STUDIES ON NON-TIMBER FOREST PRODUCTS (NTFPS) OF PLANT ORIGIN AND LIVELIHOOD STRATEGIES IN NORTHERN MIZORAM, INDIA.

A THESIS

SUBMITTED TO THE MIZORAM UNIVERSITY IN FULFILLMENT FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENVIRONMENTAL SCIENCE

BY

J. LALREMRUATA

Ph. D. Registration number : MZU/Ph.D/107/ dated 30.11.06

DEPARTMENT OF ENVIRONMENTAL SCIENCE
SCHOOL OF EARTH SCIENCES AND NATURAL RESOURCES MANAGEMENT
MIZORAM UNIVERSITY
TANHRIL, AIZAWL
2012

CONTENTS

		Page
Declaration		iii
Supervisors' certificate		iv
Acknowledgements		v
List of tables		vi
List of figures		vii
List of photoplates		viii
Chapter 1.	**INTRODUCTION**	
1.1	Concept and terminology	1
1.2.	Definitions	10
1.3.	Standard classification of NTFPs	13
	1.3.1. NTFPs species classification	13
1.4.	Categories and uses of NTFPs	16
	1.4.1 Food products	17
	1.4.2. Medicinal value	18
	1.4.3. Fuel (energy supply)	19
	1.4.4. Animal fodder	22
	1.4.5. Construction materials	23
	1.4.6. Households utensils and agricultural equipment	23
	1.4.7. Rattans	23
	1.4.8. Marketing	24
1.5.	Scope of the study	25
1.6.	Objectives	27
Chapter 2.	**REVIEW OF LITERATURE**	
2.1.	Studies abroad	28
2.2.	Studies in India	30
2.3.	Studies in North East India	41
2.4.	Studies in Mizoram	43
Chapter 3.	**STUDY AREA**	
3.1.	General introduction to Mizoram	47
3.2.	Description of northern Mizoram	50
3.3.	Status of forest and forest types in Mizoram	52
3.4.	The study Area	57
3.5.	Socio-economic Profile	59
Chapter 4.	**METHODOLOGY**	
4.1.	Socio-economic / household characters	65
4.2.	Inventory in NTFPs diversity	
	4.2.1. Participatory Rural Appraisal (PRA) exercise	65
	4.2.2. Field sampling	66
	4.2.3. Ethnobotanical survey	67
	4.2.4. Market survey	68
4.3.	Consumption pattern of fuelwood (per capita and seasonal)	68
4.4.	Preference of fuelwood according to matrix ranking through PRA exercise	70
4.5.	Determination of Fuelwood Value Index (FVI)	70
4.6.	Livelihood and income generation through NTFPs	72
4.7.	Statistical analysis	72

Chapter 5. RESULTS AND DISCUSSIONS
5.1. NTFPs diversity
5.1.1. Variation in NTFPs types between different sites 74
5.1.2. Variation in NTFPs in vegetation 78
5.1.2.1. Medicinal plants 78
5.1.2.2. Edible fruit plants 80
5.1.2.3. Edible food plants 81
5.1.2.4. Fuelwood species 83
5.1.2.5. Fodder species 84
5.1.2.6. Palm species 85
5.1.2.7. Ornamental species 85
5.1.2.8. Bamboo species 86
5.1.2.9. Dominant families 86
5.1.3. Variation in NTFPs in different local markets 88
5.1.4. Ethnobotanical use among people and differences between sites / tribes 89
5.2. Prioritization of NTFPs based on various criteria 90
5.3. Fuelwood species characteristics
5.3.1. Fuelwood preferences (Matrix ranking) 93
5.3.2. Fuelwood Value Index (FVI) 97
5.4. Consumption pattern of fuelwood by the people
5.4.1. Daily and Per capita consumption 99
5.4.2. Consumption of fuelwood per season 100
5.5. People's dependence on NTFPs 101
5.5.1. Seasonal availability 102
5.5.2. Pattern of utilization of medicinal plants 102
5.5.3. Pattern of consumption of food plants 103
5.5.4. Pattern of consumption of fruit plants 104
5.5.5. Pattern of consumption of fodder 105
5.5.6. Pattern of consumption of broomstick 105
5.5.7. Pattern of consumption of thatching 106
5.5.8. Pattern of consumption of bamboo pole 107
5.5.9. Pattern of consumption of charcoal 107
5.6. Contribution of different NTFPs to the household economics
5.6.1. Monetary contribution 108
5.6.2. Comparison of NTFPs contribution to the households with agricultural commodities 109
5.7. Status of NTFPs through market survey
5.7.1. Food 110
5.7.2. Fruit 111
5.8. Pearson correlation coefficients analysis of NTFPs in northern Mizoram 112

SUMMARY AND CONCLUSIONS 115
Tables 121
Figures 166
Photo plates 180
References 196
Paper published 222
Biodata 229

DECLARATION

I, J. Lalremruata, do hereby declare that the thesis entitled **"Studies on Non-Timber Forest Products (NTFPs) of plant origin and livelihood strategies in Northern Mizoram, India"** is a record of work done by me during 2006 to 2011 under the supervision and guidance of Prof. H. Lalramnghinglova, Head, Department of Environmental Science and Dr. U.K. Sahoo, Department of Forestry, Mizoram University. The thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and it has not been submitted by me for any research degree in any other University/Institute.

This is being submitted to the Mizoram University for the degree of Doctor of Philosophy in Environmental Science.

(J. LALREMRUATA)

MIZORAM UNIVERSITY

DEPARTMENT OF ENVIRONMENTAL SCIENCE
School of Earth Sciences & Natural Resources Management
Aizawl – 796004

Post Box No. : 190 ; Gram : MZU, Phone No: 0389-2330532
Tele Fax : 0389 – 2330385

SUPERVISORS' CERTIFICATE

We certify that the thesis entitled "**Studies on Non-Timber Forest Products (NTFPs) of plant origin and livelihood strategies in Northern Mizoram, India"** submitted by Shri J. Lalremruata for the degree of Doctor of Philosophy of Mizoram University, Aizawl embodies the record of original investigation under our supervision. He has been duly registered and the thesis presented is worthy of being considered for the award of the Ph.D degree. The work has not been submitted for any degree of any other University.

AIZAWL
The ……. December, 2012

(PROF. U.K. SAHOO) (PROF. H. LALRAMNGHINGLOVA)
Joint Supervisor Supervisor

ACKNOWLEDGEMENTS

It gives me a great pleasure to express my deep sense of gratitude and honor to my supervisor Prof. H. Lalramnghinglova, Head, Department of Environmental Science and Prof. U.K. Sahoo, Department of Forestry, Mizoram University, Aizawl, Mizoram for rendering constant guidance, valuable suggestions, immense knowledge and encouragements during the course of study and also for shaping and sharpening my ideas towards new direction.

I am grateful to the Principal Chief Conservator of Forests, Department of Environment & Forests, Govt. of Mizoram for giving me necessary information related to my research work.

I would also like to express my sincere thanks to all the Village Councils and Young Mizo Association of the studied villages in northern Mizoram.

Kind help in identification and consultation of herbarium by the scientists of Botanical Survey of India, Eastern Circle, Shillong, is greatly acknowledged.

The assistance received from the faculty and staff members of Environmental Science Department, Mizoram University, Aizawl, Mizoram, during the course of work is greatly appreciated.

I would also like to add special note to Mr. Vanlalfela, Dr. Lalchhuanawma and Mr. Lalchhanhima, Department of Environmental Science, Mizoram University for their help in the laboratory work during the course of study.

I gratefully acknowledged the contributions, help and support of my colleagues and friends R. Lalrinkima, Lallawmkimi, Dr. Saithantluangi Zote, Lalchhingpuii, Alfred Malsawmsanga without whom the completion of this study would not have been possible.

Kind and valuable encouragement, prayers, cooperation and moral support received from my parents Mr. & Mrs. J. Zatawna and all other members of my family are greatly appreciated.

I also like to thank all those whose names have not mentioned but have helped directly or indirectly during the course of my study.

Financial support received from the University Grants Commission, Govt. of India, in the form of Rajiv Gandhi National Fellowship and GBPIHED, Almorah is greatly acknowledged.

Above all, I thank the Almighty God for the countless blessings He has showered upon me to complete this work successfully.

AIZAWL

The ……. December, 2012

(J. LALREMRUATA)

List of Tables **Pages**

Table 1.	Socio-economic profile of the villages in the study area	61
Table 2.	Availability and distribution of medicinal plants in the studied area	121
Table 3.	Availability and distribution of important fruit plants in the studied area	127
Table 4.	Status of available fruit plants	128
Table 5	Availability and distribution of important edible food plants in the studied area	129
Table 6.	Availability and distribution of fuelwood species in the studied area	132
Table 7.	Availability and distribution of fodder species in the studied area	133
Table 8.	Availability and distribution of Palm species in the studied area	134
Table 9.	Availability and distribution of Ornamental species in the studied area	134
Table 10.	Availability and distribution of bamboo species in the studied area	135
Table 11.	The first ten dominant families showing number of genera and species contributing to NTFPs diversity	136
Table 12.	Availability of various NTFPs in the local market of Mizoram	136
Table 13.	Uses of medicinal plants available in the study area	139
Table 14.	Prioritization of NTFPs based on various criteria	150
Table 15.	Matrix ranking for 30 indigenous fuelwood species of northern Mizoram using 12 quality criteria	152
Table 16.	Fuelwood Value Index (FVI) of selected fuelwood species	153
Table 17.	Fuel wood consumption (daily and per capita per year)	154
Table 18.	Seasonal consumption pattern of fuelwood by the people	154
Table 19.	Seasons of availability of various food plants available in the local market of Mizoram	155
Table 20.	Seasons of availability of various fruit plants available in the local market of Mizoram	157
Table 21.	Pattern of utilization of medicinal plants	158
Table 22.	Pattern of consumption of edible food plants	158
Table 23.	Pattern of consumption of fodder	159
Table 24.	Pattern of consumption of broomstick	159
Table 25.	Utilization patterns of major NTFPs in metric tonnes	159
Table 26.	Contribution (Monetary) of different NTFPs to the household economics	160
Table 27.	Contribution (Monetary) of different NTFPs to the household economics (Percentage data)	160
Table 28.	Comparison of NTFPs contribution to the households with agricultural commodities	161
Table 29.	Market Survey on food species in Aizawl City	162
Table 30.	Market Survey on fruit species in Aizawl City	163
Table 31.	Pearson correlation coefficients analysis of NTFPs in northern Mizoram	164
Table 32.	Combined percentage frequency distribution of selected variables in the NTFPs in northern Mizoram	165

List of Figures **Pages**

Fig. 1.	Mizoram Map showing different districts and boundaries	62
Fig. 2.	Map showing the study forest sites	63
Fig. 3.	Map showing different ethnic communities	64
Fig. 4.	Number of medicinal plants found in northern Mizoram	166
Fig. 5.	Number of fruit plants found in northern Mizoram	166
Fig. 6.	Number of edible food plants found in northern Mizoram	166
Fig. 7.	Pattern of utilization of medicinal plant in northern Mizoram	167
Fig. 8.	Pattern of consumption of edible food plants (part wise)	167
Fig. 9.	Status of fruit plants	168
Fig. 10.	Prioritization of NTFPs in the surveyed area	168
Fig. 11.	Per capita consumption of fuelwood species (in metric tonnes)	169
Fig. 12.	Annual consumption of medicinal plant species (in metric tonnes)	169
Fig. 13.	Annual consumption of edible food plant species (in metric tonnes)	170
Fig. 14.	Annual consumption of fruit plant species (in metric tonnes)	170
Fig. 15.	Annual consumption of fodder species (in metric tonnes)	171
Fig. 16.	Annual consumption of broomstick species (in metric tonnes)	171
Fig. 17.	Annual consumption of thatching species (in metric tonnes)	172
Fig. 18.	Annual consumption of bamboo pole species (in metric tonnes)	172
Fig. 19.	Annual consumption of charcoal plant species (in metric tonnes)	173
Fig. 20.	Annual consumption of NTFPs species (in metric tonnes)	174
Fig. 21.	Relative contribution of different NTFPs to household economics in Hnahlan forests site	175
Fig. 22.	Relative contribution of different NTFPs to household economics in Ngopa forests site	175
Fig. 23.	Relative contribution of different NTFPs to household economics in Bairabi forests site	176
Fig. 24.	Relative contribution of different NTFPs to household economics in Phullen forests site	176
Fig. 25.	Relative contribution of different NTFPs to household economics in Farkawn forests site	177
Fig. 26.	Relative contribution of different NTFPs to household economics in Phuldungsei forests site	177
Fig. 27.	Relative contribution of different NTFPs to household economics in Kawrthah forests site	178
Fig. 28.	Relative contribution of different NTFPs to household economics in N. Hlimen forests site	178
Fig. 29.	Annual income of five different markets on Food Species	179
Fig. 30.	Annual income of five different markets on Fruit Species	179

List of Photoplates **Pages**

Plate 1 – 3. Edible foods 180

1) *Melocanna baccifera* 2) *Eryngium foetidium*
3) *Alocassia fornicata* 4) *Zanthoxylum rhetsa*
5) and 6) Young shoots of *Melocanna baccifera*
7) and 8) *Enteloma macrocarpum*
9) and 10) *Zalacca secunda*
11) and 12) *Musa acuminata*
13) and 14) *Agaricus campestris*
15) and 16) *Oryxylum indicum*
17) and 18) *Adiantum caudatum*
19) and 20) *Amorphophallus paeniifolius*
21) *Parkia roxburghi*

Plate 4 - 5 Edible fruits 183

22) and 23) *Ficus prostrata*
24) and 25) *Dillenia indica*
26) and 27) *Terminalia chebula*
28) *Bruinsmia polysperma* 29) *Baccaurea ramiflora*
30) *Protium serratum* 31) *Emblica officinalis*
32) *Rhus semialata* 33) *Elaegnus latifolia*
34) *Litchi chinensis* 35) *Ficus semicordata*
36) and 37) *Glochidion arborescens*

Plate 6 - 10 Medicinal plants 185

38) and 39) *Helicia robusta*
40) *Justica adhatoda* 41) *Costus speciosus*
42) *Mimosa pusica* 43) *Alstonia scholaris*
44) and 45) *Centalla asiatica*
46) and 47) *Pseudodrynaric coronans*
48) *Zanonia indica* 49) *Curculigo capitulata*
50) *Pratia nummularis* 51) *Zanthoxylum armatum*
52) and 53) *Dillenia pentagnium*
54) *Aeginetia indica* 55) *Paederia scandens*
56) *Clerodendrum colebrookianum*
57) *Scoporia dulcis* 58) *Cissus javanica*
59) *Clerodendrum viscosum* 60) *Litsea cubeba*
61) *Maesia indica* 62) *Rubus ellipticus*
63) *Passiflora nepalensis*
64) and 65) *Thunbergia coccinea*
66) *Mirabilis jalapa* 67) *Smilax pervifolia*
68) and 69) *Litsea monopetala*
70) and 71) *Smilax glabra*
72) *Murdannia nudiflora* 73) *Thunbergia glandiflora*
74) *Polygonum chinensis* 75) *Piper diffudum*
76) *Derris thyrsiflora* 77) *Drega volubilis*

List of Photoplates **Pages**

Plate 11 - 12 Ornamental species 190
78) and 79) *Erythrina sricta*
80) *Prunus cerasoides* 81) *Saraca asoca*
82) *Rhododendron wightii* 83) *Rhododendron arboreum*
84) *Bauhinia variegata* 85) *Renanthera imschootiana*
86) and 87) *Langerstromia speciosa*
88) *Bombax ceiba* 89) *Vanda coerulea*

Plate 13. Fodder species 192
90) *Musa acuminata* 91) *Mikania cordata*
92) and 93) *Colocasia esculenta*
94) *Manihota esculenta* 95) *Imperata cylindrica*

Plate 14. Bamboo and Canes 193
96) *Dendrocalamus hamiltonii* 97) *Phyllostachis manii*
98) *Bambusa vulgaris* 99) *Melocalamus compactiflorus*
100) and 101) *Calamus flagelum*

Plate 15 - 16 Fuelwood and other important NTFPs 194
102) Fuelwood stock inside the forest
103) Fuelwood ready to use
104) *Thysanolaena maxima*
105) Bamboo for smoking pipe
106) Bamboo product (for roping purpose)
107) *Borassus flabellifer* for roofing
108) Bamboo product (hat)
109) Bamboo product for baby's bed
110) Bamboo product (for making basket)
111) Bamboo for house construction
112) and 113) Cane products

CHAPTER – 1

INTRODUCTION

1.1. Concept and terminology

Non Timber Forest Products (NTFPs), Non Wood Forest Products (NWFPs), Minor Forest Products (MFPs), Special Forest Products (SFPs), Secondary Forest Products (SFFs), among others, are different terms used in the forestry sector that still do not have a consensual definition (Tacon, 1997; Chamberlaind *et al.*, 1998; Belcher, 2003; Rajchal, 2006). As Neumman and Hirsh (2000) stated "*The concept is inexact because it is defined not by what it is, but what it is not: a NTFP is literally any and every natural resource from the forest except timber.*" However, no standard definition for NTFPs currently exists (Lettman and Kutara, 2005), even though over the last 15 years FAO, IUCN among other organizations have been working to unify this terminology.

During the two past decades, non-timber forest products have been widely promoted as a potential solution to high rates of deforestation. These products are an important tool in addressing poverty issues for marginalized, forest dependent communities, by contributing to livelihood outcomes, including food security, health and well being, and income (FAO, 1995). The commercial development of NTFPs, such as fruits, nuts, resins, fiber and medicines derived from plants, could increase the value of forest resources and thereby reduce the conversion of forest to other land uses. As a result, many development agencies and conservation organizations have fostered the commercial development of such products, with the aim of encouraging forest conservation while alleviating rural poverty (Marshall and Schreckenberg, 2003). NTFPs often have a variable

value, they vary greatly over time and places, and they can fluctuate strongly in response to markets. Therefore, a careful evaluation must be conducted before promoting them as a panacea for improving the quality of life of rural communities and preserving native forests and cultures (Tacon, 1997; Wollenberg, 1998).

Historically governments have paid little attention to non-timber forest products as they were until recently regarded as 'minor' forest products whilst timber was regarded as the 'major' forest product. NTFP activities that were small scale and mainly contributed to household subsistence were generally ignored (Trynor, *et al*, 2002). Beginning in the early 1980s, efforts to link conservation and development focused attention on the alarming rates of deforestation. This attention coincided with new commitments to address rural poverty and the recognition that forests can provide multiple products and services. Forest products, especially non-timber forest products (NTFPs), were given a high profile at this time because of the perception that exploitation of products other than timber is less damaging (Ruiz –Perez *et al.*, 2004).

Non- Timber Forest Products play a vital role in livelihood of people in and around the forests (Quang, 2006). NTFPs comprise medicinal plants, dyes, mushrooms, fruits, resins, bark, roots and tubers, leaves, flowers, seeds, honey and so on (Anonymous, 1995). NTFPs (also called as "minor forest products" in national income accounting system) are sources of food and livelihood security for communities living in and around forests. They are also known as Non-wood, minor, secondary, special or specialty forest products (Shiva, 1993).

At global level, more than two billion people are dwelling in forests, depending on NTFPs for subsistence, income and livelihood security (Vantomme, 2003). NTFPs are considered to be important for sustaining rural livelihoods,

reducing rural poverty, biodiversity conservation, and facilitating rural economic growth (Global NTFP partnership, 2005). An estimated 80 % of the population of the developing world uses NWFPs (Non Wood Forest Products) to meet some of their health and nutritional needs (FAO, 2008). It is an important source of income for the poor in many developing countries. In addition, several opportunities for improved rural development are linked to NTFPs (Adepoju, 2007).

The gathering of NTFPs is as old as the human species itself. Wild food and other items from the forest provided food, shelter, medicine and materials for ceremonies and worship. When people began to domesticate plants and animals they became less dependent on wild food and other forest material. Native Americans traditionally used plants and plant products for food, and medicine, and shared this knowledge with early settlers. They used the bark of trees for housing, branches and stems for utensils and other useful items. These traditional forest products became an integral part of rural economies. According to Hammett and Chamberlain (1998), there was a dramatic increase in demand for natural products in the 1990's including those of NTFPs. This is attributed to a number of factors which includes a growing interest in alternative medicines and homeopathy. Homeopathy is an alternative system of medicine developed in the early 19^{th} century, based on the concept that a disease can be cured when a patient is treated with minute quantities of a substance that produces symptoms of the disease in a healthy person. Homeopathy focuses on healing the underlying cause of disease, not simply eliminating the symptoms caused by the disease.

In India over 50 million people are dependent on NTFPs for their subsistence and cash income (Hegde *et al.*, 1996). This provides about 50 % of household income for nearly 20 to 30 % of rural population particularly for the

tribals who lived adjacent to the forests. Potentially about 3000 plant species are reported to be useful, out of which the products of 126 species have good market (Maithani, 1994). NTFPs also contribute substantially to the national economics. For example, around 50 % of forest revenues and 70 % of forest based export income of the country comes from the NTFPs. Thus it may not be wrong to depict that NTFPs form one of the mainstays of income and sustenance for many tribal communities (Rao, 1987; Gauraha, 1992; Chopra, 1993; Mallik, 2000).

Tribal livelihood systems vary considerably between different regions as also among the various ethnic groups, depending on ecological, historical and cultural factors. These tribal communities largely occupy the forest regions since time immemorial, living in isolation from the mainstream life, maintaining harmony and a symbiotic relation with nature. The collection of NTFPs by tribals has been primarily for meeting their subsistence needs. Over time, these NTFPs acquired commercial value resulting from huge trade transactions and income levels due to rising demand. Trade in NTFPs can act as an incentive for forest conservation by providing a source of income from resources that might otherwise appear to have little financial value (Cottray *et al.*, 2003).

In India, among the 3000 NTFPs species reported 325 species producing NTFPs are very common and have commercial value and thus have a base in major industry. Besides they are exported or imported; 879 species are used locally; 677 species are potentially useful only locally; and 1343 species can be described as “others lesser known”. According to Shiva (1993) about 200 to 300 million village people depend on products from forests to varying degrees. The forestry sector, with 23 percent of the country's geographical area, provides 2.3 million person-years of employment. Of this total, 1.6 million person-years

are related to NTFPs. Most NTFPs often provide employment during only part of the year because the processing of NTFPs is still poorly developed (Gupta, 1994). Commercial NTFPs are estimated to generate ` 3 billion (US$ 100 million) annually. Despite the fact that NTFPs can potentially raise household's income, they generate some of the lowest wages of the rural employment sector. While the minimum wage in most states ranges from ` 30 to 40 per day (US$ 1 to US$ 1.30), most NTFP collectors earn from ` 0.5 to 15 (US$ 0.25 to US$ 0.50) per day. Low wages reflect the low productivity of the forest arising from poor management, and depressed prices imposed by state trading monopolies and private buyers (Poffenberger, 1994). Most of the NTFPs are consumed locally (Shiva, 1995a) and there are limited quantitative records of the diverse NTFPs that are collected by forest inhabitants for their local use and for their subsistence economy.

India exports a large number of NTFP to other countries after meeting internal requirements. Foreign exchange earnings from these NTFPs account about ` 10 billion (US$ 384 million) annually (Shiva, 1995b). They are primarily exported in raw forms (Gupta, 1994).

Agenda 21 and Forest Principles adopted at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, identified forest products other than wood as an important area requiring increased attention, as a source of environmentally sound and sustainable development. In India, an increasing focus was also paid on NTFPs especially after a ban imposed by the Hon'ble Supreme Court of India.

NTFPs are very diverse. They are also known by the other names such as :

- Minor forest products;

- Other forest products;
- Other economic forest products;
- Special forest products;
- Non-wood forest benefits;
- Non-wood goods and services;
- Non-wood forest products.

The term '*minor forest products'* had different meaning for different countries and at different situations. For an example, 'minor forest products' assumed timber or wood to be the major product. But in countries whose timber was less important compared to other forest products like gums and resins, the term becane less relevant and lacked consistence as what was minor in one situation became major in another and vice versa.

The other term like '*other forest products'* and '*other economic forest products'* suffered similar inconsistencies and inadequacies.

The term '*special forest products'* was also reported vague due to its extent of coverage and scope and changes from one situation to another. Moreover, it did not refer exclusively to products other than wood.

The term '*non-wood forest benefits'* covering marketable and non-marketable as well as measureable and non-measureable benefits was nevertheless a better definition to cover its scope and quantification of benefits. However, this also could not explain the forest influences / benefits such as watershed values, environmental conservation, amenity values, etc., coming out of either wood or non-wood. They are generated by the forest ecosystem as a whole, and not only by wood or non-wood.

In the term '*non-wood goods and services'* the word *services* was often interpreted to include environmental influences of forests, scenic beauty,

heritage values and so on, even though services in the strict sense are *products* or *services* produced (**e.g.** managed grazing).

The term '*non-timber forest products'* and '*non-wood forest products'* are comparatively precise and suggestive of their scope. A tendency is however seen often to use the words *timber* and *wood* loosely and interchangeably.

Non-Timber Forest products (NTFPs) were called Minor Forest Products (MFPs) due to their minor income / revenue upto the middle of the 21st century. With the growing importance of MFPs and realisation of more income from NTFPs, the word '*minor*' was irrelevant and thus various user groups started naming MFPs as Non-Wood Forest Products (NWFPs). In the World Forestry Conference, 1954 Minor Forest Products were first referred to the 'Forest produce other than timber'. The change of nomenclature from MFPs to NWFPs was made to include the shrubs woods or small woods from trees for fuel energy, while the wood obtained from a few species yield commercially important MFPs like Sandalwood, Khairwood, Santaline wood for dye etc. (Shiva, 1998).

Owing to over-exploitation of wood beyond potential production to meet the growing and increased needs of the rising population during the last two decades, it has been realized that the NTFPs - based enterprises are predominately savior to the socio-economy of the people. Hence, extraction of NTFPs gradually increased to meet the requirement of growing population and face the impacts of the rise in price index. This situation also attached greater importance to Non-Timber Forest Products (Lalramnghinglova, 2002).

Infact, the NTFPs have not received the attention they deserved in many parts of the globe and thus have not been traditionally given due place in the economy of most countries. Several factor such as lack of knowledge on the appropriate uses on NTFPs and their managements, lack of long term sustainable

resources management policies, lack of effective institutional frameworks to improve management and may be due to lack of supporting services and partnership between Govt., private sector groups, communities and industry could have caused this. Since the volume of NTFPs extracted is often low, economic development efforts in most countries have not assigned a high priority to their improvement. Thus these products have been perceived as unprofitable, with low market visibility and characterized by a high degree of waste and inefficiency throughout the collection, processing, storage and marketing phases. It has been estimated that NTFPs are an integral part of the livelihood of 500 million people living in or near tropical forests that cover 20% of the world's land mass (Shiva, 1998).

Non-Timber Forest Products (NTFPs) have gained momentum especially after the banns imposed on timber harvest by the Hon'ble Supreme Court of India. These products are of immense use to the local people especially the forest villagers in sustaining their livelihood. Although these products are available in minor quantities, but they are myriad in forms and so, when gathered together, can contribute substantially to the rural economy. It has been estimated that NTFPs can provide employment to millions of people in India. India is bestowed with diverse flora owing to the varied climatic condition prevailing in various bio-geographical regions of the country. India is known to have more than 17,500 species of higher plants including 168 major and minor crop species and 334 of their wild relation oil seeds (120), fibre plants (24), fruits (109), vegetables (5), spices and condiments (26). In addition, nearly 9,000 plants species of ethno-botanical uses have been reported from the country of which 7,500 are of ethno-medicinal purpose and 3,900 are multipurpose / edible species, thereby

contributing immensely to the international NTFPs scenario (Shiva and Verma, 2002).

In India, some 7,000 plants are being used as indigenous medicine. About 3,000 plants species have been reported in the MFPs database built by the centre of MFPs (COMFORPS), Dehra Dun for different uses. The value of direct contribution of NTFPs in India has been estimated to be about US$27 billion, compared to only about US$17 billion for wood products. Besides, NTFPs account for about 50 of total forest revenues to the Govt. and some 70% of forest based earning, about half a billion US$ as estimated in 1991. About 14% of its population is forest dwellers. Millions of people residing in and around forests rely mainly on NTFP for their subsistence and that more than half of the employment generated in the forestry sector is through NTFPs. Nearly four hundred million people living and around forests in India depend on NTFPs for their sustenance and supplemental income. It is being reported that NTFPs provide as much as 50% of the income of about 30% of rural people and 5% of the total employment in India's forestry sector is attributed to NTFPs ***i.e.***, about 4 million people. Some 50 million tribal people in India depend on NTFPs for meeting their subsistence consumption and income needs (Nautiyal and Kaul, 2002). NTFPs provide 60% of their food and medicinal needs and as much as 60% of their income. Possibility of continuous income from NTFPs can provide a strong incentive for them to adopt it as one of the most important alternative to shifting cultivation in upland areas (Nautiyal and Kaul, 2002).

1.2. Definitions

There is an overabundance of terminologies which has been used interchangeably by various authors and organisations with terms such as ‘‘non-wood forest products, minor forest products”, “forest biological resources”, special forest products”, “non-wood forest benefits” “non-wood goods and services”, “forest garden products”, “wild products”, “natural products”, “non-timber forest products”, “by-products of forests”, “secondary forest products” “minor forest products’’, and ‘‘hidden harvest’’ (Chandrasekharan, 1995; FAO, 1999; Wunder and Angelsen, 2003; FAO, 2006).

NTFPs has proven to be difficult to define due to some of the ‘blurred’ boundaries between timber and non-timber products as well as the basic difficulty in defining a forest (Davidson-Hunt *et al.*, 2001). There is an abundant variety of non-wood forestry products and services that differ in origin and characteristics. On the one hand conservation and management and on the other socioeconomic roles present a particular system of problems and potentialities for these products (FAO, 1995).

The debate started since De Beer and McDermott coined the term in 1989. At that time they stated that ‘*the term 'non-timber forest products' encompasses all biological materials other than timber that are extracted from forests for human use’*. These include food, medicines, spices, essential oils, resins, gums, latexes, ornamental plants, wildlife, fuel wood and raw materials like rattan, small wood and fibers.

In this vein, FAO has been an important actor working on a clear and consistent definition. FAO have chosen to use the term Non Wood Forest Products (NWFPs) and Chandrasekharan (1992) stated that “*all non wood forest products include all goods of biological origin, as well as services, derived from*

forest or any land under similar use, and exclude wood in all its forms". After some years FAO, using a series of regional and global consultations, revised its definition of NWFPs, specifying that "*NWFPs are goods of biological origin other than wood, derived from forest, other wooded land and trees outside forest"* (FAO, 1999). This definition excludes all woody raw materials such as timber, chips, charcoal, fuel wood and services (carbon sequestration, watershed, tourism, etc), and includes products derived from both natural forests and plantations. Considering that the earlier definitions did not include some key concepts indispensable for its use in the environmental conservation context, the World Conservation Union (IUCN) developed their own definition. They stated that even though the definition made by De Beer and McDermott in 1989 emphasizes the physical properties of the product, the IUCN expressed that the definition made by Falconer in 1990 (which explicitly considers the extraction of forest products by local people for home consumption and sale, and specify that this activity is different from large-scale extraction) is more appropriate to use because it considers rural development. Finally they proposed a new definition for NTFPs as "*all biological products, excluding wood, fuel and charcoal which are obtained from natural forest for human use"*. This definition excludes specifically all products derived from wood, independently of its final use or kind of extraction. It also limits the origin to natural forest, excluding forestry plantations of exotic species (IUCN, 1996; Crafter *et al.*, 1997).

Ros-Tonen *et al.* (1995) defined non-timber forest products as "*all tangible animal and plant products from the forest, other than industrial wood*". But in 1998, they slightly modified this definition to include "*all tangible animal and plant forest products other than industrial wood, coming from natural forests, including managed secondary forests and enriched forests* (Ros-Tonen *et al.*,

1998) because in practice, *the distinction between 'wild' and semi-cultivated products is often difficult to make* (Ros-Tonen *et al.*, 1998; Belcher, 2003).

Based on the discussion held in the 21st IUFRO World Congress held at Kuala Lumpur from 7 -12 August, 2000, COMFORPTS has suggested definition of NTFPs which may appear sound and appealing to other readers as:

"All products obtained from plants of forest origin and host plant species yielding products in association with insects and animals or their parts and items of mineral origin except timber, may be defined as Minor Forest Products (MFPs) or Non-Wood Forest Products (NWFPs) or Non-Timber Forest Products (NTFPs)" (Shiva and Mathur, 1997)

Non-Timber Forest Products (NTFPs) may be defined as *"All usufructs / utility products of plant, animal and mineral origin except timber obtained from forests or afforested / domesticated land areas. NTFPs are also termed as Non-Wood Forest Products (NWFPs) or Minor Forest Products (MFPs). Services for tourism and recreation including wildlife watching are also attributed to MFPs resources in the modern concept"* are also been termed as NTFPs which covers all goods of biological origin, as well as services, derived from forest or any land under similar use, and exclude wood in all its forms (Shiva, 1998).

Wong (2000) defined it as *'all products derived from biological resources found on forest land but not including timber, fuelwood, or medicinal plants harvested as whole plants'* in the European Tropical Forest Research Network Workshop: Developing Needs-Based Inventory Methods For Non-Timber Forest Products, FAO, Rome, Italy, 4-5 May 2000. Somehow all these definitions vary slightly but basically give same message.

1.3. Standard classification of NTFPs

Various classifications of NTFPs species has been proposed since 1954. Efforts were made to evolve a standard NTFPs classification and documentation manual after a long exercise of holding discussions in a Workshop during January, 1996 and circulating draft followed by another Workshop in November, 1996 attended by NWFPs Chief from FAO, Rome and NWFPs Group Leader of IUFRO and other eminent Botanists and Foresters. Thus, the centre of Minor Forest Products (COMFORPTS), Indirapuram, Dehradun (India) published the following "Standard NTFPs Classification and Documentation Manual" (Shiva and Mathur, 1997) for storage and dissemination of information for global use:

To make the documentation system worthy of being put on computer nine-subheads are provided under each major head.

1.3.1. NTFP species classification :

A new NTFPs classification of the species in the bio diversity has been evolved for universal adoption in the following two groups:

Group I - relates to Commodities of NTFPs obtained from species/sources grouped in following three sections according to nature, kind and use of the products obtained from NTFPs species;

(a) NTFPs species of Plant Origin;

(b) Host NTFPs species yielding products in association with insects/animal and their parts (Here only a few items have selectively been chosen purposely as it was envisaged to address NTFPs obtained in association with animals/insects and plants)

(c) NTFPs items of Mineral Origin.

Group II - Services, Industrial use, afforestation, antipolluted, adulterants, soil binder plants, species recommended for inter-cropping etc.

Different categories of NTFPs have been allotted separate alphabets (A to Z) as shown below:

Group I:-

(a) Plant Species Yielding Non-Timber Forest Products

i. Edible products	A
ii. Spices and Condiments	B
iii. Medicines (Indigenous & Pharmaceuticals)	C
iv. Aromatic or Essential oils	D
v. Fatty oils	E
vi. Plant exudates:	F
1. Gums	
2. Resin	
3. Gum-Resin	
4. Oleo-Resin	
5. Gum-Oleo Resin	
6. Wax	
vii. Tannins	G
viii. Dyes and Colours	H
ix. Fibres & Flosses	I
x. Bamboos	J
xi. Canes	K
xii. Fodder & Forage	L
xiii. Fuelwood, Charcoal and their Briquitte	M
xiv. Bioi wrapper leaves & Bidid	N

xv.Other leaves for Platters, Plates, bowls etc.	O
xvi. Beads for Ornament & Decoration	P
xvii. Saponin (Detergent, Metal cleaner, etc.) & Marking Nut	Q
xviii. Others	R
1. Species for Green Manures	
(For humus formation. Littres, etc)	
2. Hedges	
3. Ornamentals	
(b) Host NTFPs Spesies in Association with Insects and Animals	
xix. Honey & Bees wax	S
xx. Lac & Shellac	T
xxi. Tussar and other Silks	U
xxii. Insects and Animals	V
xxiii. Hides, Skin & Feathers	W
xxiv. Horns, Borns, Shells, Ivory & Musk	X
(c) NTFPs Items of Mineral Origin	
xxv. Mica, Sand, Gravel & Other Minerals	Y
Group II- Services:	Z
xxvi. Identification and Utilization of Plant Species	
1. For industrial use	
2. For afforestation	
3. Environment as anti-pollutant and pollution reclaimant	
4. Substitutes and adulterants	

5. Shade tolerant and sun loving
6. As soil binder
7. Used in inter-cropping

1.4. Categories and uses of NTFPs

Forests contribute to all aspects of rural life: providing food, fodder, fuel, medicines, building materials, and materials for all sorts of household items, as well as many more intangible benefits such as cultural symbols, ritual artifacts and locals (Falconer, 1990, 1995). There is, however, great variation in the extent to which forest products are used from area to area and even between households within a community. Because of this variation, it is difficult to abstract generalizations about NTFPs use. Indeed, this variation reflects the extent to which NTFPs are an integral part of rural livelihoods. People only exploit resources from the forests when they cannot be found on nearby fallow lands, or when they are collecting for trade and better supplies are available in the forest. Classifying these products into like categories is an important first step of understanding the NTFPs industry.

NTFPs can be classified into different categories, based on the purpose of use (for example, as food, fuel, medicine, house hold utensils, farm implements); level of use (self supporting, commercial); the part of plants harvested (leaf, fruit, stem ,roots) and trophy from wild animals (Jeannette, 2000). For this study, the classification of NTFPs is based on categories related to their use and on the recently developed International Economic Botany Data Collection Standard use categories of NTFPs is considered (Andel, 2006).

1.4.1. Food Products

Food products include wild fruits, vegetables, nuts, edible roots, bush meat, edible insects, honey and food additives like spices, flavorings, food colorants, fermentation agents (Andel, 2006). Many non-timber forest products are harvested each year from forests around the world. Many of the products harvested are forest botanicals that are used personally or are sold as commercial trade in the food products industry. Berries, herbs and mushrooms are among some of the most valuable non-timber forest products being harvested and sold to established markets throughout the world (Barfoot, 2006). Other food products include essential oils, honey, nuts, seeds, spices, coffee, teas and saps. In many developing countries, wild forest plants comprise a great portion of the daily diet for many people. In central and West Africa, for example, approximately 1,500 species of wild plants are collected for consumption. Oiled seeds, leaves and fruit are among the non-timber forest products which contain many of the necessary vitamins and other nutritional elements for survival. Falconer (1992) noted that forest foods continue to contribute significantly to the diet of many rural households while a great variety of goods are gathered from forest and fallow lands, the forests commonly supply tubers, mushrooms and snails. Many different fruits and seeds are eaten as snacks on the farm or in the bush, especially by children. Food gathered from fallow and forest areas are added to sauces as flavoring, as medicines, as substitutes for staple food during periods of scarcity and especially for their healing properties. Collectively, these foods add diversity and flavor to the diet as well as providing protein, energy, vitamins and minerals (Falconer, 1992).

1.4.2. Medicinal value

It includes medicinal plants, bark, resin and seeds (Andel, 2006). Forests supply medicines for the vast majority of urban and rural people and medicines are consistently ranked as one of the most-valued forest products by local people. All people use plant medicines and the majority of them (80%) rely on wild plants as their main medicinal source (Falconer, 1992). Even amongst urban households plant medicines are widely used, especially as first aid. Although there are many different healing practices and beliefs, common to most are the use of plants. Knowledge is not confined to specialist healers; common plant treatments are known and used by the majority of people. Women play a critical role in this regard as it is usually they who administer first aid to their children. Knowledge of common medicines is passed on through families and this knowledge continues to evolve as the environment changes. Many forest plants have been used for their medicinal value for many years. In Sub-Saharan Africa, for example, health care is largely a forest-based service. Barfoot (2006) indicated that there are many reports that caution the extraction of non-timber forest products from the forest, especially of medicinal plants. It has been noted that plants used for medicinal purposes are harvested more than any other product from the natural world. China, for example, is home to approximately 24,000 native species, with more than 10,000 of these being used medicinally. It is also estimated that 50,000 species of plants are used medicinally throughout the world.

Out of all categories of NTFPs, edible and medicinal plants have been used since time immemorial. But, medicinal plants are given global importance. There are around 35,000 to 70,000 plants of the 2,65,000 known species of higher plants that have been used for medicinal purposes in the world. In the developing countries, nearly 80% of people continue to rely chiefly on traditional,

predominantly herbal medicines for health care. The growing population and emerging demands for botanical products in the medicine and cosmetic industry is leading to enhanced gathering of such material from forest area even to an unsustainable level (Shiva and Verma, 2002).

Approximately 80% of world's population largely depends on traditional natural medicines, which are derived from plants, insects and other animal products. In addition, some 20% of the drug in modern Pharmacopoeias is also plant derived both wild and cultivated. It is estimated that some 35,000 plant species have, at one time or other, been used in some culture or other for medicinal purposes. Among the Asia, Pacific countries, the importance of medicinal plants was probably first realized by China, then by India, followed by Indonesia, Thailand and others. Sometimes around 300 BC, Shen Nung, the Chinese Emperor wrote down what is believed to be the earliest recorded use of plants as medicine (Shiva and Verma, 2002).

1.4.3. Fuel (Energy supply)

Andel (2006) also noted that fuel includes fuel wood (firewood, charcoal), petroleum substitutes, and lighting resins. All rural households rely on fuel wood to meet all their energy needs. But, most fuel wood is collected from farms and bush fallow, rather than the forest. The supply of fuel wood is not a problem in any of the study villages. Although in some cases, where the fuel wood is used in a processing enterprise such as palm oil production or preparation of cooked foods for sale, fuel wood collection may be difficult and claim that readily available supplies are scarce (Falconer, 1992).

Fuelwood is the largest energy source for the three-quarters of the world's population who live in developing countries (Scurlock and Hall, 1990).

Indeed, the demand for fuelwood is likely to continue as the most important energy source for rural areas of many countries. In India, about 70% of energy requirement is met by the fuelwood and about 50 million tons of wood are removed from the forests every year (Ministry of Environment and Forest, 1995–96).

The rural people of northeast India have traditionally been relying on fuelwood as a primary source of energy, which in turn is responsible for rapid deforestation of the region (Maikhuri and Gongwar, 1991). To avert this situation, it is highly necessary to establish energy plantation on unused and degraded lands of the region. However, while selecting the tree species for energy plantation, special attention should be given to the indigenous species, which have traditionally been preferred for fuel by the local people. Moreover, local people's choice should be considered for identifying the tree species as they have an intimate knowledge of the local environment and the local tree species (Jungerius, 1995).

Fuelwood Value Index (FVI), which depends upon calorific value, density, moisture and ash content of wood, is an important parameter for screening desirable fuelwood species (Goel and Behl, 1996; Bhatt and Todaria, 1992; Abbot *et al.*, 1997); Purohit and Nautiyal (1987). Recently Konwer *et al.* (2001), Kataki and Konwer (2001, 2002) have reported the fuelwood characteristics of some indigenous tree species of northeast India. Abbot *et al.* (1997) screened some indigenous fuelwood species of Malawi by using pair-wise comparison method, which depends upon certain quality criteria of fuelwood. From their studies, they concluded that pair-wise ranking was a simple but accurate procedure for the identification of preferred firewood species from the sample area.

Fuelwood has remained the principle component of rural domestic energy in India and in most developing countries. Most of the fuelwood has been reported to be derived from forest with some from trees growing on homesteads, farmlands and common lands outside forests. Because of the increasing population, the area under agriculture expanded and forests shrunk. In India, the land under cultivation increased from 118 million in 1951 to 142 million ha by 1987. This expansion also included the diversion of about 4.5 million ha of forests to agriculture. On the other hand the demand for fuelwood increased in spite of the rapid growth in the commercial energy sector.

Having a total area of 328.76 million ha, which is just 2.47% of the world's geographical area and with a mere 1% of the world's forests, India supports 16.1% of the world's human population. Thus, the pressure exerted on Indi's forest resources is tremendous. More than 70% of the Indian population is rural and 62% of the domestic fuel needs of this segment are meeting from wood. The forest resource cover of India is inadequate to meet local needs, particularly the demand for fuelwood, which accounts for about 66% of all commercial energy consumed in the country (Vergara, 1997).

Different estimates have been put forward by various agencies regarding the extant of wood fuel production and demand in the country. The Forest Survey of India (FSI) in 1987 estimated that the wood fuel demand in the country to be about 235 million cubic mt (FSI, 1987). Against this the recorded wood fuel production in the country was assessed to be only 40 million cubic meters.

Rural people collect fuelwood freely within their localities. For the urban people, fuelwood is delivered from rural sources through a commercial system (Brigham *et al.*, 1996). The unrecorded removal fuel wood from forests

was considered as an extra drain on the forests resources. The FAO and other international organizations identified fuelwood collection as one of the underlying causes of deforestation in developing countries. Over exploitation of fuelwood was responsible for a number of environmental problems.

The present consumption of fuelwood is giving as being between 150 and 450 million meter cube. The potential supply of fuelwood from the “forests” is now often given as 17 – 28 million tones. Unrecorded production of fuelwood from forests has been estimated to be 17 – 22 times higher than the recorded. Ravindranath and Hall (1995) have estimated the supply of wood from the forests to be 19 million tones. They also estimated that the forests give over 50 million tones with logging waste, twigs and branches.

Wood fuel account for about 20 – 30% of all energy used in India, wood makes up 60% of all fuel needs in rural areas and 35% of all needs in urban areas. The fuel wood consumption in urban India is going down. The proportion of fuel wood in total energy consumption is increasing in rural areas.

1.4.4. Animal Fodder

Most of the households collect fodder for their livestock even though they are often free ranging for part of the day (Falconer, 1992). Forests play a significant role in feeding domestic and wild animals through the provision of fodder trees and fodder shrubs. The importance of fodder trees has received recognition by the wider scientific communities in recent years, as the number of livestock increased proportionally with the increment of human population in most of tropical countries. Then it is assumed that fodder plants are important components of animal feed particularly as suppliers of proteins and supplement feed in dry seasons (FAO, 1992).

1.4.5. Construction materials

This includes forest products like palm leaves or grass for roof thatch, bamboo, wood (sticks and poles) (Andel, 2006). Building material**s** such as cement and aluminum roofing sheets are available, but the majority of rural households cannot afford these, relying instead on the forest for their building materials. Falconer (1992) explained that in most cases, rural houses are mud and wattle, utilizing sapling-size trees as standing poles and raphia (leaf petioles) or bamboo to produce a lattice. While specific species are sought after for particular needs, a great variety of different materials are used, even within one community.

1.4.6. Household utensils and agricultural equipment

This encompasses forest products such as fibers, baskets, furniture, bow and arrow, dye, paint, varnish glue (Andel, 2006). NTFPs also features commonly in the material culture, providing household, agricultural and marketing equipment. other essential household items include mortars, furniture and sleeping mats, wood for hoe and other tool handles, farm implements, poles for crop storage containers and crop dryers, canes for baskets, crop drying mats, fish traps and other fishing equipment. Most items are made within the household rather than being purchased and every household uses items made from NTFPs in daily life (Falconer, 1992).

1.4.7. Rattans

Rattans are spiny climbing palms occurring in tropics and subtropics that can attain lengths of over 185 meters. There are 13 rattan genera with 700 known species. (INBAR, 2008) They are found in peat swamp, evergreen, dry evergreen and mixed deciduous forests at elevations up to 1,000 m above mean

sea level. Rattans are source of cane for the cane furniture industry, while at the same time being used for a wealth of minor purposes locally. Most cane entering world trade is collected from the wild from primary and logged-over forests, and throughout much of South- East Asia rattan represents the most important forest product after timber. At a local level, rattan may be of great social significance in providing source of income for the poorer societies living near forest (Dransfield and Manokaran 1994).

At present the resource is seriously threatened by loss of habitat as forests are converted to agricultural and other land uses, and by overexploitation of the remaining stocks (Dransfield and Manokaran, 1994).

1.4.8. Marketing :

With recognition of rapidly dwindling forest resources (especially in tropical regions) and concern over sustainable development emerging as an UNICED follow-up, sustainable forestry has come to the forefront of the debate on environmental forestry development. Sustainable forestry consists of conservation, sustainable forest management and sustainable utilization of forest resources. Compared to the conservation and resource management, sustainable utilization appears to be frequently overlooked in the forestry sector, although it is the element which is creating value for the resource and thus making resource conservation and management feasible and attractive. It is an important means not only in creating value but also in distributing it among those involved in forestry operations. The value from the forest resources is derived through harvesting, processing and marketing of products based on wood, non-wood materials and services provided by the forests (Lintu, 1995).

According to Lintu (1995), in the socio-economic context of forestry, marketing is one of the means, in combination with processing and resource management, to cater for the needs of people involved. Marketing provides a set of tools with which people can create more efficiently economic value for the resource and products made of it. Proper marketing also assists in a more equal distribution of the economic value created among the participants. Marketing is therefore vital not only to medium and large-scale industrial enterprises but also in helping small farming and forestry communities move from a subsistence economy to one in which they can start and sustain profitable enterprises on their own.

Discussing marketing in the context of NTFPs means discussing marketing in all its possible variations. NTFPs comprise such a varied group of products that meet the needs and wants of all kinds of end-users. Some of the products find markets with final consumers without any major processing (**e.g.** fruits, berries, mushrooms, etc.), others have markets with industrial consumers which use them as raw materials in making either other industrial products (**e.g.** converting essential oils or gums to fragrances and flavours) or consumer products (**e.g.** rattan furniture).

In sustainable forest utilization, marketing provides a means for maximizing the values and distributing them among the participants in forestry activities. It is closely link to processing which converts the resources into marketable products.

1.5. Scope of the study

Most of the NTFPs are diverse in nature. There is, however, a very limited information with regards to uses of NTFPs, their methods of utilization,

collection, value addition, propagation to replenish the natural resources, etc. and after related issues (Shiva and Verma, 2002). With the increasing demand of NTFPs in industries and trade, there is a need for ascertaining their potentials. In a large number of important species, data is either not available or incomplete for which forest officers are helpless in giving detailed information about the availability and types of forest products present in the area. Thus many of the potential products remain unexploited. In order to exploit these resources fully it is necessary for forest officers / person concerned to know, what, when, where and how much he can supply from his area. It is therefore essential to conduct surveys for finding out the distribution and exploitable yield of at least the more important species. The uses of traditional medicines have been practiced since a very long time which they have learn from their fore-fathers or inherited through generations. The indigenous doctors have got specializations in different types of diseases. The local people collect, process and market a large number of NTFPs such as bamboo, rattan, bidi leaves, resin, gums, lac, oilseeds, essential oils, broom grass, fodder, green manures, thatching materials, medicinal herbs and tanning materials. Rural communities also draw upon forests for a number of items such as honey, mushroom, fruit, nuts, tubers, edible worms and insects and vegetables which are consumed locally (Shiva and Verma, 2002).

In general, the plant resources of Mizoram (timber, NTFPs and crops etc.) are getting depleted day by day due to high population pressure coupled with reduced acreage of available land. The increasing extraction of NTFPs to meet the requirement of growing population is another threat to the dwindling plant resources of the state. The diversity of NTFPs in Mizoram with its various uses is perhaps unrivalled in any other part of the country. The NTFPs individually may not appear to be a great value but collectively they are of immense value to the

country as a whole. The people living in the vicinity of the forests are highly dependent on the forest resources particularly for their day-to-day requirements of food, fodder, shelter and medicines. The NTFPs provide employment to unskilled and skilled laborers, which is of crucial importance to the otherwise rather stagnant rural economy in the hills of the North- Eastern India (Tiwari, 2000).

1.6. Objectives

The study focuses on the following objectives:

1) To inventorise NTFPs diversity of plant origin, their occurrence, habit and habitats and availability pattern in different forest types of northern Mizoram.

2) To understand the dependence of NTFPs by the people especially the villagers living in and around the forests.

3) To find out the consumption pattern of important fuelwood by different tribes and their preference of fuelwood species.

4) To determine the Fuelwood Value Index (FVI) of important species and study their market chain and employment prospective.

(5) To determine the quantity of various NTFPs available in different local market based on market survey.

CHAPTER – 2

REVIEW OF LITERATURE

2.1. Studies abroad

The contributions of NTFPs cannot be over emphasized when considering the roles they play in any nation. Historically, mankind has depended on non-wood resources for meeting basic needs (FAO, 1992). NTFPs play important subsistence and safety-net roles in the rural economy, but only a small subset of forest products possesses potential for significant cash income and employment generation (Wollenberg and Belcher, 2001). Despite the globalization of the World's economy and the rise of industry, NTFPs still remains an important source of income for hundreds of millions for rural livelihoods (Poffenberger, 2006). NTFPs would appear to have potential to diversify the rural economy as the rural economy is heavily reliant on arable crop harvests. The uncertainty of a successful harvest means that there is always an element of instability in the rural economy. Thus diversification would in turn lead to increased stability. For many rural poor this is their sole means of income (Taylor and Parratt, 1995).

A study by Wills and Lipsey (1999) in British Colombia, Canada estimated that in 1997 the commercial harvest of wild mushrooms, floral greens and other products employed almost 32000 people on a seasonal or full-time basis, which generated direct business revenues of $ 280 million and overall provincial revenues in excess of $ 680 million. A study conducted by Grimes *et al.* (1994) showed that NTFPs would contribute 77 % to the annual net returns, if dry deciduous forests are exploited sustainably. The present value of the NTFPs

on an average would be US $ 1182 per hectare, which is, however much less than that of compared to similar estimation made for Equador where it was US $ 2830. The significance of the Amazonian forest is also affirmed by Peters *et al.,* (1989) who estimated that the Net Present Value of sustainable fruit and latex harvested to be as high as US $ 6330 per hectare.

The importance of NTFPs in Hantana forest of Sri Lanka was analyzed by Abeygunawardena and Wikramasinghe (1992). They observed that one person entered the forest for five days in a week and collected five bundles of fuel wood. Out of these five bundles, one was kept for his own use and others were sold. They reported that the monetary value of the fuel wood collected from the forest per hectare per year was ` 1,052 while that of grass was about ` 578. When all NTFPs collected were valued, they found that the monetary value was equivalent to ` 1,961 per hectare per year.

A study in Botswana of the Southern African Plateau (Taylor and Parratt, 1995) depicts that people most likely to be involved in NTFPs use (namely rural communities) have very limited access to technology. As such, it is likely that they will end up selling the NTFPs in a relatively 'raw' state to an intermediary who will then end up selling it to a processor. The profit margin increased further up the chain you go and the harvester would thus realize the least profit margin.

Research by Sunderland *et al.* (1999) reconfirms that NTFPs provide sources of food, medicines, and income to many households in Central Africa. Yet, these studies also confirm that the contribution of NTFPs to local and national economies is typically small relative to agriculture. In four forest villages in South-Western Cameroon, NTFPs contributed 9% to the household economy compared with 43% for agriculture. Similar figures are reported for households in

South-Eastern Cameroon (NTFPs 1.2%; agriculture 31%) and South-Western Central African Republic (NTFPs 10%; agriculture 51%). Harvesting of wild NTFPs is most important for poor families that have limited or no access to agricultural markets. Wealthy households or those with access to agricultural markets (***i.e.*** those that can sell cash crops) often consume NTFPs, but seldom harvest them for sale. The study conducted in the South-West and North-West provinces of Cameroon by Abwe *et al.* (1999) reported that, the total value of NTFPs production and marketing exceeded US $19 million in 1999, and contributed 2.8% to the regional economy. In contrast, timber in this area was predominantly logged-over area, which contributed 5% and while agricultural crops contributed 27%.

Pervez (2002), in his study on NTFPs sector in Dhading district of Nepal observed that the NTFPs generated maximum employment (60.72 %), followed by agriculture (22.30%), allied activities (15.83 %) and other sources (1.16 %). With regard to income generation, allied activities were the major contributor to the total household income with 34.74 % followed by NTFPs (32.08 %) and agriculture (29.50 %).

2.2. Studies in India

Studies in India have revealed that NTFPs provide substantial inputs to the livelihoods of forest dependent population, many of whom have limited non agricultural income opportunities (FAO, 1991; Chandrashekaran, 1994). About 70 % of the NTFPs collection in India takes place in the tribal belt of the country (Mitchell *et al.,* 2003). The literature reveals that the NTFPs based small scale enterprises provide up to 50 % of income for 20 to 30 % of the rural labour force and about 55 % of employment is due to forest sector alone (Joshi, 2003). It is

reported that tendu leaf collection alone provide about 90 days of employment to about 7.5 million people every year in India (Mistry, 1992).

Many researchers have worked out on the relative contribution of various NTFPs to different tribes in India. For an example, Nandakumar (1988) showed that the mean annual income of the Yerava tribes from NTFPs was ` 4,400 per annum among 62 % of the respondents, while 38 % of them belonged to high income group with ` 8,850 per annum. Similarly a study by Thiagarajan (1989) revealed that 75.5 % of the tribal households had low income while the rest 24.5 % of them had high income. Therefore the economic status of tribals (Intodia, 1990) was much below the satisfactory level as 77.87 % of them were having their annual family income less than ` 2,500, whereas 13.33 % of them were in the income group of ` 2,500 to ` 3,500 and only 9 % of them derived income above ` 3,500. Further, he reported that tribals usually had very low family annual income and spent very low amounts even for the necessities. The low level of family expenditure was mainly due to the fact of low levels of income. Hence, the contribution of NTFPs to the improvement of livelihood of the forest dwellers and equitable distribution of the income among different sections of forest dependent people is questionable and needs to be studied further.

Appasamy (1992) stated that the majority of NTFPs collectors were males in the Palani hills of Tamil Nadu and higher proportion of the NTFPs collected was used for income generation rather than for home consumption. Fifty percent of the firewood was used for home consumption and the rest was sold. A study by Gauraha (1992) depicts that, Forest dwellers in Pendra block in Bilaspur district of Madhya Pradesh obtained 70 % of their household income from settled cultivation and sale of NTFPs. Kant (1997) studied the role of NTFPs in three

tribal villages of Gujarat and West Bengal states. The study revealed that NTFPs contributed significantly to the household income in tribal village economies. In the case of Gujarat, the contribution of NTFPs to the total households' income varied from 20.1 % to 34.1 % while in the case of West Bengal, it ranged from 26.5 to 55.5 %. It was also found that majority of the household employment was generated through collection of NTFPs (36.4 %), followed by settled cultivation (15.11 %) and agricultural labour (14.3 %).

Mistry (1992) in his study on the impact of the Forest Act on the household economy of the tribals reported that tendu leaves provided enormous employment (90 days of employment to 7.5 million people every year) and income to tribes. The study by Namdeo and Pant (1994) highlighted that tendu leaves were estimated to provide employment nearly to 4 million persons annually by way of Bidi (Local cigarette) manufacturing. Rao and Singh (1996) studied the contribution of Non-wood forest products in augmenting the income of the tribal families in families of South Bihar and South West Bengal. Ten tribal villages were selected in Bihar, five in Palamau district and five in Singhbhum district and five in Midnapur district of West Bengal. They found that, among the various NWFPs collected in South Bihar, on an average, Kendu leaves contributed the most (` 3,169) per family followed by brooms (` 2,745) whereas in west Bengal, Sal leaves contributed the most (` 1,675) per family followed by kendu leaves (` 675) per family.

A study on employment, income and expenditure pattern of tribals in the Nasik district of Maharashtra (Raut *et al.,* 1992) found that the collection of minor forest products (MFPs) was found to be the only source of income during the summer season. Wage earning was the prime source of income for landless group, which amounted to the tune of 50 % of the total income. Another study by

author Suryawamshi (1992) stated that the tribals got comparatively better employment in the Kharif season due to agricultural activities. Whereas during summer season they were involved in off-farm works such as collection of fuel wood, minor forest products and scarcity works under the employment generation schemes. These studies concluded that wage earning and sale of minor forest products were the major source of income to the landless families.

Rao (1992) examined the employment and income pattern of forest dwellers in the three different ecological and economic settings in Andhra Pradesh. Resource endowment was found to have a definite bearing on the employment pattern. Position of the land and its cultivation had generated more days of employment among Araku tribes, whereas its absence drove the tribals in Nallamalai to collection of forest produce for a living. Campbell (1993) opined that according to some rough calculations based on the valuation of NTFPs, an average return of ` 2,720 was realized per hectare annually in India. He observed that forest based enterprises provided up to 50 % of income for 20 to 30 % of labor force in India.

