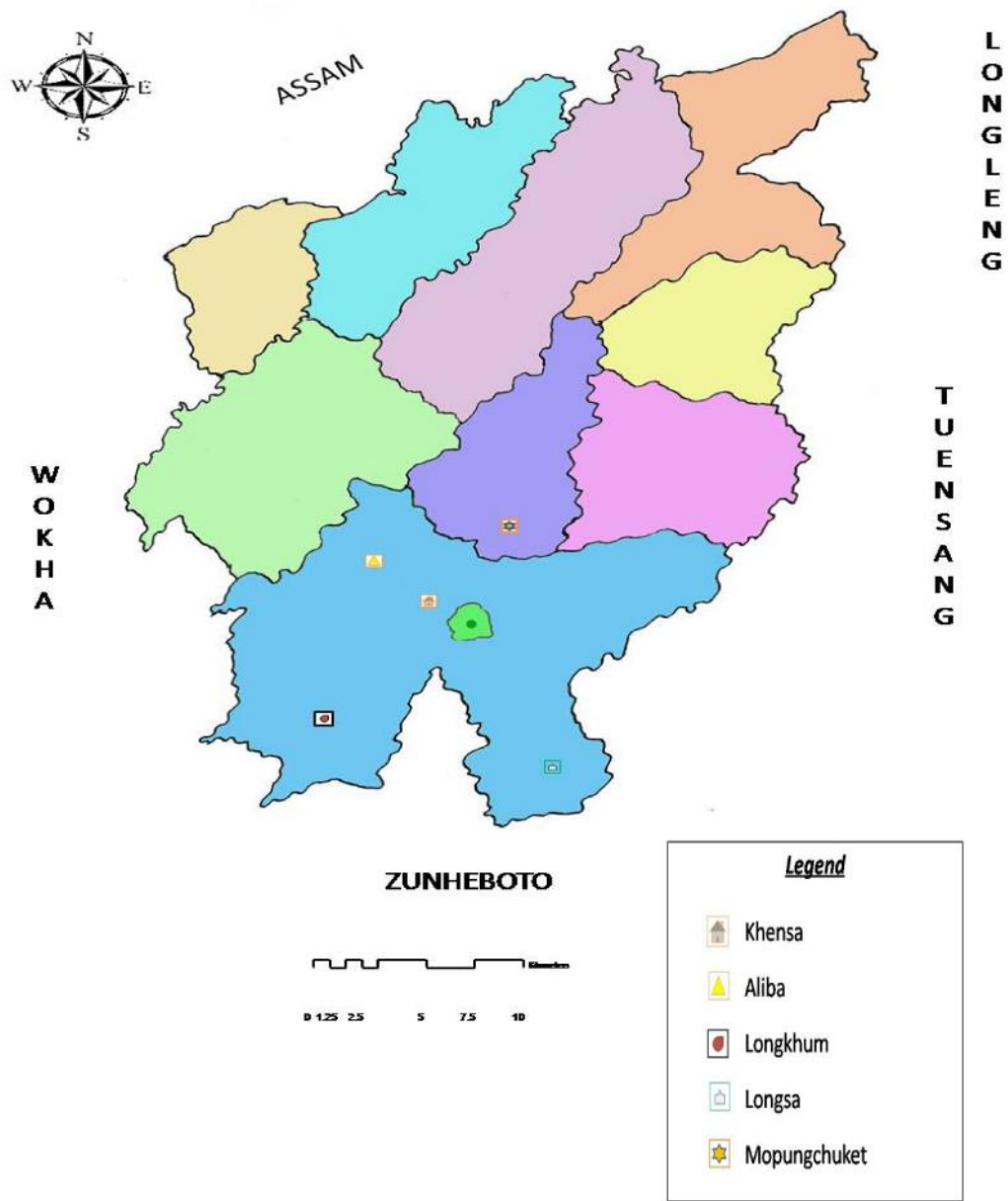


Fig: 3. 11 Sample villages under Mokokchung District

3.9.5 Sample villages and Shifting cultivation

Longkhum village

It is situated about 20 Kms southwest of Mokokchung district under Ongpangkong range. The village is known for legendary and mythical cave and stones. It's a vanguard village during the days of hunting which command a natural view. 'Mongzuki' the eagles nest is situated at a high altitude where eagles have nested for centuries. It has an altitude of 1601 meters above the mean sea level which is one of the highest altitude in the entire district of Mokokchung from there one can view the Himalayas from the top of its hillocks.

The total geographical area of the village is 80 Sq.km (8000 hectares) of which 3709 hectares is under total cultivated areas. It has a total population of 3909 (2011 census). The main occupation of the people is agriculture which is practiced in the form of Jhum cultivation based on simple technology. Out of 448 households nearly 300 households are engaged in Jhumming by grabbing an area of 205 hectares. The village is observed as one of the highest village Jhum cultivators in the entire district of which only two households are engaged in terrace cultivation.

Geographical information of the village

1. Geographical Area: 80 Sq.km (8000 hectares)
2. Boundary: North-Mangmetong and Ungma village

East- Ungma, Settsu and Zunheboto district (Shisimi, Zaphumi and Lumami)

West- Wokha district old Are, New Are, Sungro, Okotso and Pangti

South- Zunheboto district (Izheto and Sastami)

3. Location: 26 16'34'N and 26 23'20' N Latitude

94 20'20'E and 94 28'41'E Longitude

4. Average Rainfall: 2500 mm

5. Average Temperature: Minimum 10 C and Maximum 28 C

Along with Jhum, the village also cultivates different kinds of cash crops farming and animal husbandry. Crops like tomato, potato and cauliflowers are in high demand in the local market as well as in the nearby districts which sustains the local market during the off seasons. The characteristics of Longkhum forest ranges is from tropical semi-evergreen forest, sub-tropical broad leaved with hill forest and Montana wet temperate forest with moderate to heavy rainfall from April fall to Mid- October month. These factors enable to thrive and abound with vary rich biodiversity in the land. It is endowed with rich biotic resources of plants and animals having a total forest cover of 150 hectares over the decades. However, there is a considerable decline of forest cover altering the outmost of landscape and characteristic of forest vegetation cover. This is due to the continuous practice of Jhum cultivation where large scales of trees are being felled for the firewood consumptions. The interaction and the indiscriminate

removal of major and minor forest production results in deteriorating the physical environment which results in alterations of climate, soil, water and air etc.

Some of the environmental changes of Longkhum village which are being observed and collected during field survey (2008-2009) are:

1. Frost formation which was seen only in the village would accumulate up to few millimeters and thickness that lasted for days, today even dew formation has reduced.
2. Within a span of sixteen years from (1992- 2008) flow of rainfall is in irregular pattern of which the highest rainfall was recorded during 1998 which was 4878.33 millimeter and lowest in 2005 i.e. 12305 millimeter.
3. The volume of water of Tonglong River which is the largest river within the village has been reduced to a great extent.
4. The practice of shifting cultivation has brought tremendous massive destruction in forest cover as forest plays an important role in shaping in climatic patterns. This has brought changes in the occurrence of seasons that leads to change of blooming in vary species of exotic floras. *Rhodendron arboretum* (Locally known as Metsuben naro) which is found only in Longkhum village is found to be declined. The villagers claimed that it is about a decade now since they do not see much cloud in the low-lying areas as they used to see from the top of the village.

Mopungchuket village:

The village is located in the southeast of Mokokchung district under Asetkong range with an area of 65 Sq.km (6500 hectares). It has an altitude of 1325 meters above the sea level with a distance of 16 km from Mokokchung town. It lies between 26 °24' N Latitude and 94 °36'E Longitude. The population of the village has increased by 61% between 1981 and 2001 with 749 households (2011) by having a population of 2965. The village is bounded by Khar village in the north, Sungratsu village in the east, Khensa village in west and Mokokchung village towards the south. Some of the major rivers are Milak, Menung, Tsusu,

Wazuk, Etitsuba, Longrangtsu and Nangayok. Small streams are numerous which accumulates the village water sources. The village council and the traditions and customs make the village one of the socio-cultural hubs of the district. It is one of the main Tourist attractions under the Tourist Spot in the State. The village has a protected forest “**Minkong**” which covers an area of 275.32 hectares undertaken by the Tourism department and Tsuzu Watershed Project under the Forest department. The main economy of the village is agriculture of which Jhum cultivation is a pre-dominant. Out of total geographical area of 65 Sq.km (6500 hectares) the total cultivable area is 1250 hectares. Around 80 hectare of the land is under shifting cultivation while the rest is under plantation crops and horticultural farming. The plantation is common in the village with nearly 30 households are engaged in this cultivation. Most of the Tea products sell off to other nearby towns and districts. An orchard farm project is also established under the initiative of horticulture department.

Out of 749 households nearly 100 households are engaged under the Jhum cultivation which is cultivated near the Milak River. The village maintains a Jhum cycle of (8-10 years). Setting of shifting cultivation starts from the month of December onwards till February followed by burning down of debris in the month of March for the onset of paddy field, during this period large areas of wild fires occur unknowingly.

Areas under the shifting cultivation which is cultivated in Milak areas are prone to severe landslides causing massive environmental degradation due to practice on slopes. Due to environmental changes bee keeping is also affected. From the last 5-7 years the village experiences much warmer and less rainfall distribution which affects the agricultural crops due to low dew drop formation. Decline of forest cover is another problem.

Aliba village

The village is under Ongpangkong range, located 16 km away from the Mokokchung town. It lies between 94° 25' Longitude and 62° 25' Latitude. It has an area of 29 Sq.km (2900 hectares). The perimeter of the village is one of the smallest villages which have witnessed many changes towards its socio-economy. The village is economically developed, and population growth is minimal with a total population of 1044 (2011 census). Patterns of the village are compact in nature with 304 households (2011 census). It has an altitude of 1050 meters above

the mean sea level which are well suited for agricultural crops. Out of the total geographical area of 2900 hectares nearly 1250 hectares of land is under cultivable land of which around 20 hectares of land is under shifting cultivation. The main crops are cucumber and orange. Here, the cultivation of cucumber has been divided into four blocks.

The block of Shiyong was first established and cultivated by 20-25 families. According to the Village Marketing Committee Aliba, due to climate change and droughts of land for almost few years the entire Shiyong block of cucumber cultivation was dried up without bearing its fruits. Once it was a boon for the village economy, now many farmers are struggling to face the market demand (Field Survey of 2009-10). Total number of household according to 2011 census is 304 households with 1044 population. According to the State Jhum Land Survey Report (2005-06) the total number of households engaged in Jhum cultivation was 34 households and now it has increased. This shows that population is increasing giving more pressure on Jhum paddy cultivation. The village maintains a Jhum cycle of 8-10 years but now it has been reduced with the continues cultivation and shorter Jhum cycles. Fertility of the soils content has also been decreased a lot. This also inversely affects in cucumber cultivation. The village has a total forest cover of 1595 hectare out of district 161500 hectares. It maintains an area of 1250 hectares comes under Community Reserved Forest. The status of the forest cover has been reduced to a great extent with the continuous cultivation of Jhum.

Some effects of environmental degradation experience by the village are-

1. Cultivation of cucumber is decreasing due to climatic change. More susceptible of soil erosion due to vast forest destruction causing natural biodiversity habitat during the onset of Jhum.
2. With the reduction in Jhum cycle and immense involvement of Jhum fertility of the soil content has been reduced to a great extent.
3. Loss of habitat.
4. Landslide is frequent.

Khensa village

The village is situated in the northwest of Mokokchung district under Ongpangkong range with a distance of 5 km from Mokokchung town. It is located between 26° 20 '57.66 N Latitude and 94 °29'19.227'E Longitude. The physiography of the village is narrow ridges less than 200 meters wide and have thin mantle of soil with slope ranging from 10-15%. It also comprises of slope which is a continuous unit after the very steep slopes, and due to breaking of the steep slopes some accumulation of colluvial materials starts in this unit. This unit has slope ranging from 16.40% and is more found to occur on the lower sides of the high hills. The soil consists of loamy (Skeptical Typicudorthents) and fine loamy soils (Typeic Palendults). It enjoys a climatic condition of 2°C average to maximum 32°C by having an average rainfall amount of 2500mm.

On each side the village is bounded by Milak and Tzuza River with the formation of different streams, rivulets and gorges. Out of the total geographical area of 70 Sq.km around 2800 hectares is under forest cover with Community Reserved Forest of 320 hectares.

It has an altitude of 1300 meters above the mean sea level which plays an important role in controlling the temperature and temperature decides the occurrence of natural vegetation in the village. It has a sub-tropical low hill climate with lashes of heavy rainfall at the time of south west monsoon.

