ABSTRACT

STUDY OF MEDICINAL PLANTS IN TROPICAL AND SUB – TROPICAL SEMI – EVERGREEN FOREST OF MIZORAM

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I. INTRODUCTION :

Man's dependence on plant species dates back to the beginning of the human race. In the early days he had limited needs. But with the advancement of civilization his requirements also grew.

The term 'ethnic' has been described as a race or racial group having similarities in their cultural traditions. The people of each ethnic group had distinct bank of knowledge on the use of plants and their properties.

- **Ethnobotany :**

Ethnobotany is an offshoot of botany that deals with how plants are used by the ethnic people. The term ethnobotany deals with " the study of plants used by primitive and aboriginal people". Although many explanations have been put forward, it can be explained that Ethnobotany concerned basely on the study of the relation between plants and human beings.The use of plants as medicine for human beings as well as animals in India dates back to the pre – Vedic age. The indigenous system of medicine from the Vedic ages has been an integral part of Indian culture.

- **Ethnomedicine :**

Ethnomedicine is a component of Ethnobotany which refers to the use of plants by humans as medicine.

It is assumed that about 80 % of the 5200 million people of the world live in less developed countries. The World Health Organization estimates that about 80 % of these people rely almost exclusively on traditional medicine for their primary health–care. Since medicinal plants are the ' backbone ' of traditional medicine, this means that more than 3300 million people in the less developed countries utilised medicinal plants on a regular basis (Farnsworth 1994).

- **Scope of ethnomedicinal research :**

Professor R.E. Schultes once stated " the Indian sub-continent represents one of the greatest emporia of ethnomedicinal wealth ". The richness is due to great ethnic diversity, phytogeographical variation and rich flora.

The northeastern region is one of the richest biodiversity zone in the Indian sub-continent with high endemism. It is a rich region of ethnobiocultures. The actual forest cover is also high despite the on-going practice of ethnoagriculture. The unique richness of ethno-culturo-biodiversity is a great challenge to the scientist to explore the region.

The state of Mizoram receives little attention so far as the survey of medicinal plant is concerned. No effort has been made on the survey of medicinal plants of Tropical and Sub-tropical Semi-evergreen Forest of Mizoram. There is, therefore, a need for documentation of medicinal plants of this area for the purpose of conservation, education and research in the development of new drugs.

The present study is designed with the following objectives:

- Collection, identification and documentation of plants of medicinal value. To keep voucher specimens in the herbarium for future reference.
- Recording of phenology, growth behaviour, silvicultural character, associates, altitude and analysis of soil samples to know the site condition.
- Delineation on the maps to show the actual place of availability of the plant (*in situ* condition).
- Screening of medicinal plants for phytochemical analysis, and
- Phytochemical analysis of few important medicinal plants.

II. REVIEW OF LITERATURE :

During the study 278 papers / reports published in different books and Journals have been reviewed.

III. METHODOLOGY :

In the study of medicinal plants, the following methods and techniques are adopted :

- Collection of information through local literature.
- Conducting personal or group interviews.

- Ethnobotanical field work.
  - i) Collection and Processing of plant samples.
  - ii) Pre-planned field trip programme
  - iii) Actual field work.
- Identification and matching of the specimens.
- Soil Analysis.
  - i) Determination of pH (Ghosh *et al* 1983).
  - ii) Determination of Organic Compound content by Walkley & Black's Method using the formula of

$$OC\ \% = \frac{10\,(B - T) \times 0.003}{B} \times \frac{100}{\text{wt. of soil}}$$

Where B = Vol. in ml of ferrous sulphate solution required for blank titration and T = Vol. of ferrous sulphate solution need for soil sample.

  - iii) Estimation of available Phosphorus by Olsen's Method.
  - iv) Determination of available Potassium by Wood & De Turk's Method.
- Delineation on map.
- Phytochemical analysis in collaboration with Chemistry Division, Forest Research Imstitute, Dehra Dun.

IV. STUDY AREA :

i) Geographical location : Lies between 21° 31' N to 23° 15' N latitude and 92° 16' E to 93° 26' E longitude.

ii) Area : It covers 8312.50 sq. km. which is 39.43 % of the total geographical area (21,081 sq. km) of the state.

iii) Temperature : 10° C to 30° C, heavy rainfall with an average of 2850mm per annum.

iv) Soil : Immature, young and sandy, highly acidic, rich in organic carbon, low in phosphate content but high in available potash.

v) Vegetation : Abundant growth of vegetation. 18,775 sq. km. Is covered by natural vegetation i.e. 89 % of the total area.

vi) Socio-Economic : There are 472 villages with a total population of 4,29,476. The health care facilities provided through 7 Hospitals, 9 ommunity Health Centres, 6 Subcidiary Health Centres, 17 Public Health Centres and 192 Health Sub-Centres.

V. RESULT :

- **Description of plants :**

The plant species having ethnomedicinal importance are altogether sixty eight in numbers. Out of sixty eight plant species, sixty six belongs to Dicotyledons and two comes under Monocotyledons. Two plant samples (Dicotyledons) are epiphytes. The plant species represent forty four families (Table 1).

Scientific names of plants are arranged alphabetically. Description of the plant species are made in the sequences of : local name, family, locality with latitude and longitude, altitude, important morphological characters, phenology, growth behaviour, silvicultural characters, analysis of soil, collected from the growing site of the plant species, associates and uses (used in Mizoram : MZ and elsewhere : EW in the world), their preparations and doses.

- **Delineation on maps :**

After collection of the plant samples, the forest beat was surveyed thoroughly to check the distribution patterns of plants. The adjacent forest beats were also covered to ascertain the range of distribution and degree of abundance of the plant species. The range of distribution was recorded. The topo sheets covering that particular area were collected, latitude and longitude were measured to delineate on the map to show the place of availability of the plants. In course of study the following topographical map sheets numbers were used : 83 D/15, 83 D/16, 83 D/18, 84 A/9, 84 A/10, 84 A/11, 84 A/12, 84 A/13, 84 A/14, 84 A/15, 84 A/16, 84 B/9, 84 B/10, 84 B/13, 84 B/14, 84 B/15, 84 E/1, 84 E/2, 84 E/4, 84 F/1.

- **Screening of plants having pharmaceutical importance :**

Screening helped in determining the medicinal plant species which is not subjected for biological assays (Table 2). Total 18 species were selected as candidate plant species suitable for chemical analysis to identify the active compound.

- **Chemical analysis :**

Sixty eight plant species has been recorded with pharmaceutical potential in the present study. Out of sixty eight, eighteen species are selected as candidate plant species suitable for chemical analysis to identify the active compound.

The below mentioned three plants species are selected for chemical analysis :

- ***Garcinia sopsopia*** Mabb. (**Vawmva**)
- ***Mallotus roxburghianus*** Muell.- Arg. (**Zawngtenawhlung**)
- ***Vitex peduncularis*** Wall. (**Thingkhawilu**)

Results of chemical analysis are given in Table 3.

VI. DISCUSSION AND CONCLUSION :

The plant samples collected from the ethno-biomedical resources of Tropical and Sub-tropical Semi-evergreen Forest of Mizoram covers about 36 major diseases.

The diseases and the plants or plant parts used to cure diseases are mentioned under paranthesis : Diarrhoea (*Berginia ciliata, Chikrassia tabularis, Diospyros variegata, Engelhardtia spicata, Jusminum dispermum, Mangifera indica, Mikania micrantha, Psidium guajava, Rhus semialata, Stephania japonica.*); Dysentery (*Berginia ciliata, Diospyros variegata, Engelhardtia spicata, Jusminum dispermum, Mikania micrantha, Psidium guajava*); Stomach ulcer (*Adina cordifolia, Aporosa octandra, Artemisia indica, Chonemorpha fragrans, Morinda anguistifolia, Saraca asoca, Solanum nigrum*); Stomachache (*Blumea lanceolaria, Dysoxylum gobara, Lannea coromandelica, Vitis peduncularis*); Gastric problem (*Chikrassia tabularis*); Tonsilitis (*Aeschynanthus sikkimensis, Ilex umbellulata*); Sore throat (*Gynocardia odorata, Kaempferia rotunda, Sterculia vilosa*); Cuts & Wounds (*Callicarpa arborea, Chromolaena odorata, Schima wallichii, Tetrameles nudiflora*); Rheumatism (*Oroxylum indicum, Stereospermum colais*); Cough (*Cinnamomum verum*); to stop

vomiting (*Cinnamomum verum*); Malarial fever (*Ficus benjamina, Justicia zeylanica, Picrasma javanica, Vitex peduncularis*); Black water fever (*Vitex peduncularis*); to remove tooth worms (*Solanum khasianum*); Heart disease (*Centella asiatica*); Hypertension (*Clerodendrum colebrookianum*); Venereal disease(*Costus speciosus*); Ring worms (*Cassia alata, Morinda anguistifolia*); Kidney trouble (*Mimosa pudica*); to dissolve stone in gall bladder (*Mimosa pudica*); Renal disorder and genito-urinary problem(*Osbekia rostrata*); to dissolve stone in kidney (*Hedyotis scandens*); Urinary tract infection (*Hedyotis scandens, Pramanthes scandens*); Diabetes (*Mallotus roxburghianus, Mangifera indica, Phyllenthus fraternus*); to remove retained placenta (*Dendrocnide sinuata, Elaeagnus caudata*); Jaundice (*Momordica charantia, Parabarium hookeri, Phyllenthus fraternus, Scoparia dulcis*); Bad sore (*Ostodes paniculata*), Fester (*Lobelia angulata*); Breast cancer (*Aeschynanthus sikkimensis*); Burst inguinal lymphodeuopathy (*Aeschynanthus sikkimensis*).

The analysis of the findings reveals that in cases of many ethomedicinal plants, the uses suggested by the workers from outside Mizoram do not match with the plants used in Mizoram. The ethnomedicinal plants of these categories are : *Adina cordifolia, Ampelocissus latifolia, Artemisia indica, Berginia ciliata, Bidens biternata, Blumea laciniata, Blumea lanceolaria, Cassia alata, Centella asiatica, Chonemorpha fragrans, Chromolaena odorata, Chikrassia tabularis, Cinnamomum bejolghota, Clerodendrum colebrookianum, Costus speciosus, Elaeagnus caudata, Ficus bemjamina, Gmelina arborea, Gynocardia odorata, Hedyotis scandens, Ilex umbellulata, Justicia zeylanica, Kaempferia rotunda, Lindernia ruelloides, Mimosa pudica, Momordica charantia, Morinda anguistifolia, Musseanda roxburghii, Ostodes paniculata, Phyllenthus emblica, Picrasma javanica, Rhus semialata, Schima walichii, Scoparia dulcis, Securinega virosa, Sterculia vilosa, Stereospermum colais* and *Vitex peduncularis.*

The medicinal uses of plants which show similarities fully or partially with the uses reported by the ethnobotanists elsewhere are : *Alstonia scholaris, Callicarpa arborea, Cinnamomum verum, Lannea coromandelica, Lobelia angulata, Mangifera indica, Mikania micrantha, Oroxylum indicum, Phyllenthus fraternus,*

Psidium guajava, Saraca asoca, Solanum khasianum, Solanum nigrum and *Stephania japonica;* whereas twelve plants reported for the first time having ethnomedicinal values are : *Aeschynanthus sikkimensis, Alocasia fornicata, Aporosa octandra, Dysoxylum gobara, Garcinia sopsopia, Jasminum dispermum, Lindernia ruelloides, Mallotus roxburghianus, Osbekia rostrata, Parabarium hookeri, Pramanthes scandens* and *Tetrameles nudiflora.*

Ethnomedicinal survey clearly indicates pharmaceutical potential of plant species collected from the Tropical and Sub-tropical Semi-evergreen Forest.

The *in-situ* and *ex-situ* conservation along with judicious exploitation of wild ethnobiomedical reserve is the need of the day. The conservation of ethno-biomedicinal reserve, specially, hot spots like Ralvawng, Chawnhu, Khawbung and Sihphir Reserve forests of study area are essential to save the genetic resources. This needs designing of suitable conservation strategies to pave the ecological sustainability of local ethnic groups.

Table 1: Plant species having ethnomedicinal importance

Sl. No.	Plant species	Local name	Family	Locality	Altitude (m)	Uses	Part used	Preperation	Soil character			
									pH	OC %	P (kg/ha)	K (kg/ha)
1	Adina cordifolia	Lungkhup	Rubiaceae	Ralvawng	1070	Stomach ulcer	Bark	Crushed & boiled	6	2.1	2.11	102
2	Aeschynanthus sikkimensis	Bawltehlantai	Gesnariaceae	Bualte	1240	Breast cancer	Root	Crushed & boiled		Epiphyte		
3	Alocasia fornicata	Baibing	Araceae	Lengpui	543	Snake bite	Whole	Juice	5.5	0.62	0.56	114
4	Alstonia scholaris	Thuamriat	Apocynaceae	Darlung	943	Typhoid	Bark	Decoction	5.5	1.6	12.76	72
5	Ampelocissus latifolia	Hruipawl	Vitaceae	Chawnhu	1060	Tooth ache	Whole	Chewed raw	5.5	0.88	0.56	88
6	Aporosa octandra	Chhawntual	Euphorbiaceae	Chawnhu	1060	Stomach ulcer	Bark	Decoction	5.9	1.6	7.24	90
7	Artemisia indica	Sai	Asteraceae	Khawbung	1200	Stomach ulcer	Leaf	Decoction	4.3	0.88	13.32	81
8	Berginia ciliata	Khamdamdawi	Saxifragaceae	Farkawn	1310	Diarrhoea & dysentery	Stem	Powdered	4.5	0.68	0.98	17
9	Bidens biternata	Chabet	Asteraceae	Ratu	1270	Rheumatism	Stem	Chewed	5.67	1.2	0.87	98
10	Blumea laciniata	Khuanglawi	Asteraceae	Lengpui	543	Snake bite	Root	Paste	5.5	0.88	26	121
11	Blumea lanceolaria	Buarze	Asteraceae	Serchhip	1281	Stomach ache	Leaf	Chewed raw	6.01	1.1	2.22	99
12	Callicarpa arborea	Hnahkiah	Verbenaceae	Darlawn	1256	Cuts & Wounds	Bark	Juice	5.56	0.76	1.67	105
13	Cassia alata	Tuihlo	Caesalpiniaceae	Lawngtlai	847	Ring worms	Leaf	Crushed & paste	5.5	0.62	0.56	114
14	Centella asiatica	Lambak	Apiaceae	Lungdai	1300	Heart disease	Whole	Boiled or fried	5.5	1.02	0.65	72
15	Chonemorpha fragrans	Theikelki suak	Apocynaceae	Ralvawng	1070	Stomach ulcer	Root	Decoction	5.6	0.65	6.58	121
16	Chromoleana odorata	Tlangsam	Asteraceae	Khawbung	1200	Cuts & Wounds	Leaf	Crushed & paste	5.6	0.93	12	90
17	Chikrassia tabularis	Zawngtei	Meliaceae	Bualte	1240	Diarrhoea & gastritis	Bark	Decoction	6	1.43	123	202
18	Cinnamomum bejolghota	Thakthingsuak	Lauraceae	Sihphir	1300	Liver disorder	Bark	Decoction	5.4	1.62	0.62	90
19	Cinnamomum verum	Thakthing	Lauraceae	Sihphir	1300	Cough & Vomiting	Leaf	Infusion	4.5	0.63	1.62	78
20	Clerodendrum colebrookianum	Phuihnam	Verbenaceae	Bukpui	920	Hypertension	Leaf	Infusion	5.5	0.82	0.67	62
21	Costus speciosus	Sumbul	Costaceae	Sihphir	1300	Venereal disease	Rhizomes	Crushed & paste	5.4	0.86	1.83	82
22	Dendrocnide sinuata	Thakpui	Urticaceae	Tamdil	900	Retain placenta	Root	Powdered	5.4	1.24	13.02	112
23	Diospyros variegata	Raisentur	Ebenaceae	Lungrang	749	Diarrhoea & dysentery	Root	Powdered	5.2	0.92	3.33	150
24	Dysoxylum gobara	Thingthupui	Meliaceae	Kawnpui	930	Stomach problem	Leaf	Infusion	6.1	1.23	56	110
25	Elaeagnus caudata	Sarzuk	Eleagnaceae	Chaltlang	1231	Retain placenta	Leaf	Infusion	5.5	1.52	0.63	67
26	Engelhardtia spicata	Hnum	Juglandaceae	Vangtlang	1620	Diarrhoea & dysentery	Bark	Decoction	5	0.62	5.17	99
27	Ficus benjamina	Zamanhmawng	Moraceae	Lungsen	854	Malarial fever	Bark	Decoction	5.1	1.6	5.12	162
28	Garcinia sopsopia	Vawmva	Clusiaceae	Rawpuichhip	867	Snake bite	Bark	Powdered	5.5	0.66	6.2	82
29	Gmelina arborea	Thlanvawng	Verbenaceae	Hmunpui	555	Blood disease	Root	Paste	5.6	0.65	1.37	97
30	Gynocardia odorata	Saithei	Floacourtiaceae	Sairep	1556	Sore throat	Bark	Paste & Decoction	6.5	1.6	56	114
31	Hedyotis scandens	Kelhnamtur	Rubiaceae	Khawbung	1200	Urinary tract infection	Leaf	Decoction	4.9	0.88	12.21	261
32	Ilex umbellulata	Thinguihahni	Aquifoliaceae	Ralvawng	1070	Tonsilitis	Bark	Decoction	5.2	1.6	0.56	81
33	Jusminum dispernum	Hrui damdawi	Oleaceae	Chawnhu	1060	Diarrhoea & dysentery	Leaf	Juice	5.6	0.65	9	98
34	Justicia zeylanica	Kawldai	Acanthaceae	Sihphir	1300	Malarial fever	Leaf	Boiled	5.6	1.22	25	123

Sl. No.	Plant species	Local name	Family	Locality	Altitude (m)	Uses	Part used	Preperation	Soil character			
									pH	OC %	P (kg/ha)	K (kg/ha)
35	Kaempferia rotunda	Tuktin par	Zingiberaceae	Chaltlang	1231	Sore throat	Root	Paste & Decoction	5.6	1.64	2.64	78
36	Lannea coromandelica	Tawitawsuak	Ancardiaceae	Ralvawng	1070	Stomach disorder	Bark	Decoction	5	1.62	0.76	112
37	Lindernia ruelloides	Thasuih	Scrophulariaceae	Changte	683	Cramp	Whole	Paste	5	0.62	0.56	62
38	Lobelia angulata	Choakathi	Lobeliaceae	Ratu	1270	Fester	Whole	Juice	5.6	0.92	1.35	76
39	Mallotus roxburghianus	Zawngtenawhlung	Euphorbiaceae	Sihphir	1300	Diabetes,hypertension	Leaf	Decoction	5.5	0.66	13.25	122
40	Mangifera indica	Theihai	Anacardiaceae	Lungsen	854	Diabetes & diarrhoea	Leaf	Decoction	5.6	1.26	98	223
41	Mikania micrantha	Japan hlo	Asteraceae	Dungtlang	1520	Diarrhoea & dysentery	Leaf	Decoction	5.6	1.62	13	122
42	Mimosa pudica	Hlonuar	Mimosaceae	Sairang	457	Kidney problem	Root	Infusion	5	0.56	1.62	201
43	Momordica charantia	Changkhate	Cucurbitaceae	Phullen	1100	Jaundice	Leaf	Boiled	5.6	1.62	17	121
44	Morinda anguistifolia	Lum	Rubiaceae	Lungrang	749	Stomach ulcer	Bark	Decoction	4.5	0.88	14.4	73
45	Musseanda roxburghii	Vakeb	Rubiaceae	Zemabawk	1220	Snake bite	Leaf	Paste	5.6	1.23	22	143
46	Oroxylum indicum	Archangkawm	Bignoniaceae	Hmunpui	555	Rheumatism	Bark	Paste	5	0.62	0.56	69
47	Osbekia rostrata	Builukhampa	Melastomaceae	Samthang	1230	Genito-urinary problem	Root	Decoction	5.5	1.22	17	99
48	Ostodes paniculata	Beltur	Euphorbiaceae	Phullen	1100	Bad sore	Bark	Crushed	5.6	1.59	0.56	106
49	Parabarium hookeri	Theikelki	Apocynaceae	Ralvawng	1070	Jaundice	Bark	Decoction	5.5	1.62	0.56	22
50	Phyllanthus emblica	Sunhlu	Euphorbiaceae	Phullen	1100	Tetanus	Bark	Crushed taken raw	5.7	1.23	2.01	68
51	Phyllanthus fraternus	Mitthi sunhlu	Euphorbiaceae	Farkawn	1310	Diabetes & Jaundice	Whole	Crushed juice	4.5	1.59	0.55	106
52	Picrasma javanica	Thingdamdawi	Simaroubaceae	Zotlang	1228	Malaria	Bark	Decoction	5.6	0.66	2.2	54
53	Pramanthes scandens	Kawlhlo	Asteraceae	Khawbung	1200	Urinary tract infection	Leaf	Dried crushed	5.1	0.87	9.28	201
54	Pseudodrynaria coronans	Awmvel	Polypodiaceae	Ralvawng	1070	Herpes zoaster	Stem	Crushed	Epiphyte			
55	Psidium guajava	Kawlthei	Myrtaceae	Lengpui	543	Diarrhoea & dysentery	Leaf	Juice	5.7	2.11	12	123
56	Rhus semialata	Khawmhma	Anacardiaceae	Darlawn	1256	Diarrhoea	Fruit	Grined	6.5	0.96	1.38	120
57	Saraca asoca	Mualhawih	Caesalpiniaceae	Hmunpui	555	Stomach ulcer	Bark	Decoction	5	0.66	22	54
58	Schima wallichii	Khiang	Theaceae	Vangtlang	1620	Cuts & wounds	Bark	Crushed	5.5	1.35	1.22	121
59	Scoparia dulcis	Perhpawngchaw	Scophulariaceae	Dungtlang	1520	Jaundice	Whole	Juice	6.5	1.23	12	133
60	Securinega virosa	Saisiak	Euphorbiaceae	Zemabawk	1220	Measles & Scabies	Leaf	Decoction	5.5	1.66	12	156
61	Solanum khasianum	Rulpuk	Solanaceae	Zemabawk	1220	Remove tooth worms	Fruit	Burnt fume	5.4	0.7	1.76	109
62	Solanum nigrum	Anhling	Solanaceae	Sairang	457	Stomach ulcer	Leaf	Infusion	5.6	1.22	17	121
63	Stephania japonica	Hnahbial	Menispermaceae	Farkawn	1310	Diarrhoea	Root	Boiled water	5.5	0.66	0.56	72
64	Sterculia villosa	Khaupui	Sterculiaceae	Hmunpui	555	Throat problem	Bark	Boiled water girgle	5.5	0.72	72	102
65	Stereospermum colais	Zinghal	Bignoniaceae	Rualalung	678	Rheumatism&scabies	Bark	Decoction	5.5	0.82	1.23	201
66	Tetrameles nudiflora	Thingdawl	Tetramelaceae	Rawpuichhip	560	Cuts & wounds	Bark	Milky sap	5.6	0.66	21	108
67	Vitex peduncularis	Thingkhawilu	Verbenaceae	Chawnhu	1060	Malaria & Black fever	Bark	Decoction	5.6	1.6	0.56	72
68	Vitis peduncularis	Pasaltakaza	Verbenaceae	Chawnhu	1060	Stomach problem	Bark	Decoction	5	0.5	5.2	270

Table 2 : Candidate plant species (having pharmaceutical potential) suitable for chemical analysis to identify the active compound.