Sekar *et al.* (1993) found that among the tribal households, three members were involved per day in NTFPs collection, whereas only two members served as agricultural labourers. The income realised was ` 2,800 per annum per head from NTFPs' collection. In respect of marketing of the NTFPs, two marketing channels were found to exist. The study by Sekar *et al.* (1996) in the Sathyamangalam Hill LAMP cooperative society, found that around 83 % of the members were tribals who were actively involved in minor forest products collection and earning on an average ` 11,180 per annum by spending 8-10 hours in a day for the purpose. The study by Namdeo and Pant (1994) highlighted that sal seeds had potential to provide employment to 4.5 million persons for a period

of 40 days and regular employment of 300 days per year for 0.436 million persons in processing of sal seeds. The annual production of the gum karaya was about 6000 tons and creation of 0.6 million mandays of work at the rate of 10 kg per person per day. The study by Rao and Singh (1996) estimated that non- wood forest products offer employment to about one million people every year.

Das (1995) studied the role of NTFPs in the economy of forest fringe dwellers of South-West Bengal. He observed that on an average, one NTFPs collector working for five to six hours a day could earn ` 17 to 26 from NTFPs and the collection season were more or less distributed throughout the year. He reported that, of the five Forest Protection Committees (FPCs) studied, the average family income from NTFPs varied from ` 6,046 in Dalangora FPC to ` 9,569 in Khatam. Palit (1995) in his study on the role of NTFPs in Joint Forest Management revealed that an average, each household of Raigarh forest protection committee was engaged for 63 days per year in the collection of NTFPs. The income earned from the sale of NTFPs was ` 2,421 per household.

Olawoye (1996) opined that rural households spend income realized from NTFPs to buy food to maintain their families. This provides a supplement to the economic status in the lives of the generality of the rural dwellers. Hence, dependence upon several combined and seasonal activities is an important way to ensure household food security.

A percentage comparison of income composition and employment of the three tribal communities (Jenu kurubas, Soligas and Betta kurubas) in Madumalai Wild life sanctuary in India by Hegde (1997) showed that Jenu kurubas derived more employment and income from commercial Non- Wood Forest products than the Soligas and Betta kurubas communities. The analysis of the correlation indicates that Jenu Kuruba community was more dependent of

forests than others. It was seen that all other sources of income, such as forest labour, wage labour and salaried jobs reduced the reliance of the people on the forest.

The study conducted in India (Surayya, 2000) on contributions of Forests, Microfinance, and NTFPs Marketing and Policy interventions for Reducing Poverty portrayed that mean annual income generated by forest dwellers by NTFPs collection and sale was ` 2,337, mean income from collection and sale of firewood and livestock sale was accounted to be ` 2,500, whereas income from agricultural source & borrowing and others was uttered to be highest which was about ` 4,846 and ` 3,388 respectively.

The study by Pandit and Thapa (2002) revealed that the NTFPs grown on marginal lands contributed to farm household economies, as 24 % of the annual household income in the upper watershed and 13 % in the lower watershed was realized from the sale of NTFPs based products. They also found that the domestication of the NTFPs reduced local people's dependency on NTFPs as well as other forest resources, as the frequency of visit to forest fodder and fuel-wood resources reduced with the increasing NTFPs domestication.

The role of NTFPs in the economy of communities living in and around forests of South Bihar was highlighted by Vidyarthy and Gupta (2002). Nearly 49 items of the NTFPs found to sustain the people especially landless and marginalized groups during lean season and supplement their income during other seasons. The study showed that NTFPs contributed significantly to the annual income of the households (86%). Besides the economic value of NTFPs, local communities were also enjoying several qualitative benefits from the forest such as medicinal, religious and aesthetic needs. The study conducted by Sawhney and Engel (2003) in Bandhavgarh National Park, India pointed out the majority of the

sampled households (97%) collected NTFPs. All the households collecting NTFPs also sold it, though there is a ban on sale of NTFPs. Overall, sale of NTFPs constitutes the most important source (26%) of cash income for the households, and the third most important source of total income (13.8%). On an average each household made US $ 44 from the sale of NTFPs in 2000. From the sale of different source of NTFPs to the total NTFPs income, amla11 product (42%) contribute the highest followed by tendu patta (41%), mahua (12%) and fuelwood (4%) where as chironji (1%) contributed the least.

Studies on the role of NTFPs in South India indicated that forest dwellers in Western Ghats region depend for up to 50 % for their income and employment on NTFPs (Girish, 1998; Ganapathy, 1998; Hegde *et al.,* 1996; Suryaprakash, 1999). A study by Ganapathy (1998) on role of NTFPs in the tribal economy of Kollegal taluk of Karnataka covered four forest range of Kollegal taluk ***viz.***, Hanur, Kollegal, Malai Mahadeshwara Hills (M. M. hills) and Rampuram. He reported most employment (42.96%) was generated by NTFPs for the tribals' households followed by farm employment (22.06%), allied employment (12.72%), wage employment (11.86%) and other source of employment (10.40%). The analysis of the composition of the income of tribal households revealed that NTFPs was the main income generator. It contributed for about 34.09 % of the total income of the household, followed by farm income (28.26%), allied income (18.61%), wage income (13.20%) and other sources of income (5.84%).

The study by Suryawamshi (1992) reported that, almost six months in a year, the forest dwellers in Western Ghats zone of Maharashtra were unemployed. Due to continuous rains in the kharif season the forest dwellers got comparatively better employment in off-farm works such as collections of

NTFPs, hunting and scarcity works under employment guarantee scheme. The forest work alone contributes more than 30 % of the total employment. Wage earning and sale of forest products were the main sources of income in the landless families. Gathering forest produce during the season in Kerala; the tribal family would make between ` 2,000 and ` 2,500. But during lean season a family made a meagre sum of ` 70 to ` 100 even by risking their lives (Anonymous, 1985). The percentage of family income in different income groups include up to ` 2,000 (14.89 %); ` 2,001 to ` 4,000 (43.41 %), ` 6,001 to ` 8,000 (8.51 %), and ` 8,000 (12.34 %) per annum among Kota tribal people of Niligiris district (Varadarajan, 1980). The study by another author (Manjula, 1991) on the same community reported that the average annual income of a family was ` 7,700 per annum. The annual income of the farm family was medium for 54 % of the families, high for 33 %, while low for 14 %, but in general, the income of the tribal farm families was low. When Family expenditure considered, it shows that 90 % of the income earned was spent on necessities while 5 % was on recreation and cash savings account hardly 2.36 %, while borrowing accounted for 8.36 % and investment accounted for less than 30 % of the total income (Lal *et al.,* 1983).

Life and livelihoods are linked to the biological and physical world in a complex way. Humans are bound by their physical and biological environment in terms of provision of food, water, shelter and other environmentally related services (Centre for Indian Studies, 2003). Livelihood security is dependent on two related factors – one, the access to resources to meet the basic needs of a community and, second the state policies in this regard and the attitude of the civil society are reflected in the state policies (Sudarsen and Sumathi, 2003). There is an intricate relationship between livelihood pursuits of tribal communities and surrounding natural resources like forest, land, water-bodies and other flora and

fauna. The critical balance between the two is very essential for sustainable livelihoods of forest dwellers in the world in general. The coping mechanisms developed by them are cultural responses to combat the scarcity and poverty conditions that threaten them periodically (Prasad and Eswarappa, 2005).

Pathak and Vagholikar, (2006) have provided a detailed set of comments on the Scheduled Tribes and Other Forest Dwellers (Recognition of Forest Rights) Act 2006. A central factor affecting tribal livelihood possibilities is access to and control over natural resources such as land and forests. A major problem is that traditional homelands of tribal communities have been classified by the colonial government and subsequently by the independent Indian government, as forest lands vested with the state. In the absence of clearly defined property rights, millions of tribal families living in or around forest land can be deemed encroachers and thereby illegal occupants, continually living under the shadow of eviction. It is a matter of historical record that all such areas have witnessed serious conflicts over land rights in the form of agitational activities such as Dharnas and Rasta rokos, often resulting in loss of life. Acharya (2007) has mentioned that, the Wildlife (Protection) Amendment Act 2002 implemented in 2006 bans adviasis (aboriginal tribes) from gathering non-timber forest produce (NTFPs) such as honey, wild herbs, mosses, lichens and fruits for commercial purposes from parks and sanctuaries. Till the ban, Soliga tribes had usufruct rights to collect NTFPs and sell them to their own cooperative LAMPs (Large-scale Adivasi Multipurpose Society) which in turn would auction them to the highest bidder, generally traders who in turn sell the produce to various industries.

Sharma and Tiwari (1992) reported that the tribal living in the high altitude areas of Himachal Pradesh was leading a very tough and hard life. The literacy level was found to be very low (43.77 %). Agriculture was the mainstay

with 60 % of the workers being cultivators. Farming, sheep and goat rearing were the main means of livelihood. More than half of the income was contributed by agricultural sector alone, but in some regions sheep and goat played a dominant role. Prasad (1993) stated that production of NTFPs fluctuated also between years. He observed that the rural communities living in and around such forests depended only on selling forest produce. The situation could be altered only with alternative sources of employment opportunities for cash income. The income and labour relationships in collection of minor forest products examined by Alibaba *et al.* (2000) showed that labour spent on gum and tamarind collection was significant in generating income by tribals in forest areas. Their study concluded that all the tribal households faced problems in searching minor forest products and danger of wild animals. Furthermore there was a need for controlled exploitation of minor forest products in order to give scope for rejuvenation of forests.

Sudarsen and Sumathi (2003) reported that Malayali schedule tribe of Tamil Nadu heavily depends on the forest for their livelihood. With the increasing strictures on access to the forest resources and changes in the policies created by government departments, they are facing acute problems in utilizing the resources. The major problem is to have a secondary source of income or more precisely to generate their minimum needs of food during the crisis period. The impact of external agencies like non-tribal money lenders, traders and extremist's activities creating unrests among the interior tribals result into disturbances in their livelihood. The non-tribal private traders also buy the minor forest produce items from the tribals at low price and false weights and measures (Subramanyam, 2003). NTFPs collected and sold in unprocessed form through co-operatives in a tribal sub plan area in Rajasthan fetched lower prices

(Chakravarty and Verma, 1991). Endeavour by the co-operatives in marketing of NTFPs is an important step in saving the tribals from exploitation by the middleman. In Sundergarh district of Orissa, India (Mahapatra, 1992) money lenders of the area advanced loan to villagers only after they handed over the minor forest products (MFPs) collected. Thus became obligatory for the tribals to sell minor forest products to the lender at a price fixed by the trader. An attempt has been made by Kulirani (2003) to present on social, political and economic changes that have happened in Wayanad from a socio- historical point of view and the shrinking livelihood strategies of the Paniyar. Vast majority of tribals still have many unresolved problems especially landlessness in their traditional home land. The nutritional problems can be derived from inborn errors of metabolism or from cultural and environmental factors. The problem of malnutrition is associated with the scarcity of food resources in many tribal ecological zones including Eastern Ghats (Subramanyam, 2001). In general the incidence of malnutrition among the tribal population and lack of water conservation attitude in the tribal areas is more, resulting in health problems and other water born diseases reducing the working capacity among them. Reddy and Rao (2003) observed that the kurumbas and Irulas tribes are the first settlers and occupied and dwelling in the low lands of the Nilgiris are much more subjected to sickle cell anaemia caused due to virulent malaria causing mosquitoes. But it was absent in case of Toda and Kota tribes (Saha, 1976) as it is evident that these two were dwelling in the upland plateau of Nilgiris.

Mishra (2007) reported that some social support system to cope during drought periods existed in Oraon tribe. At household level, reduction of food consumption and change in the pattern of food consumption are important coping strategies. The majority of people in this area changed their occupation,

when agriculture fails due to drought. Also many households either sold or mortgaged their lands and household assets. Some of the people, including young children migrated temporarily to other places for livelihood.

OTELP (Orissa Tribal Empowerment and Livelihoods Project) in 2007, points out that ecological degradation, erratic rainfall and a high risk of drought in the area have resulted in high food insecurity, increasing out-migration and periodic deaths from starvation. Among the disasters ecological imbalance is now seriously undermining the livelihood patterns and increasing vulnerability. In addition to these, a small land base, low agricultural productivity and low incomes have led to rising indebtedness, trapping tribals into a vicious circle of exploitation. The life of the tribals is increasingly vulnerable due to a persistent lack of assured entitlements to their resource base. Land alienation has deprived them of their land; forest legislation has turned them into encroachers on land they have always used; and they have also been disproportionately affected by displacement due to mining operations, irrigation projects, wildlife sanctuaries etc.

2.3. Studies in North East India:

In North East India, a lot of work on NTFPs have been work out. The notable among are the works of Sajem and Gosai (2006) on the 'Traditional use of medicinal plants by the Jaintia tribes in North Cachar Hills district of Assam, northeast India'. They documented 39 medicinal plant species belonging to 27 families and 35 genera in their studies. Mao *et al.*, (2008) documented some important medicinal plants and its status in the wild and also discussed on the need for harnessing the rich bio-resources and translating it to economic products in their paper 'Plant wealth of Northeast India with reference to ethnobatany'.

They highlight the rich plant resources and the vast wealth of ethnobotanical information available with the various tribes of the region.

Jasmine *et al.,* (2007) recorded 249 species of wild edibles belonging to 153 genera and 82 families in their paper on 'Wild edible plants of Meghalaya northeast India'. Among them 129 are trees, 54 shrubs, 37 herbs and 29 climbers. The majority of the species were fruits bearing (125).

The flora of Assam is still regarded as a major floristic account of the region (Kanjilal *et al.* 1940). In-depth studies on rattans have been started recently in the region. Thomas and Haridasan (1999) reported 24 species of rattans under 4 genera from Arunachal Pradesh. Singh *et al.* 2003 reported 13 species under 3 genera from Manipur. Deb (1983), reported 6 species belonging to the genus *Calamus* from Tripura. Anderson (1871), enumerated 7 species of rattans of Sikkim. But, most of the works are pertaining to rattans of Western Ghats and Andaman and Nicobar Islands, and the North East Region is largely neglected.

Konwer *et al.*, (2001), Kataki and Konwer (2001, 2002) have reported the fuelwood characteristics of some indigenous tree species of northeast India. They studied on Fuelwood characteristics ***viz***. moisture content, ash, silica, carbon, nitrogen, volatile matter, density and calorific value of 35 indigenous tree species of the age group of 10–15 years growing in their natural habitat in north-eastern region of India were determined and Fuel Value Index (FVI)**.** Deka, Saikia and Konwer, (2007) also works on fuelwood species of north east India. In their study, ten indigenous fuelwood species of northeast India were ranked by pair-wise comparison, a technique used by rural people for selection of fuelwood, and also from their fuel value indexes calculated by using three different formulae.

Maikhuri (1991), *Fuelwood consumption pattern of different tribal communities living in Arunachal Pradesh in North East India; Fuelwood use by*

different tribal and non-tribal communities in North East India published by Maikhuri and Gongwar (1991); *Non-Timber Forest Product of North East India* by Tiwari (2000), *Forest Flora of Meghalaya* by Haridansan and Rao (1985, 1987), *Fork-lore medicobotany of rural Khasi & Jaintia tribes in Meghalaya* by Kharkonger and Joseph (1981) etc. in north-east India.

2.4. Studies in Mizoram

Compared to other parts of our country, N.E. India in general and Mizoram in particular lack in depth studies on various aspects of NTFPs (Sahoo *et al.*, 2010a). In Mizoram, Lorrain (1940) mentioned a few traditional medicines used by the Lushais (Mizos). Irish (1975) enlisted 90 diseases/ailments with treatment by ethno medicine. Thangchuanga (1979) recoded 93 diseases along with medicines (plants /animals). He also recorded some food plants of Mizoram. Zoram Upa Pawl Thurawn Bu (Anonymous, 1984) may be treated as a milestone in documenting herbal medicine or local medicine. A total of 228 cases of human diseases and 27 diseases of animals along with ethno-medicine used by the different tribes of Mizoram have been documented. Darlianthanga (1989) reported 97 diseases along with herbal medicine. Saptawna (1990) reported 58 plants species used as medicine. Lallianthanga (1990) reported the local medicinal uses of 128 plant species. Vailinga (1991) also documented 165 diseases and ethno-medicine.

Lalramnghinglova (1991) in his paper '*Medicinal and Aromatic Plants of Mizoram*' documented 437 plant species on the basis of field work and secondary information. Lalramnghinglova (1992) reported food plants, fruit plants and medicinal plants with respective uses in his paper *'Food plants, Fruit Plants*

and Medicinal Plants of Mizoram'. Neeti Mohanta (1994) published the work on 'Tribal Ethnobotany of Mizoram'.

Chawngkunga (1996) documented detailed information on about 85 plants, local classification of diseases (250 human and 17 veterinary diseases). Again, Lalramnghinglova (1996) documented 238 ethnomedicinal plants comprising 201 genera under 101 families in his paper Ethnobotany of Mizoram – A preliminary survey. This paper is the first hand information dealing with an enumeration of medicinal plants used by the local people of Mizoram in the primary health care system. Further, Lalramnghinglova and Jha (1996) investigated medicinal plants having ethnobotanical uses, the preparation, doses and mode of application, disease-wise. Ethnobotanical floras in the humid sub-tropical semi evergreen forests of Mizoram are reported by Lalnundanga, *et al.* (1997). The ethnomedicine including mineral products, ethnoveterinary plants and parts of plants and animals combined, used by ethnic communities was reported by Lalramnghinglova and Jha (1997). Detailed accounts of 231 plant species of ethnobotanical importance have been documented by Lalramnghinglova (1998). Other noted studies include *Non-Wood Forest Products in Mizoram by* Thapa *et al.* (2000); *Trade and marketing of non-timber forest products in North-East India* by Sahoo *et al.* (2006); *Market survey of edible bamboo species in Mizoram* published by Jha *et al.,* 2000. A total 89 plant species belonging to 57 families and 83 genera were found to have on use for curing more than 35 ailments in Dampa Tiger Reserve in Mizoram by Sahoo *et al.* (2010b). Sahoo *et al.* (2010c) documented the role of NTFPs in the livelihood of communities in and around Dampa Tiger Reserve in North-East India. The flora of Mizoram by Singh *et al.,* (2002) have been consulted.

Mizoram which has diverse forest types ranging from evergreen, semi-evergreen, tropical, bamboo forests harbours a number of important medicinal plants. Traditional uses of herbal medicines among the tribal people living in and around these diverse forest types are in use in the state since time immemorial. The knowledge on the use of folklore medicine passed through generations and oral folklores have been in great help for curing different ailments, particularly among the villagers. The sub-tribes, such as, Bru and Chakma in the western low belts of Mizoram, the Maras in the interior south-end, and the Hmar and Paite in the north-east corner of Mizoram have been traditionally using the herbal medicines for various medicare. There are common areas in which the same species of medicinal plants are used for the same kind of diseases, notwithstanding certain differences in the preparation and application. The Brus and Tlanglaus have their own classification of medicinal plants into ranks, ***viz***. Major-rank, Captain-rank, Adjutant-rank and constables. The major-ranks alone can cure certain diseases without the help of other lower ranks. But effective remedy is achieved with admixture of different ranks for different diseases. The medicinal plants are found mostly in evergreen and semi-evergreen forests, but the abundance or distribution is quite varied from one location to the other. They are mainly confined to the natural forest clads and sanctuaries when they are conserved. Many varieties have been lost due to the manual slash and burn agriculture or jhuming in the state and many must be have extinct due to human activities and fire (Lalramnghinglova and Jha, 1997).

Notwithstanding, Non- Timber Forest Products (NTFPs) have enormous potential in the state of Mizoram (Lalremruata *et al.,* 2007). The hilly topographic nature of the state together with high rainfall and humidity favor the luxuriant growth of many NTFPs such as Bamboo poles, Bamboo shoots, Canes,

Orchids and medicinal plants. In the forests, bamboos predominant and the orchids are abundantly available. A good number of medicinal plants also grow in the forests and considerable varieties of canes have their natural abode in these natural forest areas of evergreen and mixed deciduous forests. The age-old practice of shifting cultivation or 'jhuming' is the single major factor for large scale depletion of natural forest cover in Mizoram affecting many species of orchids, medicinal plants, bamboos and canes. Bamboos are however, the least affected as culms/sprouts are coming out annually from the rhizome remaining underground and somehow restored the same status as before in areas where they are undisturbed. Other species are badly affected to the extent of extinction. Through proper management, this will not only enhanced the state's exchequer but can easily be a source of livelihood for many rural families (Lalramnghinglova and Jha, 1997).

A bird eye view of literature reveals that although a lot of work on various aspects of NTFPs has been carried out in greater details elsewhere, very little work has been undertaken in Mizoram. Therefore the proposed study seeks to inventorise NTFPs diversity, their occurrence, and use pattern for different tribes which may provide clues to better economic and employment opportunities for the rural poor of Mizoram.

CHAPTER – 3

STUDY AREA

3.1. General introduction to Mizoram

Location:

Mizoram is situated between 21°58’ north to 24°35’ north latitude and 91°15’ east to 93°29’ east longitude covering an area of 21,081 sq.km. The tropic of cancer passes just through the southern periphery of Aizawl Town at 23° 30’ N latitude (Anonymous, 1996). The length of the state from north to south is 277 km and the width from east to west is 121 km. Mizoram is flanked by Manipur state and Cachar District of Assam in the north, Chin Hills of Myanmar in the east, Chittagong Hills of Bangladesh and Tripura state in the west and on the south Arakan Hill ranges of Myanmar. Mizoram shares its borders over a stretch of 123 km with Assam, 66 km with Tripura and 95 km with Manipur. The international border with Bangladesh extends over 318 km and over 404 km with Myanmar (Anonymous, 1996).

Climate:

Mizoram enjoys moderate climate. In the lower altitude at foot hills and the valleys, typical tropical climate is obtained while in the mid region with large expanse, the subtropical moist climate is experienced. A special feature of the climate here is the occurrence of North-westerly thunderstorms, sweeping over-the hills in entire state with heavy downpour during April and May being very common.

Temperature varies from about 11° C in winter to 30° C in summer or spring. Winter or cold season starts from November to February with temperature ranging between 8° C and 20° C. The season is pleasant, dry and refreshing during morning and evening hours usually with no rain or very little rain. Winter is followed by warm or spring season, starting from March and continuing upto May with temperatures ranging between 19° C and 30o C. Occasional -rainfall occurs and sky is not clear. The rainy or summer season lasts for a longer period and heavy rainfall comes during June to August which covers 89 per cent of the total annual rainfall. September and October are the autumn months when rains cease and temperature is usually between 19° C and 25° C.

During winter, the remote, high altitude places of Champhai region, like Zote and Ngur in the East, and Bualpui and Phawngpui or Phawngpuitlang (Blue mountain) in the South, experience low temperature, while maximum temperature during summer season is experienced at Kanhmun, Lokicherra and Bairabi in the North-western part of Mizoram, Demagiri and Chawngte in the western side and Tuipang area in the southern region.

The state receives annual rainfall between 2000 - 3600 mm from both North-east and South-west monsoons. The North-western part of the state (Longai, Tut and Dhaleshwari region) gets maximum rainfall of over 3500 mm annually. The southern part of Mizoram, including Lunglei area also gets higher rainfall of over 2500 mm. The high rainfall with moist climate is conducive for the vigorous growth of varied types of vegetation.

Rainfall:

The entire state of Mizoram is under the direct influence of maritime tropical airmass brought in by South-West monsoon. The rainy season lasts from

May to October with an average rainfall of 2500 mm per annum. July and August are the rainiest months, whereas December and January are the driest months of the year with almost no rainfall.

Humidity is relatively high nearly all the year round. The relative humidity is highest during monsoon rains. It is above 90%. The period from January to April is comparatively dry, whereas the relative humidity remains between 60 and 70% (Pachuau, 1994).

Soil:

The soils of Mizoram in general are young, immature and moderate to highly acidic. The contents of potash and phosphorus are low, whereas the content of nitrogen is high, due to the accumulation of organic matter in the uneroded soils. The soils are generally fertile and responsive to the vigorous growth of vegetation as well as arable crops.

Soils of Mizoram are categorized into three orders :(i) Entisols, (ii) Inceptisols, and (iii) Ultisols (USDA, 1988) followed by Hrahsel (1988), Singh & Datta (1989), Pachuau (1994) and Saithantluanga (1997).

According to Kumar (1997), the soils of Mizoram are broadly classified into Alluvial and Residual soils. The alluvial soils usually occur in the foothills of the north and west and in the intermontane plains, and valleys, dominated by coarse sand. Residual soils which are further classified as lateritic, brown earth and podzolic occur in most parts of the State on steep slopes.

The soils of Mizoram are essentially derived from sedimentary rocks belonging to Barail, Surma and Tipam Groups of Miocene to Pleistocene periods (Kumar, 1997) or the product of slow dia-genetic changes of the parent materials

comprising mica schist, ferrugenous sandstone and shales giving the inherent acidic character (Saithantluanga, 1997).

Topography:

The slope gradients are very steep, and they leave only 59,197 ha of land arable for W.R.C. (Wet Rice Cultivation) which is 2.80% of the total geographical area of 21,081 km^2 (Anonymous, 1997).

The entire territory is mostly mountainous and hilly with precipitous slopes forming deep gorges culminating into several streams and rivers. Almost all the hill ranges traverse in the north-south direction. The average height of the hills is about 920 meters. The highest peak in Mizoram is the Blue Mountain (Phawngpui) with a height of 2,220m above mean sea level whereas the lowest spot lies at Bairabi with 40 meters above the mean sea level. In the lowest altitude at foothills and valleys, typical tropical forest is obtained, while in mid-region with large expanse, the sub-tropical moist climate prevails and in the upper reaches temperate climate is experienced.

The major rivers in Mizoram flow either in northernly or southernly direction. The lengths of some of the major rivers are. : *Tlawng* 185.15 km; *Tiau* 159.39 km, *Chhimtuipui* (Kolodyne) 138.46 km; *Khawthlangtuipui* 128.08 km; *Tuichang* 120.75 km, *Mat* 90.16 km and *Tuipui* 86.94 km (Anonymous, 1992, 1996).

3.2. Description of northern Mizoram:

Northern Mizoram covered four districts which were Aizawl district, Mamit district, Champhai district and kolasib district. The total geographical area covered are 11,168 Sq.km which is 52.98% of the total geographical area of the

state. Northern Mizoram lies between 23°5'N and 24°5'N latitude and 92°30' E and 93°5' E longitude with altitudinal variations between 35 meters to 1896 meters above sea level. The maximum and minimum temperatures ranges between 11°C to 21°C in winter and 19° C to 35°C during summer season. The studied area enjoys a warm and wet summer and dry cool winter throughout the year. Extreme heat or cold is not felt throughout the year. Rainfall is quite abundant and the rainy season lasts over 5 months in a year. The major farming system is shifting cultivation. The people mainly depend upon farming for their livelihood.

According to Statistical Handbook of Mizoram (2010), Anonymous (2009), Anonymous (2010), Forest Survey of India (2009) and Sahu (2011) the following are some facts about the four districts covered under the present study:

Aizawl district:

Aizawl district covers 3,576 Sq.km inhibiting 78,606 households with 4,04,054 (2,01,072 – male and 2,02,982 – female) population. Population density per Sq.meter is 113. The Literacy Rate is 98.50 %. No. of inhabited villages is 97 with 4 no. of towns. The total forest cover is 3,323 Sq.km which is 92.95 % of the total geographical area of the district. Out of the forest covers, 32 Sq.km is covered with very dense forest; 1,013 Sq.km with moderate dense forest and 2,278 Sq.km with open forest.

Champhai district:

Champhai district covers 3,185 Sq.km inhibiting 23,787 households with 1,25,370 (63,299 – male and 62,071 – female) population. Population density per Sq.meter is 39. The Literacy Rate is 93.51 %. No. of inhabited

villages is 84 with 4 no. of towns. The total forest cover is 2,757 Sq.km which is 86.56 % of the total geographical area of the district. Out of the forest covers, 58 Sq.km is covered with very dense forest; 1,180 Sq.km with moderate dense forest and 1,519 Sq.km with open forest.

Mamit district:

Mamit District covers 3,025 Sq.km inhibiting 16,142 households with 85,757 (44,567 – male and 41,190 – female) population. Population density per Sq.meter is 28. The Literacy Rate is 85.96%. No. of inhabited villages is 87 with 3 no. of towns. The total forest cover is 2,746 Sq.km which is 90.78 % of the total geographical area of the district. Out of the forest covers, 41 Sq.km is covered with very dense forest; 1,568 Sq.km with moderate dense forest and 2,137 Sq.km with open forest.

Kolasib district:

Kolasib district covers 1,382 Sq.km inhibiting 16,183 households with 83,054 (42,456 – male and 40,598 – female) population. Population density per Sq.meter is 60. The Literacy Rate is 94.54 %. No. of inhabited villages is 39 with 4 no. of towns. The total forest cover is 1,300 Sq.km which is 94.07 % of the total geographical area of the district. Out of the forest covers, 210 Sq.km with moderate dense forest and 1, 090 Sq.km with open forest.

3.3. Status of forest and forest types in Mizoram:

Forests and forestry constitute dominant feature of the State's landscape, economy and environment. According to the Forest Survey of India, State of Forest Report 2009, out of 21,081 Sq.km of the total geographical area of

the State, 91.27 % is covered by forests. But due to the age-old traditional practice of shifting cultivation, uncontrolled fire, unregulated felling and land allotment to individuals, two-third of the area has already been degraded. Such depleted and partly degraded forest could not meet the growing demands of timber and other forest produce in the state.

It cannot provide a safeguard to the ecological functions like protection of soil and land, maintenance of agricultural productivity and protection of catchments. Contribution of forestry sector to the state's economy and well-being of the people is very high and significant. In terms of economic value of goods (***i.e.*** timber, fuelwood, etc.) and service (income and employment) contribution of forestry sector is estimated at ` 100 crore per year.

The forest cover of the State, based on satellite data of 2007 assessment is 19, 240 Sq.km, which is 91.27% of the geographic area. Very dense forest is 134 Sq.km, moderately dense forest, 6,251 Sq.km, and open forest, 12,855 Sq.km. An increase of 640 Sq.km of forest cover has been assessed in the present assessment as compared to the previous assessment based on satellite data of 2005 assessment (SFR, 2009).

Increase in forest cover is mainly due to re-growth in shifting cultivation areas in all the districts. The losses reported in the forest cover in the district of Aizawl, Mamit, Kolasib, Champhai and Serchhip are due to bamboo flowering as observed by FSI officials during field verification and also corroborated by the State Forest Department.

Based on Champion and Seth (1968), Negi (1989) and Subramanian and Sasidharan (1996), Lalramnghinglova (2003) classified the forests of Mizoram as follows:

(a) Tropical Wet Evergreen Forests (up to 900 m);

(b) Tropical Semi-Evergreen Forests (900-1200 m);

(c) Sub-tropical Hill Forests (200 - 1600 m);

(d) East Himalayan Temperate Forests (1600 – 2200 m)

The common timber trees in each forest type and some economically important plants species are given below:

(a) Tropical Wet Evergreen Forests

The common important tree species with local names are given in parentheses: *Dipterocarpus turbinatus* Gaertn. f. (Lawngthing); *D. retusa* HI. (Thingsen); *Terminalia myriocarpa* Heurek & Muell.-Arg. (Char); *T. chebula* Retz. (Reraw); *T.bellirica* (Gaertn.) Roxb. (Thingvandawt); *Aphanamixis wallichii* (King) Haridasan & Rao (Sahatah); *Michelia champaca* I.inn. (Ngiau); *Haldina cordifolia* (Roxb). Rids. (Lungkhup); *Mitragyna rotundiifolia* (Roxb.) O.Ktz.(Lungkhup); *Lagerstroemia speciosa* (L.) Pers.(Thlado); *Chukrassia tabularis* A. Juss. (Zawngtei); *Artocarpus chama* Buch-Ham. (Tatkawng); *Bombax ceiba* L. (Phunchawng); *B.insigne* Wall. (Pang); B*ischofia javanica* Bl. (Khuangthli); *Duabanga grandiflora* (Roxb.ex DC.) Walp (Zuang); *Toona ciliata* M. Roem. (Teipui); *Dillenia indica* L. (Knwrthindeng); *Calophyllum polyanthum* Choisy (Sentezel); *Podocarpus neriifolia* D.Don. (Tufar, Thlangfar); *Stereospermum colais* (Dillow). Mabb. (Zinghal); *Knema linifolia* (Roxb.) Warb. (Thingthi); *Garcinia* spp. (Chengkek, Vawmva); *Gmelina arborea* Roxb. (Thlanvawng); *Gynocardia ordorata* R.Br. (Saithei); *Hydnocarpus kurzii* (King.) Warb. (Khawitur); *Baccaurea ramniflora* Lour. (Pangkai) etc.

Of cane species, *Calmus* spp. (Hruipui, Hruizik); *Zalaca baccarii* HK. I. (Thilthek); *Plectocarpia khasiana* Griff. (Mawt), etc are common. Of palms, *Barassus flabellifera* L. (Siallu); *Licuala peltata* Roxb. (Laisua) and *Typha*

elephantiana Roxb. (Sakuhlakhuih) are very common. *Melocanna baccifera* (Roxb). Kurz. (Mautak) is predominant over the species of *Dendrocalamus longispathus* Kurz. (Rawnal); *Bambus tulda* Roxb.

A moderately slope gradient secondary forest are being utilized for large-scale plantations of the most valuable timber species, *Tectonia grandis* L. (Teak/Tlawr).

(b) Tropical Semi-Evergreen Forests

This type of forest covers the central biogeographic zone and the coverage is approximately 50% of the total geographical area.

The common important tree species are : *Gmelina arborea* Roxb. (Thlanvawng); *Phoebe attenuata* Nees. (Bulbawr); *Persia petiolaris* (Hook.f.) Deb. (Bulpui); Syzygium cumini (L.) Skeels (Hmuipui); *S. fructicosum* DC. (Hmuichawl); *Albizia chinensis* (Osb.) Merr. (Vang); *A. odoratissima* (L.F.) benth. (Kangtekpa); *A. procera* (Roxb.) Benth. (Kangteknu); *A. thompsonii* Brandis (Thingri chi khat); *Sapium baccatum* Roxb. (Thingvawkpui); *S. eugeniaefolium* Ham.ex Hook.f. (Thingvawkpuipa); *Schima wallichii* (DC.) Korth. (Khiang); *Pterospermum acerifolium* Wild. (Siksil); *Castanopsis tribulodies* (Sm). DC. var. *typica* King (Thingsia); *Cassia javanica* L. ssp. *nodosa* (Buch Ham.ex Roxb.) K.&S. Larsen (Makpazangkang); *Chisocheton paniculatus* (Roxb.) Hiern. (Sahatahpui); *Carallia brachiata* (Lour.) Merr. (Theiria); *Styrax polyspermum* Cl. (Theipalingkawh); *Alstonia scholaris* (L.) R.Br. (Thuamriat); *Erythriana stricta* Roxb. (Fartuah/Tuahpui); *Firmiana colorata* (Roxb.) R.Br. (Khaukhim); *Neolamarckia cadamba* (Roxb.) Bossue (Banphar); *Eurya acuminata* DC. (Sihneh); *Ficus* spp. (Theipui/Hmawng chi); *Dillenia pentagyna* Roxb. (Kaizawl/Kawmkaw); *Emblica officinalis* Gaertn. (Sunhlu); *Quercus*

semiserrrata Roxb. (Sehawrvar); *Litsea* spp. (Nauthak); *Mesua farrae* L. (Herhse); *Cinnamomum* spp. (Thakthing chi) etc.

Major bamboo species have been reported by Lalramnghinglova and Jha (1995); Lalramnghinglova (1997) in which *Melocanna baccifera* (Roxb.) Kurz. is predominant. *Dendrocalmus* spp. are common, whereas *Neohonzeaua dullooa* (Gamble) Camus (Rawthla) and *Pseudostachyum polymorphum* Munro (Chal/Chalte) are rare species.

Among the palm species, *Pandanus odoratissimus* (Lamk.) L. (Ramlakhuihthei); *Caryota mitis* Lour. (Meihle); *C.urens* L. (Turn); *Arenga saccharifera* Labill (Thangtung); *Wallichia densiflora* Mart. (Tawlhpahrit) and *W.disticha* T. Anders (Lem) are present in small populations. Cane population is gradually decreasing, whereas epiphytic orchid population is emerging towards the eastern higher altitude above 1200 m asl.

(c) Sub-Tropical Hill forests

This type of forests come under the major group Montane Sub-tropical Forests (Subramanian and Sasidharan, 1996) or Sub-tropical Broadleaved Hill Forests (Negi, 1989) in the eastern fringes bordering Myanmar and approximately extending from 1500-2158 m asl. The area constitutes about 24% of the total geographical area. It has a sub-temperate climate and the temperature varies from 9° C to 25°C.

The forests are characterized by *Rhododendron arboreum* Sm. (Chhawkhlei); *Myrica esculenta* Buch.Ham. ex D.Don (Keifang); *Engelhardtia spicta* Leschn. ex Blume (Hnum); *Pinus kesiya* Royle ex Gordon. (Far); *Lithocarpus dealbata* (Miq.) Render. (Fah*); Quercus griffithii* Hk.f. & Th. ex DC (Sasawthing); *Quercus serrata* Thumb. (Sehawrdum) etc.

Arundinaria callosa Munro (Phar); *Chimonobambusa khasiana* (Munro) Nakai (Lik); *Dendrocalamus sikkimensis* Gamble (Rawmi) and *D. giganteus* Munro (Rawpui) are the characteristic bamboo species. *Melocalamus compactiflorus* Benth. (Sairil) are also present, whereas distribution of *Melocanna baccifera* (Roxb.) Kurz is restricted to the forests. *Trachycarpus martiana* H. Wendl. (Siallute) and few *Cycads* are also present.

This forest type is the natural abode of epiphytic orchids like *Renanthera inschootiana* Rolfe (Senhri); *Vanda coerulae* Griff ex Linda, (Lawhleng); *Mantisia saltoria* and *M.wengerii* Fischer (Ruala, 1985; Singh *et al.,* 1990).

3.4. The study sites:

To study Non-Timber Forest Products (NTFPs) of plant origin and livelihood strategies in northern Mizoram, eight different forest ranges covering four districts were selected based on the community tribes inhibiting different localities in northern Mizoram (**Figure 1**). The community consists of Mizo, Hmar, Chakma, Bawm and Riang (Bru) in the selected study Area (**Figure 3**). There were altogether 4210 households inhabiting 34,993 populations in the study area.

In **Site 1**, three villages, namely, Hnahlan, Vapar and Ngur (Champhai district)) were covered which consists of 4751 population with 851 households. In the study site, there are 420 persons engaged in full time exploiter and 4331 people's part time exploiter of NTFPs. The main forest type in this area is sub-broadleaved hill forests. The inhabitants of the studied area were Mizos.

In **Site 2**, there are two villages, namely, Kawlbem and Ngopa (Champhai district) which consists of 7177 population with 1013 total households. In this area, there are 700 persons engaged in full time and 6477

persons engaged in part time exploiter of NTFPs. The main forest type in this area is sub broadleaved hill forests. The main inhabitants are Mizos and Bawms.

In **Site 3**, there are 3 villages, namely, Bairabi, Meidum and Suarhliap (Kolasib district) which consists of 3745 population with 580 total households. In this site, 300 persons full time exploiter of NTFPs and 3445 people's part time exploiter of NTFPs make available the local needs on various products. The main forest type in this area is tropical evergreen forests. The inhabitants of the studied area are Mizos and Riangs (Brus).

In **Site 4**, two villages, namely, Phullen and Phuaibuang (Aizawl district) which consists of 1650 population with 275 total households. In the site, 148 persons engaged in fulltime and 1502 persons part time exploiter of NTFPs. The main forest type in this area is sub-tropical broadleaved hill forests. The inhabitants of the studied area were the common Mizo people and Hmar community.

In **Site 5**, there are three villages, namely Farkawn, Chawngtui and Vaphai (Champhai district) which consists of 5573 population with 446 total households. In this site, 613 persons full time and 4960 persons part time exploiter of NTFPs were found present. This area is located somewhat at a higher elevation in comparison to other sites and is at an altitudinal variation between 1302 - 1733 meters. The main forest type in this area is sub-tropical broadleaved hill forests. The inhabitants were mainly Mizos, the dominant people.

In **Site 6**, six villages, namely Lallen, Saithah, Phuldungsei, Phulpui, Marpara and W. Phaileng (Mamit district) which consists of 7283 population with 1185 households. In the study site, there are 1520 persons engaged in full time exploiter and 7500 persons part time exploiter of NTFPs. The main forest type in

this area is tropical wet evergreen forests. The inhabitants of the studied area are Mizos and Riangs (Brus).

In **Site 7**, there are four villages, namely Kawrthah, Zamuang, Darlak and Tumpanglui (Mamit district) which consists of 3271 population with 658 total households. In this site, 550 persons full time exploiter of NTFPs and 2721 persons part time exploiter of NTFPs make available the local needs on various products. The main forest type in this area is tropical wet evergreen forests. The inhabitants of the studied area were Mizos and Riangs (Brus).

In **Site 8**, two villages, namely N.Hlimen and Bukpui (Kolasib district) which consists of 1543 population with 450 total households. In the site, 220 persons engaged in fulltime and 1323 persons part time exploiter of NTFPs. The main forest type in this area is tropical wet evergreen forests. The inhabitants of the studied area were Mizos and Riangs (Brus).

Study sites are shown in **Figure 2**.

3.5. Socio-economic Profile:

A total of 25 villages were surveyed covering 8 (eight) sites of northern Mizoram (**Table 1**). These included **Site 1** (Hnahlan, Vapar and Ngur); **Site 2** (Kawlbem And Ngopa) ; **Site 3** (Bairabi, Meidum and Suarhliap); **Site 4** (Phullen and Phuaibuang); **Site 5** (Farkawn, Chawngtui and Vaphai); **Site 6** (Lallen, Saithah, Phuldungsei, Phulpui, Marpara and W. Phaileng); **Site 7** (Kawrthah, Zamuang, Darlak and Tumpanglui); **Site 8** (N.Hlimen and Bukpui). It was found that **Site 2** had highest number of household (1013) followed by **Site 1** (851), **Site 3** (580), **Site 6** (540), **Site 5** (446), **Site 7** (315) and **Site 4** (275) while **Site 8** had the least household with 190. From the table, it is observed that **Site 6** had highest population (7283) followed by **Site 2** (7177), **Site 5** (5573), **Site 1**

(4751), **Site 3** (3745), **Site 7** (3271), **Site 4** (1650), while **Site 8** had the least population with 1543.

As far as the farming system was concerned, majority of people depends on shifting cultivation. The sites were varied widely on the basis of altitudinal zone. **Site 3**, **Site 7** and **Site 8** were somewhat at lower elevation compared to other sites. **Site 1, Site 2, Site 4, Site 5** and **Site 6** situated at a higher elevation as compared to that of the other sites. As of the forest types, **Site 1, Site 2, Site 4** and **Site 5** belongs to the Sub-tropical broadleaved hill forest; **Site 3** belongs to tropical evergreen forest; **Site 6** and **Site 7** belongs to tropical wet-evergreen forest and **Site 8** belongs to tropical semi-evergreen forest.

A majority of the population depends on NTFPs. Out of the total population (34993), 4471 ***i.e.***, 12.78% were full time exploiter and 30622 ***i.e.***, 87.22% were part time exploiter. **Site 6** had maximum number of NTFPs exploiter while **Site 4** had minimum number of NTFPs exploiter. The community consists of Mizo, Hmar, Paihte, Chakma, Bawm and Riang (Bru) in the selected study sites.

Socio economics condition of the people living in the study area are shown in the **Table 1**.

Table 1: Socio-economic profile of study sites

Characteristics	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Location	Hnahlan Forest range	Ngopa Forest range	Bairabi Forest range	Phullen Forest range	Farkawn Forest range	Phuldungsei Forest range	Kawrthah Forest range	N. Hlimen Forest range
Latitude	23º 43’ N	23º 52' N	24º 13’ N	23º 49’ N	23º 5’ N	$23^0$30’ N	$23^0$55’ N	$24^0$5’N
Longitude	93º 25’ E	93º 13' E	92º 34’ E	93º 5’ E	93º 20’ E	$92^0$30’ E	$92^0$30’ E	$92^0$47’E
Altitude	1576– 1896m	1127 – 1504m	36 – 1712m	1243 – 1397m	1302 – 1733m	900 – 1009 m	35 – 698 m	350-1600 m
Total household (no.)	851	1013	580	275	446	540	315	190
Villages surveyed (no.)	3	2	3	2	3	6	4	2
Name of the villages surveyed	1. Hnahlan 2. Vapar 3. Ngur	1. Kawlbem 2. Ngopa	1. Bairabi 2. Meidum 3. Suarhliap	1. Phullen 2. Phuaibuang	1. Farkawn 2. Chawngtui 3. Vaphai	1. Lallen 2. Saithah 3. Phuldungsei 4. Phulpui 5. Marpara 6. W.Phaileng	1. Kawrthah 2. Zamuang 3. Darlak 4. Tumpanglui	1. N. Hlimen 2. Bukpui
Population (no.)	4751	7177	3745	1650	5573	7283	3271	1543
Male	2154	3433	1825	710	2731	3753	1635	833
Female	2597	3744	1920	940	2842	3530	1636	760
Full time exploiter of NTFP	420	700	300	148	613	1520	550	220
Part time exploiter of NTFP	4331	6477	3445	1502	4960	5863	2721	1323
Major farming system	Shifting cultivation	Shifting cultivation	Shifting cultivation	Shifting cultivation	Shifting cultivation	Shifting cultivation	Shifting cultivation	Shifting cultivation
Forest type	Sub-tropical broadleaved hill forest	Sub-tropical broadleaved hill forest	Tropical evergreen forest	Sub-tropical broadleaved hill forest	Sub-tropical broadleaved hill forest	Tropical wet evergreen forest	Tropical wet evergreen forest	Tropical semi-evergreen forest
Major ethnic group	Mizo	Mizo and Paihte	Mizo and Riang (Bru)	Mizo and Hmar	Mizo and Paihte	Mizo and Riang (Bru)	Mizo and Riang (Bru)	Mizo and Riang (Bru)

* Site 1 - Hnahlan Forest Site; Site 2 - Ngopa Forest Site; Site - 3 Bairabi Forest Site a; Site 4 - Phullen Forest Site; Site 5 – Farkawn Forest Site; Site 6 – Phuldungsei Forest Site; Site 7 – Kawrthah Forest Site; Site 8 – N. Hlimen Forest Site

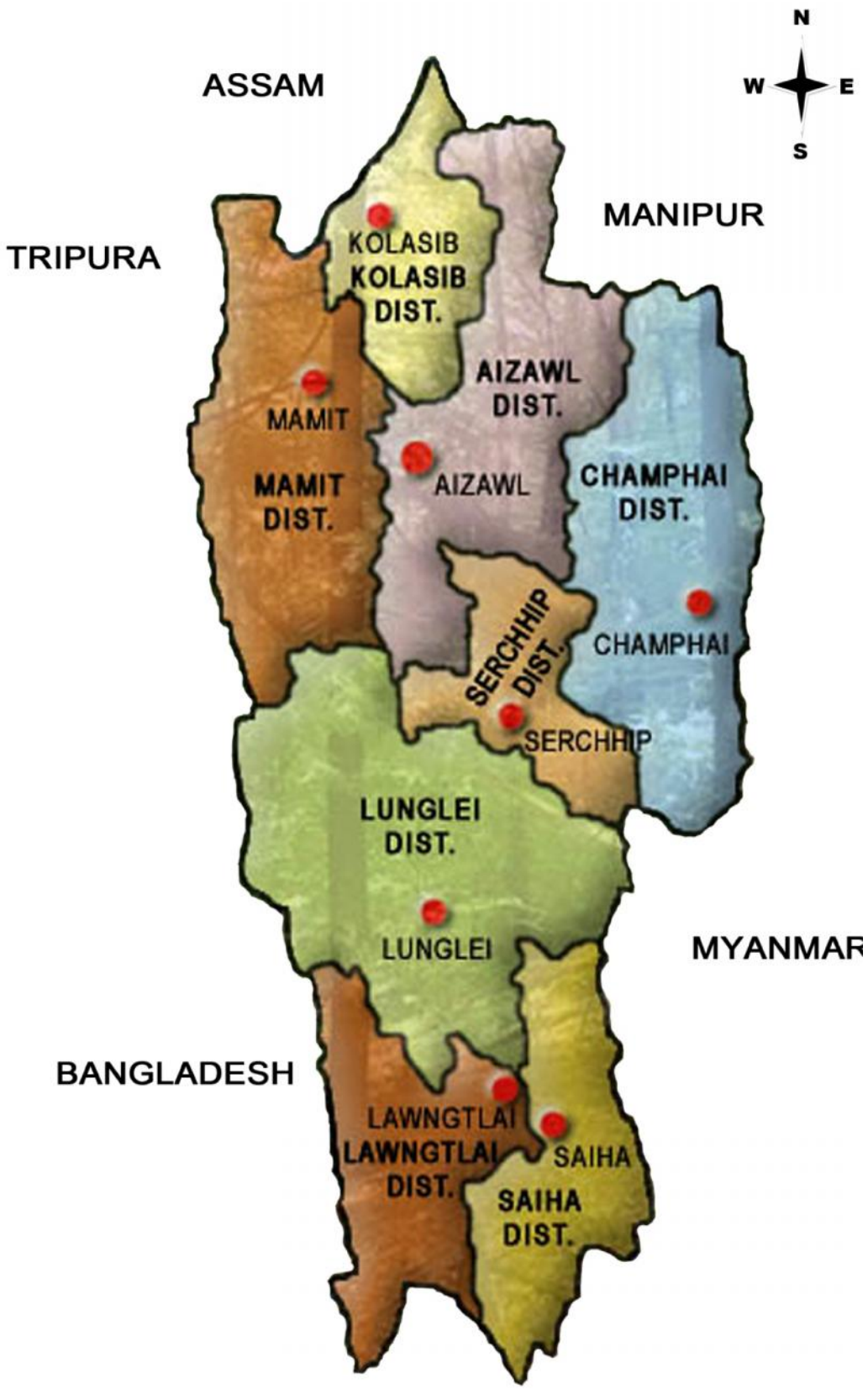


Figure 1: Mizoram Map showing different districts and boundaries.

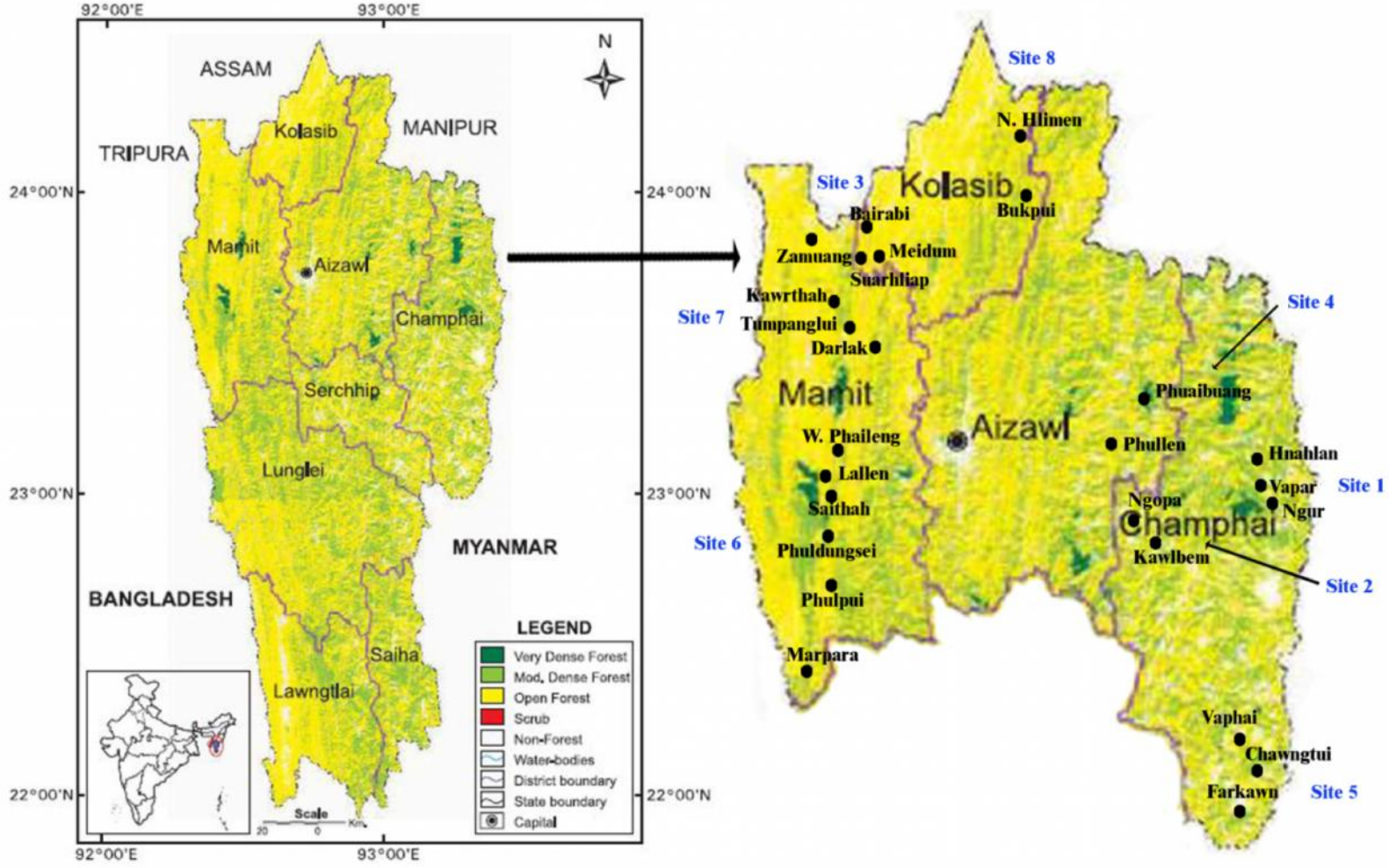


Figure 2: Map showing the study sites

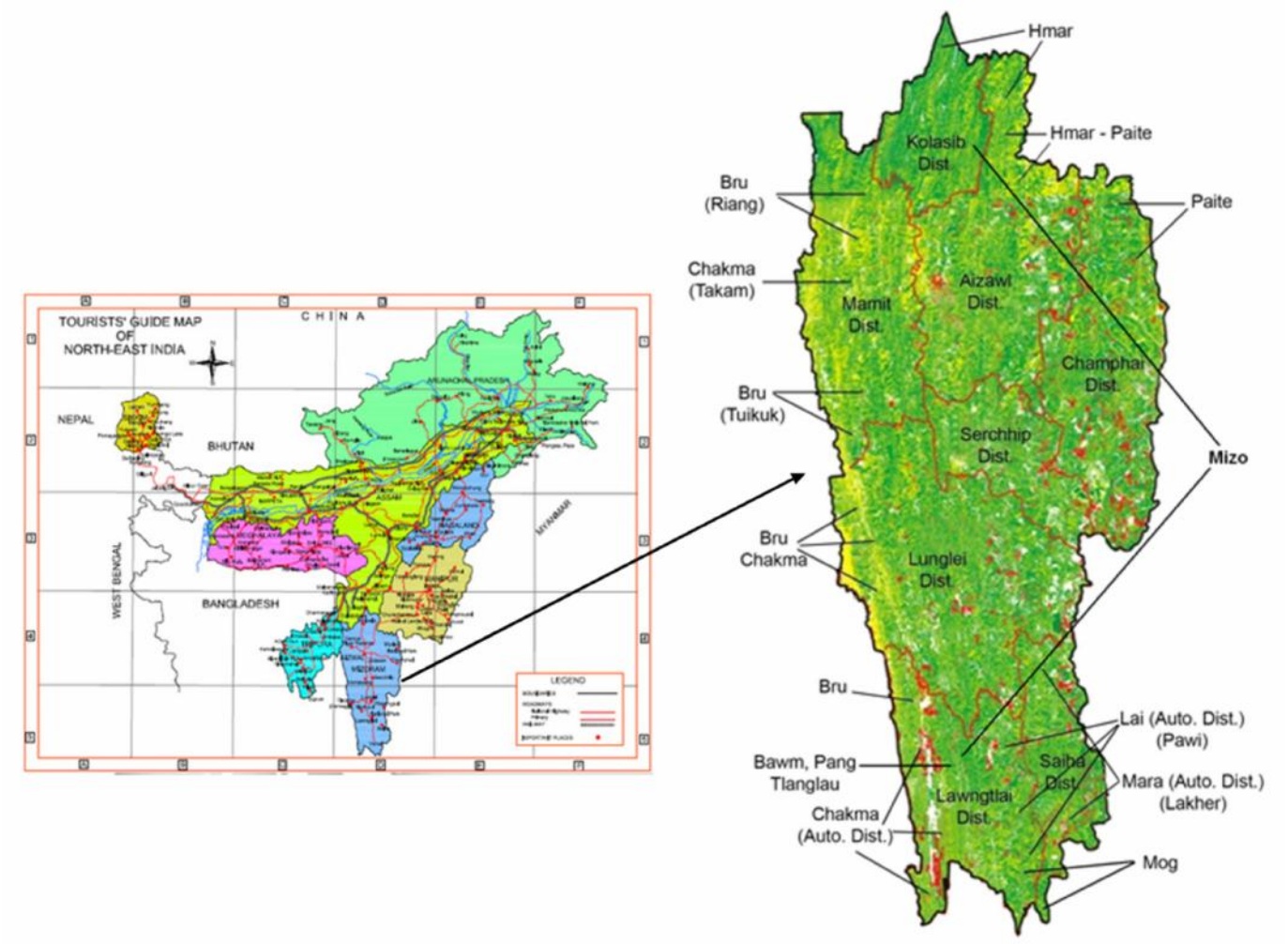


Figure 3: Map showing different ethnic communities

CHAPTER – 4

METHODOLOGY

4.1. Socio-economic / household characters:

The Socio-economic profiles of the villages around the studied forest area were carried out using a semi-structured questionnaire. For the purpose, about 10% of the households in each selected village under a particular forest range were randomly chosen and included for the survey.

Household characters such as family size, educational background, literacy rate, sex ratio, income, sources of income (from agriculture, NTFPs, job sector etc.), access to nearby forest, infrastructure, road, communication, availability of market, knowledge of market system were recorded from the survey.

4.2. Inventory in NTFP diversity:

4.2.1. Participatory Rural Appraisal (PRA) exercises:

In every village, to get first vast information on the NTFP resources, their relative importance to the villagers, infrastructure, market linkages etc., a PRA exercise using resource mapping, matrix ranking were carried out during 2007. For the purpose, 2 – 3 groups of volunteers about 6-7 in number in each group was requested to develop resource mapping. In order to verify the information provided by the group, a forest walk was also carried out with the groups.

4.2.2. Field sampling:

In each surveyed forest located adjacent to the selected eight forest ranges, about 2 km forest area was selected for NTFPs inventory. About 5 100m X 100m transects were laid after every 200m apart. In this transects, 5 randomly quadrats of 10m X 10m were selected for trees of NTFP importance; 5 quadrats of 5m X 5m for shrubs and 10 quadrats of 1m X 1m for herbs, ferns, epiphytes, climbers and grass species.

Density, frequency, abundance and IVI of different component species which are of NTFP importance were calculated as per the following formulae:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all the sample plots}}{\text{Total Number of sample plots study}}$$

$$\text{Relative Density} = \frac{\text{Total number of individuals of a species}}{\text{Total Number of individuals of all species}} \times 100$$

$$\text{Frequency} = \frac{\text{Total number of quadrats in which the species occur}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Number of occurrence of a species}}{\text{Number of occurrence of all species}} \times 100$$

$$\text{Abundance} = \frac{\text{Total number of individuals of the species in all quadrats}}{\text{Total number of quadrats in which the species occurred}}$$

$$\text{Basal area} = \frac{\text{Total basal area}}{\text{Number of trees}}$$

$$\text{Relative dominance} = \frac{\text{Total basal area of the species in all the quadrats}}{\text{Total basal area of all the species in all the quadrats}} \times 100$$

IVI = Relative Frequency + Relative Density + Relative Dominance.

The species which were not identified in the study sites were brought to the Department and got identified with the help of herbaria.