According to 2011 census, the total population was 3914 with 769 households. Out of the village total geographical area of 7000 hectares nearly 1350 hectares of land is under cultivation. By having a sub-tropical low climate different varieties of crops are cultivated by the villages. Cultivation of cotton was also prominent during the past decades but today it has found to be decayed due to the adoption of other cultivation and variation in climatic conditions. The areas of Yimpang (upper) and yimlang (lower) area are the main cultivable areas which altogether come up to seventeen areas. Shifting cultivation known as '*Tekong lu*' is cultivated in rotation under these mention areas with nearly 60% of the village are involved in this cultivation. One of the main causes of experience faced by the villagers is the forest fires. Annually large hectares of forest areas are been destroyed by the Jhum cultivators. Around 40 hectares of land i.e. Ajen, Yajen and Kupong areas was almost destroyed down during the year 2009 and 2013. Owing to this natural reserved forests and endangered species of floras and faunas nestling habituated were completely destroyed.

The environmental degradation faced by the villagers

1. Cultivation of Jhum paddy fields in the hilly terrain cause irreparable damage to the top soil with low yields.
2. Perennial streams have dried up and natural forest canopy are rare due to forest fires.
3. Domination of tall grass like broom and shrubs is common in the entire areas.
4. Invasion of more weeds is common in the paddy fields.
5. Due to late monsoon time of sowing seeds are affecting to a large extent.

It is perceived that this method of cultivation accounts to a larger percentage in environmental degradation.

Longsa village

The village is situated in the eastern part of Mokokchung district under Ongpangkong range located between 2613'19.017 'N Latitude and 94 25'55.962'E Longitude. It has an area of 50 Sq.km with 3500 population (2011). The State Highway from Tuensang district to Mokokchung passes this village cutting the lower range. The village is bounded by Sapotimi (Zunheboto district) on the north, Chubayimkum on the south, Lumami (Zunheboto) on the east and Chungliyimti (Tuensang) on the west. The hilly and the undulating topography with micro-climate vary from place to place with an altitude of 1031 meters above the mean sea level. It receives an annual rainfall of around 200 mm on an average.

The texture of the soil is clay loam with PH 5.90 with 2.40 organic carbons contents. The main economy of the village derives from the forest and lands and these are the major economic resources of the whole community. The majority of the villagers depend on agriculture which is overwhelming categorized under three land use systems-shifting cultivation, horticulture and plantation. Nearly 90 hectares of land is under shifting cultivation with an average Jhum cycle of 11 years. Cash crops like beans, pumpkin, maize etc., are grown mixed with the paddy crop. The village has a forest cover of 450 hectares but with the growing population and expansion of Jhum land forest cover has been tremendously narrowed down. Forest fires are common in the village on the onset of burning Jhum fields during dry months.

The effect of environment due to massive slashing of forest simultaneously relates to climate factors. Comparing to last few years the farmers experience low yield in paddy due to late monsoon. More weeds are also common in the paddy fields. Among the cash crops, chilly is the most important crop which was been abundantly found in the local markets. It a capacity of disposing to all the districts and even to neighboring states and foreign countries packed as chilly pickles. Recently, the production is low compared to last few years back.

With low yield in paddy crops and environmental degradation faced by the villagers now they are focusing more on horticultural crops and plantation crops. Farmers Club of Longsa was established in September, 2010 under the assistance of Agriculture and Funding Agency like NABARD. Large areas of land are also

converted into tea plantation which is cultivated near the Moalenden site 11 kms away from the village. The village is also known as the major producer of essential oil of lemongrass in Mokokchung district cultivated under less than 20 hectares of the village land. A distillation unit is also installed at Tsuktsung valley.

Field Survey observation during (2010-11)

1. Felling of huge forest and clearing of jungles accelerate soil erosion and accentuate variability of rainfall affects in crop production.
2. Growth of population and short fallow period.
3. Burning of Jhum fields during dry season intentionally creates forest fires.
4. Extinction of varieties of exotic floras and endangered faunas.
5. Drying of natural perennial streams and ponds in the village areas.

CHAPTER: 4 - IMPACT OF SHIFTING CULTIVATION

4.1 Introduction

Shifting cultivation is an important form of primitive agricultural land use. In this system forest area is cleared by slash and burn techniques. *Till 1950's shifting cultivation, under its diverse forms of slash-and-burn system was a traditional method of cultivating tropical highland and mountain soils, mostly for providing a minimum subsistence to the peasantry (Jasbir Singh, 1997).* For primitive cultures, the cultivation was a remarkable innovation which is based on the revolutionary transition from forest based food gathering to agriculture based food production. The cycle of rotation was also long having enough time to regenerate the soil. This is how a nomadic cropping system for self-sufficient subsistence economy developed with labour efficient systems.

In course of time, various adverse effects arise due to cultivation of Jhum. With the increasing population, more pressure on land increased with shorter Jhum cycles. Short fallow periods are no longer adequate to restore the soil productive capacity therefore, decline in crops yield arise. With the increase in population pressure on the land and the Jhum cycle decreased. The main reason behind the persistency of this system of cultivation lies in its compatibility with the physical environment.

The sparse population, steep and undulating topography, community land tenure system and other aspects of socio-economy and cultural factors are some of the reasons that went in its favours, in Northeast region where shifting cultivation is practiced by most of the hilly people. There are various effects of shifting cultivation with large scale deforestation due to this cultivation it occurs undesirable ecological imbalances. Since, the hill tops particularly the catchments areas are the source of water, deforestation in the hills that lead to elimination of the sources of water which increased the run-off due to consequent inability of the soil to retain the water.

The clearance of forest causes deforestation which accelerates soil erosion and accentuates the variability in rainfall distribution. Burning of Jhum land can be considered as one of the worst impact on climate because it gives scope in high rate of soil erosion and soil erosion structural stability by runoff and winds. The availability of water in the soil for the crop production also decreases which is vulnerable to climatic variation. As the farmers cultivate the same plot of land for two years in some village, fertility of the soil decreases with its debilitating impact of crop production. The fragmentation of natural habitat loss native species and invasion of more exotic weeds arise and burning down of sun-dried vegetation pollutes the air with carbon-monoxide, nitrous oxide and many other harmful gases are some of the consequences of shifting cultivation on environment.

4.2. People's view of Shifting cultivation

Shifting cultivation which is the most complex and multifaceted form of agriculture has become a subject of debate and intervention since the colonial era. The practice has been criticized by numerous scientists, environmentalists, foresters, developmental practitioners, policy makers as well as the general public's being primitive, backward, destructive or wasteful, unproductive and exploitative and the cause of widespread environmental degradation. Shifting cultivators are blamed for the destruction of much of the world's tropical forest, land degradation, atmospheric pollution and global climatic change. As a result, shifting cultivation in many forms is being destructive to the environment because forest areas are being converted to agriculture through its practices thus, diminishing the area under primary forest. Contemporary critics of shifting cultivation, pejorative terms that perpetuate misperceptions about shifting cultivators (Thruppetal, 1997). It has brought lots of changes in the ecological settings of the surrounding environment. The loss of forest cover influences the climate that contributes to loss of biodiversity. Further on, siltation, flooding and soil degradation affect the economic activity and threaten the livelihoods and cultural integrity of forest-dependent people. The cause of deforestation and forest degradation are complex. It has been identified that demographic factors are one of the important underlying causes.

While it has been recognized that shifting cultivation is one of the main culprits of tropical deforestation. Some of the demographic and economic factors that are already adding pressure on rich natural resources are:

1. Intensive Jhum cultivation
2. Deforestation threats
3. Rapid urbanization
4. Incidence of forest fires
5. High rate of unemployment

It has viewed that the land resource for agricultural activities should be assessed on the basis of slope, dissection index, soil and vegetation cover and land-use of a land at micro-level (Wagh, etal; 1984). In Nagaland the Jhum paddy covers an area of 95550 hectares (2011-12). There is no doubt that shifting cultivation is destabilizing the environment by means of deforestation, soil erosion and emission of carbon dioxide by the burning of Jhum fields. Nevertheless, the cultivators are left with no other choice because there is no suitable for alternative method to substitute. Some views of the people's perception are:

1. The hill topography permits only the slash and burn method of cultivation, cultivation of terrace needs low-lying areas and it involves huge money. It has been found that the Government has promised to provide schemes for the terrace cultivation but the very schemes never reached the cultivators.
2. For most of the people living in rural areas there is no source of income unlike the people living in the urban areas their only source is encroachment of more land under agriculture and depend on the forest resources.

The farmers also practice soil conservation base on the physical barriers and live barriers. They used poles, logs and bamboos across the slope areas as a contour bund to check soil erosion in the Jhum fields. Cash crops like cucumber, ginger, yam etc., are cultivated in the contour bunds. This ensure in food security as well as in economic livelihood subsistence for the rural people. With these traditional approaches the State Government has launched a programme known as the Communalization of public Institutions and Services and NEPED. The declaration of Vegetable village in Longkhum village in the district has suffered tremendous loss due to lack of marketing facilities. Hence, the State Government should come forward with a sustainable alternative approaches towards in landuse system to ensure the security of livelihood for the shifting cultivators. Shifting cultivation is affecting the environment and productivity of land adversely. Alternative avenues of income, suitably harmonized with the right land use practices, should be devised to discourage shifting cultivation. Efforts should be made to contain such cultivation within the area already affected by propagating improved agricultural practices. Already damage by such cultivation should be rehabilitated through social forestry and energy plantations (National Forest Policy, 1988).

The view is that shifting cultivation is wasteful and inefficient mode of crop production. It is true that productivity from the point of land use is low under shifting cultivation (Barkakoti, 1990).

The climate induced variability of key parameters as assessed by few modeling studies have found unanimously that in addition to the existing development challenges being faced in forest cover in the Mokokchung district. The fluctuations in temperature and precipitation will impose added burden of the natural resources that has been conserved and protected so far through the method of traditional practices like community ownership and technical engagement of forest Department. It will be almost impossible to achieve the laid down objectives of afforestation and re-forestation to maintain sustainable management of forest resources.

4.3 Impact of Shifting Cultivation on environment in Mokokchung District

The district of Mokokchung is a land of village with 102 inhabited villages (2001census) and the people of the rural communities depend on environment for their livelihood subsistence. The land belongs to the individual, clan and community. Shifting cultivation which is also known as slash and burn cultivation is an old age practice deeply rooted within the Ao-Naga community. According to 2011 census, the total population of the district comprise of 1, 93,171 and out of this rural constitute of 1, 37,517 population. Approximately 70% of the cultivation practice shifting cultivation.

Out of the district geographical area of 161500 hectares, Jhum cultivation covers an area of 9770 hectares during the year 2011-2012. *According to Nagaland Jhum Land Act 1970, Jhum land means such land which any member or members or a village or a community have a customary right to cultivates by means of shifting*

cultivation or to utilize by clearing jungle or for grazing livestock and includes any beds of rivers provided that such village or community is in permanent location.

The study reveals that Jhum cultivators in the district are constantly modifying and innovating upon their traditional practices to improve but it still has a negative impact on the environment and their economy. The district was once known to be rich diversity today it has been exploited a lot due population pressure on agricultural land and by various human activities on environment. Over the years, the district has witnessed serious depletion on forest cover as well as on environmental changes.

The increase in population and encroachment of land under Jhum has however affected the environment to a greater extent. The burning of Jhum fields has also contributed slowly to the change in climatic variations. It is evident that large portions of wild fires that occur each year are caused due to burning of Jhum cultivation. This has caused numerous changes in the forest cover which eventually brought changes in the environmental condition of the district.

The district which has a tropical climate has raised its temperature by a few degree Celsius undergoing slight changes in the climatic condition. This slight alteration in degrees eventually affects in crop production. The year 2009 was the warmest year with drought like situation as the rainfall was uneven.

All these variations in climate have cause change in blooming of fruits and vegetables crops as well as in the reduction of natural resources. Moreover, farmers irrespective of their cultivation type have been the most affect with paddy crops and different kinds of cash crops yield lesser in the quantity of production. Among the

worst hit are the cultivators of cucumber under Aliba village. Almost a block of cucumber cultivation was dried off without bearing its fruit.