Sl.No.	Botanical name	Local name	Family	Uses
1.	* *Aeschynanthus sikkimensis* Stampf. syn. *A. maculata* Cl.	Bawltehlantai	Gesneriaceae	Flower chewed raw for tonsilitis. Decoction of fleshy root bulb against burst inguinal lymphodeuopathy and breast cancer.
2.	**Alocasia fornicata*(Roxb.)Schott.	Baibing	Araceae	Juice is applied on snake bite.
3.	**Aporosa octadra* (Buch.- Ham. ex D.Don) Vick. syn.*A.dioica* (Roxb.) Muell.- Arg. *A.roxburghii* Baill.	Chhawntual	Euphobiaceae	Decoction of brak for stomachache.
4.	*Blumea laciniata* (Roxb.) DC	Khuanglawi	Asteraceae	Roots are used in snakr bite
5.	*Blumea lanceolaria* (Roxb.) syn. *Gynura conyza* Sp.	Buarze	Asteraceae	Decoction of leaf for stomachache and chronic ulcer.
6.	**Dysoxylum gobara*(Buch.-Ham)	Thingthupui	Ebenaceae	Decoction of leaves for diarrhoea & dysentery.
7.	*Engelhardtia spicata* Lescheni. ex Blume.syn.*E.colebrookianam* Lindl. ex Wall.	Hnum	Juglandaceae	Decoction of bark for diarrhoea & dysentery. Juice of root is used for scabies.
8.	* *Garcinia sopsopia* Mabb.	Vawmva	Clusiaceae	Bark made into powder is used in snake bite.
9.	*Hedyotis scandens* Roxb. *Oldenlandia scandens* K.Schum.	Kel hnamtur	Rubiaceae	Decotion of leaf for urinary tract infection. Root colic and for rheumatism.

Sl. No.	Botanical name	Local name	Family	Uses
10.	**Jusminum dispermum* Lour.	Hrui damdawi	Oleaceae	Leaf juice is taken for diarrhoea and dysentery.
11.	**Lindernia ruelloides* (Colsm.) Mukherjee.syn. *Bonnya reptans* Spreng.*Ilysanthes reptans* Urban.	Thasuih	Scrophulariaceae	Whole plant crushed is used externally for cramp.
12.	**Mallotus roxburghianus* Muell. Arg.	Zawngtenawhlung	Euphorbiaceae	Decoction of leaves is used against diabetes. Infusion of bark is good for hypertension.
13.	**Osbekia rostrata* D.Don.	Builukhampa	Melastomaceae	Root extract is used for renal and genito-urinary disorder.
14.	**Parabarium hookeri* Pierre. syn. *P.micranthum* (DC.) Pierre ex Spire.	Theikelki	Apocynaceae	Decoction of bark is used against jaundice. Latex is applied to wounds.
15.	**Pramanthes scandens* Lour.	Kawlhlo	Asteraceae	Dried leaves taken with water for urinary tract infection
16.	*Solanum khasianum* Cl.	Rulpuk	Solanaceae	Smoke of burnt fruits or seeds is used for removing tooth worms from the mouth.
17.	**Trameles nudiflora* R.Br.	Thingdawl	Tetramelaceae	Sap is used externally for cuts and wounds.
18.	*Vitex peduncularis* Wall.	Thingkhawilu	Verbenaceae	Decoction of bark and leaves is used for pneumonia black water fever.

* Medicinal Plants reported for the first time in respect to their uses

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STUDY OF MEDICINAL PLANTS IN TROPICAL AND SUB – TROPICAL SEMI – EVERGREEN FOREST OF MIZORAM

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submitted
in partial fulfillment of the requirement of the Degree of Doctor of Philosophy in Forestry of North Eastern Hill University, Shillong.

The North - Eastern Hill University
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I, Lalnundanga, hereby declare that the subject matter of this Thesis is the record of work done by me, that the contents of this Thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the Thesis has not been submitted by me for any research degree in any other University/ Institute.

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Above all, I thank the Almighty God, without Him, man is meaningless.

4th August 2000.

(LALNUNDANGA)

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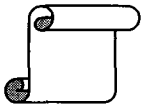
LIST OF ABBREVIATIONS USED

Anon.	:	Anonymous
auct. non	:	*auctorum nonnulorum* : of some authors
BC	:	Before Christ
° C	:	degree Celcius
cm.	:	*centemeterum* : centimetre
E	:	East
Ed; ed(s).	:	Edition; editor(s) or edited
et al.	:	*et alii* : and others
etc.	:	*et ceteri* or *cetera* : and the others
ex	:	published by
ex auct.	:	*ex autoribus* : according to authors
ex-situ	:	in an artificial condition
f	:	*fide* : according to
		filius : son
g / gms.	:	gram (s)
in-situ	:	in natural condition
m	:	*metrum* : metre
mm.	:	*millimetrum* : millimetre
ml	:	millilitre
N	:	North
no.	:	*numero* : number
p., pp.	:	*pegina* : page, pages
ser.	:	*sercis* : series
sp., spp	:	species (singular); species (plural)
Syn.	:	*synonymy* : synonym

CHAPTER 1  INTRODUCTION

INTRODUCTION

Man's dependence on plant species dates back to the beginning of the human race. In the early days he had limited needs. But with the advancement of civilization his requirements also grew and the people of each ethnic groups developed their own culture, customs, religious rites, legends and myths, taboos, foods and even medicinal practices.

The term 'ethnic' has been described as a race or racial group having similarities in their cultural traditions. The various wild plants as well as cultivated plants play an important role in the lives of ethnic races throughout the world. The people of each ethnic group had distinct bank of knowledge on the use of plants and their properties.

1.1 ETHNOBOTANY :

Ethnobotany is an offshoot of botany that deals with how plants are used by the ethnic people. The term ethnobotany deals with " the study of plants used by primitive and aboriginal people" (Anonymous 1895; Harshberger 1896). Prior to him, Powers (1873 – 1875) used the word 'aboriginals botany' to denote " all forms of the vegetative world which the aboriginal used for medicine, food, cloth etc." Different definitions and explanations of the term " Ethnobotany " are given by various workers. A few worth mentioning are : the study of the relations which exist between human and their ambient vegetation (Gilmour 1932; Castetter 1944); the interrelations between the culture and the plant its uses (Jones 1941); the study of the direct relationship between humans and plants (Ford 1978); the study of plants by

humans including the plants used as food, medicine, building material and for any other economic applications (Farnsworth 1994); the study of the uses of plants in primitive societies in both modern and ancient time encompassing the study of uses, technological manipulation, classification, indigenous nomenclature, agriculture systems, magico-religious concepts, conservation techniques and general sociological importance to the flora in primitive pre-literate societies (Schultes 1992); and the total direct relationship between human and plants (Jain 1994).

The use of the word ' primitive ' is not acceptable by many ethnobotanists of the world. Balee comment on paper of Schultes 1994 suggests that " we could more broadly define ethnobotany as the total relationship between people and plants. It need not be, for example, non-literate societies only that have ethnobotanical systems. What about Chinese ethnomedicinal system, Ayurvedic ethnobotany in India or Mayan ethnobotany, all of which are based on literate traditions ? ". Jain (1994) has suggested to remove the word ' primitive' from the definitions of ethnobotany.

The use of plants as medicine for human beings as well as animals in India dates back to the pre – Vedic age. The indigenous system of medicine from the Vedic ages has been an integral part of Indian culture. Written records of the use of plants for curing human or animal diseases in India can be traced back to as early as 4500 – 1600 BC and is believed to be as ancient as the scripture of the Hindus, the *Rigveda* (Jain 1994). Ayurveda, the indigenous system of medicine which dates back to the Vedic ages (1500 – 800 BC), has been an integral part of the Indian culture (Wiess 1987). The Vedic Aryans were familiar with medicinal plants. Several plants are described in *Atharva Veda.* This was followed by monumental

ancient treatise on the subject, like *Charak Samhita* (1000 – 800 BC); *Sushrut Samhita* (800 – 700 BC); The Unani system which originated in Greece in about 400 BC; The Siddha system, with a recorded history from about 2000 BC. The test of each system deals with uses of plants .

The tobacco plant was rolled and smoked by the native Cuban people which was previously unknown to the Europeans (Cotton 1996). Columbus Christopher collected *Zea mays* L. (1742), *Pimenta dioica* and *Gossipium arborium*, all of which were collected on the basis of observation of local use (Simpton & Conner – Ogorzaly 1986 : In Cotton 1996). Captain Cook in 1770 also brought the Australian aboriginal plant used by the *Australia aborigines* (Fitzgerald 1982). The use of plant pigments in dyeing textiles or fabrics dates back to the Pre-dynastic period of ancient Egypt in 500 – 3150 BC (Hall 1986).

The new era of ethnobotanical studies began to flourish in the 1900's. David Barrows was first awarded a Ph. D. degree in ethnobotany in 1900 (Ford 1986). Prof. Edward F. Castetter introduced a master degree programme in ethnobotany at the University of New Mexico in 1930, and expanded the study to include animals in the field of ethnobiology (Castetter 1944). Dr. Melvin R. Gilmour founded Ethnobotanical Laboratory in the University of Michigan Museum of Anthropology in 1930 to primarily study plants remain of archeological sites (Ford 1986). The Havard University of Botanical Museum has trained intellectual leaders in the field of ethnobotany during 1930's and 1940's. Since then, ethnobotanical data were rapidly accumulated, and by the 1980's it became widely recognised in U.S.A. The American contingent certainly marks a significant point in the evolution of

ethnobotanical study and the beginning of interest in indigenous plant use (Cotton 1996).

The South – west (USA) is the best studied area in the world for ethnobotany (Ford 1986). The American – based Society of Ethnobiology was founded with the publication of *Journal of Ethnobiology* in 1981, while in Europe, *Journal of Ethnopharmacology* (bioscientific evaluation of indigenous drugs) was published. In India a Society of Ethnobotanists was founded in 1981 with the publication of *Journal of Ethnobotany*. Recently, an Institute of Ethnobiology was established in 1995 in India at the National Botanical Research Institute, Lucknow.

Prance (1994) opined that ethnobotany is a changing science and it is appropriate to consider where we are today. Post-graduate and under-graduate programmes in ethnobotany became increasingly available and many projects focused on the practical applicability in traditional botanical knowledge. The publications in ethnobotany in between 1990 and 1994 was almost doubled compared with the previous five years (Cotton 1996). By 1995, as many as 420 research papers and 14 books on ethnobotany had been published from India covering ethnobotanical investigation of about 250 ethnic groups (Rao 1996). Recently, ethnobotany has been amplified as an interdisciplinary science including ethnopharmocology, ethnoorthopedics, ethnoveterinary, ethnomusicology etc. and the sub-disciplines such as ethnocology, ethnotaxonomy, ethnomedicobotany, paleo-ethnobotany etc. More recently, ethnobotany has been expanded and diversified into a multidisciplinary field of ethnoscience including anthropology, chemistry, phytochemistry, pharmacology, ecology, economic botany, conservation biology, biodiversity prospecting etc.

The international network data established in 1975 at the University of Illinois, Chicago (USA) is known as NAPRALERT – Natural Product Alert contains more than 1,10,000 scientific articles of 4,700 species of organisms including 27,000 species of higher plants, of which about 9,000 have ethnomedical literature associated with them. A more or less similar data bank was established in 1980's known as TRAMIL – Traditional Medicines in the Islands to document medicinal herbs in the Caribeans to develop and improve health care in the region. The MEDFLOR – Medicinal Flora data- base dedicated to ethnobiological data was also established in the University of Illinois at Chicago (Farnsworth 1994).

The influence of modern civilization made most of the primitive societies to break away from many of their cultural and traditional beliefs and practices. This has made people ignorant and incapable of recognising and making use of the economical plants which are within easy reach and at their disposal. Lalnundanga & Jha (2000) have stated

- "Ethnobotanical works" help in the search of plants which are used by local people as folk medicine. This information act as useful indicator of biologically active substance of a pharmaceutical potential species. This has generated interest of pharmaceuticals and medical world in folklore medicine and
- Vital importance of conservation of culture as well as biodiversity. Ethnobotany plays an important role in maintaining cultural identity.

1.2 ETHNOMEDICINE :

Ethnomedicine is a component of Ethnobotany which refers to the use of plants by humans as medicine.

Health and disease are coeval with life. As indicated by Rubin (1960) "by necessity man has undoubtedly always been concerned with the question of health and survival and has sought within the framework of his knowledge, solutions to problems of illness ". Human beings everywhere, at all times and places had to deal with the threat of disease and illness. People generally tended to look into the health problems from the perspective of their own societal structure, societal frame and cultural backgrounds. Health and diseases are parameters of the effectiveness with which human groups adapt to their environments. The groups utilized the biological and socio-cultural resources in their own way to develop fitness to resist environmental threats and dangers emanating from known and unknown forces and to strengthening role in research (Raghunathan 1995).

It is assumed that about 80 % of the 5200 million people of the world live in less developed countries. The World Health Organization estimates that about 80 % of these people rely almost exclusively on traditional medicine for their primary health–care. Since medicinal plants are the ' backbone ' of traditional medicine, this means that more than 3300 million people in the less developed countries utilised medicinal plants on a regular basis (Farnsworth 1994).

1.2.1 Quantification and credibility of ethnomedicine :

Prescriptions in folk medicines are usually and obviously based on the individual's personal experience with patients. In the modern sense there seems little scientific or experimental basis to these claims. The use of plant

for the same purpose in several societies or region has been taken as one criterion for greater credibility (Saklani 1992, Saklani & Jain 1992). Johns *et al* (1990) and Phillips and Gentry (1993) suggested statistical methods for the quantification of consensus on such remedies.

1.2.2 **Biological screening and approach to drug discovery :**

Different workers abroad and in India have been conducting ethnomedicinal researches so that the slowly disappearing knowledge of the tribal people would not completely die down. They have been trying to preserve the knowledge of the medicinal plants so that it could be used to help in the search for new medicines in the modern world. Thus screening of plants ascertain their uses, bioassays of screened plants to know pharmaceutical potential of a species i.e. search of biologically active substance is essential to discovery of a drug (Lalnundanga & Jha 2000).

Screening plants for biological activity was initiated about 25 years ago, mainly at the CDRI, Lucknow. Initially, any plant material was tested, but with the accumulation of more data on ethnomedicobotany in the last 15 years, screening has been directed towards ethnomedicinal plants (Jain1994). Some 3500 plant samples have been tested and the results published in a series of papers (Dar *et al* 1968 – 1990).

The ethnobotanical leads have resulted in three different types of drug discovery : 1) Unmodified natural plant products where ethnomedicinal use suggested clinical efficacy; 2) Unmodified natural products of which the therapeutic efficacy was only remotely suggested by indigenous plant use; and

3) modified natural or synthetic substances based on a natural product used in folk medicine (Cox 1994).

1.2.3 **Scope of ethnomedicinal research :**

Professor R.E. Schultes once stated " the Indian sub-continent represents one of the greatest emporia of ethnomedicinal wealth ". The richness is due to great ethnic diversity, phytogeographical variation and rich flora. The considerable part of indigenous knowledge is already documented, some of it has been subjected to modern evaluation. Data on over 2500 plants were extracted from nearly 400 publications (Jain 1991). With advances in experimental methods in phytochemistry and pharmacology, in the course of time, several of the folk medicines were tested for active principles and biological activity; the successful ones were added to Indian pharmacopoeias (Jain 1994). Jain and De Fillips (1991) reviewed some of the significant work. Yet much of this knowledge existed only in folk traditions.

The northeastern region is one of the richest biodiversity zone in the Indian sub-continent with high endemism. It is a rich region of ethnobiocultures. The actual forest cover is also high despite the on-going practice of ethnoagriculture. The unique richness of ethno-culturo-biodiversity is a great challenge to the scientist to explore the region (Lalramnghinglova 2000).

The diverse ethnic communities with their traditional cultures are often exploited and are gradually losing their knowledge of plants having medicinal properties; there is an urgent need to record as much information about them and to study their properties and implications. For this purpose ethnobiologists have great

responsibilities, they need not only inventorise these medicinal plants but help conserve and revitalise the traditional culture and beliefs and also safeguard this knowledge from being misused by the modern societies. Thus, the task of finding out and recording the medicinal plants, conducting research on them and helping to conserve them so that they would not completely disappear, lies with the ethnobotanist of the north eastern states.

The state of Mizoram receives little attention so far as the survey of medicinal plant is concerned. The ethnomedicinal knowledge of the tribes of Mizoram has been descending through generations since time immemorial; Lalramnghinglova & Jha (1997), Lalramnghinglova (1999) and Lalramnghinglova & Jha (1999) have conducted ethnobotanical survey of Mizoram. Nevertheless, no effort has been made on the survey of medicinal plants of Tropical and Sub-tropical Semi-evergreen Forest of Mizoram. There is, therefore, a need for documentation of medicinal plants of Tropical and Sub-tropical Semi-evergreen Forest for the purpose of conservation, education and research in the development of new drugs.

The present study is designed with the following objectives:

- Collection, identification and documentation of plants of medicinal value. To keep voucher specimens in the herbarium for future reference.
- Recording of phenology, growth behaviour, silvicultural character, associates, altitude and analysis of soil samples to know the site condition.

- Delineation on the maps to show the actual place of availability of the plant (*in situ* condition).
- Screening of medicinal plants for phytochemical analysis, and
- Phytochemical analysis of few important medicinal plants.

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CHAPTER 2 REVIEW OF LITERATURE

REVIEW OF LITERATURE

2.1 AN OVERVIEW :

Mankind, since the earliest civilization, has used plant species to produce medicine, essential oil, insecticides and so on. As the modern civilization has now spread to most regions of the world, it has made most of the primitive societies to break away from many of their cultural and traditional beliefs and practices. This divorcement from culture and tradition brought about a slow disintegration in the knowledge of plants and their properties. This slow but steady decline has made most people ignorant and incapable of recognising and making use of the various medicinal plants which are easily accessible to them.

The diverse ethnic communities with their traditional cultures are often exploited, making them gradually lose their knowledge and information about their own traditional cultures in the modern world. Because of this, they are unable to use many of their forest resources. And so, before these people completely lose their knowledge of plants having medicinal properties, there is an urgent need to record as much information about them and to study their properties and implications.

Ethnobotanical investigations on medicinal plants used by ethnobotanically rich human societies have been carried out and documented for future researches and use. In some region, it has been found that inspite of modernisation and the deteriorating tradition and culture, much of the ethnobotanical knowledge has survived. It has also been discovered that medicinal plants hold much importance among some of the tribal and even modernised people of certain regions of the world. Some of the ethnobotanical survey has also revealed that some

prescriptions are still very much in use to treat common ailments and preferred by the majority of the masses over generations in some regions. Through the ethnobotanical surveys, many of the medicinal plants have been recorded, analysed and preserved for posterity.

The ethnobotanists have been trying to preserve the use of medicinal plants by various ethnic groups so that the information could be passed on to the modern world and be applied by the modern man in treating different diseases in a more modernised way in the form of medicines etc.

The medicinal plants continue to receive attention of scientists from chemical, pharmacological and clinical angles in India and abroad. The studies on folk medicines through ethnobotanical survey are gaining importance. In discussing the role of ethnobotany in our search for new drug plants, we must constantly bear in mind the widespread exaggeration of the usefulness of ethnobotanical data. Nevertheless, we cannot afford to pre-judge reports of aboriginal uses of plants simply because they seem to fall beyond our limits of credence. Since primitive man does have some knowledge as yet unknown to us, there is no reason to suppose that man in primitive society possesses nothing more than a very limited intuition about the properties of plants. It, therefore, behoves us to push forward, along with ethnobotanical investigation, studies on the flora in general (Schultes 1962; Lalramnghinglova & Jha 1999).

Systematic study about the knowledge gained by various ethnic group from their ancestors in regard to plants used in foods, medicine, clothing, or religious rituals, are covered under ethnobotany. The work so far undertaken in the field of medicinal plants under ethnobotanical researches by different workers to acquaint the

modern world as well as local communities in an attempt to preserve and document vanishing knowledge and to introduce the use of medicinal plants abroad and in India are reviewed here.

2.2. ABROAD :

2.2.1. Ethnomedicinal:

Ethnobotanical investigations on medicinal plants in ethnobotanically rich human societies have been undertaken by various ethnobotanist abroad. A few significant contributions are mentioned below.

The evolution of the modern approach to the science of ethnobotany started in the United States, and the foremost center is the Botanical Museum of Harvard University in Massachusetts. Ethnobotanists such as E.Wade Davis, Richard GordenWasson, Rachard Evans Schultes, Sir Von Reis Altschul, Timothy Plowman, and others have contributed in various fields of ethnobotany from this centre (Jha & Lalnundanga 1998). The best studied area for this purposes is the South-West of the United States of America (Ford 1985).

El Rayah (1993) documented a brief account of herbal medicines prescribed for various ailments in Sudan.

Barrett (1994) has investigated 152 plants used by the people of Nicaragua's Atlantic Coast for the treatment of various diseases. The diversity and prevalence of medicinal plant used for this region has been reported for the first time.