4.2.3. Ethnobotanical survey:

About 15 detailed ethno-botanical surveys were carried out during 2007 – 2010 to different forest ranges. During each survey, the following methods were adopted:

- Group discussion with villagers
- Discussion with village headmen, knowledge persons, herbal practitioners. Details pertaining to plant use, method of preparation, dose of administration, frequency and time of administartion, precautions to be taken care etc. were collected, after a formal trust building measure.
- Forest transect walk with some villagers
- Secondary source of information like 'Micro-plan' prepared by the Village Forest Development Committee (VFDC), recorded data from NGOs and herbal practitioners, elderly persons etc.

All the plant specimens collected from the field during each ethnobotanical survey were identified using voucher specimen available with the Department of Environmental Science, Mizoram University and in cases, where it was not possible to identify, these species were sent to BSI, Shillong / Kolkata for identification. All the species identified have been kept in the University for

future reference. For ethnobotanical inquiry, Jain and Rao (1977) and Martin (1995) were followed.

4.2.4. Market survey:

A thorough survey on local markets adjacent to each forest village or markets that are available within a particular forest range / circle was carried out during every visit in order to verify the availability of any new NTFPs arriving in the market. The objectives of this exercise was to cross check / verify if any NTFPs that are collected and sold in the market are missed during field inventory. The market survey was conducted so as to know if new products of plant origin were available across different seasons.

4.3. Consumption pattern of fuelwood (per capita and seasonal):

10 households randomly selected from each village were considered for a fuelwood consumption study. The study commenced in March 2007 and was completed in September 2010. The estimation of fuelwood requirement / consumption by each sample household was worked out on the basis of personal observation over a period of 24 hours by adopting a weight survey method. During the survey, each sample households were visited and requested the head person of the family to monitor the amount of fuelwood that would be burned during the particular day. The wood was weighed by a spring balance and then left in the Kitchen (a 25kg wood bundle) of each household with instructions to burn only wood from the bundle. On the next day, each household were visited again and the remaining wood was again weighed and deducted from the original bundle to calculate the actual consumption per day. Time spent for collection of

fuelwood was noted when the members of the family / household went to the forests.

The daily consumption in each forest site is calculated by multiplying the quantity consumed by each household with the number of household utilizing the species as shown below:

$D_c = A_{dc} \times hh$

Where:

D_c = Daily consumption

A_{dc} = Average daily consumption

hh = Total no. of household

The annual per capita fuel wood consumption was evaluated by knowing:

- the average number of days one household goes with single bundle of firewood;
- the total population within a settlement; the average weight of a single bundle of firewood and
- the total number of household in a settlement .

The per capita fuel wood figure was determined with the help of the formula below (Nibbering *et al.*, 1980).

$$P_{cap} = \frac{365days \ x \ hh \ x \ Wt.b}{Db \ x \ Tpop}$$

Where:

Pcap = per capita use (tonnes/cap/year)

hh = number of households using fire wood

Wt.b = weight of one bundle of firewood

Db = average number of days one household goes with one bundle

Tpop = total number of people in the settlement

4.4. Preference of fuelwood according to matrix ranking through PRA exercise:

An evaluation of people's preference ranking for fuelwood was conducted using pairwise ranking tool for Participatory Rural Appraisal (PRA) following the methods described in Jain and Rao (1977). This exercise was carried out with a group of 10-15 local individuals in each village. A matrix table was drawn up with each group listing the most widely used firewood species along both horizontal and vertical axes. This matrix was used to compare species preference with group members, asked to give reason why they prefer one species over the others. Discussion on each pairwise species comparison continued until a consensus was reached within the whole group. This process was continued until all the species were compared with all others. Then the number of times each species was listed as preferable to other species was tallied based on their total counts from different villages within a site. The species with its highest score was interpreted as the most preferred species as firewood and the lowest as the least preferred one. The scores were also cross checked with five elderly people having knowledge on fuelwood from their experience for authentication.

4.5. Determination of Fuelwood Value Index (FVI) :

A total of thirty most widely used firewood species were selected for the study. These include *Acrocarpus fraxinifolius* (Nganbawm), *Adina cordifolia* (Lungkhup), *Albizia procera* (Kangtekpa), *Albizia chinensis* (Vang), *Albizia thompsonii* (Thingri), *Anogeissus acuminata* (Zairum), *Bischofia javanica* (Khuangthli), *Callicarpa arborea* (Hnahkiah), *Castanopsis tribuloides* (Thingsia), *Derris robusta* (Thingkha), *Eleocarpus lanceofolious* (Kharuan), *Ficus*

semicordata (Theipuithing), *Macaranga indica* (Hnahkhar), *Macropanax dispermus* (Phuanberh), *Mesua ferrea* (Herhse), *Myrica esculenta* (Keifang), *Quercus floribunda* (Thal), Q*uercus helferiana* (Hlai), *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil), *Quercus serrata* (Sasua), *Quercus xylocarpa* (Then), *Schima wallichi* (Khiang), *Sterospermum personatum* (Zihnghal), *Styrax serrulatum* (Hmarhleng), *Tetrameles nudiflora* (Thingdawl), *Toona ciliata* (Tei), *Vitex peduncularis* (Thingkhawilu), *Wendlandia grandis* (Batling) and *Wightia speciosissima* (Chawngtlai).

Samples were collected from three individuals of each of the thirty species that was evaluated for people's preference. Firewood samples were collected from large branches greater than 12 cm in diameter. The samples were stored in airtight polythene bags and brought to the laboratory within 24 hour of their collection.

The energy value, moisture and ash content, wood density and biomass/ash ratio of the selected firewood species were determined for each species following the methods outlined by Anderson and Ingram (1993). The moisture content (g/g), used to calculate the Fuelwood Value Index (FVI) for each firewood species, was determined by comparing each sample's fresh weight against that measured after drying to constant weight in a hot air oven at 70^{o}C for 24h. The dried samples were used to determine density using the water displacement method. These samples were again dried, milled in an electric grinder and passed through 2 mm mesh sieve for all subsequent analyses. Ash content (g/g) was determined by burning a weighed sample in a muffle furnace at 550^{o}C for 3 h stationed at Regional Institute of Paramedical & Nursing Siences (*RIPANS*), Aizawl. The biomass–ash ratios were calculated by dividing dry

weights by ash weights. Energy values for each sample were estimated using an oxygen bomb calorimeter following the method described by Leith (1975). For all parameters, mean values and standard errors were calculated based on the three replicate analyses for each species. The Fuelwood Value Index was estimated using formula of Purohit and Nautiyal (1987), as follows :

$$FVI = \frac{\text{Energy value (kJ/g) x density (g/cm}^3\text{)}}{\text{Ash content (g/g) x Moisture content (g/g)}}$$

6. Livelihood and income generation through NTFPs:

About 10% of the respondent in each village were asked to prioritize the different NTFPs that they collect over different seasons which provide them subsistence and / or income. The quantity of these NTFPs that are collected by each household in a given season was noted down using a questionnaire specifically developed for the purpose. The amount of the NTFPs that are consumed by a household was also noted and the quantity of the given NTFPs sold either in the nearby market or through middle men was recorded. The prevailing market price was taken into consideration to calculate the livelihood / income generation from a particular NTFP category. A household drawing 2 – 3 types of NTFPs or more, were accordingly prepared and summed up to draw the income generations.

7. Statistical analysis:

A comparison of NTFPs availability between different forest range / circle and / or different villages were made. The collection pattern of NTFPs was tried to relate with the educational background and income class of the

respondents. The Pearson Correlation coefficient was used to compare selected variables and to determine positive (>0) or negative (<0) relationships. The p-values were used to evaluate the probability of obtaining correlation coefficient as extreme as the observed ones. Frequencies were used to empirically evaluate the correlation coefficients analysis, as per the empirical evidences in each household surveyed under each of the eight forest ranges.

CHAPTER – 5

RESULTS AND DISCUSSIONS

5.1. NTFPs diversity:

5.1.1. Variation in NTFPs types between different sites:

The distribution of different NTFPs varied widely between the sites (**Tables 1-11**). During the study period, a total of 200 medicinal plants, 60 edible plant species , 42 fruit species, 15 fodder species, 30 fuel wood species, 18 palms, 10 Ornamental species, 18 bamboo species were recorded from the selected sites. There are some variations on the pattern of NTFPs availability not only between the sites but also between the villages within a study sites.

A total of 297 different species under 230 genera were recorded from the selected sites and a total of 104 families of different plant species contributed to the NTFPs deversity.

On field observation, medicinal plant species such as *Albizia odoratissima* (Kangteknu), *Albizia procera* (Kangtekpa), *Gynocardia odorata* (Saithei), *Cordia dichotoma* (Muk), *Livistona cochirensis* (Buarpui chempai), *Pithecellobium monadelphum* (Ardahte), *Plumeria acuminata* (Vaingai), *Podocarpus neriifolius* (Thlangfar), *Saraca asoca* (Mualhawih), *Stereopermum chelonoides* (Zihnghal), *Terminalia bellirica* (Thingvandawt), *Zanthoxylum armatum* (Arhrikreh), *Blumea lanceolaria* (Buarze), *Ervatamea coronaria* (Pararsi), *Holarrhena antidysenterica* (Thlengpa), *Tinospora cordifolia* (Theisawntlung), *Homalomena aromatica* (Anchiri), *Zanonia indica* (Lalruanga dawibur) were confined to western part of Mizoram and inner part of the state and usually not found in eastern part of the state. On the contrary, species like *Bombax*

ceiba (Phunchawng), *Helicia robusta* (Pasaltakaza), *Hydnocarpus kurzii* (Khawitur), *Myrica esculenta* (Keifang), *Phyllanthus acidus* (Kawlsunhlu), *Prunus cerasoides* (Tlaizawng), *Artemesia indica* (Sai), *Piper diffusum* (Pawhrual), *Aeginetia indica* (Sangharvaibel), *Bergenia ciliata* (Kham damdawi), *Pogonia plicata* (Phurthakhlo), *Senecio scandens* (Saiekhlo) prefers higher altitude and found mostly in Champhai District bordering Myanmar **(Table 2)**.

Almost all the wild fruit species were distributed commonly throughout the study area ***i.e.*** northern Mizoram. As far as availability is concern, there are slight variations between the sites. For example, few species like *Myrica esculenta* (Keifang), *Phyllanthus acidus* (Kawlsunhlu) were confined to eastern part of the state and thus found in Hnahlan, Ngopa, Phullen and Farkawn forest range only while species like *Tinospora cordifolia* (Theisawntlung) and *Flacourtia jangomas* (Sakhithei) were confined to lower altitude of Ngopa, Bairabi, Phuldungsei, Kawrthah and N. Hlimen forest range only. The result shows that the fruit species availability is quite high as most of them are frequent in nature **(Table 3)**.

The 60 edible wild plants distributed throughout the entire study area more or less uniformly. Few species such as *Livistona cochirensis* (Buarpui chempai), *Calamus acanthospathus* (Thilte), *Calamus flagellum* (Hruipui), *Rhynchotechum ellipticum* (Tiarrep), *Zanthoxylum armatum* (Arhrikreh), *Zalacca secunda* (Hruitung), *Hedychium spicatum* (Aithur) were distributed in western part of Aizawl and Kolasib Districts covering Bairabi, Phullen, Phuldungsei, Kawrthah and N. Hlimen forest range and were not usually available in Champhai forest range. *Rhynchotechum ellipticum* (Tiarrep) were not found in Hnahlan and Farkawn forest range but found in all other studied forest range **(Table 4)**.

The recorded fuelwood species shows different distribution. *Quercus* spp. mainly confined to higher altitude of eastern site and *Acrocarpus fraxinifolius* (Nganbawm), *Adina cordifolia* (Lungkhup), *Albizia procera* (Kangtekpa), *Eleocarpus lanceofolious* (Kharuan), *Sterospermum personatum* (Zihnghal), *Ficus semicordata* (Theipuithing), *Styrax serrulatum* (Hmarhleng) were reported from eastern site covering Bairabi, Phuldungsei, Kawrthah and N. Hlimen forest range. Species like *Adina cordifolia* (Lungkhup), *Eleocarpus lanceofolious* (Kharuan), *Ficus semicordata* (Theipuithing), *Styrax serrulatum* (Hmarhleng) belongs to western part of the study sites. Species like *Myrica esculenta* (Keifang), *Quercus floribunda* (Thal), *Q. helferiana* (Hlai), *Q. pachypylla* (Fah), *Q. polystachya* (Thil), *Q. serrata* (Sasua), *Q. xylocarpa* (Then) *and Wightia speciosissima* (Chawngtlai) were restricted to Hnahlan, Ngopa, Phullen and Farkawn forest range only **(Table 5)**.

The recorded fodder species were found in all the study area with slight differnces in their density **(Table 6)**. As far as availability is concerned, palm species shows slight variation between the sites. These species were distributed mostly in western part of the state. Species like *Calamus flagellum* (Hruipui), *Calamus tenuis* (Changdam/Hnahbawr), *Calamus nambariensis* (Mawtpui), *Calamus khasianus* (Mawt), *Plectocomia khasiana* (Mawt), *Zalacca secunda* (Hruitung) etc. confined to Bairabi, Phuldungsei, Kawrthah and N. Hlimen forest range. Palm species like *Areca trianda* (Uvai), *Arenga pinnata* (Thangtung), *Calamus gracilis* (Kawrtai), *Calamus guruba* (Tairua/Taite), *Caryota urens* (Tum), *Daemonorops jenkinsianus* (Raichhawk), *Licuala peltata* (Laisua) and *Pinanga gracilis* (Tartiang) were distributed to the whole study area more or less uniformly **(Table 7)**. The field observation on ornamental species

indicates that species like *Bauhinia variegata* (Vaube), *Erythrina stricta* (Fartuah), *Langerstromia speciosa* (Thlado/Chawnpui) and *Renanthera imschootiana* (Senhri) were distributed to all the forest range studied but species like *Bombax ceiba* (Phunchawng), *Prunus cerasoides* (Tlaizawng), *Rhododendron wightii* (Chhawkhlei par var) and *Rhododendron arboretum* (Chhawkhlei par sen) confined to high altitude in Hnahlan, Ngopa and Farkawn forest range while *Vanda coerulea* (Lawhlei)were recorded from Hnahlan, Ngopa, Farkawn and N. Hlimen forest range. *Saraca asoca* (Mualhawih) confined in lower altitude of the studied area thus found in Bairabi, Phuldungsei, Kawrthah and N. Nlimen forest range. Bamboo species were found mostly in Aizawl, Mamit and Kolasib district but were found less in Champhai district **(Table 8)**. As far as availability is concern, bamboo species shows little variation in the studied eight forest range in northern Mizoram. For example, *Bambusa khasiana* (Rawte / Chalte) were limited to Ngopa, Bairabi, Phullen, Phuldungsei and N. Hlimen forest range; *Bambusa nutans* (Ankuang) was restricted to Phuldungsei and Kawrthah forest range; *Bambusa oliveriana* (Talan) was found in Bairabi forest range only; *Bambusa vulgaris* (Vairua) was restricted to Bairabi and N. Hlimen forest site; *Chimonobambusa callosa* (Phar) was limited in Ngopa, Phullen and Farkawn forest range and vice versa **(Table 9)**.

5.1.2. Variation in NTFPs in vegetation:

5.1.2.1. Medicinal plants:

A total of 200 medicinal plants species were encountered during the field sampling over eight forest range of the state. The 200 medicinal plant species under 168 genera belongs to 91 families. Out of which 90 were trees, 34

shrubs, 47 herbs, 4 ferns, 2 epiphytes, 21 climber species and 2 bamboos and grass species. Out of 200 species of medicinal plants, 10 species belongs to Asteraceae family, 9 species belongs to Euphorbiaceae family, 8 species belongs to Mimosaceae family, 6 species belongs to Moraceae and 5 belongs to Fabaceae family **(Figure 4)**.

Among tree species, *Emblica officinalis* (Sunhlu) has highest density per hectare followed by *Schima wallichii* (Khiang) and *Ficus semicordata* (Theipui). Among shrub species, *Mimosa pudica* (Hlonuar) shows highest density followed by *Borassus flabellifer* (Siallu) and *Melastoma malabathricum* (Builukham). Among herb species, *Alocasia fornicata* (Baibing) shows highest density followed by *Amomum dealbatum* (Aidu). Among climber species, *Mikania micrantha* (Japanhlo) shows highest density followed by *Hodgsonia macrocarpa* (Khaum) and *Dregea volubilis* (Ankhapui). All the species can be categorized into rare, frequent, fairly frequent, common, very common, abundant etc. There are 2 species which are very rare and 24 species rare. Four species are fairly frequent, 6 very frequent and 63 frequent amongst the medicinal plants; 32 species very common and 51 species less common **(Table 2)**.

The species like *Achyranthes bidentata* (Vangvattur), *Adiantum caudatum* (Chakawkria), *Albizia chinensis* (Vang), *Albizia odoratissima* (Kangteknu), *Albizia procera* (Kangtekpa), *Bauhinia variegata* (Vaube), *Canna indica* (Kungpuimuthi), *Costus specious* (Sumbul), *Curculigo capitulata* (Phaiphek), *Ficus hispida* (Paihte maian), *Helianthus annuus* (Nihawipar), *Imperata cylindrica* (Di), *Lepionurus sylvestris* (Anpangthuam), *Musa acuminata* (Changel), *Oroxylum indicum* (Archangkawm), *Parkia roxburghii* (Zawngtah), *Lantana camara* (Shillongpar), *Mallotus roxburghianus* (Zawngtenawhlung) etc.

were very common to the forest range; species like *Anogeissus acuminata* (Zairum), *Artocarpus chama* (Tatkawng), *Bischofia javanica* (Khuangthli), *Camellia sinnensis* (Thingpui), *Chromolaena odorata* (Tlangsam), *Dillenia indica* (Kawrthindeng), *Dinochloa compactiflora* (Sairil), *Garcinia paniculata* (Vawmva), *Lagerstroemia speciosa* (Thlado / Chawnpui), *Passiflora nepalensis* (Nauawimu) etc. were frequent to the site; species such as *Aegle marmelos* (Belthei), *Artemesia indica* (Sai), *Averrhoa carambola* (Theiherawt), *Bombax ceiba* (Phunchawng), *Cassia alata* (Tuihlo), *Cissus javanica* (Sangharhmai), *Gynocardia odorata* (Saithei), *Hedychium spicatum* (Aithur), *Helicia excels* (Sialhma), *Helicia robusta* (Pasaltakaza), *Juglans regia* (Khawkherh), *Podocarpus neriifolius* (Thlangfar), *Rubus ellipticus* (Hmutau), *Saraca asoca* (Mualhawih), *Senecio scandens* (Saiekhlo), *Strobilanthes cusia* (Ting), *Zanonia indica* (Lalruanga dawibur), *Zanthoxylum armatum* (Arhrikreh) etc. were very rare.

Some of the medicinal plants are cultivated in home gardens, but preserve on adjacent forests is also enormous. The species having higher density does not mean that those species were having higher remedial values. The study reveals that northern Mizoram is very rich in species having remedial values. **Table 2** clearly indicates that the abundance and density per hectare of the available medicinal plants is still high. Though the study area covers only some villages in each site, abundant number of medicinal plants was found plenty in quantity. Therefore, these species, though important from NTFPs prospective, require immediate conservation measures. During our survey, the 30% respondents knew about the important of these rare medicinal plants growing in

their locality, but they expressed their dependence owing to the monetary benefits they draw from the resource.

5.1.2.2. Edible fruit plants:

A total of 42 edible fruit plant species were encountered during the field sampling over the studied eight forest range. There are 38 genera out of 42 fruit bearing species belonging to 26 families. Out of which 6 species belongs to Moraceae family, 4 species belongs to Euphorbiaceae family. Out of 42 species, 35 species were tree, 5 shrubs, 1 herb and 1 climber **(Figure 5)**. The highest density among tree species is *Artocarpus heterophyllus* (Lamkhuang) followed by *Emblica officinalis* (Sunhlu) and the lowest density is *Phyllanthus acidus* (Kawlsunhlu). Among shrub species highest density is *Elaegnus caudata* (Sarzukpui) and the lowest is *Xeromphis spinosa* (Sazutheipui) **(Table 3)**.

Fruit species can be categorized into frequent, abundant and rare as given in **Table 4**. There are 4 rare species and 31 species ***i.e.*** 73.81 % were found to be frequent and 7 abundant **(Figure 6)**. Species such as *Anodendron paniculatum* (Theikelki), *Artocarpus lakoocha* (Theitat), *Averrhoa carambola* (Theiherawt), *Bruinsmia polysperma* (Theipalingkawh), *Dillenia indica* (Kawrthindeng), *Embelia subcoriacea* (Tling), *Ficus rostrata* (Thetit), *Xeromphis spinosa* (Sazutheipui) etc. were frequent in nature; species like *Amomum dealbatum* (Aidu), *Elaegnus caudata* (Sarzukpui), *Emblica officinalis* (Sunhlu), *Mangifera indica* (Theihai), *Rhus semialata* (Khawmhma), *Tamarindus indica* (Tengtere) were abundant; species such as *Juglans regia* (Khawkherh), *Litchi chinensis* (Vaitheifeihmung), *Myrica esculenta* (Keifang) and *Rubus ellipticus* (Hmutau) were rare.

The result shows that the fruit species availability is quite high as most of them are frequent in nature. The local people collect these wild fruits mainly from the forests for family consumption. These NTFPs were utilized to improved their health and for digestion. Few people collect and sold these produces in the local market as well as in the city market. Most of the edible fruits come from tree species and lowest from herb and climbers. The fruit species were readily available during their fruiting period for consumption.

5.1.2.3. Edible food species:

A total of 60 edible food species belonging to 51 genera under 35 families were encountered during the field survey from eight forest range in northern Mizoram. There are 18 edible tree species, 14 species of shrubs and 18 herbs, 6 species belongs to the climbers and 4 species of bamboo **(Figure 7)**. Out of 60 species, 7 species belongs to Euphorbiaceae family; 4 species belongs to Poaceae family and 3 belong to Caesalpinaceae family **(Table 5)**.

Among trees species, *Oroxylum indicum* (Archangkawm) shows highest density per hectare followed by *Cinnamomum verum* (Thakthing). Of shrubs species, *Clerodendrum colebrookianum* (Phuihnam) and *Derris wallichii* (Hulhu) are most common. Among herbs, *Musa velutina* (Changvandawt) shows highest density and of climber species, *Hodgsonia macrocarpa* (Khaum) and *Dregea volubilis* (Ankhapui) has highest density per hectare followed by *Dioscorea bulbifera* (Rambahra) and *Luffa cylindrica* (Awmpawng). Among bamboo species, *Meloccana baccifera* (Mautak) shows highest density.

Food species can be categorized into frequent, fairly freequent, common, very common, cultivated, abundant and rare. Species like

Amorphophallus paeniifolius (Telhawng), *Bischofia javanica* (Khuangthli), *Cassia tora* (Kelbean), *Dioscorea alata* (Bahrachim), *Leea compactiflora* (Kawlkar), *Lepionurus sylvestris* (Anpangthuam), *Passiflora nepalensis* (Nauawimu) etc. were found frequent; species such as *Acacia caesia* (Khanghu), *Agaricus campestris* (Maupa), *Clerodendrum colebrookianum* (Phuihnam), *Dendrocalamus hamiltonii* (Phulrua), *Dysoxylum gobara* (Thingthupui), *Entoloma microcarpum* (Pasawntlung), *Eryngium foetidium* (Bahkhawr), *Spilanthes acmella* (Ankasa), *Trema orientalis* (Belphuar) etc. were found common; species like *Bambusa tulda* (Rawthing), *Costus speciosus* (Sumbul), *Dendrocalamus longispathus* (Rawnal), *Ficus hispida* (Paihte maian), *Musa acuminata* (Tumbu), *Parkia timoriana* (Zawngtah), *Zanthoxylum rhetsa* (Chingit) etc. were very common; species like *Crotolaria juncea* (Tumthang), *Leuceana leucocephala* (Japanzawngtah), *Livistona cochirensis* (Buarpui chempai) and *Luffa cylindrica* (Awmpawng) were cultivated; species like *Arenga pinnata* (Thangtung), *Caryota urens* (Tum), *Hedychium spicatum* (Aithur), *Musa glauca* (Saisu), *Zanthoxylum armatum* (Arhrikreh) were rare in nature **(Table 5)**.

Local people make use of wild edible food plants to meet their daily requirements. The collection is mainly for family consumption and selling purposes. People usually collect food plants whenever the plant is available to them during their visit to the nearby forest. The surplus, if any, was sold to their neighbors and also to the market. Few people involved as full time collectors for selling these items.

5.1.2.4. Fuelwood species:

A total of 30 fuelwood species under 23 genera were encountered during the field survey from eight different forest range from northern Mizoram. These fuelwood species belongs to different 21 families. Out of the total 30 species, 7 species belongs to Fagaceae family; 2 species each belongs to Fabaceae, Rubiaceae and Verbenacea family. Out of 30 species of fuelwood, there are 3 *Albizia* spp. and 6 *Quercus* spp. *Schima wallichii* (Khiang) has highest density per hectare followed by *Anogeissus acuminata* (Zairum) **(Table 6)**.

Fuelwood species can be categorized into frequent, fairly frequent, common and very common. For example, species such as *Acrocarpus fraxinifolius* (Nganbawm), *Albizia chinensis* (Vang), *Albizia thompsonii* (Thingri), *Anogeissus acuminata* (Zairum), *Bischofia javanica* (Khuangthli), *Ficus semicordata* (Theipuithing), *Quercus spp., Wendlandia grandis* (Batling) etc. were frequent in nature; species like *Castanopsis tribuloides* (Thingsia), *Macaranga indica* (Hnahkhar), *Mesua ferrea* (Herhse), *Schima wallichii* (Khiang) and *Vitex peduncularis* (Thingkhawilu) were common; species like *Adina cordifolia* (Lungkhup), *Albizia procera* (Kangtekpa) and *Tetrameles nudiflora* (Thingdawl) were found very common and *Callicarpa arborea* (Hnahkiah) were found fairly frequent in nature.

Among the various NTFPs, fuelwood was the most direct use of small wood as a source of energy. It required little or no treatment and had to be simply broken down into small billets of suitable size. Fuelwood is a renewable natural resource and widely distributed which is relatively very easy to harvest or obtain from the forests and no special tools or skill is required for the purpose. The operation is simple and inexpensive. Wood is also an excellent fuel as, when fully

dry, it contains upto 99% of combustible material. Hence, very little ash is left behind. It produces a flame and hence is able to provide heat to a large surface and again as it is very inexpensive, it can be easily afforded by the poor masses especially in rural areas.

5.1.2.5. Fodder species:

Fifteen species of fodder plants under 23 genera were recorded from studied eight different forest range to feed livestock. Fodder species belongs to 9 families: 3 species from Moraceae, Asteraceae and Poaceae. Five species such as *Macaranga indica* (Hnahkhar), *Manihota esculenta* (Pangbal), *Amorphophallus paeniifolius* (Telhawng), *Bidens pilosa (*Vawkpuithal) and *Spilanthes acmella* (Ankasa) were found to be common; 5 species such as *Colocasia esculenta* (Dawl), *Musa acuminata* (Tumbu), *Saccharum spontaneum* (Luang), *Thysanolaena maxima* (Hmunphiah) and *Imperata cylindrica* (Di) were found very common in nature; 4 species such as *Artocarpus heterophyllus* (Lamkhuang), *Artocarpus lakoocha* (Theitat), *Ficus rostrata* (Thetit) and *Ipomea batatas* (Kawlbahra) were frequent in nature and *Mikania micrantha* (Japanhlo) is found abundant. Out of 15 species, 5 species belongs to tree species; 3 species belongs to shrub, 6 species to herbs and 1 climber species. Among tree species, *Artocarpus heterophyllus* (Lamkhuang) shows highest density per hectare. Among herbs, *Colocasia esculenta* (Dawl) has highest density per hectare followed by *Amorphophallus paeniifolius* (Telhawng) and *Thysanolaena maxima* (Hmunphiah) **(Table 7)**.

5.1.2.6. Palm species:

There were 18 species recorded from Palm species, Out of 18 species, 9 species belongs to *Calamus* spp. in the study area. All the palm species belongs to Asteraceae family. Among palms, *Borassus flabellifer* (Siallu) has highest density per hectare followed by *Licuala peltata* (Laisua).

Palm species can be categorized into frequent, very frequent, rare and infrequent. Out of 18 species, 13 species were found frequent which include *Calamus gracilis* (Kawrtai), *C. guruba* (Tairua/Taite) , *C. inermis* (Mitperh), *Licuala peltata* (Laisua), *Pinanga gracilis*, *Caryota urens* (Tum) etc.; 3 species such as *Borassus flabellifer* (Siallu), *Calamus acanthospathus* (Thilte) and *Calamus erectus* (Thilthek) were found very frequent; *Arenga pinnata* (Thangtung) is rare and *Areca trianda* (Uvai) is infrequent.

5.1.2.7. Ornamental species:

There were 10 ornamental species recorded from eight forest range from the survey. Among ornamentals, *Bauhinia variegata* (Vaube) shows highest density per hectare and least by *Rhododendron wightii* (Chhawkhlei par var) **(Table 9)**.

Ornamental plant species can be categorized into common, very common, frequent and rare. Out of 10 Ornamental species, 6 species were found rare such as *Bombax ceiba* (Phunchawng), *Renanthera imschootiana* (Senhri), *Rhododendron wightii* (Chhawkhlei par var), *R. arboretum* (Chhawkhlei) etc., *Langerstromia speciosa* (Thlado/Chawnpui) and *Prunus cerasoides* (Tlaizawng) were frequent, *Erythrina stricta* (Fartuah) is found common; *Bauhinia variegata* (Vaube) was found very common in nature. The 10 species belongs to 8 different

families such as Ericaceae, Orchidacea etc. Among ornamentals, *Bauhinia variegata* (Vaube) shows highest density per hectare and least by *Rhododendron wightii* (Chhawkhlei par var).

5.1.2.8. Bamboo species:

There were 18 species of bamboo available in the studied eight forest range belonging to Poacea family. Among bamboos, *Melocanna baccifera* (Mautak) has highest density followed by *Dendrocalamus hamiltonii* (Phulrua) and least density is *Dendrocalamus strictus* (Tursing) **(Table 10)**.

Bamboo species can be categorized into less common, frequent, abundant and rare. Species such as *Bambusa khasiana* (Rawte / Chalte), *Bambusa nutans* (Ankuang), *Bambusa oliveriana* (Talan), *Bambusa tulda* (Rawthing), *Bambusa vulgaris* (Vairua), *Chimonobambusa callosa* (Phar) were found less common; *Chimonobambusa khasiana* (Lik), *Dendrocalamus hamiltonii* (Phulrua) etc. were frequent in nature; *Dendrocalamus sikkimensis* (Rawmi) and *Schizostachyum fuchsianum* (Rawngal) were rare while *Melocanna baccifera* (Mautak) was found abundant in nature.

5.1.2.9. Dominant families:

Among the different NTFPs, the 10 dominant families showing number of genera and species from the study forest ranges are given in **Table 11**. The data is based on the use pattern from eight different study sites for fulfilling most of the local people needs. These families represented mostly to the NTFP diversity in Mizoram. A total of 112 species were recorded from the 10 dominant families. The 10 dominant families are: Poaceae with 22 species, Arecaceae 19

species, Euphorbiaceae 12 species, Asteraceae 12 species, Mimosaceae 10 species, Caesalpinaceae 8 species, Moraceae 8 species, Fabaceae 7 species, Fagaceae 7 species and Rubiaceae 7 species.

As far as utilization is concerned, the dominant families shows different genera and species number from the actual number of species as particular species are used for more than one purposes. Poaceae contributes 15 genera and 28 species; Arecaceae 18 genera and 27 species; Euphorbiaceae 14 genera and 15 species; Asteraceae 14 genera and 14 species; Mimosaceae 10 genera and 12 species; Caesalpinaceae 9 genera and 9 species; Moraceae 9 genera and 17 species; Fabaceae 9 genera and 9 species; Fagaceae 2 genera and 8 species and Rubiaceae 8 genera and 8 species. In total, there were 147 different species and 108 genera drawn from the 10 dominant families contributing to the NTFPs diversity in the study sites (**Table 11**).

In the table, the total number of species under each family is higher than the actual total number of species because the individual species under particular family is used for more than one purpose. For example, under Poaceae family, bamboo species were used as medicinal plants, the same species were used for food item (shoot) and the same species were recorded under bamboo (bamboo pole) present in the study area. Thus, the total comes to 28 species while the actual number of species found under Poaceae family is 22 and so on. The difference between total number of counted species under various uses and the actual number of species ***i.e.*** 147 and 112 comes to 35 species. This means that 35 species under the 10 dominant families are utilized for more than one purpose.

5.1.3. Variation in NTFPs in different local markets:

Availability of different NTFPs species in the local market varied widely (**Table 12**). The variations in the availability of the species between different markets were ascribed to several factors such as their availability in the vicinity forests, homegardens, orchards; consumption pattern of the NTFPs by the households; seasonality of the NTFPs; species location; market demand; utility values of the NTFPs in question. It could also be due to the fact that the species may be excessively exploited in the past and totally consumed at household level **(Table 12)**.

Three NTFPs species such as *Cassia floribunda* (Rengan), *Emblica officinalis* (Sunhlu) and *Meloccana baccifera* (Mautak) were found in all the surveyed local markets which indicate that these species are of high demand and are of common recurrence. The species like *Amomum dealbatum* (Aidu), *Crotolaria juncea* (Tumthang), *Glochidion arborescens* (Tuaitit), *Litsea cubeba* (Sernam), *Musa acuminata* (Tumbu) and *Passiflora nepalensis* (Nauawimu) were also available in most sites suggesting their better utility values. Species which were found in plenty in the surveyed lacal markets includes *Alstonia scholaris* (Thuamriat), *Aralia foliosa* (Chimchawk), *Artocarpus heterophyllus* (Lamkhuang), *Chrysophyllum cainito* (Theipabuan), *Curcuma longa* (Aieng), *Dillenia pentagyna* (Kaihzawl), *Dioscorea alata* (Bahrachim), *Dioscorea bulbifera* (Bahra), *Eryngium feotidum* (Bahkhawr), *Eurya cerasifolia* (Sihneh), *Ficus hispida* (Paihte maian), *Lepionurus sylvestris* (Anpangthuam), *Livistona cochirensis* (Buarpui chempai), *Mangifera indica* (Theihai), *Memecylon ceeruleum* (Theikawrak), *Musa glauca* (Saisu), *Parkia timoriana* (Zawngtah), *Phrynium capitatum* (Hnahthial), *Phyllanthus fraternus* (Mitthisunhlu),

Polygonum plebium (Bakhate), *Rubus ellipticus* (Hmutau), *Schizophyllum commune* (Pasi), *Solanum nigrum* (Anhling), *Xeromphis spinosa* (Sazutheipui) and *Zanthoxylum rhetsa* (Chingit).

Most of these NTFPs belonged to wild fruit category. Many people relish these NTFPs and therefore these species are commonly found sold in large quantities in the markets. The number of NTFPs species coming to different market did not vary significantly between the markets. As has already been discissed, the availability of a species was directly linked to its demand from utility view point and imparts its ability to fetch income. Most of these NTFPs were low volume and high priced category. In other words, though the quantity of these NTFPs available in the local markets were relatively small compared to fuelwood, charcoal, broomgrass (referred as high volume and low value NTFPs), their contribution to income was substantially high.

5.1.4. Ethnobotanical use among people and differences between sites / tribes:

A total of 200 species were found to have ethnobotanical importance. These species have been used by the people for curing various ailments ranging from dysentery, diarrhoea, fever, typhoid, asthma, anti-septic, boils, rheumatism, blood pressure problems, ulcers, kidney problems to sore, skin diseases, liver complaints, dandruff, tonsillitis, tooth problems etc. A large number of plants are used for curing stomach problems like dysentery, stomach ache and diarrhoea.

Different parts of the medicinal plants used for remedial purposes were given in **Table 13** and **Figure 8**. There were in total 228 number of plant species utilized for remedies. The table shows that out of the total 200 medicinal

plants, leaves part of 65 species were utilized to cure ailments which is 28.5 % of the total different plant species ***i.e.*** 228, 26 fruit body, 40 bark, 14 stem, 30 root, 9 rhizome/tuber, 28 whole plant, 3 flower and 13 seed parts. **Figure 8** shows number of different parts of the medicinal plants utilized to cure different ailments. The result is shown for different habits of the medicinal plants. Medicinal tree species alone contribute 103 plant parts, 50 from herbs, 45 from shrubs, 23 from climbers, 4 from fern species, 2 from bamboo and grass and 1 from epiphytes. Our results show that a particular species is used for more than one diseases / ailments. Different parts of the same species may be used for remedial purposes or it may be mixed with parts of the different species depending on the diseases treated with.

5.2. Prioritization of NTFPs based on various criteria:

All the NTFP species occured in the surveyed villages spread over eight forest ranges were grouped into four categories based on various attributes. Generally, category 1 NTFPs wise were preferred than category 2 and so on. The criteria that were considered for prioritizing of NTFPs into different groups were:

a) Abundance of the species in nature

b) Relative importance of the species for its utility value, a species having higher utility values was considered more useful than a species with lower utility value

c) Relative importance of the species towards income generation

d) Importance of the species on improving diets or supplementing food value to the households and/or curing certain ailments.

Based on these criteria, a total of 96 species were found under category 1 **(Table 14)** which forms a major source of livelihood for majority of the forest dwellers and also was a source of income generation. Similarly, 107 species were identified under category 2 (**Table 14)** which are not threatened in nature but whose sustainable supply is a big question unless sustainable harvest of these NTFPs are carried out and a policy in this direction are formulated and strictly applied as NTFP management by the state government.

Some common and important NTFPs of category 1 are *Alocasia fornicata* (Baibing), *Alstonia scholaris* (Thuamriat), *Borassus flabellifer* (Siallu), *Emblica officinalis* (Sunhlu), *Elaegnus caudata* (Sarzukpui), *Meloccana baccifera* (Mautak), *Oroxylum indicum* (Archangkawm), *Solanum nigrum* etc.; category 2 are *Anogeissus acuminata* (Zairum), *Baccaurea ramiflora, Dendrocalamus longispathus, Ficus rostrata* (Thetit), *Langerstromia speciosa* (Thlado/Chawnpui), *Licuala peltata* (Laisua), *Livistona cochirensis* (Buarpui chempai), *Mesua ferrea* (Herhse), *Prunus cerasoides* (Tlaizawng), *Vitex peduncularis* (Thingkhawilu) etc.; category 3 are *Aeschynanthus sikkimensis, Calamus sps., Canarium strictum, Daemonorops jenkinsianus, Schizostachyum polymorphum, Quercus sps., Zalacca secunda, Zanonia indica* (Lalruanga dawibur) etc.; category 4 are *Aegle marmelos* (Belthei), *Bombax ceiba* (Phunchawng), *Hedychium spicatum* (Aithur), *Helicia robusta* (Pasaltakaza), *Rhododendron arboretum* (Chhawkhlei par sen), *Rhododendron waghtii* (Chhawkhlei par var), *Saraca asoca* (Mualhawih), *Vanda coerulea* (Lawhlei) etc.

As it is evident, the category 1 and 2 species which are mostly available in nature, as of now, no restriction on their harvest is being imposed. The NTFPs collectors harvest these NTFPs unsustainably leading to exploitation

of the resorces. The immediate consequence of these exploitation are not felt because these NTFPs are available in relatively larger quantities, but a time may soon come when these NTFPs will be very scare and the people depending on these NTFPs for their livelihood shall be on risk, unless they follow a method of sustainable harvesting and/or unless regeneration of these NTFPs species are carried out extensively in some jhum fallows, homegardens, orchards etc. Category 3 and 4 NTFPs species are though cultivated and therefore these species are better conserved and sustainably utilised by the growers, it is fyrther suggested that the state government should come with some incentives in order to promote that more of such NTFPs are domesticated so that not only these species are multiplied but the income from these species are more ensured in time to come.

Under category 1, 39 species belonged to medicinal plants, 28 edible food plants, 10 fodder plants, 9 fruit plants, 7 fuelwood, 2 ornamental species and 1 species each belong to bamboo and palm. Under category 2, 37 species belonged to medicinal plants, 21 fruit species, 14 food and fuelwood, 11 bamboo, 4 ornamental and 3 palms and fodder. Under category 3, about 32 species belonged to medicinal plants, 13 palm, 6 fuelwood, 4 fruit, 3 bamboo and 2 food plants. Under category 4, 19 species belonged to medicinal plants, 4 ornamental, 3 fruit and 1 fuelwood and fodder **(Figure 10)**.

5.3. Fuelwood species characteristics:

5.3.1. Fuelwood preferences (Matrix ranking):

A ranking matrix for 30 indigenous fuelwood species of northern Mizoram using 12 quality criteria is presented in **Table 15**. The table presents a

comparison of the ranks of the fuelwood species obtained on the basis of pairwise comparison.

From **Table 15**, it can be seen that among all the fuelwood species under study, the most abundant species (availabilty) were *Callicarpa arborea* (Hnahkiah), *Schima wallichii* (Khiang), *Tetrameles nudiflora* (Thingdawl) and the less abundant species were *Acrocarpus fraxinifolius* (Nganbawm), *Albizia chinensis* (Vang), *Albizia thompsonii* (Thingri), *Eleocarpus lanceofolious* (Kharuan), *Macropanax dispermus* (Phuanberh) and *Wendlandia grandis* (Batling).

Species like *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil), *Macaranga indica* (Hnahkhar), *Sterospermum personatum* (Zihnghal), were reported to have fast drying rates, whereas *Acrocarpus fraxinifolius* (Nganbawm), *Albizia chinensis* (Vang), *Albizia thompsonii* (Thingri), *Bischofia javanica* (Khuangthli), *Ficus semicordata* (Theipuithing), *Macropanax dispermus* (Phuanberh), *Myrica esculenta* (Keifang) and *Tetrameles nudiflora* (Thingdawl) were reported to have slow drying rates.

According to the respondents, wood of *Mesua ferrea* (Herhse), *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil), *Schima wallichii* (Khiang), *Quercus xylocarpa* (Then) and *Vitex peduncularis* (Thingkhawilu) when burnt produce hot flame while those of *Macropanax dispermus* (Phuanberh), *Ficus semicordata* (Theipuithing), *Macaranga indica* (Hnahkhar), *Styrax serrulatum* (Hmarhleng) and *Tetrameles nudiflora* (Thingdawl) produce flame with low heat.

Long-lasting embers can produce uniform heat, which is more effective for space heating and brick burning process. Out of these fuelwood

species, *Anogeissus acuminata* (Zairum), *Schima wallichii* (Khiang) and *Vitex peduncularis* (Thingkhawilu) were reported to produce ember.

In Mizoram, food is cooked mostly by women and in rural households of the region; the kitchens normally do not have proper ventilation for release of smoke. Therefore, fuelwood species that produce less smoke are preferred by the users. In the present investigation, based on pair-wise comparison, it was found that *Mesua ferrea* (Herhse), Q*uercus helferiana* (Hlai), *Quercus serrata* (Sasua) and *Vitex peduncularis* (Thingkhawilu) produce comparatively much less smoke on burning as compared to the other species.

Easily flammable fuelwood species take less time to start fire and thereby reduce the trouble of initial burning operation. Among all the species *Castanopsis tribuloides* (Thingsia), *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil) and *Quercus xylocarpa* (Then), were found to be easily flammable.

Sparking from the fuelwood during burning is an undesired quality, as it may create hazards to nearby or around the burning places. Though the respondents did not mention this quality criterion frequently for selection of fuelwood, they indicated that except *Toona ciliata* (Tei) and *Wightia speciosissima* (Chawngtlai), the other species under the present study had very little sparking behaviour.

Though *Bischofia javanica* (Khuangthli), *Callicarpa arborea* (Hnahkiah), *Styrax serrulatum* (Hmarhleng) and *Tetrameles nudiflora* (Thingdawl) showed light weight when dry, but they were found to be incompatible for the most favoured fuelwood quality criterion such as fast drying, hot flame, ability to produce ember etc.

Four species like *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil), *Quercus xylocarpa* (Then) and *Vitex peduncularis* (Thingkhawilu) were producing bright flame while *Acrocarpus fraxinifolius* (Nganbawm), *Bischofia javanica* (Khuangthli), *Macaranga indica* (Hnahkhar), *Macropanax dispermus* (Phuanberh) and *Toona ciliata* (Tei) produces less bright flame compare to other species.

Easiness of splitting as one of the favorable character of fuelwood, species like *Callicarpa arborea* (Hnahkiah), *Ficus semicordata* (Theipuithing), *Macaranga indica* (Hnahkhar), *Macropanax dispermus* (Phuanberh), *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil), *Quercus serrata* (Sasua), *Quercus xylocarpa* (Then) and *Wendlandia grandis* (Batling) were foumd to be easy to split from the original wood log. Species such as *Albizia procera* (Kangtekpa), *Anogeissus acuminata* (Zairum), *Albizia thompsonii* (Thingri), *Mesua ferrea* (Herhse), *Sterospermum personatum* (Zihnghal) though they possess higher quality of other criteria, they were hard to split.

Most of the species contains low moisture while species such as *Adina cordifolia* (Lungkhup), *Bischofia javanica* (Khuangthli), *Ficus semicordata* (Theipuithing), *Macaranga indica* (Hnahkhar), *Macropanax dispermus* (Phuanberh), *Styrax serrulatum* (Hmarhleng) and *Tetrameles nudiflora* (Thingdawl) possess high moisture during fresh cutting period.

Fuelwood when set to fire differs on the period of burning (***i.e.*** long flame), species such as *Anogeissus acuminata* (Zairum), *Derris robusta* (Thingkha), *Mesua ferrea* (Herhse), *Quercus floribunda* (Thal), Q*uercus helferiana* (Hlai), *Quercus pachyphylla* (Fah), *Quercus polystachya* (Thil),

Quercus xylocarpa (Then), *Schima wallichii* (Khiang) and *Vitex peduncularis* (Thingkhawilu) shows longer duration of burning/flaming.

Thus, the matrix ranking of fuelwood species for the first rank is *Quercus pachyphylla* (Fah) followed by *Quercus xylocarpa* (Then), *Quercus polystachya* (Thil), *Vitex peduncularis* (Thingkhawilu), *Schima wallichi* (Khiang), *Quercus serrata* (Sasua), *Quercus floribunda* (Thal), Q*uercus helferiana* (Hlai), *Castanopsis tribuloides* (Thingsia), *Derris robusta* (Thingkha), *Sterospermum personatum* (Zihnghal), *Mesua ferrea* (Herhse), *Wendlandia grandis* (Batling), *Albizia procera* (Kangtekpa), *Anogeissus acuminata* (Zairum), *Myrica esculenta* (Keifang), *Callicarpa arborea* (Hnahkiah), *Eleocarpus lanceofolious* (Kharuan), *Macaranga indica* (Hnahkhar), *Styrax serrulatum* (Hmarhleng), *Albizia thompsonii* (Thingri), *Albizia chinensis* (Vang), *Adina cordifolia* (Lungkhup), *Tetrameles nudiflora* (Thingdawl), *Bischofia javanica* (Khuangthli), *Wightia speciosissima* (Chawngtlai), *Toona ciliata* (Tei), *Macropanax dispermus* (Phuanberh), *Acrocarpus fraxinifolius* (Nganbawm) and *Ficus semicordata* (Theipuithing).

The community matrix ranking of fuelwood species in the study area was prepared from selected twenty key informants with equal number of men and women in each site considering their long experiences with fuelwood use. The result shows that *Quercus pachyphylla* (Fah) rank first as these species achieve the highest point in 4 quality criterion. *Quercus xylocarpa* (Then) rank second with 3 highest point followed by *Quercus polystachya* (Thil) with 3 highest point but low point in light weight after dry. *Vitex peduncularis* (Thingkhawilu) comes at the fourth rank though it attains high points in many criteria but as the species availability is low, heavy weight when dry and problems of splitting. *Schima*

wallichi (Khiang) had problems of fast drying, smoky, flammability and splitting, thus, it comes to fifth rank. In the same manner, other species though they may possess good quality in some quality criteria, their total score is affected by low points in other criteria as seen in the table.

5.3.2. Fuelwood Value Index (FVI):

Density, moisture content, ash content and calorific values of the fuelwood species along with their fuel value indexes are given in **Table 16**. Community ranking of species revealed that *Quercus pachyphylla* (Fah) was the most preferred firewood species, followed by *Quercus xylocarpa* (Then), *Quercus polystachya* (Thil), *Vitex peduncularis* (Thingkhawilu), *Schima wallichii* (Khiang) and *Quercus serrata* (Sasua). Some of the least preferred firewood species were *Toona ciliata* (Tei), *Acrocarpus fraxinifolius* (Nganbawm), *Macropanax dispermus* (Phuanberh), *Wightia speciosissima* (Chawngtlai) and *Ficus semicordata* (Theipuithing).

Among the selected fuelwood species *Quercus polystachya* (Thil) has the highest calorific / energy value (19.75 KJ/g), followed by *Messua ferrea* (Herhse) (19.05 kJ/g), *Anogeissus acuminata* (Zairum) (19.2 KJ /g), *Quercus pachyphylla* (Fah) and *Vitex peduncularis* (Thingkhawilu) (19 KJ/g). Of these, *Messua ferrea* (Herhse) showed higher ash content (1.85%) and lowest in *Vitex peduncularis* (Thingkhawilu) (1.43%) followed by *Anogeissus acuminata* (Zairum) and *Quercus pachyphylla* (Fah) and *Quercus polystachya* (Thil) (1.73%). The least calorific value was shown by *Tetrameles nudiflora* (Thingdawl) (10.04 KJ/g) and *Macropanax dispermus* (Phuanberh) (10.03 KJ/g). The highest moisture content was observed in *Ficus semicordata* (Theipuithing)

(58%) followed by *Tetrameles nudiflora* (Thingdawl) (56%) and *Albizia chinensis* (Vang) and *Callicarpa arborea* (Hnahkiah) (55%).

Overall, the biomass–ash ratio was the highest for *Quercus pachyphylla* (Fah) and *Quercus polystachya* (Thil) (60), followed by *Quercus serrata* (Sasua) (55), *Callicarpa arborea* (Hnahkiah) and *Schima wallichii* (Khiang) (54), *Messua ferrea* (Herhse), Q*uercus helferiana* (Hlai) and *Vitex peduncularis* (Thingkhawilu) (50), *Quercus xylocarpa* (Then) and *Styrax serrulatum* (48), *Wendlandia grandis* (Batling) (45), *Quercus floribunda* (Thal) and *Sterospermum personatum* (Zihnghal) (44), and the value was the lowest in *Albizia procera* (Kangtekpa) (23).

Among the species with high calorific value, *Messua ferrea* (Herhse) showed the highest wood density (0.58 g/cm2). *Anogeissus acuminata* (Zairum) showed the highest fuelwood index value (1370) with its low ash content, high wood density and low moisture content. The species of *Quercus pachyphylla* (Fah) (1361), *Vitex peduncularis* (Thingkhawilu) (1276), *Messua ferrea* (Herhse) (1244), *Quercus polystachya* (Thil) (1210), *Quercus xylocarpa* (Then) (1193), Q*uercus helferiana* (Hlai) (1110) and *Quercus serrata* (Sasua) (1077) were found to be highly desirable firewood species based on fuelwood value index. The least desirable species were *Bischofia javanica* (Khuangthli), *Macropanax dispermus* (Phuanberh) and *Tetrameles nudiflora* (Thingdawl) primarily due to their low energy value, low density, high moisture content and high ash content.

According to local people, an ideal firewood species is the one that gives comparatively better heat during combustion and a long lasting fire; it must be heavy, but with low water content, and must not produce too much ash. Among the high-ranking species, almost all had high energy values and densities,

and low moisture and ash contents, supporting the relationships reported by Purohit and Nautiyal (1987). Due to its low ash content, high wood density and low moisture, *Anogeissus acuminata* (Zairum) was found to be the most desirable firewood with the highest FVI value. These preference indicators are very much related to high energy value, high density, low ash content and low moisture content (Purohit and Nautiyal, 1987).

5.4. Consumption pattern of fuelwood by the people:

5.4.1. Daily and Per capita consumption:

The fuelwood consumption pattern (daily consumption and per capita per year consumption) were given in **Table 17**. Weight of 1 bundle of fuelwood measured using weight balance is taken on an average as 2 kg. Average daily consumption per household in each is represented in kilogram. Average number of day one household goes with 1 bundle is calculated. Among the surveyed sites, **Site 2** had maximum consumption of fuel wood with 3241.6 kg, followed by **Site 1** with 2978.5 kg, **Site 6** with 1836 kg, **Site 5** with 1561 kg and least by **Site 8** with 684 kg (**Table 17**). The total daily consumption of fuelwood in the 8 study sites is 14,015.6 kg.

The per capita consumption is represented in tonnes/cap/year (**Table 17**). Among the surveyed sites, **Site 1** had maximum per capita consumption of fuelwood with 228.83 tonnes/cap/year, followed by **Site 4** with 206.83 tonnes /cap/year and the least by **Site 6** with 92.01 tonnes/cap/year. In total, the per capita consumption of fuelwood in the selected 8 sites is 1242.15 tonnes /cap/year (**Figure 11**).

Though there are some households using both LPG and fuel wood, these were negligible as compared to those using fuel woods only. Some households sold their surplus fuelwood collection in the market. Distribution of fuel wood species in the study sites has large effect upon the availability of the individual species in the study area. Particular fuelwood species were preferred in each village as the study sites covered different areas as shown in **Figure 2.**

5.4.2. Consumption of fuelwood per season:

Consumption of fuelwood was highest in Hnahlan forest range followed by Phullen, Bairabi, Ngopa, N. Hlimen, Kawrthah and Farkawn forest range while it was least in Phuldungsei forest range. Consumption of fuelwood was highest during winter season (***i.e.*** November – February) followed by rainy season (***i.e.*** June – October) and least during summer season (***i.e.*** March – May). Highest consumption of fuelwood during winter season was ascribed to varied use of fuelwood such as domestic cooking, cooking for pig food and for room heating / warming, charcoal making, for making fermented rice beer/wine and for ceremonial use. Fuelwood consumption in rainy season however was higher compared to summer obviously related to warm living rooms. The major utility of fuelwood throughout the study area is for cooking food **(Table 18)**.

The surveyed villages under Hnahlan forest range experienced colder weather being located at high elevation compared to other sites. Moreover, the sites is more remotely located where transportation for LPG cylinder is a big hindrances for replacing them once it was used up whereas the surveyed villages under Phuldungsei forest range are located in warmer region and are better

positioned to have regular LPG supply, thereby lowering the households dependence on fuelwood.

Consumption of fuelwood was lowest in Kawrthah forest range and during winter, Farkawn forest range consumed least fuelwood as the strength of population in these forest range is less compared to other forest range. Less consumption of fuelwood in Kawrthah forest range could also be ascribing to ease replacement of gas cylinder, an alternate source for utilisation of fuelwood for cooking purpose. Farkawn forest range had abundant availability of good quality of fuelwood species; this might have resulted into lower consumption of fuelwood.

5.5. People's dependence on NTFPs:

The understand the dependency on various NTFPs by the local people living in and around the forests, data are collected in the field of seasonal availability, pattern of utilization of medicinal plants, pattern of consumption on food item, pattern of consumption of fruit, fodder, broomsticks, fuelwood, thatching, bamboo pole and charcoal (**Figure 20**).

5.5.1. Seasonal availability:

The seasonal availability of various food and fruit plants recorded are shown in **Table 19** and **20**. Among food plants, 18 species lasts for the whole year and the other 42 species lasts for 4 – 6 months in a year (**Table 19**). Fruit plants were available for specific period of time varying with the plants and none of the fruits were available for the whole year (**Table 20**). **Table 19** shows the seasonality and utilization of food plants and **Figure 9** shows the various parts

used for food items. **Table 20** shows the seasonality of fruit plants by the people especially the villagers living in and around the forest.

The seasonality of various forest products provide useful supply to the people in the state during slack period to a great extend. Food and fruit species which last for the whole year accounts for higher annual income. This record is useful in calculating the income from various markets in Aizawl City.

5.5.2. Pattern of utilization of medicinal plants:

Various uses of medicinal plants to cure different ailments were shown in **Table 21**. The plants are used to treat common diseases like diarrhoea, dysentery, stomach problem, fever, ulcer, kidney troubles, influenza, eye problem, cut and wounds, as antiseptic, skin problems, sore, boils, rheumatism, blood pressure problems, tooth problems, food allergy, placenta, astringent, jaundice, tonsil problems, nausea, diabetes, strains, dropsy.

Though the total number of medicinal plants found in the study area was 200, 228 medicinal plant parts were used for curing different ailments because the species when counted for part wise utilization, different parts of the species are used for different ailments. The result indicates that 228 different parts of the medicinal plants were used to cure different ailments.

The result shows that for remedial purposes, highest numbers of leaves were used singly or in combination with the same plant/other plants. It is observed from the result that least number of flower parts of the plant is utilized for curing different ailments. The result clearly shows that among medicinal plants, highest ingredients were obtained from tree species.

Table 25 shows the total annual consumption of medicinal plants to cure different ailments in the surveyed villages is 3.35 metric tonnes (**Figure 12**). Medicinal plants is collected and used up a year from the forests. Highest consumption is observed in **Site 1** with 1.4 metric tonnes and least consumption is observed from **Site 4** with 0.055 metric tonnes/year.

The result is obtained from the interview with the local herbal practitioners in each site. The calculation is done through how much medicinal plants were utilized by the practitioners in a year. The quantity is converted in kilogram first and then to metric tonnes.

5.5.3. Pattern of consumption of food plants:

Table 22 shows the different parts of the edible plants consumed by the people. There were in total 70 number of edible plant parts consumed as food material. Tree species provide 24 plant parts, shrub 17, herbs 19, climber contribute 7 parts and bamboo 4 parts. The highest number of edible plant parts is shown by leaves of the plant with 20 numbers of species ***i.e.*** 28.57 % of the total species consumed followed by 11 species of the shoot parts ***i.e.*** 15.71 %. 8 species of fruiting body, 6 tender pith/flesh, 5 whole plant, 5 tuber/rhizome/bulb, 4 spadix, 4 pod, 3 flower, 2 bud, 1 root and 1 seed (**Figure 13**).

The result indicates that 70 plant parts were used out of the 60 edible plants recorded. This means that more than one part of the species were consumable. The result shows that the number of plant parts exceeds the number of available plants by 10 numbers. Out of 60 edible plants, the consumable whole plant is from herb species with 5 numbers. The highest consumption of edible

plant part comes from leaves followed by the shoot parts. Tree species provide highest edible part for consumption.

The total annual consumption of edible food plant as shown in **Table 25** is 110.3 metric tonnes to meet their daily requirements (**Figure 13**). The highest consumption is observed from **Site 2** with 22.5 metric tonnes followed by **Site 6** with 20.65 metric tonnes and least consumption is observed from **Site 4** with 5.75 metric tonnes.

The result is maintained for the studied villages. The result is obtained through the questionnaire from the people involved in extracting edible food plant from the forests.

5.5.4. Pattern of consumption of fruit plants:

Table 25 shows the total annual consumption of edible fruit is 50.72 metric tonnes to improve their health (**Figure 14**). Besides, these fruits served as good source of income to the local communities by way of selling these products. The wild fruit gathered from the forest were edible and very diverse where consumption is highest in **Site 2** with 10.8 metric tonnes and least in **Site 4** with 2.76 metric tonnes a year (**Figure 14**).

Local people utilized wild edible fruits to improve their health. Besides, these fruits served as good source of income to the local communities by way of selling these products. The wild fruit gathered from the forest were edible and very diverse (**Table 20**). This result shows the consumption by the surveyed villages only.

5.5.5. Pattern of consumption of fodder:

The daily and annual consumption of fodder in the study site is calculated and represented in **Table 23**. For Cattle and Mithun, it is 4 kg/day; for Horse 3 kg/day; for Goat and Pig 1 kg/day. The total daily consumption of fodder is 3894 kilogram. The total annual consumption is 1317.29 metric tonnes (**Figure 15**). The consumption is highest in **Site 6** with a total of 700 kg daily and 255.5 metric tonnes annually. The consumption is least in **Site 3** with a total of 275 kg daily and 100.38 metric tonnes a year.

The results are obtained from the surveyed villages and the number of livestock is calculated from the local NGO pre-survey. The average daily consumption for each livestock is maintained through the local people feeding pattern. The calculation is done separately for each livestock as the daily average consumption quantity is different.