The delay in rainfall also constraint in the formation of dew drops thereby affects the pollination by bees and insects. With varies in altitude and changes in environment may varies from one village to another. Of all the cultivators of Jhum, Longkhum village is having the highest cultivators. A change in environment has been altered from the last five years. The frost formation seen only in Longkhum village which used to be accumulated upon few millimeters in thickness and lasted for several days has been reduced. Today, even due formation has been reduced within a span of 16 years starting from (1992-2008). The flow of rainfall is in an irregular pattern of which the highest rainfall was received in 1998 with 4878.33 mm and the lowest was in 2005 with 12305 mm. The Tonglong River which is the main barrier of water source for the villagers its volume of water has been reduced to a great extent. Drying up of natural perennial streams is also common in all the villages in the district. As a result of such seasonal shifts in weather condition the district had faced several landslides. The landslide that occurred on 22nd June, 1992 and 26th May, 2005 have been the district worst affect which was caused by the continuous heavy rainfall with more than 170.7 mm.

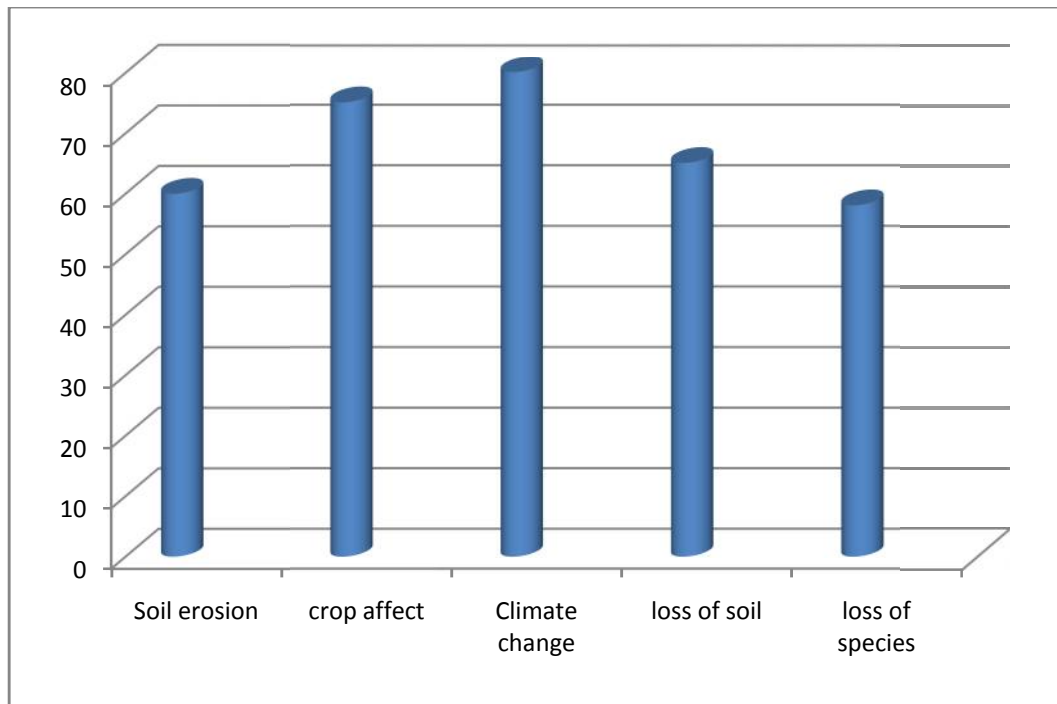


Fig: 3.12 Environmental Impact in Sampled villages (in %)

Source: Field Survey (2009-2011)

Field survey was conducted in the sampled villages to know more about the environmental impact and the social implications of the farming communities. It was carried out based on personal interviews and questionnaires as shown in (Fig: 3.12).

Forest resources are the most important assets for the Nagas. The district total forest cover in 2007 to 2008 was 139500 hectares but it has drastically decreased in 2010 to 2011 by 28976.79 hectares with remains the same from (2009 to 2011). Destroying of village forest is another problem according to 2008-09 the village forest cover was 134523.21 hectares but due to agricultural activities forest cover has been deforested a lot which has been reduced to 24000 hectares only.

The ownership and management of forest and turning large areas of forests cover under shifting cultivation has resulted into deforestation. During the first onset of Jhum, large tracts of trees are felled down and the felled trees products are used as timber and firewood. These process leads to the depletion at an alarming rate with people remain more or less ignorant about the long term consequences on the environment.

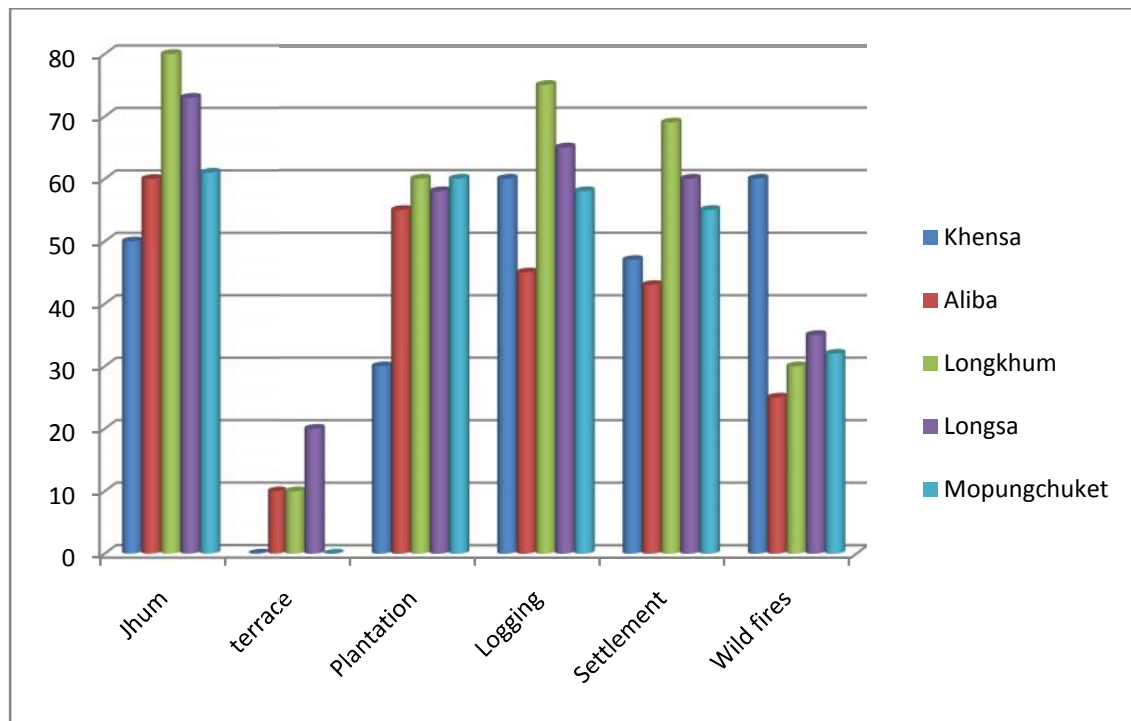


Fig: 3.13 Deforestation cause by different activities (in %)

Source: Field Survey (2010-2011)

The problem of deforestation is caused by human intervention by different activities. (Fig: 3.13) shows from the Field Survey respondents under different sampled villages. The overall deforestation is caused by shifting cultivation in which the highest response was in Longkhum village followed by Longsa village. Logging

and wild fires is also another problem of deforestation which are all inter-linked with the practice of shifting cultivation. In almost all the sampled villages cultivation of terrace is low; this is due to the hill topography. The deforestation status was also carried out in different villages to know more about the management of forest and deforestation. It has been observed that, forest cover in all the different ranges has been decreased to a large extent due to the pressure of Jhum cultivators and logging. Langpangkong, Tzurangkong, Japukong and Changkikong ranges have large hectares under forest cover with thick and dense vegetation.

The destruction of virgin forests causes more landslides which are common in these ranges. Numerous natural abode diversity of fauna and flora are also disappearing due to destruction of evergreen and moist-deciduous forest. *The destruction of the world's tropical forest, which is disappearing at an alarming rate, is one of the today's most urgent global environmental issues (K.C.Agrawal, 1998).* The indigenous plant species *Rhododendrom Arboretum* (locally known as Metsuben naro) which was once abundantly embellishes the forest of Longkhum village has reduced expressively.

Impact of environment in the district observed during Field Study

1. Shifting cultivation has become non-sustainable.
2. Increase in population and pressure on agricultural land has brought huge forest under shifting cultivation.
3. Mass destruction of forest cover leads to deforestation and loss of biodiversity on environment.

4. Burning of Jhum is one of the worst impacts on climate as it produce huge junks of smoke and released into the atmosphere.
5. Rising of a temperature by a few degrees Celsius.
6. Decline in soil fertility with low yield is common in all the ranges.
7. Late monsoon and warm climate.

Keeping in view that, shifting cultivation is a way of life for the Ao-Naga community leaned with culture, customs and beliefs. Perhaps it will not go easily from the Naga farming system. Abolition of Jhum cultivation is not a realistic solution unless alternative methods for livelihoods are available. To ensure sustainable maintenance of the environment and productivity of Jhum cultivation some suggestions are pertinent:

1. Introducing of Alder trees (*Alnus nepalensis*).
2. Encouraged settled cultivation.
3. Topography of the district is undulating, use of broom grass on contours as vegetative barriers to reduce soil erosion.
4. Use of salt to control weeds must be banned as it loosens the soil which leads to soil erosion.
5. Introduction of leguminous crops in Jhum fields during cropping years to enhance land productivity and crop yields.
6. Afforestation must be encouraged under the guidance of village councils, district authorities along with forest department, NGO's and other agencies.
7. Organic farming must be encouraged.
8. Balanced use of fertilizer to maintain soil fertility.



Plate 4.1 Emissions of smoke effecting the environment



Plate 4.2 Soil erosion in the hilly slopes under Jhum cultivation



Plate 4.3 Effects of Forest fire on vegetation cover



Plate 4.4 Virgin Forest Cover



Plate: 4.5 Massive Deforestation in Virgin Forest



Plate 4.6 Felled Trees for firewood



Plate: 4.7 Women folks tending fire wood

4.4 Environmental Impact of Shifting cultivation

4.4.1 Degradation of Soil Fertility

Soils are the vital natural resource, on whose proper use depend the life supporting system and socio-economic development (Dr.K.Kire, 2006). The stability and future of many soils is under threat from a wide variety of human activities including over-grazing, poor agricultural practices, land-use change and forest clearance (Chris Park, 2001).

Shifting cultivation results in huge loss of soil and soil fertility and contributes a large volume of carbon to the atmosphere. It ultimately sustains on natural regeneration of soil fertility. It is an important period since the natural processes takes a minimum period to restore the cultivated land to its original fertility level. The maintenance of Jhum cycle varies according to different villages under Mokokchung district. It has been observed that, Jhum cycles have been drastically narrowed down due to constant practice in some villages. *This period varies according to the bio-physical and agro-climatic conditions of the area usually known as the critical period (Sharma, 1984).* It has been observed that, Jhum cycles have been drastically narrowed down. Due to the loss of soil nutrients, productivity of crop yield decreases.

It is true that productivity from the point of view of land use is low under shifting cultivation (Barkakoti, 1990). Larger forest areas are felled and burned down during shifting cultivation. The process of clearing jungles, burning, and dibbling of seeds accounts for nearly 3.7 tones/hectares of soil materials to slide down to foothills (Singh, 1978). There is very likelihood that organic matter of the surface soil is also oxidized causing reduction in the levels of organic matters and other nutrients in the soil. The large addition of ash which is rich in minerals destroys vast quantities of organic matter and bacteria which affects the soil formation processes and soil micro-organisms.

4.4.2 Deforestation

Forest plays a vital role by providing a wide range of choice for an independent spirited Ao-Naga. Shifting cultivation has become unsustainable and has been blamed for the forest degradation in the entire district of Nagaland.

It has a profound influence on the structure and function of human habitat locally as well as globally and also the largest reservoir of flora and fauna. The cause of deforestation is the extension of shifting cultivation which has been identified as one of the principal causes of deforestation in most of the tropical regions. The current district total forest covers an area of 28976.79 hectares.

According to 2008-2009, village forests cover was 134523.21 hectares but it has decreased to 24000 hectares in 2010-2011 this is due to massive destruction of forest. It has a protected forest that covers 428 hectares (2010-11). *Loss of natural forest ecosystems always results in loss of biodiversity and often in a range of environmental impacts (Gordon Dickinson, Kevin Murphy, 2007)*. Of all the deforestation, village forest covers are the main regions that are highly deforested. The trend of village forest cover in the district from 2007-2009 was 134523.21 hectares but it has been narrowed down to 2400 hectares from 2010-11.