The traditional and modern uses of 48 native plants which grow in the First Yukon region, Alaska, have been documented and the medicinal and edible material used by the Guich in Athabaskan and Caucasian residents have been

identified. The present and past values of these plants in Guich's culture are discussed (Holloway & Alexander 1990). George (1995) has reported pharmacopoeia of 108 medicinal species from 52 families. Fifty per cent of the pharmacopoeia is composed of species indigenous to Tonga, 30 per cent are species introduced by Polynesian settlers, and 20 per cent are species of post-European introduction.

The medicinal uses of 121 species which grow in the Akha tribes zone of Thailand have been documented by the Anderson (1985). Cunningham (1993) studied African medicinal plants with emphasis on conservation and primary health care. Ethnobotanical information on 52 medicinal plants used in traditional medicine of Bahrain is reported by Abbas *et al* (1992). Capitanio *et al* (1989) have reported 100 anti-leucodermic traditional herbal medicines consisting of 80 medicinal plant species being employed by Caucasians in the Mediterranean area. The possibility of the recorded plant species in stimulating physiological skin pigmentation is described in the light of present phytochemical and pharmacological knowledge. Ethnobotanic information on 52 plants species of Sengkurong and 29 plant species of Bukit Udal of Darrussalam were given by Haji Mohiddin *et al* (1991) and Holdsworth (1991), respectively.

Joshi and Edington (1990) reported medicinal plants of Central Region of Nepal. Ethnobotanical observation on 7 plant species from Tharu tribe of Chitwan District, and 86 plant species from Makawanpur District of Nepal were reported by Dangol and Gurung (1991) and Bhattarai (1990), respectively.

Huyin *et al* (1998) have reported that *Baphicacanthus cusia* plays a very important role in the traditional life of the Hani and other ethnic groups in Jinpin

country, Yunnan province. Indigo obtained from aerial parts is used to dye their traditional clothes, and the roots and leaves are used as medicine.

Youngken *et al* (1970) documented plants for antimalarial activity. Ethnobotanical studies from Central Nigeria includes 52 plant species having ethnobotanical importance (Bhat *et al* 1990).

Halbarstein and Saunders (1978) have reported traditional medicinal practices and medicinal plant usage on a Bahamian Island. Weniger *et al* (1986) have documented popular medicinal plants of the Central Plateau of Haiti. The Iranian plants having saponins, alkaloids, flavonoids and tannins were recorded by Aynehchi *et al* (1985). The ethnomedicinal plants from Garifuna of Eastern Nicaragua is reported by Coce and Anderson (1996). The folk herbal medicine used by Fiji Indians is documented by Singh (1986).

Caceres *et al* (1990) have screened 84 plants which is used to cure gastrointestinal disorders caused by Enterobacteria in Guatemala.Giron *et al* (1991) have reported medicinal flora used by the Caribs of Guatemala.The 16-ethnomedicinal plants used by the people of Guatemala against Gram-Positive Bacteria (causing agent of respiratory diseases) were evaluated by Caceres *et al* (1993).

It appears from the above referred contributions that ethnomedicinal investigations abroad have been undertaken in ethnobotanically rich human societies. Some other important contributions also may be mentioned, such as, Ethnobotany of the Island Caribs of Dominica (Hodge & Taylor 1956). Medicinal plants of Samoa (George 1974), Colombia (Gonzalvez 1980), Sudan (Ahmed 1970), Turkey (Sezik *et al* 1992), Western Washington (Gunther 1945), herbal folk medicine in

North-western Argentina (Gbati 1983), medicinal plants of Rarotonga, Cook Island (Holdsworth 1991), medicinal plants to cure Hepatitis in Taiwan (Lin & Kan 1990); Iranian plants for antimicrobial activity (Aynehchi *et al* 1982); phytomedicine of the Madang Province, Papua New Guinea (Holdsworth 1984), Herbal medicine in the Cook Islands (Whistler 1985), plants with antifertility properties in the South America (Gonzalez & Silva 1987); plants to cure leprosy in Africa (Nwude & Ebong 1980); *Terminalia catappa* preparations and cure Bronchial Asthma (Prazeres 1995) medicinal plants of Seberida Ria province, Sumatra and Indonesia (Mahyar *et al* 1991) and traditional Amazonia Nerve tonics (Elisabetsky *et al* 1992).

2.2.2. **Ethno-Phytochemical :**

The phytochemical analysis of ethnomedicinal plants to see their physiological effectiveness is the need of the day. This analysis may result in the discovery of new chemical compounds and drugs for modern medicine. There is a vast emporium of unknown chemical compound awaiting discovery from the flora which is yet to be studied. A few significant contribution on phytochemical analysis of medicinal plants are antibacterial substance in seed plants against *Tubercle bacilli* (Gottshale *et al* 1950); constituents from Muira-Puama : the roots of *Ptychopetalum olacoides* (Ito *et al* 1995); antifungal properties of the leaf oils (Zygadlo *et al* 1994); antifungal activity of dihydrodiosocrine extracts from *Dioscorea bulbifera* (Adeleye & Ikotum 1989), antiasthmatic effect of onion extracts (Dorsch *et al* 1985); antiasthmatic principles of *Allium cepa* (Wagner *et al* 1988); phytochemical analysis of *Aloe vera* (Rowe & Parks 1941), screening of antiradical,

antilipoperoxidant and hepatoprotective effects of plants extract (Joyeur *et al* 1995); identification of Melatonin and its effect on plasma melatonin levels (Hattori 1995); screening of Diphenylamine (Karawva 1986); determination of 1, 8-dihydroxyanthracine derivatives in vegetable drugs (Zwaving & Elama 1976); biologically active substance of *Allium* species (Pobozsny *et al* 1979; Wagner *et al* 1988). Herz *et al* (1981) have reported presence of Damsinic acid and Ambrosonolids from *Ambrosic hispida.* Quantitative analysis of Garlic essential oil (Bekdairava & Klysher 1982). Oxalate content of some leafy vegetables (Gad *et al* 1982). Haq and Hannan (1981) analysed leaves of *Aloe vera* and reported presence of Glucogalacto-nannan. The cancer cell growth inhibitory constituents of *Terminalia arjuna* (Pettit *et al* 1996); anti-inflammatory and anti-arthritic properties of *Terminalia ivorensis* (Iwu & Anyanwu 1982); effect of amino acid in *Aloe* extract (Yagi *et al* 1987); phytochemical analysis of *Terminalia catappa* (Diyabalanoya *et al* 1997); natural products as inhibitors of Human Immuno deficiency Virus Type I (Tan *et al* 1991); pharmacological screening of plant decoctions used in Cuban folk medicine (Carbajal *et al* 1991) and Chebulanin from *Terminalia chebula* as an anticancer agents. (Tokura & Kagawa 1993) ; Ross (1999) has reported 26 common medicinal plants of the world with their chemical constituents and pharmacological activities.

2.3 **INDIA :**

2.3.1 **Ethnomedicinal:**

The use of plants as medicine for human beings as well as animals in India dates back to the earliest times. Scripture of the Hindus viz.,The *Rigveda*

(4500 – 1600 BC), *Ayurveda*, the indigenous systems of medicine from the Vedic ages (1500 – 800 BC), has been an integral part of Indian culture (Lalramnghinglova & Jha 1999). The Vedic Aryans were familiar with medicinal plants. Several plants are described in the *Atharva Veda*. This was followed by monumental ancient treatise on the subject like *Charak Samhita* (1000 – 800 BC), *Sushrut Samhita* (800 – 700 BC) and *Vaghatta's Astanga Hridaya*. The Yunani system which originated in Greece in about 400 BC came to India, through Arab Physicians, who accompanied Mogul invaders, and came to be known as Yunani–Tibb. The Siddha system, with a record history from about 2000 BC, is believed to have originated from Lord Shiva and to have been passed on through his wife Parvati to a number of disciples. Its use became common in Dravidian civilization. The texts of each of these three systems deal with herbs used in these systems only. Books in English, written usually include plants from all these systems (Jain 1994).

The Indian system of herbal medicine had caught the attention of the west during the colonial days and since 1563, books on these have been published. The important contributions are : (a) *Colloquies on the Simples and Drugs of India* in 1563 by the personal physician of the then Portuguese Governor in India, (b)12 volumes work on Kerala Medicinal Plants (1678 – 1703) from Amsterdam, (c) *A catalogue of Indian Medicinal Plants and Drugs* (Fleming 1810) and (d) *Materia Medica of Hindoostan* (Ainslie 1813).

Studies on ethnobotany in India was initiated by the economic botany section of Botanical Survey of India since 1954. Dr. E.K. Janki Ammal (1956) had published a paper on subsistence economy of India. Dr. S.K. Jain started intensive

field studies among the tribals of Central India in 1960 and published a good number of papers on ethnobotany (Jain 1963 a–c ; 1964 a–b ; and 1965 a–b). The last two decades have seen different works carried on to record information on different medicinal plants from different regions of the country (Jain & Mitra 1997). Mudgal and Pal (1987) gave a synoptic treatment on ethnobotanical works in India. Binu *et al* (1992) compiled an outline of ethnobotanical work carried in India. Ved Prakash (1998) reviewed status of Indian medicinal plants. Through the reports of ethnobotanists who had surveyed States and U.Ts of India, different medicinal plants prevalent in particular regions among different people of different states, and even some less well known medicinal plants have been recorded and informations provided. Ethnomedicinal contributions are arranged statewise, alphabetically. Work carried in North-Eastern States, on the medicinal plants employed by the people of these regions, have been reviewed separately.

2.3.1.1 ***Andhra Pradesh*** *:*

Hemadri *et al* (1987) recorded 211 species of the medicinal plants wealth of the state. The medicinal plants wealth of Karimnagar district was documented by Hemadri (1990, 1991). Reddy *et al* (1989) investigated plant based crude drugs of Anantpur and Chitoor districts. They reported 64 plant drugs. Aruneekumar & Nisteswar (1990) documented 188 medicinal plant species of Kakinada district. The medicinal plants used for family planning and birth control is reported by Vedavathy *et al* (1991). The plant species having ethno-veterinary value, used by the Chenchus, Sugalis and Yorukalas tribes

are recorded by Goud and Pullaiah (1996). The traditional medicines practised by the Yanadi tribe is documented by Vedavathy and Mrudula (1996). Rao *et al* (1996) reported 27 plant species used to cure dental disorder at Tirumala Hills in Chittor district. Reddy *et al* (1997) have reported medicinal plants used by the Chenchus, Erakalus, Yanadis, Sugalis etc. for the treatment of ephemeral fevers and anthrax in cattle. Vargheese *et al* (1988) focussed on ethno-medical alternative in treatment of Kala – Azar. Reddy *et al* (1998) documented plants used in ethno – veterinary practices in Warangal district. Medicinal plants used by the tribals of Praksam district is recorded by Vijay Kumar and Pullaiah (1998).

2.3.1.2 ***Bihar:***

Boddings (1925 & 1927) documented Santhals taboos, medicines and folklore customs. The plants of ethnomedicinal value are reported by Srivastva and Verma (1981). The medicinal plants used by Santhals, Mundas, Orans, Birhors, Bedia of Chotanagpur plateau are reported by Tarafder (1983 a-b, 1984 a-b). Tarafder (1983 c-e) documented ethnogyanaecolgy of different tribals in the state. The ethnomedicinal plants of famous Saranda forest is documented by Jain (1989). Jha *et al* (1989) reviewed folk medicine of Mithila zone of Bihar. Other important contributions of importance are ethnomedicinal plant species of 'Paaharia' tribe (Singh *et al* 1992); Sauri Paaharia tribe (Jha & Verma 1996); Santhal and Paharia

tribes (Kaushal & Goel 1998) and Hazaribagh forest mines regions (Prasad *et al* 1998). Verma and Pandey (1990) reported 32 species having medicinal value from Lohardaga district.

2.3.1.3 ***Gujarat*** *:*

The ethnomedicinal information along with other uses of 133 plant species used by tribals of Saurashtra are recorded by Shah *et al* (1981). The folk medicines of Dangs are reported by Joshi *et al* (1980). Shah and Gopal (1982) reported 145 plant species having medicinal uses. The plant species having ethnomedicinal value, used by Bhils, Rabaries, Gharashias and Dubias tribes in Gujarat were documented by Shah and Gopal (1985). Joshi (1988) provided information on 139 plants of medicinal value. The ethnomedicinal uses of plants in Sunderban recorded by Tribedi *et al* (1993).

2.3.1.4 ***Haryana*** *:*

Lal and Yadav (1983) recorded 69 species having medicinal importance and 66 prescriptions for therapeutic dose were also mentioned. Medicinal application of each species was presented. Jain (1984) documented 26 medicinal plant species of Morni and Kabasar hills in Ambala district.

2.3.1.5 ***Himachal Pradesh*** *:*

The medicinal plants of Chamba Forest Division and Kangra Forest Division (Uhal valley) are recorded by Gupta (1964) and Uniyal and Chauhan (1971), respectively. 50 plant species having ethnomedicinal importance along with part of plants used and mode of administration of each species are reported by Kapahi (1990).

2.3.1.6 ***Jammu & Kashmir*** *:*

The folk medicine prevalent amongst the people of Sudh–Mahadeo region is documented by Karnick (1980). The medicinal plants used by Amchis of Ladakh have been recorded by Srivastva *et al* (1981). Other important studies on medicinal plants are survey on the ethnobotany of Kashmir Sind Valley (Dar *et al* 1983); herbal drugs traditionlly used in Ladhakh (Uniyal & Issar 1988); traditionally important medicinal plants of Dudu Valley (Kapur 1991); traditionally important plants of Bhaderwah hills (Kapur 1996) and ethnobotanical uses of plant species by the Gaddhis, Gujjars and Bakerwals inhibiting Bhadarwah hill in Jammu (Kapur & Nanda 1992).

2.3.1.7 ***Karnataka*** *:*

Important contributions on medicinal plants are medicobotany of Mysore (Rao 1977) cited by Binu *et al* 1992; medicobotany of Tumkur district (Yoganarasimhan *et al* 1982); folk medicine of

Bangalore district (Pushpalata *et al* 1990); ethnobotany of Soligas in Biligiri Betta (Hosagaudar & Henry 1996) and the ethnobotany of Gowlis of Uttara Kannada district (Bhandary *et al* 1996).

2.3.1.8 ***Kerala:***

The ethnomedicinal investigations containing information about the medicinal plants are reported by Mooss (1952,1976 & 1978); Kolammal (1979); Manilal (1981); Ramachandran and Nair (1981),Nambiar *et al* (1986) and Sivarajan and Balachandran (1994) and Radhakrishnan *et al* (1996).

2.3.1.9 ***Madhya Pradesh*** *:*

Pandey *et al* (1991) reported folk medicine of Baiga tribes and mentioned medicinal uses of 25 species. The flowering plants (233 numbers) of high medicinal value of the state recorded by Oommachan and Masih (1991). The medicinal plants commonly used by 'Sahariya' tribe recorded by Jain (1992). A few other contributions are ethnomedicinal herbal legumes of Bundelkhand (Bhalla *et al* 1992); ethnomedicinal plants of Murias of the Indravati Tiger Reserve, Bastar (Kumar 1996; Maheshwari & Singh 1996), ethnobotany of Surguja district (Vivek & Jain 1998).

2.3.1.10 ***Maharashtra*** *:*

The relevant contribution in the field of ethnomedicine are medicinal plants from the hilly region of Pune and Sata districts (Vartak 1959); medicinal plants (165 species) from Khed Tallaka (Janardhanan 1963); medicinal plants (126 species) from Chandrapur district (Malhotra & Moorthy 1973) ; medicinal plants of Karnala tribal area of Kolaba district (Vartak 1981); medicinal plants of Dahanu Forest Division (Shah *et al* 1983) ;medicinal plants of Khandala (Ved Prakash & Mehrotra 1987) ; ethnomedico-botany of some sacred plants of Western Maharashtra (Upadhye *et al* 1997) and ethnomedico-botany of genus *Mucuna* from Western Maharashtra (Upadhye *et al* 1997).

2.3.1.11 ***Orissa*** *:*

Saxena and Dutta (1975) have investigated 82 medicinal plants used for antifertility, fibre and food by the rural folk of the state. Saxena and Tripathi (1990) recorded 200 plant species having medicinal uses. Other important publications containing ethnomedicinal studies are survey of medicinal plants used by tribals of Mayurbhanj (Mudgal & Pal 1980 ; Tribedi *et al* 1982 ; Saxena *et al* 1981); medicinal plants used by tribes of Koraput (Paul & Mudgal 1985; Das & Mishra 1987, 1988 ; Das & Kant 1988), ethnobotanical information on plants of Keonjhar district (Mandal & Mukherjee 1992) ; some plants of ethnopaediatric importance in district Koraput

(Srivastava & Rout 1994). Medico-ethnobotanical studies in Ganjam and Phulbani district (Mohanty *et al* 1996); ethnomedicinal plants of Bhadrak district (Girach *et al* 1997) and folk veterinary herbal medicine of Bhadrak district (Girach *et al* 1994).

2.3.1.12 ***Punjab*** :

Some of the relevant contributions are primitive folk and modern medicines (Kakar 1973: In Binu *et al* 1992), ethnobotany of Lahul (Koelz 1979) and plants used by Bhat community to regulate fertility (Lal & Lata 1980).

2.3.1.13 ***Rajasthan*** :

The most relevant contributions are medicinal plants of Ajmer Forest Division (Dixit & Mishra 1976); medicoethnobotany of Mount Abu (Sebestian & Bhandari 1984); plants of medicinal value used by tribals of Mukundara hills of Jhalawar district (Sharma 1990); a review on herbal drugs from Udaipur district (Singh & Anwar 1993); ethnomedicine of Kathodias with special notes on remedies against snakebites and scorpion- stings (Joshi 1993); ethnomedicinal plants suitable to cure venereal and gynaecological diseases (Singh & Pandey 1996); folk medicine of Udaipur district (Katewa & Arora 1997); ethnomedicobotany of household remedies of Phagi Tehsil of Jaipur district (Sen & Balra 1997); ethnomedicine of Bhills in Rajasthan : plants used in diarrhoea (Khandelwal 1998);

ethnomedicinal observations from certain watershed areas of Rajasthan (Katewa & Sharma 1988).

2.3.1.14 ***Tamil Nadu*** *:*

The notable works related to ethno-medico-botany are medicinal flora of Nilgiri (Raghunathan 1976); folk medicinal claims from North Arcot district (Anandan & Veluchamy 1986); folklore medicine of Anaikhatty hills (Lakshman and Narayanan 1988); ethnomedicinal plants used by Malayali and Veduvar tribes of Salem district (Dwarkan & Ansari 1992) and tribal ethnobotany of Nilgiri district (Mandal & Basu 1996).

2.3.1.15 ***Uttar Pradesh*** *:*

Some of the notable works done in U.P are medicinal plants of Bhagirathi valley (De 1962); plant species used by Kols, Gondas, Lodhas and Gujars of Banda district against various infections (Saxena & Vyas 1981); medicinal plants used by the people of Dhasal valley (Saxena & Vyas 1983); ethnomedicinal plants of Terai in Gorakhpur (Singh *et al* 1987); plants of ethnobotanical value from Alpine region of Kumon (Rawat & Pangtey 1987); ethnomedicinal plants of Mathura district (Singh & Dhakre 1989); phytotherapy in Varanasi district (Singh & Maheshwari 1983); traditional uses of medicinal plants from Jaluan district (Khanna *et al* 1996); medicinal plants used by the forest ethnics of Gorakhpur district (Singh &

Siddiqui 1997); native medicine of Jaunsari tribe (Singh 1997); ethno-medico-botanical studies on the fungi of Kumaun Himalaya (Joshi *et al* 1997) and native plant remedies for liver disorder among the tribals of Uttar Pradesh (Singh & Prakash 1998).

2.3.1.16 ***West Bengal*** :

The contributions in the field of ethnomedicobotany are plants of ethnobotanical importance used by Santhals, Bhumijs, Birhors and Kherias in Purulia (Jain & De 1996; Sur *et al* 1992); ferns of medicinal value of Darjeeling (Dixit *et al* 1978); herbal medicines in Bhankura district (Namhata & Mukherjee 1989); herbal remedies of Loha tribes in Midnapore (Pal & Jain 1989); herbal medicines used by the tribals of Bhankura district (Namhata & Ghosh 1993); 36 plants used for rheumatic pain, chronic acidity and tuberculosis (Mishra *et al* 1997) and ethnomedicine to modern medicine : An observation studies in some villages in West Bengal (Ghosh & Sen Sarma 1997).

2.3.1.17 ***Andaman and Nicobar (U.T.)*** :

Ethnobotanically, the flora of Andaman and Nicobar constitutes an interesting group as it consists of considerable percentage of Malaysian elements (Binu *et al* 1992). Some of the interesting contributions in the field of ethnomedicobotany are ethnobotany of Shompens of Great Nicobar (Chakrabarty & Rao

1988); ethnomedicobotany of Nicobarese (Dagar 1989; Dagar & Chakhtai 1989) and folk medicines of Nicobarese (Dagar & Dagar 1991 & 1996).

North Eastern States : The ethnomedicinal studies have been recorded and reports and information on the medicinal plants employed by the people of these regions have been provided by the variuos ethnobotanists.

2.3.1.18 ***Assam*** :

Some of the notable works are medicinal plants used by the Karbi Anglong of Mikir hills (Borthakur 1976); ethnomedicinal surveys of Miris (Hajra & Baishya 1981); medicinal plants from Tezpur (Puri 1987); ethnobotany of Miris and Mishings of Assam (Borthakur 1996); herbal remedies of the Nepalese of Assam (Borthakur *et al* 1996) and plant used to cure jaundice in Golaghat district (Pandey *et al* 1996).

2.3.1.19 ***Arunachal Pradesh*** :

The most relevant contributions are medicinal plants of Arunachal Pradesh (Hajra 1977); ethnomedicinal plants of Tirap district (Tiwari *et al* 1978); plants used by the Monpas tribes of Kameng district (Dam & Hajra 1981); ethnobiological records on 171 plant species of lower Subansiri district (Gangwar & Ramakrishnan 1990); medicinal plants of Lohit district (Bhuyan

1989); medicinal plants of the tropical, sub-tropical and temperate regions of Siang, Subansiri and Tirap districts (Tiwari and Tiwari 1996) and notes on the ethnobotany of the Monpa tribe of Tawwang district (Rawat *et al* 1997).