5.5.6. Pattern of consumption of broomstick:

The consumption of broomsticks in the study sites was represented in **Table 24**. This was collected from the nearby forests and dried for use. The surpluses if any were sold to the village market as well as to the city market. It was found that few households buy this product from the local market while almost all the household in the city do not gather from adjacent forest rather preferred purchasing from the market. The average quarterly fresh consumption of broomstick per household is maintained which ranges from 6 kg to 7 kg quarterly ***i.e.*** 4 months. The total daily consumption is 26,494 kg and the total annual consumption is 105.96 metric tonnes (**Figure 16**). The consumption is highest in **Site 2** with 6078 kg per day and 24.31 metric tonnes per year followed

by **Site 1** with 5276 kg/day and 21.1 metric tonnes /year. The consumption is least in **Site 8** with 1197 kg/day and 4.79 metric tonnes /year.

Out of the total of 4210 households surveyed, broomstick was the most common NTFP used by each household in the area (**Table 24**). This was collected from the nearby forests and sun-dried for use. The surpluses if any were sold to the village market as well as to the city market. It was found that few households buy this product from the local market while almost all the household in the city do not gather from adjacent forest rather preferred purchasing from the market.

Table 24 shows that the consumption is calculated through the fresh collection of broomsticks. The consumption is maintained quarterly as the consumption per month may not be appropriate for calculation. The average quarterly fresh consumption per households is maintained after interviewing with the people how much is consumed in 4 months and then the average is taken for each site.

5.5.7. Pattern of consumption of thatching:

The total annual consumption of thatching in the study sites is 40.31 metric tonnes (**Figure 17**). The consumption of thatching is highest in **Site 6** with 12.5 metric tonnes and lowest in **Site 4** with 0.42 metric tonnes (**Table 25**).

The consumption of thatching / roofing is mainly for house roofing. The local people used species like *Imperata cylindrica* (Di), *Licuala peltata* (Laisua), *Borassus flabellifer* (Siallu) etc. for roofing purposes. The calculation is done through the record provided by the village headmen based on the number of

roofing house available in each village. The person involved in construction of roofing houses was again interviewed and then the results were calculated.

5.5.8. Pattern of consumption of bamboo pole:

The total annual consumption of bamboo pole for various purposes is 47 metric tonnes per year (**Figure 18** and **Table 25**). The consumption is highest in **Site 2** with 9.79 metric tonnes followed by **Site 1** and **Site 6** with 7 metric tonnes each. The consumption is least in **Site 4** with 3.04 metric tonnes. Bamboo poles are use for house construction, for fencing and for furniture making.

Bamboo poles had a wide range of use in the sites. Local people use it for house construction, local bridge construction, for fencing and for furniture making.

5.5.9. Pattern of consumption of charcoal:

The consumption of charcoal for domestic purposes calculated from the eight different forest range shows that the annual consumption is 3.998 metric tonnes (**Table 25**). **Figure 19** shows the consumption is highest in **Site 2** with 1.14 metric tonnes followed by **Site 1** with 0.995 metric tonnes and least consumption by **Site 4** with 0.185 metric tonnes a year.

Many people in the forest ranges are involved in making charcoal out of wood from the forests. These charcoal were utilized for cooking and for making them warm. The main species used for making charcoal includes *Anogeissus acuminata* (Zairum), *Schima wallichii* (Khiang), *Vitex peduncularis* (Thingkhawilu) etc. The calculation is done through local people involved in making charcoal.

5.6. Contribution of different NTFPs to the household economics:

5.6.1. Monetary contribution:

Table 26 and **27** shows that out of the various NTFPs, fuelwood provided maximum annual income irrespective of sites, followed by bamboo Pole, broom grass, bamboo shoot, edible leaves, mushroom, charcoal, edible fruits, thatching and least income by fodder. Fuelwood alone contributed more than 40% of NTFPs income to household economics. The other NTFPs in terms of their economic importance in the survey villages were in the order of bamboo pole > broomgrass > bamboo shoots > edible leaves > mushroom > charcoal > edible fruits > thatching > fodder. (**Figure 21-28**).

Most NTFPs such as edible leaves, edible fruits, bamboo shoot, mushroom were consumed by the household level to improve dietary requirement while the supply quantity were sold at the local market to fetch cash. However, the other NTFPs like fuelwood, broom grass were mostly sold for income generation than household consumption. The NTFPs species which contributed to thatching were *Imperata cylindrica* (Di), *Licuala peltata* (Laisua) and *Borassus flabellifer* (Siallu) etc. and these NTFPs were mostly used for house roofing, pig-sty and for godown or store house making and for temporary sheds. Charcoal was found to be yet another important NTFPs product which contributed good amount of income to the household. Many charcoal collectors burn the fallen woods, shrimps in the forest to make charcoal and it was found to be a very popular way for income generation, as there is a heavy charcoal demand in Aizawl, the capital city of Mizoram. The charcoal collected from various forest ranges are routed to the capital city for better income return to the households.

5.6.2. Comparison of NTFPs contribution to the households with agricultural commodities:

A comparison made from different source of income in the surveyed area **(Table 28)** reveals that NTFPs contribution to the household income is quite commendable. Although NTFPs are available in low quantities and consumed mostly at the household level, their contribution to the household income with other farm activities is significant. NTFPs such as cane, young shoots of bamboo, spadix of *Musa* spp. etc. were not available in jhum fields but were available in plenty inside the forests. NTFP from orchards require a gestation period of 3-5 years; therefore farmers mostly avoid growing NTFPs in the orchards and instead collect these from forests.

Various products of NTFPs for **e.g.** bamboo shoots etc. are available at different seasons. The collectors preferred the NTFPs over Orchards as these provide immediate income. Marketing of orchard products are yet not that rosy than that of NTFPs. The income collected from Orchards become less even after collected from the field as these products were not sold immediately. The annual contribution of NTFPs to the household income varied between ` 4,500 (**Site 2**) to as high as ` 6.500 (**Site 8**). Similarly, contribution from Jhum cultivation to the households was better in **Site 8** followed by **Site 4** and **Site 6**. Employment contributed maximally to the household income at **Site 4** while income from other sources was more at **Site 1** and **Site 5**.

5.7. Status of NTFPs through market survey:

The quantity of various NTFPs of both food and fruit available in the market is recorded as shown in the **Table 29** and **Table 30**. Five markets were

surveyed which includes New market, Mission Veng market, Chanmari market, Bawngkawn market and Zemabawk market. The annual amount of NTFPs available in the markets and income generated from those NTFPs were recalculated as follows:

5.7.1. Food:

The total quantity of various NTFPs available in five markets for food items comes to 60,926 kg/year. The annual income of five different markets in Aizawl town is shown in **Table 29** and the **Figure 29** which clearly depicts that largest and highest income for food item is from New Market with ` 7,09,800 followed by Mission Veng market with ` 6,07,580; Zemabawk market with ` 3,48,240; Chanmari market with ` 2,99,500 and the least income is from Bawngkawn market with ` 2,70,640. **Table 29** clearly shows that the total annual income from food alone in the five selected markets within Aizawl city accounts to ` 22,35,760.

5.7.2. Fruit:

The total quantity of various NTFPs available in five markets for fruit items comes to 1,19,328 kg/year (**Table 30**). **Figure 30** shows that highest income for fruit items is from New market with ` 10,17,258 followed by Mission veng market with ` 5,01,442; Zemabawk market with ` 4,99,356; Chanmari market with ` 3,16,856 and the least income is from Bawngkawn market with ` 2,66,000 and **Table 30** shows that the total annual income from fruit from the selected 5 markets in Aizawl city accounts for ` 26,00,912. Thus the total annual

income from food and fruit species sold in five different markets in Aizawl city are ` 48,36,672.

From the **Figure 29** and **Figure 30**, it is clear that the income from fruit is much more abundant than food. This is due to the fact that fruiting period is longer than the season for food species. It is also due to that fruit are produced in large amount and the income from fruit items is higher depending upon the season. Some fruits like *Musa paradiasica (*Balhla) and *Carica papaya* (Thingfanghma) etc. last for the whole year which accounts for higher annual income for fruiting species. The number of species studied for fruit is also greater than that of food species.

Thus, selling of NTFPs by exploiters / collectors is highly profitable because ` 48,36,672 is annual income from selling NTFPs from the selected five different markets studied in Aizawl city. Most city dwellers are highly depending upon NTFPs for their daily sustenance.

5.8. Pearson correlation coefficients analysis of NTFP in northern Mizoram:

The p-values measure the strength of the correlation coefficients. As a rule, p-values <0.05 means that there is linear correlation and the relation is strong. When the p-values are large, there may be linear correlation, but the correlation is not significant. At the stage of the SPSS processing of data, the variables whose p-values were greater than 0.05 did not have the asterisks(s), which showed that they were not significant, hence they were dropped. Consequently, all the correlation coefficients in table 1, are significant and the

two variables are linearly correlated at the 1-tail of either 5% (*) or 1% (**) levels of significance.

Based on the correlation coefficient value, the economic advantage of NTFPs can either be attained or disadvantaged. For examples when a NTFPs has acquired high education, there will be a corresponding increase in volume of sales per week. This will multiply into higher profit and avoid middle men inference and thus lead to the creation of employment, generation of income in northern Mizoram.

All the surveyed households in the forest ranges has high non formal and primary educational qualifications. **Site 6** was the highest in non formal education, while **Site 1** recorded the highest in primary education. **Site 4** had the highest of secondary education. This shows that as at present, NTFP is being sold only at the local market and majority of them are of low educational qualifications.

At 84.2%, the bamboo pole business was most invested in by **Site 6** investors, followed by **Site 1**, 50%. However, the community performed the least in firewood and charcoal businesses. **Site 5** investors recorded 90% in firewood business, seconded by **Site 4**. A higher percentages of the households surveyed were founding collecting their bamboo pole and firewood from natural forests. This is reflected in the percentages of 31.8%, 26.3%, 58.8%, 20%, 55%, 33.5%, 36% and 41.2% for **Site 1, Site 2, Site 3, Site 4, Site 5, Site 6, Site 7** and **Site 8,** respectivley. Alternatively, the cultivated farm sources for the communities are 9.1%, 21.1%, 17.6%, 30%, 25%, 20%, 25.5% and 28%. **Site 1** sourced 40.9% of its NTFPs from the market. The cost of a bundle of NTFP is on the average ` 50 – 100[3]. This is reflected in the high percentages of 40.9% in **Site 1**, 57.9% in **Site 2**,

29.4% in **Site 3**, 10% for **Site 4** and **Site 5**, 35.2% in **Site 6**, 30% in **Site 7** and 15.4% in **Site 8**. However, for the cost of ` 101 – 150 per bundle showed an outlier of 70%. But the sale price is mainly ` 100 – 200 per bundle. This implies a gross profit of ` 50 to ` 100 per bundle. However. **Site 1**, **Site 3, Site 6** and **Site 7**, the profit is higher, because sales price per bundle was up to ` 201 – 300.

At **Site 1**, 63.6% made a profit of < ` 1000, while **Site 2,** 94.7% made the same profit per week. **Site 3, Site 5, Site 6 Site 7** and **Site 8** showed the same profit range, but at 64.7%, 85%, 58.2%, 65.5% and 64.2% respectively. The least profit were made by **Site 4** with 30%. These are small amounts in annual values, which only benefits the investors in income (**Site 4** and **Site 5**), profit (**Site 1, Site 2** and **Site 6**), employment in **Site 1** and **Site 8** and improving living standard (**Site 3**). These benefits are largely used in feeding, and/or savings. This shows that the full potentials of NTFPs have not been realized in the study area. Most of the investors in NTFPs are on full time bases. This was the case for **Site 1** (68.2%), **Site 3** (88.2%), **Site 5** (95.0%) and **Site 8** (64.4%). However, **Site 4** has a high record of part time involvement in business of 80%. This high full time involvement and the small monetary benefits show that the time value of money for the investors is not realized. As a result, they will be unable to meet with future costs/expenses from the investment of their time in NTFPs.

The main constraints to the NTFPs collectors are lack of market access, competition and seasonal change effects. Our results suggest that differentiating variables are educational qualifications, type of NTFPs traded in, sources of collection in each forest range. Some government policies are also relevent to affect NTFPs business. Nevertheless NTFPs could be a viable option to promote economic development of the households in all the forest range

provided the state government come up with a clear policy on NTFPs management and promote the forest dependent people on various issues of NTFPs.

SUMMARY AND CONCLUSIONS

Although documentary proofs and some instance on Timber Forest Produce are available, they are scattered here and there and inadequate and non-exhaustive; they can, of course, supplement and provide material assistance to the proposed work. An exhaustive research on locally indigenous resources of NTFPs will bring about field based data information on the occurrences, ecological distribution, habit and habitat, form of uses or purposes, local extraction and management, the legal regulations, socio-economic significance for development of the rural community. In the state, locally a large number of vendors are involved in selling NTFPs. Many of them sell products collected by them for making extra income; others are supported by a network of merchants and several levels of buyers and sellers. The main products locally sold include fruits, leaves, tubers, bags, baskets, mats, thatch and other building materials, medicinal plants etc. Local traders and merchants are the main intermediates who buy NTFPs cheaply from collectors and sell them o exporters or processor or their agents at a higher price. Thus, the main different marketing channel from producers to the final consumer is producer – village trader – primary wholesaler – secondary wholesaler – retailer – consumer. Provision of steady and efficient transport is vital for affecting the sales in distant markets. Head loading is most common practice to carry the produce.

As the research work focuses on Non-Timber Forest Products (NTFPs) of plant origin and livelihood strategies in Northern Mizoram, India, the work mainly deals with NTFPs of plant origin available in the northern part of Mizoram utilized by the rural populace.

The results obtained from the study reveals that Mizoram is very rich in NTFPs diversity covering broadly medicinal plants, wild fruit plants, wild edible plants, fodder plants, fuel wood species, ornamental plants, bamboo, cane and palm species, among which the most important and preferred species by the communities are *Quercus pachyphylla* (Fah), *Vitex peduncularis* (Thingkhawilu), *Macaranga indica* (Hnahkhar), *Messua ferrea* (Herhse), *Anogeissus acuminata* (Zairum), *Quercus polystachya* (Thil) for fuelwood; *Mellocana bambosoides* (Mautak), *Agaricus campestris* (Mau pa), *Alocacasia formicata* (Baibing), *Amomum dealbatum* (Aidu), *Musa acuminata* (Tumbu), *Calamus flagellum* (Hruipui), *Zalacca secunda* (Hruitung), *Entoloma macrocarpum* (Pasawntlung), *Adiantum caudatum* (Chakawkria) for food; *Castanopsis tribuloides* (Thingsemim), *Emblica officinalis* (Sunhlu), *Bruinsmia polysperma* (Theipalingkawh), *Ficus semicordata* (Theipui), *Juglans regia* (Khawkherh), *Cinnamomum verum* (Thakthing), *Rhus semialata* (Khawmhma), *Protium serratum* (Bil) for fruit; *Saccharum longisetosum* (Luang), *Musa acuminata* (Changel), *Mikania micrantha* (Japanhlo), *Colocasia esculenta* (Dawl), *Ipomea batatas* (Kawlbahra), *Manihota esculenta* (Pangbal) for fodder; *Oryxylum indicum* (Archangkawm), *Lepionurus sylvestris* (Anpangthuam), *Dillenia pentagyna* (Kaihzawl), *Cinnamomum verum* (Thakthing), *Chromolaena odorata* (Tlangsam), *Alstonia scholaris* (Thuamriat), *Ageratum conyzoides* (Vaihlenhlo), *Mikania micrantha* (Japanhlo), *Helicia robusta* (Pasaltakaza), *Mimosa pudica* (Hlonuar), *Centella asiatica* (Lambak / Hnahbial) for medicinal plants (Lalramnghinglova, 1992).

The important NTFP which are produced in large scale such as edible plants include bamboo shoots, mushroom, tree beans, many wild leaves and fruits

come to the market. The market survey indicates that there is huge amount of income generated from wild edible food plants and fruit plants.

Almost all the people / household participated in collection of one or more forms of NTFPs. For example, the entire household required broomstick for domestic use which were found in the entire household. Likewise, bamboo shoot is extensively consumed by almost all the household during its season to supplement household agricultural requirements. From the surveyed it is found out that local people dependence on NTFPs is very less as compared to that of their dependence on agricultural products. This may be because of their farming system ***i.e.,*** shifting cultivation wherein vast areas of forests were destructed from where these NTFPs are collected. The dependence on medicinal plants for remedial purpose is also less in comparison to the local people dependence on chemical drugs. However, local people extract fuel wood to a large extent for domestic purpose especially in areas where LPG connection is not available. Various kinds of NTFPs were extracted and utilized by the local people but the same people do not realize the gift of the nature and as a result there is no sustainable management for almost all kinds of NTFPs in each study sites.

In rural areas, people largely depend on NTFPs to meet their necessities. They get a better living condition through the use of NTFPs in constructing houses, to meet their daily food requirements and also in improving their economics condition. NTFPs supplements household agricultural benefits through essential nutritional inputs, medicine, fodder etc. Seasonality of forest food also helps to reduce the shortages suffered during “hunger periods” of specially the marginal and shifting population of cultivators and forest dwellers. These NTFPs related activities provide employment during slack period of

agriculture cycle as well as buffer against risk and household emergencies. It plays an important role in improving the economic condition of forest and village dwellers. NTFPs support to a higher nutritional and health standard particularly important in remote upland area without access to preventive or curative medical services. Thus NTFPs play an important role in rural economy through supply of goods and services for food security, health care, employment opportunities to a very large number of people.

It has been shown that the tribals of Mizoram make a wide range of use of a large variety of plants and fruits available to them. Such activities on one hand contributed to our knowledge of various uses of biodiversity and on the other have resulted in rapid depletion of natural resources. Their demand in the local market has increased causing a threat to these wild species. Such plants too may become the vegetable for the future. Although these wild edible plants wealth are in use, to meet future needs, this invaluable treasure of native diversity needs care and in depth research focusing on its collection, conservation and sustainable use. The overexploitations of medicinal resources in unscientific manner by unskilled labour and poor natural or artificial regeneration result have resulted in virtual extinction of certain vital species. The demands of medicinal plants are increasing day by day within and outside the country and serious and effective measures are required to meet the challenge. Therefore there is an urgent need for a local inventory of medicinal plants, to identify the species that merit priority and to formulate strategy for the *in-situ* conservation and cultivation of these species.

In remote areas like Mizoram, the dependency on Non-Timber Forest Products (NTFPs) is quite high to meet their needs. In many areas, NTFPs

improves economic condition of the forest and village dwellers. Various localities meet their demand through NTFPs in bamboo house construction, daily food requirements and employment opportunities. In remote areas within the state, people sustain their livilihood through the use of NTFPs as most of the forest dwellers were below poverty lines. The use of medicinal plants for various ailments by the people helps to improve the health status of the poor people.

The abundant availabilty of NTFPs like bamboo, fuelwood, charcoal, broomstick, and grass species meet the people demand for various purposes. Small Industries based on cane and its products were established in villages as well as in the towns and sub-towns. The seasonality of various forest products provides useful supply to the people in the state during slack period to a great extend. The income generated from edible food and fruit alone is very large and the demand of these products in Aizawl is very high.

Based on the income generated by the wild edible food plants, the most promising NTFPs is *Calamus flagellum* (Hruipui) which is abundantly found in the market during the market survey followed by *Zanthoxylum rhetsa* (Chingit); *Zalacca secunda* (Hruitung); *Meloccana baccifera* (Mau tak); *Acacia caesia* (Khanghu); *Musa acuminata* (Tumbu); *Parkia timoriana* (Zawngtah); *Agaricus campestris* (Maupa) and so on.

Based on the income generated by the wild fruit plants, the most promising NTFPs is *Musa paradiasica (*Balhla); *Mangifera indica* (Theihai); *Emblica officinalis* (Sunhlu); *Carica papaya* (Thingfanghma); *Passiflora edulis* (Sapthei); *Citrus medica* (Nimbu); *Bruinsmia polysperma* (Theipalingkawh) and so on.

Among the medicinal plants, the promising NTFPs is selected based on the easy availability and the availability period which includes *Mimosa pudica* (Hlonuar); *Centella asiatica* (Lambak/ Hnahbial); *Dillenia pentagyna* (Kaih-zawl / Hnahkhauh); *Alstonia scholaris* (Thuamriat); *Catharanthus roseus* (Kumtluang); *Curcuma longa*(Aieng); *Oryxylum indicum* (Archangkawm); *Swertia angustifolia* (Khawsik Damdawi); *Pseudodrynaric coronans* (Awmvel) and so on.

Based on the demand-supply chain, the promising NTFPs include *Thysanolaena maxima* (Hmunphiah); Young shoots of *Meloccana baccifera* (Mau tak); Spathe of *Musa acuminata* (Tumbu); Poles of *Bambusa tulda* (Rawthing), *Dendrocalamus longispathus* (Rawnal) and *Dendrocalamus hamiltonii* (Phulrua); *Calamus flagellum* (Hruipui); *Calamus gracilis* (Mitpeh/Kawrtai); *Calamus guruba* (Tairua / Taite); *Melocalamus compactiflorus* (Sairil).

Thus, it can be concluded that about 80% of the rural populace depends on agriculture and forestry products - Non Timber Forest Products for their livelihoods sustenance as well as subsistence. There is a lot of need of market sheds, small processing units and preservation facilities or warehouse at certain clustered apexes. Sustainable harvesting of raw materials and capacity building innovation in this regard is paramountly important, and above all, sustainability of the nature gift is most important for the rural life in Mizoram.

Table 2: Availability and distribution of medicinal plants in the studied area

Sl. No.	Scientific Name	Local Name	Status	Density per hectare in Forest Sites							
				Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
A. Tree species (10m x 10m Quadrat) from 20 Quadrats											
1	*Aegle marmelos* (L) Corr. Ex Roxb.	Belthei	Rare	60	40	45	40	35	55	50	45
2	*Albizia odoratissima* Benth.	Kangteknu	Very common	0	0	80	0	0	70	60	65
3	*Albizia procera* (Roxb.) Benth.	Kangtekpa	Very common	0	0	80	0	0	75	65	50
4	*Albizia chinensis* (Osb.) Merr.	Vang	Very common	40	30	45	70	40	50	65	50
5	*Alstonia scholaris* (L.) R.Br.	Thuamriat	Very frequent	50	40	40	60	50	45	50	70
6	*Anogeissus acuminata* (Roxb.) Wall.	Zairum	Frequent	50	50	45	60	55	65	65	70
7	*Aporusa octandra* (Butch.-Hm. Ex D.Don.)	Chhawntual	Common	50	45	35	35	30	55	60	40
8	*Aquilaria malaccensis* Lam.	Thingrai	Frequent	40	50	30	35	50	45	35	40
9	*Ardisia colorata* Roxb.	Hnunthlum	Common	45	50	60	65	50	45	55	40
10	*Ardisia peniculata* Roxb.	Naunuar	Frequent	60	50	55	65	50	60	40	50
11	*Artocarpus lakoocha* Roxb.	Theitat	Frequent	40	25	35	25	25	30	35	30
12	*Artocarpus chama.* Butch.-Ham.	Tatkawng	Frequent	60	50	55	40	65	55	50	55
13	*Averrhoa carambola* L.	Theiherawt	Rare	50	55	45	55	65	55	60	60
14	*Baccaurea ramiflora* Lour.	Pangkai	Frequent	50	45	40	30	55	50	45	50
15	*Bauhinia variegata* L.	Vaube	Very common	40	50	55	65	60	75	60	50
16	*Bischofia javanica* Bl.	Khuangthli	Frequent	45	35	15	45	20	70	20	40
17	*Bombax ceiba* L.	Phunchawng	Rare	35	15	0	0	35	0	0	0
18	*Bombax insigne* Wall.	Pang	Very common	50	20	25	30	30	40	35	35
19	*Butea monosperma* (Lam.) Taub.	Tuahpui	Common	55	20	25	20	35	40	35	30
20	*Callicarpa arborea* Roxb.	Hnahkiah	Fairly common	40	45	45	50	45	65	40	45
21	*Canarium strictum*Roxb.	Berawthing	Frequent	35	30	40	25	20	30	25	20
22	*Carralia brachiata* (Lour.) Merr.	Theiria	Frequent	60	50	65	50	40	55	60	50
23	*Castanopsis tribulaides* (Sm.) DC.	Thingsia	Common	35	45	60	45	55	70	30	35
24	*Chukrasia tabularis* A. Juss.	Zawngtei	Common	40	25	25	20	15	35	30	30
25	*Cinnamomum bejolghota* (Butch. Ham.) Sweet	Thakthingsuak	Frequent	40	35	45	50	40	50	50	60
26	*Cinnamomum verum* Presl.	Thakthing	Fairly frequent	50	40	50	60	60	60	50	40
27	*Cordia dichotoma* Forst.	Muk	Frequent	0	0	10	15	0	20	15	15
28	*Derris thyrsiflora* Benth.	Hulhu	Frequent	40	35	35	30	40	45	50	35
29	*Dillenia indica* L.	Kawrthindeng	Frequent	75	40	40	60	55	50	45	50
30	*Dillenia pentagyna* Roxb.	Kaihzawl /Hnahkhauh	Very frequent	50	60	45	60	55	65	40	60

31	*Dipterocarpus turbinatus* Gaertn.f.	Lawngthing	Common	30	35	40	30	20	50	40	30
32	*Dysoxylum gobara* (Butch.-Ham.) Merr.	Thingthupui	Common	30	20	20	20	45	55	60	40
33	*Emblica officinalis* Gaertn.	Sunhlu	Abundant	60	65	65	60	70	85	50	70
34	*Erythrina stricta* Roxb.	Fartuah	Common	30	25	30	40	30	40	25	25
35	*Eurya acuminata* DC.	Sihneh (zik sen)	Common	70	50	40	30	60	75	40	35
36	*Ficus bengalensis* Linn.	Hmawng	Common	60	50	40	40	50	40	45	40
37	*Ficus hispida* Linn.	Paihte maian	Very common	40	30	20	35	45	50	35	40
38	*Ficus rostrata* Lam.	Theitit	Frequent	45	45	25	15	40	25	20	20
39	*Ficus semicordata* Butch.-Ham.	Theipui	Frequent	70	80	65	60	50	45	60	60
40	*Garcinia cowa* Roxb. Ex DC.	Chengkek	Frequent	40	50	40	45	30	50	40	35
41	*Garcinia paniculata* (G.Don) Roxb.	Vawmva	Frequent	35	35	25	25	20	30	20	20
42	*Garuga pinnata* Roxb.	Bungbutuairam	Frequent	30	20	15	15	25	30	15	15
43	*Gmelina arborea* Roxb.	Thlanvawng	Fairly common	50	40	30	30	40	30	40	35
44	*Gynocardia odorata* R.Br.	Saithei	Rare	0	0	20	0	0	20	20	24
45	*Helicia excelsa* (Roxb.) R.Br. ex Wall	Sialhma	Rare	60	40	35	25	20	35	50	40
46	*Helicia robusta* (Roxb.) R.Br. ex Wall	Pasaltakaza	Rare	80	40	0	0	50	0	0	0
47	*Hydnocarpus kurzii* (King.) Warb.	Khawitur	Very rare	15	20	0	0	15	10	0	0
48	*Ilex umbellulata* (Wall.) Loes.	Thinguihahni	Common	20	15	15	15	20	20	15	15
49	*Juglans regia* L.	Khawkherh	Rare	20	15	10	20	20	20	15	15
50	*Lagerstroemia speciosa* Pers.	Thlado / Chawnpui	Frequent	55	60	30	40	55	45	45	50
51	*Leea compactiflora* Kurz.	Kawlkar	Frequent	25	25	25	30	20	30	20	20
52	*Lepionurus sylvestris* Bl.	Anpangthuam	Very common	40	70	65	40	25	50	45	50
53	*Litsea cubeba* Pers.	Sernam	Frequent	20	15	15	20	10	15	15	10
54	*Litsea monopetala* Roxb.	Nauthakpui	Frequent	50	40	45	60	60	55	55	50
55	*Livistona cochirensis* Mart.	Buarpui chempai	Cultivated	0	0	20	10	0	10	10	5
56	*Mangifera indica* L.	Theihai	Abundant	25	35	25	30	40	30	30	30
57	*Mesua ferrea* Linn.	Herhse	Common	75	60	70	40	25	70	55	45
58	*Michelia champaca* L.	Ngiau	Fairly common	55	65	65	50	45	55	60	55
59	*Myrica esculenta* Butch.-Ham. Ex D. Don.	Keifang	Rare	40	35	0	10	30	0	0	0
60	*Oroxylum indicum* (L.) Vent.	Archangkawm	Very common	40	55	70	60	20	65	55	75
61	*Parkia roxburghii* D. Don.	Zawngtah	Very common	60	40	35	35	30	25	40	40
62	*Phyllanthus acidus* (L.) Skeels.	Kawlsunhlu	Frequent	10	5	0	15	10	0	0	0
63	*Picrasma javanica* Bl.	Thingdamdawi	Frequent	5	10	10	10	5	10	10	5
64	*Pithecellobium monadelphum* (Roxb.) Kosterm.	Ardahte	Frequent	0	0	5	0	0	10	10	10
65	*Plumeria acuminata* Ait.	Vaingai	Cultivated	0	0	10	0	5	10	10	10

66	*Podocarpus neriifolius* D.Don.	Thlangfar	Rare	0	0	15	0	0	10	10	10
67	*Prunus cerasoides* D.Don	Tlaizawng	Frequent	25	20	0	15	15	0	0	0
68	*Pterospermum acerifolium* Willd.	Siksil	Frequent	10	10	10	15	15	10	5	5
69	*Rhus semialata* Merr.	Khawmhma	Abundant	60	50	65	45	50	70	40	25
70	*Rhus succedanea* L.	Chhimhruk	Common	35	25	30	25	20	10	20	20
71	*Ricinus communis* Linn.	Mutih	Common	5	10	15	10	10	5	10	10
72	*Saraca asoca* (Roxb.) de Wilde	Mualhawih	Rare	0	0	15	0	0	10	10	10
73	*Schefflera elliptica* (Bl.) Harms	Kelbuh	Common	10	15	15	10	25	10	10	10
74	*Schima wallichii* (DC.) Korth.	Khiang	Common	60	50	65	70	65	70	60	65
75	*Semecarpus anacardium* Linn.	Vawmbalpui	Frequent	20	15	20	15	10	10	10	10
76	*Spondias pinnata* (L.f) Kurz	Taitaw	Frequent	50	65	55	60	25	20	30	25
77	*Sterculia villosa* Roxb.	Khaupui	Common	15	15	20	15	10	10	15	20
78	*Stereopermum chelonoides* (Butch. Ham. Ex Dillon.)	Zihnghal	Frequent	0	0	40	0	0	35	30	35
79	*Syzygium cumini* (L.) Skeels.	Hmuipui	Frequent	20	15	15	15	10	10	15	10
80	*Tamarindus indica* L.	Tengtere	Abundant	30	25	35	30	25	20	25	25
81	*Terminalia bellirica* (Gaertn.) Roxb.	Thingvandawt	Common	0	0	25	0	0	30	35	30
82	*Terminalia chebula* Retz.	Reraw	Fairly frequent	10	10	15	15	15	25	30	30
83	*Tetrameles nudiflora* R.Br.	Thingdawl	Very common	10	15	15	10	15	30	30	35
84	*Trema orientalis* (L.) Bl.	Belphuar	Common	10	10	15	15	10	10	15	15
85	*Trevesia palmata* (Roxb.) Vis.	Kawhtebel	Common	50	55	40	45	55	40	20	30
86	*Vitex peduncularis* Wall. Ex Schauer	Thingkhawilu	Common	40	50	45	50	55	60	50	55
87	*Xylia xylocarpa* (Roxb.) Taub.	Thinguk	Common	15	15	10	15	15	10	10	10
88	*Zanthoxylum armatum* DC.	Arhrikreh	Rare	0	0	10	0	0	10	10	10
89	*Zanthoxylum rhetsa* (Roxb.) DC	Chingit	Very Common	30	20	30	25	30	30	25	25
90	*Ziziphus mauritiana* Lam.	Borai	Frequent	30	35	35	25	30	30	25	30
B. Shrub species (5m x 5m Quadrat) from 20 Quadrats											
91	*Artemesia indica* Willd.	Sai	Rare	40	30	0	20	25	0	0	0
92	*Blumea lanceolaria* (Roxb.) Druce.	Buarze	Common	0	0	10	0	0	15	15	15
93	*Borassus flabellifer* L.	Siallu	Very frequent	35	45	60	40	40	50	60	40
94	*Camellia kissi* Wall.	Lallai	Frequent	60	40	20	0	60	20	40	60
95	*Camellia sinnensis* (L.) O. Kuntze.	Thingpui	Frequent	40	40	60	35	40	60	40	40
96	*Cassia alata* L.	Tuihlo	Rare	20	40	60	20	40	60	40	60
97	*Catharanthus roseus* (L.) G.Don.	Kumtluang	Cultivated	40	20	40	60	20	40	20	20
98	*Clerodendrum colebrookianum* Walp.	Phuihnam	Common	35	55	45	60	40	60	30	25
99	*Clerodendrum viscosum* Vent	Phuihnamchhia	Common	30	50	45	40	60	55	40	30

100	*Crotalaria juncea* L.	Tumthang	Cultivated	20	20	40	60	20	40	20	20
101	*Dendrocnide sinuata* (Bl.) Chew.	Thakpui	Common	40	20	40	40	20	60	40	20
102	*Elaegnus caudata* Schl. Ex Mom.	Sarzuk	Abundant	40	40	60	40	40	20	60	40
103	*Embelia subcoriacea* (Cl.) Mez.	Tling	Frequent	0	20	40	60	40	40	20	20
104	*Ervatamea coronaria* (Jack.) Stapf.	Pararsi	Fairly frequent	0	0	20	0	0	20	40	20
105	*Gelsemium elegans* Benth.	Hnamtur	Frequent	20	0	0	20	40	20	40	0
106	*Hedyotes scandens* (Roxb.)	Laikingtuibur/ Kelhnamtur	Common	40	60	45	40	60	60	40	20
107	*Holarrhena antidysenterica (*L.) Wall.	Thlengpa	Common	0	0	40	20	0	40	60	40
108	*Inula cappa* DC.	Buarthau	Common	60	40	35	40	40	40	20	40
109	*Justicia zeylanica* Medicus.	Kawldai	Frequent	40	20	40	60	60	40	45	50
110	*Lantana camara* Linn.	Shillongpar	Very common	40	40	60	40	60	20	40	40
111	*Lyonia ovalifolia* (Wall.) Drude	Tlangham	Frequent	20	40	20	40	40	20	20	40
112	*Mallotus roxburghianus* Muell.-Arg.	Zawngtenawhlung	Very common	0	20	40	20	40	40	40	60
113	*Melastoma malabathricum* L.	Builukham	Frequent	40	60	40	40	60	35	40	55
114	*Mimosa pudica* L.	Hlonuar	Frequent	60	40	60	40	60	40	40	40
115	*Morinda angustifolia* Roxb.	Lum	Common	0	20	40	20	40	20	40	20
116	*Murraya paniculata* (L.) Jack.	Arpatil	Very common	40	20	40	40	20	40	20	40
117	*Mussaenda roxburghii* Hk. F.	Vakep	Common	40	20	40	20	60	40	20	40
118	*Osbeckia nepalensis* Hook.	Builukhampa	Frequent	30	40	60	50	40	80	30	20
119	*Piper diffusum* Vahl.	Pawhrual	Frequent	40	20	0	40	60	0	0	0
120	*Rubus ellipticus* Sm.	Hmutau	Rare	40	60	40	40	60	40	20	40
121	*Securinega virosus* (Roxb.) Baillon	Saisiak	Frequent	55	60	25	30	55	40	20	25
122	*Solanum torvum* Sweet	Tawkpui	Common	40	20	40	40	20	20	40	60
123	*Tinospora cordifolia* (Wall.) Miers.	Theisawntlung	Frequent	0	0	20	20	0	40	20	40
124	*Urena lobata* L.	Leithi	Rare	20	20	0	20	20	40	20	40
C. Herbs species (1m x 1m Quadrat) from 20 Quadrats											
125	*Achyranthes bidentata* Bl.	Vangvattur	Very common	500	1000	500	500	500	1000	500	500
126	*Aeginetia indica* L.	Sangharvaibel	Frequent	500	1000	0	500	500	0	0	0
127	*Ageratum conyzoides* L.	Vaihlenhlo	Rare	1000	1000	1500	500	1000	500	1000	500
128	*Alocasia fornicata* Roxb.	Baibing	Very common	1000	1500	1000	1500	2000	1000	1000	1000
129	*Amaranthus spinosus* Linn.	Lenhling (Mizo); Hadamarik (Chakma)	Fairly common	0	500	1000	500	0	1500	500	1000
130	*Amaranthus viridis* L.	Zamzo	Frequent	500	500	0	1000	500	1000	0	500

131	*Amomum dealbatum* L. Roxb.	Aidu	Cultivated	1000	1500	1000	500	1000	1000	1500	2000
132	*Begonia inflae* Cl.	Sekhupthur	Abundant	500	1000	0	500	1000	500	500	1000
133	*Bergenia ciliata* (Haw.) Sternb.	Khamdamdawi	Common	500	1000	0	0	1000	0	0	0
134	*Bidens pilosa* L.	Vawkpuithal	Rare	1000	1000	500	1000	500	1000	1000	500
135	*Canna indica* L.	Kungpuimuthi	Very common	500	500	1000	500	0	500	500	0
136	*Centella asiatica* (L.) Urb.	Lambak/ Hnahbial	Cultivated	0	500	1000	1000	500	1000	500	500
137	*Chromolaena odorata* (L.) King & Rob.	Tlangsam	Frequent	1000	500	500	500	1000	1000	1000	1000
138	*Costus specious* Smith.	Sumbul	Very common	500	1000	1500	500	1000	2000	1500	1000
139	*Curculigo capitulata* (Lour.) O. Kuntze.	Phaiphek	Very common	500	500	1000	500	500	1500	1000	1500
140	*Curcuma longa* Roxb.	Aieng	Cultivated	500	1000	500	0	500	0	500	0
141	*Datura suaveolens Hamb. & Bruph*	Tawtawrawt par	Very common	0	500	1000	500	0	500	0	500
142	*Eryngium foetidium* L.	Bahkhawr	Common	1000	500	1000	1500	500	1000	500	1000
143	*Girardinia palmata* (Forsk) Gaud.	Kangthai	Very common	500	0	1000	500	0	1000	1000	1000
144	*Hedychium coccineum* Ham.	Aichhia	Abundant	1000	500	500	0	500	500	1000	0
145	*Hedychium spicatum* Buch.-Ham.	Aithur	Rare	0	500	1000	0	500	1000	500	500
146	*Helianthus annuus L.*	Nihawipar	Very common	1000	0	500	1000	500	1000	1500	500
147	*Homalomena aromatica* Schott.	Anchiri	Very frequent	0	0	1500	0	0	500	500	1000
148	*Hydrocotyle javanica* Thumb.	Hlovaidawr	Common	500	500	500	500	0	1000	500	500
149	*Jatropa curcas* L.	Kangdamdawi	Cultivated	0	500	0	500	500	0	500	500
150	*Lindernia ruelloides* (Colsm.) Pennell.	Thasuih	Frequent	1000	500	1000	1500	1000	500	1000	1000
151	*Lobelia niwtianaefolia* Roth. Ex Schultes.	Berawchal	Frequent	1000	1000	0	1000	500	500	0	500
152	*Maesa ramentacea* Wall.	Arngengpui	Frequent	500	500	500	500	0	500	1000	500
153	*Maesia indica* (Roxb.) DC.	Arngeng	Frequent	500	1000	500	500	1000	500	1000	500
154	*Merremia umberlata* (L.) Hall.	Vawktesentil	Common	0	500	1000	500	0	500	1000	500
155	*Mirabilis jalapa* Linn.	Aratukkhuan	Common	500	1000	500	1500	500	1000	500	1000
156	*Musa acuminata* Colla	Changel	Very common	1000	500	1000	1500	500	1500	1000	500
157	*Musa glauca* Roxb.	Saisu	Rare	500	500	0	1000	0	500	500	500
158	*Orthosiphon aristatus* (Bl.) Miq.	Zunthlumkung	Frequent	500	0	500	1000	0	500	1000	1000
159	*Oxalis corniculata* L.	Siakthur	Common	500	500	1000	500	500	1000	500	500
160	*Phrynium capitatum* Wild	Hnahthial	Very frequent	500	500	1500	500	1000	2000	1500	500
161	*Phyllanthus fraternus* Webs.	Mitthisunhlu	Rare	0	500	1000	500	0	500	500	1500
162	*Pogonia plicata* (Roxb.) Lindl.	Phurthakhlo	Frequent	1000	500	0	0	2000	0	0	0
163	*Polygonum barbata* L.	Anbawng	Frequent	1000	500	500	0	500	1000	0	500
164	*Polygonum chinensis* L.	Taham	Frequent	500	1000	0	500	1000	500	1000	1000
165	*Polygonum plebium* R. Br.	Bakhate	Very common	500	500	500	500	0	500	500	1000
166	*Pratia nummularis* Kurz.	Choakthi	Very common	1000	500	1000	500	1500	500	1000	500

167	*Scoporia dulcis* Medic.	Perhpawngcha w/ Hlothlum	Fairly frequent	1000	1000	1500	1000	1500	1000	1500	1000
168	*Solanum nigrum Linn.*	Anhling	Common	1500	500	1000	500	1000	1000	500	1500
169	*Strobilanthes cusia* (Nees) Imlay	Ting	Rare	0	500	0	500	0	500	1000	0
170	*Swertia angustifolia* Ham.ex D. Don **var.**	Khawsik damdawi	Cultivated	0	1000	0	500	0	1500	500	0
171	*Tagetes erecta* L.	Derhken	Very common	500	1500	1000	2000	1000	500	500	1000
D. Ferns species (1m x 1m Quadrat) from 20 Quadrats											
172	*Adiantum caudatum* L.	Chakawkria	Very common	500	1000	500	1000	500	500	0	500
173	*Adiantum phillippense* L.	Chakawkte	Very common	500	1500	500	1000	500	2000	0	2000
174	*Diplazium maximum* (D.Don.) C. Chatt.	Chakawkeichi	Very common	1000	1000	1000	2000	1500	500	0	500
175	*Pteridium acquilinum* (v) Kuhn.	Katchat	Very common	1500	1000	500	1000	500	1000	1500	1000
E. Epiphytes species (1m x 1m Quadrat) from 20 Quadrats											
176	*Aeschynanthus sikkimensis* (Cl.) Stapft.	Bawltehlantai	Frequent	500	0	500	1000	1000	1500	1000	500
177	*Pseudodrynaric coronans* (Wall. ex Mett) Ching.	Awmvel	Common	500	500	1000	500	500	2000	1000	1000
F. Climbers species (1m x 1m Quadrat) from 20 Quadrats											
178	*Cissus javanica* DC.	Sangharhmai	Rare	0	500	0	500	0	500	0	500
179	*Dinochloa compactiflora* (Kurz) McClure.	Sairil	Frequent	500	500	1000	500	500	1500	1000	2000
180	*Dioscorea alata* L.	Bahrachim	Common	500	500	500	1000	500	500	500	1000
181	*Dioscorea bulbifera* L.	Bahra	Frequent	500	500	500	1000	500	500	500	1000
182	*Dregea volubilis* Benth.	Ankhapui	Very common	1000	1000	1500	1000	1000	1500	500	1000
183	*Entada pursaetha* DC.	Kawi	Common	500	1000	500	1000	500	1500	1000	1500
184	*Hodgsonia macrocarpa* (Bl.) Cogn.	Khaum	Frequent	1000	1000	1500	1000	1000	1500	500	1000
185	*Lonicera macrantha* (D. Don) Spreng	Leihruisen	Very frequent	500	1000	1500	500	1000	500	1000	1000
186	*Mikania micrantha* Kunth.	Japanhlo	Abundant	1000	2000	1500	500	1000	2000	2500	3000
187	*Mucana pruriens* (Linn.) DC.	Uiteme	Common	1000	500	1000	500	500	1000	1500	500
188	*Murdannia nudiflora* Linn.	Dawng	Common	500	500	1000	500	1000	500	1500	1000
189	*Paederia scandens* (Lour.) Merr.	Vawihuihhrui	Common	1000	500	1000	500	1000	1000	500	1000
190	*Passiflora nepalensis* Wall.	Nauawimu	Frequent	500	1000	500	1000	500	500	1000	500
191	*Senecio scandens* Butch. Ham. ex D. Don	Saiekhlo	Rare	500	500	0	500	1000	0	0	0
192	*Smilax glabra* Roxb.	Tluangngil	Rare	0	0	500	0	500	1000	500	500
193	*Smilax pervifolia* Roxb.	Kaihapui	Common	500	0	1000	500	0	0	1000	1000
194	*Thunbergia coccinea* Wall.	Fahrah hrui	Frequent	500	500	0	500	500	500	1000	500
195	*Thunbergia grandiflora* Roxb.	Vako, Zawngafian	Fairly common	1000	500	1000	500	500	1000	500	500
196	*Tinospora sinensis* (Lour.) Merr.	Hruivankai	Frequent	500	500	1000	500	1000	1000	1500	1000

197	*Uncaria sessilifructus* Roxb.	Ralsamkuai (ziksen)	Frequent	0	500	500	0	500	500	1000	500
198	*Zanonia indica* Linn.	Lalruanga dawi bur	Very rare	0	0	500	0	0	500	0	500
G. Bamboo and grasses (5m x 5m Quadrat) from 20 Quadrats											
199	*Melocanna baccifera* (Roxb.) Kurz.	Mautak	Abundant	10	10	40	10	15	50	45	40
200	*Imperata cylindiica* (L.) Beauv.	Di	Very common	60	40	20	30	60	20	40	60

* Sites as in Table 1

Table 3: Availability and distribution of important fruit plants in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
A. Tree species (10m x 10m Quadrat) from 20 Quadrats												
1	*Artocarpus lakoocha* Roxb.	Theitat	Moraceae	Frequent	40	25	35	25	25	30	35	30
2	*Artocarpus chama.* Butch.-Ham.	Tatkawng	Moraceae	Frequent	60	50	55	40	65	55	50	55
3	*Artocarpus heterophyllus* Lam.	Lamkhuang	Moraceae	Frequent	55	60	55	85	60	95	80	75
4	*Averrhoa carambola* L.	Theiherawt	Averrhoaceae	Frequent	50	55	45	55	65	55	60	60
5	*Baccaurea ramiflora* Lour.	Pangkai	Euphorbiaceae	Frequent	50	45	40	30	55	50	45	50
6	*Bruinsmia polysperma* (Cl.) Van Steenis	Theipalingkawh	Styraceae	Frequent	35	25	30	60	25	60	55	50
7	*Carralia brachiata* (Lour.) Merr.	Theiria	Rhizophoraceae	Frequent	60	50	65	50	40	55	60	50
8	*Chrysophyllum cainito* Linn.	Theipabuan	Sapotaceae	Frequent	25	45	20	25	20	30	35	25
9	*Cyanthocalyx martabanicus* Champ.	Hreirawt	Anonaceae	Frequent	15	35	30	55	25	35	40	25
10	*Dillenia indica* L.	Kawrthindeng	Dilleniaceae	Frequent	75	40	40	60	55	50	45	50
11	*Emblica officinalis* Gaertn.	Sunhlu	Euphorbiaceae	Abundant	60	65	65	60	70	85	50	70
12	*Eugenia jambolana* Lam.	Lenhmui	Myrtaceae	Abundant	15	40	20	30	25	30	25	20
13	*Euphoria longan* Steud.	Theifeimung	Sapindaceae	Frequent	25	30	25	50	20	35	40	25
14	*Ficus rostrata* Lam.	Theitit	Moraceae	Frequent	45	45	25	15	40	25	20	20
15	*Ficus semicordata* Butch.-Ham.	Theipui	Moraceae	Frequent	70	80	65	60	50	45	60	60
16	*Flacourtia jangomas* (Lour.)	Sakhithei	Binaceae	Frequent	0	10	20	0	0	30	20	25
17	*Garcinia cowa* Roxb. Ex DC.	Chengkek	Clusiaceae	Frequent	40	50	40	45	30	50	40	35
18	*Garcinia paniculata* (G.Don) Roxb.	Vawmva	Clusiaceae	Frequent	35	35	25	25	20	30	20	20
19	*Garuga pinnata* Roxb.	Bungbutuairam	Burseraceae	Frequent	30	20	15	15	25	30	15	15
20	*Glochidion arborescens* Blume.	Tuaitit	Euphorbiaceae	Frequent	35	60	30	50	30	40	30	25
21	*Juglans regia* L.	Khawkherh	Juglandaceae	Rare	20	15	10	20	20	20	15	15
22	*Kadsura heteroclita* (Roxb.) Craib	Theiarbawm	Magnoliaceae	Frequent	15	10	15	20	25	30	30	25

23	*Litchi chinensis* (Gaertn.) Sonn.	Vaitheifeimung	Sapindaceae	Rare	15	25	35	15	10	20	15	10
24	*Mangifera indica* L.	Theihai	Anacardiaceae	Abundant	25	35	25	30	40	30	30	30
25	*Meliosma pinata* Roxb.	Tuairam	Sabiaceae	Frequent	25	25	25	30	45	35	40	30
26	*Memecylon ceeruleum* Jack.	Theikawrak	Melastomataceae	Frequent	20	30	15	25	35	30	40	35
27	*Morus australis* Poir.	Lungli	Moraceae	Frequent	15	0	20	30	20	25	30	20
28	*Myrica esculenta* Butch.-Ham. Ex D. Don.	Keifang	Myricacea	Rare	40	35	0	10	30	0	0	0
29	*Phyllanthus acidus* (L.) Skeels.	Kawlsunhlu	Euphorbiaceae	Frequent	10	5	0	15	10	0	0	0
30	*Protium serratum* Eugl.	Bil	Burseraceae	Frequent	80	80	75	60	50	50	55	60
31	*Rhus semialata* Merr.	Khawmhma	Anacardiaceae	Abundant	60	50	65	45	50	70	40	25
32	*Spondias pinnata* (L.f) Kurz	Taitaw	Anacardiaceae	Frequent	50	65	55	60	25	20	30	25
33	*Syzygium cumini* (L.) Skeels.	Hmuipui	Myrtaceae	Frequent	20	15	15	15	10	10	15	10
34	*Tamarindus indica* L.	Tengtere	Caesalpinaceae	Abundant	30	25	35	30	25	20	25	25
35	*Ziziphus mauritiana* Lam.	Borai	Rhamnaceae	Frequent	30	35	35	25	30	30	25	30
B. Shrub species (5m x 5m Quadrat) from 20 Quadrats												
36	*Elaegnus caudata* Schl. Ex Mom.	Sarzuk	Elaegnaceae	Abundant	40	40	60	40	40	20	60	40
37	*Embelia subcoriacea* (Cl.) Mez	Tling	Elaegnaceae	Frequent	0	20	40	60	40	40	20	20
38	*Rubus ellipticus* Sm.	Hmutau	Rosaceae	Rare	40	60	40	40	60	40	20	40
39	*Tinospora cordifolia* (Wall.) Miers.	Theisawntlung	Menispermaceae	Frequent	0	0	20	20	0	40	20	40
40	*Xeromphis spinosa* Keay.	Sazutheipui	Rubiaceae	Frequent	20	0	0	20	15	25	10	20
C. Herbs species (1m x 1m Quadrat) from 20 Quadrats												
41	*Amomum dealbatum* L. Roxb.	Aidu	Zingiberaceae	Abundant	1000	1500	1000	500	1000	1000	1500	2000
D. Climbers species (1m x 1m Quadrat) from 20 Quadrats												
42	*Anodendron paniculatum* A. DC.	Theikelki	Melastomataceae	Frequent	1000	500	1500	500	500	500	500	500

* Sites as in Table 1

Table 4: Status of available fruit plants

Habit	Frequent	Rare	Abundant	Total
Tree	27	3	5	**35**
Shrub	3	1	1	**5**
Herb	0	0	1	**1**
Climber	1	0	0	**1**
Total	**31**	**4**	**7**	**42**
Percentage (%)	**73.81**	**9.52**	**16.67**	**100**

Table 5: Availability and distribution of important edible food plants in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
A. Tree species (10m x 10m Quadrat) from 20 Quadrats												
1	*Bischofia javanica* Bl.	Khuangthli	Bischofiaceae	Frequent	45	35	15	45	20	70	20	40
2	*Cinnamomum verum* Presl.	Thakthing	Lauraceae	Fairly frequent	50	40	50	60	60	60	50	40
3	*Dysoxylum gobara* (Buch.-Ham.) Merr.	Thingthupui	Meliaceae	Common	30	20	20	20	45	55	60	40
4	*Eurya cerasifolia* (D. Don) Kubuski	Sihneh	Theaceae	Common	70	50	40	30	60	75	40	35
5	*Ficus hispida* Linn.	Paihte maian	Moraceae	Very common	40	30	20	35	45	50	35	40
6	*Leea compactiflora* Kurz.	Kawlkar	Vitaceae	Frequent	25	25	25	30	20	30	20	20
7	*Lepionurus sylvestris* Bl.	Anpangthuam	Opiliaceae	Frequent	40	70	65	40	25	50	45	50
8	*Leuceana leucocephala* (Lamk.) de W.	Japan zawngtah	Mimosaceae	Cultivated	20	25	30	25	30	35	30	25
9	*Livistona cochirensis* Mart.	Buarpui chempai	Arecaceae	Cultivated	0	0	20	10	0	10	10	5
10	*Oroxylum indicum* (L.)Vent	Archangkawm	Bignoniaceae	Very common	40	55	70	60	20	65	55	75
11	*Parkia timoriana* (A.DC.) Merr.	Zawngtah	Mimosaceae	Very common	60	40	35	35	30	25	40	40
12	*Rhynchotechum ellipticum* (Wall. Ex Dietr.)	Tiarrep	Gesneriaceae	Frequent	0	10	10	15	0	20	15	10

	A. DC.											
13	*Sarcochhamys pulcherrima* Gaud.	Lehngo	Urticaceae	Frequent	10	15	10	15	10	10	10	15
14	*Trema orientalis* (L.) Bl.	Belphuar	Ulmaceae	Common	10	10	15	15	10	10	15	15
15	*Trevesia palmata* (Roxb.) Vis.	Kawhtebel	Caprifoliaceae	Common	50	55	40	45	55	40	20	30
16	*Wendlandia grandis* (Hook. f.) Cowan	Batling	Rubiaceae	Very common	60	40	45	40	35	55	50	45
17	*Zanthoxylum armatum* DC.	Arhrikreh	Rutaceae	Rare	0	0	10	0	0	10	10	10
18	*Zanthoxylum rhetsa* (Roxb.) DC.	Chingit	Rutaceae	Very Common	30	20	30	25	30	30	25	25
B. Shrub species (5m x 5m Quadrat) from 20 Quadrats												
19	*Acacia caesia* **var.** *subnuda* (Craib) Nielsen	Khanghu	Mimosaceae	Common	25	30	35	30	25	40	35	30
20	*Aralia foliosa* Seem.	Chimchawk	Araliaceae	Infrequent	40	30	25	35	30	40	30	30
21	*Areca triadra* Roxb.	Uvai	Arecaceae	Infrequent	10	15	10	10	15	15	10	10
22	*Arenga pinnata* (Wurmb.) Merill	Thangtung	Arecaceae	Rare	10	15	10	20	15	20	30	25
23	*Calamus acanthospathus* Griff.	Thilte	Arecaceae	Very frequent	0	0	15	0	0	30	15	20
24	*Calamus flagellum* Griff.	Hruipui	Arecaceae	Very frequent	0	0	20	0	0	30	20	25
25	*Caryota urens* Linn.	Tum	Arecaceae	Rare	15	10	30	10	10	30	25	20
26	*Cassia floribunda* Cav.	Rengan	Caesalpiniaceae	Cultivated	10	15	20	15	20	30	25	25
27	*Cassia tora*L.	Kelbean	Caesalpinaceae	Frequent	20	15	30	15	10	35	30	25
28	*Clerodendrum colebrookianum* Walp.	Phuihnam	Verbenaceae	Common	35	55	45	60	40	60	30	25
29	*Crotolaria juncea* Linn.	Tumthang	Fabaceae	Cultivated	20	20	40	60	20	40	20	20
30	*Derris wallichii* Prain	Hulhu	Caesalpineaceae	Frequent	40	35	35	30	40	45	50	35
31	*Solanum torvum* Sw.	Tawkpui	Solanaceae	Common	40	20	40	40	20	20	40	60
32	*Zalacca secunda* Griff.	Hruitung	Arecaceae	Very frequent	0	0	15	0	0	45	25	35
C. Herbs species (1m x 1m Quadrat) from 20 Quadrats												
33	*Agaricus campestris* Linn.	Maupa	Agaricaceae	Common	2000	1500	3000	2500	1500	2000	2000	2500
34	*Alocasia fornicata* (Roxb.) Schott	Baibing	Araceae	Fairly common	1000	1500	1000	1500	2000	1000	1000	1000
35	*Amomum dealbatum.* L. Roxb.	Aidu	Zingiberaceae	Abundant	1000	1500	1000	500	1000	1000	1500	2000
36	*Amorphophallus paeniifolius* (Dennst.) Nicols.	Telhawng	Araceae	Frequent	1500	2000	2500	3000	1500	3000	2000	1000
37	*Costus speciosus* (Koenig) Sm.	Sumbul	Costaceae	Very common	500	1000	1500	500	1000	2000	1500	1000
38	*Diplazium maximum* (D. Don) C. Chatt.	Chakawk ei	Athyriaceae	Very	1000	1000	1000	2000	1500	500	0	500

		chi		common								
39	*Entoloma microcarpum* Berk & Br.	Pasawntlung	Agaricaceae	Common	1000	1500	1000	1500	2000	3000	2500	2000
40	*Eryngium feotidum* Linn.	Bahkhawr	Apiaceae	Common	1000	500	1000	1500	500	1000	500	1000
41	*Hedychium spicatum* Buch.-Ham.	Aithur	Zingiberaceae	Rare	0	500	1000	0	500	1000	500	500
42	*Lycianthes laevis* (Dunal) Bitter	Vanian	Solanaceae	Uncommon	1000	500	1000	1500	500	1000	1500	500
43	*Musa acuminata* Colla.	Tumbu	Musaceae	Verycommon	1000	500	1000	1500	500	1500	1000	500
44	*Musa glauca* Roxb.	Saisu	Musaceae	Rare	500	500	0	1000	0	500	500	500
45	*Musa velutina* Wendl.	Changvandawt	Musaceae	Very common	1500	2000	1500	2500	2000	3000	3500	1500
46	*Polygonum barbatum* Linn.	Anbawng	Polygonaceae	Frequent	1000	500	500	0	500	1000	0	500
47	*Polygonum plebium* R.Br.	Bakhate	Polygonaceae	Frequent	500	500	500	500	0	500	500	1000
48	*Schizophyllum commune* Fr.	Pasi	Agaricaceae	Common	2000	1500	1000	2500	2500	2000	1500	1500
49	*Solanum nigrum* Linn.	Anhling	Solanaceae	Fairly frequent	1500	500	1000	500	1000	1000	500	1500
50	*Spilanthes acmella* Hook.	Ankasa	Asteraceae	Common	500	1000	500	1500	500	1000	500	1000
D. Climbers species (1m x 1m Quadrat) from 20 Quadrats												
51	*Dioscorea alata* Linn.	Bahrachim	Dioscoreaceae	Frequent	500	500	500	1000	500	500	500	1000
52	*Dioscorea bulbifera* Linn.	Rambahra	Dioscoreaceae	Very frequent	1000	1500	1000	500	1000	1000	500	1500
53	*Dregea volubilis* Benth.	Ankhapui	Asclepiadaceae	Very Common	1000	1000	1500	1000	1000	1500	500	1000
54	*Hodgsonia macrocarpa* (Blume.) Cogn	Khaum	Cucurbitaceae	Frequent	1000	1000	1500	1000	1000	1500	500	1000
55	*Luffa cylindrica* Roem.	Awmpawng	Cucurbitaceae	Cultivated	500	1000	500	500	1000	500	1000	500
56	*Passiflora nepalensis* Wall.	Nauawimu	Cucubitaceae	Frequent	500	1000	500	1000	500	500	1000	500
E. Bamboo species (1m x 1m Quadrat) from 20 Quadrats												
57	*Bambusa tulda* Roxb.	Rawthing	Poaceae	Very common	20	15	10	10	15	15	10	10
58	*Dendrocalamus hamiltonii* Nees & Arn.	Phulrua	Poaceae	Common	10	25	30	20	10	20	30	30
59	*Dendrocalamus longispathus* Kurz.	Rawnal	Poaceae	Very common	10	20	15	25	5	20	15	30
60	*Meloccana baccifera* (Roxb.) Kurz	Mautak	Poaceae	Abundant	10	10	40	10	15	50	45	40