The cultivation of Jhum leads to loss of natural forest ecosystems creating huge impact on environment. The extraction and the felling of large tracts of forest cover on the onset of Jhum distribute the environment in many ways. Loss in forest cover results on climatic variation like-uneven rainfall, precipitation, wind, humidity etc. Further, on siltation, flooding and soil degradation and loss of biodiversity affect the economic activity and threaten the livelihood and cultural integrity of forest-dependent people. Deforestation is also cause by forest fires. The phenomenon of forest burning is responsible for killing of fauna, wildlife, forest species of plant and animal kingdom. Wild fires commonly occur on the onset of Jhum during the dry seasons of February and March months. Though using of fire is an integral part of land management in both agriculture and forestry, it has a wide ranging negative environmental impact.

According to the State Climate Change Projection, the temperature in the mid-century starting from (2020-2050) is likely to experience an increase in annual average temperature between 1.6C and 18C. While the southern districts

show higher increase in temperature with Kohima, Wokha, Phek, Zunheboto and Tuensang districts showing an increase of temperature between 1.7 C and 1.8C. The northern districts of Mon and Mokokchung are projected to have an increase in average temperature of between 1.6C and 1.7C. This shows that reduction in forest cover contribute to heating of the earth.

4.4.3 Loss of Biodiversity

Environmental protection, sustainable development, good management of natural resources and conservation of biodiversity are some of the emerging subjects of growing public concern in the world. Increasing attention is drawn on the issues of human impact on the fast depletion of biological diversity. The earth is a home of rich diverse and array living organisms where genetic diversity has relationships with one another and with their physical environment constitutes rich biodiversity. Moreover, the ethical, aesthetic, spiritual, cultural and religious values of human societies are the integral part of these complex resources.

The district has an absolute store house of rich biodiversity which has been preserved in its natural habitat for centuries. The inception of modern civilization and increase of population and continuing practice of traditional method of cultivation bring changes in the environment. The physical alteration of forest and jungles is one of the sole factors for the great loss of biodiversity. It

has witnessed a massive change in the forest cover. The felling of trees and forest permanently has brought great loss and the recovery would take many years. Longkhum village which is under Ongpangkong range is one of the rich biodiversity hot spot. Today, it has been endangered and the vicinity of reserved forest have been put into cultivation due to massive destruction of forest for Jhum fields. The blooming of Rhododendron Arboretum is decline which was once well adopted at the higher altitude with moderate climate and heavy rainfall.

One of the main causes for the loss of biodiversity is population explosion and resultant deforestation (K.C. Agrawal (1998)). The loss in biodiversity affects the environmental climatic conditions of a region affecting the abode of various faunas. Migratory birds like grey peacock pheasant (*polyplectron bicalcaratum*) which is believed to be migrated from Indonesia, golden langur. Panther tigers etc. are some of the species which was found in abundance in the entire district is no more seen for the last 20 years. There has been maximum decrease in the total number of species.

The most deciduous and evergreen forest which adorned the entire district is an abode of exotic floras and magnificent faunas. Due to reckless cutting down of forest cover their population has been considerably reduced. There are many plants that do not exist anymore and no effort was been made to revive and preserve them. If proper preservation and conservation with effective implementation are not initiated they are definitely on the verge of extinction.

The status of biodiversity in the district has undergone drastic changes within a span of 50 years. There are adverse effects of human impact due to the encroachment of forest resources with the continuous practice of traditional cultivation. The private forests vested in the villages have been haphazardly and unscientifically exploited. All kinds of restrictions are imposed in the Reserved Forest, sanctuaries, felling of trees, hunting, fishing etc., are still going on. It has increased dramatically and threatens the very foundation of sustainable development and quality of life. Loss, fragmentation and diversity of species and genes in the biodiversity affect the ability of ecological communities to resist or recover from disturbance and environmental change that includes long term climatic change.

4.4.4. Forest Fire

Forest fire is common in all the areas under shifting cultivation as burning of Jhum fields sets in during the dry seasons which are susceptible to fires. There is considerable loss of forest cover and its products due to frequent burning of forest. It has a wide range of negative environmental impact.

These immense fires are visible from space, disrupt air travels and increase carbon-dioxide adds to the atmosphere, treasure house of biodiversity (Gordon Dickinson, Kevin Murphy; 2007). The burning of vegetation in forest

cover release large quantities of smokes into the atmosphere which impact the ecological environment by arising in climatic variations of an area.

Human induced in the environmental is at large and it increases on and on. The district has faced numerous fire incidents in 2009-2010 which was occurred during the time Jhum field burning. Altogether 80 hectares of forest cover were completely slashed down during these years. Due to this numerous natural biodiversity abode were loss.

Gasses warms the earth surface -18 C with the green house effect, the earth would be too cold for life. However, the more of these gases the atmosphere contains, the more heat is retained. *Human activities add small quantities of water vapour to the atmosphere but, much more importantly, they added large quantities of carbon-dioxide and methane and these are increasing temperatures on earth (Kran Arms, 1990).* Lots of initiatives were taken up by village communities as well as Government policies and NGO's to deal with the fire incidents but still the rules and regulations which were implemented are also weaning away from the local communities. The State has banned jungle burning since 1996 but it was not adhered.

Measures and precautions should be implemented especially to the rural people who are mostly cultivating Jhum cultivation. Local communities together

with the fire department and different agencies must come forward to supplement rules and precautions in conserving towards our community forest covers.

4.4.5 Effect on Hydrological Cycle

Deforestation that results from the cause of shifting cultivation interference with the rain as vegetation plays a vital role in the rain cycle. The mass destruction of forest cover with forest canopy gaps lead to deforestation and this limit in rain formation due to low limited evapo-transpiration. It is undertaken as one of the primary sources for water vapour during the formation of cloud. The water catchment areas also dry out when forest cover are cleared which results into droughts.

4.4.6 Land Degradation

The productivity of land deteriorates easily in the areas where shifting cultivation is prominent. In India, people of the Eastern and Northeastern regions heavily practiced Jhum on hill slopes. With the increase land use, the cycle of cultivation is affected. It has been observed that, Jhum cycle has been reduced from 10-15 years now to 8-10 years. In some ranges in the district it has come down to 5-7 years. Due to the reduction in cycle, the resilience of ecosystems has been broken down and the land falls into deteriorating condition. Under this, the land is deteriorated with more vulnerable to soil erosion and loss of soil fertility.

4.4.7 Proliferation of Weeds, Pests and Diseases

Land preparation and the cultivation also create condition favorable for the gradual proliferation of crop-weeds, diseases and pests. Large canopy forest cover prevents the growth of weeds. However, when the forest cover are felled down for the preparation of Jhum field, weeds are more vulnerable to light, less competitive but with the aggressive growth rate begin to invade the cultivated land. In the first cropping phase, the densities of the weed are low but they increase rapidly during the subsequent cropping phase. In shifting cultivation, often the same species of crops are repeatedly planted and these may contribute to the specific crop weeds over a period of time. The shifting of land one after to another phase of every 1 to 2 years causes pests and diseases which are more common in the crops.

CHAPTER: 5 -CONSERVATION AND MANAGEMENT OF ENVIRONMENT

5.1 Introduction

Human beings are among the innumerable species inhabiting the earth like other species, living by developing a relationship with their environment comprising both living organism and non-living substances (Sengupta, R.P; 2001).

The human intervention itself reshapes the natural environment in its own image. It has been indicated as one of the interdependent relations among the components of population, environment, resources, social organization and technology. The fundamental question in the relationship is how people and culture affect the environment and how the physical environment affects culture and people. The environment is a term with several dimensions. It can be subdivided into natural environment and built environment. Natural environment refers to a geographical feature such as mountain, valley and ocean and also environmental conditions such as temperature, rainfall, flora and fauna. Whereas built environment refers to the result arising out of people alterations of the environment.

The inter-relationships between human and ecological components involve around 'Territorial localized system' (U.A.Shimary, 2007).

However for the Nagas, land and their local environment are the basic foundation of their social, culture and economic system. *Generally, Naga economic system revolves around the ecological parameters like village territory, land and forest (Berry, 1976).* For centuries, human settlement and cultivation have left their impact on ecosystem and the high land-human ratio has helped to conserve its natural heritage. The increasing population pressure and hectic process of encroachment on forest resources and with the practice of traditional agricultural system has cause a heavy toll on the environment. The practice of traditional cultivation thus affects the ecosystem that result into severe environmental hazards. Such as frequent landslides, soil erosion, extinction of valuable plants, herbs and rare species of animals and birds. It eventually affects the paradigm shift in the climatic condition of a region.

Jhum or shifting cultivation is a way of life for the Ao-Nagas and which is deeply rooted in all the Naga cultures, customs and beliefs. The ever increasing population pressure and changing life styles Nagas faced challenges of meeting livelihood needs for sustaining their environmental resource conservation. Problems of deforestation, soil degradation and low yield of crops are some of the environmental causes. Interventions to improve livelihoods and strengthened the natural resource management practices for food security and environmental sustainability management must be done in a culturally appropriate way that involves all the communities.

Environmental conservation and management is an imperative derivation of a secured livelihood management. The management of natural resource such as soil, water, land and forest assume a paramount importance for the maintenance of ecosystem of a particular region. Environmental management is the process to improve the relationship between man and environment so that the quality of both the environment and human society maybe improved. This improvement of relationship between man and environment may be achieved through check on destructive activities of man conservation, protection, regulation and regeneration of nature. Conservation and management of environment is a mass which must tackle down through active community participation.

5.2 Range-Wise Conservation on Environment

Mokokchung district has a total number of circles with six ranges stood at different altitudes. It has a geographical area of 161500 hectares, constitute with 105 villages. The district dominated by sub-tropical humid climate which is covered with moist deciduous and evergreen forest. The variation in topography, climate and soil conditions favours a luxurious rich biodiversity. During the past decade, the indigenous communities maintain an intimate relationship with their natural environment for their sustenance harnessing what the nature stores for them.

The last few decades in the district has witnessed high growth rate of population thus, pressure of land use increased and vast expansion of shifting cultivation has brought tremendous change in the environment. The district once known for its rich forest and bio-resources is experiencing a drastic environmental crisis which has been almost derived on by human interference on land use. The practice of traditional cultivation is partially responsible for depredating the forest area in the district as it is marked by slash and burn method. This ultimately creates deforestation loss of habitat of plants and animals which are all inter-linked with environment.

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 the vegetation give rise to rejuvenate secondary forests. The systematic land use pattern and the method of practice of agriculture has arise a burning issue in the present century as the human interference lead to climate change, soil erosion, loss of forest cover, low yield crops, and massive extinction of floras and faunas. Such impact is witnessed globally and the district is also facing the same problem.

It has been observed in the study area that, the conservation of environment has been tackling on by the people under different ranges. The practice of traditional method of cultivation has created lot of environmental impacts with low yields comparing to last few decades. In Tzurangkong range,

the villagers have made a mandatory to increased Jhum cycle by atleast 10 years so as to regenerate the forest cover and to stabilize the status of the soil fertility.

Conservation towards environment has been taken up by many agencies through seminars, presentation and booklets. Under this, different department's has come forward like agriculture, horticulture, forest, water and resource management etc., by spreading out positive message towards conservation of environment and land use patterns.

Today, much of the Jhum lands are converting to monoculture and plantation farming. In Merangkong village under Langpangkong range approximately 30% of the Jhum land has been converted into tea plantation farming and terrace cultivation are also practiced in small patches. It has been observed that bamboo cultivation is also been cultivated initiated by the Bamboo Mission, government of Nagaland by financing the Jhum cultivators for clearing up the jungle, plantation and by maintaining them. This is how the villagers have the advantage of cultivating paddy along with bamboo cultivation for about two years. The Jhum cycle in Changtongya village has also been decreased to 7-8 years as the village does not have much land under its jurisdiction for cultivation. In recent years, some Jhum cultivators have started cultivation of monoculture farming where used of salt to control weeds in the field is banned.

Farmers in Nagaland have undertaken land use change to meet increasing livelihood, and market factors. This enhance in conserving the environment in many ways. One common noticeable change during the field survey was the

conservation of traditional Jhum areas into permanent forest or cash crops plantations.

Sungratsu village under Asetkong range has converted an entire traditional community Jhum site in model farming where sedentarised farming activities for producing cash crops and vegetables were encouraged. With the change of land use from Jhum to intensive cash crop farming the number of families engaged in Jhum has drastically reduced from 150 to 50. This result into reduction of area under Jhum cultivation by giving substantial increased in forest cover. Today, the village council has set aside a portion of their Jhum land into a wildlife reserve. Change in land use system not only change the farming systems but also influenced a stable environment.