2.3.1.20 ***Manipur*** *:*

Some of the important contributions are : medicinal uses of 36 species used by Naga tribes in Ukhrul district (Elangbam *et al* 1989). Ethnobotanical uses of 931 medicinal plants (Sinha 1987); folk medicines used to cure twenty five diseases by the Manipuris (Sinha 1990). Singh (1996) reported aphrodisical plants used by Meitei community. Medico-botany of Meitei community in Manipur state is recorded by (Singh & Huidrom 1997).

2.3.1.21 ***Meghalaya*** *:*

The main contributions are : ethnobotany of Khasi and Jaintia tribes (Joseph & Kharkongor 1981); ethnobotany of Khasi and Garo (Rao & Neogi 1980) and medicinal plants used by Garo (Rao and Shampru 1997; Rao 1989).

2.3.1.22 ***Nagaland*** *:*

Some of the notable works are medicinal plants used by Nagas (Rao & Jamir 1982 a, b); medicinal plant species used by the Angamis of Kohima district (Megoneitso & Rao 1983); medicinal

plants used by Zealang sub-tribes (Jamir & Rao 1990); ethnobotany of the Ao and Angami Nagas (Rao & Jamir 1990) and the medicinal herbs utilized by the Naga tribes (Jamir 1997).

2.3.1.23 ***Sikkim*** :

The contributions made by Hajra and Chakraborty (1982), Bennet (1983) and Uniyal (1980) in the field of ethnomedicinal plants are important.

2.3.1.24 ***Tripura*** :

Deb (1968) has recorded medicinal plants of Tripura. Ethno-medico- botanical studies in Tripura reported by Singh *et al* (1997).

2.3.1.25 ***Mizoram*** :

In the state of Mizoram in particular, inspite of its ethnobiocultural richness and the traditional uses of medicinal plants, scientific researches on ethnobotany is still at its infant stage. Mention was made by Lorrain (1940) about few traditional medicinal plants, after which some diseases ailments along with medicinal treatments from plants were mentioned by Irish (1975) and Thangchuanga (1979). The " Zoram Upa Pawl Thurawn Bu " (Anon. 1984) documented a total of 228 cases of human diseases and 27 animal diseases along with herbal medicine used for their treatments. This

document may be regarded as spearheading medicinal survey in the state of Mizoram.

Herbal medicine used for treatment of 97 diseases has been reported by Darlianthanga (1989). Saptawna (1990) reported 58 plant species used as medicine. Lallianthanga (1990) reported 128 plant species used as local medicine. Vailinga (1991) also documented 165 diseases and their ethnomedicine. Lalramnghinglova (1991) documented 437 plant species on the basis of secondary informations.

Some of the most notable contributions (based upon actual ethnobotanical survey) are made by Lalramnghinglova (1996); Lalramnghinglova and Jha (1996); Lalnundanga *et al* (1997); Lalramnghinglova and Jha (1997), Jha and Lalnundanga (1998) and Lalnundanga and Jha (2000).

2.3.2 **Ethnophytochemical :**

It is not possible to cover all ethno-phytochemical researches being carried in India. A few significant contributions are : A new flavone from *Terminalia arjuna* (Nagar *et al* 1979); phytosterol in some plant materials (Beri 1970); a new potential antitumor alkaloid from *Tylophora asthmatica* (Mulchandani *et al* 1971); calcium oxalate as a source of oxalic acid in barks of seven species of *Terminalia* (Bharadwaj & Chandra 1983); antiasthmatic principles of *Allium cepa* (Handa *et al* 1983). Gallic acid from Myrobalans (Grampurohit 1986); Triterpenoids and their Glucosides from *Terminalia bellirica* (Nandy *et al* 1989); hexahydroxydiphenic

acid ester in *Terminalia bellirica* fruits (Ali & Bhutani 1991). Pentacyclic triterpenoid sapogenols and their glycosides from *Terminalia bellirica* (Mahato *et al* 1992); chemical evaluation of fruits of *Terminalia bellirica* (Ali 1992); a triterpene glycoside from *Terminalia arjuna* (Tripathi *et al* 1992); constituents of *Terminalia pallida* (Gunasekar *et al* 1993); phytochemical investigation of *Terminalia* genus (Bajpai & Tiwari 1994); triterpenoid constituents of the seed of *Diospyros melanoxylon, Tecomella undulata* and *Terminalia bellirica* (Singh & Sharma 1997) and a tennin anti-cancer promoter from *Terminalia arjuna* (Kandil & Nassar 1998).

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CHAPTER 3 METHODOLOGY

METHODOLOGY

In the study of medicinal plants, the following methods and techniques are adopted.

3.1 COLLECTION OF INFORMATION FROM LOCAL LITERATURE:

In this course of the research, the first step that was taken has been the collection of information from literature which were available locally. This literature pertains to any kind of literature, printed or unprinted which can be found to give information on the traditional uses of medicinal plants. Through this literature, different plants and their medicinal uses are noted down. These are sorted out and arranged; then after careful scrutiny, they are again compiled in the field notebook which serve as an aid making it easy in the field investigation during the research.

The local literature which was collected and consulted for this particular work are as follows: *Dictionary of the Lushai Language* (Lorrain 1940), *Local Medicine – Tualchher Damdawi* (Irish 1975), *Mizo Damdawi leh Fanau Enkawl Dan* (Thangchuanga 1979), *Zoram Upa Pawl Thurawn Bu* (Anonymous 1984), *Fa Duhthlan Dan leh Mizo Damdawi* (Darlianthanga 1989), *Tualchhuak Damdawi* (Saptawna 1990), *Mizo Pipute Sulhnu leh Mizo Damdawi* (Vailinga 1991), *Mizo Damdawi leh An Hmannate* (Lianhnuna 1991), *Mizo Damdawi* (Sawithanga 1993), *Mizo Damdawi* (Lunghnema 1995), *Mizo Damdawi* (Rozika 1995), *Tualchhuak Damdawi* (Chawngkunga 1996) and *Mizo Damdawi Siam Dan leh Hmanna* (Anonymous 1996).

3.2 CONDUCTING PERSONAL OR GROUP INTERVIEWS:

The interviews were conducted at different places, different occasions, and according to convenience. The chief informants in these interviews were real practitioners, people who used their knowledge of medicinal plants on their immediate families, friends and a few others. Besides this, others were also interviewed, mostly old men who had some knowledge on the subjects handed down by their fathers and some women who had first- hand experiences and a few who were being treated with medicinal plants. Some homeopathists, naturopathists, therapists and faith – healers were also contacted and interviewed.

Every possible opportunity was seized to conduct these interviews. Some people were contacted at their homes, some at public meetings and conferences, social gatherings and there were some chance meetings too. Not all, but some of the informants were people who sort of specialised in a particular disease or diseases and so interviews were also sometimes focussed on certain disease – states of special interest.

All the information gathered at these interviews were carefully recorded in a note book which was used to confirm the authenticity of the uses of medicinal plants. The information gathered especially from real practitioners (Photo 2) proved very useful and advantageous when combined with direct field observation.

3.3 ETHNOBOTANICAL FIELD WORK

This is the most important method and it includes gathering of primary information from real practitioners or local medicine-men, authentification of voucher specimens and preservation of plant samples for proper identification.

The principle guidelines followed in plant collections and herbarium techniques were given by Jain and Rao (1977); Womersley (1981); Mehrotra (1989); Martin (1995) and Cotton (1996).

3.3.1 Collection and Processing of Plant Samples:

The following equipments and chemicals were used during the collection and processing of plant samples :

(a) Field equipments :

(i) Field note book (22cm x 12cm), (ii) Wooden plant press (50cm x 34cm x 3cm), (iii) Portable plant press (48cm x 32cm x 1cm) , (iv) Camera, (v) Rucksack, (vi) Knife, (vii) Scissor, (viii) Altimeter, (ix) Old newspaper, (x) Scale and pencils, (xi) Polythene bags, (xii) Small spade for collecting soil sample.

(b) Laboratory equipment and chemicals :

(i) Plastic or Enamel tray (40cm x 30cm x 3cm), (ii) Dissecting box, (iii) Cane forceps, (iv) Fevicol / Dendrite or Quick fix, (v) Specimen jars, (vi) Ethyl alcohol (98 %), (vii) Rectified spirit, (viii) Formaldehyde, (ix) Mercuric Chloride, (x) Paraformaldehyde, and (xi) Sodium Carbonate.

(c) Herbarium equipments :

(i) Genus cover (48cm x 32cm), (ii) Species cover (42cm x 30cm), (iii) Mounting boards (42cm x 30cm), (iv) Absorbers or Blotters (46cm x 30cm), (v) Corrugated cardboards (45cm x 30cm), (vi) Labels (11cm x 9cm), (vii) Straps and Needles , (viii) Napthalene balls, and (ix) Pigeon-hole herbarium cabinets (170cm x 62cm x 50c).

3.3.2 **Pre-planned field trip programme :**

This pre-planned programme helps in enabling the work to cover as many areas as possible and also in speeding up the actual field work. Before starting the actual field work, a programme for a field trip had to be chalked out. By using local maps, important places where collection of samples are to be undertaken were demarcated on the basis of centres of biodiversity ; all these areas were marked at random. Then the areas, routes and time to be covered were chalked out in order to be able to cover as much as possible the important areas of collection such as the centres of biodiversity.

3.3.3 **Actual field work :**

Actual field collection was conducted throughout the study area (Photo 1). As the study area is very vast, covering more than half of the total area of the state of Mizoram, some important areas were selected in such a way that these areas should represent the entire study area. The study area extended from Tinghmun in the extreme north to the Zawngling in the south and from Rawpuichhip in the west to Farkawn in the extreme east. The selected areas in blockwise were : W. Phaileng Block, Tlangnuam Block, Thingdawl Block , Darlawn Block, Phullen Block, Khawbung Block, Lungsen Block, Chawngte Block and Lawngtlai Block. In each block several villages were surveyed.

The villages visited during the actual field work usually have at least one or more medicine men who were ' Key informants '. It is important to have information about these people beforehand so that they could be easily located.

In some villages, the local medicinemen sometimes were not easily available, and in their absence, village heads and sometimes even government personnel were very helpful. Besides these people, the locals were interviewed too so that the authenticity of the uses of particular plant or plants to cure diseases can be proved.

Although interviews with locals, village heads and others were not difficult, the medicinemen were sometimes very reluctant to share their knowledge; since most of the time their knowledge had been secretly handed down through generations only within their family, and that, too, only from father to son. So while interviewing the local specialist, the suggestions made by Rao and Hajra (1987); Rao (1989) and Lipp (1989) were applied and found quite helpful. Here again, the techniques applied vary from one place to another depending upon the society background of the people.

A very important aspect in conducting interviews during field investigation is to gain the trust of the medicinemen. To gain the trust of the people, not words but deeds are very important. A field worker has to show through his actions, his genuine appreciation, empathy and respect of the culture, customs and traditions of the particular tribe or tribes he is in contact with. This means that he must adapt

comfortably to the local environments, habit and taste of the people. If a local medicineman feels he is talking to a trustworthy person, he is very cooperative and does not hesitate to share his knowledge. But again, as mentioned earlier, the interviews have to be held in private as most of these medicinemen do not want to disclose their knowledge, especially in front of their own people. All in all, interviews with these local specialists went smoothly and the information gathered were most helpful in the actual field work.

After verification of the authenticity of the uses of particular medicinal plants, collection has been undertaken with the help of local people who know better regarding the locality of the particular plant species. The habit & habitat, associates, growth behaviour , phenology, silviculture character etc. of the medicinal plants were recorded (Photo 3). The soil samples were collected to analyse the nutrient status of the site.

3.4 PLANT PROCESSING :

Plant processing includes collection of plant, herbarium techniques, identification and preservation of plant samples.

The collected plant materials were brought to the camp for proper processing. The plant sample was kept inside the folder (absorbers). The twig of the plant were immersed in an enamel or plastic tray containing the solution of 4 % of Paraformaldehyde (100 gms of Paraformaldehyde + 5 gms of Sodium Carbonate + 1 litre of boiled water) to prevent the falling of leaves, flowers and fruits. After

this treatment the plant materials were kept inside the folders or absorbers and properly pressed with the help of plant press. While pressing care should be taken that all parts of the plant like leaves, flowers and fruits were placed in proper manner that each and every part of the plant could be clearly studied as much as possible from the plant pressed. While pressing, some extra sheets of corrugated cardboard were placed in between the layer in order to make the air pass through the spaces. Sometimes, additional folded old newspapers were inserted to make the pressed plant material at its best leveling in case of the presence of fruits and other bigger twig which could make the flat level irregular.

The pressed plant material was exposed to sunlight for drying. Depending upon the plant variety, the time taken for drying varied. In some case 3 days was sufficient and in some other cases more than three days was needed. In gloomy and less sunny days, a long period is taken for drying. An electric hot oven was also used at 60° C for two to three days during rainy season. Due care was paid to avoid over drying of plants and prevent fungal infestation.

The properly dried materials were poisoned by dipping into a plastic tray containing ' Kew Mixture ' (115 gms of Mercuric Chloride dissolved in 4.5 litres of Ethyl alcohol or Rectified Spirit). The dried specimens were then mounted on mounting boards with the help of quick drying adhesive like fevicol or dendrite or quick fix. A printed label was pasted on the right bottom of the mounting board which comprised brief ethnomedicinal information of the specimens.

The plant part used for medicines were also collected (Photo 4) and preserved in a specimen jar with 8 % of formaldehyde .

3.5 IDENTIFICATION AND MATCHING OF THE SPECIMENS :

Mounted specimens were used for the purpose of identification. Identification of plants was done with the help of available floras such as : (i) *Flora of British India* (Hooker 1872–1897) , (ii) *Forest flora of British Burma* (Kurz 1877), (iii) *A Botanical Tour in the South Lushai Hills* (Gage 1889), (iv) *Indian Trees* (Brandis 1906), (v) *Flora of Assam* (Kanjilal *et al* 1934 – 1940; Bor 1940), (vi) *Flora of the Lushai Hills* (Fischer 1938), (vii) *Flora of Tripura State* (Deb 1981 & 1983), (viii) *Forest Flora of Meghalaya* (Haridasan & Rao 1985 & 1987) and (ix) *Some Mizo – Botanical and Zoological Names* (Sawmliana 1988).

Besides these floras, in order to match the specimens for confirmation and to identify the unidentified species, plant specimens were taken to the established national herbaria *viz*, Central National Herbarium, Howrah (CAL) , Herbarium of National Botanical Research Institute, Lucknow (LWG) and Herbarium of Botanical Survey of India (Eastern Circle), Shillong. The local herbarium of parent Department and Environment & Forest Department, Mizoram, had also been consulted for confirmation and identification .

3.6 SOIL ANALYSIS:

3.6.1 Collection of Soil :

Soil samples were collected, at the time of actual field work; the soil was dug with the help of sampling tool, i.e. small spade, at the depth of at least 10cms. and about 1kg. was collected and packed in a clean polythene back.

As soon as the sample arrived at the laboratory these were serially registered giving all the necessary information in the information sheets (Table 1).

Table 1. INFORMATION SHEET TO ACCOMPANY SOIL SAMPLE

Name of owner _____ Address _____

Village _____ P.O. _____ District _____ State _____

Sl. No.	Laboratory No.	Sample No. sample	Depth of samples	Number of sample	Elevation	Plant growth
1	2	3	4	5	6	7

Source : Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi.

3.6.2 **Processing :**

The samples collected were air dried. Here care should be taken that there ~~should not be any~~ contamination. The air dried soil ~~is~~ passed through 2 mm. sieve for analysis. Before sieving, the soil clods were crushed in wooden pestle and mortar so as to pass it through sieves of finer mesh size (0.2 – 0.5 mm) (Ghosh *et al* 1983).

3.6.3 **Determination of pH :**

The pH of the soil sample ~~has~~ been measured by the methods of soil to water ratio of 1 : 2 (Ghosh *et al* 1983) . By this method 20g of soil is taken in a 100ml beaker to which 40ml of water is added. The suspension is stirred at regular intervals for 30 minutes and the pH is recorded with the help of pH meter where care ~~should~~ be taken that just before the electrodes ~~is~~ immersed the suspension must be stirred well.

3.6.4 **Estimation of Organic Carbon :**

For the estimation of Organic Carbon the method given by Walkley and Black (1934) is adopted. Following the above method, soil is grounded and completely passed through 0.2 mm sieve and 1.00g is replaced at the bottom of a dry 500ml. Conical flask. 10ml of 1N $K_2Cr_2O_7$ is pipetted in and swirled a little. The flask is kept on Asbestos sheet. Then 20ml of H_2SO_4 (containing 1.25% Ag_2SO_4) is run in and swirled again two or three times. The flask is allowed to stand 30 mins. And thereafter 200ml of distilled water is added. After in corporation of 10ml of phosphoric acid or 0.5g sodium floride and 1ml of diphenylamine indicator are titrated with ferrous ammonium sulphate solution till the colour flashes from the blue-violet to green. Simultaneously, a blank is run without soil. The result are calculated by the following method:

$$\text{Organic Carbon (\%)} = \frac{10(B - T)}{B} \times 0.003 \quad \frac{x100}{\text{wt. of soil}}$$

Where B = volume (in ml) of ferrous ammonium sulphate solution required for blank titration; and T = volume of ferrous ammonium sulphate need for soil sample.

3.6.5 **Estimation of available Phosphorus:**

Phosphorus (P) in soil occurs as orthophosphate in several forms and combinations and only a small fraction of the total amount present may be

available to plants which is of direct relevance in assessing the phosphorus fertility level.

A wide variety of chemical soil tests for available P has been proposed which extract variable quantities of phosphorus. One of the procedures normally used is given below :

Olsen's method (Olsen *et al* 1954): According to this method, 2.5g. of the soil sample is taken in 100ml conical flask a little of Dargo G 60 or equivalent grade of activated carbon (free of phosphorus) is added followed by 50ml of Olsen's reagent. A blank is run without soil. Then the flasks are shaken for 30 minutes on a platform type shaker and the contents are filtered immediately through dry filter paper (Whatman No.1) into clean and dry beakers or vials. In the filtrate phosphorus is estimated colorimetrically by Dickman and Bray's procedure.

According to the above method (Dickman & Bray 1940), 5ml of soil extract is pipetted into a 25ml volumetric flask to which 5ml of the Dickman and Bray's reagent is poured in. The neck of the flask is washed down and the contents is diluted to about 22ml. Then 1ml of the diluted stannous chloride solution is added and volume make up to the mark level. The intensity of the blue colour is measured (using 660 mμ filter) just after 10 minutes and the concentration of P is determined from the standard curve. This is very important as the colour starts fading after sometime. With each samples a blank is taken.

3.6.6 **Determination of available Potassium :**

Available Potassium (K) incorporates both exchangeable and water soluble forms of the nutrient present in the soil. The estimation of K of water soluble forms is determined with the help of photometer (Ghosh *et al* 1983). 5gm. of soil sample is shaken with 25ml of neutral normal ammonium acetate (pH 7) for 5 minutes and filtered immediately through a dry filter paper (Whatman No. 1). First few ml of the filtrate is rejected. Potassium concentration in the extract is determined in the flame photometer.

For the determination of non-exchangeable potassium Wood and De Turk's (1940) method is used. According to this method, to 5ml of the sieved soil (2mm) placed in a dry 100ml conical flask 50ml of 1N HNO_3 is pipetted in and the contents are heated on a hot plate (low heat) under reflux for 10 minutes after boiling starts. On cooling, the suspension is filtered through dry filter paper and potassium concentration is estimated by flame photometric.

3.7 **DELINEATION ON MAP :**

The topo sheet (scale 1 : 50,000) which covers the site of collections are collected. The latitudes and longitudes are measured to delineate the place of availability of the plants.

3.8 **PHYTOCHEMICAL ANALYSIS :**

The plant sample collected were analysed by the following methods:

3.8.1 **Drying of plant sample :**

Plant sample (part used for medicine) collected are taken for air drying in such a way that in the case of leaves they are spread so that there

should not be any overlapping for fast drying, under sun shine and in the case of bark, they are cut into small pieces for easy drying (Photo 5 & 6). Care should be taken that any fungal contamination and rotting of the sample should be prevented by checking and rechecking during drying.

3.8.2 **Isolation of essential oil :**

Air dried sample (500gm.) cut into small pieces

⇩

Added 2 litres of water

⇩

Heated on a heating mantle to boiling at 90-95°C for 4 hrs.

⇩

Essential oil along with water collected in flask

⇩

Taken in separating funnel and extracted with diethyl ether (2 x 50 ml)

⇩

Ether layer washed with water and dried over anhydrous sodium sulphate

⇩

Removed the ether and distilled off on a gently heated water bath

⇩

Essential oil amount determined, weighed and yield determined on moisture free basis

3.8.3 **Preparation of extract :**

Powdered plant sample of 500gm. Are extracted sequentially in a soxhlet apparatus with petroleum ether, acetone and methanol. Solvents removed on water bath to give petroleum ether extract.

3.8.4 **Thin Layer Chromatography (TLC) of plant extractives :**

TLC plates are prepared using TLC silica gel. Plates are activated in the oven for 1 hr. at 100°C. The activated plates are taken out and developed in 10% MeOH - $CHCl_3$ 5% H_2SO_4 in water is used as spraying reagent. A spot is obtained on TLC.

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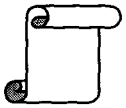
CHAPTER 4  STUDY AREA

STUDY AREA

3.1 GEOGRAPHICAL LOCATION :

The study area falls under the Tropical and Sub-tropical semi-evergreen forest of Mizoram. It covers an area of 8312.50 sq.km which is 39.43 % of the total geographical area (ie.21,081 sq.km.) of the state; lies between 21° 30' N to 23° 15' N latitude and 92° 16' E to 93° 26' E longitude bordered by Assam and Manipur on the north and Myanmar on the east. The altitude varies from 86 m on the western side to 1556 m on the eastern side (Map No. 1). It forms parts of the Topographical Maps No. 83 D/15, 83 D/16, 83 D/18, 84 A/9, 84 A/10, 84 A/11, 84 A/12, 84 A/13, 84 A/14, 84 A/15, 84 A/16, 84 B/9, 84 B/10, 84 B/13, 84 B/14, 84 B/15, 84 E/1, 84 E/2, 84 E/4, 84 F/1 of Forest Survey of India.

3.2 CLIMATE :

The area as a whole enjoys moderate climate, neither very cold nor very hot. But temperature variation is very wide as the western part enjoys the temperature variation of around 15°C to 41°C while in the eastern part temperature ranges from 10°C to 30°C. The places at higher altitude experience the lower diurnal range of temperature while places at low altitude have higher temperature ranges.