* Sites as in Table 1

Table 6: Availability and distribution of fuelwood species in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
1	*Acrocarpus fraxinifolius* Wight & Arn.	Nganbawm	Caesalpinaceae	Frequent	0	0	10	0	0	15	10	15
2	*Adina cordifolia* (Wild. ex Roxb.) Kh.f. ex Brandis	Lungkhup	Rubiaceae	Very common	0	0	15	0	0	25	20	20
3	*Albizia chinensis* (Osbecks) Merr.	Vang	Mimosaceae	Frequent	40	30	45	70	40	50	65	50
4	*Albizia procera* (Roxb.) Benth.	Kangtekpa	Fabaceae	Very common	0	0	80	0	0	75	65	50
5	*Albizia thompsonii* Brandis	Thingri	Leguminosae	Frequent	15	10	30	20	10	30	25	30
6	*Anogeissus acuminata* (Roxb. Ex. DC.) Wall.	Zairum	Combretaceae	Frequent	50	50	45	60	55	65	65	70
7	*Bischofia javanica* Bl.	Khuangthli	Bischofiaceae	Frequent	45	35	15	45	20	70	20	40
8	*Callicarpa arborea* Roxb.	Hnahkiah	Verbenaceae	Fairly common	40	45	45	50	45	65	40	45
9	*Castanopsis tribuloides* (Sm.) DC.	Thingsia	Fagaceae	Common	35	45	60	45	55	70	30	35
10	*Derris robusta* Benth.	Thingkha	Fabaceae	Frequent	20	15	20	10	15	30	35	30
11	*Eleocarpus lanceofolious* Roxb.	Kharuan	Tiliaceae	Frequent	0	0	10	0	0	20	10	15
12	*Ficus semicordata* Butch.-Ham.	Theipuithing	Moraceae	Frequent	0	0	10	0	0	20	15	20
13	*Macaranga indica* Wight.	Hnahkhar	Euphorbiaceae	Common	10	20	20	15	10	35	30	40
14	*Macropanax dispermus* (Blume) Kuntze	Phuanberh	Araliaceae	Frequent	30	20	0	20	25	0	0	0
15	*Mesua ferrea* Linn.	Herhse	Clusiaceae	Common	75	60	70	40	25	70	55	45
16	*Myrica esculenta* Buch. Ham. e. D. Don	Keifang	Myricaceae	Rare	40	35	0	10	30	0	0	0
17	*Quercus floribunda* Lindl.	Thal	Fagaceae	Frequent	50	40	0	20	55	0	0	0
18	*Quercus helferiana* A.DC.	Hlai	Fagaceae	Frequent	65	35	0	40	75	0	0	0
19	*Quercus pachyphylla* Kurz.	Fah	Fagaceae	Frequent	55	40	0	20	60	0	0	0
20	*Quercus polystachya* Wall.	Thil	Fagaceae	Frequent	60	20	0	10	55	0	0	0
21	*Quercus serrata* Murray	Sasua	Fagaceae	Frequent	20	10	0	0	25	0	0	0
22	*Quercus xylocarpa* Kurz.	Then	Fagaceae	Frequent	50	20	0	15	45	0	0	0
23	*Schima wallichii* (DC.) Korth	Khiang	Theaceae	Common	60	50	65	70	65	70	60	65
24	*Sterospermum personatum*(Hassk) D. Chatterjee	Zihnghal	Bignoniaceae	Frequent	0	0	40	0	0	35	30	35
25	*Styrax serrulatum* Roxb. C.B. Clarke	Hmar-hleng	Styraceae	Frequent	0	0	5	0	0	15	10	30
26	*Tetrameles nudiflora* R.Br.	Thingdawl	Tetramelaceae	Very common	10	15	15	10	15	30	30	35
27	*Toona ciliata* M. Roem.	Tei	Meliaceae	Frequent	10	10	20	10	10	30	20	25
28	*Vitex peduncularis* Wall ex Schauer	Thingkhawilu	Verbenaceae	Common	40	50	45	50	55	60	50	55
29	*Wendlandia grandis* (Hook. f.) Cowan	Batling	Rubiaceae	Frequent	60	40	45	40	35	55	50	45
30	*Wightia speciosissima* (D. Don) Merr.	Chawngtlai	Scrophulariaceae	Frequent	10	10	0	15	30	0	0	0

* Sites as in Table 1

Table 7: Availability and distribution of fodder species in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
A. Tree species (10m x 10m Quadrat) from 20 Quadrats												
1	*Macaranga indica* Wight.	Hnahkhar	Verbenaceae	Common	10	20	20	15	10	35	30	40
2	*Artocarpus heterophyllus* Lam.	Lamkhuang	Moraceae	Frequent	55	60	55	85	60	95	80	75
3	*Artocarpus lakoocha* Roxb.	Theitat	Moraceae	Frequent	40	25	35	25	25	30	35	30
4	*Ficus rostrata* Lam.	Theitit	Moraceae	Frequent	45	45	25	15	40	25	20	20
B. Shrub species (5m x 5m Quadrat) from 20 Quadrats												
5	*Manihota esculenta* Crantz.	Pangbal	Euphorbiaceae	Common	20	20	15	20	25	20	15	15
C. Herbs species (1m x 1m Quadrat) from 20 Quadrats												
6	*Amorphophallus paeniifolius* (Dennst.) Nicols	Telhawng	Araceae	Common	1500	2000	2500	3000	1500	3000	2000	1000
7	*Bidens pilosa* L.	Vawkpuithal	Asteraceae	Common	1000	1000	500	1000	500	1000	1000	500
8	*Colocasia esculenta* (Linn.) Schott	Dawl	Araceae	Very common	1500	1500	2000	2500	3000	3500	2500	2000
9	*Mikania micrantha* (Burm.) B.C.Robinson	Japanhlo	Asteraceae	Abundant	1000	2000	1500	500	1000	2000	2500	3000
10	*Musa acuminata* Colla	Changel	Musaceae	Very common	1000	500	1000	1500	500	1500	1000	500
11	*Spilanthes acmella* Hook.	Ankasa	Asteraceae	Common	500	1000	500	1500	500	1000	500	1000
12	*Saccharum spontaneum* Linn.	Luang	Poaceae	Very common	2500	1000	1500	2000	1500	1500	2500	2000
13	*Thysanolaena maxima* (Roxb.) Kuntze	Hmunphiah	Poaceae	Very common	2500	1500	2000	2500	2000	2500	2000	1500
D. Climbers species (1m x 1m Quadrat) from 20 Quadrats												
14	*Ipomea batatas* (Linn.) Lam.	Kawlbahra	Convolvulaceae	Frequent	500	500	500	1000	500	500	500	1000
E. Grass species (5m x 5m Quadrat) from 20 Quadrats												
15	*Imperata cylindrica* (L.) Beauv.	Di	Poaceae	Very common	60	40	20	30	60	20	40	60

* Sites as in Table 1

Table 8: Availability and distribution of Palm species in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
1	*Areca trianda* Roxb.	Uvai	Arecaceae	Infrequent	10	15	10	10	15	15	10	10
2	*Arenga pinnata* (Wurmb.) Merill	Thangtung	Arecaceae	Rare	10	15	10	20	15	20	30	25
3	*Borassus flabellifer* Linn.	Siallu	Arecaceae	Very frequent	35	45	60	40	40	50	60	40
4	*Calamus acanthospathus* Griff.	Thilte	Arecaceae	Very frequent	0	0	15	0	0	30	15	20
5	*Calamus erectus* Roxb.	Thilthek	Arecaceae	Very frequent	0	10	10	0	10	25	20	20
6	*Calamus flagellum* Griff.	Hruipui	Arecaceae	Frequent	0	0	20	0	0	30	20	25
7	*Calamus gracilis* Roxb.	Kawrtai	Arecaceae	Frequent	10	20	15	15	10	15	20	25
8	*Calamus guruba* Buch. – Ham.	Tairua / Taite	Arecaceae	Frequent	15	15	20	10	15	20	15	20
9	*Calamus inermis* T. Anders	Mitperh	Arecaceae	Frequent	10	10	15	15	10	15	10	15
10	*Calamus khasianus* Becc.	Mawt	Arecaceae	Frequent	0	0	10	0	0	15	10	15
11	*Calamus nambariensis* Becc.	Mawtpui	Arecaceae	Frequent	0	0	0	0	0	10	15	10
12	*Calamus tenuis* Roxb.	Changdam	Arecaceae	Frequent	0	0	10	0	0	15	10	10
13	*Caryota urens* Linn.	Tum	Arecaceae	Frequent	15	10	30	10	10	30	25	20
14	*Daemonorops jenkinsianus* (Griff.) Mart.	Raichhawk	Arecaceae	Frequent	10	15	10	10	15	20	15	20
15	*Licuala peltata* Roxb.	Laisua	Arecaceae	Frequent	30	35	40	40	35	70	60	60
16	*Pinanga gracilis* Blume.	Tartiang	Arecaceae	Frequent	20	15	20	15	10	20	25	15
17	*Plectocomia khasiana* Griff.	Mawt	Arecaceae	Frequent	0	0	10	0	0	15	10	10
18	*Zalacca secunda* Griff.	Hruitung	Arecaceae	Frequent	0	0	15	0	0	45	25	35

* Sites as in Table 1

Table 9: Availability and distribution of Ornamental species in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
1	*Bauhinia variegata* Linn.	Vaube	Caesalpinaceae	Very common	40	50	55	65	60	75	60	50
2	*Bombax ceiba* Linn.	Phunchawng	Bombacaceae	Rare	35	15	0	0	35	0	0	0
3	*Erythrina stricta* Roxb.	Fartuah	Fabaceae	Common	30	25	30	40	30	40	25	25
4	*Langerstromia speciosa* Pers.	Thlado (Chawnpui)	Lythraceae	Frequent	55	60	30	40	55	45	45	50
5	*Prunus cerasoides* D.Don	Tlaizawng	Rosaceae	Frequent	25	20	0	15	15	0	0	0
6	*Renanthera imschootiana* Rolfe.	Senhri	Orchidaceae	Rare	5	10	0	10	15	10	5	5

7	*Rhododendron wightii* Hook	Chhawkhlei par var	Ericaceae	Rare	10	5	0	0	5	0	0	0
8	*Rhododendron arboreum* Sm.	Chhawkhlei par sen	Ericaceae	Rare	10	10	0	0	5	0	0	0
9	*Saraca asoca* (Roxb.) de Wilde	Mualhawih	Caesalpinaceae	Rare	0	0	15	0	0	10	10	10
10	*Vanda coerulea* Griff.	Lawhlei	Orchidaceae	Rare	5	10	0	0	10	0	0	5

* Sites as in Table 1

Table 10: Availability and distribution of bamboo species in the studied area

Sl. No.	Scientific Name	Local Name	Family	Status	Density per hectare in Forest Sites							
					Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
1	*Bambusa khasiana* Munro.	Rawte / Chalte	Poaceae	Less common	0	5	5	10	0	5	0	10
2	*Bambusa nutans* Wallich ex Munro	Ankuang	Poaceae	Rare	0	0	0	0	0	10	10	0
3	*Bambusa oliveriana* Gamble	Talan	Poaceae	Less common	0	0	10	0	0	0	0	0
4	*Bambusa tulda* Roxb.	Rawthing	Poaceae	Common	20	15	10	10	15	15	10	10
5	*Bambusa vulgaris* **var**. (Lodd. Ex Lindl.) Gamble	Vairua	Poaceae	Less common	0	0	15	0	0	0	0	10
6	*Chimonobambusa callosa* Munro.	Phar	Poaceae	Less common	0	10	0	10	5	0	0	0
7	*Chimonobombusa khasiana* Munro.	Lik	Poaceae	Frequent	0	10	0	15	0	0	0	0
8	*Dendrocalamus sikkimensis* Gamble	Rawmi	Poaceae	Rare	0	0	10	0	0	5	0	0
9	*Dendrocalamus hamiltonii* Nees & Arn. ex Munro.	Phulrua	Poaceae	Frequent	10	25	30	20	10	20	30	30
10	*Dendrocalamus hookeri* Munro.	Rawlak / Rawkhauh	Poaceae	Less common	0	0	0	15	0	0	0	10
11	*Dendrocalamus longispathus* Kurz.	Rawnal	Poaceae	Abundant	10	20	15	25	5	20	15	30
12	*Dendrocalamus strictus* (Roxb.) Nees	Tursing	Poaceae	Less common	0	0	0	10	0	0	0	0
13	*Melocalamus compactiflorus* Benth.	Sairil	Poaceae	Less common	0	15	0	10	0	20	10	10
14	*Melocanna baccifera* (Roxb.) Kurz	Mautak	Poaceae	Abundant	20	45	50	40	10	60	55	50
15	*Phyllostachis manii* Gamble	Shillong mau	Poaceae	Frequent	10	15	5	10	10	15	10	10
16	*Schizostachyum fuchsianum* (Gamble)	Rawngal	Poaceae	Rare	5	10	0	10	5	0	0	0
17	*Schizostachyum polymorphum* (Munro.) Majumdar	Chal	Poaceae	Frequent	10	15	10	10	5	10	15	10
18	*Schizostochyum dullooa* Gamble	Rawthla	Poaceae	Less common	0	0	10	0	0	10	0	5

* Sites as in Table 1

Table 11: The first ten dominant families showing number of genera (G) and species (S) contributing to NTFP deversity

Sl. No.	Family	Medicinal plants		Fuel wood		Fruit		Fodder		Edible food plants		Palm		Bamboo		Ornamental plants		Total		Actual total no. of species
		G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	G	S	
1	Poaceae	3	3	0	0	0	0	3	3	3	4	0	0	6	18	0	0	**15**	**28**	**22**
2	Arecaceae	2	2	0	0	0	0	0	0	6	7	10	18	0	0	0	0	**18**	**27**	**19**
3	Euphorbiaceae	8	9	1	1	4	4	1	1	0	0	0	0	0	0	0	0	**14**	**15**	**12**
4	Asteraceae	10	10	0	0	0	0	3	3	1	1	0	0	0	0	0	0	**14**	**14**	**12**
5	Mimosaceae	6	8	1	1	0	0	0	0	3	3	0	0	0	0	0	0	**10**	**12**	**10**
6	Caesalpinaceae	4	4	1	1	1	1	0	0	1	1	0	0	0	0	2	2	**9**	**9**	**8**
7	Moraceae	2	6	1	1	3	6	2	3	1	1	0	0	0	0	0	0	**9**	**17**	**8**
8	Fabaceae	5	5	2	2	0	0	0	0	1	1	0	0	0	0	1	1	**9**	**9**	**7**
9	Fagaceae	1	1	1	7	0	0	0	0	0	0	0	0	0	0	0	0	**2**	**8**	**7**
10	Rubiaceae	4	4	2	2	1	1	0	0	1	1	0	0	0	0	0	0	**8**	**8**	**7**
Total		**45**	**52**	**9**	**15**	**9**	**12**	**9**	**10**	**17**	**19**	**10**	**18**	**6**	**18**	**3**	**3**	**108**	**147**	**112**

* G- Genus, S- Species

Table 12: Availability of various NTFPs in the local market of Mizoram

NTFPs types 1) Food plants Scientific Name	Local Name	Local markets								Frequency of occurence (%)
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	
Agaricus campestris Linn.	Maupa	-	-	-	+	+	-	+	-	37.5
Alocasia fornicata (Roxb.) Schott	Baibing	+	-	+	-	-	+	+	-	50
Amomum dealbatum L. Roxb.	Aidu	+	-	+	+	+	+	+	+	87.5
Amorphophallus paeniifolius (Dennst.) Nicols.	Telhawng	+	-	-	-	-	+	+	+	50
Aralia foliosa Seem.	Chimchawk	+	+	-	+	+	+	-	+	75
Bambusa tulda Roxb.	Rawthing	-	+	-	+	-	-	-	+	37.5
Calamus acanthospathus Griff.	Thilte	-	+	-	-	-	+	-	+	37.5
Calamus flagellum Griff.	Hruipui	-	-	+	-	-	+	+	+	50
Caryota urens Linn.	Tum	+	+	-	+	+	-	-	-	50

Cassia floribunda Cav.	Rengan	+	+	+	+	+	+	+	+	100
*Cassia tora*L.	Kelbean	+	+	-	-	-	+	-	+	50
Cinnamomum verum Presl.	Thakthing	+	+	-	+	-	+	-	+	62.5
Clerodendrum colebrookianum Walp.	Phuihnam	-	+	-	+	+	-	-	+	50
Costus speciosus (Koenig) Sm.	Sumbul	+	-	+	-	-	+	+	-	50
Crotolaria juncea Linn.	Tumthang	-	+	+	+	+	+	+	+	87.5
Dendrocalamus hamiltonii Nees & Arn.	Phulrua	-	-	-	+	+	-	-	+	37.5
Dendrocalamus longispathus Kurz.	Rawnal	+	+	-	-	-	+	+	-	50
Derris wallichii Prain	Hulhu	-	+	-	-	+	-	+	+	50
Dioscorea alata Linn.	Bahrachim	+	-	+	+	+	-	-	+	62.5
Dioscorea bulbifera Linn.	Rambahra	-	-	+	+	-	-	+	-	37.5
Diplazium maximum (D. Don) C. Chatt.	Chakawk ei chi	+	+	-	-	-	+	-	+	50
Dregea volubilis Benth.	Ankhapui	-	-	+	-	-	-	-	+	25
Dysoxylum gobara (Buch.-Ham.) Merr.	Thingthupui	+	-	+	-	-	+	-	-	37.5
Entoloma microcarpum Berk & Br.	Pasawntlung	+	+	-	-	-	-	+	-	37.5
Eryngium feotidum Linn.	Bahkhawr	-	-	+	+	-	+	+	+	62.5
Eurya cerasifolia (D. Don) Kubuski	Sihneh	+	+	-	+	-	-	+	+	62.5
Ficus hispida Linn.	Paihte maian	+	-	+	-	+	+	+	+	75
Hedychium spicatum Buch.-Ham.	Aithur	-	+	-	-	+	-	-	-	25
Hodgsonia macrocarpa (Blume.) Cogn	Khaum	-	-	+	-	+	-	-	+	37.5
Leea compactiflora Kurz.	Kawlkar	-	+	-	-	-	-	+	+	37.5
Lepionurus sylvestris Bl.	Anpangthuam	+	-	+	-	+	+	+	+	75
Leuceana leucocephala (Lamk.) de W.	Japan zawngtah	-	-	-	+	-	+	+	-	37.5
Livistona cochirensis Mart.	Buarpui chempai	-	+	-	+	-	+	-	+	50
Luffa cylindrica Roem.	Awmpawng	+	+	-	+	-	+	-	-	50
Lycianthes laevis (Dunal) Bitter	Vanian	-	-	-	-	-	-	-	+	12.5
Meloccana baccifera (Roxb.) Kurz	Mautak	+	+	+	+	+	+	+	+	100
Musa acuminata Colla.	Tumbu	+	+	+	-	+	+	+	+	87.5
Musa glauca Roxb.	Saisu	+	+	-	+	-	+	+	-	62.5
Musa velutina Wendl.	Changvandawt	+	-	-	-	+	-	+	-	37.5
Oroxylum indicum (L.)Vent	Archangkawm	+	-	+	-	+	-	+	-	50
Parkia timoriana (A.DC.) Merr.	Zawngtah	-	+	+	+	-	+	+	+	75
Passiflora nepalensis Wall.	Nauawimu	-	+	+	+	+	+	+	+	87.5
Polygonum barbatum Linn.	Anbawng	+	+	-	-	+	+	-	-	50
Polygonum plebium R.Br.	Bakhate	+	-	+	+	-	+	+	-	62.5
Rhynchotechum ellipticum (Wall. Ex Dietr.) A. DC.	Tiarrep	-	+	-	+	-	+	-	-	37.5
Schizophyllum commune Fr.	Pasi	+	+	-	-	+	+	-	+	62.5

Solanum nigrum Linn.	Anhling	-	+	+	+	+	-	+	-	62.5
Solanum torvum Sw.	Tawkpui	-	-	-	+	-	-	-	+	25
Spilanthes acmella Hook.	Ankasa	+	+	-	-	-	+	-	-	37.5
Trevesia palmata (Roxb.) Vis.	Kawhtebel	-	-	+	+	-	-	+	+	50
Zalacca secunda Griff.	Hruitung	-	-	+	-	-	+	+	-	37.5
Zanthoxylum rhetsa (Roxb.) DC.	Chingit	-	+	-	+	+	+	+	+	75
2) Fruit plants	**Local Name**	**Local markets**								**Frequency of occurence (%)**
Scientific Name		**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	
Anodendron paniculatum A. DC.	Theikelki	-	-	+	+	-	+	-	+	50
Artocarpus heterophyllus Lam.	Lamkhuang	-	-	+	+	-	+	+	+	62.5
Artocarpus lakoocha Roxb.	Theitat	+	+	-	-	+	-	+	-	50
Averrhoa carambola L.	Theiherawt	-	-	+	-	+	-	-	+	37.5
Baccaurea ramiflora Lour.	Pangkai	+	-	+	+	-	+	-	-	50
Bruinsmia polysperma (Cl.) Van Steenis	Theipalingkawh	+	+	-	-	+	-	+	-	50
Carralia brachiata (Lour.) Merr.	Theiria	-	+	-	-	+	-	-	+	37.5
Chrysophyllum cainito Linn.	Theipabuan	+	-	+	+	+	+	-	+	75
Dillenia indica L.	Kawrthindeng	-	-	+	-	-	+	+	-	37.5
Elaegnus caudata Schl. Ex Mom.	Sarzuk	+	-	-	+	-	+	+	-	50
Emblica officinalis Gaertn.	Sunhlu	+	+	+	+	+	+	+	+	100
Eugenia jambolana Lam.	Lenhmui	+	+	-	-	-	-	-	+	37.5
Euphoria longan Steud.	Theifeimung	+	+	-	-	-	+	-	-	37.5
Ficus rostrata Lam.	Theitit	-	-	-	+	+	-	+	-	37.5
Ficus semicordata Butch.-Ham.	Theipui	+	+	-	-	-	+	-	+	50
Garcinia cowa Roxb. Ex DC.	Chengkek	-	-	-	+	-	-	+	-	25
Garuga pinnata Roxb.	Bungbutuairam	-	-	-	+	-	+	+	+	50
Glochidion arborescens Blume.	Tuaitit	+	+	+	+	+	+	+	-	87.5
Juglans regia L.	Khawkherh	-	+	-	-	+	-	-	-	25
Kadsura heteroclita (Roxb.) Craib	Theiarbawm	-	+	+	+	-	-	+	-	50
Litchi chinensis (Gaertn.) Sonn.	Vaitheifeimung	-	-	+	-	+	-	-	-	25
Mangifera indica L.	Theihai	+	-	+	-	-	+	+	+	62.5
Meliosma pinata Roxb.	Tuairam	-	-	+	-	-	+	+	-	37.5
Memecylon ceeruleum Jack.	Theikawrak	-	+	+	+	+	-	+	+	75
Myrica esculenta Butch.-Ham. Ex D. Don.	Keifang	+	+	-	-	-	-	-	-	25
Phyllanthus acidus (L.) Skeels.	Kawlsunhlu	+	-	-	+	+	-	-	-	37.5
Protium serratum Eugl.	Bil	-	+	-	-	+	+	+	+	62.5

Rhus semialata Merr.	Khawmhma	+	-	-	+	+	-	-	-	37.5
Rubus ellipticus Sm.	Hmutau	-	+	+	-	+	+	+	+	75
Spondias pinnata (L.f) Kurz	Taitaw	+	-	-	+	-	-	-	-	25
Syzygium cumini (L.) Skeels.	Hmuipui	-	+	-	+	+	+	-	-	50
Tamarindus indica L.	Tengtere	-	-	+	-	-	-	+	-	25
Tinospora cordifolia (Wall.) Miers.	Theisawntlung	-	-	+	+	-	-	+	+	50
Xeromphis spinosa Keay.	Sazutheipui	+	-	-	+	+	+	+	+	75
Ziziphus mauritiana Lam.	Borai	-	-	+	-	-	+	+	+	50
3) Medicinal plants	**Local Name**	**Local markets**								**Frequency of occurence (%)**
Scientific Name		**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	
Alstonia scholaris (L.) R.Br.	Thuamriat	+	+	-	-	+	-	+	+	62.5
Curcuma longa Roxb.	Aieng	+	+	+	-	+	-	+	-	62.5
Dillenia pentagyna Roxb.	Kaihzawl	-	-	+	+	-	+	+	+	62.5
Dioscorea bulbifera L.	Bahra	+	-	-	+	+	+	+	+	75
Entada pursaetha DC.	Kawi	-	+	-	+	-	+	-	+	50
Litsea cubeba Pers.	Sernam	+	+	-	+	+	+	+	+	87.5
Phrynium capitatum Wild	Hnahthial	+	-	+	-	+	-	+	+	62.5
Phyllanthus fraternus Webs.	Mitthisunhlu	-	+	-	+	-	+	+	+	62.5

* Sites as in Table 1

Table 13: Uses of medicinal plants available in the study area

Sl. No.	Scientific Name	Local Name	Family	Uses	Part used
1	*Achyranthes bidentata* Bl.	Vangvat-tur	Amaranthaceae	The leaves is crushed and the juice is applied for the remedy of poisoned leach bite sores	Leaves
2	*Adiantum caudatum* L.	Chakawkria	Adiantaceae	The aerial part is used as antispasmodic or an antiasthmatic	Leaves
3	*Adiantum phillippense* L.	Chakawkte	Adiantaceae	Frond tea is used to strengthen mucosal membranes, treat coughs, throat congestion, and respiratory irritation caused by air pollution.	Whole plant
4	*Aeginetia indica* L.	Sangharvaibel	Orobanchaceae	Juice of the rhizome is applied to mumps & inflammatory glands; Root in combination with other plants prescribed as the pills for fertility	Rhizome
5	*Aegle marmelos* (L) Corr. Ex Roxb.	Belthei	Rutaceae	Decoction of fruit is applied for the remedy of dysentery, stomachache & digestive problems	Fruit
6	*Aeschynanthus sikkimensis* (Cl.) Stapft.	Bawltehlantai	Gesneriaceae	Infusion of flowers is taken against tonsilitis. Juice of crushed leaves	Flower,

				is applied and drunk for inflammatory glands. Decoction of the root is taken for fever and ailment.	leaves and root
7	*Ageratum conyzoides* L.	Vailenhlo	Asteraceae	The root is crush with *Callicarpa arborea* (*Hnah kiah*) bark and rhizome of *curcuma* (*Aieng*) and the juice is drunk for the remedy of stomach cancer; stem and leaf as anti-diarrhoeal & also aid in clotting of blood	Root, stem and leaves
8	*Albizia odoratissima* Benth.	Kangteknu	Mimosaceae	The leaf is boiled in ghee & is used in remedy for cough	Leaves
9	*Albizia procera* (Roxb.) Benth.	Kangtekpa	Mimosaceae	The poultice of leaves is applied to ulcers	Leaves
10	*Albizia chinensis* (Osb.) Merr.	Vang	Mimosaceae	Infusion of bark is used as lotion for cuts, skin burn and other skin diseases.	Bark
11	*Alocasia fornicata* (Roxb.) Schott	Baibing	Araceae	The sap or juice of plant is applied on snake-bite. Infusion of the spadix with the stem and leaves of Dysoxylum gobara is taken orally to kill round-worms.	Whole plant
12	*Alstonia scholaris* (L.) R.Br.	Thuamriat	Apocynaceae	The latex is applied on wounds. The bark and leaves are boiled and the water is taken for high blood pressure, dysentery, typhoid and asthma.	Bark and leaves
13	*Amaranthus spinosus* Linn.	Lenhling (Mizo); Hadamarik (Chakma)	Amaranthaceae	Juice of crushed plant is used as antidote in snake bite. The roots are rubbed on grindstone and dipped into a cup of water and then drunk twice a day against haemorrhage. The leaves are boiled in water and the water is drunk for difficult urination. Juice of crushed leaves is used to stop bleeding from the nose. Chakmas use the juice of twigs in combination with that of Bacopa monnieri for headache and in hemicrania, by external application, with the help of cotton wool, thrice daily.	Whole plant
14	*Amaranthus viridis* L.	Zam-zo	Amaranthaceae	Juice of leaves is used as emollient in scorpion-sting.	Leaves
15	*Amomum dealbatum* L. Roxb.	Aidu	Zingiberaceae	The bark is crushed and the juice is used for the antiseptic	Bark
16	*Anogeissus acuminata* (Roxb.) Wall.	Zairum	Combretaceae	The Barks is crushed and the juice is applied for antiseptic	Bark
17	*Aporusa diotica* (Roxb.) Muell.Arg.	Chhawntual	Euphorbiaceae	Infusion of the coat of the inner bark is taken orally for colic and stamachache.	Bark
18	*Aquilaria malaccensis* Lam.	Thing-rai	Thymelaeaceae	The agar extracted from wood is used against vomiting.	Stem
19	*Ardisia colorata* Roxb.	Hnunthlum	Myrsinaceae	A poultice made of bark is used in ulcers.	Bark
20	*Ardisia peniculata* Roxb.	Naunuar	Myrsinaceae	Decoction of root is used for rheumatism and pains in venerial diseases.	Root
21	*Artemesia indica* Willd.	Sai	Asteraceae	The water of the boiled leaves is taken against fever and stomachache. Juice of pressed leaves is used to stop nose bleeding and bleeding from gum-boil.	Leaves
22	*Artocarpus lakoocha* Roxb.	Theitat	Moraceae	The seed is used for purgative and the powder bark is applied to sores to draw out purulent matter, infusion is applied to pimples and	Seed and bark

				cracked skin	
23	*Artocarpus chama.* Butch.-Ham.	Tatkawng	Moraceae	Decoction of bark is taken against diarrhoea	Bark
24	*Averrhoa carambola* L.	Theiherawt	Averrhoaceae	Three or four slices of fruit are taken daily for jaundice, bleeding piles and as anti-scorbutic	Fruit
25	*Baccaurea ramiflora* Lour.	Pang-kai	Euphorbiaceae	Infusion of bark is astringent and is taken for food allergy, e.g. fish etc.	Bark
26	*Bauhinia variegata* L.	Vaube	Caesalpinaceae	Bark is carminative, tonic; astringent, antidiarrhoea, as blood purifier, as tonic, used in goitre; flower as laxative	Bark
27	*Begonia inflae* Cl.	Sekhupthur	Begoniaceae	The whole plant is eaten raw against dysentery. The root is crushed and the juice is taken against malaria.	Whole plant
28	*Bergenia ciliata* (Haw.) Sternb.	Khamdamdawi	Saxifragaceae	The plant is bruised and applied to boil and opthalmia. The medicine is highly reputed for dissolving stones in the kidney.	Whole plant
29	*Bidens pilosa* L.	Vawkpuithal	Asteraceae	Aerial parts of the plant is boiled and taken orally for diarrhoea and dysentry	Whole plant
30	*Bischofia javanica* Bl.	Khuangthli	Bischofiaceae	Juice of leaves is considered cure for sore	Leaves
31	*Blumea lanceolaria* (Roxb.) Druce.	Buarze	Asteraceae	Pressed juice of leaves is applied on wounds and chronic ulcers. Infusion of leaves is taken against dysentry. The leaves are boiled and the water is strained through chase-cloth and taken orally against bronchitis, asthma, cancer and liver ailments.	Leaves
32	*Bombax ceiba* L.	Phunchawng	Bombacaceae	The root is used for stimulant, tonic the root and bark is also used for emetic. Gum is used for aphrodis demulcent, homeostatic astringent, tonic alternative used in diahhroea, dysentery and minor. Fruit and flower are also used as against in snake bite	Whole plant
33	*Bombax insigne* Wall.	Pang	Bombacaceae	The bark is peeled off and chewed and the juice is swallowed as an effectie remedy against tonsilitis	Bark
34	*Borassus flabellifer* L.	Siallu	Arecaceae	Juice of plant is used as antiphlegmatic and in dropsy. The fan like leaves is used as roof-thatching in villages.	Whole plant
35	*Butea monosperma* (Lam.) Taub.	Tuahpui	Fabaceae	The seeds are taken to expel intestinal worms.	Seed
36	*Callicarpa arborea* Roxb.	Hnahkiah	Verbenaceae	The bark is crushed and the juice is drunk for the remedy of stomach pain, dysentery and vomiting	Bark
37	*Camellia kissi* Wall.	Lallai	Theaceae	The infusion of bark is taken orally for the treatment of kidney problems.	Bark
38	*Camellia sinnensis* (L.) O. Kuntze.	Thingpui	Theaceae	Tealeaf boiled is used as astringent, stimulant, diuretic.	Leaves
39	*Canarium strictum*Roxb.	Berawthing	Burseraceae	The bark is boiled in water and the water is used for bathing as an effective cure for skin eruptions (rash) caused by the sap of *Drimycarpus recemosus.* Infusion of bark or fruit is taken orally for colic	Bark and fruit
40	*Canna indica* L.	Kungpuimuthi	Cannaceae	Seed juice relieves earaches. Root bark and stalks are used to the	Seed and

				cattle suffering from poisoning.	root
41	*Carralia brachiata* (Lour.) Merr.	Theiria	Rhizophoraceae	Infusion of bark is applied on itches. Fruits edible.	Bark
42	*Cassia alata* L.	Tuihlo	Caesalpinaceae	The leaves are bruised and applied on ringworm.	Leaves
43	*Castanopsis tribulaides* (Sm.) DC.	Thingsia	Fagaceae	The juice coming out of the cut stem is used in an infection of mouth and tongue.	Stem
44	*Catharanthus roseus* (L.) G.Don.	Kumtluang	Apocynaceae	The raw leaves are taken for the remedy of high blood pressure	Leaves
45	*Centella asiatica* (L.) Urb.	Lambak/ Hnahbial	Apiaceae	The leaves is boiled and the water is taken for the remedy of asthma and eyes problems	Leaves
46	*Chromolaena odorata* (L.) King & Rob.	Tlangsam	Asteraceae	Juice of leaves is applied on cuts and wounds as haemostatic.	Leaves
47	*Chukrasia tabularis* A. Juss.	Zawngtei	Meliaceae	Raw roots are taken for the remedy of stomach pain	Root
48	*Cinnamomum bejolghota* (Butch. Ham.) Sweet	Thakthingsuak	Lauraceae	Decoction of bark is taken for dyspepsia and liver complaints.	Bark
49	*Cinnamomum verum* Presl.	Thakthing	Lauraceae	The root bark and stem bark are aromatic and employed as spices. They are taken against nausea and vomiting.	Root and stem
50	*Cissus javanica* DC.	Sangharhmai	Vitaceae	The juice of crushed plant is applied externally on the wounded surface of sprain, boil and sore.	Whole plant
51	*Clerodendrum colebrookianum* Walp.	Phuihnam	Verbenaceae	Cold infusion of leaves is drunk against hypertension and to decrease breast milk. The roots are rubbed on grindstone and dipped them into a cup of water and the water is drunk against uteritis per day.	Leaves and root
52	*Clerodendrum viscosum* Vent	Phuihnamchhia	Verbenaceae	The boiled water of the roots and leaves is apply on itches. Infusion of the leaves is also orally taken against dysentery and pin worm. The boiled juice of leaves is also used for washing off dandruff.	Leaves and root
53	*Cordia dichotoma* Forst.	Muk	Boraginaceae	Decoction of bark is taken for strengthening the function of uterus and used for *Zu-hri*, the blood -poison by rat-bite.	Bark
54	*Costus speciosus* (Koenig) Sm.	Sumbul	Costaceae	The whole plant is taken as a raw for the remedy of tonsillitis	Whole plant
55	*Crotalaria juncea* L.	Tumthang	Fabaceae	The seeds are used in anaemia and psoriasis.	Seed
56	*Curculigo capitulata* (Lour.) O. Kuntze.	Phaiphek	Hypoxidaceae	Juice of tuber is used in stomachache	Tuber
57	*Curcuma longa* Roxb.	Aieng	Cucurbitaceae	Rhizome is crushed and the juice is used for antiseptic	Rhizome
58	*Datura suaveolens* Hamb. & Bruph	Tawtawrawtpar	Solanaceae	Leaves are dried & smoked as tobacco for chest complaints, asthma while roasted leaf is applied on breast lump/ stony hard breast	Leaves
59	*Dendrocnide sinuata* (Bl.) Chew.	Thakpui	Urticaceae	The root is boiled along with crabs and the water is taken for the remedy of jaundice	Root
60	*Derris thyrsiflora* Benth.	Hul-hu	Fabaceae	Decoction of fruit is taken for dysentry and stamachache.	Fruit
61	*Dillenia indica* L.	Kawrthindeng	Dilleniaceae	The fruit is boiled and the water is taken for remedy of stomach problem	Fruit
62	*Dillenia pentagyna* Roxb.	Kaihzawl	Dilleniaceae	The bark and leaves are boiled and the water is taken for diarrhoea	Bark and

		/Hnahkhauh		and cancer. The bark is crushed and added to the pig food to remove sore-worms.	leaves
63	*Dinochloa compactiflora* (Kurz) McClure.	Sairil	Poaceae	The outer skin is scraped off and applied externally on cuts and bandaged to stop bleeding. The sap oozing out of the cut-stem is given to children for influenza, cough and chest complaints.	Whole plant
64	*Dioscorea alata* L.	Rambachim	Dioscoreaceae	Decoction of tuber isused in leprosy, piles and gonorrhoea	Tuber
65	*Dioscorea bulbifera* L.	Bahra	Dioscoreaceae	The dried grinded tubers into powder is taken for piles.	Tuber
66	*Diplazium maximum* (D.Don.) C. Chatt.	Chakawkeichi	Athyriaceae	The frond are crushed and applied externally on skin diseases	Leaves
67	*Dipterocarpus turbinatus* Gaertn.f.	Lawngthing	Dipterocarpaceae	The bark yield resin and is apllied on ulcers and cutaneous affections.	Bark
68	*Dregea volubilis* Benth.	Ankhapui	Asclepediaceae	External application of the paste of grinded leaves is used for the treatment against Herpes zoster (shingles), bone fracture and enlarged glands.	Leaves
69	*Dysoxylum gobara* (Butch.-Ham.) Merr.	Thingthupui	Meliaceae	Decoction of leaves and buds is used as against in diarrhea and dysentery.	Leaves
70	*Elaegnus caudata* Schl. Ex Mom.	Sarzukpui	Elaegnaceae	The root is boiled and the water is taken for the remedy against retained placenta	Root
71	*Embelia subcoriacea* (Cl.) Mez.	Tling	Elaegnaceae	Decoction of leaves is used for bathing in the treatment of smallpox.	Leaves
72	*Emblica officinalis* Gaertn.	Sunhlu	Euphorbiaceae	The raw fruit is taken for the remedy of stomach problem	Fruit
73	*Entada pursaetha* DC.	Kawi	Mimosaceae	The seed are soaked in water and the water is dropped into the nostrils against leech.	Seed
74	*Ervatamea coronaria* (Jack.) Stapf.	Pararsi	Apocynaceae	The root is chewed for to relief of toothache; root & bark used as antidote for scorpion sting; milky juice is used for disease of eyes	Root and bark
75	*Eryngium foetidium* L.	Bahkhawr	Apiaceae	The crush root is taken for stomachic, and the leaves are taken for pinwprms and food allergy. The bruished leaf is also apllied externally on gland-swellings.	Root
76	*Erythrina stricta* Roxb.	Fartuah	Fabaceae	The bark is used as astringent and antidote to snake bite.	Bark
77	*Eurya acuminata* DC.	Sihneh (zik sen)	Theaceae	Decoction of leaves is taken for colic and stomachache.	Leaves
78	*Ficus bengalensis* Linn.	Hmawng	Moraceae	The milky juice is applied externally for pains in rheumatism, lumbago. Infusion of bark is used as tonic, astringent used in dysentery, diarrhoea and diabetes.	Bark
79	*Ficus hispida* Linn.	Paihte maian	Moraceae.	The filter juice extracted out from wet ash through the seven sheets of leaves is used to apply on eye for eye problems. Leaf sap extracted by warming the leaf is also used for eye-sore.	Leaves
80	*Ficus rostrata* Lam.	Theitit	Moraceae	The root is crushed and the juice is applied for the remedy against poisoned snake bites	Fruit
81	*Ficus semicordata* Butch.-Ham.	Theipui	Moraceae	The young fruits are astringent and are taken for dysentery.	Root
82	*Garcinia cowa* Roxb. Ex DC.	Chengkek	Clusiaceae	The leaves are boiled and the water is taken for diarrhoea half cup	Leaves

				twice daily.	
83	*Garcinia paniculata* (G.Don) Roxb.	Vawmva	Clusiaceae	The seed is used as against in roundworm.	Seed
84	*Garuga pinnata* Roxb.	Bungbutuairam	Burseraceae	Juice of stem bark is dropped into the eye to cure opacities of conjunctiva. Juice of leaves mixed with sugar is taken for asthma.	Stem and leaves
85	*Gelsemium elegans* Benth.	Hnamtur	Loganiaceae	Juices of the crushed root is dluted wit water and taken for stomah trouble. It s also apllied axternally on ringworms.	Root
86	*Girardinia palmata* (Forsk) Gaud.	Kangthai	Urticaceae	The root is crushed and the juice is taken against food allergy e.g. pork,	Root
87	*Gmelina arborea* Roxb.	Thlanvawng	Verbenaceae	Roasted fruit is applied externally in itches.	Fruit
88	*Gynocardia odorata* R.Br.	Saithei	Flacourtiaceae	The fruits are crushed and the seeds are extracted manually. The seed oil is used as antileprosy.	Fruit
89	*Hedychium coccineum* Ham.	Aichhia	Zingiberaceae	The rhizome is crushed and applied to bee-sting and also to the anus against pinworms.	Rhizome
90	*Hedychium spicatum* Ham. ex Sm.	Aithur	Zingiberaceae	The rhizome is crushed and the juice is taken for liver complaints and body pain.	Rhizome
91	*Hedyotes scandens* (Roxb.)	Laikingtuibur/ Kelhnamtur	Zingiberaceae	The whole plant is boiled and the water is taken for the remedy against swollen and kidney problem	Whole plant
92	*Helianthus annus L.*	Nihawipar	Asteraceae	Seed-diuretic, expectorant, febrifuge, stomachache, in bronchitis and in laryngeal & pulmonary infections.	Seed
93	*Helicia excelsa* (Roxb.) R.Br. ex Wall	Sialhma	Proteaceae	Decoction of bark is taken orally for colic, stomach-ache and for strengthening of uterus.	Bark
94	*Helicia robusta* (Roxb.) R.Br. ex Wall	Pasaltakaza	Proteaceae	Decoction of root and stem is taken internally for stomachache, flatulence, kidney problems.	Root and stem
95	*Hodgsonia macrocarpa* (Bl.) Cogn.	Khaum	Cucurbitaceae	The seeds are boiled and taken for placental disorder.	Seed
96	*Holarrhena antidysenterica (*L.) Wall.	Thlengpa	Apocynaceae	Decoction of bark and powdered seeds are taken against dysentery, diarrhoea and intestinal worms.	Bark and seed
97	*Homalomena aromatica* Schott.	Anchiri	Araceae	Rhizome is used as aromatic stimulant. Juice of whole plant is used as lotion in skin diseases. Essential oil extracted from the rhizome is used in perfume. The burnt smoke of rhizome is used as mosquito repellant.	Whole plant
98	*Hydnocarpus kurzii* (King.) Warb.	Khawi-tur	Flacourtiaceae	The fruits are crushed and the seeds are extracted manually. The seed oil is used as antileprosy. The crushed leaf massaged on body prevent from the bite of bees. Oil extracted from seed is applied in leprosy and skin diseases.	Whole plant
99	*Hydrocotyle javanica* Thumb.	Hlovaidawr	Apiaceae	Infusion of leaves is taken as tonic, in dysentery and applied on eye-sore.	Leaves
100	*Ilex umbellulata* (Wall.) Loes.	Thinguihahni	Aquifoliaceae	The crushed bark is mixed with pig food to cure illness of pig.	Bark
101	*Imperata cylindrica* (L.) Beauv.	Di	Poaceae	Juice of roots is used for removal or expelling of intestinal worms.	Root

102	*Inula cappa* DC.	Buarthau	Asteraceae	The leaves are crushed with those of Plantago asiatica & Lobelia angulata & the juice is taken orally for diabetes & jaundice	Leaves
103	*Jatropa curcas* L.	Kangdamdawi	Euphorbiaceae	Nut is purgative; plant in scabies, eczema, in ring worm; twig is used as tooth brush in swollen gums	Fruit and stem
104	*Juglans regia* L.	Khawkherh	Juglandaceae	Juice of the bark is used as anthelmintic.	Bark
105	*Justicia zeylanica* Medicus.	Kawldai	Acanthaceae	Decoctions of leaves are taken against fever. Leaf is antispasmodic, used in chronic bronchitis, anti-diarrhoea, expectorant, antirheumatism, insecticidal; root antiseptic, antiperiodic, antithelminthic, antigornorrhic; flowers and fruits are also antispasmodic.	Whole plant
106	*Lagerstroemia speciosa* Pers.	Thlado / Chawnpui	Lythraceae	Decoction of root is taken for jaundice and infusion of bark is taken for diarrhea and dysentery.	Root
107	*Lantana camara* Linn.	Shillong-par	Anacardiaceae	Juice of pressed plant's leaves is applied externally on cuts, ulcers and swellings. Plant decoction is given tetanus, rheumatism and malaria and much used in atoxy of the abdominal viscera. The bark of stems and roots contain a quinine-like substance 'lantanine' with possessed antipyretic and anti-spasmodic properties, finds application in the treatment of asthma, bronchitis, arterial hypotension and fever.	Whole plant
108	*Leea compactiflora* Kurz.	Kawlkar	Vitaceae	The flowers are boiled and the water is drunk against placental disorder.	Flower
109	*Lepionurus sylvestris* Bl.	Anpangthuam	Opiliaceae	Decoction of leaves is taken for diabetes	Leaves
110	*Lindernia ruelloides* (Colsm.) Pennell.	Thasuih	Scrophulariaceae	Externally used for Rheumatism, sciatica, skin worms, wounds & also internally for eye problems	
111	*Litsea cubeba* Pers.	Sernam	Lauraceae	Fruit is antiparalytic, anticephalagic, antihysteric, carminative, in dizziness & in loss of memory	Fruit
112	*Litsea monopetala* Roxb.	Nauthakpui	Lauraceae	Decoction of the bark is taken orally against jaundice and hepatisis.	Bark
113	*Livistona cochirensis* Mart.	Buarpui chempai	Arecaceae	The fruit is used against high blood pressure.	Fruit and leaves
114	*Lobelia niwtianaefolia* Roth. Ex Schultes.	Berawchal	Lobeliaceae	Juice of the plant is applied to boils and warts.	Whole plant
115	*Lonicera macrantha* (D. Don) Spreng	Leihruisen	Caprifoliaceae	Decoction of leaves is taken for dysentery and stomach-ache.	Leaves
116	*Lyonia ovalifolia* (Wall.) Drude	Tlangham	Ericaceae	Infusion of young leaves is used to kill insects and also applied on skin diseases.	Leaves
117	*Maesa ramentacea* Wall.	Arngengpui	Myrsinaceae	The pounded leaf is applied on itches and skin diseases.	Leaves
118	*Maesia indica* (Roxb.) DC.	Arngeng	Myrsinaceae	The berries are taken as anthelmintic. The young shoots or leaves are eaten against dysentery and other stomach problems.	Fruit and leaves
119	*Mallotus roxburghianus* Muell.-Arg.	Zawngtenawh	Euphorbiaceae	The whole plant is boiled and the water is taken for the remedy	Whole

		-lung		against diabetes and retained placenta	plant
120	*Mangifera indica* L.	Theihai	Anacardiaceae	Decoction of leaves is taken for diarrhoea.	Leaves
121	*Melastoma malabathricum* L.	Builukham	Melastomataceae	Bark is used as wound healer; leaf as antidiarrhoeal, antiseptic; leaf & flower top astringent & antileucorrhoeic	Bark, Leaves and flower
122	*Melocanna baccifera* (Roxb.) Kurz	Mautak	Poaceae	The outer skin is scraped off and applied on cuts as haemostatics.	Stem
123	*Merremia umberlata* (L.) Hall.	Vawktesentil	Convolvulaceae	Poultice of leaves is pplied on burns & sores	Leaves
124	*Mesua ferrea* Linn.	Herhse	Clusiaceae	Flower is used as astringent, stomachic while flower and leaves are also used against as snakebite & scorpion sting.	Flower and leaves
125	*Michelia champaca* L.	Ngiau	Magnoliaceae	Infusion of leaves is taken with honey for colic. The fruit and seeds are crushed and made into paste and applied to the crackle in the feet.	Leaves, fruit and seed
126	*Mikania micrantha* Kunth.	Japanhlo	Asteraceae	The leaf juice is a good haemostatic. The leaves boiled with that *Vitex peduncularis* is taken against fever; also the leaves juice is good for dysentery.	Leaves
127	*Mimosa pudica* L.	Hlonuar	Mimosaceae	Leaves and root are used for pile and fistula; decoction of root is useful in gravelliest complaint.	Leaves and root
128	*Mirabilis jalapa* Linn.	Aratukkhuan	Nycaraginaceae	Roots are used as aphrodisiac. Infusion of leaves is used for itching by applying externally. Sprain and bone fracture are treating with this plant by bandaging over the injured area with the leaves.	Whole plant
129	*Morinda angustifolia* Roxb.	Lum	Rubiaceae	A poultice made of leaves is applied to a crack in the feet,	Leaves
130	*Mucana pruriens* (Linn.) DC.	Uiteme	Fabaceae	The powdered seeds pounded with yolk are taken with water for aphrodisiac, spermatorhoea and as nervine tonic. Decoctin of root is given for delirinium in fever and in dropsy.	Seed and root
131	*Murdannia nudiflora* Linn.	Dawng	Commelinaceae	The paste of crushed leaves and stem is applied externally on skin itching and other skin diseases. The same is applied on burns, sore and boils.	Leaves and stem
132	*Murraya paniculata* (L.) Jack.	Arpatil	Rutaceae	Decoction of leaves is drunk in dropsy.	Leaves
133	*Musa acuminata* Colla	Changel	Musaceae	The sap of the stem is applied for antiseptic	Stem
134	*Musa glauca* Roxb.	Saisu	Musaceae	The seeds are made into beads and used as necklace by children against convulsion associated with fever. The sap of the cut stem is taken orally for dysentery and as coolant. Local people prefer the wild plantation which grows on tree-trunk for dysentery. The watery juice of the stem is applied externally on insect-bite, snake-bite, wounds, sores and whitlow. The powdered seeds of Musa spp., is used as an effective remedy against tape-worm and diabetes.	Whole plant

135	*Mussaendra roxburghii* Hk. F.	Vakep	Rubiaceae	The bark is crushed and the juice is effectively used in snake bite.	Bark
136	*Myrica esculenta* Butch.-Ham. Ex D. Don.	Keifang	Myricacea	The bark is crushed and the juice is taken for fever and cough.	Bark
137	*Orthosiphon aristatus* (Bl.) Miq.	Zunthlumkung	Lamiaceae	The died leaf is made into tea and drunk for kidney trouble. Juice of leaves is diuretic and taken for diabetes.	Leaves
138	*Oroxylum indicum* (L.) Vent.	Archangkawm	Bignoniaceae	Decoction of both root-bark and stem-bark are used effectively in diarrhoea and dysentery and in rheumatism.	Root and stem
139	*Osbeckia nepalensis* Hook.	Builukhampa	Melastometaceae	Decoction of leaves is taken for diarrhoea and dysentery. Steamed roots & extracted solution is taken internally for renal disorder & genitorurinary problems; decoction of roots is taken for idney trouble & stomachache	Leaves and root
140	*Oxalis corniculata* L.	Siakthur	Oxalidaceae	Leaves are taken as stomachic, scorbutic and refrigerant. The whole plant is crushed and made it to a paste which is applied on eye for different eye problems.	Whole plant
141	*Paederia scandens* (Lour.) Merr.	Vawihuihhrui	Rubiaceae	The crushed leaves is retain in the mouth to cure toothache and gum boil. All part emits foetid smell.	Leaves
142	*Parkia roxburghii* D. Don.	Zawngtah	Mimosaceae	The skin of fresh pod is scrapped off and made into paste and applied on scabies. The scrapped pod is eaten raw as vegetables.	Fruit
143	*Passiflora nepalensis* Wall.	Nauawimu	Passifloraceae	The root is boiled & the water is taken to cure malaria	Root
144	*Phrynium capitatum* Wild	Hnahthial	Marantaceae	The young shoot and leaves or stem is used for burns and itches. It is applied externally on the wounded surface as a paste.	Leaves and stem
145	*Phyllanthus acidus* (L.) Skeels.	Kawlsunhlu	Euphorbiaceae	The fruit is astringent and make it into pickles. The root is considered antidote to viper venom.	Fruit and root
146	*Phyllanthus fraternus* Webs.	Mitthisunhlu	Euphorbiaceae	Infusion of plant @ 50 ml twice daily for diabetes; juice of whole plant is used for liver problems & jaundice; fruits & the plant parts are useful in thirst, bronchitis, leprosy, anaemia, urinary discharges, anuria & asthma	Whole plant
147	*Picrasma javanica* Bl.	Thingdamdawi	Simaroubaceae	Decoction of bark is taken against high blood pressure and fever.	Bark
148	*Piper diffusum* Vahl.	Pawhrual	Piperaceae	Infusion of the leaves or juice of crushed leaves is used for sprains, spasm and swellings by external application.	Leaves
149	*Pithecellobium monadelphum* (Roxb.) Kosterm.	Ar-dah-te	Mimosaceae	The crushed leaf is retained in the mouth against gum-boil and toothache.	Leaves
150	*Plumeria acuminata* Ait.	Vaingai	Apocynaceae	The rrot bark is used in herpes and venereal sores.	Root
151	*Podocarpus neriifolius* D.Don.	Thlangfar	Podocarpaceae	Juice of crashed bark is taken and applied on the bite of centipede.	Bark
152	*Pogonia plicata* Roxb.) Lindl.	Phurthakhlo	Lamiaceae	Juice of leaves is applied externally on burns and itches.	Leaves
153	*Polygonum barbatum* L.	Anbawng	Polygonaceae	Seeds are taken to relieve colic.	Seed
154	*Polygonum chinensis* L.	Taham	Polygonaceae	Juice of the plant is used as tonic. The young shoot is crushed and	Whole

				applied on wart. The wart has to be incised before applying the plants. Leaves and stem are chewed to cure teeth edge set.	plant
155	*Polygonum plebium* R. Br.	Bakhate	Polygonaceae	Decoction of the plant is taken against cirrhosis of liver and gastric complain.	Whole plant
156	*Pratia nummularis* Kurz.	Choakthi	Campanulaceae	The leaves is crushed and the juice is taken for the remedy of dysentery and vomiting	Leaves
157	*Prunus cerasoides* D.Don	Tlaizawng	Rosaceae	The bark is boiled and the water is taken against fever.	Bark
158	*Pseudodrynaric coronans* (Wall. ex Mett) Ching.	Awmvel	Polypodiaceae	The hair is removed and the rhizome is crushed and the juice is applied on herpes located below the chest around the body.	Rhizome
159	*Pteridium acquilinum* (v) Kuhn.	Katchat	Pteridiacea	Decoction of rhizome is given in chronic spleen disorder.	Rhizome
160	*Pterospermum acerifolium* Willd.	Siksil	Sterculiaceae	The bark is charred and mixed with the powder from *Mallotus philippensis* and applied externally to small pox eruptions. The leaves are used for lining umbrellas and *'Thul'* baskets.	Leaves and bark
161	*Rhus semialata* Merr.	Khawmhma	Anacardiaceae	The fruits are taken against colic and dysentery.	Fruit
162	*Rhus succedanea* L.	Chhimhruk	Anacardiaceae	Juice of stem bark is used for japanning gun stock and tobacco pipes. Fruits are used in phthisis. Contact with the tree affects rash to the body.	Stem and fruit
163	*Ricinus communis* Linn.	Mutih	Euphorbiaceae	Young leaves after heating are used in ulcer, sciatica & paralysis while crushed leaves are applied as bandage against urinary problems	Leaves
164	*Rubus ellipticus* Sm.	Hmutau	Rosaceae	Decoction of root is taken against colic, diarrhoea and dysentery.	Root
165	*Saraca asoca* (Roxb.) de Wilde	Mualhawih	Caesalpinaceae	The stem is boiled and the water is taken for easy delivery and diuretic. The inner stem-bark is used as a substitute for milk in tea.	Stem
166	*Schefflera elliptica* (Bl.) Harms	Kelbuh	Araliaceae	Juice of crushed fruit is applied on strains.	Fruit
167	*Schima wallichii* (DC.) Korth.	Khiang	Theaceae	Decoction of fruit is used for snake bite and insect bite.	Fruit
168	*Scoporia dulcis* Medic.	Perhpawng chaw/ Hlothlum	Scrophulariaceae	The whole plant is crushed and the juice is taken for the remedy of kidney stone, jaundice & genitor-urinary troubles	Whole plant
169	*Securinega virosus* (Roxb.) Baillon	Saisiak	Euphorbiaceae	The leaves are boiled and the water is taken for bathing children from scabies and measles	Leaves
170	*Semecarpus anacardium* Linn.	Vawmbalpui	Anacardiaceae	Juice of fruit (nut) is applied externally on sprain & in rheumatism	Fruit
171	*Senecio scandens* Butch. Ham. ex D. Don	Saiekhlo	Asteraceae	Bark is astringent, used in uterine inflution and in gonor,, in scorpion sting.	Bark
172	*Smilax glabra* Roxb.	Tluangngil	Liliaceae	Taken in uterine and stomach infection	
173	*Smilax pervifolia* Roxb.	Kaihapui	Liliaceae	The root is grounded with old molasses or with coagulated lows milk, mixed with water and drink as a remedy against blood	Root
174	*Solanum nigrum* Linn.	Anhling	Solanaceae	Infusion of the plant is prescribed for liver problem & dropsy	Whole plant
175	*Solanum torvum* Sweet	Tawkpui	Solanaceae	The crushed seed is applied to toothache and tooth decay.	Seed