The extraction and indiscriminate removal of major and minor forest has resulted in deteriorating the physical environment. One of the main reasons of deforestation preventing in the district is due to shifting cultivation. It is marked by slash and burn method before being cleared, during this period large tracts of forest cover are being felled down. At the same time demand of firewood and loggings, forest fires also creates deforestation. It has been observed that, the villages under different ranges are trying to implement laws and orders to conserve community forest area under the village jurisdiction. It has laws and regulations by imposing fines on illegal destruction of forest covers. Community Reserved Forests are going at large in every range. Following are some of the community reserved forest under different ranges.

Ongpangkong range

1. Kongyung forest (Chuchuyimpang village)
2. Amalongpang forest (Longkhum forest)

Langpangkong range

1. Kanglutu Biodiversity Reserved (Changtongya village)
2. Sungkongtsuyong Bird Sanctuary (Merangkong village)

Asetkong range

1. Yangermanglu pok (Core zone)-Mopungchulet village
2. Meyong pentong forest (Longpha village)
3. Shengtakba lopok (Longjang village)

Changkikong range

1. Anujakong (Molungkimong village)
2. Aleptoi (Dibuia village)

Japukong range

1. Retongkong (Japu village)

Tzurangkong range

1. Yimkup (Longpayimsen village)

The year 1999 has been declared as the tree planting year by the Government of Nagaland under this theme, the district has been perceived and organized by the people to plant trees in their Jhum fields. It has been organized around the town and at the community land. NEPED and other NGO's have also organized workshops, seminars on environmental protection and ecological development at the grass root level.

Laws on hunting and poaching are also implemented in all the sample villages to maintain the extinction of rare faunas. The range of Langpangkong, Asetkong and Tzurangkong are also implementing on plantation like rubber and tea. Nearly, 560 hectares of land is under plantation crops. Home garden which are small farms are also cultivated and managed by the farmers. It has an indigenous fertility management system. Vegetables, condiments, fruits, medicinal herbs etc., are grown. Waste drainage water from the kitchen can be used to start seedling or irrigate annual crops. Home gardens through small and total area are important in the overall production system by maintaining stable ecological environment.

5.3 Village Council and Management of Forest

In Mokokchung district as well as in the State, village councils act as an important forest management institutions to promote and protect the forest in the rural areas. Given the specific political history and the recognition of the traditional local institutions by the State as the managers of the natural resources

and the sensitization of the degeneration of forest among the local people seems to proof that local traditional institution can be more effective then the State in the management of natural resources provided with legal and managerial powers. In the district, the local communities have their own specific institutions and laws according to their traditions and base on village wise category in the management of natural resources.

The local institutional structure and function reflects that forest is an important asset which is recognized. In some community in Nagaland, the village council has no power to stop the individuals but in the case of Aos the village council has the power to regulate and decide the land cultivation and the villagers and no individuals are allows cultivating at other site, going against the decision of the village council invites fines or punishments.

The extraction from forest is another major factor in the degeneration of forest in Nagaland. Among the communities studied, the extraction of firewood is mostly done during a specific period and apart from the collection of fallen dry twigs and dry leaves of which indiscriminate cutting down of trees is prohibited. Excessive cutting down of trees for the production of charcoal for commercial purpose is a major factor for the degeneration of forest cover. The village council has the power

to imposed restrictions on the individuals even the private land overriding the individual property rights.

Most of the village councils in the district have adopted measures to check on the forest degeneration through the setting-up of Forest Committees whose responsibility is to protect the forest. The council prohibits the cutting down of trees and punished who violates the rules and regulation. The village council also regulates indiscriminate grazing of livestock's the prohibition for grazing in specific period and areas are also designated for the villagers. The setting-up of Forest Communities within the village council for the protection and management of forest is significant innovation of the local institutions towards the protection of forest in Nagaland. For this certain external intervention has to be adopted in tune with the local socio-economic situations to protect natural resources and to safeguard the environment.

5.4 Watershed Management

Livelihood Security and healthy environment are two sides of the same coin which are equally important for the survival of mankind. Many civilizations were said to have perished due to misuse or the negligence in natural resources like soil and water.

The challenge in the watershed development is therefore, to manage natural resources like soil and water. So as to sustain livelihood security on the one hand and healthy environment on the other thereby keeping away such catastrophe from happening the district, state, region, country or any part of the world.

Watershed is a catchment basin i.e. an area of land that forms the drainage of a stream or river. It constitutes a big area which comprises the down catchment area of the river at the foothills to the steep mountains slopes. Surrounding the up-hill forest, which observe rain water and to control its runoff. Watershed act as a function as a natural reservoir from which the rivers and tributaries draw water. It is an important unit in the process of sustainable natural resource management. Therefore watershed management is essential for conservation of forest, land and water. The main objective of watershed management is to store water, prevent soil erosion and to regulate the flow of streams.

It involves integrated ecosystem units that include terrestrial and aquatic ecosystem with man and his activities. The socio-economic aspects of an area can be improved by taking a holistic approach in respect of afforestation, enhancement and development of water resources and increased in crop yield production and animal production. The maintenance of dense forests in the hilly areas can ensure water supplies during the dry seasons.

It has been observed that, the district forest cover is decreasing to a large extent due to the massive practice of shifting cultivation. This reckless deforestation on hill slopes lead to drainage of water down the slope below so that there is no scope for water shortage on top hill slopes. An efficient function of watershed function is likely to increase in production of fuel wood and fodder, boost horticulture, animal husbandry and pesiculture thereby opening up avenues for job for the people. In addition, it will also reduce downward runoff and flood disaster.

The State under the department of Soil and Water Conservation has taken up watershed management around the villages to ensure sustainable development of the environment. In order to bring about sustainable livelihood and healthy environment, it is therefore imperative to provide soil and water conservation oriented treatment to watershed in an integrated manner by adopting appropriate conservation technologies. Those technologies which can be adopted according to the suitable local agro-climatic conditions and be broadly categories as agronomic, mechanical and afforestation measure and methods. The integrated usage of such techniques is important so as to reduce the runoff of erosion. Rainfall can be obstructed and stored in soil at the place where it is received thereby reducing not only soil erosion but also siltation of river beds and tanks. The water stored in soil can support good crops and also increased in production. This can also encourage luxuriant vegetation growth and coverage of those non-arable lands by conserving the natural environment.

5.5 Traditional Methods of Conservation on Jhum Land

Complex community-based processes and traditional laws for managing village land and environment has evolved through years. High rate of population growth have placed a heavy burden on traditional practices. People have learned that not everything from the past is effective today. Field study observed that, much invaluable traditional knowledge has been already weaned away from the memory of the younger generations. The reason for the loss of traditional methods of conserving the environment can be attributed due to the lack of documentation.

In a Naga society, however the traditional knowledge is usually transferred from the fore-fathers after one generation to another. Thus, in response to these new pressures traditional resource management systems have continued to evolve, as they always have done through the generations. Villagers in Nagaland have begun adopting innovative approaches that use more broadly based measures to check the forces responsible for the degradation of environment.

Indigenous knowledge is a valuable resource that exists within a society. Any development initiated in the society should combine conventional know-how and modern techniques with traditional method wisdom. Soil is the medium for growing crops and it is the main source from where the essential nutrients are obtained. Jhum fields in Mokokchung up to 60 degree slope makes them more prone to erosion than flat farms lands in the plains.

However, the existence of traditional practices to control soil erosion using both physical and biological barriers which indicates that farmers understand the need for soil conservation practices. Protecting this is therefore an integral part for improving the productivity of crops. In spite of the fact that they had to abandon the land during the fallow period, farmers still practice these traditional methods. Such erosion control practices are rarely found among the shifting cultivators in other parts of the world. The Nagaland Empowerment of People through Economic Development (NEPED) Project also attempted to build upon these traditions and improve these methods. Following are some of the traditional soil conservation practices.

According to the Article 10 (C) states that protection and encourage customary use of biological resources in accordance with the traditional cultural practices so as to conserve and sustainable use of these resources. Further, according to Article 18.4 contracting parties are also obliged to develop and use indigenous and traditional technologies to conserve the biological diversity and sustainable use of its components.

Hence, the invaluable traditional methods of conservation should be conserved and applied in the management of natural environment. Some of the traditional methods to conserve soil erosion in the Jhum fields are physical barriers and live barriers.

1. **Physical Barriers**

Barriers with boulders/ stones- Boulders and stones are placed along the contours of the fields. Cultivation is done in the same plot in small patches continuously for years.

Using Poles- The method of constructing mechanical barriers using logs was found very effective in preventing soil erosion. The barriers were placed at regular intervals of 2-5 m, and held in space with the help of wooden pegs.

Using split bamboo- This consists of splitting bamboo and making a mat-like frame of 30 centimeter high which is laid across the slope with the spacing 3-5m between the barriers.

Soil furrow- While preparing the field for crops like paddy and vegetables the soil is heaped in the rows across the slope on which the crops are dibbled. This method not only prevents erosion but also provides enough moisture to the soil zone.

2. **Live Barriers**

Use of crops- Crops like maize, millets, soya bean etc are planted closely in lines across the slopes to control soil erosion. Crops like arhar and soya bean are known to increase the nitrogen content of the soil. During inter-cultural operations, soils are heaped to strengthen the root zone portion. The leaf litter adds organic matter to the soils. These practices not only prevent the soil erosion but also conserve the soil moisture.

Use of Broom grass-Rhizomes of broom grass are planted across the slope at a closer spacing between plants and 3-5m between rows to row. It establishes and grows fast with accumulation of high quality of eroded soil was observed.

5.5 Fallow Management

Fallow is the intrinsic part of shifting cultivation. It is a period of time where cultivated land is left unused until the next Jhum cycle. Fallow systems normally occurs when crop production becomes more difficult with arise in weeds, pests and diseases or declining soil fertility. In recent years, due to increase in population and increase of land use fallow period has been drastically reduced leading to fallow degradation. In some cases fallow period has been reduced even up to 4-5 years and this adversely affects the productivity of land. Therefore good fallow management systems that are biologically and economically sustainable are needed for a better production.

Planting of leguminous trees, shrubs and perennial herbs has shown potential to restore soil fertility in a shorter period of time. Fast growing species that produce a lot of biomass are planted and allowed to grow on the fallow lands for a certain period of time to provide an artificial canopy. Trees and shrubs in fallow lands also remove natural weeds and other noxious grass. Planting of locally available fast growing trees species which may be harvested within a few years should be introduced in the fallow period.

Some of the fast growing trees species are *duabanga grandiflora* (Khokan), *antocephalus chinensis* (Kadam) and *spondia exillarias* (Naga Neem) etc.

5.7 Strategies to Control Shifting cultivation

Shifting cultivation is a non-viable resource utilization of traditional method of cultivation and the local people still cultivate to sustain themselves. Shifting cultivators are blamed for much of the destruction of the world's tropical forest, atmospheric pollution, land degradation and global climatic change. A lot of efforts, consideration and policies will be required for achieving the desired goals to protect the natural environment. The policy and strategy to control shifting cultivation should therefore be made into high considerations. The alternative system of cultivation as recommended through research are the only based for a proper formulating projects suited to various agro-climatic conditions according to the topographic and situations after local survey.

Following are the steps:

1. Land and its resources should be largely vested around the local communities, mass awareness on the impact of environmental problems and actions necessary to combine them must be initiated.
2. Adopting appropriate cropping patterns for the entire district in the State will help in balance cropping and for the improvement of organic content in the soil status for a sustainable agricultural production.
3. Massive awareness programmes should be organized to make the farmers aware of the impact of environment by shifting cultivation. Such programmes

should be implemented through village community, clan, district councilors etc. By forming village forest communities for the protection of protected forests and degraded forest covers.

4. To develop eco-developmental plan areas under shifting cultivation to made ecologically sustainable. Agricultural practices are sometimes at the cost of loss of biodiversity. Introducing of farm forestry should be implemented. This strategy would work best in the mountain ecosystems.
5. Cultivation of plantation crops like rubber, tea etc. should be depend upon the provision of market and regeneration of the degraded Jhum land by cultivating alder and perennial crops etc.
6. Effective training programmes on watershed based farming should be implemented.
7. Local resources like bamboo, Soil, timber etc., should be utilized on water harvesting so that farmers can use technology.
8. By encouraging co-operative efforts to carry out forest based activities such as rope making, basket making, cane furniture etc. and processing of minor forest products like honey collection have to be made commercially by providing proper marketing facilities.

5.7.1 Agro-Forestry

According to **King K.F.S, M T. Chandler (1978)** *agro-forestry has been defined as a “Sustainable and management system which increases the overall yield of the land, combines the production of crops (including tree crops) and forest plants or animals simultaneously or sequentially, on the same unit of land, and applies management practices that are compatible with the cultural practices of the local population”.*

More, broadly, it is the combination of silvi-cultural, agriculture and other land use technologies so that joint application will increase productivity, sustainability, equity or achieve other social cause. Agro-forestry can be effectively practiced on lands subjected to shifting cultivation, on the mountain ecosystems denuded of vegetation from biotic causes and in arid and semi-arid tracts. The main objective of agro-forestry is to optimize production and economic return per unit area especially in the rural areas.