The entire state of Mizoram is under the influence of monsoon. The study area also receives heavy rainfall during May to September with the average of 2850 mm per annum. Within the study area, Lunglei block of the southern part of the state receives heaviest rainfall with an average of 4640.8 mm. per annum (Anon.

1995 b). Normally July and August are the wettest months whereas December and January are the driest months (Pachuau 1994).

3.3 SOILS :

The soils of Mizoram are classified by Sanker and Nandy (1976) into three orders of soil taxanomy : (i) Entisols, (ii) Inceptisols and (iii) Ultisols followed by Anon. (1998), Hrahsel (1988), Singh and Dutta (1989) and Saithantluanga (1997).

The soils of the study area also fall under the above three orders. They were generally young, immature and sandy. The surface soils are dark, highly leached and poor in bases, rich in iron and have low pH values ranging from 4.5 - 5.5. *i.e.* highly acidic. They are well drained, rich in organic carbon, low in phosphate content and high in available potash. The surface soil texture are loam to clay loam with clay content increasing in depth. The pH and organic carbon content decreases with the increase in depth. They are capable of providing substantial oxygen supply for plant growth and retaining moisture for sufficient supply of oxygen throughout the year. The percentages of clay, silt and sand within 50cms.of the surface is 15 - 30 %, 35 - 45 % and 25 - 45 % respectively (Anon. 1999).

3.4 VEGETATION :

The state of Mizoram has abundant growth of vegetation. Out of the total geographical area (21,081 sq.kms), 18,775 sq.kms is covered by natural vegetation which is about 89 % of the total area of the state (Anon. 1998).The vegetation of Mizoram can be simply divided into three categories : 1)Tropical Wet

Evergreen Forest, 2) Tropical Semi Evergreen Forest and 3) Montane Sub-tropical Forest (Champion & Seth 1964).

The study area covers the forest types of - Tropical and Sub-tropical Semi- Evergreen Forest. Within this area, more than 65 % of the population practices shifting cultivation which has led to a severe degradation of forest and disturbed plant succession. The original plant species are replaced mostly by *Melocana bambusoides, Mikania micrantha, Eupatorium odoratum, Saccharum spontaneum and Imperata cylindrica.* The common tree species growing in the study area are : *Albizia chinensis* (Vang), *Albizzia thomsoni* (Thingri), *Anogeissus acuminata* (Zairum), *Bauhinia variegata* (Vaube), *Bombax ceiba* (Phunchawng), *Callicarpa arborea* (Hnahkiah), *Castenopsis tribuloides* (Thingsia), *Cedrella toona* (Tei), *Cratoxylum neriifolium* (Thingsir), *Derris robusta* (Thingkha) ,*Duabanga grandiflora* (Zuang), *Engelhartia spicata* (Hnum), *Erythrina stricta* (Fartuah), *Ficus semicordata* (Theitit), *Ficus fistulosa* (Theipui), *Firmina colorata* (Khaukhim), *Gmelina arborea* (Thlanvawng), *Helicia robusta* (Sialhma), *Lithocarpus pachyphyllus* (Thil), Measa *indica* (Arngeng), *Melocanna bambusoides* (Mau), *Michelia champaca* (Ngiau), *Parkia roxburghii* (Zawngtah), *Phyllenthus emblica* (Sunhlu), *Protium serratum* (Bil), *Quercus dilatata* (Thal), *Quercus helpheriana* (Hlai), *Sapium baccatum* (Thingvawkpui), *Saraca asoca* (Mualhawih), *Sarauja punduana* (Tiar), *Schima wallichii* (Khiang), *Sterculia vilosa* (Khaupui), *Stereospermum colais* (Zinghal), *Terminalia myriocarpa* (Char), *Tetrameles nudiflora* (Thingdawl), *Wendlandia grandis* (Batling), *Vitex peduncularis* (Thingkhawilu). (Anon. 1991, 1993, 1995 a-c & 1997 a-e).

3.5 SOCIO - ECONOMIC CONDITION :

The economic status varies from place to place and from individual to individual, but it can be summarised thus : in general, people are poor. The crop production per unit area is low and marketing facilities is also poor due to lack of transport and communication. The inhabitants of the study area mostly depend on jhum cultivation. The source of income other than agricultural produces are forest products like timber, fuel wood and bamboo.

The total number of villages within this study area are 472 with a total population of 4,29,476 where 2,19,775 are male and 2,09,701 are female (Anon. 1989). There are 78,331 households (Anon. 1998).

The health care facilities provided through 7 Hospitals, 9 Community Health Centres, 6 Subcidiary Health Centres, Pulic Health Centres 17 and 192 Health Sub- Centres in the study area.

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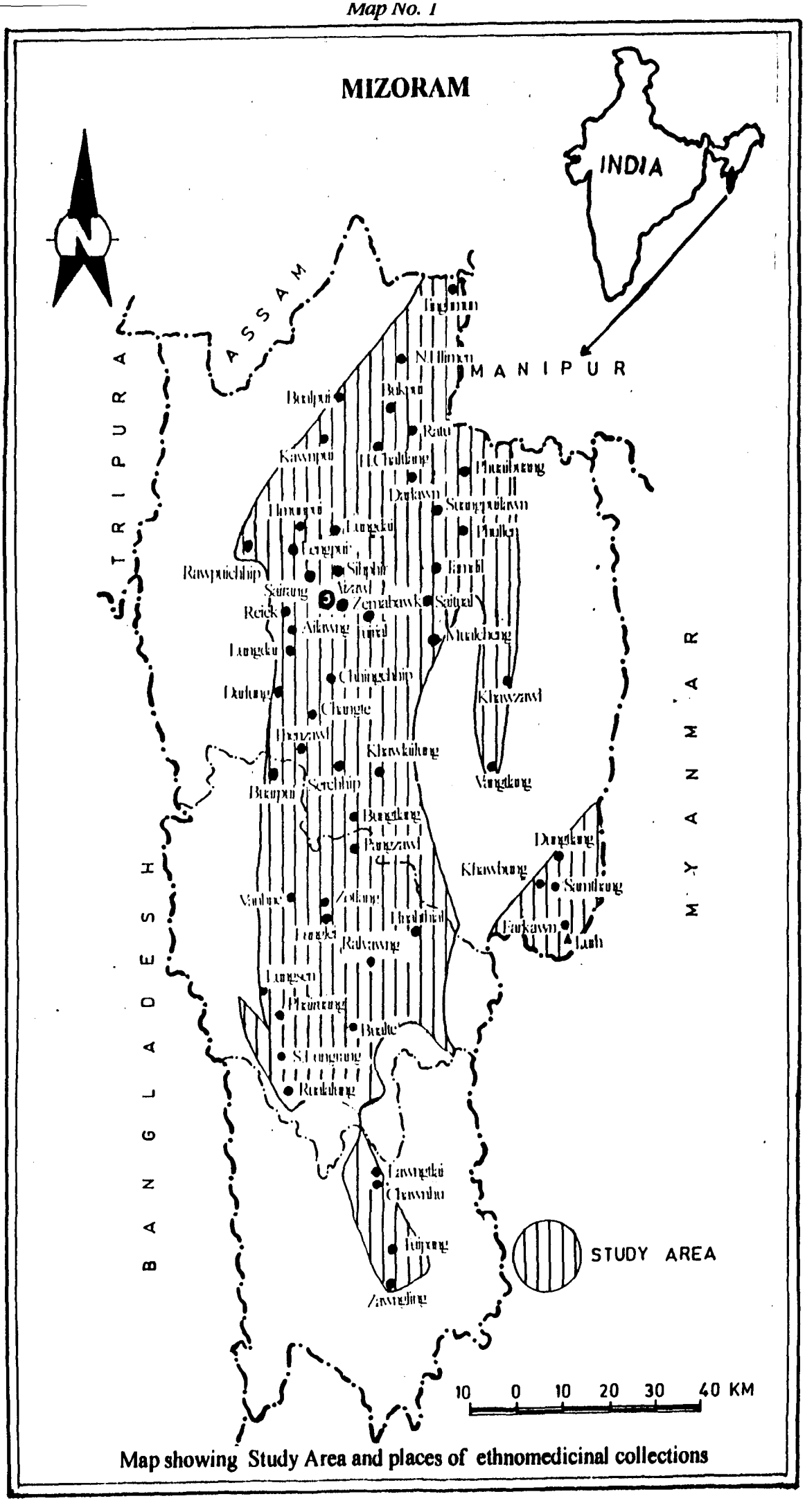
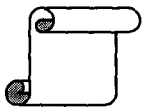


Map showing Study Area and places of ethnomedicinal collections

CHAPTER 5  RESULT

RESULT

5.1 DESCRIPTION:

5.1.1 Presentation of Data :

The plant species having ethnomedicinal importance are altogether sixty eight in numbers. Out of sixty eight plant species, sixty six belongs to Dicotyledons and two comes under Monocotyledons. Two plant samples (Dicotyledons) are epiphytes. The plant species represent forty four families (Table 2).

Scientific names of plants are arranged alphabetically, where an effort has been made to give the latest botanical names with the help of "*Name changes in Flowering Plants of India and Adjacent Regions*" (Bennet 1987). Synonyms also given at the end as far as applicable. Description of the plant species are made in the sequences of : local name, family, locality with latitude and longitude, altitude, important morphological characters, phenology, growth behaviour, silvicultural characters, analysis of soil (Hydrogen potentials : pH, Organic compound : OC content in percentage : %, content of Phosphorus : P and Potassium : K in Kilograms per Hectres : kg/ha) collected from the growing site of the plant species, associates and uses (used in Mizoram : MZ and elsewhere .: EW in the world), their preparations and doses. Some of the plant species having medicinal values are reported for the first time (Table 3). Total eighteen species are selected as candidate species suitable for chemical analysis to identify the active compound. Three of the plant species *viz. Garcinia sopsopia, Mallotus roxburghianus and Vitex peduncularis*

are chemically analysed with the help of Chemistry Division of Forest Research Institute, Dehra Dun.

5.1.2 **Description of plants :**

Adina cordifolia (Willd. ex Roxb.) Benth. & Hook. f. ex Brandis (Syn. *Haldina cordifolia* (Roxb.) Rids.,*Nauclea cordifolia* Roxb.) AE : 118.1996; CIMP 1 : 12.1995; FTM : 41.1997; GIMP : 25.1956; IMP 2 : 1253.1935; IMPC 3 : 117.1995; TIMP 5 : 74. 1997.

Local name	:	Lungkhup
Family	:	Rubiaceae
Locality	:	Ralvawng (22° 57' N latitude and 92° 51' 55" E longitude), Phullen, Khawbung, etc.
Altitude	:	*1000 – 1400* m.
Description	:	Big tree, grows in a virgin forest, stem solid with a thick bark grey in colour, leaf is big, pubescent, simple stipulate, opposite cordate and ovate, flower brown. However, yellow flower is reported elsewhere (Kirtikar & Basu 1981) . Inflorescence is panicle.
Phenology	:	Leaf shedding : Evergreen. However, the species is ~~deciduous~~ elsewhere (Brandis1990).
		New leaf : March – April
		Flowering : June – July. It is also reported up to August (Chatterjee& Prakashi 1997).
		Place of flower : Axillary
		Fruiting : August–September. Fruiting in October – December is reported by Chatterjee & Prakashi (1997).

Growth behaviour : Evergreen tree, attains upto 35m height, with long, straight clean bole and girths of 5 – 6m.

Silvicultural character : Light demander, resistant to jhum fire, no problem in natural and artificial regeneration.

Soil (*in situ* condition): pH=6.0, OC=2.10 %, P=2.11 kg/ha, K=102 kg/ha. (22° 57'N latitude and 92° 51' 55"E longitude).

Associates : *Thea sinensis, Parkia roxburghii, Cinnamomum bejolghota.*

Uses MZ : Bark is crushed and boiled and the water is taken to cure diarrhoea and stomach ulcer.

EW : Bark is also used in inflammation, blood disease, skin disease; juice is used to kill worms in sore and root is used as astringent in dysentery (Kirtikar & Basu 1981). Bark is also used for fever, urinary complaint and cough (Verghees 1996).

Aeschynanthus sikkimensis Stamp f. (Syn. *A. maculata* Cl.). FFM 2 : 652.1987; FJ 2 : 345.1983; FA 3 : 389.1939. **(Pl. III, Photo 7 & 8)**

Local name : Bawltehlantai
Family : Gesneriaceae
Locality : Bualte (22° 48' 25"N latitude and 92° 49' 5"E longitude), Ralvawng, Sihphir, Lunglei.
Altitude : 1000 – 1400 m.

Description : Stem solid and strong; bark greyish; leaf alternate, sessile, linear, acuminate; root is fleshy bulb; flower small, red with yellow spot hanging on the stem, cluster, capitate.

Phenology :
Leaf shedding : November – February
New leaf : March – April
Flowering : March – May
Place of flower: Any place on the stem
Fruiting : July – September

Growth behaviour : Epiphytic herb, attains height up to 1 m.

Silvicultural character: Moderate light demander, resistant to drought and heavy rain, natural and artificial regeneration has no problems.

Associates : *Castanopsis tribuloides* (Host plant).

Uses MZ : Flower chewed (in raw) for tonsillitis, decoction of fleshy root is used for breast cancer by taking one cup twice a day, crushed fleshy root is applied externally to cure burst inguinal lymphodeuopathy.

First time reported

Alocasia fornicata (Roxb.) Schott. (Syn. *Arum forniculatum* Roxb.). CIMP 2 : 32.1996; FBI 6 : 528.1890; FT 2 : 396.1983. **(Pl. III, Photo 9)**

Local name : Baibing
Family : Araceae
Locality : Lengpui (23°49'75" N and 92°37'5"E longitude), Kawnpui, Sairang, Darlawn.
Altitude : 400 – 1200 m.

Description : Perennial herb; large leaf with long petiole or sheath, fleshy, orbicular, entire, obtuse and base is cordate; spadix inflorescence with spathe where male and female flowers are embedded in such away that female on the lower portion; white flower, sessile; fruit long.

Phenology :
Leaf shedding : September – February
New leaf : March
Flowering : March – April
Place of flower: Spadix
Fruiting : May – August

Growth behaviour : Perennial herb, up to 0.50m in height.

Silvicultural character: Moderate light demander, resistant to jhum fire, natural and artificial regeneration has no difficulties.

Soil (*in situ* condition): pH=5.5, OC=0.62 %, P=0.56 kg/ha, K=114 kg/ha. (23° 49' 75" N and 92° 37' 5"E longitude).

Associates		:	*Pteridium aquilinum, Adiantum incisum, Adiantum capillus.*
Uses	MZ	:	Juice of the plant is applied on snakebite.

First time reported

Alstonia scholaris Brown. (Syn. *Echites scholaris* Linn., *Alstonia cuneata* Wall.). CCENI : 43.1994; CIMP 1 : 26.1995; FA 3 : 253.1939; FBI 3 : 642.1880; FFM : 599.1985; FT 2 : 12.1983; FTM : 74; FUG 2 : 34.1994; GIMP : 5.1956; IMP 2 : 1565.1935; IMPC 1: 111.1994; SGIMP : 5.1969; TIMP 4 :102.1995. **(Pl. IV, Photo 10)**

Local name	:	Thuamriat
Family	:	Apocynaceae
Locality	:	Darlung (23° 27' 75" N latitude and 92° 36' 75" E longitude), common every where in Mizoram.
Altitude	:	140 – 1400 m.
Description	:	Middle size tree; branch symmetrical dichotomy; bark grey with bitter milky juice; leaf whorled with eight number of leaflets in one whorl, obovate - lanceaolate, rounded or obtuse, dark green above but paler beneath, base tapering; flower greenish white in a panicle pyramidal; fruit long, follicle, linear, drooping; seeds possessing brown hair.
Phenology	:	Leaf shedding : September – October New leaf : February – March Flowering : February – March Place of flower: Terminal Fruiting : April – May
Growth behaviour	:	Deciduous tree, medium size, height up to 4 – 5m.
Silvicultural character	:	Light demander, resistant to high rainfall, acceptable to jhum fire, artificial and natural regeneration is easy.
Soil (*in situ* condition)	:	pH=5.5, OC=1.6 %, P=12.76 kg/ha, K=72 kg/ha. (23° 27' 75" N latitude and 92° 36' 75"E longitude)
Associates	:	*Tetrameles nudiflora, Bauhinia variegata, Duranta repens.*

Uses MZ : Decoction of bark is used against typhoid by taking the water at the rate of one cup thrice a day, its milky juice is applied to cure cuts and wounds.

EW : It is also reported that the bark is astringent tonic, anthelmintic, valuable in chronic diarrhoea and dysentery and milky juice is applied in ulcer (Kirtikar & Basu 1981). Some other reported that bark is useful in malarial fevers, asthma and bronchitis (Sala 1994).

Ampelocissus latifolia Planch. (Syn. *Vitis latifolia* Roxb.). FA 1 : 293.1934; FBI 1 : 651.1872; FFM : 242.1985; FUG 1 : 171.1994; GIMP : 60 : 1956; IMP 1: 606.1935; IT : 177. 1906. **(Pl. IV, Photo 11)**

Local name : Hruipawl
Family : Vitaceae
Locality : Chawnhu (22° 29' 25"N latitude and 92° 53' 55"E longitude), Ralvawng, Kawnpui, Khawbung.
Altitude : 1000 -1370m.

Description : Climber with long tendrils; stem is quadrangular, solid covered with powdery white substances, smooth green, node and inter-node very distinct, node with a purple color, young shoot hollow; leaf simple, alternate, stipulate, oblique covered with waxy like substances; flower red, pentamerous, small in a stout peduncle together with tendrils, fruit globose.

Phenology :
Leaf shedding : March – April
New leaf : May – June
Flowering : July – August
Place of flower: Axillary
Fruiting : August – October

Growth behaviour : Annual climbing herb, attains length up to 3 m.

Silvicultural character : Shade bearer, resistant to heavy rainfall, natural regeneration has no difficulty but artificial regeneration is very difficult.

Soil (*in situ* condition): pH=5.5, OC=0.88 %, P=0.56 kg/ha, K=88 kg/ha (22° 29'25"N latitude and 92° 53' 55"E longitude).

Associates : *Mikania micrantha, Chromolaena odorata, Ficus* spp.,

Uses MZ : Whole plant chewed raw to cure toothache.

EW : Roots are also applied to wounds (Kirtikar & Basu 1980).

Aporosa octandra (Buch. Ham. ex Don.) Vick. (Syn. *A. dioica* (Roxb.) Muell. Arg., *A. roxburghii* Baill.) CCENI : 220.1994; FA 4 : 162.1940; FBI 5 : 348.1886; FFM 2 : 773.1987; FTM : 77.1997; IMP:79.1956; IT : 563.1906. **(Pl. IV, Photo 12)**

Local name : Chhawntual
Family : Euphorbiaceae
Locality : Chawnhu (22° 29' 25"N latitude and 92° 53' 55"E longitude), Ralvawng, Rawpuichhip, S.Lungrang.
Altitude : 450 – 1070 m.

Description : Small evergreen tree; small trunk with many branches; bark pale brown, rough and thick; leaf newly developed red in color, alternate, linear, acute, cuspidate, entire; flower in cluster, yellow, male spike is long, bracteate, calyx pubescent.

Phenology :
Leaf shedding : Evergreen
New leaf : March – April
Flowering : November – January
Place of flower: Terminal
Fruiting : February – March

Growth behaviour : Evergreen tree, attains height of 3 – 5 m.

Silvicultural character : Moderate light demander, resistant to jhum fire and heavy rainfall, natural and artificial regeneration has no problems.

Soil (*in situ* condition): pH=5.9, OC=1.60 %, P=7.24 kg/ha, K=90 kg/ha. (22°29'25"N latitude and 92° 53' 55"E longitude).

Associates : *Schima wallichii, Sapium baccatum, Actinodaphne obovata, Clerodendrum viscosum.*

Uses MZ : Decoction of bark is taken one cup after every meal to cure stomach ulcer.

First time reported

Artemisia indica Willd. (Syn. *A. nilagirica* (Cl.) Pamp., *A. vulgaris* (non Linn.) Hook.f.). CCENI :49.1994; FA 3 : 119.1939; FBI 3 : 325.1880; FFM 2 : 518.1987; FM : 462.1981; FUG 1 : 477.1994; GIMP 26.1956; IMP 2 : 1395.1935; IMPC 1 : 202. 1994; TIMP 5 : 142.1997. **(Pl. V, Photo 13)**

Local name : Sai (h)
Family : Asteraceae
Locality : Khawbung (23° 9' 8"N latitude and 93° 13' 5"E longitude), Dungtlang, Ratu, Kolasib, etc.
Altitude : 1000 –1340 m.

Description : Tall aromatic herb or undershrub, stem cylindrical, paniculately branched, solid and brown; leaf simple, alternate, lanceolate, sagittate; white flower borne on panicled head, petal ligulate; fruit achene, minute, pappus absent.

Phenology :
Leaf shedding : June – November
New leaf : February - March
Flowering : December – March. However, flowering is in the month of August – November is reported by Chaterjee & Prakashi (1997).
Place of flower: Axillary
Fruiting : April – May

Growth behaviour : Shrub, grows in an open fallow land, attains up to 1 m. height.

Silvicultural character : Needs abundant light or moderate light demander, acceptable to jhum fire, moderately resistant to heavy rainfall, natural regeneration has no difficulties but artificial regeneration is difficult.

Soil (*in situ* condition): pH=4.3, OC=0.88 %, P=13.32 kg/ha, K=81 kg/ha. (23° 9' 8"N latitude and 93° 13' 5"E longitude).

Associates : *Schima wallichii, Ageratum conyzoides, Chromolaena odorata.*

Uses MZ : Decoction of leaf is used to cure stomach ulcer.

EW : Whole plant is used as antilithic, anthelmintic and also in measles and skin disease (Chaterjee & Prakashi 1997). Leaf is powerful deobsruent and antispasmodic (Lindley 1981).

Berginia ciliata (Haw.) Sternb. (Syn. *B. ligulata* Engl., *Saxifraga ligulata* Wall.). CCENI : 59.1994; CIMP 1 : 57.1995; CMPD : 54.1982; FA 2 : 233.1937; IMP 2 : 993.1935; IMPC 5 : 16.1996; NPEI : 41.1991; SGIMP :11.1969. **(Pl. V, Photo 14)**

Local name : Khamdamdawi
Family : Saxifragaceae
Locality : Farkawn (Lurh–23° 4'5"N latitude and 93°17'5"E longitude)
Altitude : 1935 m.