176	*Spondias pinnata* (L.f) Kurz	Taitaw	Anacardiaceae	The bark is refrigerant, useful in dysentery, gourd and mixed with water rubbed in both auricular and muscular rheumatism.	Bark
177	*Sterculia villosa* Roxb.	Khaupui	Sterculiaceae	The bark is crushed and the juice is taken against tonsilitis, diarrhoea and dysentery.	Bark
178	*Stereopermum chelonoides*(Butch. Ham. Ex Dillon.)	Zinghal	Bignoniaceae	Decoction of leaves is used as febrifuge and leaf juice is applied on itch.	Leaves
179	*Strobilanthes cusia* (Nees) Imlay	Ting	Acanthaceae	The crushed leaves applied on rat-bite.	Leaves
180	*Swertia angustifolia* Ham.ex D. Don **var.**	Khawsik damdawi	Gentianaceae	Infusion of the plant is taken against fever, tonic and as antiperiodic.	Whole plant
181	*Syzygium cumini* (L.) Skeels.	Hmuipui	Myrtaceae	Infusion of fruit pulp is taken as stomachic and diuretic.	Fruit
182	*Tagetes erecta* L.	Derhken	Asteraceae	Juice of leaves is dropped to ear-ache.	Leaves
183	*Tamarindus indica* L.	Tengtere	Caesalpinaceae	Infusion of the pulp is taken against diarrhoea. The kernel is effectively in snake-bite, centipede, etc. The kernel is put to the affected part and adheres itself till the venom is sucked out.	Fruit
184	*Terminalia bellirica* (Gaertn.) Roxb.	Thingvandawt	Combretaceae	The fruit is taken against for stomach problem	Fruit
185	*Terminalia chebula* Retz.	Reraw	Combretaceae	The fruit is taken against for stomach problem	Fruit
186	*Tetrameles nudiflora* R.Br.	Thingdawl	Tetramelaceae	The sap or juice of crushed bark is used for the bite of grey-wood tick by external application or dropped into the year.	Bark
187	*Thunbergia coccinea* Wall.	Fahrahhrui	Acanthaceae	The whole plant is crushed and made it to a paste which is applied on sore especially on the head.	Whole plant
188	*Thunbergia grandiflora* Roxb.	Vako, Zawngafian	Acanthaceae	The stem is cut off to produce a sap which is dropped into the eye for eye-sore and opthalmia.	Stem
189	*Tinospora cordifolia* (Wall.) Miers.	Theisawntlung	Menispermaceae	The bark and leaves are boiled in 4 cups of water and ¼ of it (water) is taken as an effective remedy against rheumatism. The medicine is taken one tablespoonful twice daily.	Leaves and bark
190	*Tinospora sinensis* (Lour.) Merr.	Hruivankai, Vankaihrui	Menispermaceae	Local application of direct droping of the sap into the infected spot. Infusion is used for diabetis and fever.	Leaves
191	*Trema orientalis* (L.) Bl.	Bel-phuar	Ulmaceae	Decoction of root bark is taken against epilepsy.	Root
192	*Trevesia palmata* (Roxb.) Vis.	Kawhtebel	Anacardiaceae	The leaf is crushed and the juice is taken as an effective remedy for colic, stomachache and high blood pressure.	Leaves
193	*Uncaria sessilifructus* Roxb.	Ralsamkuai. (zik sen)	Rubiaceae	The shoots and young leaves are boiled and the the water is taken half a cup twice daily for tonsilities and throat-pain.	Leaves
194	*Urena lobata* L.	Leithi	Malvaceae	The mucous gland of root is applied in rheumatism.	Root
195	*Vitex peduncularis* Wall. Ex Schauer	Thingkhawilu	Verbenaceae	The bark is boiled and the water is drunk against for typhoid fever.	Bark
196	*Xylia xylocarpa* (Roxb.) Taub.	Thinguk	Mimosaceae	Decoction of bark is used in ulcer, gonorrhoea and diarrhoea; seed oil is antirheumatic, used also in piles, bark and seed oil are antileprotic	Bark and seed
197	*Zanonia indica* Linn.	Lalruanga dawibur	Cucurbitaceae	The ripened fruit is boiled and the water is taken against stomach problem	Fruit

198	*Zanthoxylum armatum* DC.	Arhrikreh	Rutaceae	The leaves are used towards off fouls, lice; fruit as appetizer, anticephalgic, antiasthmatic, antihelminthic, in leucoderma, eye & ear diseases, piles; flower used as antidote for snake bite	Leaves, fruit and flower
199	*Zanthoxylum rhetsa* (Roxb.) DC	Chingit	Rutaceae	The paste of the grinded roots is drunk against fever.	Root
200	*Ziziphus mauritiana* Lam.	Borai	Rhamnaceae	Decoction of root is taken for fever and root powder is applied externally on chronic ulcer.	Root

Table 14: Prioritization of NTFPs based on various criteria

Category	Species Name
Category 1	*Acacia caesia, Achyranthes bidentata, Adiantum caudatum, Adiantum phillippense, Albizia chinensis, Albizia odoratissima, Albizia procera, Alocasia fornicata, Alstonia scholaris, Amaranthus spinosus, Amaranthus viridis, Amomum dealbatum, Amorphophallus paeniifolius, Aporusa octandra, Artocarpus chama, Bauhinia variegata, Bombax insigne, Borassus flabellifer, Callicarpa arborea, Canna indica, Cassia floribunda, Catharanthus roseus, Chromolaena odorata, Cinnamomum verum, Clerodendrum colebrookianum, Clerodendrum viscosum, Colocasia esculenta, Costus speciosus, Curculigo capitulata, Curcuma longa, Diplazium maximum, Dregea volubilis, Emblica officinalis, Eryngium feotidum, Eurya acuminata, Eurya cerasifolia, Datura suaveolens, Dillenia pentagnya, Dysoxylum gobara, Elaegnus caudata, Girardinia palmata, Gmelina arborea, Hedychium coccineum, Helianthus annuus, Imperata cylindrica, Ipomea batatas, Justicia zeylanica, Lepionurus sylvestris, Lonicera macrantha, Luffa cylindrical, Macaranga indica, Mallotus roxburghianus, Mangifera indica, Manihota esculenta, Melastoma malabathricum, Meliosma pinata, Melocalamus compactiflorus, Meloccana baccifera, Michelia champaca, Mikania micrantha, Mimosa pudica, Mirabilis jalapa, Murraya paniculata, Musa acuminata, Musa glauca, Musa velutina, Oroxylum indicum, Osbeckia nepalensis, Paederia scandens, Parkia roxburghii, Passiflora nepalensis, Phrynium capitatum, Polygonum barbatum, Polygonum chinensis, Polygonum plebium, Pratia nummularis, Protium serratum, Pteridium acquilinum, Rhus semialata, Saccharum spontaneum, Schima wallichii, Schizophyllum commune, Scoporia dulcis, Solanum nigrum, Securinega virosus, Semecarpus anacardium, Solanum torvum, Spilanthes acmella, Spondias pinnata, Sterospermum personatum, Tamarindus indica, Tagetes erecta, Trevesia palmata, Tetrameles nudiflora, Thysanolaena maxima,* Zanthoxylum rhetsa

Category 2	*Acrocarpus fraxinifolius, Adina cordifolia, Agaricus campestris, Albizia thompsonii, Anogeissus acuminata, Anodendron paniculatum, Aralia foliosa, Ardisia peniculata, Arenga pinnata, Artocarpus heterophyllus, Artocarpus lakoocha, Baccaurea ramiflora, Bambusa khasiana, Bambusa nutans, Bambusa oliveriana, Bambusa tulda, Bambusa vulgaris, Begonia inflae, Bischofia javanica, Bruinsmia polysperma, Butea monosperma, Camellia sinnensis, Carralia brachiata, Cassia tora, Castanopsis tribuloides, Centella asiatica, Chimonobambusa callosa, Chimonobombusa khasiana, Cinnamomum bejolghota, Chukrasia tabularis, Crotolaria juncea, Cyanthocalyx martabanicus, Dendrocalamus sikkimensis, Dendrocalamus hamiltonii, Dendrocalamus hookeri, Dendrocalamus longispathus, Dendrocalamus strictus, Dendrocnide sinuata, Derris robusta, Derris thyrsiflora, Dillenia indica, Dinochloa compactiflora, Dioscorea alata, Dioscorea bulbifera, Dipterocarpus turbinatus, Eleocarpus lanceofolious, Entada pursaetha, Entoloma microcarpum, Erythrina stricta, Eugenia jambolana, Euphoria longan, Ficus bengalensis, Ficus hispida, Ficus rostrata, Ficus semicordata, Flacourtia jangomas, Garcinia cowa, Garcinia paniculata, Garuga pinnata, Gelsemium elegans, Glochidion arborescens, Hodgsonia macrocarpa, Inula cappa, Kadsura heteroclita, Langerstromia speciosa, Lantana camara, Lepionurus sylvestris, Leuceana leucocephala, Licuala peltata, Litchi chinensis, Litsea cubeba, Litsea monopetala, Livistona cochirensis, Lycianthes laevis, Macropanax dispermus, Maesa ramentacea, Maesia indica, Memecylon ceeruleum, Mesua ferrea, Morinda angustifolia, Mucana pruriens, Murdannia nudiflora, Phyllanthus acidus, Phyllanthus fraternus, Pinanga gracilis, Piper diffusum, Pogonia plicata, Prunus cerasoides, Pseudodrynaric coronans, Renanthera imschootiana, Rhynchotechum ellipticum, Ricinus communis, Smilax pervifolia, Sterculia villosa, Styrax serrulatum, Syzygium cumini, Terminalia bellirica, Terminalia chebula, Tinospora cordifolia, Tinospora sinensis, Toona ciliata, Trema orientalis, Vitex peduncularis, Wendlandia grandis, Wightia speciosissima, Xeromphis spinosa, Xylia xylocarpa*
Category 3	*Aeginetia indica, Aeschynanthus sikkimensis, Areca trianda, Aquilaria malaccensis, Bergenia ciliata, Blumea lanceolaria, Calamus acanthospathus, Calamus erectus, Calamus flagellum, Calamus gracilis, Calamus guruba, Calamus inermis, Calamus khasianus, Calamus nambariensis, Calamus tenuis, Camellia kissi, Canarium strictum, Chrysophyllum cainito, Caryota urens, Cordia dichotoma, Daemonorops jenkinsianus, Embelia subcoriacea, Ervatamea coronaria, Hedyotes scandens, Holarrhena antidysenterica, Homalomena aromatica, Hydrocotyle javanica, Ilex umbellulata, Leea compactiflora, Lindernia ruelloides, Lobelia niwtianaefolia, Lyonia ovalifolia, Merremia umberlata, Morus australis, Mussaenda roxburghii, Orthosiphon aristatus, Oxalis corniculata, Phyllostachis manii, Picrasma javanica, Plectocomia khasiana, Plumeria acuminata, Pterospermum acerifolium, Rhus succedanea, Sarcochhamys pulcherrima, Scheffllera elliptica, Schizostachyum fuchsianum, Schizostachyum polymorphum, Schizostochyum dullooa, Swertia angustifolia, Quercus floribunda, Quercus helferiana, Quercus pachyphylla, Quercus polystachya, Quercus serrata, Quercus xylocarpa, Thunbergia coccinea, Thunbergia grandiflora, Zalacca secunda, Zanonia indica, Ziziphus mauritiana*
Category 4	*Aegle marmelos, Ageratum conyzoides, Artemesia indica , Averrhoa carambola, Bidens pilosa, Bombax ceiba, Cassia alata, Cissus javanica, Gynocardia odorata, Hedychium spicatum, Helicia excelsa, Helicia robusta, Hydnocarpus kurzii, Juglans regia, Myrica esculenta, Podocarpus neriifolius, Pithecellobium monadelphum, Rhododendron arboretum, Rhododendron waghtii, Rubus ellipticus, Saraca asoca, Senecio scandens, Smilax glabra, Strobilanthes cusia, Uncaria sessilifructus, Urena lobata, Vanda coerulea, Zanthoxylum armatum*

Table 15: Matrix ranking for 30 indigenous fuelwood species of northern Mizoram using 12 quality criteria

Sl. No.	Species name	Local Name	Quality criteria												Total score	Rank
			Availability	Fast drying	Hot flame	Ability to produce embers	Flame not smoky	Easiness of flammability	Non-sparking	Light weight when dry	Bright flame	Easiness of splitting	Low moisture when fresh cut	Long burning		
1	*Quercus pachyphylla* Kurz.	Fah	7	7	8	7	6	7	8	3	8	7	7	8	83	1
2	*Quercus xylocarpa* Kurz.	Then	6	6	8	6	7	7	6	7	8	7	7	7	82	2
3	*Quercus polystachya* Wall.	Thil	7	7	8	6	6	7	8	3	8	7	7	7	81	3
4	*Vitex peduncularis* Wall ex Schauer	Thingkhawilu	5	6	8	7	7	6	7	5	8	5	7	7	78	4
5	*Schima wallichii* (DC.) Korth	Khiang	8	6	8	7	5	5	6	6	7	5	6	7	76	5
6	*Quercus serrata* Murray	Sasua	5	6	7	6	7	6	7	4	7	7	6	6	74	6
7	*Quercus helferiana* A.DC.	Thal	5	7	8	6	5	5	6	6	5	6	7	7	73	7
8	*Quercus floribunda* Lindl.	Hlai	5	6	6	6	7	6	7	4	7	5	6	7	72	8
9	*Castanopsis tribuloides* (Sm.) DC.	Thingsia	7	5	7	5	5	7	6	5	6	5	7	6	71	9
10	*Derris robusta* Benth.	Thingkha	7	4	7	6	6	4	7	3	7	4	7	7	69	10
11	*Sterospermum personatum*(Hassk) D. Chatterjee	Zihnghal	4	7	7	5	6	4	6	5	5	6	7	6	68	11
12	*Mesua ferrea* Linn.	Herhse	5	4	8	6	7	4	6	4	4	4	7	7	66	12
13	*Wendlandia grandis* (Hook. f.) Cowan	Batling	3	6	5	6	6	6	6	6	6	6	6	3	65	13
14	*Albizia procera* (Roxb.) Benth.	Kangtekpa	7	5	6	4	5	5	6	4	6	3	7	6	64	14
15	*Anogeissus acuminata* (Roxb. Ex. DC.) Wall.	Zairum	4	4	7	6	4	5	5	5	5	4	7	7	63	15
16	*Myrica esculenta* Buch. Ham. e. D. Don	Keifang	6	3	7	4	3	3	6	5	6	7	6	6	62	16
17	*Callicarpa arborea* Roxb.	Hnahkiah	8	5	5	2	2	6	6	7	4	7	5	4	61	17
18	*Eleocarpus lanceofolious* Roxb.	Kharuan	3	5	6	2	5	6	6	5	6	6	5	5	60	18
19	*Macaranga indica* Wight.	Hnahkhar	7	7	4	2	3	6	7	6	3	7	3	4	59	19
20	*Styrax serrulatum* Roxb. C.B. Clarke	Hmar-hleng	4	6	4	2	5	6	6	7	5	6	3	4	58	20
21	*Albizia thompsonii* Brandis	Thingri	3	3	6	4	6	3	6	4	7	4	5	5	56	21
22	*Albizia chinensis* (Osbecks) Merr.	Vang	6	5	5	3	2	6	6	6	5	6	2	3	55	22
23	*Adina cordifolia* (Wild. ex Roxb.) Kh.f. ex Brandis	Lungkhup	3	3	6	2	4	5	5	4	5	6	6	5	54	23
24	*Tetrameles nudiflora* R.Br.	Thingdawl	8	3	4	2	2	6	6	7	5	3	3	3	52	24
25	*Bischofia javanica* Bl.	Khuangthli	4	3	5	2	2	6	7	7	3	6	3	3	51	25
26	*Wightia speciosissima* (D. Don) Merr.	Chawngtlai	4	5	6	3	4	3	2	4	5	5	4	5	50	26
27	*Toona ciliata* M. Roem.	Tei	7	6	5	2	6	6	1	3	3	3	4	3	49	27
28	*Macropanax dispermus* (Blume) Kuntze	Phuanberh	3	3	3	2	1	6	7	6	3	7	3	4	48	28
29	*Acrocarpus fraxinifolius* Wight & Arn.	Nganbawm	3	3	6	2	1	5	7	5	3	2	7	3	47	29
30	*Ficus semicordata* Butch.-Ham.	Theipuithing	6	3	4	3	3	2	6	3	4	7	2	3	46	30

* For each of the quality criterion, the score ranges from 0–10 (best). Rank ranges from 1 (best) to 10 (worst).

Table 16: Fuelwood Value Index (FVI) of selected fuelwood species

Sl. No.	Scientific Name	Local Name	Family	Score	Community ranking	Energy value (KJ/g)	Moisture content (%)	Density (g/cm2)	Ash content (%)	Biomass/ash ratio	Fuelwood Value Index (FVI)	Ranking
1	*Anogeissus acuminata* (Roxb. Ex. DC.) Wall.	Zairum	Combretaceae	63	15	19.2	47	0.55	1.64	42	1370	1
2	*Quercus pachyphylla* Kurz.	Fah	Fagaceae	83	1	19	46	0.57	1.73	60	1361	2
3	*Vitex peduncularis* Wall ex Schauer	Thingkhawilu	Verbenaceae	78	4	19	51	0.5	1.46	50	1276	3
4	*Mesua ferrea* Linn.	Herhse	Clusiaceae	66	12	19.05	48	0.58	1.85	50	1244	4
5	*Quercus polystachya* Wall.	Thil	Fagaceae	81	3	19.75	50	0.53	1.73	60	1210	5
6	*Quercus xylocarpa* Kurz.	Then	Fagaceae	82	2	18.6	41	0.56	2.13	48	1193	6
7	*Quercus helferiana* A.DC.	Hlai	Fagaceae	73	7	17.5	44	0.48	1.72	50	1110	7
8	*Quercus serrata* Murray	Sasua	Fagaceae	74	6	18.2	42	0.46	1.85	55	1077	8
9	*Schima wallichii* (DC.) Korth	Khiang	Theaceae	76	5	19.4	52	0.48	1.93	54	928	9
10	*Quercus floribunda* Lindl.	Thal	Fagaceae	73	7	19.9	48	0.49	2.27	44	895	10
11	*Wendlandia grandis* (Hook. f.) Cowan	Batling	Rubiaceae	66	12	17.6	47	0.48	2.05	45	877	11
12	*Albizia thompsonii* Brandis	Thingri	Leguminosae	56	21	17.5	49	0.51	2.1	25	867	12
13	*Myrica esculenta* Buch. Ham. e. D. Don	Keifang	Myricaceae	62	16	15.65	46	0.49	2.08	43	801	13
14	*Sterospermum personatum*(Hassk) D. Chatterjee	Zihnghal	Bignoniaceae	68	11	18.1	43	0.42	2.3	44	769	14
15	*Castanopsis tribuloides* (Sm.) DC.	Thingsia	Fagaceae	71	9	18.85	49	0.54	2.86	36	726	15
16	*Derris robusta* Benth.	Thingkha	Fabaceae	69	10	17.2	42	0.54	3.2	31	691	16
17	*Callicarpa arborea* Roxb.	Hnahkiah	Verbenaceae	61	17	14	55	0.44	1.93	54	580	17
18	*Albizia procera* (Roxb.) Benth.	Kangtekpa	Fabaceae	64	14	14.04	47	0.57	3.2	23	532	18
19	*Adina cordifolia* (Wild. ex Roxb.) Kh.f. ex Brandis	Lungkhup	Rubiaceae	54	23	13.3	48	0.42	2.2	45	529	19
20	*Macaranga indica* Wight.	Hnahkhar	Euphorbiaceae	59	19	14	45	0.44	2.66	38	515	20
21	*Styrax serrulatum* Roxb. C.B. Clarke	Hmar-hleng	Styraceae	58	20	12	51	0.45	2.13	48	497	21
22	*Eleocarpus lanceofolious* Roxb.	Kharuan	Tiliaceae	60	18	14.56	53	0.42	2.96	34	390	22
23	*Wightia speciosissima* (D. Don) Merr.	Chawngtlai	Scrophulariaceae	50	26	13.4	47	0.44	3.5	34	358	23
24	*Toona ciliata* M. Roem.	Tei	Meliaceae	49	27	12.3	52	0.45	3.1	40	343	24
25	*Acrocarpus fraxinifolius* Wight & Arn.	Nganbawm	Caesalpinaceae	47	29	14.3	51	0.48	4.4	24	306	25
26	*Ficus semicordata* Butch.-Ham.	Theipuithing	Moraceae	46	30	11.5	58	0.43	2.93	35	291	26
27	*Bischofia javanica* Bl.	Khuangthli	Bischofiaceae	51	25	13.5	54	0.34	3.13	33	272	27
28	*Albizia chinensis* (Osbecks) Merr.	Vang	Mimosaceae	55	22	11.2	55	0.38	3.2	32	242	28
29	*Macropanax dispermus* (Blume) Kuntze	Phuanberh	Araliaceae	48	28	10.03	50	0.46	4.2	26	220	29
30	*Tetrameles nudiflora* R.Br.	Thingdawl	Tetramelaceae	52	24	10.04	56	0.42	3.46	25	218	30

Table 17: Fuel wood consumption (daily and per capita per year)

Consumption pattern	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Total / Average
Total No. of household	851	1013	580	275	446	540	315	190	4210
No. of population	4751	7177	3745	1650	5573	7283	3271	1543	34993
Weight of 1 bundle (kg)	2	2	2	2	2	2	2	2	2
Average daily Consumption of fuelwood per household (kg)	3.5	3.2	3	3.4	3.5	3.4	3.3	3.6	3.36
Average number of days one household goes with one bundle	0.57	0.63	0.67	0.59	0.57	0.59	0.61	0.56	0.59
Daily consumption per each site (kg)	2,978.5	3,241.6	1,740	935	1,561	1,836	1,039.5	684	14,015.6
Per capita use (tonnes/cap/year)	228.83	164.86	169.59	206.83	102.24	92.01	115.99	161.80	1242.15

* Sites as in Table 1

Table 18: Seasonal consumption pattern of fuelwood by the people

Locality	Consumption per seasons (in metric tonnes)			Total (in metric tonnes)
	Rainy (June – Oct.)	Summer (March – May)	Winter (Nov. – Feb.)	
Hnahlan Forest Area	73.83	57.00	98.00	228.83
Ngopa Forest Area	54.00	44.00	66.86	164.86
Bairabi Forest Area	52.00	40.00	77.59	169.59
Phullen Forest Area	65.00	53.86	88.00	206.83
Farkawn Forest Area	38.24	24.00	40.00	102.24
Phuldungsei Forest Area	26.00	24.00	42.01	92.01
Kawrthah Forest Area	36.00	23.99	56.00	115.99
N. Hlimen Forest Area	50.00	41.00	70.80	161.80
Total	**395.07**	**307.85**	**539.26**	**1242.18**

Table 19: Seasons of availability of various food plants available in the local market of Mizoram

Sl. No.	Scientific Name	Local Name	Family	Parts eaten	Availability period
1	*Acacia caesia* **var.** *subnuda* (Craib) Nielsen	Khanghu	Mimosaceae	Leaves	January - June
2	*Agaricus campestris* Linn.	Maupa	Agaricaceae	Whole	June - October
3	*Alocasia fornicata* (Roxb.) Schott	Baibing	Araceae	Spadix, fruiting body	June - September
4	*Amomum dealbatum.* L. Roxb.	Aidu	Zingiberaceae	Buds, flowers, young shoots	February - June
5	*Amorphophallus paeniifolius* (Dennst.) Nicols.	Telhawng	Araceae	Bulb	March - April
6	*Aralia foliosa* Seem.	Chimchawk	Araliaceae	Tender shoots & leaves	March - May
7	*Areca triadra* Roxb.	Uvai	Arecaceae	Tender fleshy part	September - November
8	*Arenga pinnata* (Wurmb.) Merill	Thangtung	Arecaceae	Tender heart/peel of the stem	Whole year
9	*Bambusa tulda* Roxb.	Rawthing	Poaceae	Shoot	April – August
10	*Bischofia javanica* Bl.	Khuangthli	Bischofiaceae	Young leaves	Whole year
11	*Calamus acanthospathus* Griff.	Thilte	Arecaceae	Tender pith	Whole year
12	*Calamus flagellum* Griff.	Hruipui	Arecaceae	Tender pith	Whole year
13	*Caryota urens* Linn.	Tum	Arecaceae	Fleshy pith	February - June
14	*Cassia floribunda* Cav.	Rengan	Caesalpiniaceae	Leaves	April - June
15	*Cassia tora*L.	Kelbean	Caesalpinaceae	Young leaves	August - November
16	*Cinnamomum verum* Presl.	Thakthing	Lauraceae	Root/stem bark	Whole year
17	*Clerodendrum colebrookianum* Walp.	Phuihnam	Verbenaceae	Young shoot & leaves	Whole year
18	*Costus speciosus* (Koenig) Sm.	Sumbul	Costaceae	rhizome	Whole year
19	*Crotolaria juncea* Linn.	Tumthang	Fabaceae	Flowers, pods	May – December
20	*Dendrocalamus hamiltonii* Nees & Arn.	Phulrua	Poaceae	Shoot	June - October
21	*Dendrocalamus longispathus* Kurz.	Rawnal	Poaceae	Shoot	June - October
22	*Derris wallichii* Prain	Hulhu	Caesalpineaceae	Young leaves	February - March
23	*Dioscorea alata* Linn.	Bahrachim	Dioscoreaceae	Tuber	July - December
24	*Dioscorea bulbifera* Linn.	Rambahra	Dioscoreaceae	Tuber	November - February
25	*Diplazium maximum* (D. Don) C. Chatt.	Chakawk ei chi	Athyriaceae	Young leaves	March - October
26	*Dregea volubilis* Benth.	Ankhapui	Asclepiadaceae	Leaves	February – May
27	*Dysoxylum gobara* (Buch.-Ham.) Merr.	Thingthupui	Meliaceae	Young shoots, leaves & flowers	March - June
28	*Entoloma microcarpum* Berk & Br.	Pasawntlung	Agaricaceae	Fruiting body.	April - September
29	*Eryngium feotidum* Linn.	Bahkhawr	Apiaceae	Whole Plant	Whole year
30	*Eurya cerasifolia* (D. Don) Kubuski	Sihneh	Theaceae	Leaves	April - June
31	*Ficus hispida* Linn.	Paihte maian, Theithawt, Theibate	Moraceae	Young leaves	Whole year
32	*Hedychium spicatum* Buch.-Ham.	Aithur	Zingiberaceae	Shoots	Whole year

33	*Hodgsonia macrocarpa* (Blume.) Cogn	Khaum	Cucurbitaceae	Fruits	July - October
34	*Leea compactiflora* Kurz.	Kawlkar	Vitaceae	Shoots	Whole year
35	*Lepionurus sylvestris* Bl.	Anpangthuam	Opiliaceae	Young leaves	November - February
36	*Leuceana leucocephala* (Lamk.) de W.	Japanzawngtah	Mimosaceae	Young pods	April - July
37	*Livistona cochirensis* Mart.	Buarpui chempai	Arecaceae	Young buds.	November - April
38	*Luffa cylindrica* Roem.	Awmpawng	Cucurbitaceae	Young fruits	May - January
39	*Lycianthes laevis* (Dunal) Bitter	Vanian	Solanaceae	Whole Plant	June – December
40	*Musa velutina* Wendl.	Changvandawt	Musaceae	Spadix	Whole year
41	*Meloccana baccifera* (Roxb.) Kurz	Mautak	Poaceae	Shoot	June - September
42	*Musa acuminata* Colla.	Tumbu	Musaceae	Spadix	Whole year
43	*Musa glauca* Roxb.	Sai-su	Musaceae	Spadix	Whole year
44	*Oroxylum indicum* (L.)Vent	Archangkawm	Bignoniaceae	Pods	October - January
45	*Parkia timoriana* (A.DC.) Merr.	Zawngtah	Mimosaceae	Pods, seeds	September - February
46	*Polygonum barbatum* Linn.	Anbawng	Polygonaceae	Leaves	August - October
47	*Polygonum plebium* R.Br.	Bakhate	Polygonaceae	Fruiting body	January - May
48	*Rhynchotechum ellipticum* (Wall. Ex Dietr.) A. DC.	Tiarrep	Gesneriaceae	Leaves	October - March
49	*Sarcochhamys pulcherrima* Gaud.	Lehngo	Urticaceae	Leaves	September - February
50	*Schizophyllum commune* Fr.	Pasi	Agaricaceae	Fruiting body	April - November
51	*Solanum nigrum* Linn.	Anhling	Solanaceae	Whole Plant	March - December
52	*Solanum torvum* Sw.	Tawkpui	Solanaceae	Fruits	July - November
53	*Passiflora nepalensis* Wall.	Nauawimu	Cucurbitaceae	Leaves	July - October
54	*Spilanthes acmella* Hook.	Ankasa	Asteraceae	Whole Plant	September - February
55	*Trema orientalis* (L.) Bl.	Belphuar	Ulmaceae	Young leaves	Whole year
56	*Trevesia palmata* (Roxb.) Vis.	Kawhtebel	Caprifoliaceae	Fruits, young leaves	February - May
57	*Wendlandia grandis* (Hook. f.) Cowan	Batling	Rubiaceae	Young leaves	Whole year
58	*Zalacca secunda* Griff.	Hruitung	Arecaceae	Tender pith	Whole year
59	*Zanthoxylum armatum* DC.	Arhrikreh	Rutaceae	Leaves	October - May
60	*Zanthoxylum rhetsa* (Roxb.) DC.	Chingit	Rutaceae	Young shoots & leaves	Whole year

Table 20: Seasons of availability of various fruit plants available in the local market of Mizoram

Sl. No.	Scientific Name	Local Name	Family	Availability period
1	*Amomum dealbatum* L. Roxb.	Aidu	Zingiberaceae	February - June
2	*Anodendron paniculatum* A. DC.	Theikelki	Melastomataceae	August – December
3	*Artocarpus lakoocha* Roxb.	Theitat	Moraceae	June – September
4	*Artocarpus chama.* Butch.-Ham.	Tatkawng	Moraceae	June – August
5	*Artocarpus heterophyllus* Lam.	Lamkhuang	Moraceae	April - July
6	*Averrhoa carambola* L.	Theiherawt	Averrhoaceae	November – May; March - April
7	*Baccaurea ramiflora* Lour.	Pang-kai	Euphorbiaceae	March - July
8	*Bruinsmia polysperma* (Cl.) Van Steenis	Theipalingkawh	Styraceae	September – February
9	*Carralia brachiata* (Lour.) Merr.	Theiria	Rhizophoraceae	April – June
10	*Chrysophyllum cainito* Linn.	Theipabuan	Sapotaceae	September – February
11	*Cyanthocalyx martabanicus* Champ.	Hreirawt	Anonaceae	September – November
12	*Dillenia indica* L.	Kawrthindeng	Dilleniaceae	November – February
13	*Elaegnus caudata* Schl. Ex Mom.	Sarzuk	Elaegnaceae	February - March
14	*Embelia subcoriacea* (Cl.) Mez	Tling	Elaegnaceae	November - December
15	*Emblica officinalis* Gaertn.	Sunhlu	Euphorbiaceae	October – January; June - July
16	*Eugenia jambolana* Lam.	Lenhmui	Myrtaceae	February - May
17	*Euphoria longan* Steud.	Theifeimung	Sapindaceae	March - June
18	*Ficus rostrata* Lam.	Theitit	Moraceae	June - July
19	*Ficus semicordata* Butch.-Ham.	Theipui	Moraceae	May - July
20	*Flacourtia jangomas* (Lour.)	Sakhithei	Binaceae	September - November
21	*Garcinia cowa* Roxb. Ex DC.	Chengkek	Clusiaceae	March - April
22	*Garcinia paniculata* (G.Don) Roxb.	Vawm-va	Clusiaceae	March - April
23	*Garuga pinnata* Roxb.	Bungbutuairam	Burseraceae	September – January
24	*Glochidion arborescens* Blume.	Tuaitit	Euphorbiaceae	August - October
25	*Juglans regia* L.	Khawkherh	Juglandaceae	October - January
26	*Kadsura heteroclita* (Roxb.) Craib	Theiarbawm	Magnoliaceae	July – September
27	*Litchi chinensis* (Gaertn.) Sonn.	Vaitheifeimung	Sapindaceae	May - July
28	*Mangifera indica* L.	Theihai	Anacardiaceae	May – August
29	*Meliosma pinata* Roxb.	Tuairam	Sabiaceae	September – December; June - July
30	*Memecylon ceeruleum* Jack.	Theikawrak	Melastomataceae	July - September
31	*Morus australis* Poir.	Lungli	Moraceae	March – May; October – November
32	*Myrica esculenta* Butch.-Ham. Ex D. Don.	Keifang	Myricacea	May - June
33	*Phyllanthus acidus* (L.) Skeels.	Kawlsunhlu	Euphorbiaceae	May - June

34	*Protium serratum* Eugl.	Bil	Burseraceae	June –November
35	*Rhus semialata* Merr.	Khawmhma	Anacardiaceae	September – January
36	*Rubus ellipticus* Sm.	Hmutau	Rosaceae	April - May
37	*Spondias pinnata* (L.f) Kurz	Taitaw	Anacardiaceae	August – February
38	*Syzygium cumini* (L.) Skeels.	Hmuipui	Myrtaceae	March - July
39	*Tamarindus indica* L.	Tengtere	Caesalpinaceae	December - January
40	*Tinospora cordifolia* (Wall.) Miers.	Theisawntlung	Menispermaceae	April - July
41	*Xeromphis spinosa* Keay.	Sazutheipui	Rubiaceae	August - December
42	*Ziziphus mauritiana* Lam.	Borai	Rhamnaceae	December – February

Table 21: Pattern of utilization of medicinal plants

Habit	Leaves	Fruit	Bark	Stem	Root	Rhizome/Tuber	Whole Plant	Flower	Seed	Total
Tree	21	23	33	7	12	0	2	1	4	103
Shrub	21	0	5	0	10	0	4	2	3	45
Herb	15	2	1	3	4	5	17	0	3	50
Fern	2	0	0	0	0	1	1	0	0	4
Epiphyte	0	0	0	0	0	1	0	0	0	1
Climber	6	1	1	3	3	2	4	0	3	23
Bamboo & Grass	0	0	0	1	1	0	0	0	0	**2**
Total	**65**	**26**	**40**	**14**	**30**	**9**	**28**	**3**	**13**	**228**
Percentage (%)	**28.5**	**11.4**	**17.54**	**6.14**	**13.15**	**3.94**	**12.28**	**1.31**	**5.7**	**100**

Table 22: Pattern of consumption of edible food plants

Habit	Whole plant	Leaves	Fruit	Tuber/rhizome/ bulb	Shoot	Bud	Flower	Root	Tender pith/flesh	Spadix	Pod	Seed	Total
Tree	0	11	1	1	3	1	1	1	0	3	3	1	24
Shrub	0	5	2	0	2	0	1	0	6	0	1	0	17
Herb	5	2	3	2	2	1	1	0	0	1	0	0	19
Climbers	0	2	2	2	0	0	0	0	0	0	0	0	6
Bamboo	0	0	0	0	4	0	0	0	0	0	0	0	4
Total	**5**	**20**	**8**	**5**	**11**	**2**	**3**	**1**	**6**	**4**	**4**	**1**	**70**
Percentage (%)	**7.14**	**28.57**	**11.42**	**7.14**	**15.71**	**2.85**	**4.28**	**1.42**	**8.57**	**5.71**	**5.71**	**1.42**	**100**

Table 23: Pattern of consumption of fodder

Consumption pattern		Average consumption per each livestock (kg)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Total
No. Of livestock consuming fodder	Cattle	4	90	85	30	45	40	90	70	30	480
	Goat	1	55	50	20	15	25	50	35	10	260
	Pig	1	100	90	80	70	115	130	120	50	755
	Mithun	4	17	16	10	5	40	25	30	12	155
	Horse	3	15	25	5	0	18	20	14	16	113
Daily consumption per each site (kg)			628	619	275	285	514	700	597	276	3894
Annual consumption per each site (in metric tonnes)			229.22	225.94	100.38	104.25	187.61	255.5	217.91	100.74	1317.29

* Sites as in Table 1

Table 24: Pattern of consumption of broomsticks

Consumption pattern	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Total
Total No. of Household	851	1013	580	275	446	540	315	190	4210
Average quarterly fresh consumption of broomstick per household (kg)	6.2	6	6.5	7	5.8	6.4	7	6.3	6.4
Quarterly consumption per each site (kg)	5,276	6,078	3,770	1,925	2,587	3,456	2,205	1,197	26,494
Annual consumption per each site (in metric tonnes)	21.1	24.31	15.08	7.7	10.35	13.81	8.82	4.79	105.96

* Sites as in Table 1

Table 25: Utilization patterns of other major NTFPs in metric tonnes

NTFPs	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Total
Thatching	3.4	3.3	1.34	0.42	9.82	12.5	6.3	3.23	40.31
Bamboo pole	7	9.79	5.38	3.04	4.57	7	6	4	47
Edible fruits	8.88	10.8	5.88	2.76	4.58	8.63	5.84	3.35	50.72
Edible plants	19.25	22.5	12.25	5.75	9.55	20.65	13.5	6.85	110.3
Medicinal Plants	1.4	0.742	0.103	0.055	0.106	0.854	0.062	0.032	3.354
Charcoal	0.995	1.14	0.49	0.185	0.33	0.5	0.234	0.124	3.998

* Sites as in Table 1

Table 26: Contribution (Monetary) of different NTFPs to the household economics

Types of NTFPs	Annual income (in `)							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Fuelwood	12,000±840	10,500±735	15,000±1050	12,000±840	13,500±945	21,000±1470	16,500±1155	19,500±1365
Edible leaves	1,500±120	1,600±128	2,500±200	1,400±112	1,000±80	4,500±360	3,500±280	4,000±320
Edible fruits	950±85	800±72	850±76	900±81	1,000±90	2,300±207	1,700±153	1,500±135
Bamboo shoot	4,200±336	3,800±304	5,000±400	4,500±360	5,000±400	9,500±760	7,500±600	5,500±440
Mushroom	1,400±98	1,800±126	2,800v196	1,600±112	1,400±98	4,200±294	3,200±224	3,600±252
Broom grass	4,000±320	4,500±360	5,500±440	3,000±240	4,000±320	12,000±960	8,000±640	9,000±720
Charcoal	1,500±135	1,950±175	1,600±144	1,850±166	1,800±162	2,400±216	1,900±171	2,000±180
Fodder	150±13	200±18	225±20	250±22	275±24	350±31	250±22	300±27
Thatching	450±40	500±45	550±49	600±54	700±63	900±81	1,200±108	1,100±99
Bamboo Pole	2,500±200	3,500±280	9,500±760	4,500±360	2,000±160	16,500±1320	12,000±960	14,500±1160

* Sites as in Table 1

Table 27: Contribution (Monetary) of different NTFPs to the household economics (Percentage data)

Types of NTFPs	Annual income (% data)							
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Fuelwood	41.88	36.02	34.46	39.22	44.01	28.51	29.60	31.97
Edible leaves	5.24	5.49	5.74	4.58	3.26	6.11	6.28	6.56
Edible fruits	3.32	2.74	1.95	2.94	3.26	3.12	3.05	2.46
Bamboo shoot	14.66	13.04	11.49	14.71	16.30	12.90	13.45	9.02
Mushroom	4.89	6.17	6.43	5.23	4.56	5.70	5.74	5.90
Broom grass	13.96	15.44	12.64	9.80	13.04	16.29	14.35	14.75
Charcoal	5.24	6.69	3.68	6.05	5.87	3.26	3.41	3.28
Fodder	0.52	0.69	0.52	0.82	0.90	0.48	0.45	0.49
Thatching	1.57	1.72	1.26	1.96	2.28	1.22	2.15	1.80
Bamboo Pole	8.73	12.01	21.83	14.71	6.52	22.40	21.52	23.77

* Sites as in Table 1

Table 28: Comparison of NTFPs contribution to the households with agricultural commodities

Commodities	Amount in ` per household per year							
	Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**
NTFPs	5000±400	4500±405	5500±440	6000±540	5000±400	5500±385	6000±480	6500±520
Agricultural income								
a) Jhum Cultivation	7000±560	6000±540	6500±520	8000±560	6500±520	7500±600	8000±560	8500±680
b) Orchard	5000±350	4000±360	4500±315	5000±400	4500±405	4000±280	3500±280	3000±240
c) Employment	8000±560	7500±600	8500±595	9000±630	8000±560	7500±600	7000±560	8000±560
d) Any other	3000±210	2500±200	2000±180	2500±200	3000±210	3000±240	2500±225	2000±180

* Sites as in Table 1

Table 29: Market Survey on Food species in Aizawl City

Sl. No.	Scientific Name	Local Name	Total Annual income (in `)					Total Quantity (kg)	Total (in `)
			New market	Mission veng	Bawngkawn	Zemabawk	Chanmari		
1	*Acacia caesia* **var.** *subnuda* (Craib) Nielsen	Khanghu	48,000	12,000	24,000	24,000	24,000	1320	132,000
2	*Agaricus campestris* Linn.	Maupa	40,000	16,000	30,000	16,000	24,000	1260	126,000
3	*Amomum dealbatum L. Roxb.* L. Roxb.	Aidu	20,000	18,000	16,000	10,000	10,000	3700	74,000
4	*Amorphophallus paeniifolius* (Dennst.) Nicols.	Telhawng	1,200	480	720	480	480	168	3,360
5	*Antidesma diandrum* Heyne ex. Roth	Thurtean	3,000	600	2,000	1,200	1,200	160	8,000
6	*Aralia foliosa* Seem.	Chimchawk	5,400	1,800	2,400	1,800	2,700	282	14,100
7	*Bambusa tulda* Roxb.	Rawthing	24,000	28,800	16,000	19,200	12,000	5000	100,000
8	*Calamus flagellum* Griff.	Hruipui	80,000	96,000	25,600	32,000	24,000	5152	257,600
9	*Calamus acanthospathus* Griff.	Thilte	28,000	17,500	11,200	11,200	11,200	1582	79,100
10	*Dendrocalamus longispathus* Kurz.	Rawnal	30,000	48,000	10,000	24,000	12,000	6200	124,000
11	*Dendrocalamus hamiltonii* Nees & Arn.	Phulrua	20,000	24,000	8,000	10,000	8,000	3500	70,000
12	*Diplizium maximum* (D. Don) C. Chatt.	Chakawk ei chi	11,200	8,400	5,600	6,720	4,480	910	36,400
13	*Derris wallichii* Prain	Hulhu	3,000	6,400	800	1,200	1,200	252	12,600
14	*Dysoxylum gobara* (Buch.-Ham.) Merr.	Thingthupui	16,000	19,200	8,000	8,000	8,000	1480	59,200
15	*Entoloma microcarpum* Berk & Br.	Pasawntlung	24,000	18,000	10,800	19,200	14,400	864	86,400
16	*Lepionurus sylvestris* Bl.	Anpangthuam	4,800	4,800	1,920	1,920	1,920	384	15,360
17	*Livistona cochirensis* Mart.	Buarpui chempai	18,000	18,000	4,800	4,000	5,000	498	49,800
18	*Meloccana baccifera* (Roxb.) Kurz	Mautak	80,000	48,000	16,000	40,000	32,000	10800	216,000
19	*Musa acuminata* Colla.	Tumbu	32,000	41,600	16,000	19,200	22,400	6560	131,200
20	*Musa velutina* Wendl.	Changvandawt	5,600	5,880	4,480	3,360	3,360	1134	22,680
21	*Oroxylum indicum* (L.)Vent	Archangkawm	7,200	6,400	3,200	2,400	4,800	240	24,000
22	*Parkia timoriana* (A.DC.) Merr.	Zawngtah	30,000	25,000	25,000	30,000	9,000	2380	119,000
23	*Schizophyllum commune* Fr.	Pasi	8,400	6,720	6,720	3,360	3,360	476	28,560
24	*Zanthoxylum rhetsa* (Roxb.) DC.	Chingit	90,000	72,000	5,400	27,000	36,000	2304	230,400
25	*Zalacca secunda* Griff.	Hruitung	80,000	64,000	16,000	32,000	24,000	4320	216,000
		Total	**7,09,800**	**6,07,580**	**2,70,640**	**3,48,240**	**2,99,500**	**60,926**	**22,35,760**

Table 30: Market Survey on Fruit species in Aizawl City

Sl. No.	Scientific Name	Local Name	Total Annual income (in `)					Total Quantity (kg)	Total (in `)
			New market	Mission veng	Bawngkawn	Zemabawk	Chanmari		
1	*Anodendron paniculatum* A. DC.	Theikelki	9,000	1,800	1,500	1,500	2,250	1070	16,050
2	*A.lakoocha* Roxb.	Theitat	2,880	2,560	720	1,920	1,440	476	9,520
3	*Artocarpus integrifolia* Linn.	Tatte	5,000	1,800	5,000	2,400	1,200	616	15,400
4	*Averrhoa carambola.* Linn.	Theiherawt	28,000	2,520	1,280	1,680	4,480	1898	37,960
5	*Baccaurea ramiflora* Lour.	Pangkai	28,000	10,500	5,040	9,600	18,000	2371	71,140
6	*Bruinsmia polysperma* (Cl.) Van Steenis	Theipalingkawh	50,400	18,000	4,000	18,000	12,000	2048	102,400
7	*Carallia branchiata* (Lour.) Merril	Theiria	15,000	3,600	3,000	4,800	2,400	576	28,800
8	*Carica papaya* Linn.	Thingfanghma	63,000	63,000	2,520	49,980	31,500	14000	210,000
9	*Chrysophyllum cainito* Linn.	Theipabuan	3,600	2,160	160	1,440	960	416	8,320
10	*Citrus medica* Linn.	Nimbu / Limbu	60,000	45,000	4,000	36,000	20,000	8250	165,000
11	*Citrus reticulata* Blanco	Serthlum	60,000	24,000	5,400	38,400	24,000	10120	151,800
12	*Citrus macroptera* Montor.	Hatkora	15,600	13,440	1,920	8,640	12,000	2580	51,600
13	*Cyathocalyx martabanicus* Champ.	Hreirawt	1,200	960	480	720	360	372	3,720
14	*Dillenia indica* Linn.	Kawrthindeng	19,200	6,400	3,200	4,000	3,200	1800	36,000
15	*Elaegnus latifolia* Linn.	Sarzuk	48,000	34,560	8,000	21,600	12,000	6208	124,160
16	*Emblica officinalis* Gaertn.	Sunhlu	62,400	91,200	6,720	72,000	24,000	8544	256,320
17	*Eugenia jambolana* Lam.	Lenhmui	960	576	64	384	256	280	2,240
18	*Euphoria longan* Steud.	Theifeimung	48,000	4,800	2,000	2,400	10,000	1344	67,200
19	*Ficus rostrata* Lam.	Theitit	2,000	1,600	400	800	600	216	5,400
20	*Ficus semicordata* Butch.-Ham.	Theipui	23,040	5,760	5,600	2,880	5,760	1076	43,040
21	*Garcinia cowa* Roxb.	Chengkek	29,120	10,240	1,920	6,400	6,400	2704	54,080
22	*Garcinia sopsopia* Roxb.	Vawmva	480	360	360	240	160	160	1,600
23	*Garuga pinnata* Roxb.	Bungbutuairam	4,320	960	960	480	480	600	7,200
24	*Glochidion arborescens* Bume.	Tuaitit	4,500	2,250	2,250	1,350	1,350	468	11,700
25	*Kadsura heteroclite* (Roxb.) Craib	Theiarbawm	2,688	672	672	336	504	348	4,872
26	*Mangifera indica* Linn.	Theihai	140,000	24,000	57,600	32,000	16,000	13480	269,600
27	*Mangifera sylvatica* Roxb.	Haifawvang	16,200	6,480	11,880	5,400	10,800	2820	50,760
28	*Meliosma pinata* Roxb.	Tuairam	2,400	864	864	1,152	576	488	5,856
29	*Morus australis* Poir.	Lungli	2,160	360	360	360	360	240	3,600
30	*Memecylon ceeruleum* Jack.	Theikawrak	2,250	12,000	1,200	900	900	690	17,250
31	*Musa paradiasica* Linn.	Balhla	72,000	36,000	72,000	86,400	36,000	16800	302,400

32	*Passiflora edulis* Sims.	Sap-thei	61,440	32,000	30,720	35,200	25,600	4624	184,960
33	*Persea americana* Mill.	Avocado	32,400	7,200	3,600	9,504	8,640	2556	61,344
34	*Protium serratum* Eugl.	Bil	17,280	9,600	3,840	16,800	9,600	2856	57,120
35	*Psidium guajava* Linn.	Kawlthei	7,200	4,800	2,400	5,760	2,400	1128	22,560
36	*Rhus semialata* Murr.	Khawmhma	25,000	10,000	8,000	6,000	5,000	1080	54,000
37	*Spondias piñata* (Linn. f.) Kurz	Taitaw	3,360	4,480	2,240	5,600	1,120	840	16,800
38	*Stixis suaveolens* (Roxb.) Pierre	Theisawntlung	1,600	640	640	480	480	384	3,840
39	*Syzygium cumini* (Linn.) Skeels	Hmuipui	900	900	1,350	900	600	310	4,650
40	*Terminalia chebula* Retz.; C.B. Clarke	Reraw	1,680	1,600	1,600	1,200	480	328	6,560
41	*Ziziphus mauritiana* Lam.	Borai	45,000	1,800	540	3,750	3,000	2163	54,090
		Total	**10,17,258**	**5,01,442**	**2,66,000**	**4,99,356**	**3,16,856**	**1,19,328**	**26,00,912**

Table 31: Pearson correlation coefficients analysis of NTFP in northern Mizoram

Sl. No.	Correlated variables	Pearson correlation coefficients	p-values
1	Educational qualification and type of NTFP	.197*	.033
2	Educational qualification and total sale per week	.231*	.015
3	Type of NTFP and source of collection	.291**	.003
4	Type of NTFP and gender	.208*	.026
5	Type of NTFP and bundle buying cost	.426**	.000
6	Type of NTFP and bundle price	.196*	.036
7	Type of NTFP and total sale per week	.197*	.033
8	Source of collection and total sale per week	.276**	.005
9	Source of collection and level of involvement in business	.183*	.044
10	Total sale per week and source of collection	.276**	.005
11	Net profit / income per week and total sale per week	.407**	.000
12	Net profit / income per week and help from benefit	.306**	.002
13	Benefit derived and total sale per week	.192*	.037
14	Benefit derived and help from benefit	.203*	.029
15	Benefit derived and government policies affecting business	(.202)*	.030

Note: * means that correlation is significant at 5% (1 tail) and ** implies that correlation is significant at 1% (1 tail)

Table 32: Combined percentage frequency distribution of selected variables in the NTFPs in northern Mizoram

VARIABLES/ COMMUNITIES	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Educational qualification								
Non formal	45.5	43.2	41.2	40.0	45.0	47.4	41.0	34.2
Primary	40.9	33.4	29.4	30.0	35.0	31.6	32.6	35.2
Secondary	9.1	18.4	29.4	30.0	20.0	15.8	22	20.4
Others	4.5	5	0	0	0	5.2	4.4	10.2
Type of NTFP								
Bamboo pole	50	33.6	47	30	5	84.2	35.3	46.5
Fuelwood	27.3	45	35.3	60	90	5.3	48.4	36
Charcoal	22.7	15.2	11.8	10	5	5.3	16.3	10.2
Others	0	6.2	5.9	0	0	0	0	7.3
Source of collection								
Natural forest	31.8	26.3	58.8	20	55	33.5	36	41.2
Cultivated farm	9.1	21.1	17.6	30	25	20	25.5	28
Market	40.9	10.5	11.8	10	5	30	18.2	13
Others	4.5	26.3	11.8	0	0	12.2	6.5	3.2
Bundle buying cost								
50-100	40.9	57.9	29.4	10	10	35.2	30	15.4
101-150	27.3	5.3	5.9	10	70	36.2	30.2	15
151-200	13.6	0	17.6	10	15	15	12.3	11.2
201-250	4.5	15.8	5.9	10	5	6	7.4	12
Total sale per week								
<2500	13.6	84.2	0	20	80	12.5	25.6	36
2501-5000	22.7	10.5	52.9	20	15	31	20	15
5001-7500	40.9	0	17.6	30	0	22	33.2	0
7501-10000	18.2	0	5.9	30	0	10	8.5	6.5
>10000	4.5	0	11.8	0	0	5	2.5	24
Net profit per week								
<1000	63.6	94.7	64.7	30	85	58.2	65.5	64.2
1001-2000	27.3	0	29.4	30	10	12.5	24	18.5
2001-3000	0	0	0	20	5	14.6	0	5.2
3001-4000	4.5	0	0	20	0	3.6	9.8	5.7
Benefit derived								
Income	27.3	36.8	17.6	90	90	40.5	35.2	42
Employment	4.5	0	0	0	5	3.5	0	35.4
Profit	54.5	47.4	23.5	0	0	44.3	32	0
Improve standard of living	13.6	10.5	58.8	10	0	10	31.2	20
Level of involvement in business								
Full time	68.2	42.1	88.2	20	95	54	48.2	64.4
Part time	31.8	52.6	11.8	80	5	45.5	45.6	34.2
Major constraints								
Scarcity	9.1	15.8	5.9	10	30	10	5	14.2
Transportation	18.2	10.5	0	40	10	38.2	19.2	11
Completion	18.2	21.1	35.3	10	15	14	35.2	25.5
Availability of substitutes	27.3	21.1	23.5	20	15	20.5	12.5	16
Change effect	22.7	26.3	35.3	20	10	12	24.4	24

* Sites as in Table 1

** Please note the values in percent in some cases do not add upto 100.

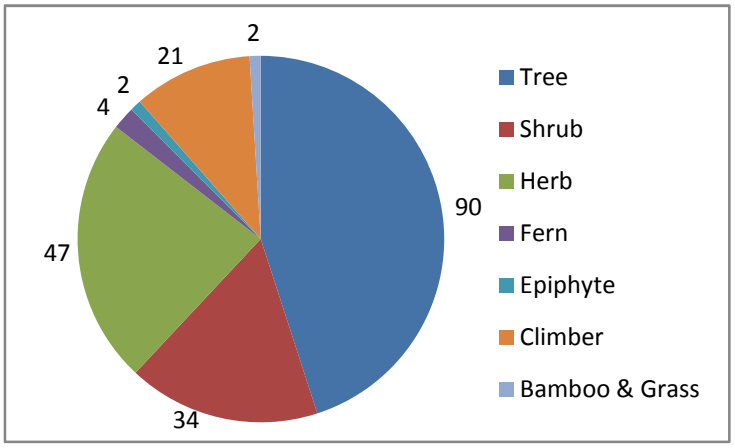


Figure 4: Number of medicinal plants found in northern Mizoram

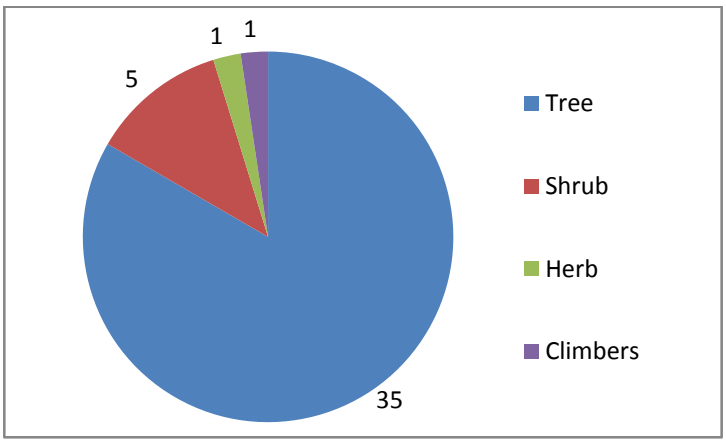


Figure 5: Number of fruit plants found in northern Mizoram

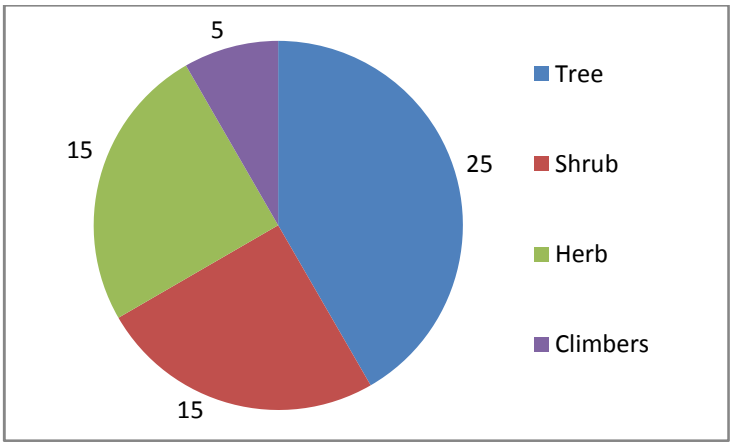


Figure 6: Number of edible food plants found in northern Mizoram

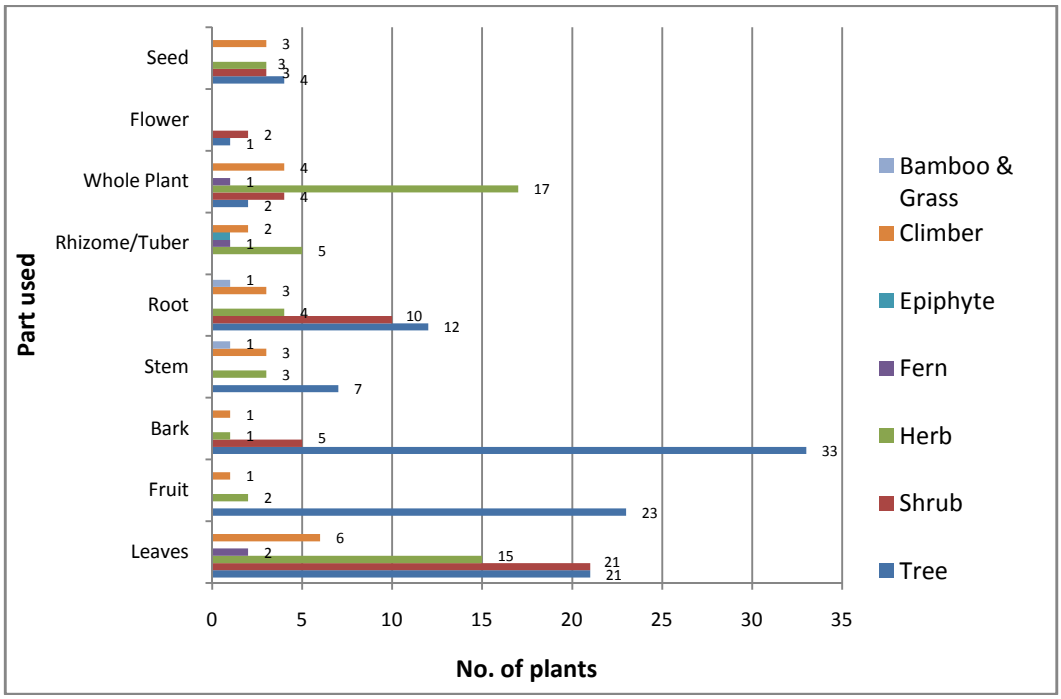


Figure 7: Pattern of utilization of medicinal plant parts in northern Mizoram

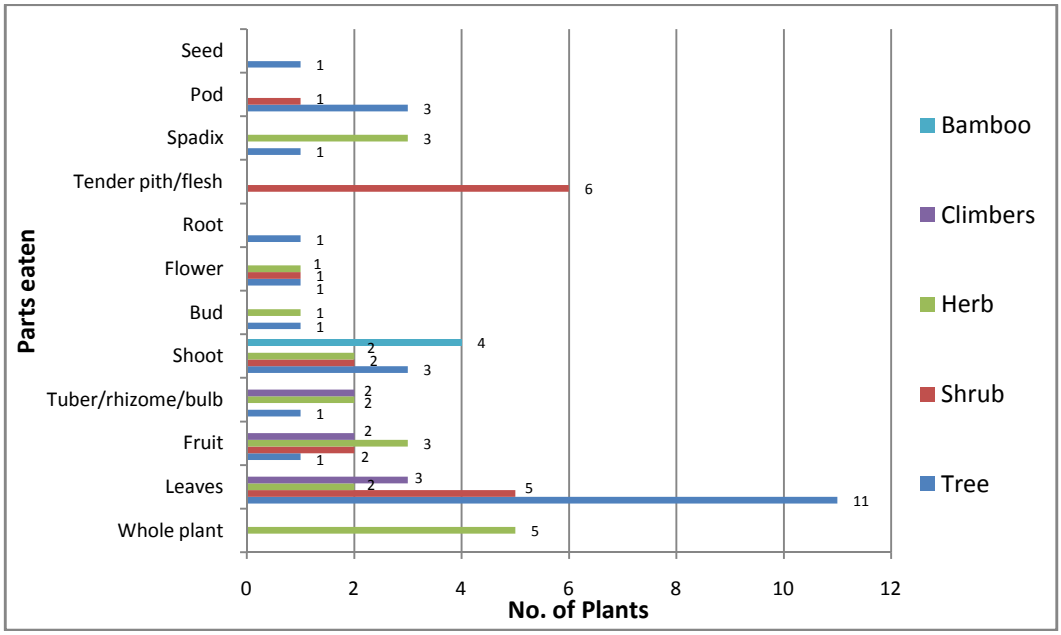


Figure 8: Pattern of consumption of edible food plants (part wise) in northern Mizoram

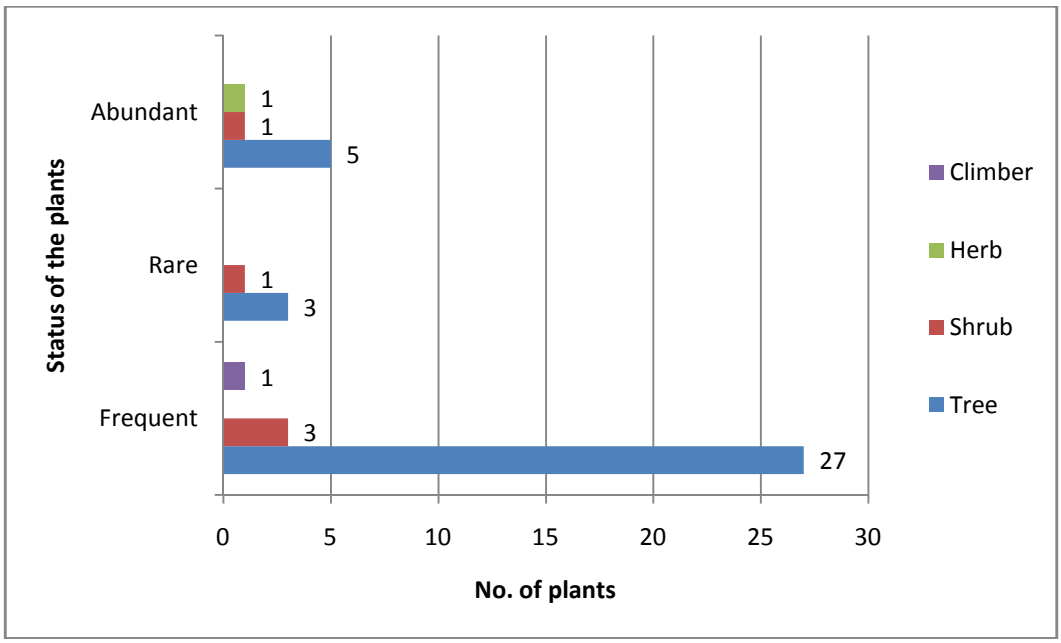


Figure 9: Status of fruit plants in northern Mizoram

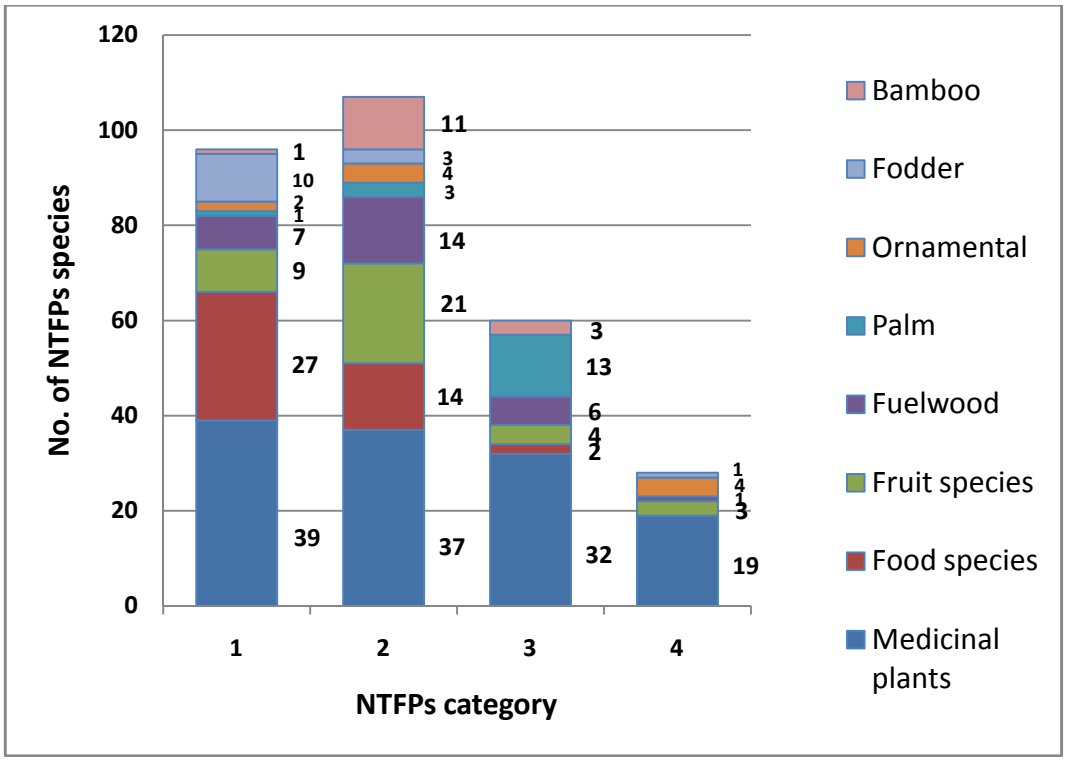


Figure 10: Prioritization of NTFPs in the surveyed area. The values represent the pooled data from all sites.