This system of the land use can provide diversified raw materials, field wood, fodder etc., which could contribute stable employment in the rural areas. Apart from these, it can yield medicinal products, edible and non-edible oil seeds.

Through the proper selection of tree species it should be possible to minimize the soil erosion to tap nutrients from the deeper levels than those reached by the roots of agricultural crops. It also replace through leaf fall and fixation of atmospheric nitrogen the nutrients removed in the crops. The leaf fodder trees

constitute an important source of fodder in many parts of the world. The agro-forestry in the hilly region shall require special emphasis on the cultivation of indigenous trees which have multiple economic and traditionally important and with varied applied fuels like nectar flora for bee keeping, sericulture fibre and pesiculture which will further increase the income of the marginal farmers throughout the agro-based industries.

Agro-forestry land use system plays a significant role in soil and water conservation. The plantation of crop combination like coffee or cacao with *Erythrina*, *Inga* and *cordial* are the characterized by large return of organic matter and nutrients to the soil in litter and pruning that comes up with a moderate level of nitrogen fixation. Trees species like *Acacia spp.*, *Calliendraca lothyrus*, *Sesbania seban*, *Casuriana equisitifolia*, *Glyricidia sapium* etc., should be planted for potential to regain the soil fertility.

The Nagaland Environment Protection for Economic Development (NEPED) which was funded by the Canadian International Development Agency (CIDA) through the Indian-Canadian Environment Facility (ICEF) was initiated in 1995 to make Nagaland self-sufficient in agro-forestry. Under this project experienced by the government demonstrate the villagers to set aside 6 hectares of land known as the test plot over two and half years. The plot of land required to plant 1,200 seedlings along with the usual crops under the guidance of the village council and a project team. These were much effective in many rural areas in Nagaland.

5.7.2 Social Security and Sustainable Resource Management

Social security is considered as the main functions in local communities for shifting cultivators. The strength of shifting cultivation to contribute towards conservation lies in its diversity and communities. The diversified cropping patterns and land use system ensure multi-crop which is required even the poorest to the poor. The fact is that there are no landless people in cultivation areas as every household has the equal right and access to land for practicing shifting cultivation. An important factor of community drive the shifting cultivation is the principle of cultivation is for all. The different categories of forest land that an individual can depend upon for both farming and NTFPs is very wide and anybody can approach the different levels and village land use.

These are generally land institutions for permission and forest resources that are owned by the village often conserved as reserves. The community members may get permission from the village council to collect firewood, to construct houses or other clan land. The management and control of such resources lies with the village elders or councils. Today, the management of the local resources has implemented laws and regulations to safeguard the environment towards sustainable resource management. Among are the- Customary custodianship and control of community based resource tenure systems, use of traditional knowledge, strategic management of community resources to banned hunting and poaching inside the village jurisdiction.

5.7.3 Solution for Shifting cultivation

Shifting cultivation which is a traditional agricultural system practiced by the cultivators should utilize the given natural forest resources and land use system systemically without jeopardizing the ecological environment. The method of this cultivation in the district has been developed over a long period of time and went through multiple experiments that were passed on from generation to generation. In most of the situations, this traditional system could be environmentally stable and works as long as the cultivators are available to live at a level near the subsistence. An increase in the well-being means an improvement in the production of the agricultural products requires an improvement in productivity.

Richard, H.B (1993) *any form of shifting cultivation, if the reform is needed may imply their methods of production.* Therefore, it is important to understand the principal of traditional system of agriculture before trying to impose alternative methods of conservation. Under these aspects it is well known to find solution to the cultivators for the livelihood subsistence in the hilly rugged areas which considers that the problem is not strictly technical but it has a fundamental human component. The most priority is to find solution which is not only sustainable but also responds directly to the concern needs of the people. Most of the cultivators have also percept that, they have loss something with the felling of the forest cover. They are aware that felling of the trees has a negative impact on the environment on the natural resources which are produce by the forest.

The impact has also changed in rainfall distribution, water scarcity, and land degradation as well as in the loss of biodiversity. Therefore, forest cover is essential to provide protection to the soil and water conservation levels, and it is key elements in preventing its degradation. All these indicate their predisposition to accept the changes in their way of doing traditionally method of agriculture that certain changes do not jeopardize the survival of the mankind.

Among the technical solutions which are presented to address the problem of shifting cultivation that deals with the impact on environment is to implement appropriate re-forestation and forest management programmes with the selection of appropriated species should be encouraged. To protect the forest cover in the rural hilly areas forest management is one of the techniques to deal with the problems of traditional method system of cultivation. Thus, more concern should be given to the forest sectors as it covers all the environmental factors. To sum-up with this, the plain area should be used for food production, intermediate zones should be used as agro-forestry zones and the altitude zones as the forest production.

For effective measure to regain the fertility of the soil status, organic matters such as fallen tree leaves and organic residues should be encouraged. *It recommends that the conversion of slashing and burning in slashing and mulching.*

(Egashira et al, 2006). This is a simple technique to prevent soil degradation and to keep the soil more productive which leads in the improvement of quantity and quality of agricultural production.

A technical solution in the socio-economic context is not sufficient due to various complexities of social organization of which integrated solution should be implemented. This integrated solution should be dealt in within the community. The fundamental elements of the integrated solutions should be based with community active participation. With this regard to participation it is noted that the successful implementation of a project is aimed to foster of strategies.

5.7.4 Government Policies and Programmes

A programme under any Government Policy should be based on a definite policy. After the attainment of Indian independence, the Forest Policy which was inherited from the British, considered as the Forest Government property and treated them as a source of raw material and revenue for industry. In Nagaland, though the private ownership of forest was accepted the policy of treating the forests as a source of raw material was also accepted till the formulation of the National Forest Policy of 1988. It has been noted that National Forest Policy has undergone lots of changes over the years. Likewise, the policy of the Government of Nagaland has also changed.

The most import aspects of this tremendous change are that the village council has been empowered to look after the forest under their Laws and

Regulations. At present, the Government of Nagaland has articulated the Forest Policy which is said to be in consonance with the National Forest Policy. According to the State Government Policy in official publications it states that atleast one third of the geographical area should be under forest cover. It also states that in the hill areas atleast 60% of the area should be under forest to protect environmental degradation and to prevent soil erosion to as to maintain the stability of the impact of environment. In consonance with these objectives, the State Policy has emerged into:

1. Conversion of Jhum land into economically and ecologically sustainable.
2. Regulation on harvesting of forest resources on the principles of sustainability.
3. Protect and conserve the endangered species of flora and fauna.
4. Rising of developed local species rather than exotic ones.
5. Protect, conserve and management of biodiversity in Reserve Forests and Wildlife Sanctuaries based on principles of in-Situ conservation.

Soil and water are the natural resources vital for human subsistence is loss causing degradation of land. The cause of this is attributed to the practice of traditional cultivation and improper use of land system. In order to weaned away this problem, proper land use management planning and water conservation techniques like bunding, afforestation, farm forestry, plantation , cash crops and stream bank erosion control strategy should be implemented. The above policy

statement that promotes the method of exploitation along with conservation in the areas of Jhum land has been a major concern. This point out a gradual shift in policies by encouraging people to give up Jhumming in favour of settled cultivation. However, conservation of Jhum land is not a simple matter as Naga society has a close relationship with the traditional cultivation interlinked with its own culture. It is a way of life which evolves as a reflex to the physiological character of land under its sub-tropical ecosystem based on monsoon climate. Keeping this in mind, the nature of Jhumming is not possible to eliminate all together. What is required is the use of an intensive cultivation that includes multiple cropping along with other cultivation to increase its productivity and also for the livelihood subsistence.

The GEF-UNDP Nagaland, under SLEM (Sustainable land and Ecosystem management) in shifting cultivation Areas of Nagaland for ecological and livelihood Security project has promoted Azolla cultivation in all the project areas considering its wide value and application in agriculture practices. Azolla is a nitrogen fixing capability being used as a fertilizer. The rotting plant material releases nitrogen to the rice plants, providing up to nine tones of protein per hectare per year. The use of Azolla increases rice yield by 20-30%. Moreover, it reduces evaporation from the water surface and increases water use efficiency in rice.

The Directorate of Wasteland Department of Nagaland aims at regeneration by intervention in the degraded Jhum land through plantation

programmes on watershed bases, for conservation of soil and moisture. These enhance in maintaining the ecological balance and protect the environment through the participation of the rural community so as to improve the socio-economic condition of the community.

A major effort made by the Government of Nagaland is the NEPED jointly funded by the Government of India and Canada by covering 1000 rural areas in different district of Nagaland. The project envisages the introduction of innovative agro-forest practice with people's participation. Following are the aims and objectives of the project.

1. Conservation of natural forest covers from being encroached upon by Jhum cultivation.
2. Transforming through demonstration of land use cover under Jhum in which agro –forestry techniques will be applied. The aim of NEPED is to make shifting cultivation practiced more productive and profitable.

The most recent effort which was made under the initiative of the Government of Nagaland is the declaration of tree planting in 1999 under its objective for realistic efforts at afforestation were introduced. Under this programme, Department of Forest, Ecology and wildlife distributed 40, 00000 of

stumps and seedlings. The Nagaland Forest Act of 1968 has various rules which deal with the different aspects of forest and their exploitation. The rules are as follows:

1. Rules to regulate the export of forest products.
2. Rules for the protection of conservation of wildlife in reserved forests.
3. Rules for the protection of forest from fire.
4. Rules to regulate the transport of forest resource by land, air and water within and outside the State.
5. Rules to regulate the salvage, collection and disposal of drifts and other timbers.
6. Rules to regulate the removal of orchids from the forests in Nagaland.
7. Rules on the quarrying of stones from all forest of Nagaland.
8. Nagaland settlement of forest coupes and mahals by tenure system rules.
9. Nagaland settlement of forest coupes and mahals by auction and sale system rules.

The rules and regulation are of little significance because in Nagaland most of the forests are under village councils, clans and privately owned. With the Supreme Court order of 1996, banning the extraction of timber has two significant developments. The first system is the Joint Forest Management (JFM) and the

other system is the Non-Timber Forest Produce (NTFP). In Nagaland, most of the forest is owned privately, so Joint Forest Management has been implemented rather easily and new afforestation schemes have also been taken up under JFM.

For sustainable land and ecosystem management in shifting cultivation areas of Nagaland for livelihood and ecological security the United Nation Development Programme (UNDP) Project was started with the collaboration of Government of Nagaland. It aims to address the land degradation in shifting cultivation through participatory planning, general awareness programs, building institutions and supports the integrated farm development that enables sustainable landuse and ecological management.

The daily weather conditions monitored by the Department of Soil and Water Conservation, Government of Nagaland through its 15th number of meteorological centers that are installed around in different parts of the district at different altitudes is arising an alarm rate. The records indicate that Nagaland is also experiencing a climate change along with the rest of the world in the form of change in rainfall pattern and rising temperature. During 2009, the State has experienced drought like situation with rainfall dropping down drastically affecting the yield of crops. The most important contributing factor is the extensive practice of shifting cultivation. This has cause massive destruction to

bio-mass by denuding the land of its vegetative cover. The Department therefore, acknowledges that optimum use and judicious management of land and water resources to promote sustainable basic approach towards this are:

1. To put land to optimum use according to its capability and to treat the land according to its needs by adopting appropriate soil and water conservation measure.
2. To encourage permanent cultivation and to discourage shifting cultivation as far as possible.

Land development like bench terracing, counter bunding etc can be taken up for mitigating soil erosion and sustaining soil fertility and productivity on arable land. Thus, integrated adoption of soil and water conservation measures has the potential to increase production and sustain the increased production and also protect the environmental consequences.

It has been seen that the integrated area development approach in which agro-forestry played a leading role has contributed to the success of programmes for shifting cultivation control. Like in other tribal region, the Ao-Naga people of Mokokchung district do practice shifting cultivation and raise different agricultural crops and trees simultaneously for various purposes. As per the Ao customs the people cultivate varieties of crops which grow in different Jhum lands called the first year cultivation and second year cultivation. They cultivate crops for food and trees like timber, bamboos etc. for construction of house, building

materials, fencing, agricultural implements and firewood. Now days, they also devote their land for cultivation of cereals, cardamoms, tea and rubber plantations. The objective is to produce the best return from the land.