Description : Creeping plant with a big stout stem; root developed from the eye of the creeper; leaf developed at the apex of the stem only, big, green, darker on the above and paler beneath, young leaf with reddish brown on the lower surface, short petiole, fimbriate; flower white, big raceme, pentamerous.

Phenology :
Leaf shedding : September – October
New leaf : November
Flowering : May – June
Place of flower: Terminal
Fruiting : August – September. However, flowering and fruiting during February to April is reported by Jain *et al* 1991.

Growth behaviour : Creeping perennial herb, grows in a rocky hill slope, attains length of 1m

Silvicultural character: Shade bearer, resistant to high rainfall, but acceptable to jhum fire, natural and artificial regeneration has no problem problems.

Soil(*in situ* condition) : pH=4.5, OC=0.68 %, P=0.98 kg/ha, K=17 kg/ha. (23° 4' 5"N latitude and 93° 17' 5"E longitude).

Associates : *Setaria glauca, Eleusine indica, Cyperus rotundus.*

Uses MZ : Dried stem crushed into powder and mixed with water is taken at the dose of one cup thrice a day is used to cure severe diarrhoea and dysentery.

EW : Dried stem crushed into powder is used for treating piles (Malhotra & Balodi 1984). Dried rhizome astringent, tonic, given in ulcers, cough, spleen and also in urinary disease (Jain *et al* 1991).

Bidens biternata (Lour.) Merr. & Sheriff, (Syn. *B. bipinnata* Linn., *B. chinensis* (Linn.) Willd., *B. pilosa* Linn.,). CIMP 5:129.1998; FBI 3 : 309.1880; FT 2 : 204.1983; FUG 1 : 472.1994; GIMP : 37.1953; IMP 2 : 1373.1935; MPPI : 322.1986; SGIMP : 123.1969. **(Pl. V, Photo 15)**

Local name : Vawkpuithal / Chabet
Family : Asteraceae
Locality : Ratu (24° 6' 25"N latitude and 92° 55' 5"E longitude), common to everywhere in Mizoram.
Altitude : 140 – 1350 m.

Description : Annual herb; stem rectangular, pubescent; branch opposite; leaf usually two sub-opposite pair of leaflets, leaflet sub-sessile, ovate, acute, serrate; ray floret ligulate and white; fruit long, hairy.

Phenology :
Leaf shedding : Annual herb
Flowering : February – March
Place of flower: Axillary
Fruiting : April – May

Growth behaviour : Annual herb, grows in open waste land, attains up to 0.25m. height.

Silvicultural character: Light demand is high, acceptable to jhum fire, regenerate naturally.

Soil (*in situ* condition): pH=5.67, OC=1.20 %, P=0.87 kg/ha, K=98 kg/ha. (24° 6' 25"N latitude and 92° 55' 5"E longitude).

Associates : *Chromolaena odorata, Cyperus rotundus, Centella asiatica, Plantago major.*

Uses MZ : Young shoot chewed against rheumatism.

EW : Dried flower ground, mixed with alcohol for toothache, juice of the leaf for ear and eye complaints, infusion of leaf and root for colic (Kirtikar & Basu 1981).

Blumea laciniata (Roxb.) DC. FA 3 : 113.1938; FBI 3 : 264.1880; FT 2 : 206.1983; FUG 1 : 454.1994; NPEI : 46.1991. **(Pl. VI, Photo 16)**

Local name : Khuanglawi
Family : Asteraceae
Locality : Lengpui (23° 49' 5"N latitude and 92° 37' 5"E longitude), Sihphir, Darlawn, Bukpui, etc.
Altitude : 435 – 1350 m.

Description : Herb with an erect stout stem, dark reddish in colour; leaf sharply lobed, sinuate; flower yellow, broadly corymbose; involucre bracts lanceolate, acuminate; fruit achenes; pappus white.

Phenology :
Leaf shedding : June – July
New leaf : November
Flowering : March – April
Place of flower: Axillary
Fruiting : May – June

Growth behaviour : Herb, grows in dense forest, attains up to 0.25m height.

Silvicultural character: Moderate light demander, acceptable to jhum fire, resistant to heavy rainfall, natural regeneration is very adequate.

Soil (*in situ* condition): pH=5.5, OC=0. 88 %, P=26 kg/ha, K=121 kg/ha. (23° 49' 5"N latitude and 92° 37' 5"E longitude).

Associates : *Polygonum* spp., *Musa* spp.

Uses MZ : Crushed root made into paste is applied on snake-bite externally.

EW : Leaves are used for curing eczema and other skin affections (Rajwar 1983).

Candidate Species

Blumea lanceolaria (Roxb.) Druce. (Syn. *Blumea myriocephala* DC., *Gynura conyza* Sp.) CIMP 2:102.1996; FT 2 : 207.1983; GIMP : 38.1956. SGIMP : 129.1969. **(Pl. VI, Photo 17)**

Local name : Buarze
Family : Asteraceae
Locality : Serchhip(23° 9' 75"N latitude and 92° 46' 75"E longitude), Ralvawng, Zemabawk.
Altitude : 1070 – 1300 m.

Description : Stem green, stout; leaf spirally alternate, simple, acute, oblanceolate, serrate; flower white, capitate with ray and disc florets; fruit achene, white pappus.

Phenology :
Leaf shedding : June – July
New leaf : November
Flowering : March – April
Place of flower: Terminal
Fruiting : May – June

Growth behaviour : Perennial herb, mostly grows in a shady moist condition, attains height up to 1.5 m.

Silvicultural character: Shade bearer, resistant to heavy rainfall, natural regeneration has no difficulty but artificial regeneration is very difficult.

Soil (*in situ* condition): pH=6.01, OC=1.10 %, P=2.22 kg/ha, K=99 kg/ha. (23° 9'75"N latitude and 92° 46'75"E longitude).

Associates : *Ageratum conyzoides, Mikania micrantha, Begonia* spp., *Musa* spp.

Uses MZ : Leaf chewed raw or decoction of leaf is taken at SOS to cure stomachache.

EW : Decoction of leaf with leaves of *Blumea sessiliflora, Blumea balsamifera* and *Mikania cordata* used for bathing to cure body pain (Asolkar 1992).

Candidate Species

Callicarpa arborea Roxb.ex Clarke., CCENI : 66.1994; CIMP 2 : 121.1996; FA 3 : 463.1939; FFM : 672.1987; FT 2 : 203.1983; FUG 2 : 219.1994; GIMP : 45.1956; IMP 3 : 1920.1935; IT : 512.1906; NPEI : 55.1991; SGIMP : 155.1969. **(Pl. VI, Photo 18)**

Local name : Hnahkiah
Family : Verbanaceae
Locality : Darlawn (24°1'N latitude and 92°55'5"E longitude), Hnahthial, Sihphir, Sairang.
Altitude : 450 – 1500 m.

Description : Small tree; trunk stout; bark light grey and soft; leaf big, rough, opposite, elliptic-lanceolate, ovate, acute, entire, base cuneate; flower pale purple at axillary peduncle, fruit drupe.

Phenology :
Leaf shedding : October - December
New leaf : March
Flowering : April – June
Place of flower: Axillary
Fruiting : August – September

Growth behaviour : Deciduous tree, grows in thick forest, attains height up to 8m.

Silvicultural character : Moderate light demander, resistant to jhum fire and heavy rainfall, regenerate naturally and artificially.

Soil (*in situ* condition): pH=5.56,OC=0.76 %, P=1.67 kg/ha, K=105 kg/ha. (24° 1'N latitude and 92° 55' 5"E longitude)

Associates : *Albizia chinensis, Syzygium fructicosa, Wendlandia grandis.*

Uses MZ : Bark juice is used to cure cuts and wounds.

EW : Decoction of bark is applied in cuteneous diseases and considered tonic and carmative (Kirtikar & Basu 1986). Juice of its bark is also used for pneumonia (Dar *et al* 1983). Bark is also used in various skin diseases (Saklani & Jain 1994).

Cassia alata Linn. (Syn. *C. herpatica* Jacq., *C.bracteata* Linn. f . Sppl., *Senna alata* Roxb.). CCENI : 71.1994; CIMP 2 : 147.1996; FA 2 : 133.1938; FBI 2 : 264.1976; FFM 1 : 319.1985; FM : 260.1981; GIMP : 54.1956; IMP 2 : 870.1935; MPW : 101.1999; SGIMP : 176.1969; TIMP 2 : 34.1992. **(Pl. VII, Photo 19)**

Local name : Tuihlo
Family : Caesalpiniaceae
Locality : Lawngtlai (22° 32'N latitude and 92° 53' 6"E longitude), Ralvawng.
Altitude : 820 – 1200 m.

Description : Domesticated; not seen in the forest; stem solid; bark dark grey; branching in alternate manner; leaf sub-sessile, leaflets oblong, cuspidate, obtuse, stalk, entire; flower large, yellow, stamens unequal, raceme peduncle inflorescence; fruit four winged pods.

Phenology :
Leaf shedding : October – December
New leaf : February – March
Flowering : October – November
Place of flower: Terminal
Fruiting : December

Growth behaviour : Large shrub grows in an open land, height up to 1.5 – 2 m.

Silvicultural character : Moderate light demander, resistant to heavy rainfall, regenerate naturally.

Soil (*in situ* condition): pH=5.5, OC=0.62 %, P=0.56 kg/ha, K=114 kg/ha. (22° 32'N latitude and 92° 53' 6"E longitude).

Associates : *Mangifera indica, Psidium guajava, Ficus* spp.

Uses MZ : Crushed leaf is applied to cure skin diseases like tinea versicolar, ringworms.

EW : It is also reported that leaf cures all poisonous bites, strengthen the body (Lindley 1981). Decoction of dried leaves is taken orally for asthma (Ross 1999).

Centella asiatica (L.) Urb. (Syn. *Hydrocotyle asiatica* Linn.). ADPS : 290.1994; CCENI : 74.1994; CIMP 1 : 96. 1995; FA 2 : 340.1938; FBI 2 : 669.1876; FJ : 218.1981; FT 2 : 192.1983; IMP 2 : 1193.1935; IMPC 2 : 52.1994: MP : 48.1968; SGIMP : 14.1969; TIMP 4 : 33.1996. **(Pl. VII, Photo 20)**

Local name : Lambak
Family : Apiaceae
Locality : Lungdai (23° 53'N latitude and 92° 44' 5"E longitude), common to everywhere in Mizoram.
Altitude : 190 – 1500 m.

Description : Prostrate herb; rooting at the nodes; stem small and delicate; leaf orbicular-reniform, entire, crenate or lobulate; bracteate but small , ovate; flower white in fascicled umbels, sessile; fruit ovoid, hard.

Phenology : Leaf shedding : Not periodical
Flowering : April – May
Place of flower: Axillary
Fruiting : May – June

Growth behaviour : Prostrate herb, grows in a shade locality, attains height up to 0.025m.

Silvicultural character: Shade bearer, resistant to drought and heavy rainfall, natural and artificial regeneration has no difficulties.

Soil (*in situ* condition): pH=5.5, OC=1.02 %, P=0.65 kg/ha, K=72 kg/ha. (23° 53'N latitude and 92° 44' 5"E longitude).

Associates		:	*Plantago major, Sonchus* spp., Grasses.
Uses	MZ	:	Whole plant is boiled or fried as vegetable, used for heart disorder.
	EW	:	The plant is significant in peptic ulcer (Chao *et al* 1981). Sedative action (Ramaswamy *et al* 1970; Agarwal 1981). Significant improvement in anxiety neurosis (Singh *et al* 1981).

Chonemorpha fragrans (Moon) Alston, (Syn. *Echites fragrans* Moon, *Chonemorpha macrophylla* (Roxb.) G. Don.). CIMP 2 : 53.1996; FA 3 : 270.1938; FBI 3 : 668.1880; GIMP : 73.1956. IMP 2 : 1590.1935. **(Pl. VII, Photo 21)**

Local name	:	Theikelki suak
Family	:	Apocynaceae
Locality	:	Ralvawng (22° 57'N latitude and 92° 51' 5"E longitude)
Altitude	:	1070m.
Description	:	Climbing shrub, large woody branch; stem fluted and stout; bark smooth, brown and thick; leaf large, simple, short-petioled, elliptic or oblong, acuminate, base rounded; flower white turning yellow, fragrant, in terminal cyme, calyx tube; follicle long.
Phenology	:	Leaf shedding : December – February New leaf : April Flowering : January – March Place of flower: Axillary Fruiting : March – April
Growth behaviour	:	Shrub, attains height up to 2 m.
Silvicultural character	:	Light demander, resistant to jhum fire, natural regeneration is difficult but artificial regeneration is easy through stem cutting.
Soil (*in situ* condition):		pH=5.6, OC=0.65 %, P=6.58 kg/ha, K=121 kg/ha. (22° 57'N latitude and 92° 51' 5"E longitude)
Associates	:	*Schima wallichii, Saurauja punduana,* Bamboo.

Uses MZ : Decoction of bark is used as a remedy of stomach trouble.

EW : Root is used to have ipecacuanha properties (Chopra *et al* 1969). Root bark is also used in urinary, heart and skin diseases, control vomitting and purifies blood (Sivaranjan & Baluchandan 1994).

Chromolaena odorata (L.) King & Robn. (Syn. *Eupatorium odoratum* L.). CCENI : 76.1994; CIMP 4 : 306. 1997; FA 3 : 108.1939; FBI 3 : 244.1880; FFM : 522.1987; FT 2 : 218.1983; GIMP : 113.1956; NPEI : 67.1991; SGIMP : 158.1969. **(Pl. VIII, Photo 22)**

Local name : Tlangsam
Family : Asteraceae
Locality : Khawbung (23° 9' 8"N latitude and 93° 13'E longitude), Serchhip, Sairang, Bukpui.
Altitude : 450 – 1340 m.

Description : Shrub; stem and branches glandular, pubescent when young; leaf opposite, ovate-lanceolate, acuminate, dentate-serrate, base oblique; flower light blue, terminal axillary, corymb inflorescence; bracteolate; fruit minute, anaemophyllic.

Phenology :
Leaf shedding : partial shedding in January - February
New leaf : March – April
Flowering : October – December
Place of flower: Axillary
Fruiting : December – January

Growth behaviour : Shrub, grows in open waste land, attains up to 0.75m. height.

Silvicultural character : Light demander, acceptable to jhum fire but resistant to drought, natural regeneration is adequate.

Soil (*in situ* condition): pH=5.6, OC=0. 93 %, P=12 kg/ha, K=90 kg/ha. (23° 9' 8"N latitude and 93° 13'E longitude)

Associates		:	*Mikania micrantha, Schima wallichii,* ferns.
Uses	MZ	:	Leaf crushed applied to cuts and wounds.
	EW	:	Decoction of leaves is taken for dysentery (Kharkongor & Joseph 1981).

Chikrassia tabularis Wight. & Arn. (Syn. *Chukrassia tabularis* A. Juss., *Plagiotaxis chikrassa* Wall., *Swietenia chikrassa* Roxb.). CIMP 2 : 179.1996; FA 1 : 241.1934; FBI 1 : 568.1872; FM : 157.1981; GIMP : 63.1956; IMP 1 : 560.1935; IT : 144.1906; SGIMP : 199.1969; TIMP 3 : 79.1994.

Local name	:	Zawngtei
Family	:	Meliaceae
Locality	:	Bualte (22° 48'N latitude and 92° 49' 25"E longitude), Zotlang, Rawpuichhip, Darlawn.
Altitude	:	550 –1300 m.
Description	:	Big tree with wide canopy; bark brownish – black, rough deeply fissured; leaf pinnate, leaflet 5- 8 pairs, alternate, ovate-lanceolate; flower pinkish white in terminal panicles, petals erect; fruit woody dark brown capsule; seed winged, brown flat.
Phenology	:	Leaf shedding : November – December New leaf : February – March Flowering : April – May Place of flower: Terminal panicles Fruiting : December – March
Growth behaviour	:	Deciduous tree, straight trunk, attain height of 7-8m. with a girth of 2 – 4m.
Silvicultural character	:	Moderate light demander, resistant to jhum fire, drought and heavy rainfall, naturally regenerate, but artificial regeneration is very difficult.
Soil (*in situ* condition)	:	pH=6.0, OC=1.43 %, P=123 kg/ha, K=202 kg/ha. (22° 48'N latitude and 92° 49' 25"E longitude)
Associates	:	*Cinnamomum glanduliferum, Anogeissus acuminata*

Uses	MZ	:	Decoction of bark and outer cover of fruit or seed is used against diarrhoea and gastric problem.
	EW	:	Bark is powerfully astringent (Lindley 1981).

Cinnamomum bejolghota (Buch. Ham.) Sweet. (Syn. *C. obtusifolium* Roxb. ex Nees.). CCENI : 76.1994; CIMP 4 : 185.1997; FA 4 : 56.1940; FBI 5 : 128.1886; FFM : 720.1987; GIMP : 65.1956; IMP 2 : 2147.1935.

Local name	:	Thakthingsuak
Family	:	Lauraceae
Locality	:	Sihphir (23° 48' 5"N latitude and 92° 44'E longitude), Ralvawng.
Altitude	:	1070 – 1300 m.
Description	:	Tree with dense ovoid crown; bark dark grey and rectangular; leaf opposite, large, elliptic obtuse, distinct nerve from the base of the lamina, base cuneate; flower yellowish–white, large panicle; fruit ellipsoidal.
Phenology	:	Leaf shedding : September – December New leaf : January – February Flowering : February – March Place of flower: Sub-terminal Fruiting : April – September
Growth behaviour	:	Small tree, grows in open forest, attains height upto5 m.
Silvicultural character	:	Moderate light demander, acceptable to jhum fire, resistant to heavy rainfall, regenerate naturally and artificially.
Soil (*in situ* condition)	:	pH=5.4, % OC=1.62, P=0.62 kg/ha, K=90 kg/ha. (23° 48' 5"N latitude and 92° 44'E longitude)
Associates	:	*Aporosa octandra, Wendlandia grandis, Derris thyrsiflora, Itea macrophylla.*
Uses MZ	:	Decoction of bark is used to cure liver disorder by taking one teaspoon full thrice a day.

EW : Bark is also used for urinary trouble and stone in gall bladder (Saklani & Jain 1994).

Cinnamomum verum Presl., (Syn. *C. zeylanicum* Blume.) CCENI : 77.1994; CIMP 2 : 183.1996; FBI 5 : 131.1886; IMP 3 : 2149.1935; IMPC 2 : 87.1994; SGIMP : 204.1969; TIMP 1 : 105.1991. **(Pl. VIII, Photo 23)**

Local name : Thakthing
Family : Lauraceae
Locality : Sihphir (23° 48'N latitudes and 92° 43' 75"E longitudes), Kolasib, Thenzawl, etc.
Altitude : 500 - 1300m.

Description : Evergreen small tree, all parts of the plant aromatic; bark dark brown, thick; leaf opposite, ovate – lanceolate, acute, the upper surface with distinct mid-rib in a parallel manner and shinning, base acute; flower white, panicles usually longer than leaves; fruit ellipsoidal.

Phenology :
Leaf shedding : Evergreen
New leaf : March – April
Flowering : March – April
Place of flower: Terminal of the branches
Fruiting : May – June

Growth behaviour : Evergreen tree, coppice shoots are very vigorous and grow up to 3-4m in height.

Silvicultural character : Moderate light demander, good coppicer.

Soil (*in situ* condition): pH=4.5, OC=0.63 %, P=1.62 kg/ha, K=78 kg/ha. (23° 48'N latitudes and 92° 43.75'E longitudes)

Associates : *Oroxylum indicum, Prunus cerosoides, Wendlandia grandis.*

Uses MZ : Infusion of leaves is used for cough and root bark is eaten raw against vomiting.

EW : Bark is useful in bronchitis, asthma, cardiac disorder and diarrhoea (Sala 1994).

Clerodendrum colebrookianum Walp. (Syn. *C. glandulosum* Coleb. ex Walp.) CCENI :79.1994; CIMP 3 :184.1996; FA 3 : 488.1939; FFM : 676.1987; FT 2 : 107.1983; NPEI : 72.1991; SGIMP : 216.1969. **(Pl. VIII, Photo 24)**

Local name : Phuihnam
Family : Verbenaceae
Locality : Bukpui (24° 5'N latitude and 92° 47'E longitude) and frequent in degraded forest.
Altitude : 350 – 1600m.

Description : Shrub; bark dark grey, stem quadrangular, green, lenticellate; leaf big, ovate – orbicular, acuminate, cordate; flower white, terminal corymbs; fruit drupes, globose, green when young, blueish – black when ripe.

Phenology :
Leaf shedding : October - January
New leaf : February – April
Flowering : September - October. Fruiting during June – December is reported by Jain *et al* (1991).
Place of flower: Terminal
Fruiting : October – January

Growth behaviour : Shrub, height attains up to 1m.

Silviculture character : Moderate light demander, resistant to heavy rainfall, regeneration by natural and artificial methods.

Soil (*in situ* condition): pH=5.5, OC=0.82 %, P=0.67 kg/ha, K=62 kg/ha. (24° 5'N latitude and 92° 47'E longitude)

Associates : *Zanthoxylum rhetsa, Psidium guajava, Mangifera indica.*

Uses MZ : Infusion of leaves is taken as vegetables to cure hypertension.

EW : Young leaves taken to kill intestinal worms (Borthakur 1976). Decoction of root, leaves and bark for malarial fever (Rao & Jamir 1982).

Costus speciosus (Koen. ex Retz.) Smith. ADPS : 108.1994; CCENI : 83.1994; CIMP 2 : 215.1996; CMPD : 88.1982; FBI 6 : 249.1890; FJ : 519.1983; FT 2 : 371.1983; GIMP : 78.1056; IMPC 2 : 201.1935; MP : 62.1968; NPEI : 83.1991; SGIMP : 234.1969. **(Pl. IX, Photo 25)**

Local name : Sumbul
Family : Costaceae
Locality : Sihphir (23° 48'N latitude and 92° 44'E longitude), Ralvawng, etc.
Altitude : 200 -1300m.

Description : Erect, perennial herb with tuberous rhizome; leafy stem, stout, leaf oblong, acute almost without petiole, spirally arranged, pubescent beneath, bracteate; flower white in dense long spike; fruit capsule.

Phenology :
Leaf shedding : not recorded
Flowering : June – October
Place of flower: Terminal
Fruiting : October – March. Flowering and fruiting during August-September is reported by Jain *et al* (1991).