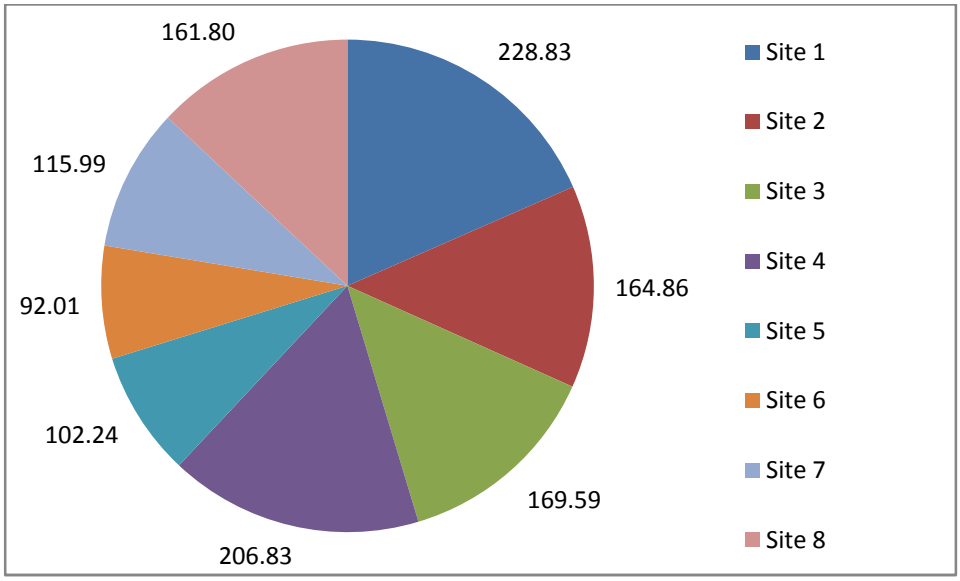


Figure 11: Per capita consumption of fuelwood species (in metric tonnes) in northern Mizoram

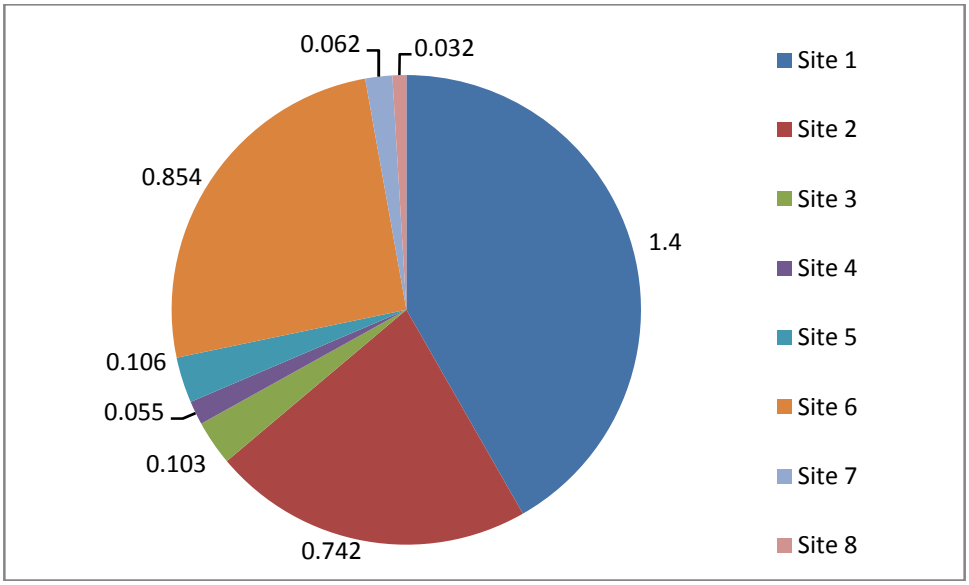


Figure 12: Annual consumption of medicinal plant species (in metric tonnes) in northern Mizoram

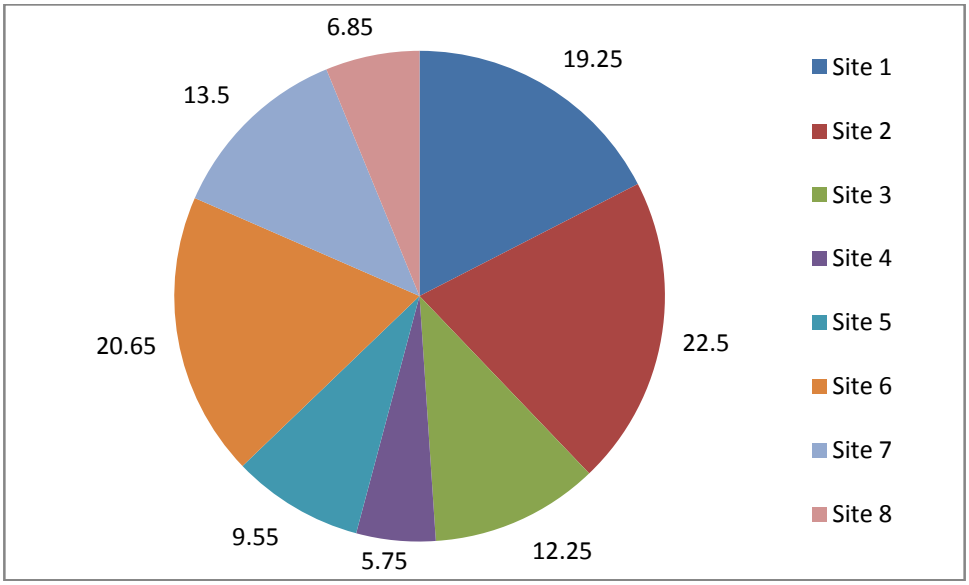


Figure 13: Annual consumption of edible food plant species (in metric tonnes) in northern Mizoram

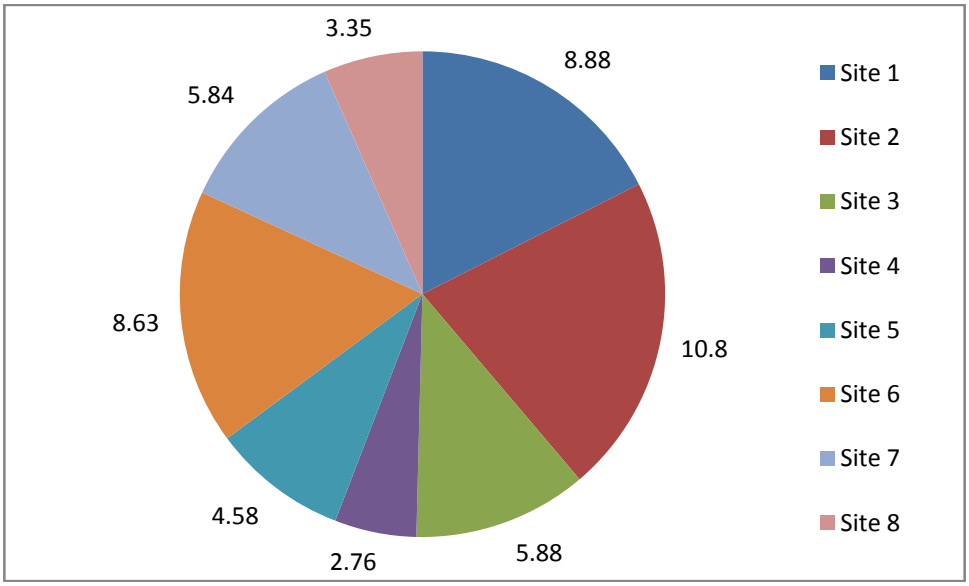


Figure 14: Annual consumption of fruit plant species (in metric tonnes) in northern Mizoram

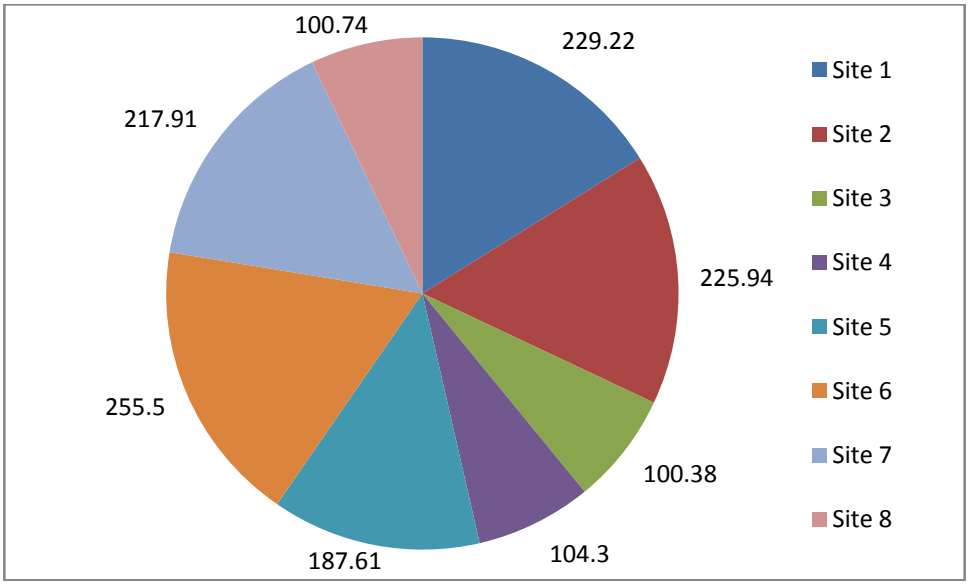


Figure 15: Annual consumption of fodder species (in metric tonnes) in northern Mizoram

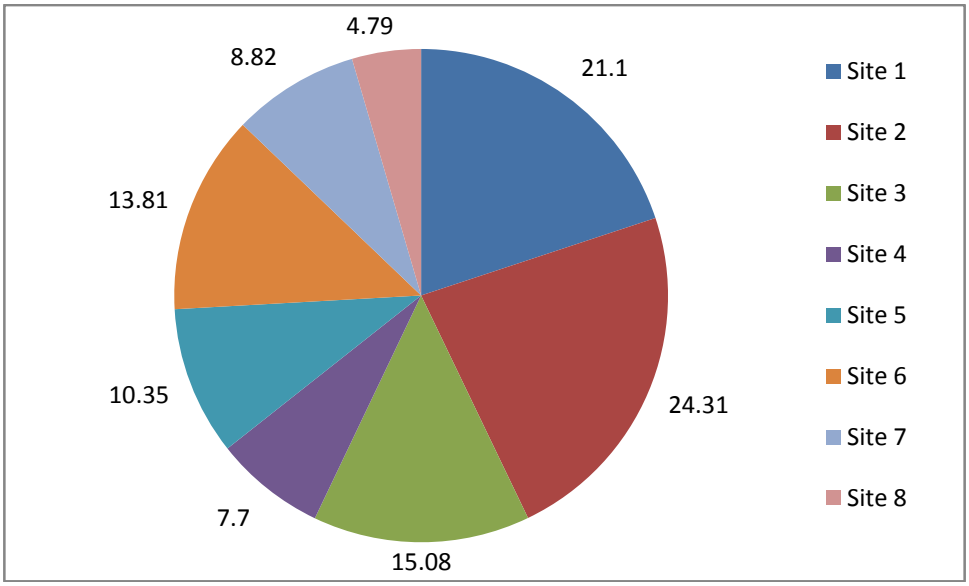


Figure 16: Annual consumption of broomstick species (in metric tonnes) in northern Mizoram

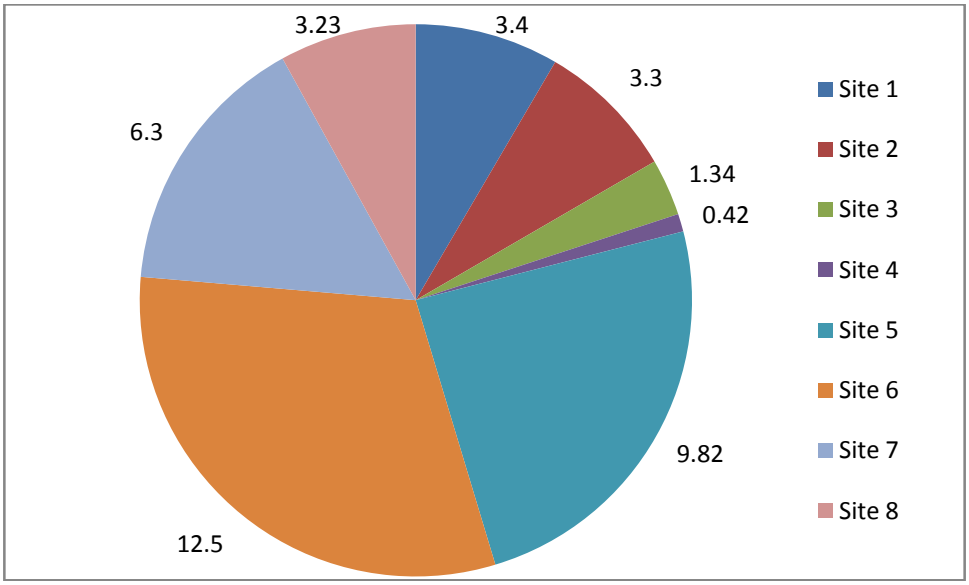


Figure 17: Annual consumption of thatching species (in metric tonnes) in northern Mizoram

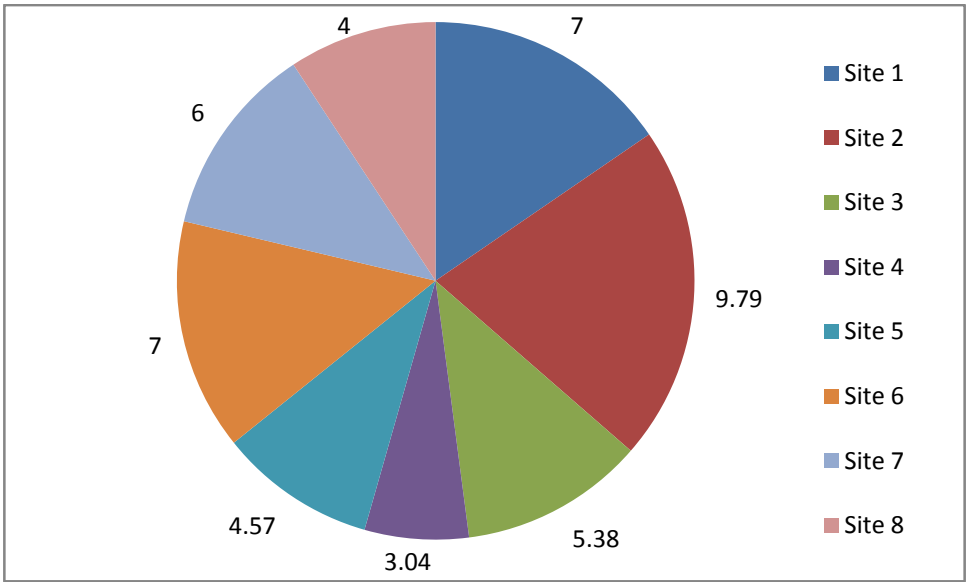


Figure 18: Annual consumption of bamboo pole species (in metric tonnes) in northern Mizoram

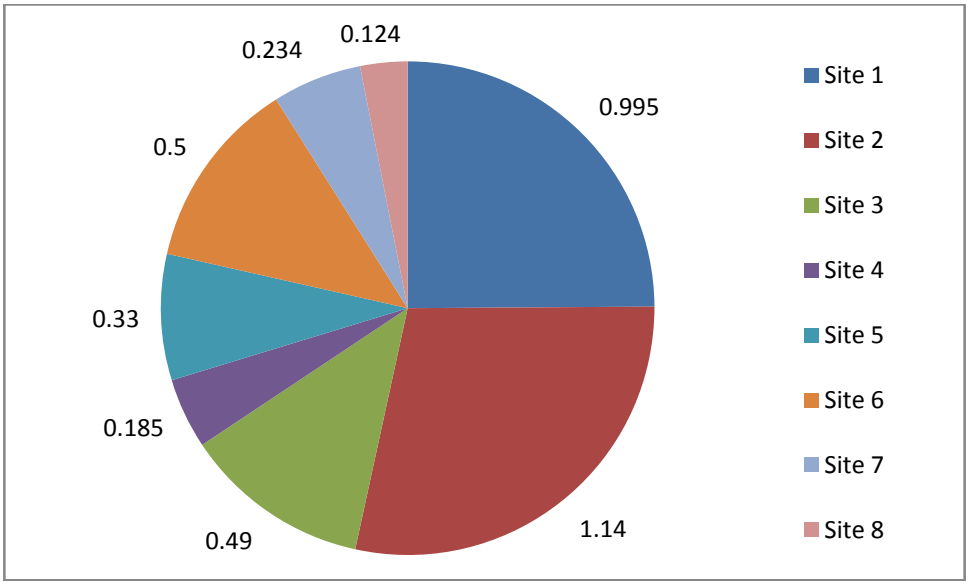


Figure 19: Annual consumption of charcoal plant species (in metric tonnes) in northern Mizoram

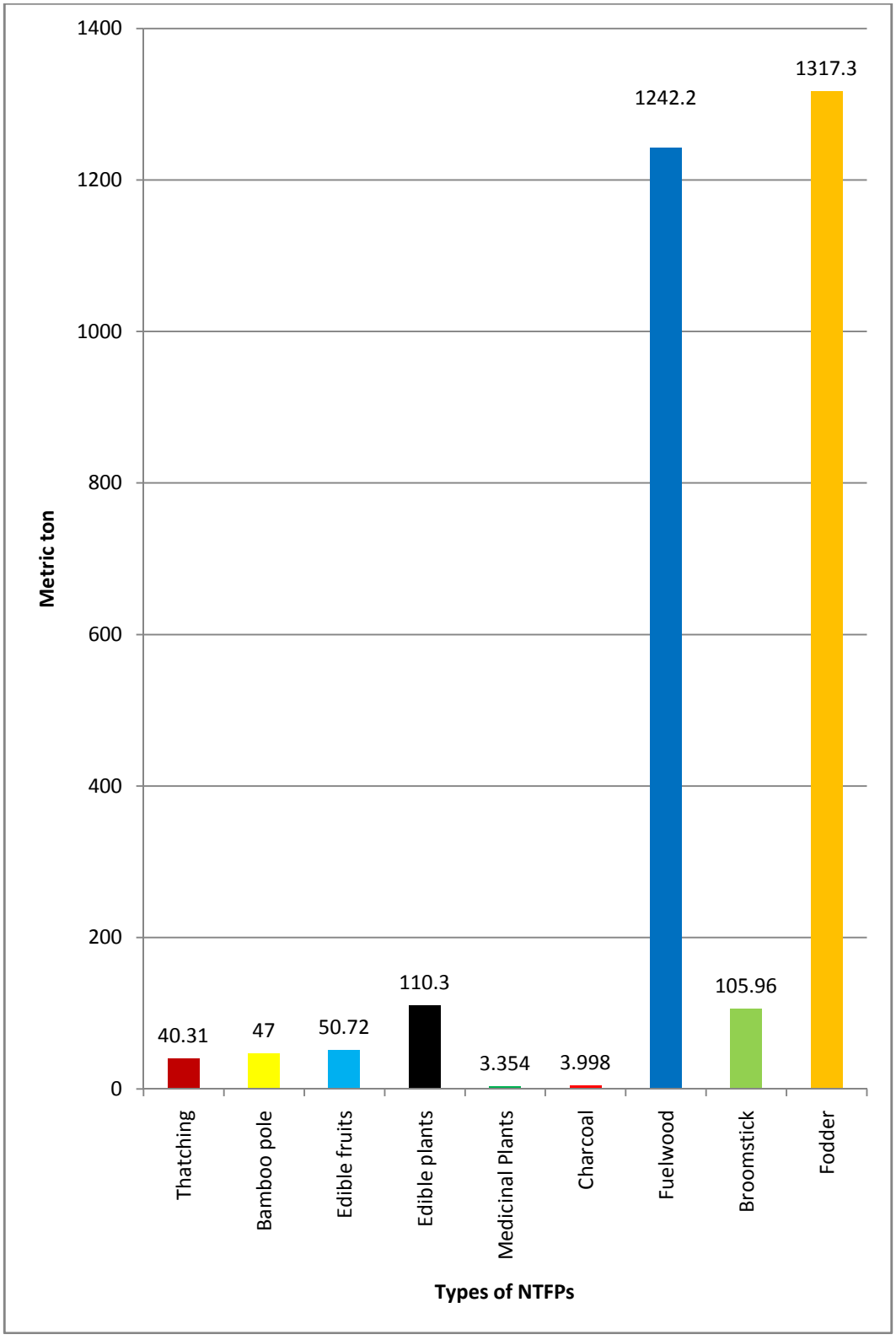


Figure 20: Annual consumption of NTFPs species (in metric tonnes) in northern Mizoram

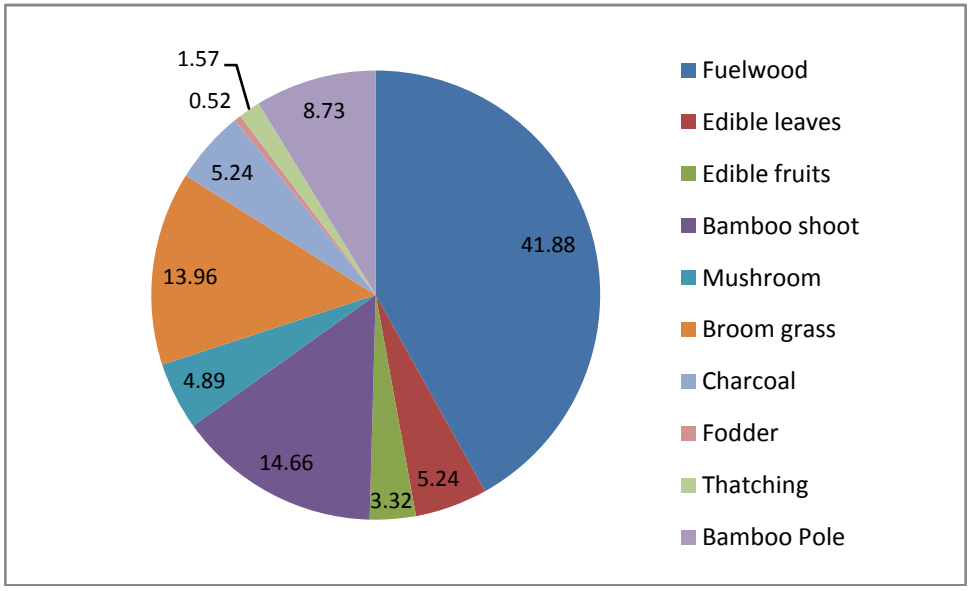


Figure 21: Relative contribution of different NTFPs to household economics in Hnahlan forests Area

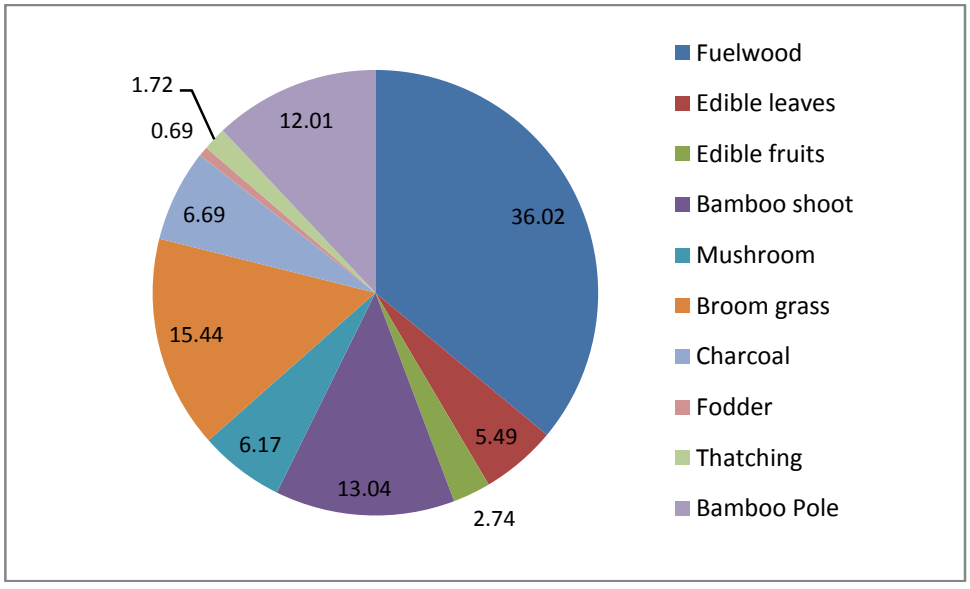


Figure 22: Relative contribution of different NTFPs to household economics in Ngopa forests Area

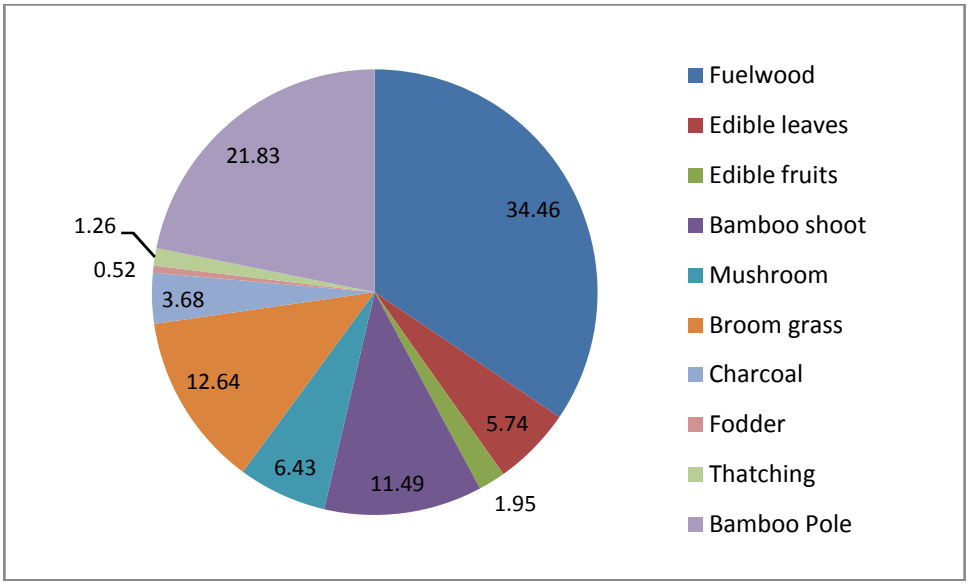


Figure 23: Relative contribution of different NTFPs to household economics in Bairabi forests Area

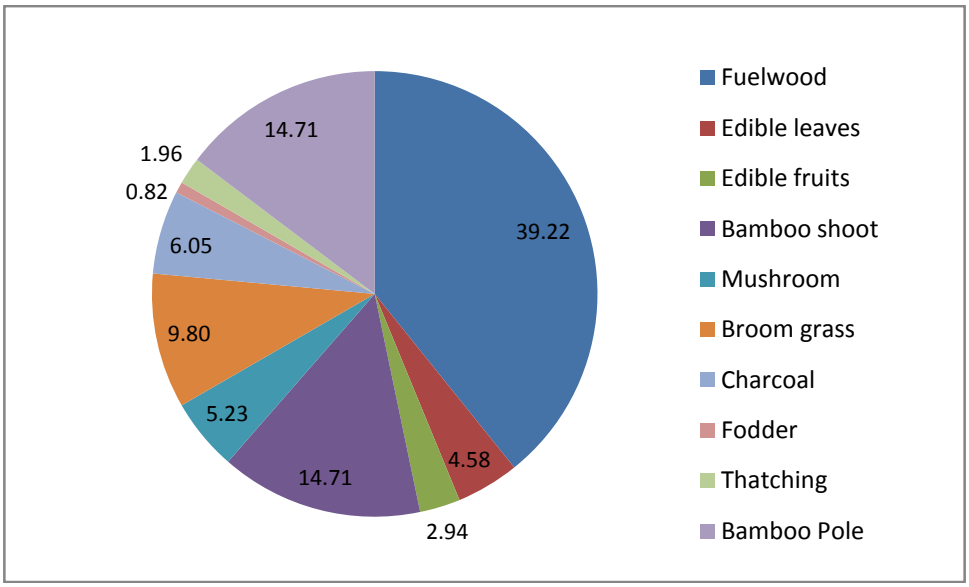


Figure 24: Relative contribution of different NTFPs to household economics in Phullen forests Area

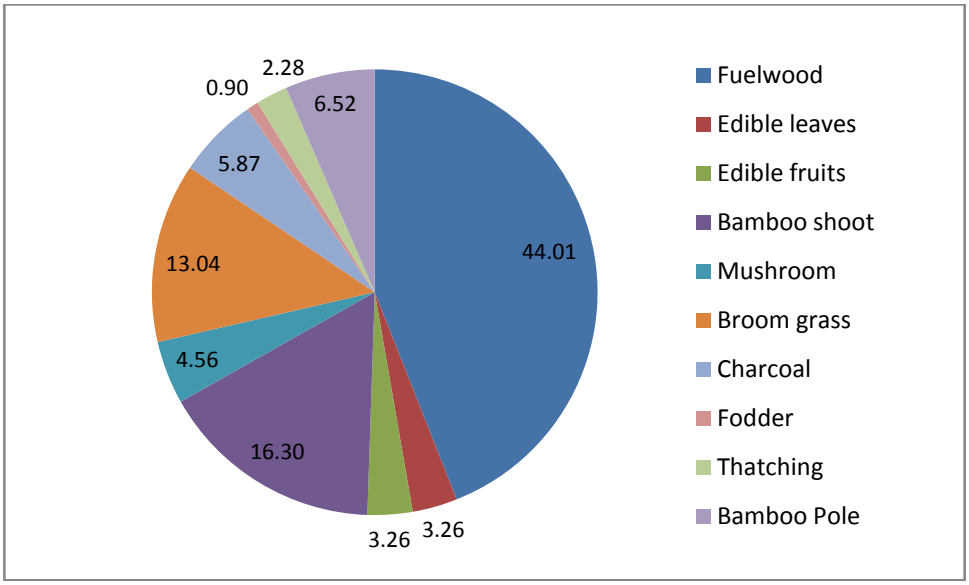


Figure 25: Relative contribution of different NTFPs to household economics in Farkawn forests Area

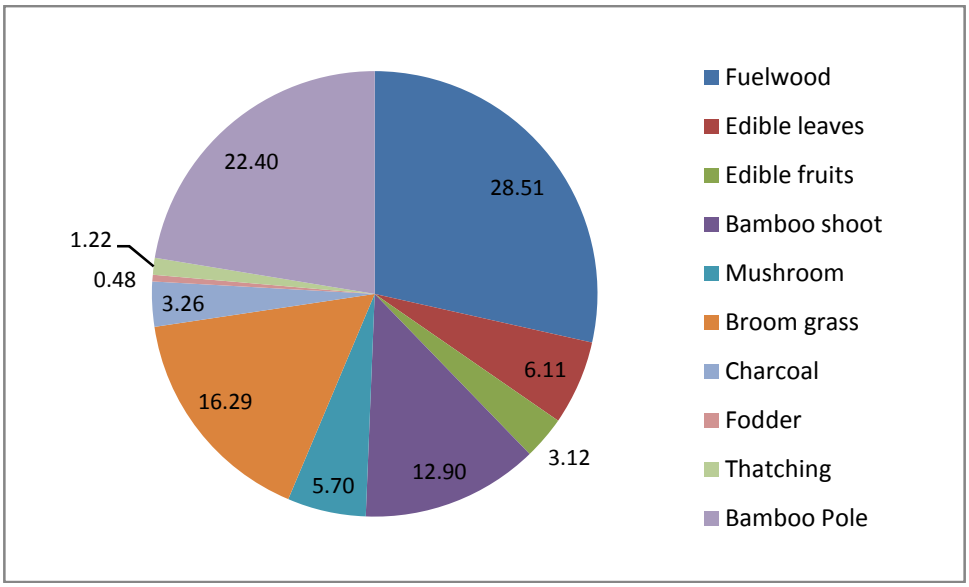


Figure 26: Relative contribution of different NTFPs to household economics in Phuldungsei forests Area

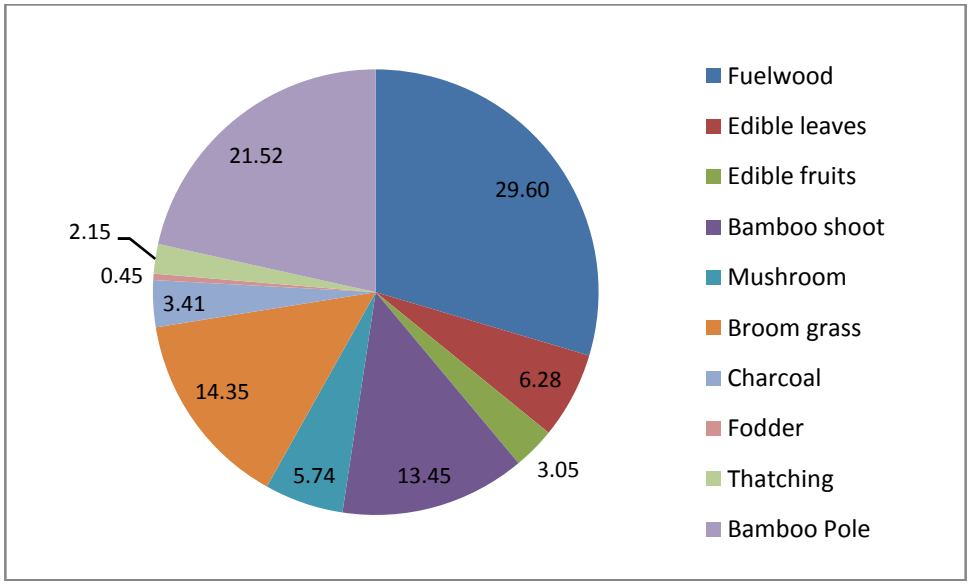


Figure 27: Relative contribution of different NTFPs to household economics in Kawrthah forests Area

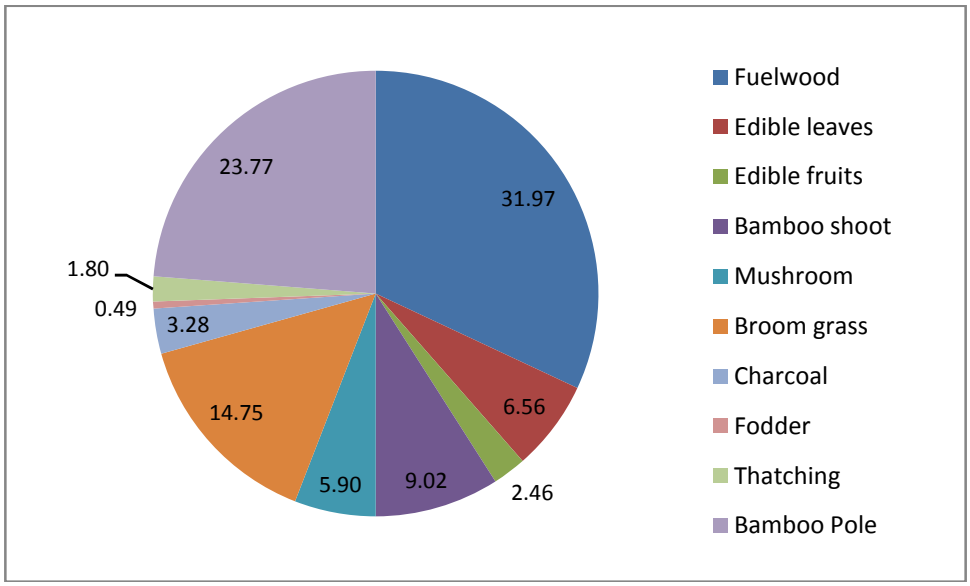


Figure 28: Relative contribution of different NTFPs to household economics in N.Hlimen forests Area

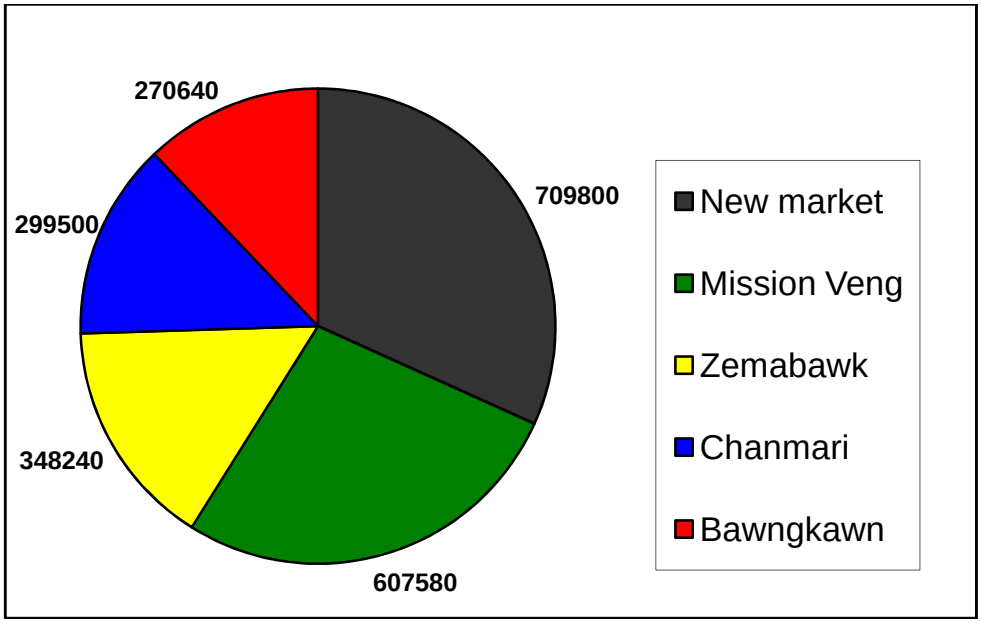


Fig. 29: Annual income (in `) of 5 different markets on Food Species

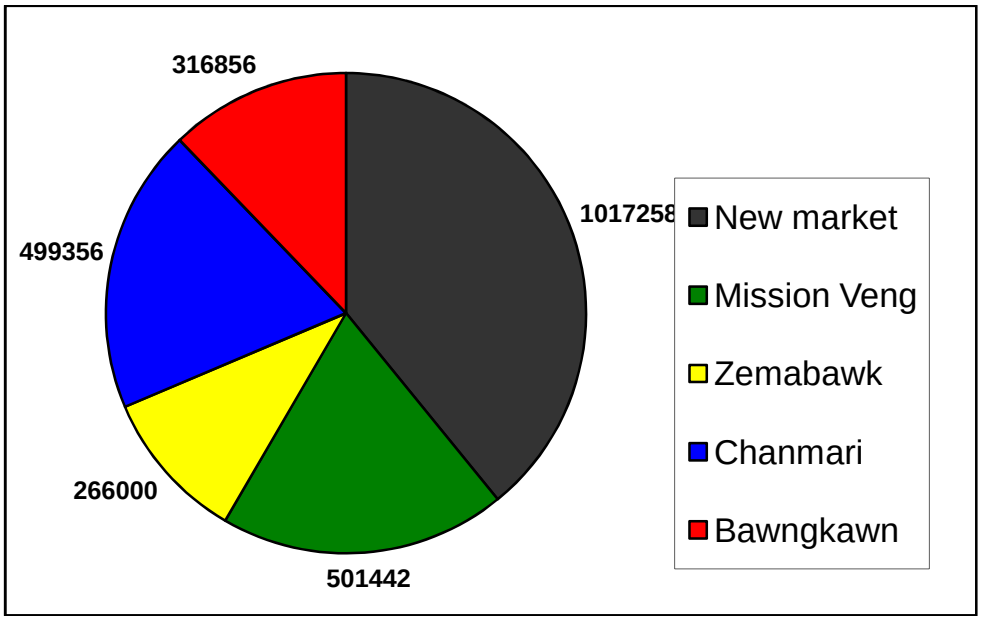


Fig. 30: Annual income (in `) of 5 different markets on Fruit Species

Pictures of various NTFPs available in northern Mizoram.

Plate 1 (Edible food)

Pic 1 : *Melocanna baccifera* (Roxb.) Kurz (Mautak tuai)

Pic 2 : *Eryngium foetidum* Linn. (Bahkhawr)

Pic 3 : *Alocassia fornicata* (Roxb.) Schott (Baibing)

Pic 4 : *Zanthoxylum rhetsa* (Roxb.) DC. (Chingit)

Pic 5 & 6 : Young shoots of *Melocanna baccifera* (Roxb.) Kurz (Mautak tuai)

Pic 7 & 8 : *Enteloma macrocarpum* Berk & Br. (Pasawntlung)

Pictures of various NTFPs available in northern Mizoram.

Plate 2 (Edible food)

Pic 9 & 10 : *Zalacca secunda* Griff. (Hruitung)

Pic 11 & 12 : *Musa acuminata* Colla. (Tumbu)

Pic 13 & 14 : *Agaricus campestris* Linn.(Maupa)

Pic 15 & 16 : *Oryxylum indicum* (L.) Vent (Archangkawm)

Pictures of various NTFPs available in northern Mizoram.

Plate 3 (Edible food)

Pic 17 & 18 : *Adiantum caudatum* (D. Don) C. Chatt (Chakawk)

Pic 19 & 20 : *Amorphophallus paeniifolius* (Dennst.) Nicol. (Telhawng)

Pic 21 : *Parkia roxburghii* (A.DC.) Merr. (Zawngtah)

Pictures of various NTFPs available in northern Mizoram.

Plate 4 (Edible fruits)

Pic 22 & 23 : *Ficus prostrata* Lam. (Theitit)

Pic 24 & 25 : *Dillenia indica* L. (Kawrthindeng)

Pic 26 & 27 : *Terminalia chebula* Retz.(Reraw)

Pic 28 : *Bruinsmia polysperma* (Cl.) Van Steenis (Theipalingkawh)

Pic 29 : *Baccaurea ramiflora* Lour. (Pangkai)

Pictures of various NTFPs available in northern Mizoram.

Plate 5 (Edible fruits)

Pic 30 : *Protium serratum* Eugl. (Bil)

Pic 31 : *Emblica officinalis* Gaertn. (Sunhlu)

Pic 32 : *Rhus semialata* Merr. (Khawmhma)

Pic 33 : *Elaegnus latifolia* Schl. Ex Mom. (Sarzuk)

Pic 34 : *Litchi chinensis* (Gaertn.) Sonn. (Vaitheifeimung)

Pic 35 : *Ficus semicordata* Butch.-Ham. (Theipui)

Pic 36 & 37 : *Glochidion arborescens* Blume. (Tuaitit)

Pictures of various NTFPs available in northern Mizoram.

Plate 6 (Medicinal Plants)

Pic 38 & 39 : *Helicia robusta* (Roxb.) R. Br. ex Wall (Pasaltakaza) - Leaves and bark

Pic 40 : *Justica adhatoda* Medicus. (Kawldai)

Pic 41 : *Costus specious* Smith. (Sumbul)

Pic 42 : *Mimosa pudica* L. (Hlonuar)

Pic 43 : *Alstonia scholaris* (L.) R. Br. (Thuamriat)

Pic 44 & 45 : *Centella asiatica* (L.) Urb. (Lambak / Hnahbial) - Leaves and Root

Pictures of various NTFPs available in northern Mizoram.

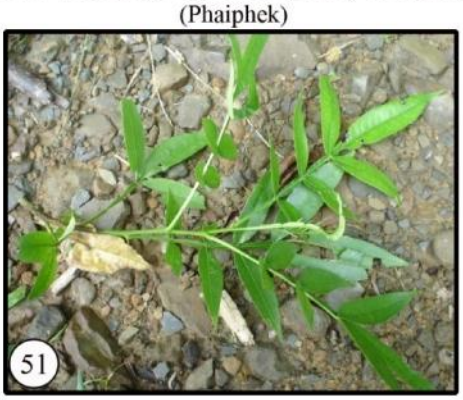
Plate 7 (Medicinal Plants)

Pic 46 & 47 : *Pseudodrynaric coronans* (Wall. ex mett) Ching. (Awmvel) - Root and Leaves

Pic 48 : *Zanonia indica* Linn. (Lalruangdawibur)

Pic 49 : *Curculigo capitulata* (Lour.) O. Kuntze. (Phaiphek)

Pic 50 : *Pratia nummularis* Kurz. (Choak-thi)



Pic 51 : *Zanthoxylum armatum* DC. (Arhrikreh)

Pic 52 & 53 : *Dillenia pentagyna* Roxb. (Kaihzawl) - Leaves and Bark

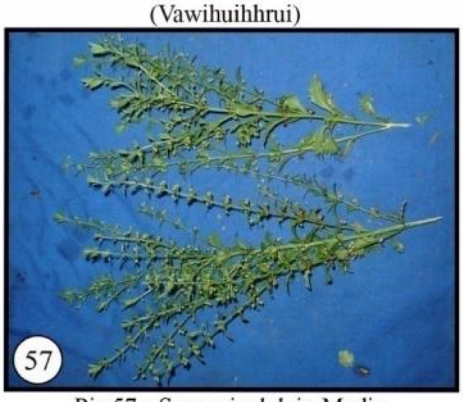
Pictures of various NTFPs available in northern Mizoram.

Plate 8 (Medicinal Plants)

Pic 54 : *Aeginetia indica* L. (Sangharvaibel)

Pic 55 : *Paederia scandens* (Lour.) Merr. (Vawihuihhrui)

Pic 56 : *Clerodendrum colebrookianum* Wall. (Phuihnam)



Pic 57 : *Scoporia dulcis* Medic. (Perhpawngchaw)

Pic 58 : *Cissus javanica* DC. (Sangharhmai)

Pic 59 : *Clerodendrum viscosum* Vent (Phuihnamchhia)

Pic 60: *Litsea cubeba* Pers. (Sernam)

Pic 61 : *Maesia indica* (Roxb.) DC. (Arngeng)

Pictures of various NTFPs available in northern Mizoram.

Plate 9 (Medicinal Plants)

Pic 62 : *Rubus ellipticus* Sm. (Hmutau)

Pic 63 : *Solena amplexicaulis* Wall. (Nauawimu)

Pic 64 & 65 : *Thunbergia coccinea* Wall. (Fahrahhrui)

Pic 66 : *Mirabilis jalapa* Linn. (Aratukkhuan)

Pic 67 : *Smilax pervifolia* Roxb. (Kaihapui)

Pic 68 & 69: *Litsea monopetala* Roxb. (Nauthakpui)

Pictures of various NTFPs available in northern Mizoram.

Plate 10 (Medicinal Plants)

Pic 70 & 71 : *Smilax glabra* Roxb. (Tluangngil)

Pic 72 : *Murdannia nudiflora* Linn. (Dawng)

Pic 73 : *Thunbergia grandiflora* Roxb. (Vako)

Pic 74 : *Polygonum chinensis* L. (Taham)

Pic 75 : *Piper diffusum* Vahl. (Pawhrual)

Pic 76: *Derris thyrsiflora* Benth. (Hulhu)

Pic 77: *Dregea volubilis* Benth. (Ankhapui)

Pictures of various NTFPs available in northern Mizoram.

Plate 11 (Ornamental plants)

Pic 78 & 79 : *Erythrina stricta* Roxb. (Fartuah)

Pic 80 : *Prunus cerasoides* D. Don (Tlaizawng)

Pic 81 : *Saraca asoca* (Roxb.) de Wilde (Mualhawih)

Pic 82 : *Rhododendron wightii* Hook
(Chhawkhlei par var)

Pic 83 : *Rhododendron arboreum* Sm.
(Chhawkhlei par sen)

Pictures of various NTFPs available in northern Mizoram.

Plate 12 (Ornamental Plants)

Pic 84 : *Bauhinia variegata* Linn. (Vaube)

Pic 85 : *Renanthera imschootiana* Rolfe. (Senhri)

Pic 86 & 87 : *Langerstromia speciosa* Pers. (Thlado / Chawnpui)

Pic 88 : *Bombax ceiba* Linn. (Phunchawng)

Pic 89 : *Vanda coerulea* Griff. (Lawhlei)

Pictures of various NTFPs available in northern Mizoram.

Plate 13 (Fodder Plants)

Pic 90 : *Musa acuminata* Colla (Changel)

Pic 91 : *Mikania cordata* (Burm.) B.C. Robinson (Japanhlo)

Pic 92 & 93 : *Colocasia esculenta* (Linn.) Schott (Dawl & Bal)

Pic 94 : *Manihota esculenta* Crantz. (Pangbal)

Pic 95 : *Imperata cylindrica* (L.) Beauv. (Di)

Pictures of various NTFPs available in northern Mizoram.

Plate 14 (Bamboo & Canes)

Pic 96 : *Dendrocalamus hamiltonii* Nees & Arn. ex Munro (Phulrua)

Pic 97 : *Phyllostachis manii* Gamble (Shillong mau)

Pic 98: *Bambusa vulgaris* (Lodd. ex Lindl.) Gamble (Vairua)

Pic 99: *Melocalamus compactiflorus* Benth. (Sairil)

Pic 100 & 101 : *Calamus flagellum* Griff. (Hruipui)

Pictures of various NTFPs available in northern Mizoram.

Plate 15 (Fuelwood & other important NTFPs)

Pic 102 : Fuelwood stock inside the forest

Pic 103 : Fuelwood ready to use

Pic 104: *Thysanolaena maxima* (Roxb.) Kuntze (Hmunphiah)

Pic 105: Bamboo for smoking pipe

Pic 106 : Bamboo product (for roping purpose)

Pic 107 : *Borassus flabellifer* Linn. (Siallu) for roofing

Pictures of various NTFPs available in northern Mizoram.

Plate 16 (Fuelwood & other important NTFPs))

Pic 108 : Bamboo product (Hat)

Pic 109 : Bamboo product for Baby's Bed

Pic 110: Bamboo product (for making basket)

Pic 111: Bamboo for house construction

Pic 112 & 113 : Cane products

References:

Abbot, P., Lowore, J., Khofi, C., and Werren, M. (1997). Defining firewood quality: A comparison of quantitative and rapid appraisal technique to evaluate firewood species from a Southern African Savana. *Biomass Bioenergy* 12:429–437.

Abeygunawardena, P. and Wikramasinghe, A. (1992). An Economic evaluation of non-timber products of Hantana Forest. Paper presented at the Workshop on Methods for Social Science Research on Non-Timber Forest Products, May 18-20, 1992, Bangkok, Thailand.

Abwe, M. D., Ebia, R. N., Ewane, D.E., Mesue, C.A., Ntonifer, Z., Nzohngandembou, G.W., Tangwa, M., Vandorp, A., Niemeijer, and Offermans, D. (1999). *The wealth of forests in Cameroon*. Limbe, Cameroon: CERUT and AIDEnvironment. In: ETFRN news 32 (ed.): NTFPs.

Acharya, K. (2007). *ENVIRONMENT-INDIA*: Tribals distressed by ban on forest gathering. Inter press news agency.

Adepoju, K. (2007). Economic Valuation of Non-Timber Forest Products (NTFPs), Nigeria.

Akerele, O. (1988). Medicinal plants and primary health care : an agenda for action *Fitoterapia* **59(5)** : 355-363.

Alibaba, Md: Subba Rao, D.V., and Vasudev, N. (2000). Economics of minor forest products in Adilabad district (Andhra Pradesh), Indian Journal of Agricultural Economics, **55(3)**: 451-452.

Andel (2006). Non-timber forest product and the value of wild plants. The Netherlands.

Angelsen A. and Wunder S., (2003). *Exploring the Forestry-Poverty Link: Key Concepts, Issues and Research Implications*. CIFOR Occasional Paper No. 40. Center for International Forestry Research, Bogor, Indonesia.

Anderson, T. (1871). An enumeration of the Palms of Sikkim. *J.Linn. Soc. (Botany*) *11*:4 – 14.

Anderson, J.M., Ingram, J.S.I., (1993). Tropical Soil Biology and Fertility. A Handbook of Methods. CAB International, UK.

Anonymous (1984). *Zoram Upa Pawl Thurawn Bu*. Zoram Upa Pawl, Headquarter, Aizawl, pp. 1 – 80.

Anonymous (1985).Tarzan of Keralai primeral forests. *Indian Express*, 53 (314).

Anonymous (1986). *North-Eastern Area (Reorganisation) Act 1986* (53rd amendment).

Anonymous (1992). *Report of Forest Resources of Lunglei and Chhimtuipui Districts (Mizoram State).* Forest Survey of India, Eastern Zone, Calcutta, p.4.

Anonymous (1995). *Non-wood forest products 7*: Non- wood forest products for rural income and sustainable forestry. FAO, Rome, Italy.

Anonymous (1996). *Statistical Hand Book Mizoram.* Directorate of Economics & Statistics, Govt. of Mizoram (p.p. 1-89).

Anonymous (1997). *Statistical Hand Book Mizoram.* Directorate of Economics & Statistics, Govt. of Mizoram (p.p. 1-97).

Anonymous, (2006). The Scheduled Tribes and other traditional forest Dwellers (Recognition of Forest Rights) Act, 2006. Ministry of Law and Justice, New Delhi, pp. 1 – 14.

Anonymous (2009). *The State of Forest Report.* Forest Survey of India, Ministry of Environment and Forests, Kaulagarh Road, Dehra Dun, pp.125-128.

Anonymous (2010). *Statistical Hand Book Mizoram,* Directorate of Economics & Statistics, Govt. of Mizoram. pp. 1-38.

Appaswamy, Paula P. (1992). Role of non-timber forest products in an interface forest project. Paper presented at the workshop on methods for social science research on NTFPs, May 18-20, Bangkok, Thailand.

Barfoot, J. (2006). A Study to Investigate the Potential for Development of Non-Timber Forest Products and Values from the Boreal Forests of Newfoundland and Labrador Memorial University of Newfoundland Botanical Garden.

Belcher, B.M. (2003). What isn't an NTFP?. *International Forestry Review* **5 (2)**:161-168.

Bhatt, B. P., and Todaria, N. P. (1992). Fuelwood characteristics of some mountain trees and shrubs. *Commonwealth Forestry* Rev. 47:363–366.

Bridson, D. and L. Forman (1999). *The Herbarium Handbook*. Royal Botanic Gardens, Kew. 3rd Edn (Edi.), pp. 4.

Brigham, T., Chihongo, A. and Chidumayo, E. (1996). Trade in woodland products from the miombo region. In: *The Miombo in Transition: Woodlands and Welfare in Africa* (ed. B. Campbell). CIFOR, Bogor. pp 137-174.

Cambell, J.Y. (1993). Putting the people's products first, non-timber forest products and the challenge of managing forest to enhance local income. Paper presented at the International seminar on MFP in forestry. 17-18th April, Dehradun, India. Census of India, 2001. Available at http://www.censusindia.gov.in/Census_Data_2001/India_at_glance/fsex.aspx

Centre for Indian Studies, (2003). Interdisciplinary conference, Mysore, India, and 17–19 October 2003.

Chakravarty and Verma, R. (1991). Marketing of minor forest products in tribal sub-plan area through co-operatives in Rajastan, *Indian Journal of Agricultural economics*, **71(282)**:311-320.

Chamberlain, J; Bush, R. and Hammett. A.L. (1998). Non Timber Forest Products, the "other" forest products. *Forest Product Journal* **48 (10)**:10-19.

Champion H.G. and Seth, S.K. (1968). *A Revised Survey of the Forest Types of India.* Govt. of India Publication, New Delhi.

Chandrasekharan, C. (1992). *Terminology, Definition and Classification of Forest products Other than Wood.* FAO, Rome, Italy.

Chandrasekharan, C. (1995). Terminology, definition and classification of forest products other than wood. In: *Report of the International*

Expert Consultation on Non-Wood Forest Products. Yogyakarta, Indonesia. 17-27 January 1995. Rome: FAO, pp. 345-380

Chandrashekharan, C. (1994). Non-wood forest products: A global view of potential and challenges. In *proceeding international seminar on management of minor forest products*, 13-15 November, 1994, Dehradun, India.