There are also several barriers to realize Jhum cultivation as being an integral part of sustainable land use and ecosystem management strategy in the district as well as in the State. These range from weakness in the policy, planning and institutional environment that influence Jhum to weak capacities at the local level among the village institutions and Jhum cultivators to promote sustainable Jhum-based livelihoods. It includes the need for better integral local knowledge and technologies to improve Jhum cultivation, concerned departments such as Agriculture, Land Resource and Soil and Water Conservation were included. The aim is to improved Jhum practices as part of SLEM strategy at the community levels.

The strategy is to introduce participatory planning processes and to finance priority activities that are identified through the involvement of the entire community in the development of community resources management plans which reflects more productive and sustainable use of the available resources.

Shifting cultivation practices are linked with the ecological, socio-economic and cultural life of the people and are closely connected to the rituals and festivals. It is interwoven through the whole generation of life of primitive society, whose whole philosophy of life is a product of the system of economy of

people with very little capital and technology. This is the reason why many new methods of cultivation and strategies are recently introduced into the district have failed to win the cultural acceptance.

National Forest Policy states that atleast one third of the geographical area should be under forest cover. And further states that, in the hilly region like the state of Nagaland, atleast 60% of its geographical area should be under forest cover to prevent from the degradation of land and soil erosion so as to maintain the stability of the impact of environment. In regard with these objectives the State Policy has introduced these following policies:

1. To convert Jhum land areas into economically and sustainable woodland.
2. To raise and develop important commercial crops.
3. To regulate harvesting of forest resources on the principles of sustainability.
4. To protect and conserve biodiversity of endangered species of both flora and fauna.
5. To protect and conserve, biodiversity such as Reserved Forest Sanctuaries based on scientific and in-situ conservation.

CHAPTER: 6- SUMMARY AND CONCLUSIONS

A summary of findings of the current research report has been presented in this chapter. The research work attempts to understand the impact of shifting cultivation on environment and the responses of the Ao-Naga tribe of Mokokchung district to work on it. The purpose was to examine the role of ecological factors and the intervening force of the cultivators and society which by and large affects the environment. The study assumes that the environment setting provides the primary basis of shifting cultivation and the nature of ecology that creates conditions for differential responses to work.

The ecological setting of the study area is divided into six parallel ranges on the basis of terrain, climate, soil and the type of vegetation cover. The area of the district is a part of the Naga Hills which are dismembered branch of the Eastern Himalayas. The topography of the district is accompanied with hills and has got a number of mountain ranges which are coupled with sharp crust ridges and narrow valleys with few plains. Majority of the district is too rugged that permits agriculture to be practiced only in the manageable slopes and with limited river valleys which provides little area for almost of them flows in v-shaped valleys. As a result, agriculture is of highly subsistence in nature and supports only a part of the requirements of the people.

It is identified that the Nagas have adopted their culture and their livelihood to the norms of the natural environment. Likewise, the district of Mokokchung is a land of villages and the people are mainly depending on environment for their livelihood subsistence. Shifting cultivation is an old age practice is deeply rooted within the Ao-Naga community. According to Nagaland, Jhum land Act 1970, Jhum land means such lands which any member or members or a village or a community have a customary right to cultivate by means of shifting cultivation or to utilize by clearing jungle or for grazing livestock and includes any beds of rivers provided that such village or community is in permanent location.

Unprecedented growth in population adds to the problem in the land use system. Subsistence nature of the agricultural production is indicated by small arable areas, traditional methods of shifting cultivation which is very low level of technology and cropping pattern overwhelmingly loaded in favour of food grains. Despite the weak agrarian base, shifting cultivation continues to observe a very large proportion of the labour force.

In Jhum cultivation, various crops are undertaken with great difficulty by suitable adjusting work cycle to local variations in topography and agro-climatic conditions. The people have adjusted to the environment by evolving the first and the second year Jhum cultivation though there is a negative impact on its

practices. Due to the fragile agrarian resource base of the district, the population responds to a wide variety of other economic pursuits offered by the eco-system. Despite of the fact that, there is restriction, forest cover naturally provides an economic base for hunting, gathering, lumbering and collection of various food and other items for the people. Similarly, fishing is another activity particularly attached to the local people of the sample villages. Abundance of bamboo and cane provides excellent raw materials which are used to make several items of daily use.

It is identified that shifting cultivation is a way of life of the tribal people in the hilly areas which are inter-linked with festivals. So, as in Mokokchung district, out of the total population of 1, 93,171 (2011 census), rural population constitute 1, 37,517 and depends their livelihood directly from shifting cultivation. In Nagaland, the ownership of the land including forests is determined by traditional laws which is under the protection of Article 371(A) of the Constitution of India. According to the traditional law there is no land without ownership. However, ownership of land including forest is private and is vested with individuals, clans and the village as a whole.

It is clear that there is no concept of government being the ultimate owner of the land and the forest. If the government needs land, it must acquire through purchase from the private owner which has been a practice over the last few

decades. All the ownership rights are clearly recognized and protected by the customary laws.

It is significant that the major land use system in the district is under Jhum/Slash and Burn/Shifting cultivation. Out of the State 95550 hectares of Jhum paddy, Mokokchung district covers an area of 9770 hectares (2011-2012). It is evident that, Jhumming has become unsustainable which has brought lots of impact on environmental factors. Several studies have shown that it is an environmentally healthy practice when 18-20 years cycle is maintained. It is worth mention that, some few decades back most of the villagers in the district maintained Jhum cycle of 15-20 years at an average. Drastically it has gone down due to pressure on land thereby mounting pressure on environment is increasing. It is revealed that in most of the sample villages, where shifting is the only mode of production, the frontiers of Jhum land have been pushed to the limits. It is evident from the data that Jhumming seriously affects the forests because it destroys the vegetation cover and damages the resilience characteristics of the ecosystem.

Interestingly, the field studies have revealed that in most of the sample villages there was common noticeable changed regarding the conservation of some portions of traditional Jhum land into permanent forests or cash crop plantations. However, the extraction and indiscriminate removal of original forest trees has resulted into deteriorating with impact on the physical environment. It is

also identified that there is not much of positive result out of traditional methods of conservation on Jhum land.

The Ao tribal institutions of lack in gender inequity are amply demonstrated in the work perform by men and women. It is evident that the division is based more on complementary rather than segregation or exploitation.

The district has own hectares of forest cover which include Reserved Forest, Purchased Forest, Protected Forest, Private Forest, Village Forest and Wildlife Sanctuaries. It is evident that the district forest cover has decreased from the year 2009 onwards. The total forest cover during 2008-09 was 139500 hectares. However, according to 2009-2011 it has been decreased down to 28976.79 hectares. The main reason for the net decrease in the forest cover is due to the encroachment of land use for agricultural purposes. It is observed that the main culprit is due to practice of shifting cultivation followed by logging and firewood. The rate of deforestation is alarmingly high in village forests cover.

It is evident from the data presentation that there is much gap between 2008-2009 and 2010 -2011. The rural village forests cover has narrowed down to 24000 hectares only. According to field study, most of the virgin forest has been almost depleted in almost all the villages. Merangkong, Longpayimsen, Waromung and Chungtiayimsen villages which have strongholds of thick and dense inaccessible forest cover has already deforested followed by Longkhum and

Khensa villages even the community reserved forest have already depleted. Deforestation has disappeared numerous diversity of rare species in the district and the felling of trees causes permanent damage upon the habitat of various species. Joint Forest Management which was adopted by the Government of Nagaland in 1997 should be made known to the local communities as many of them are not aware of this policy. Agro-forestry with multiple fast growing trees and commercial species of trees should be introduced.

It is evident that, lots of people are of opinion that practice of shifting cultivation and the lack of awareness are the main cause of deforestation. The other reasons for the Government Forest, deforestation are due to the negligence of the State Government towards its policies and implementations. The district is facing numerous untold environmental phenomena. Therefore, to safeguard all these environmental consequences the district as well as the State must implement strict rules and regulations with appropriate policies by approaching the village community to have joint efforts to safeguard the environment. More consequently, the district should strictly follow the Nagaland Forest Act 1968 and the Biodiversity Act 2002.

The district exhibits a number of rivers that runs parallel to the ridges which act as a water divider either northward or southward. The direction of the tributaries is from south-north in accordance with its varying nature of topography conditions. The main rivers are perennial in nature. Milak River is the main

longest river which flows across the Ao-region. The field survey has observed that loss of forest cover has resulted on climatic variation with uneven rainfall and raise of temperature. Drying up of natural perennial rivers and streams are common in all the villages. It is observed that, removal of massive forest cover not only affects the river flow, stream and water temperature but it also brought changes in stream water chemistry.

The district is also facing numerous problems wild fires. Nevertheless, wild fire or burning of forest in the district usually takes place during Jhum cultivation. Though using of fire is an integral part of land management in both forestry and agriculture it has wide range of negative environmental impact. Nearly 40 hectares of forests cover in Khensa were destroyed in 2009 which was caused on the onset of Jhum field burning. Owing to this, many reserved forest and endangered species nestling abode were destroyed. It is observed that accumulation of carbon-dioxide in the atmosphere during the burning of Jhum fields causes enormous environmental consequences. According to the State Climate Change Protection, the temperature in the mid-century starting from 2020-2050 is likely to experience an increase in average temperature between 1.6 C and 1.8 C. The district has projected an increase between 1.6 C and 1.7 C. This shows that reduction in the forest cover contribute heating up of the earth. The Government of Nagaland has banned jungle burning in 1996 but still has considerable loss of forest resources, soil, flora and fauna.

The traditional method of the cultivation is considered as destructive by many environmentalist, scientist, researchers and Government. Its impact on the environment cannot be denied but removing from the land use system of the Nagas is a big task, as it is deeply interwoven with the tradition and culture. Realizing the fact that shifting cultivation is for the subsistence for the rural people. Abolition of this system of cultivation is not a realistic solution unless alternative mode of food production for survival of the rural people is implemented.

Although the people economic organization is characterized by less inequity in the distribution land use, significant differences in access to this important asset is emerging among the local population surveyed in the research. Though, landlessness is rare, economic differentiation in terms of access to land holdings is however taking place at a much faster phase in the study areas. Although significant development refers to an increased economic differentiation taking place in households belonging to the rural areas located closer to the urban centers. Observation of the field study reveals that, land use under agriculture and depletion of forest resources and cover is more prone in rural areas. As the rural people are solely depend on agricultural production and from the forest resources for their livelihood consumption. Moreover, the practice of Jhum cultivation can be seen more in those villages which are far away from the urban sectors. Those villages which are located nearby the urban sectors somehow is manageable in the Livelihood consumption. Under this, most of the land use is converted into model

farming cultivating cash crops and orchard farming's. This is sufficient proof of the role played by the urban development in accelerating the process of socio-economic differentiation in rural areas of Nagaland.

Conservation of environment has become an important issue and it has a long history. People have failed to learn from the history of environmental ethics as people are overwhelmed by the western cultures. It has been observed that, traditional knowledge for the conservation on environment especially in the rural areas is weaning away slowly in the district. As land and its forest resources are solely owned by the people and the governance of the land use system is mostly under shifting cultivation is a threat to the ecological settings of the environment. So, judicious sustainable management of land use for all round development towards the conservation of environment should be given high priority. Environmental conservation policies or action plan should be collectively taken care at all levels. It should be incorporated with the collective participation of the community as a whole, government, policy makers, researchers, environmentalists and NGO's should be united together to safeguard the environment.

The sample villages may not be a truly representative to present generalizations for the State as a whole. However, some of the trends on the impact of shifting cultivation on environment in the sample villages are being revealed. Unless intelligent interventions are made to protect the present

environment, the present process of environmental degradation is likely to be breakdown the values of a peasant tribal social order.

It may be suggested that efforts must be made to protect the ecological set-up to avoid the erosion of the material base of subsistence of a vast segment of people who may not necessarily depend on agrarian resource base. Skill formation is important as the shift from agrarian sector is likely to be more in future. The forest must be protected from indiscriminate felling to feed industries needing them. Efforts must be made to encourage animal husbandry for which the ecosystem has a large potential. Technological advancement in increasing production in terraces and Jhum areas without much damage to the environment is a necessary condition for all-round development of the economy and provision of avenues. An intelligent policy of regional development is necessary rather than merely allowing this hilly and tribal area to mechanically integrate with the broader national space economy. This development as the past experiences show will lead to eco-destruction and an increased dependence of the people on tertiary employment and the reckless of the market economy.