Growth behaviour : Perennial herb, attains height up to 0.25m.

Silvicultural character : Shade bearer, can withstand heavy rainfall; natural and artificial regeneration has no difficulty.

Soil (*in situ* condition): pH=5.4, OC=0.86 %, P=1.83 kg/ha, K=82 kg/ha. (23° 48'N latitude and 92° 44'E longitude)

Associates : *Albizia procera, Clerodendrum bracteata, Mikania micrantha.*

Uses MZ : Rhizomes are used in venereal disease with mixture of sugar.

EW : Rhizomes for jaundice and curing leprosy (Rao 1981). Stem used for burning sensation in urination (Saklani & Jain 1994).

Dendrocnide sinuata (Bl.) Chew. (Syn. *Laportea crenulata* Gaud., *Urtica crenulata* Roxb). CCENI : 92.1994; FA 2 : 281.1935; FBI 3 : 550.1886; FFM : 843.1987; GIMP : 150.1956; IT : 616.1906; SGIMP : 265.1969. **(Pl. IX, Photo 26)**

Local name : Thakpui
Family : Urticaceae
Locality : Tamdil (23° 44' 25"N latitude and 92° 57' 25"E longitude), Lunglei, Sairang, etc
Altitude : 250 -1270m.

Description : Young part pubescent; bark pale grey; leaf big, broadly elliptic, acuminate, base cordate, petiole stout and has burning sensation; flower greenish white in axillary pediceled; fruit achene.

Phenology :
Leaf shedding : Evergreen
New leaf : March – April
Flowering : December – March
Place of flower: Axillary
Fruiting : May – June

Growth behaviour : Evergreen shrub, grows in a shady place, attains up to the height of 1.5m.

Silvicultural character : Shade bearer, natural regeneration has no problems, resistant to heavy rainfall.

Soil (*in situ* condition): pH=5.4, OC=12.40%, P=13.02 kg/ha, K=112 kg/ha. (23°44'25"N latitude and 92° 57'25"E longitude)

Associates : *Hydechium coccinium, Polygonum glabrum, Rubus birmanicus.*

Uses MZ : Root crushed and mixed with water, taken against diarrhoea and dysentery. Root and bark are crushed into powder and mixed with water is used to remove retain placenta by drop into the vagina.

EW : Roots and leaves applied to swellings and blind abscesses (Asolkar *et al* 1992).

Diospyros variegata Kurz. CIMP 2 : 280.1996; FA 3 : 205.1938; FBI 3 : 557.1880. **(Pl. IX, Photo 27)**

Local name : Raisentur
Family : Ebenaceae
Locality : S.Lungrang (22° 44'N latitude and 92° 38'75"E longitude)
Altitude : 148m.

Description : Grows in a dense forest; bark blackish, deep vertical furrow; root bulbous; stem solid, light green, branching dichotomous; leaf big, opposite, entire, elliptic, acute, short petiole, young leaf is red; male flowers yellowish white in cymose clusters, slaver-shaped, lobes; fruit solitary, sub- globose.

Phenology :
Leaf shedding : September – October
New leaf : February – March
Flowering : April - May
Fruiting : October -December

Growth behavour : Shrub, attains up to 1m. height.

Silvicultural character : Low light demander, resistant to jhum fire, regenerate naturally.

Soil (*in situ* condition): pH=5.2, OC=0.92 %, P=3.33 kg/ha, K=150 kg/ha. (22° 44'N latitude and 92° 38'75"E longitude)

Associates : *Acer laevigatum, Chromolaena odorata, Rubus* spp., Bamboo.

Uses MZ : Root bark is air dried and powdered, mixed with water. One pinch of the powder is enough for one cup of water. Used against severe diarrhoea, dysentery and stomach ulcer by taking one cup thrice daily.

Dysoxylum gobara (Buch.- Ham.) Merr. (Syn. *D. procerum* Hiem.) CCENI : 254.1994; FFM : 209.1985; FJ 1 : 128.1981; IT : 138.1906. **(Pl. X, Photo 29)**

Local name : Thingthupui
Family : Meliaceae

Locality : Kawnpui (24°2'25"N latitude and 92° 40'55"E longitude), Chhingchip, Chhungte, etc.

Altitude : 530 - 1340m.

Description : Medium to large sized tree; bark dark-grey; leaf large and long, pinnate, leaflet alternate, ovate or elliptic, acute; petiole stout and short; flower white, fragrant; fruit capsule.

Phenology :
Leaf shedding : Evergreen
New leaf : March - June
Flowering : May – August
Place of flower: Axillary
Fruiting : July – August

Growth behaviour : Evergreen tree, grows in open land, attains height up to 5m.

Silvicultural character : Moderate light demander, resistant to jhum fire, natural and artificial regeneration is not difficult.

Soil (*in situ* condition): pH=6.1, % OC=1.23, P=56 kg/ha, K=110 kg/ha. (24° 2'25"N latitude and 92° 40'55"E longitude)

Associates : *Mangifera indica, Artocarpus heterophyllus*

Uses MZ : Decoction of leaf is used for diarrhoea, dysentery and stomach problems.

First time reported

Elaeagnus caudata Schlecht ex Momiyama (Syn. *E. conferta* Roxb., *E. latifolia* Linn.) CCENI : 100.1994; FA 4 : 114.1940; FBI 5 : 202,1886; FFM : 752.1987; GIMP : 105.1956; IMP 3 : 2175.1935; TIMP 3 : 183.1994. **(Pl. X, Photo 30)**

Local name : Sarzukpui

Family : Elaeagnaceae

Locality : Chaltlang (23° 44' 25"N latitude and 92° 43' 5"E longitude), Saitual, Lungdai.

Altitude : Up to 1500m.

Description : Shrub with blunt spines; bark light grey; leaf alternate, elliptic, acute, glossy above but silvery beneath; flower white in axillary peduncle; fruit elliptic – oblong, green but red or yellow when ripe.

Phenology :
Leaf shedding : October
New leaf : February – March
Flowering : November – December
Place of flower: Axillary
Fruiting : February – April

Growth behaviour : Shrub, grows in open land, height depends on the associates.

Silvicultural character: Moderate light demander, but more light is needed for fruiting, resistant to heavy rainfall, regeneration by natural and artificial method.

Soil (*in situ* condition): pH=5.5, OC=1.52 %, P=0.63 kg/ha, K=67 kg/ha. (23o 44'25"N latitude and 92o 43'5"E longitude)

Associates : *Leea crispa, Prunus cerasoides.*

Uses MZ : Infusion of root is used to remove retain placenta.

EW : Aerial part spasmolytic (Saklani & Jain 1994).

Engelhardtia spicata Lechen ex Blume. (Syn. *E. colebrookiana* Lindl. ex Wall.) CCENI : 104.1994; CIMP 5 : 329.1998; FA 4 : 299.1940; FBI 5 : 595.1886; FFM : 850.1987; GIMP : 107.1956; SGIMP : 193.1969. **(Pl. XI, Photo 31)**

Local name : Hnum
Family : Juglandaceae
Locality : Vangtlang (23° 23' 75"N latitude and 93° 11' 50"E longitude), Khawzawl, Khawlailung, Ralvawng.
Altitude : 500 -1060m.

Description : Large deciduous tree, bark grey and rough; leaf pinnately compound, leaflet oblong – lanceolate, entire, pubescent; flower yellow, where female flower pendulous while male flower slender spike.

Phenology	:	Leaf shedding :	October –December
		New leaf :	January – March
		Flowering :	March – April
		Place of flower:	Terminal
		Fruiting :	May – June
Growth behaviour	:	Deciduous tree, grows in an open area of virgin forest, attains height up to 5 –8m.	
Silvicultural character	:	Moderate light demander, resistant to heavy rainfall, regeneration difficult.	
Soil (*in situ* condition)	:	pH=5.0, OC=0.62 %, P=5.17 kg/ha, K=99 kg/ha. (23° 23' 75"N latitude and 93° 11' 50"E longitude)	
Associates	:	*Terminalia myriocarpa, Myristica laurifolia, Schima wallichii.*	
Uses MZ	:	Decoction of bark is used for diarrhoea and dysentery.	
EW	:	Root is used for scabies (Saklani & Jain 1994).	

Candidate Species

Ficus benjamina Linn. CCENI :111.1994; CIMP 5 : 371.1998; FA 4 : 243.1940; FBI 5 : 508.1886; FFM : 821.1987; GIMP : 118.1956; SGIMP : 313.1969. **(Pl. XI, Photo 32)**

Local name	:	Hmawng zaman (JHR)
Family	:	Moraceae
Locality	:	Lungsen (22° 44' 5"N latitude and 92° 43' 5"E longitude)
Altitude	:	854 – 1500m.
Description	:	Evergreen, medium to large size tree with drooping branches; bark grey, smooth; leaf alternate, oblong, cuspidate, entire; male flower few, pedicel and spathe present, scattered; and female flower sessile, receptacle – axillary.

Phenology	:	Leaf shedding :	Evergreen
		Flowering :	June - July
		Place of flower:	Axillary
		Fruiting :	August - September
Growth behaviour	:	Evergreen tree, grows in a closed virgin forest and height depends on the associates.	
Silvicultural character	:	Low light demander, resistant to heavy rainfall and jhum fire, natural and artificial regeneration is easy.	
Soil (*in situ* condition)	:	pH=5.1, OC=1.6 %, P=5.12 kg/ha, K=162 kg/ha. (22° 44'5"N latitude and 92° 43'5"E longitude)	
Associates	:	*Aegle marmelos, Parkia roxburghii*, Bamboo	
Uses MZ	:	Decoction of bark is used for treatment of malarial fever by taking one cup everyday and took bath once everyday.	
EW	:	Stem is used for stomach trouble (Saklani & Jain 1994).	

Garcinia sopsopia (Buch. – Ham.) Mabb.(Syn. *G. paniculata* (G. Don) Roxb.). FA 1: 108.1934; FFM : 108.1985; IT : 1906. **(Pl. XI, Photo 33)**

Local name	:	Vawmva	
Family	:	Clusiaceae	
Locality	:	Rawpuichhip(23° 47'50"N latitude and 92° 33'80"E longitude), Kawrtethawveng, Ralvawng, Lungrang.	
Altitude	:	400 – 1200m.	
Description	:	Medium to large size tree, bark dark grey and smooth; leaf opposite, big, ovate; flower white, male flower in terminal panicle and few female flower terminal spike; fruit is oval, berry.	
Phenology	:	Leaf shedding :	Evergreen
		Flowering :	November - February
		Place of flower:	Terminal axillary
		Fruiting :	March – June

Growth behaviour	:	Evergreen tree, grows in a vacant area of forest, attains height up to 12m.
Silvicultural character	:	Moderate light demander, no problem in natural and artificial regeneration.
Soil (*in situ* condition)	:	pH=5.5, OC=0.66 %, P=6.20 kg/ha, K=82 kg/ha. (23° 47'50"N latitude and 92° 33'80"E longitude)
Associates	:	*Palagium polyanthus, Sopsosina ternatum. Magnolia pterocarpa.*
Uses MZ	:	Bark is made into powder and applied in snake bite.

First time reported

Gmelina arborea Roxb. ADPS : 204.1994; AE : 117.1996; CCENI : 120.1994; FA 3 : 466.1939; FFM : 679.1987; FT 2 : 110.1983; FTM : 37.1997; FUG 2 : 220.1994; GIMP : 126.1956; IMP 3 : 1932.1935; IMPC 3 : 91.1995; IT : 509.1906; SGIMP : 335.1969; TIMP 4 : 226.1995. **(Pl. XII, Photo 34)**

Local name	:	Thlanvawng
Family	:	Verbenaceae
Locality	:	Hmunpui (23° 52'N latitude and 92° 35'E longitude), Selesih, Samthang, etc
Altitude	:	260 - 1340m.
Description	:	Deciduous tree, bark smooth and grey; branching with wide canopy; leaf broadly ovate, acuminate, entire; flower yellow, campanulate, panicle long, hairy, bracteate; fruit drupe, pyriform or ovoid.
Phenology	:	Leaf shedding : October – November.However, leaf shedding is also reported during February – April (Brandis 1990).
		New leaf : April - May
		Flowering : February - March. Sometime flowering period extended to April (Brandis 1990 & Varghees 1996).
		Place of flower: Axillary
		Fruiting : May - June

Growth behaviour : Deciduous tree, grows in a virgin forest, attains height up to 5m.

Silvicultural character : Moderate light demander, resistant to heavy rainfall and jhum fire, regenerate naturally and artificially.

Soil (*in situ* condition): pH=5.6, OC=0.65 %, P=1.37 kg/ha, K=97 kg/ha. (23° 52'N latitude and 92° 35'E longitude)

Associates : *Schima wallichii, Deris robusta, Ficus* spp.

Uses MZ : Root is used to stop burning sensation by making paste and applied externally, decoction of root is also taken for fever and blood disease.

EW : Bark paste to heal bone fracture, wound, root for blood purification, malaria; leaf for cough, bronchitis, cholera and dropsy (Varghees 1996).

Gynocardia odorata R. Br. (Syn. *Chaulmogra odorata* Roxb. *Chilmoria dodecandia* Hans.) CCENI : 121.1994; CIMP 1 : 206.1995; FA 1: 87.1934; FBI 1 : 195.1872; FFM : 92.1985; GIMP : 129.1956; IT : 40.1906; MPPI : 289. 1986; SGIMP : 341.1969; TIMP 3 : 146.1994. **(Pl. XII, Photo 35)**

Local name : Sai thei
Family : Flacourtiaceae
Locality : Sairep (22° 49' 5"N latitude and 92° 49' 5"E longitude), Bualte, Zotlang, Hmunpui.
Altitude : 1100 - 1556m.

Description : Evergreen big tree with huge branches; bark dark grey; leaf big, orbicular, entire, alternate; flower pale yellow, sweet odour, fascicle or in large bunches from the trunk, petals oblong, stamens many; fruit big, globose; seed ovoid.

Phenology :
Leaf shedding : Evergreen tree
New leaf : November
Flowering : March–April.However,flowering during hot season was reported by (Brandis 1906).
Place of flower: Main trunk

Fruiting : November – February. It is also reported elsewhere that fruiting is in the month of May & June (Varghees 1996).

Growth behaviour : Evergreen tree, grows in a thick virgin forest, attains height up to 8m.

Silvicultural character : Low light demander, prefer shade condition, resistant to high rainfall and jhum fire, natural and artificial regeneration is not difficult.

Soil (*in situ* condition): pH=6.5, OC=1.60 %, P=56 kg/ha, K=114 kg/ha. (22° 49'5"N latitude and 92° 49'5"E longitude)

Associates : *Castanopsis tribuloides, Syzygium* spp., *Quercus* spp., *Elaeocarpus tectorius.*

Uses MZ : Bark paste is applied externally for sore throat and the decoction is also taken for the same.

EW : Seeds are alterative tonic, in scrofula, skin disease, rheumatism and leprosy (Bently & Trimen 1981).

Hedyotis scandens Roxb. (Syn.*Oldenlandia scandens* K. Schum.). CCENI : 123.1994; CMPD : 58.1982; FA 3 : 37.1939; FBI 3 : 57.1880; FFM : 475.1987; FT 2 : 57.1983; IT : 375.!906; NPEI : 122.1991; SGIMP : 345.1969. **(Pl. XII, Photo 36)**

Local name : Kel hnamtur
Family : Rubiaceae
Locality : Khawbung (23° 10'N latitude and 93° 13' 5"E longitude), Pangzawl, N. Chaltlang, etc.
Altitude : 560 -1340m.

Description : Climber, climbing over low bushes; branches terete; stem purplish-tinged, bigger at the node, rough and solid; leaf opposite, lanceolate, entire, acuminate, cuneate; flower axillary, white, sub- umbellate; fruit obovoid or globose; seeds minute and numerous.

Phenology	:	Leaf shedding :	partial shedding in winter.
		Flowering :	May - June. However, flowering in cold weather reported by Biswas & Chopra (1982).
		Place of flower:	Axillary
		Fruiting :	July - August
Growth behaviour	:	Climbing herb, grows in a shaded dense forest, attains height up to 1.5m.	
Silvicultural character	:	Low light demander, tolerate shade in early stage, resistant to high rainfall, natural regeneration satisfactory, artificial regeneration through stem cuttings.	
Soil (*in situ* condition)	:	pH= 4.9, OC=0.88 %, P=12.21kg/ha, K=261 kg/ha. (23° 10'N latitude and 93° 13'5"E longitude).	
Associates	:	*Thea sinensis, Maesa indica, Schima wallichii, Artocarpus gomezianus.*	
Uses	MZ :	Decoction of leaves is used to pulvarised kidney stone by taking one cup twice a day.	
	EW :	Root colic (Biswas & Chopra 1982). Root is used for rheumatism (Chopra *et al* 1998). Leaves is also used for dysentery, diarrhoea and eye trouble (Saklani & Jain1994).Juice of crushed root is taken to remove worms and also for jaundice (Bennet 1995). Garos of Meghalaya give the decoction of its root to children for dysentery (Kumar *et al* 1980). Its crushed leaves are rubbed on skin to cure wart like disease (Rao & Jamir 1982).	

Candidate species

Ilex umbellulata *(* Wall.) Loes. (Syn. *I. godajam* Coleb. ex Wall.). FBI 1 : 601.1872; FTM : 180.1997; SGIMP : 366.1969. **(Pl. XIII, Photo 37)**

Local name	:	Thinguihahni
Family	:	Aquifoliaceae
Locality	:	Ralvawng (22° 57'2"N latitude and 92° 51'5"E longitude), Sihphir, Hmunpui, etc.

Altitude	:	853 -1070m.
Description	:	Grows in a thick forest; stem hard and solid; bark thick, soft and horizontally wrinkled, light grey, branching from the node; leaf alternate, elliptic, acuminate, acute, entire; flower bisexual, complete, pentamerous, white; fruit sphenoid, often clustered, the wood is of dull pale colour.
Phenology	:	Leaf shedding : October – December New leaf : February – April Flowering : February - April Place of flower: Terminal Fruiting : May - June
Growth behaviour	:	Deciduous, large tree, attains height up to 3.5m. and girth 2 to 3m.
Silvicultural character	:	Moderate light demander, resistant to high rainfall, no difficulty in natural regeneration, artificial regeneration is difficult.
Soil (*in situ* condition):		pH=5.2, OC=1.6 %, P = 0.56 kg/ha, K=81 kg/ha. (22° 57'2"'N latitude and 92° 51'50"E longitude).
Associates	:	*Sterculia vilosa, Gnetum* spp., *Schima wallichii.*
Uses MZ	:	Decoction of bark is used to cure tonsillitis.
EW	:	Decoction of bark is given in diarrhoea and as diuretic (Asolkar *et al* 1992).

Jasminum dispermum Wall. FA 3 : 232.1938; FBI 3 : 602.1880; FUG 2 : 23.1994.
(Pl. XIII, Photo 38)

Local name	:	Hrui damdawi
Family	:	Oleaceae
Locality	:	Chawnhu (22° 30' 50"N latitude and 92° 53' 55"E longitude), Lengpui,
Altitude	:	460 -1060m.

Description	:	Climber, glabrous scandent shrub, stem light grey, small but strong; leaf bitter taste, imparipinnate opposite, ovate, acuminate, obtuse, stalk, entire, terminal cordate, lanceolate, acuminate; flower fragrant, pinkish in few flowered axillary cymes and many flowers elongated terminal panicle; carpels ellipsoid, purplish black when ripe.
Phenology	:	Leaf shedding : October New leaf : April – May Flowering : April – May Place of flower: Axillary Fruiting : October - November
Silvicultural character:		Shade bearer, acceptable to jhum fire, resistant to heavy rainfall, natural regeneration satisfactory.
Soil (*in situ* condition):		pH=5.6, OC =0.65 %, P=9.0 kg/ha, K=98 kg/ha. (22° 30'50"N latitude and 92° 53'55"E longitude).
Associates	:	*Wendlandia grandis, Quercus incana, Aquilaria malaccensis, Aleurites montana.*
Uses MZ	:	Leaf juice is taken for diarrhoea and dysentery.

First time reported

Justicia zeylanica Medicus. (Syn. *Justicia adhatoda* Linn., *Adhatoda zeylanica* Medicus, *Adhatoda vasica* Nees.). ADPS : 503. 1994; AE : 129.1996; CCENI : 131.1994; CIMP 1 : 9.1995; FA 3 : 455.1939; FFM : 661.1987; FM : 501.1981; FT 2 : 284.1983; FUG 2 : 206.1994; GIMP : 7.1956; IMP 3 : 1899. 1935; IMPC 3 : 271.1995; IT : 498.1906; TIMP 5 : 48.1997. **(Pl. XIII, Photo 39)**

Local name	:	Kawldai
Family	:	Acanthaceae
Locality	:	Sihphir (22° 30' 50"N latitude and 92° 53' 55"E longitude), S. Hlimen, Darlung.
Altitude	:	Up to 1300m.

Description : A dense shrub; bark grey; leaf elliptic–lanceolate, acuminate, attenuate; flower white, borne in dense spike; bract ovate, sub-acute, branching axillary ; fruit capsule, 4- seeded, orbicular.

Phenology : Leaf shedding : Evergreen
New leaf : February – April
Flowering : February – April
Place of flower: Terminal
Fruiting : February - May

Growth behaviour : Evergreen gregarious shrub, grows in degraded forest, attains height up to 4m.

Silvicultural character : Moderate light demander, resistant to heavy rainfall, natural and artificial regeneration is not easy because of which they are now become under endangered species.

Soil (*in situ* condition): pH=5.6, OC=1.22 %, P= 25 kg/ha, K=123 kg/ha. (22° 30'50"N latitude and 92° 53'55"E longitude).

Uses MZ : The leaves are boiled in the water and taken thrice a day and used for bathing which is effective cure for malaria.

EW : Leaves and root are used for different kinds of cough and asthma (Chatterjee & Prakashi 1997).

Kaempferia rotunda Linn. ADPS : 160.1994; CIMP 1: 233.1995; CMPD : 90.1982; FBI 6 : 222.1890; FM : 564.1981; FT 2 : 378.1983; GIMP : 146.1956; IMP 4 : 2428.1935; IMPC 3 : 279.1995. **(Pl. XIV, Photo 40)**

Local name : Tuktin par
Family : Zingiberaceae
Locality : Chaltlang, Aizawl (23° 44'50"N latitude and 92° 43'50"E longitude), cultivated.
Altitude : Up to 1231m.