Chawngkunga, C. (1996). *Tualchhuak Damdawi*. Directorate of Health & Family Welfare, Govt. of Mizoram, Aizawl, pp. 1 – 309.

Chopra, K. (1993). The value of non-timber forest products: an estimation for tropical deciduous forests in India. *Economic botany* **47(3)**, 251-257-257.

Cottray, O., Miles, L. and Newton, A. (2003). *African forests and livelihoods*. UNEP-WCMC, Cambridge, UK.

Crafter, C.S., Awimbo, J. and Broekhoven, A.J. (1997). Non timber Forest products, value, use and management issues in Africa, including examples from Latin America. *Proceedings of a workshop held in Naro Moru, Kenya*, 8-13 May, 1994. IUCN, Nairobi, Kenya.

Darlianthanga, C. (1989). *Fa Duhthlan Dan Leh Mizo Damdawi*. C. Darlianthanga, Khatla, Aizawl, pp. 1 – 26.

Das, S.C. (1995). NTFP – a means of subsistence for forest fringe dwellers. Proceedings of seminar, March 8-9, 1995. In: Girish M. R. (ed.) 1998, Ph.D. thesis.

Davidson-Hunt, I and Berker, F. (2001). Changing Resources Management Paradigms, Traditional Ecological Knowledge, and Non Timber Forest Products. In Davidson-Hunt, Duchesne & Zasada (eds).

Forest Communities in the Third Millennium: Linking Research, Business, and Policy Toward a Sustainable Non-Timber Forest Product Sector. NTFP Conference Proceedings, USDA, Forest Service, North Central Research Station. pp 78-92.

De Beer, J.H. and McDermott, M.J. (1989). *The economic value of non-timber products in South East Asia.* The Netherlands Committee for IUCN, Amsterdam. The Netherlands Committee for IUCN de Jong W, Campbell BM, Schroder JM 2000. Sustaining incomes from non- timber forest products: Introduction and synthesis. *Int Tree Crops Journal,* 4: 267-275.

Deb, D.B. (1983). *The Flora of Tripura State, Volume – II.* Today & Tomorrow's Printers and Publishers. Pp. 428 – 430.

Deka, D., Saikia, P. and Konwer, D. (2007). Ranking of Fuelwood Species by Fuel Value Index, Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 29:16, 1499 – 1506

Dransfield, J. and Manokaran, N. (1994). *Plant Resources of South-East Asia No 6*; Rattans. Prosea Foundation, Bogor, Indonesia.137 p.

Falconer, J. (1990). The major significance of 'minor' forest products. The local use and value of forest in the West African Humid Forest zone. *Community Forestry Note 6*. FAO, Rome, Italy.

Falconer J. (1992) Non-timber forest products in Southern Ghana. *Main report*. NRI, Chatham. 244 pp.

Falconer, J. (1995). The major significance of 'minor' forest products: The local use and value of forests in the West African humid forest zone .FAO, 1995. Non- Wood Forest Products in Nutrition. Food and Nutrition Division. In: *Non-wood forest products for sustainable*

forestry. Yogyakarta, Indonesia, 17-27 January 1995. Non Wood Forest Products, FAO. Rome.

FAO (1991). *Non wood forest products*: The way Ahead, Rome, Italy

FAO (1992). Forest, trees and food, Rome. 2-4p. In: ODEBODE, Stella.O.– paper submitted to the XII world forestry congress,2003.

FAO (1993). *Non-wood forest products in Indochina; Focus: Vietnam.* Working Paper by Jenne H. De Beer. Rome, Food and Agriculture Organization of the United Nations.

FAO (1995). Non-Wood Forest Products in Nutrition. Food and Nutrition Division. In: Non-wood forest products for sustainable forestry. Yogyakarta, Indonesia, 17-27 January 1995. *Non-Wood Forest Products 3*. FAO, Rome.

FAO (1999). *FAO Forestry* – Towards a Harmonised Definition of Non-Wood Forest Products. Unasylva– No. 198, Vol. **50**.

FAO (2006). *Can Non- Wood Forest Products Help Contribute to Achieving The Millennium Development Goals*? Rome: FAO, pp. 2-14.

FAO (2008). An Information Bulletin on Non-Wood Forest Products. *Non-Wood News*, FAO, Vol 17, Rome, pp. 12-21.

FSI (1987). The State of India's Forests, Forest Survey of India, Dehradun

Ganapathy, M.S. (1998). Collection and marketing of non_timber forest products – A study in Kollegal taluk of Karnataka. MSc thesis, University of Agricultural Sciences, Bangalore.

Gauraha, A.K. (1992). Micro-economic analysis of a tribal village, *Indian Journal of Agricultural Economics*, **47(3)**: 446-447.

Girish, M.R. (1998). Role of non- timber forest products in tribal Economy – An economic study in Western Ghats region of Karnataka. Ph.D. thesis, University of Agricultural Sciences, Bangalore, India.

Global NTFP Partnership (2005). Inception Workshop held on 1-2 December at Marrakech, Morocco

Goel, V. L. and Behl, H. N. (1996). Fuelwood quality of promising tree species for alkaline soil division in relation to tree age. *Biomass Bioenergy* 10:57–61.

Grimes A., Loomis S. *et al.* (1994) Valuing the rain forest: The economic value of nontimber forest products in Ecuador. *Ambio* **23** (7): 405-410.

Gupta, B.N. (1994). India, In: Durst, P.B., Ulrich, W. and Kashio, M. (eds), *Non-Wood Forest Products in Asia.* RAPA Publication 1994/28. RAP/FAO, Bangkok: pp 19-48.

Hammett, A.L. and Chamberlain J.L. (1998). Sustainable Use of Non-Traditional Forest Product. Alternative Forest Based Income Opportunities. In: Natural Resources Income Opportunities on Private Land Conference. April 5-7th 1998. Hagerstown, Maryland Ed. Jonathan, S.K. Pg 141-147.

Haridasan, K. and Rao, RR. (1985-1987). *Forest Flora of Meghalaya*. Bishen Singh Mahandra Pal Singh Publishers, Dehra Dun, India.

Hegde, R. (1997). Role of forest in a forest fringe household economy: A case study from Madumalai Wildlife sanctuary, Southern India, Centre for International Forestry research, Jakarta, Indonesia.

Hegde, R., Suryaprakash, S., Achoth, L. and Bawa, K.S. (1996). Extraction of NTFPs in the Forests of B.R. Hills. Contribution to Rural Income. *Economic Botany*, 50, p.243.

Hrahsel, Z. (1988). Variability in Soil Properties Under Shifting Cultivation in Mizoram. M.Sc Thesis in Agriculture Chemistry and Soil Science, Assam Agriculture University, Jorhat.

INBAR. **(**2008). International Network for Bamboo and Rattan Web Site (available at www.inbar.int).

Intodia, (1990). Problems of tribals in Southern Rajastan - A Case study. Department of extension education, Rajastan College of agriculture, Rajastan Agricultural University, Udaipur.

Irish, R.F. (1975). *Local Medicine (Tualchher Damdawi)*. Rawihte Publication, Chanmari, Aizawl, pp. 1 – 23.

IUCN (1996). *1996 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland and Cambridge, UK.

Jain, S.K. and Rao, R. R. (1977). *A Handbook of Field and Herbarium Methods.* Today & Tomorrow's Printers and Publishers, New Delhi.

Jasmine, T. Sawian, S. Jeeva, S., Febreena, G. Lyndem, and Laloo, R.C. (2007). Wild edible plants of Meghalaya northeast India. *Natural Product Radiance* **6(5)**: pp.410-426

Jeannette,V.R. (2000). *Non timber forest products (NTFP).Their role in sustainable forest management in the tropics.* Theme studies, series 1, Forests, forestrty and biological diversity support group, Wageningen, the Netherlands.49p.

Jha, L.K., Jha, S.K., Roy, P.& Lalnunmawia, F. (2000). *Market survey of edible bamboo shoots in Mizoram* , Proceeding International Workshop on Agroforestry and Forest Products, Vol. I, Linkman Publication, West Bengal,pp.373-376

Joshi, S. (2003). Super market, secretive. Exploitative, is the market in the minor forest produce unmanageable? *Down to earth*, 28: 27-34.

Jungerius, P. (1985). Perception and use of physical environment in societies. *Geographicalpaper* No. 93, University of Reading, Reading.

Kanjilal, U.N., P.C. Kanjilal, A. Das, R.N. De and N.L. Bor. (1940). *Flora of Assam*. Vols. **1 – 5**. Shillong.

Kant, S. (1997). Integration of biodiversity conservation in tropical forest and economic development of local communities. *Journal of Sustainable forestry*, **4(1/2)**:33-61. In: Girish, M. R.(ed.) 1998, MSc. thesis.

Kataki, R., and Konwer, D. (2001). Fuelwood characteristics of some indigenous tree species of north-east India. *Biomass Bioenergy* 20:17–23.

Kataki, R., and Konwer, D. (2002). Fuelwood characteristics of indigenous tree species of north-east India. *Biomass Bioenergy* 22:433–437.

Kharkonger, P. (1981). *Folklore medico-botany of RuralKhasi and Jaintaia tribes in Meghalya* in S.K. Jain (Ed.) Ethnobotany manual.

Konwer, D., Kataki, R., and Deka, D. (2001). Fuelwood characteristics of some indigenous tree species of north-east India. *Indian J. Forestry* 24:316–319.

Kulirani, F. (2003). The Shrinking livelihood strategies of paniyar of Wayanad, Kerala, India. *Anthropological Survey of India*.

Kumar, G. (1997). Resource Base of Mizoram. In : L.K. Jha (Ed.) *Natural Resource Management Mizoram. :* 1 -40.

Lal, S.K., Bhatera, M. M., and Gupta, S.B.L. (1983). Pattern of consumption, investment, saving and expenditure among tribals. *Rural India*, **46 (2-3)**: 47 – 50.

Lallianthanga, R.K. (1990). *Medicinal Plants of Mizram (A Project Report).* Mizoram Council of Science, Technology and Environment, Aizawl, Mizoram; pp. 1 – 22.

Lalnundanga, Sahoo, U.K. and Jha, L.K. (1997). EEthnobotanical flora in the humid sub-tropical semi-evergreen forst of Mizoram. *Proc. National Conference on Health Care and Developments of Herbal Medicines,* Raipur, pp. 46 – 47.

Lalramnghinglova, J.H. (1991). *Medicinal and Aromatic Plants of Mizoram*. Deptt. Of Environment and Forest, Govt. of Mizoram, pp. 1 – 224.

Lalramnghinglova, J.H. (1992). *Food Plants, Fruit Plants and Medicinal Plants of Mizoram*. Environment of Forest Deptt. Mizoram, Aizawl, pp. 1 – 142.

Lalramnghinglova, J.H. (1996). Ethnobotany of Mizoram – A Preliminary Survey. *J. Eccon.Tax.Bot. Addl. Ser.* **10** : 439 – 459.

Lalramnghinglova, J. H. (1998). Studies on Plants of Ethnobotanical Imporance in the Tropical Wet Evergreen Forests of Mizoram. A Ph. D thesis, Forestry dept., North-Eastern Hill University, Mizoram Campus, Aizawl.

Lalramnghinglova, J.H. (2002). Ethno-botanical study on the edible plants of Mizoram. Ethno-botany, International Journal of the Society of Ethno-botanist, **14**, 2002. pp. 23-33

Lalramnghinglova, J.H. (2003). Ethno-medicinal plants of Mizoram. Bishen Singh, Mahendra Pal Singh, Dehra Dun, pp. 8-10

Lalramnghinglova, J.H. and Jha, L.K. (1996). Ethnobotanical importance among the Hill Tribes of Mizoram. Paper presented at Int. Workshop on prospect of medicinal plants (Nov. 4 – 7, 1996), Dr. Y.S. Parmar Univ. of Horticulture & Forestry, Nauni Solan (H.P.) India.

Lalramnghinglova, J.H. and Jha, L.K. (1997). Ethnomedicine from Mizoram – North East India. *Ethnobotany* 9 : 105 – 111.

Lalremruata, J., Sahoo, U.K. and Lalramnghinglova (2007). Inventory on non-timber forest products of Mizoram in North-East India. *Journal of Non-timber forest products,* **14(3)**: 173-180.

Leith, H. (1975). Measurement of caloric values. In: Leith, H., Whittaker, R.H. (Eds.), *Primary Productivity of the Biosphere*. Springer-Verlag, Berlin, pp. 119–129.

Lettman, G and Kutara, K. (2005). Non Timber Forest product information.

Lintu, L. (1995). Trade and marketing of non-wood forest products. Paper presented in Expert Consultation on NWFPs, 17 – 27 January. 1995. FAO, Indonesia.

Lorrain, J.H. (1940). *Dictionary of The Lushai Language*. The Asiatic Society, Calcutta (Reprint 1975).

Mahapatra, A. (1992). Forest dwellers dependence on forest –A case study of pauri bhuinya tribe of Orissa. *Journal of Rural development*. **11(6)**: 863-872.

Maikhuri, R.K (1991). Fuel-wood consumption pattern of different tribal communities living in Arunachal Pradesh in North East India. *Bio-resource Technology*, 35 : pp. 291 – 296.

Maikhuri, R.K and Gongwar, A.K (1991). Fuel-wood use by different tribal and non-tribal communities in north east India. *Natural Resource Forum.* Butterworth – Heinemann *Ltd*., pp. 162 – 165.

Maithani, G.P. (1994). Management perspectives of Minor Forest Produce. *MFP News*, October-December, 1994. Dehradun.

Mallik, R.H. (2000). Sustainable management of Non-Timber Forest Products in Orissa: Some issues and options. *Indian Journal of Agricultural Economics*, **55(3)**: 384-397.

Manjula, (1991). Participation of tribal women in agriculture, M.Sc. (Agri.) thesis, TNAU, Coimbatore.

Mao, A.A., Hynniewta, T.M. and Sanjappa, M (2008). Plant wealth of Northeast India with reference to ethnobotany. *Indian Journal of Traditional Knowledge* Vol. **8 (1)**, January 2009, pp. 104-109

Marshal, E. and Schreckenberg, K. (2003). *Women, forests and markets: researching poverty alleviation through commercialization of forest resources in Mexico and Bolivia*. UNEP-World Conservation Monitoring Center. Cambridge-UK, 15 pp.

Martin, G.J. (1995). Ethnobotany. A "People and Plants" Conservation Manual. World Wide Fund for Nature. Chapman & Hall, London

Mishra, S. (2007). Household livelihood and coping mechanism during drought among Oraon Tribe of Sundargarh District of Orissa, *India J. Soc. Sci*., **15(2)**: 181-186.

Mistry, M.D. (1992). The impact of the forest action on the household economy of the tribals. In: *The price of forests-proceedings of a seminar on the economics of the sustainable use of forest resources*, edited by Agarwal, Anil, CSE, New Delhi.

Mitchell, C. P., Corbridge, S. E., Jewit, S.L., Mahapatra, A.K., & Kumar, S. (2003). *Non timber forest products: Availability, production, consumption, management and marketing in Eastern India*.

Namdeo, R. K. and Pant, N. C. (1994). Role of minor forest products in tribal economy. *Journal of Tropical Forestry*, **10(1):** 36-44.

Nandakumar (1988). A study on Impact of Integrated Tribal Development Project on Yerava Tribals in Virajpet taluk of Coorg district. M.Sc.(Agri.) Thesis, University of Agricultural Sciences, Bangalore.

Nautiyal, S. and Kaul, A.K. (2002). *Non-Timber Forest Products of India* Dehradun, Jyoti Pub, 2003, p.538.

Neeti Mahanta, (1994). *Tribal Ethnobotany of Mizoram*. Inter – India Publication, D – 17, Raja Garden, New Delhi – 110 015, pp. 17 – 177.

Negi, S.S. (1989). *Forest Types of India, Nepal and Bhutan.* Periodical Expert Book Agency, Delhi, pp. 169-180.

Neumann, R and Hirsch, E. (2000). *Commercialization of Non-Timber Forest Products: Review and Analysis of Research*. Center for International Forestry Research. Bogor, Indonesia

Nibbering, W., Schrevel, A. and Palte., J. (1980). Firewood Trading and Comsumption in the Kalikonto Project Area, East Java: A socio-economic study in seven sample villages, University of Utrecht. Utrecht. pp98.

Olawoye, J.E. (1996). Sociological issue for sustainable forest management. *Ghana Journal of Forestry. Special edition*. 18-33p. Vol. 3. In: ODEBODE Stella O 2005.

Orissa Tribal Empowerment and Livelihoods Project (2007). – A noble effort to address the livelihood issues of the Tribal people of the State.

Pachuau, R. (1994). Geography of Mizoram. R.J. Enterprise, Venghlui, Aizawl, Mizoram. pp. 22-28.

Palit, S. (1995). Role of NTFP in Joint Forest Management. In: *Proceedings of seminar on joint Forest management (JFM)*. March 8-9, Calcutta. In: Girish M. R. (ed.) 1998, PhD thesis.

Pandit, B. and Thapa, G. (2002). *Non-timber forest products on marginal lands (Mimo).* Asian Institute of Technology, Schools of Environment, Resource and development, Thailand.

Pathak, N. and Vangholikar, N. (2006). Conservation and livelihoods, Kalpavriksh environment action group.

Pervez, M.S. (2002). Role of non-timber forest products in the economy of dwelling households of Dhading district, Nepal: An Economic Analysis, MSc thesis, University of Agricultural sciences, Bangalore.

Peters, M.C., Gentry, A.H., and Mendelssohn, R.O. (1989).Valuation of Amazonia rain forest. *Nature* 339pp.

Poffenberger, M (1994). The resurgence of community forest management in eastern India. In *Natural Connections. Perspectives in Community-based Conservation*. D Western and RM Wright, Ed. Washington, D.C, Island Press: pp 53-79.

Poffenberger, M. (2006). The importance and potential of non-timber forest products in Asia. *Proceedings of the Non-Timber Forest Product (NTFP) Workshop and Seminar*, Community Forestry International (CFI), December 2006.

Prasad, N.M. (1993). Evolving strategies for sustainable management and development of non-wood forest products. Paper presented at the international seminar on MFP in forestry, 17-18th April, Dehradun, India.

Prasad, S. and Eswarappa, (2005). Tribal livelihoods in a Limbo: Changing tribenature relationships in South asia presented in Eight sustainable development conference, Best western, Islamabad.

Purohit, A.N. and Nautiyal, A.R. (1987). Fuelwood value index of Indian mountain tree species. *Int. Tree Crops* J. 4, 177–182.

Quang, (2006). *Commercial collection of NTFPs and household living in or near the forests*, Science Direct.

Rajchal, R. (2006). *Analytical Review of the Definitions of Non Timber Forest Product*. At the web Site http://www.forestrynepal.org/images/Analytical%20Definition%20of%20NTFP.pdf Accessed 3/25/07

Rao, A. Ratna and Singh, B. P. (1996). Non-wood Forest products contribution in tribal economy. *Indian Forester*: **122(4)**:337-342.

Rao, Gopala N. (1987). Significance of minor forest produce in tribal economy: A case study, *Kurukshetra*, **7**: 23-28.

Rao, Prasad A, G. (1992). Employment and income pattern of the tribals. *Indian Journal of Agricultural Economics*, **47(3)**:440p.

Raut, R. C., Sale, D.L., and Nawadkar, D. S. (1992). Employment, income and expenditure pattern of tribals of Nasik District, *Indian Journal of Agricultural Economics*, **47 (3)**:415p.

Ravindranath, N.H. and Hall, D.O. (1995). *Biomass, energy, and environment*: a developing country perspective from India.

Reddy, K. N. and Rao, Balaji, N.S. (2003). Technology, life and livelihood strategies of tribes of the Nilgiris: past, present and continuum, Paper presented at the interdisciplinary conference on "Livelihood strategies among forest-related tribal groups of South India" Mysore, during October, 17-19, 2003.

Ros-Tonen MAF, Lammerts B EM, Dijkman W. (1995). *Commercial and Sustainable Extraction of Non- Timber Forest Products. Towards a Policy and Management Oriented Research Strategy.* Wageningen, the Netherlands: The Tropenbos Foundation.

Ros-Tonen MAF, Andel T, Assies W, Dijk JFW, Duivenvoorden JF, Hammen MC, Jong W, Reinders M, Rodríguez Fernández CA, Valkenburg JLC (1998). *Methods for Non-Timber Forest Products research. The Tropenbos Experience*. Wageningen, The Netherlands: Tropenbos Documents 14.

Ruiz-Perez, M., B. Belcher, R. Achdiawan, M. Alexiades, C. Aubertin, J. Caballero, B. Campbell, C. Clement, T. Cunningham, A. Fantini, H. de Foresta, C. García Fernández, K. H. Gautam, P. Hersch Martínez, W. de Jong, K. Kusters, M. G. Kutty, C. López, M. Fu, M. A. Martínez Alfaro, T. R. Nair, O. Ndoye, R. Ocampo, N. Rai, M. Ricker, K. Schreckenberg, S. Shackleton, P. Shanley, T. Sunderland, and Y.Youn. (2004). Markets drive the specialization strategies of forest peoples. *Ecology and Society* **9(2)**:4. At the web Site http://www.ecologyandsociety.org/vol9/iss2/art4/ Accessed 12/08/05 Peacock, S., & Turner, N. 2000. *Just like a Garden: Traditional Resource Management and Biodiversity Conservation on the Interior Plateau of British Columbia*, in Minnis, P.E. and Elisen W.J. (eds) Biodiversity and Native America. University of Oklahoma, Norman, OK.

Saha, N. (1976). Population genetic studies in Kerala and the Nilgiris. *Human heredity. 26: 175-197, In: Reddy and Rao (ed.) Technology, life and livelihood strategies of tribes of The Nilgiris: past, present and continuum, Mysore*.

Sahoo, U.K. and Singha, R.K.P.G. (2006). Trade and marketing of non-timber forest products in North-East India : Same issue on rural development. In : Goutam, H.C. and Bezbaruah, M.P. (eds). *Rural transformation in North-East India*, PP. 159-173, Ruby Art Press, Guwahati.

Sahoo, U.K., Lalremruata, J., Lalramnghinglova, H., Lalremruati, J.H., and Laliankhuma,C. (2010a). Livelihood generation through non-timber forest products by rural poor in and around Dampa Tiger Reserve in Mizoram. *Journal of non-timber forest products*, **17(2)**: 147-161.

Sahoo, U.K., Lalremruata, J., Jeeceelee, L., Lalremruati, J.H., Laliankhuma,C. and Lalramnghinglova, H (2010b). Folk utilization of non-timber forest products (NTFPs) by tribal community in and around Dampa Tiger Reserve in Mizoram. *The Bioscan, special vol* **III** : 721-729.

Sahoo, U.K., Lalremruata, J., Jeeceelee, L., Lalremruati, J.H., Laliankhuma,C. and Lalramnghinglova, H (2010c). Role of NTFPs in the livelihood of communities in and around Dampa Tiger Reserve in North-East India. *The Bioscan, special vol* ***III*** : 779-790.

Sahu, H.P. (2011). Census of India 2011. *Provisional Population Totals, Mizoram series 16*. Directorate of Census Operation, Mizoram, pp. 1 – 31.

Saithantlunaga, H. (1997). *Characterization of Acid Soils of Mizoram*, Ph.D. Thesis. Agricultural Chemistry & Soil Science, Orissa University of Agricultural & Technology, Bhubaneswar, Orissa, pp. 74-80.

Sajem, A.L. and Gosai, K.(2006). Traditional use of medicinal plants by the Jaintia tribes in North Cachar Hills district of Assam, northeast India. *Journal of Ethnobiology and Ethnomedicine* 2006, 2:33 doi:10.1186/1746-4269-2-33

Saptawna, (1990). *Tualchhuak Damdawi Thlanchhuah*. Pu Kawlkunga, Tahan, Kalemyo, pp. 1 – 216.

Sawhney, P. and Engel, S. (2003). Importance of Non-Timber Forest Produce for subsistence and income generation in the life of local people. Case of Bandhavgarh National Park, India. Centre for Development Research (ZEF), Walter-Flex-Str. 3, 53113 Bonn.

Scurlock, J. M. O., and Hall, D. O. (1990). The contribution of biomass to global energy use. *Biomass* 21:75–81.

Sekar, C., Rai, Vinaya, R.S., and Surendran, C. (1993). *Price regime analysis, marketing and trade of minor forest products* - A case study. Centre of minor forest products, Dehradun, India.

Sekar, C., Rai, Vinaya, R.S., and Ramasamy, C. (1996). Role of minor forest products in tribal economy of India: A case study, *Journal of Tropical forest Science*, **8(3)**:280-288.

Sharma, L.R. and Tiwari, S.C. (1992). Marketing of minor forest products in Himachal Pradesh – A Case study of dried seeds of Wild pomegranate. *Indian Journal of Agricultural Marketing*, **6(2)**: 107p.

Shiva, M.P. (1993). Solutions to overcome impediments in forests development through MFP based management. Paper presented at the International seminar on MFP based management. Paper presented at the international seminar on MFP in Forestry, 17-18th April, Dehradun, India.

Shiva, M.P. (1995). *Assessment of NTFP Resorces in India A report for Formulation of National Forestry Action Plan (NFAP), NTFP part. Sponsored by FAO/UNDP & Govt. of India*, Vol **I** & **II**.

Shiva, M.P. (1995a). The Centre of Minor Forest Products' Role in Supporting NWFP Development, In: Durst, P.B. and Bishop, A. (eds.), Beyond Timber: Social, Economic and Cultural Dimensions of Non-Wood Forest Products in Asia and the Pacific. *Proceedings of a Regional Expert Consultation held in Bangkok*, 28 November to 2 December 1994. FAO/RAP, Bangkok: pp 333-334.

Shiva, M.P. (1995b). Collection, Utilization and Marketing of Medicinal Plants from Forests of India, in Durst, P.B. and Bishop, A. (eds), Beyond Timber: Social, Economic and Cultural Dimensions of Non-Wood Forest Products in Asia and the Pacific. *Proceedings of a Regional Expert Consultation held in Bangkok*, 28 November to 2 December 1994. FAO/RAP, Bangkok: pp 271-281.

Shiva, M. P. (1998). *Inventory of Forest Resources for Sustainable Management and Bio-Diversity Conservation*. Indus Publishing Co., New Delhi. (With list of multipurpose tree species yielding both timber and Non-timber Forest Products (NTFP) with shrub and herb species of NTFP importance)

Shiva, M.P. and Mathur, R.B. (1997). *Standard NTFP Classification and Documentation Manual.* pp. 9 -10. Centre of Minor Forest Products, Dehradun, Khanna Bandhu.

Shiva, M.P. and Verma, S.K. (2002). *Approaches to sustainable Forest Management and Biodiversity Conservation with pivotal role of Non Timber Forest Products*.

Singh, O.P. and Data, B. (1989). Morphology, Physical and Physico-Chemical Properties of Hill Soils of Mizoram in Relation to Altitude. *Indian J. Hill Farming* **2 (1)**: 9-20.

Singh, N.P., Singh, K.P. and Singh D.K. (2002). *Flora of Mizoram.* Vol. 1 *Ranunculaceae-Asteraceae.* B.S.I., New Delhi.

Singh H.B.K., Singh R.S. & Sandhu J.S. (2003). *Herbal medicine of Manipur: A colour Encyclopedia*, (Daya Publishing House, New Delhi, India).

State of Forest Report (2009). Forest survey of India. Ministry of Environment & Forest. Govt. of India, Dehra Dun, India.

Subansenee, W. (1995). Major non-wood products of Thailand. *In Beyond timber: social, economic and cultural dimensions of non-wood forest products in Asia and the Pacific*. RAP Publication 1995/13. Bangkok, Thailand, FAO Regional Office for Asia and the Pacific.

Subramanian, K.N. and Sasidharan, K,R. (1996). The Panorama of India Forest : A Reservoir of Plant and Animal Wealth. *Diversity* **12(3)** : 26-29.

Subramanyam, (2001). Tribes and ecology of Andhra Pradesh: An anthropological study, in the Science of Man in Service of Man. In: Subramanyam (ed.) Full length paper submitted for the conference "Livelihood strategies among forest – related tribal groups of south India" held at Mysore , during October 17-19, 2003.

Subramanyam, (2003). Ecology, technology and resources management among the tribes of Eastern Ghats : An Anthropological study". Full length paper submitted for the conference " Livelihood strategies among forest – related tribal groups of south india" held at Mysore , during October 17-19, 2003.

Sudarsen and Sumathi, (2003). State and the forest-related communities: Issues and paradigms of development, Paper presented at the conference on Livelihood strategies among forest-related tribal groups of South India held at the centre for Indian Studies, Mysore, during October, 17-19, 2003.

Sunderland, T. C. H., Clark, L. E. and Vantomme, P. (1999). *Non-Wood Forest Products of Central Africa: Current research issues and prospects for conservation and development*. Rome: Food and Agriculture Organization. In: Central African Regional Program for the Environment (CARPE), 2001.

Surayya, T. (2000). Dependence of forest dwellers on fuel-wood and Non-Wood Products for their survival and pertinent marketing issues" Proceedings of international workshop on agro-forestry and forest products, November, 2000, NEHU, Aizawl, Mizoram, India.

Suryaprakash, S. (1999). An economic analysis of NTFP in the tribal economy in the Western Ghats region of Karnataka. (Report), UAS, Bangalore.

Suryawamshi, S.D. (1992). A study on employment, income and Household economy of tribals on Western Ghat zone of Maharashtra. *Indian journal of Agricultural Economics*, **47(3)**: 427-428.

Tacon, A. (1997). *Identificacion y Valoracion de productos Forestales no Maderables (PFNM) en el bosque nativo Chileno*. Documento elaborado para el curso “estructura y dinamica del Bosque Nativo”. Facultad de Ciencias Forestales, Universidad Austral, Valdivia, Chile, 28 p.

Taylor, F.W. and Parratt, N.T. (1995). The Potential of Non-Timber Forest Products of Botswana, paper presented in the Sixth Conference on the Australasian council on tree and nut crops inc. (ACOTANC-1995) Lismore, NSW, Australia, 11-15 September 1995.

Thangchuanga, (1979). Mizo Damdawi Leh Fanau Enkawl Dan. Managing Board, R.M. High School, Tuikual, Aizawl, pp. 1 – 12.

Thapa, H.S., and Jha, L.K. (2000) Non-wood forest products in Mizoram: An overview. In: Jha, L.K. et al (Eds.), *Proceeding International Workshop on Agroforestry and Forest Products*, Vol. I, Linkman Publication, West Bengal, pp. 349-358.

The Wildlife (Protection) Act, 1972 (amended 2006, 2008). Professional Book, Publisher, New Delhi, 134 p.

Thiagajrajan, R. (1989). Integrated socio-economic and cultural transformation of a tribal community – A systems approach, Ph.D.Thesis, Tamil Nadu Agricultural University, Coimbatore.

Thomas, S., and Haridasan, K. (1999). Rattans – The Prickly Palms. *Arunachal Forest News*, **Vol. 17 (1 & 2)**. 1999. Pp. 26 – 28.

Tiwari, B.K. (2000). Non-Timber Forest Product of North East India, In: L.K. Jha (ed.)*Proc. Int. Workshop on Agro-forestry and Forest Products*, Aizawl; November 28 – 30, 2000, pp. 349 – 372.

Tiwari, B.K. (2000). Non-Timber Forest Product of North East India, In. L.K. Jha (ed.)*Proc. Int. Workshop on Agro-forestry and Forest Products*, Aizawl; November 28 – 30, 2000, pp. 349 – 372.

Trynor, C.H.; Maneekul, R.;Jintana, V, and Wichawutipong, J. (2002). *Forest products utilization and contribution to household economies in Tho Saman Village, Song Watershed, Phrae Province, Northern Thailand.* In Trynor C.H; Prabudhanitisarn,S; Oksen, P; Dontree, S., and Saarnak C. (eds), Joint Interdisciplinary Research Project #1, Part V Forestry. TUCED-SLUSE, Thailand.

USDA (Rep. 1988). *Soil Taxonomy: A basic classification for making and interpreting soil surveys.* US Department of Agricultural Soil Conservation Service. Robert E.Krieger Publishing Company, Malabar, Florida, pp. 179-373.

Vailinga, Rev. M. (1991). *Mizo Pipute Sulhnu leh Mizo Damdawi*. Christian Book Store, Chanmari, Lunglei, pp. 1 – 27.

Vantomme, (2003). Forest Products Division, Forestry Department, FAO, Rome

Varadarajan, D. (1980). A Demographic survey of kota tribals in Nilgiris District. Ph.D. Thesis, TNAU, Coimbatore.

Vergara**, N.** (1997). Wood materials from non-forest areas. Working paper AO/APFSOS/WP/19. Also available at: www.fao.org/forestry/fon/fons/outlook/asia/apfsos/19/Apfsos19.htm

Vidyarthi, A.K. and Gupta, H.S. (2002). Non-wood forest produce in village economy – A case study in Chota Nagpur region. *Indian Forester*.**128 (4)**:371-378.

Wills, Russel M. and Lipsey, Richard G. (1999). An economic strategy to develop Non-Timber Forest Products and Services in British Columbia. Forest Renewal BC Project No.PA97538-ORE. Final Report. In: Integrating Non-Timber Forest Products into Forest Planning and Practices in British Columbia Forest practice Board, 2004.

Wollenberg, E. (1998). Conclusion In Wollenberg, E & Ingles, A. (eds). A. *Incomes from the Forest: Methods for the development and conservation of forest products for local communities*. CIFOR-IUCN, Bogor, Indonesia.

Wollenberg, E. and Belcher, B. (2001). European Tropical Forest Research Network (ETFRN news:32).

Wong Jenny LG (2000). The biometrics of Non-Timber Forest Product resource assessment: A review of current methodology. Report commissioned under the ZF0077 pre-project of the Forest Research Programme of the United Kingdom Department for International Development. www.etfrn.org/etfrn/workshop/ntfp/ download.html (Accessed June 2010)

Wunder, S. and Angelsen, A. (2003). Exploring the forest-poverty link: Key concepts, issues and research implications. *CIFOR occasional paper No. 40*. In: Erik Stronkhorst (MSc.) 2005 or ECOCLUB.com E-Paper Series, Nr. 12, April 2005.

PAPER PUBLISHED:

INVENTORY ON NON-TIMBER FOREST PRODUCTS OF MIZORAM IN NORTH-EAST INDIA

J. Lalremruata, U.K. Sahoo* and H. Lalramnghinglova
Department of Forest Ecology, Biodiversity and Environmental Sciences, Mizoram University, Aizawl – 796001 (Mizoram).

Abstract: An inventory on Non-Timber Forest Product resources was made during 2005-2006 covering most forest types in Mizoram, N.E. India. A total of 272 species of NTFPs was made in the present study which included medicinal plants (85 families), fruit plants (23 families), food (20 families), fuelwood (18 families) and fodder plants (8 families). Among the various families, Poaceae contributed most (24) genera followed by Arecaceae 17 genera while the least by both Fabaceae and Verbenaceae 07 each. *Albizia procera* was the most preferred fuelwood species which was consumed by as high as 2075 households while the least preferred was *Quercus pachyphylla* (only 75 households) in the surveyed sites. A diverse variety of NTFPs were found from the different forest types among which the most important NTFP from utilization prospective was Broomstick. It has also been found a large variety of plants and fruits available to people were used for a variety of purposes. Such activities on one hand contributed to our knowledge of various uses of biodiversity and on the other have resulted in rapid depletion of natural resources.

INTRODUCTION

Forests have traditionally been valued as the chief source of timber, pulp, and more recently for fuelwood. All other products, regardless of their value to local people or the national economy, have been classified as "minor forest products". These include food, medicines, household equipments and building material, raw materials for processing enterprises, materials for agricultural and other production equipment, crop storage containers, crop dryers as well as fuel used for crop processing as well as products for cash sale and thereby forming an integral part of the household economy (Shiva and Mathur, 1997). For millennia, Non-Timber Forest Products have been essential for subsistence and economic activities all around the world and these are also among the oldest and most long-standing of internationally traded commodities, dating back thousands of years to ancient times continuing in the present day and are the key to sustainable economic growth and healthy rural enterprises. Besides, they play a significant role in maintaining biological diversity, forest health, cultural well-being, and indigenous knowledge. A growing body of scientific research suggests that NTFPs can help communities meet their needs without jeopardizing forest ecosystems (Rocky *et al.*, 2004).

The NTFP sector is reportedly estimated over a billion US dollars, and is growing rapidly, perhaps faster than the timber industry. For example, the market for NTFPs has grown by nearly 20% annually over the last several years, and the related herbal medicine market at a rate of 13-15% annually (Lintu, 1995) offering good potential for increasing income, expanding opportunities, and diversifying enterprises in rural areas. Non-Timber Forest Products are basic cash and subsistence commodities in many cultures (Lalramnghinglova, 1996). Many local populations continue to have a fundamental reliance on NTFPs. In many cases these products are of far greater importance than the irregular cash income gained from commercial logging. While the preservation of NTFPs is fundamental to the maintenance and continuation of many traditional ways of life, these NTFP sources are increasingly threatened by deforestation and land development activities (Rocky and Sahoo, 2002). The recognition of intellectual property rights is important for many NTFPs. The fields of herbal medicine and biomedical research are growing rapidly. Often the plants, their uses, and harvesting and processing techniques were studied,

* Department of Forestry, Mizoram University, Aizawl – 796001 (Mizoram).

Journal of Non-Timber Forest Products, Vol. 14(3): 173-180, 2007

to other sites. Site I situated at a higher elevation as compared to that of the other four Sites. A majority of the population depended on NTFPs. Out of the total population, 5040 i.e. 20% were full time exploiter and 20488 i.e. 80% were part time exploiter. Site II had maximum number of NTFPs exploiter while Site IV had minimum number of NTFPs exploiter.

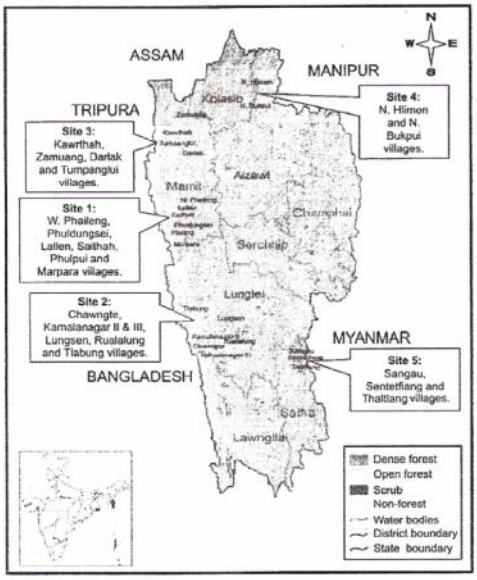


Fig. 1: Map of Mizoram showing study Sites.

Inventory on NTFPs

In order to assess the NTFPs diversity, occurrence and consumption pattern we collected information through questionnaire, interviews and forest walk with the local guide along with forest survey by laying transect belts following Mukherjee (1992). In some areas, we collected secondary information on NTFPs from the Forest Department, published literature, village headmen, elderly men and the local herbal practitioners. Local guide was hired for consultation and in identification of NTFPs of rare occurrence found in the forests. The forests adjacent to each village were surveyed laying 10 random transects each measuring 200 m x 200 m with a gap of at least 30 – 50 m between two transects. In each transect, about 10 quadrats (10 m x 10 m) were laid randomly for enumerating the trees found along with their local and botanical names, parts used and traditional uses etc. Similarly, 20 quadrats each measuring 2 m x 2 m were taken randomly for enumerating the shrubs, herbs and creepers found in each transects. The names of fuel wood species and quantity of fuelwood consumed for domestic purposes were recorded by household survey and by weight survey method with the help of a 5 kg hand balance following the method as outlined in Maikhuri (1991) and Maikhuri and Gongwar (1991). Ranking of fuel wood species was prepared for each village based on quality wise.

RESULTS AND DISCUSSION

NTFPs diversity in Mizoram

A total of 272 species of NTFPs was encountered in the present study from all the sites which include medicinal, fruit, food, fuelwood and fodder plants. Among the various NTFPs, medicinal plants contribute more than half of the total NTFP species (Table-2). The order of NTFPs is medicinal > fruit > food > fuelwood > fodder plants. The medicinal plants encountered in the study sites belonged to 85 families. The number of families contributed by fruit plants, food plants, fuelwood and fodder species were 23, 20, 18 and 8 families respectively. The total number of genera and species and their ratio were again shown in Table-2.

Table-2: Representation of different plant families to NTFPs resources in Mizoram

NTFP of plant origin	Total Families	Total no. of genera	Total no. of species	Genera : species
Medicinal	85	148	168	1:1.14
Fruit	23	34	40	1:1.18
Food	20	27	28	1:1.04
Fuel wood	18	18	21	1:1.17
Fodder	8	14	15	1:1.07
Grand total	154	241	272	1:1.12

Among the different NTFPs, the 10 dominant families are given in Fig. 2. The data is based on the

use pattern from the five different study sites for fulfilling the needs of most of the local people. The 10 dominant families are: Poaceae, Arecaceae, Moraceae, Asteraceae, Euphorbiaceae, Anacardiaceae, Mimosaceae, Verbenaceae, Caesalpinaceae and Fabaceae. These families represented mostly to the NTFP diversity in Mizoram. For an example, Poaceae contributed 24, Arecaceae 16, Moraceae and Asteraceae 13, Anacardiaceae, Euphorbeaceae and Mimosaceae 11, Caesalpinaceae 10, Verbenaceae and Fabaceae 7 genera each. In total, there were 123 different species out of 318 total species drawn from the 10 dominant families contributing to the NTFP diversity in the study areas (Fig. 2).

Fuelwood consumption pattern

Among the surveyed villages, the most preferred fuel wood species based on quantity in Mizoram as found in the present investigation are: *Albizia procera* (Kangtekpa), *Derris robusta* (Thingkha), *Anogeissus acuminata* (Zairum), *Schima wallichii* (Khiang), *Stereospermum personatum* (Zihnghal), *Vitex peduncularis* (Thingkhawilu), *Adina cordifolia* (Lungkhup), *Mesua ferrea* (Herhse), *Macaranga indica* (Hnahkhar), *Quercus pachyphylla* (Fah), *Bischofia javanica* (Khuangthli), *Acrocarpus fraxinifolius* (Nganbawm), *Albizia thomsonii* (Thingri), *A. chinensis* (Vang), *Ficus semicordata* (Theipui thing), *Callicarpa arborea* (Hnahkiah), *Elaeocarpus lanceaefolius* (Kharuan), *Quercus polystachya* (Thil), *Styrax serrulatum* (Hmarhleng), *Tetrameles nudiflora* (Thingdawl) and *Toona ciliata* (Tei).

The utilization pattern of fuelwood based on the easy availability of each fuel wood species in a particular area indicated *Albizia procera* as the most preferred species while *Quercus pachyphylla* as the least preferred species. *Derris robusta* is the second preference, and the rest based on their rank were *Anogeissus acuminata*, *Schima wallichii*, *Vitex peduncularis*, *Callicarpa arborea*, *Albizia chinensis*, *Macaranga indica*, *Tetrameles nudiflora*, *Styrax serrulatum*, *Elaeocarpus lanceaefolius*, *Ficus semicordata*, *Stereospermum personatum*, *Acrocarpus fraxinifolius*, *Toona ciliata*, *Albizia thomsonii*, *Bischofia javanica*, *Quercus polystachya*, *Mesua ferrea*, *Adina cordifolia*, *Quercus pachyphylla*. The utilization pattern of fuelwood from the total 4681 households in the studied area are represented in Fig. 3.

On an average, 44.33% of household consumed *Albizia procera*, while only 2.03% consumed *Quercus pachyphylla*. Distribution of fuel wood species in the study sites has a large effect upon the availability of the individual species in the study sites. For example, *Albizia procera* was widely distributed in the Western part of Mizoram (i.e. at

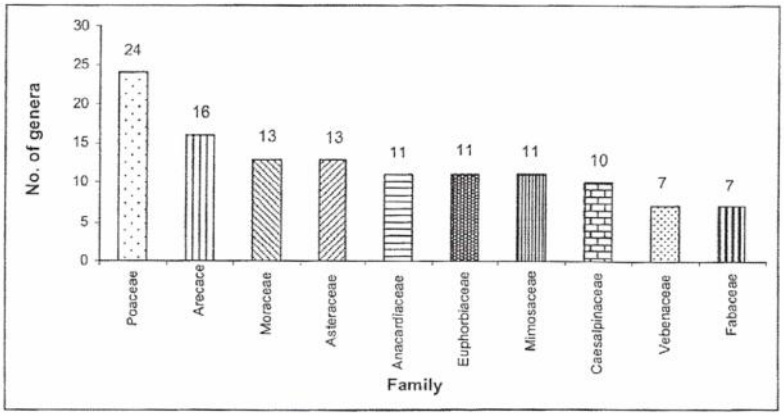


Fig. 2: The first ten dominant families showing number of genera contributing to NTFP diversity in Mizoram.

the study sites) while *Quercus pachyphylla* may be the best quality but it ranked low because of less availability in the study sites (Fig.3). The number of households consuming fuel wood species in a given village was different from that of the total in utilization pattern because one household might utilize more than one species for fuel wood.

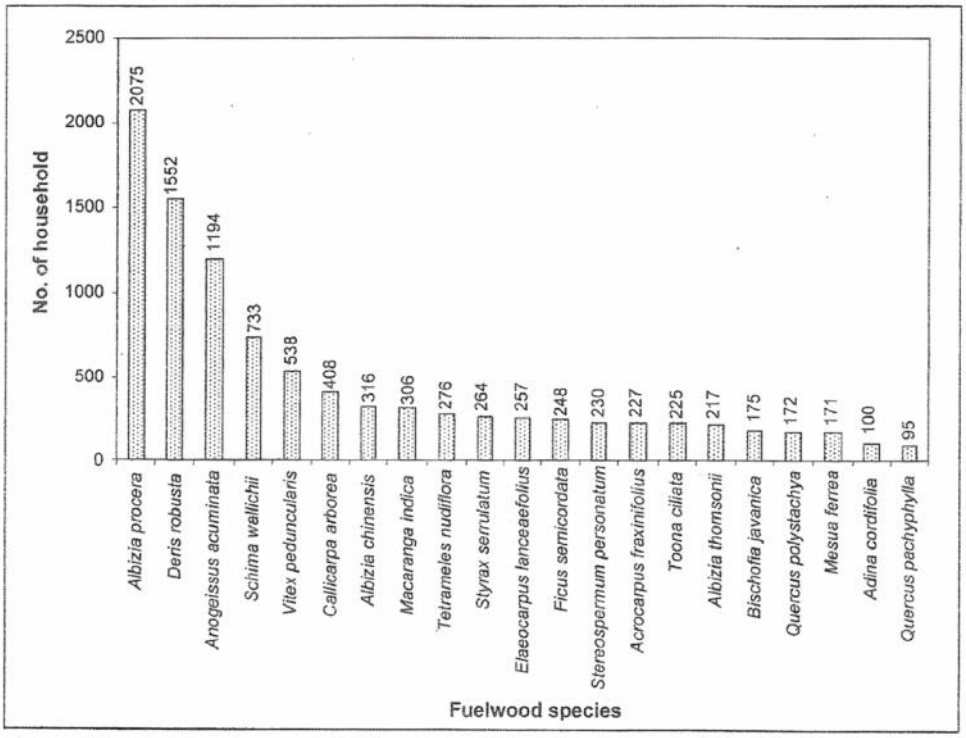


Fig. 3: Fuelwood utilization pattern (based on local preferences) in five different surveyed Sites in Mizoram.

However, based on combustibility, *Quercus pachyphylla* was found to be the most preferred species while *Ficus semicordata* was the least preferred species based on its quality (Table-3). *Vitex peduncularis* came as the second preferred species based on the quality and the rest according to their ranks were *Macaranga indica*, *Mesua ferrea*, *Anogeissus acuminata*, *Quercus polystachya*, *Albizia procera*, *Adina cordifolia*, *Schima wallichii*, *Stereospermum personatum*, *Albizia thomsonii*, *Elaeocarpus lanceaefolius*, *Styrax serrulatum*, *Bischofia javanica*, *Derris robusta*, *Albizia chinensis*, *Tetrameles nudiflora*, *Acrocarpus fraxinifolius*, *Callicarpa arborea*, *Toona ciliata*, and *Ficus semicordata*.

NTFPs utilization pattern

Out of the total 4681 households surveyed, broom grass was the most common NTFP used by each household in the area. This was collected from the nearby forests and dried for domestic use. The surpluses if any were sold to the village market as well as to the city market. It was found that few households bought this product from the local market while almost all the household in the city did not

Table-3: Species Quality Ranking (based on local preferences) for fuel wood in five different surveyed Sites in Mizoram

Sl. No.	Species	Local Name	Rank
1	*Quercus pachyphylla*	Fah	1
2	*Vitex peduncularis*	Thingkhawilu	2
3	*Macaranga indica*	Hnahkhar	3
4	*Mesua ferrea*	Herhse	4
5	*Anogeissus acuminata*	Zairum	5
6	*Quercus polystachya*	Thil	6
7	*Albizia procera*	Kangtekpa	7
8	*Adina cordifolia*	Lungkhup	8
9	*Schima wallichii*	Khiang	9
10	*Stereospermum personatum*	Zihnghal	10
11	*Albizia thomsonii*	Thingri	11
12	*Elaeocarpus lanceaefolius*	Kharuan	12
13	*Styrax serrulatum*	Hmarhleng	13
14	*Bischofia javanica*	Khuangthli	14
15	*Derris robusta*	Thingkha	15
16	*Albizia chinensis*	Vang	16
17	*Tetrameles nudiflora*	Thingdawl	17
18	*Acrocarpus fraxinifolius*	Nganbawm	18
19	*Callicarpa arborea*	Hnahkiah	19
20	*Toona ciliata*	Tei	20
21	*Ficus semicordata*	Theipui-thing	21

gather these from adjacent forest rather preferred purchasing from the market.

Apart from broom grass, fuel wood was another most common NTFP commodity for the villagers. Out of the total households, 76.9 % i.e. 3602 households were totally dependent on fuel wood and the rest 23.1 % on LPG. Though there were some households using both LPG and fuel wood, these were negligible as compared to those using fuel wood only. Some households sold their surplus collected fuel wood in the market. Out of the total households, 60.8 % i.e. 2846 households made use of wild edible plants to meet their daily requirements. 57.2 % i.e. 2676 households utilized grasses like *Saccharum spontaneum* (Luang), *Thysanolaena maxima* (Hmun-phiah), *Imperata cylindrica* (Di), *Licuala peltata* (Laisua) etc. for feeding cattle and roofing etc. 56.4 % i.e. 2640 households utilized wild edible fruits to improve their health. Besides, these fruits served as good source of income to the local communities by way of selling these products. The wild fruit gathered from the forest were edible and were very diverse. Bamboo poles had a wide range of use in the sites. 55.2 % out of the total households used it for house construction, local bridge construction (especially in Chawngte 'C' – Chakma area), for fencing and for furniture making. Medicinal plants were yet other NTFPs widely used to cure various diseases. 47.8 % i.e. 2237 households used medicinal plants collected from the forests. Although some of the medicinal plants were cultivated in home gardens, the collection of medicinal plants from the adjacent forests was a common phenomenon. It appeared that the medicinal plants grown in home gardens were used by the people only during emergency and in heavy down pour days when they can not go to the forests. Many people in the sites were involved in making charcoal out of the wood from the forests. These charcoal were utilized for cooking and for making them warm. About 42.3 % households used charcoal to meet various requirements (Fig. 4). As was obvious, each household utilized various NTFPs for livelihood (Fig. 4) which clearly indicates that NTFPs play an important role in social domain of villagers. The gathering and selling of NTFPs nevertheless was a source of income for local communities. These products supported village-level artistry and craft activity and provided raw materials to support some small scale processing enterprises such as grasses, bamboos and cane furniture, fruit plants in Mizoram.

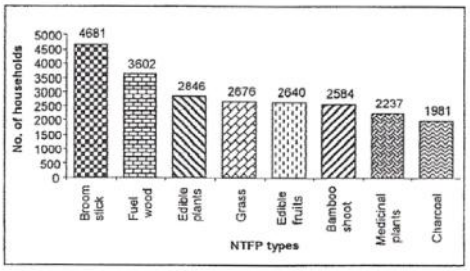


Fig. 4: Utilization pattern of major NTFPs in different Sites of Mizoram.

From our discussion with the villagers, we noted that almost all the people / household participated in collection of one or more forms of NTFPs (Mukherjee, 1992). For example, the entire household required broomstick for domestic use which were found in the entire household. Likewise, bamboo shoot is extensively consumed by almost all the household during its season to supplement household agricultural requirements. From the surveyed it was found out that local people dependence on NTFPs was less as compared to that of their dependence on agricultural products. This may be because of their farming system i.e. shifting cultivation wherein vast areas of forests were destructed from where these NTFPs are collected. The dependence on medicinal plants for remedial purpose was also less in comparison to the local people dependence on chemical drugs. However, local people extracted fuel wood to a large extent for domestic purpose especially in areas where LPG connection was not available. It was further found that the people in remote areas got better living through the use of NTFPs in constructing houses, meeting their daily food requirements and also in improving their economics condition. Besides NTFPs supplemented household agricultural benefits through essential nutritional inputs, medicine, fodder and supplied forest food during different seasons thereby reducing the shortages suffered during "hunger periods" of specially the marginal and shifting population of cultivators and forest dwellers. Comparisons of the utilization pattern of different NTFPs in five different study Sites are represented in Fig. 5.

ACKNOWLEDGEMENT

The authors are grateful to G.B. Pant Institute of Himalayan Environment & Development for financial assistance to carry out this research.

REFERENCES

Lalramnghinglova, J.H. (1996). Ethnobotany of Mizoram – A preliminary Survey. *Journal of Economic and Taxonomic Botany, Additional Series*, 12: 439-459.

Lintu, L. (1995). Trade and marketing of Non-Wood Forest Products. *Paper presented in Expert Consultation on NWFPs, 17-27 January, 1995, FAO*, Indonesia.

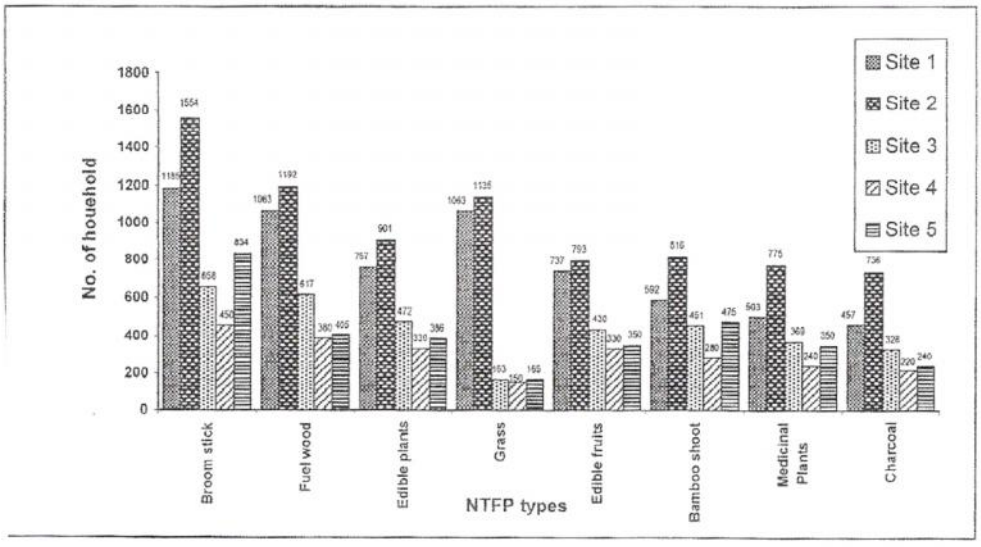


Fig. 5: Comparison on utilization pattern of NTFPs in different Sites in Mizoram.

Maikhuri, R.K. (1991). Fuelwood consumption pattern of different tribal communities living in Arunachal Pradesh in North East India. *Bio-resource Technology*, **35**: 291-296.

Maikhuri, R.K. and Gongwar, A.K. (1991). Fuelwood use by different tribal and non-tribal communities in North East India. *Natural Resource Forum*. Butterworth – Heinemann Ltd., pp. 162-165.

Mukherjee, N. (1992). *Participatory Learning and Action*. Concept Publishing Company. Pp. 299-302.

Rocky, P. and Sahoo, U.K. (2002). Tree bean (*Parkia roxburghii* G. Don): A promising NTFP of Manipur. *MFP News*, XII(2): 4-5.

Rocky, P.; Sahoo, U.K. and Thapa, H.S. (2004). Livelihood generation through Tree bean (*Parkia roxburghii* G.Don) in Imphal West District of Manipur. *Journal of Non-Timber Forest Products*, 11(2): 135-139.

Shiva, M.P. and Mathur, R.B. (1997). *Standard NTFP Classification and Documentation Manual*. Pp. 9-10.

Thapa, H.S.; Sahoo, U.K. and Jha, L.K. (2000). Non-Wood Forest Products in Mizoram : An Overview. In: Jha *et al.* (eds). *Proceeding of International Workshop on Agroforestry and Forest Products, Aizawl, Mizoram*. Pp. 349-358.

Tiwari, B.K. (2000). Non-Timber Forest Product of North East India. In: Jha *et al.* (eds). *Proceeding of International Workshop on Agroforestry and Forest Products, Aizawl, Mizoram*. pp. 349-372.

BIODATA:

Name : J. Lalremruata

Father's Name : J. Zatawna

Date of Birth : 3rd March, 1980

Sex : Male

Religion : Christian

Educational Qualification : M.Sc. (Environmental Science)

Other qualification and experience:

a) Research work :

Worked as JRF in research project in the Department of Ecology, Biodiversity & Environmental Science, Mizoram University under the supervision of Prof. H. Lalramnghinglova funded by GBPIHED during 2005 – 2006.

b) Qualified NET :

Qualified for National Egilibility Test (NET) in June, 2009 from Environmental Sciences.

c) Attended seminar / workshop:

i) Participated in UGC sponsored Two-Day National seminar on "Biodiversity & Indigenous knowledge system" held on 25-26 October, 2006 at Rajiv Gandhi University, Itanagar (Arunachal Pradesh) organized by the Centre with Potential for Excellence in Biodiversity, Rajiv Gandhi University, Arunachal Pradesh.

ii) Participated in the workshop on "Traditional healing practices in Mizoram" on 16th January, 2009 at Aizawl jointly organized by School of Earth Sciences & Natural Resources Management, Mizoram University, Aizawl and Department of Life Sciences, Assam University, Silchar, Assam.

iii) Presenting a paper in the State level workshop on "forest resources in Mizoram" held on 7-8 April, 2011 organized by Department of Environmental Sciences, MZU in collaboration with Regional Centre, NAEB, NEHU, Shillong.

iv) Participated in the One-Day State level symposium on "Chemistry-Our life, our future" on 31st August, 2011 at Pi Zaii Hall, Synod Conference Centre, Aizawl, Mizoram jointly organized by Mizo Post graduate Science Society with Mizoram Council of Science, Technology and Environment, Governmnet of Mizoram.

d) Research publication:

1) Lalremruata, J., Sahoo, U.K. and Lalramnghinglova, H. (2007). Inventory on non-timber forest products of Mizoram in North-East India. *Journal of Non-timber forest products*, **14(3)**: 173-180.

2) Sahoo, U.K., Lalremruata, J., Lalramnghinglova, H., Lalremruati, J.H., and Laliankhuma,C. (2010a). Livelihood generation through non-timber forest products by rural poor in and

around Dampa Tiger Reserve in Mizoram. *Journal of non-timber forest products*, **17(2)**: 147-161.

3) Sahoo, U.K., Lalremruata, J., Jeeceelee, L., Lalremruati, J.H., Laliankhuma,C. and Lalramnghinglova, H. (2010b). Folk utilization of non-timber forest products (NTFPs) by tribal community in and around Dampa Tiger Reserve in Mizoram. *The Bioscan*, special vol **III** : 721-729.

4) Sahoo, U.K., Lalremruata, J., Jeeceelee, L., Lalremruati, J.H., Laliankhuma,C. and Lalramnghinglova, H. (2010c). Role of NTFPs in the livelihood of communities in and around Dampa Tiger Reserve in North-East India. *The Bioscan*, special vol **III** : 779-790.

5) Lalremruata, J. and Lalramnghinglova, H. (2011). NTFPs resorces and conservation in Mizoram. *Forest resources of Mizoram, Conservation and Management.* pp. 191-209.