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CIRCLES UNDER MOKOKCHUNG, DISTRICT

Circle	Total population	No: of village	Distance from the district (in km)
Longchem	12972	14	97
Alongkima	16960	09	63
Tuli	27735	11	77
Changtongya	23560	10	45
Chuchuyimlang	22149	11	28
Kobulong	20686	08	20
Ongpangkong	85667	19	04
Mangkolemba	22356	23	87

Source: Census of India 2001, Nagaland Administrative Atlas

Published by: Government of India Controller of Publications, New Delhi (2006)

BLOCK-WISE VILLAGES/COMPOUNDS WITH ALTITUDE**Changtongya Block**

Village/Compound	Altitude (m)
Anaki 'A'	639
Kangtsung	734
Anaki 'B'	260
Anaki 'C'	220
Tzudikong	188
Wameken	377
Aopenzu	229
Tuli Town	202
Luyong	632
Molungyimsen	848
Merangkong	877
Merangkong Compound	668
Yaongyimsen & Compound	794
Liroyimti	590
Changtongya Old	732
Changtongya New	756
Changtongya Town	806
Akhoya	880
Unger	958
Chuchuyimlang	1035
Chuchuyimlang Compound	1026
Chakpa	972
Longkong	1167
Yaongyimti	1377

Salulemang	567
Asangma	401
Kilengmen	418
Mongsenyimti	1324
Mongsenyimti Compound	1216

Source: ATMA, Mokokchung: Nagaland, 2012

Ongpangkong North Block

Village/Compound	Altitude (m)
Settsu	1282
Aolichen	1334
Ungma	1268
Kubza	1116
Mokokchung village	1382
Chuchuyimpang	1386
Longmisa	868
Meyilong	765
Moalenden	699
Chubayimkum	1160
Longsa	1480

Source: ATMA, Mokokchung: Nagaland, 2012

Ongpangkong South Block

Village/Compound	Altitude (m)
Mekuli	1102
Yimyu	1158
Khensa	1105
Sapangya	906
Chungtia	971
Aliba	922
Kinunger	925
Mangmetong	1127
Longkhum	1564

Source: ATMA, Mokokchung: Nagaland, 2012

Longchem Block

Village/Compound	Altitude (m)
Alongtaki	637
Lakhuni	650
Changdang	698
Nokpu	720
Longchem	620
Aonohpu	569
Lirmen	729
Yajang 'A'	611
Yajang 'B'	237
Yajang 'C'	140
Saring	160
Tsurmen	160
Akumen	160

Source: ATMA, Mokokchung: Nagaland, 2012

Kobulong Block

Village/Compound	Altitude (m)
Yisemyong	1068
Yinchalu	1003
Sungratsu	853
Alongchen	1071
Impur	1121
Mopungchuket	1240
Chami	1065
Kobulong	853
Longpha	849
Longjang	766
Khanimo	533

Source: ATMA, Mokokchung: Nagaland, 2012

Mangkolemba Block

Village/Compound	Altitude (m)
Aosungkum	170
Aosenden	169
Aokum	203
Chungtiayimsen	164
Longphayimsen	158
Watiyim	156
Moayimti	156
Medemyim	161
Longtho	163
Tsurangkulem	162
Satsukba	510
Shapumi	531
Puniboto	584
Atupumi	472
Mangkolemba	563
Japu	625
Longjemdang	640
Molungkimong	944
Yimchenkimong	863
Waromomh	1021
Waromong Compound	1032
Alongkima	909
Dibuia	1023
Khar	760

Mongchen	1160
Chungliyimsen	1171
Changki	947
Longnak	248

Source: ATMA, Mokokchung: Nagaland, 2012

AGRICULTURE LINK ROAD

Agriculture Link Road constructed under NABARD Scheme RIDF-XIV Selected by Agriculture Department under Mokokchung, District during 2009-2010.

Name of the Village	Project
Lakhuni	Tzurong
Longmisa	Arshimang
Khensa	Pensong
Wameken	Kojemtong-Alikala
Mongsenyimti	Apensanglu
Chungtia	Ungru
Yaongyimsen	Orangpang
Longsa	Mesumtsu
Mopungchuket	Anokmen
Mokokchung Village	Kupok

Source: Government of Nagaland, local Area Development Programme (2011-2012), Mokokchung, District; District Planning & Development Board, Mokokchung: Nagaland.

OCCUPATIONAL DISTRIBUTION OF WORKERS UNDER MOKOKCHUNG
DISTRICT
(As per 2001 CENSUS)

Workers in household	
1. Workers in household industries (Male)	1,785
2. Workers in household industries (Female)	2,271
3. Other workers (Male)	23,171
4. Other workers (Female)	9,294
5. Total workers (Male)	60,612
6. Total workers Female)	48,167
Total Non-workers	
Male	57,816
Female	60,167
Cultivator	
Male	32,547
Female	32,819
Agricultural Laboures	
Male	3,109
Female	3,783

Source: Government of Nagaland, local Area Development Programme (2011-2012), Mokokchung, District; District Planning & Development Board, Mokokchung: Nagaland.

FOREST AREA CLASSIFICATION IN NAGALAND

Legal Status	Forest Area (in hectares)	Total Forest Area (in %)
Reserved Forest	8583	1.0
Purchased Forest	19162	2.2
Protected Forest	50756	5.9
Wildlife Sanctuary	22237	2.6
Village Forest Cover		
Virgin Forest	477827	55.4
Degraded Forest	284280	32.9
Total	862845	100
Ownership		
State Government	100823	11.7
Private/ Community	762107	88.3

Source: Department of Forest Ecology, Environment and Wildlife, Government
of Nagaland (Annual Administrative Report (2006-07))

METEROLOGICAL ANALYSIS OF MOKOKCHUNG DISTRICT

Year 2007

Month	Particular					
	Ave.Max. Temp (C)	Ave.Min. Temp (C)	Ave. Dew Point (C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	18.3	8.3	10.8	75.3	0.0	0
Feb	17.4	7.1	9.1	76.3	60.9	08
Mar	22.7	11.8	14.4	74.8	5.0	01
April	24.4	15.4	15.8	76.8	187.8	14
May	26.7	18.2	18.6	74.6	167.0	14
June	27.8	20.3	20.5	75.2	224.3	14
July	27.9	20.8	21.3	76.7	330.1	25
Aug	28.8	21.3	21.6	76.7	260.7	19
Sept	27.7	20.5	20.4	74.8	33.7	17
Oct	26.5	18.1	18.9	73.5	174.0	09
Nov	22.7	12.0	13.4	74.4	41.5	04
Dec	21.1	7.7	10.7	74.0	3.4	01
Total	292	181.5	195.5	903.1	1788.4	126

Source: Soil and Water Conservation Department, Nagaland

ANNEXURE-XII

Year 2008

Month	Particular					
	Ave.Max Temp (C)	Ave.Min. Temp (C)	Ave. Dew Point (C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	19.6	7.4	9.7	74.7	27.9	06
Feb	18.1	7.7	10.1	74.2	7.5	04
Mar	24.5	13.0	13.0	71.4	91.3	09
April	27.0	17.3	18.6	70.6	84.0	11
May	27.9	19.3	19.1	68.8	250.9	16
June	27.8	19.3	19.2	72.5	707.1	22
July	28.5	20.7	20.1	71.9	602.2	24
Aug	29.1	21.7	20.9	70.7	367.3	21
Sept	28.3	20.2	19.9	73.2	262.2	20
Oct	27.5	16.8	17	74.1	116.9	12
Nov	24.9	14.5	13.9	71.9	0.0	0
Dec	21.4	8.8	8.2	72.9	1.0	02
Total	304.6	186.7	189.7	866.9	2518.3	147

Source: Soil and Water Conservation Department, Nagaland

ANNEXURE-XIII

Year 2009

Month	Particular					
	Ave.Max. Temp (C)	Ave.Min. Temp (C)	Ave. Dew Point (C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	19.3	6.5	5.8	73.5	0.0	0
Feb	24.6	12.5	11.6	70.4	0.0	0
Mar	26.4	14.1	13.7	69.6	38.8	04
April	26.3	16.5	15.8	71.6	99.0	09
May	27.7	19.9	19.4	75.8	175.5	18
June	28.5	21.4	21.0	74.5	273.2	20
July	28.6	21.6	21.4	76.9	775.0	24
Aug	27.3	21.2	20.9	76.7	490.1	24
Sept	27.4	21.3	20.9	76.2	310.7	17
Oct	26.6	20.1	19.6	74.8	81.6	10
Nov	24.5	14.8	13.9	71.0	23.6	04
Dec	18.8	8.1	6.6	68.6	0.0	0
Total	306	198	190.6	879.6	2267.5	130

Source: Soil and Water Conservation Department, Nagaland

ANNEXURE-XIV

Year 2010

Month	Particular					
	Ave.Max. Temp (°C)	Ave.Min . Temp (°C)	Ave. Dew Point (°C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	20.3	8.5	7.7	63.7	2.3	01
Feb	22.1	9.5	9.9	62.6	13.1	01
Mar	25.8	12.8	14.8	72.3	146.3	06
April	26.6	16.9	16.8	72.2	182.9	16
May	26.0	18.8	18.3	74.7	263.8	19
June	26.7	20.7	20.5	77.4	601.8	22
July	28.0	23.3	23.5	85.0	453.0	25
Aug	28.8	24.3	24.7	87.9	362.4	26
Sept	27.9	23.5	24.0	88.5	293.3	20
Oct	26.5	20.6	20.4	80.8	341.7	18
Nov	23.6	14.5	13.1	67.9	0.0	0
Dec	20.3	9.8	8.7	69.6	14.5	03
Total	302.6	203.2	202.3	902.6	2675.1	157

Source: Soil and Water Conservation Department, Nagaland

Year 2011

Month	Particular					
	Ave.Max. Temp (°C)	Ave.Min. Temp (°C)	Ave. Dew Point (°C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	19.7	7.9	5.9	64.3	40.9	03
Feb	22.8	11.4	9.3	62.8	6.4	02
Mar	25.2	14.7	13.5	66.0	57.2	10
April	25.5	16.3	15.2	68.0	121.2	11
May	26.3	19.4	18.9	76.6	341.9	22
June	27.5	22.5	22.6	83.1	597.6	21
July	27.9	23.5	23.9	87.5	445.3	26
Aug	28.1	23.8	24.3	89.1	441.9	28
Sept	27.7	23.6	24.2	90.6	396.9	19
Oct	26.6	20.1	19.8	75.6	126.4	09
Nov	24.1	13.5	11.6	63.1	11.2	01
Dec	21.4	9.3	7.4	61.1	0.0	0
Total	302.8	206	196.6	887.8	2586.9	152

Source: Soil and Water Conservation Department, Nagaland

ANNEXURE-XVI

Year 2012

Month	Particular					
	Ave.Max. Temp (°C)	Ave.Min . Temp (°C)	Ave. Dew Point (°C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	18.8	6.6	4.9	62.3	74.8	11
Feb	22.0	8.0	5.6	60.9	0.0	0
Mar	25.2	10.4	8.2	61.3	38.8	04
April	26.0	14.3	12.4	62.9	240.4	16
May	28.4	17.8	16.1	61.9	121.9	10
June	28.2	19.8	18.8	69.2	284.0	22
July	28.3	21.2	21.2	81.2	484.1	22
Aug	28.2	20.8	20.6	78.4	431.2	20
Sept	27.6	19.8	19.5	75.9	302.4	16
Oct	26.3	16.8	16.1	69.8	146.5	13
Nov	23.0	11.0	10.0	62.0	9.4	03
Dec	20.0	7.9	6.3	61.3	0.0	0
Total	302	174.4	159.7	807.1	21335	137

Source: Soil and Water Conservation Department, Nagaland

ANNEXURE-XVII

Year 2013

Month	Particular					
	Ave.Max. Temp (°C)	Ave.Min. Temp (°C)	Ave. Dew Point (°C)	Ave.R/H (%)	Rainfall in (mm)	No. of Rainy days
Jan	20.8	6.1	4.5	61.6	0.0	0
Feb	23.5	8.6	6.2	60.7	18.7	02
Mar	26.6	10.1	8.1	62.2	85.5	06
April	27.4	13.3	11.5	65.4	118.9	10
May	26.8	17.3	15.9	65.8	570.2	19
June	28.6	20.5	19.8	71.1	349.5	14
July	27.0	21.1	21.1	80.9	411.9	22
Aug	27.7	21.2	21.1	79.5	348.3	19
Sept	27.9	20.9	20.2	76.1	123.7	08
Oct	26.2	17.7	16.4	69.8	76.8	09
Nov	24.2	11.5	9.2	62.4	0.0	0
Dec	19.5	6.9	4.7	61.9	12.4	03
Total	306.2	175.2	158.7	884.4	2115.9	112

Source: Soil and Water Conservation Department, Nagaland