Description : Aromatic herb with tuberous root; short leaf, oblong, short petiole, variegated with darker and lighter green above and tinged purple beneath; flower white fragrant, borne from the ground level, spike.

Phenology : Leaf shedding : November
New leaf : February – April
Flowering : March – April
Place of flower: Rhizome or underground portion of plant.
Fruiting : April – May

Growth behaviour : Herb, attains height up to 0.25m.

Silvicultural character: Light demander, acceptable to heavy rainfall, natural regeneration is difficult but artificial regeneration is done easily.

Soil (*in situ* condition): pH=5.6, OC=2.34 %, P=1.64 kg/ha, K=78 kg/ha. (22° 30'50"N latitude and 92° 53'55"E longitude).

Associates : Cultivated

Uses MZ : Root bulb crushed with bark of *Gynocardia odorata* and is used for sore throat problems.

EW : Juice of its rhizome is used as eye drops for removing cataract and also as a cure for night blindness (Rao 1981). Extract from tubers are used for fractures and dislocation of bone (Biswas & Chopra 1982).

Lannea coromandelica (Houtt.) Merr. (Syn. *L. grandis* (Dennst.) Engler., *Odina wodier* Roxb.). AE : 133.1996; CIMP 1: 238. 1995; FA 1 : 338.1934; FFM : 272.1985; GIMP : 149.1956; IMPC 3 : 297.1995; TIMP 3 : 150.1994.

Local name : Tawitawsuak
Family : Anacardiaceae
Locality : Ralvawng (22° 57'N latitude and 92° 51' 75"E longitude), Kawnpui, Bukpui, Sihphir.
Altitude : 550 –1070m

Description : Large tree,thick soft branchlet; smooth, grey in young tree and dark and rough in old trees; bark thick and fleshy; twig thick, greyish; leaf clustered at the tip of the branch, long rachis, leaflet entire, elliptical; flower greenish yellow, small, disc annular, 4-lobed; fruit drupe, long curve on the

ventral face, oblong, smooth, pink, with fleshy red epicarp and large stone.

Phenology : Leaf shedding : October – November
New leaf : December
Flowering : March – April
Place of flower: Terminal
Fruiting : June – July. However, fruiting is reported during April - June (Vergheese 1996).

Growth behaviour : Large deciduous tree, attains height up to 25m., clean cylindrical bole up to 8 – 10m.

Silvicultural character : Strong light demander, resistant to heavy rainfall and jhum fire, good coppicer. Tree can be propagated by natural and artificial methods.

Soil (*in situ* condition): pH=5.0, OC=1.62 %, P= 0.76 kg/ha, K=112 kg/ha. (22° 57'N latitude and 92° 51'75"E longitude).

Associates : *Aporosa roxburghii, Sterculia vilosa, Ficus* spp.

Uses MZ : Decoction of bark is used to cure stomach disorder.

EW : Bark paste applied around navel for fever, seed infusion for dandruff, bark for stomachache, toothache, dysentery, elephantiasis, swelling ulcers and fruit for fracture (Verghees 1996).

Lindernia ruelloides (Colsm.) Mukerjee (Syn. *Bonnya reptans* Spreng., *B. veronicaefolia* Wight., *Ilysanthes reptans* Urban.).FA 3 : 380.1938; FT 2 : 276.1983; IMP 3 : 1822. 1935; NPEI : 145.1991; SGIMP : 56.1969. **(Pl. XIV, Photo 41)**

Local name : Thasuih
Family : Scrophulariaceae
Locality : Changte (23°27'N latitude and 93°42'E longitude), Ralvawng, Lawngtlai.
Altitude : 683 -1070m.

Description	:	Small herb, prostrate creeping; rooting at the nodes; leaves also developed from the node; leaf reddish, serrate,orbicular, opposite; flower axillary, terminal raceme, light purple; fruit capsule.
Phenology	:	Leaf shedding : Annual herb Flowering : May - June Place of flower: Axillary Fruiting : July - August
Growth behaviour	:	Small herb, attains height up to 0.01m.
Silvcultural character	:	Low light demander, acceptable to jhum fire, resistant to heavy rainfall, regenerate naturally.
Soil (*in situ* condition):		pH=5.0, OC=0.62 %, P=0.56 kg/ha, K=62 kg/ha. (23° 27'N latitude and 93° 42'E longitude)
Associates	:	*Plantago major, Eleusine* spp.
Uses MZ	:	Whole plant is crushed and applied externally on the place of cramp. Three days is sufficient for this treatment.
EW	:	Applied externally for worm in the skin (Kirtikar & Basu 1986).
		First time reported

Lobelia angulata Forst. (Syn. *Pratia nummularia* Kurz., *P. begonifolia* (Wall.) Lindl.). CCENI : 302.1994; FFM : 534. 1987. **(Pl. XIV, Photo 42)**

Local name	:	Choakathi
Family	:	Lobeliaceae
Locality	:	Ratu (24° 60' 25"N latitude and 92° 55' 25"E longitude), Sairang, Durtlang, etc.
Altitude	:	500 -1287m.
Description	:	Small creeping herb; pubescent, rooting at the node; leaf ovate, serrate; flower pink on solitary axillary, fruit berry, pinkish – black.

Phenology	:	Leaf shedding :	Annual herb
		New leaf :	After germination
		Flowering :	April – May
		Place of flower:	Axillary
		Fruiting :	June – August
Growth behaviour	:	Small herb, grows in damp open locality.	
Silvicultural character	:	Shade bearer, acceptable to jhum fire, natural and artificial regeneration has no problems.	
Soil (*in situ* condition)	:	pH=5.6, OC=0.92 %, P=1.35 kg/ha, K=76 kg/ha. (24°60'25"N latitude and 92° 55'25"E longitude)	
Associates	:	*Plantago major, Polygonum* spp.	
Uses MZ	:	Juice of the whole plant is used to cure fester. The whole plant is dried and used as tea for kidney trouble.	
EW	:	Whole plant is used to stop blood discharge with urine (Jain *et al* 1994).	

Mallotus roxburghianus Muell. Arg. FA 4 : 214.1940; FFM : 796.1987. **(Pl. XV, Photo 43)**

Local name	:	Zawngtenawhlung	
Family	:	Euphorbiaceae	
Locality	:	Sihphir (23° 39' 50"N latitude and 92° 53' 5"E longitude), Hmunpui, Kawrtethawveng.	
Altitude	:	560 – 1400m.	
Description	:	Small tree; young parts softly pubescent; bark grey and rough; leaf big, rough, green, paler beneath and greenish ventral side, alternate, deltoid, serrate, caudate, base cordate and peltate; petiole long; flower raceme, terminal and long; fruit 3-lobed, sub-globose.	
Phenology	:	Leaf shedding :	October - December
		New leaf :	December
		Flowering :	May - June
		Place of flower:	Terminal
		Fruiting :	August - September

Growth behaviour : Deciduous tree, grows in dense forest, attains height up to 2m.

Silvicultural character : Moderate light demander, resistant to jhum fire, drought and heavy rainfall, regenerate naturally and artificially, good coppicer.

Soil (*in situ* condition): pH=5.5, OC=0.66 %, P=13.25 kg/ha, K=122 kg/ha. (23° 39'50"N latitude and 92° 53'50"E longitude)

Associates : *Garcinia pedunculata, Callicarpa arborea, Murraya hoenigii, Prunus cerasoides.*

Uses MZ : Decoction of leaves is used to cure diabetes by taking one cup twice a day, decoction of bark is good to control hypertension at the rate of one cup twice a day.

First time reported

Mangifera indica Linn. AE : 141.1996; CCENI : 140.1994; CIMP 1 : 265.1995; FA 1 : 335.1934; FFM : 273.1985; FM : 281.1081; FUG 1 : 189.1994; GIMP : 161.1956; IMP 1 : 652.1935; IMPC 3 : 380.1995; MPW : 197.1999; TIMP 3 : 152. **(Pl. XV, Photo 44)**

Local name : Theihai
Family : Anacardiaceae
Locality : Lungsen (22° 52' 50"N latitude and 92° 35' 50"E longitude), common everywhere in Mizoram.
Altitude : 66 – 1500m.

Description : Large evergreen tree; bark dark grey, smooth; branching enormously; leaf crowded at the apex of the branches, dark green, young leaves are red , oblong or oblong - lanceaolate, acute, margin undulate, entire; flower monoecious, yellow, panicles; fruit large drupe, ovoid with a curve tip, orange - yellow when ripe.

Phenology :
Leaf shedding : Evergreen tree
New leaf : March - April
Flowering : January - April
Place of flower: Terminal
Fruiting : May - August

Growth behaviour : Evergreen tree, attaining height from 4–10m., grows in thick forest and in open dense forest.

Silvicultural character : Cosmopolitan in habitat, light demand is high for better production of fruit, resistant to drought and heavy rainfall, natural and artificial regeneration has no problem.Generally grafting technique is used to propagate by artificial method.

Soil (*in situ* condition): pH=5.6, OC=1.26 %, P=98 kg/ha, K=223 kg/ha. (22° 52'50"N latitude and 92° 35'50"E longitude)

Associates : *Ficus* spp., Bamboo, *Tetrameles nudiflora, Prunus cerasoides*, *Ficus benjamina.*

Uses MZ : Bark and fruits are useful to cure diarrheoa and decoction of young red leaves are useful to suppress diabetes by taking as morning tea before taking anything else everyday.

EW : Root, bark and flowers are astringent, flowers cure leucorrheoa, good in dysentery, bronchitis, urinary discharges, bark stop vomiting and diarrheoa, leaf cures piles, unripe fruit or seed for asthma(Ross 1999).

Mikania micrantha Kunth. (Syn. *M. cordata* (Burm.) B.L. Robinson, *M. scandens Willd.*). CCENI :144.1994; CIMP 3 : 425.1996; FFM : 524.1987; GIMP : 167.1956. **(Pl. XV, Photo 45)**

Local name : Japan hlo
Family : Asteraceae
Locality : Dungtlang (23° 10' 75"N latitude and 93° 14'E longitude), common everywhere in Mizoram.
Altitude : Up to 1740m.

Description : A dense climbing herb without tendril; slender branch; leaf ovate-lanceolate, acuminate, undulate, rounded cordate; flower white in compound corymbose head, bracts lanceolate; fruit linear - oblong .

Phenology	:	Leaf shedding :	partial shedding in winter
		New leaf :	February – April
		Flowering :	October – February
		Place of flower:	Axillary
		Fruiting :	October – February
Growth behaviour	:	Annual herb, attains length up to 3m.	
Silvicultural character	:	Moderate light demander, natural regeneration is very successful, but artificial regeneration is difficult.	
Soil (*in situ* condition)	:	pH=5.6, OC=1.62 %, P=13 kg/ha, K=122 kg/ha. (23° 10'75"N latitude and 93° 14'E longitude)	
Associates	:	*Chromolaena odorata, Clerodendrum* spp., *Artemisia indica.*	
Uses	MZ :	Juice of crushed leaves is used to cure cuts and wounds just by pasting. Decoction of leaves is also used to control diarrhoea and dysentery, dose depends on the seriousness of the disease.	
	EW :	Stem is used for constipation and indigestion (Saklani & Jain1994).	

Mimosa pudica Linn. ADPS : 57.1994; CCENI : 145.1994; CIMP 2 : 65.1996; FA 2 : 152.1938; FBI 2 : 291.1876; FJ : 179.1981; GIMP : 167.1956; IMM : 1105.1954; IMP 2 : 915.1935; IMPC 4 : 36.1995; SGIMP : 70.1969; TIMP 2 : 65.1992. **(Pl. XVI, Photo 46)**

Local name	:	Hlonuar
Family	:	Mimosaceae
Locality	:	Sairang (23° 48' 50"N altitude and 92° 39'E longitude), Kawnpui, Zemabawk, etc.
Altitude	:	457 – 1250 m.
Description	:	Climbers or runners; stem is strong and hexagonal, prickly on the base of the branch; leaves sensitive, petioles long, leaflet sessile, linear oblong; flower soft, borne in pinkish globose head, peduncle long; pods flat, small, straw-coloured, provided with many bristles; seeds 3 –5.

Phenology	:	Leaf shedding :	partial shedding in winter.
		New leaf :	March - May
		Flowering :	November
		Place of flower:	Axillary
		Fruiting :	January - February
Growth behaviour	:	Small herb, Small herb, grows in an open fallow land, mostly on the road side, attains height of 0.5 m., forms complete dense cover.	
Silvicultural character	:	High light demander, resistant to jhum fire and drought, natural regeneration is very favourable.	
Soil (*in situ* condition):		pH=5.0, OC=0.56 %, P=1.62 kg/ha, K=201 kg/ha. (23° 48' 50"N altitude and 92° 39'E longitude).	
Associates	:	*Chromoleana odorata, Bidens biternata.*	
Uses MZ	:	Infusion of root is used for dissolving stone in the kidney and gall bladder.	
EW	:	Root and leaves prescribed in cases of piles and fistula, juice of leaves is used to cure of sinus (Kirtikar & Basu, 1982). Whole plant astringent, cooling, antiseptic, alterative and blood purifier (Sivarajan & Balachandan 1994).	

Momordica charantia Linn. ADPS : 220.1994; CCENI : 285.1994; CIMP 1: 278.1995; FA 2 : 330.1938; FBI 2 : 616.1876; GIMP : 168. 1956; IMP 2 : 1130.1935; IMPC 4 : 48.1995; SGIMP : 71.1969; TIMP 5:124.1997.**(Pl. XVI, Photo 47)**

Local name	:	Changkha te
Family	:	Cucurbitaceae
Locality	:	Phullen (23° 51'N latittude and 93° 30' 50"E longitude), cultivated in whole Mizoram.
Altitude	:	Up to 1500m.
Description	:	A slender climber; stem branch, puberulous; tendrils opposite to leaves; leaf simple, alternate, orbicular–cordate, acuminate, pubescent; flower yellow, male flowers solitary axillary, female flowers bracteate at base; fruit oblong; seed sculpture on surface, compressed.

Phenology : Leaf shedding : Annual herb
New leaf : April - May
Flowering : August
Place of flower: Axillary
Fruiting : August – March

Growth behaviour : Annual herb, cultivated in waste land, attains length up to 1.5m.

Silvicultural character: Light demand is high, acceptable to jhum fire, natural regeneration is rare found, cultivated by artificial regeneration.

Soil (*in situ* condition): pH=5.6, OC=1.62 %, P=17.0 kg/ha, K=121 kg/ha. (23° 51'N latitude and 93° 30'50"E longitude).

Associates : *Psidium guajava, Solanum nigrum, Spilanthes oleracea, Polygonum barbatum.*

Uses MZ : Leaves are boiled and the water is taken at the rate of one cup twice a day to cure jaundice and dysentery. The juice of crushed fruit is taken one cup in the morning before taking anything to cure diabetes.

EW : Whole plant is used in cough and respiratory diseases, fever, intestinal worms and skin diseases (Sivaranjan & Balachandan 1994).

Morinda anguistifolia Roxb. CCENI : 145.1994; CIMP 2 : 467.1996; FA 3 : 79.1939; FBI 3 : 156.1880; FFM : 488.1987; IT : 226. 1906; NPEI : 156.1991. **(Pl. XVI, Photo 48)**

Local name : Lum
Family : Rubiaceae
Locality : S. Lungrang (22° 44'N latitude and 92° 39'E longitude)
Altitude : 148m.

Description : Small tree, grows in an open forest; bark light grey, stem qaudrangular, node and inter node very distinct; leaf big, opposite, stipulate, oblancealote, margin entire, acuminate, acute,

glossy above, pale beneath; flower white, tube corolla, short pistil, terminal, pentamerous; fruit obovoid – globose, turbinate.

Phenology : Leaf shedding : April - May
New leaf : August
Flowering : February - March
Place of flower: Terminal
Fruiting : April– May. However, flowering and fruiting during February – October is reported by Jain *et al* (1991).

Growth behaviour : Small deciduous tree, attains height up to 5.5 m., bole straight and cylindrical.

Silvicultural character : Moderate light demander, non resistant to jhum fire, resistant to heavy rainfall, natural regeneration is simple and artificial regeneration is also very easy through the stem.

Soil (*in situ* condition): pH=4.5, OC=0.88 %, P=14.40 kg/ha, K=73 kg/ha. (22° 44'N latitude and 92° 39'E longitude)

Associates : *Morus alba, Adina cordifolia, Rhus javanica.*

Uses MZ : Decoction of bark mixed with root bark of *Saraca indica* (Mualhawih) and is used for stomach ulcer. Leaves are crushed, made into paste is applied in ring worms.

EW : Leaves are used in snake bite and root is used for cough (Saklani & Jain 1994).

Mussaenda roxburghii Hk. f. CCENI : 149.1994; FA 3 : 46.1938; FBI 3 : 87.1880; FFM : 491.1987; FT 2 : 89.1983. **(Pl. XVII, Photo 49)**

Local name : Vakeb
Family : Rubiaceae
Locality : Zemabawk (23°43'75"N latitude and 92°55'50"E longitude), Tuirial, Lungdai, Leithum, Samthang.
Altitude : 250 - 1070m.

Description : Large shrub with strong qaudrangular stem, young stem pubescent and fleshy;dichotomously branched; leaf simple, pubescent, opposite, stipulate, entire, acuminate; flower small, red, panicle, pentamerous, one of the sepal is modified into leaf-like form but white and hairy; fruit small green siliqua.

Phenology :
Leaf shedding : November – December
New leaf : February - March
Flowering : July - August
Place of flower: Axillary
Fruiting : October – November

Growth behaviour : Large shrub, grows in an open damp area, attains height up to 2m.

Silvicultural character: Shade bearer, acceptable to jhum fire, natural regeneration is difficult but artificial regeneration can be done easily by stem cutting.

Soil (*in situ* condition): pH=5.6, OC=1.23 %, P=22 kg/ha, K=143 kg/ha. (23° 43' 75"N latitude and 92° 55'50"E longitude)

Associates : *Lantana camara, Albizia chinensis, Schima wallichii.*

Uses MZ : Leaf chewed raw and paste applied externally is used for snake bite.

EW : Root and bark for mouth ulcer(Saklani & Jain1994).

Oroxylum indicum (L) Benth. ex Kurz. ADPS : 464.1994; AE : 150.1996; CCENI : 154.1994; CIMP 1 : 299.1995; FA 3 : 401.1939; FFM : 656.1987; FT 2 : 95. 1983: FTM : 91.1997; FUG 2 : 170.1994; GIMP : 182.1956; IMP 3 : 1839.1935; IMPC 4 : 186.1995; IT : 496.1906; TIMP 5 : 44.1997. **(Pl. XVII, Photo 50)**

Local name : Archangkawm
Family : Bignoniaceae
Locality : Hmunpui (23° 51' 80"N latitude and 92° 35'E longitude), Ralvawng, Pangzawl.
Altitude : Up to 1350m.

Description : Small tree with open crown; bark dark grey with traces of leaves; rachis very soft, cylindrical, swollen at the junction of the branch; leaf opposite, ternately bipinnate; leaflet ovate, entire, acuminate, peduncle thick, flower reddish purple outside and pale pinkish yellow within, numerous in large erect raceme; fruit flat capsule, tapering to both ends; seeds many, winged all round except at the base.

Phenology :
Leaf shedding : September - October
New leaf : December
Flowering : March
Place of flower: Terminal
Fruiting : May - June

Growth behaviour : Small to medium size deciduous tree, grows in a damp and shaddy locality, attains height up to 14m.

Silvicultural character : Shade bearer, resistant to heavy rainfall, natural regeneration is difficult, propagated by artificial method.

Soil (*in situ* condition): pH=5.0, % OC=0.62, P=0.56 kg/ha, K=69 kg/ha. (23° 51'80"N latitude and 92° 35'E longitude)

Associates : *Quercus semiserrata, Leea bracteate, Laportea cresulata.*

Uses MZ : Bark is used for the treatment of rheumatism.

EW : Root bark found to be effective in the treatment of amoebic dysentery (Prakash & Prasad 1973). Roots are astringent, expectorant and are also used in hiccough, cough, asthma and gout (Sala 1995).

Osbekia rostrata D.Don. CCENI : 291.1994; FA 2 : 293.1938; FBI 2 : 517.1876; FFM : 410.1985; IT : 334.1906. **(Pl. XVII, Photo 51)**

Local name : Builukhampa
Family : Melastomaceae
Locality : Samthang (24° 5' 25"N latitude and 92° 41'E longitude), Ailawng, Khawlailung, Reiek.

Altitude : 540 - 1600m

Description : Erect shrub; stem quadrangular with hairs; leaf lanceolate, acuminate, ciliate, nerves very distinct up to the apex; flower rose purple in pyrimidal terminal panicle; fruit ovoid – oblong, covered with scattered stallate hairs.

Phenology :
Leaf shedding : December – February
New leaf : March – April
Flowering : August – September
Place of flower: Terminal
Fruiting : October – December

Growth behaviour : Shrub, attains height up to 1.5m.

Silvicultural character : Shade bearer, non resistant to jhum fire, can be easily regenerate by natural and artificial methods.

Soil (*in situ* condition): pH=5.5, OC=1.22 %, P=17.0 kg/ha, K=99 kg/ha. (24° 5'25"N latitude and 92° 41'E longitude)

Associates : *Musseanda roxburghii, Schima wallichii.*

Uses MZ : Roots are used for renal disorder and genito-urinary problems.

First time reported

Ostodes paniculata Blume. CCENI : 291.1994; CIMP 3 : 463.1996; FA 4:197.1940; FFM : 797.1987; FTM : 99.1997. **(Pl. XVIII, Photo 52)**

Local name : Beltur
Family : Euphorbiaceae
Locality : Phullen (23° 50' 50"N latitude and 93° 3' 50"E longitude), Hmunpui, Darlawn, Ratu.
Altitude : 148 - 1200m.

Description : Tree with spreading crown; bark thick, grey exuding reddish gum from the outer part of the bark; leaf big, elliptic, simple and rough, acuminate, serrate, base rounded or oblique, petiole long; small flower, pinkish white in axillary panicled raceme, stamens numerous; fruit capsule, sub-globose, 3-lobed; seed globose.

Phenology	:	Leaf shedding :	October
		New leaf :	April – May
		Flowering :	March – April
		Place of flower:	Axillary
		Fruiting :	May - August
Growth behaviour	:	Deciduous tree, grows in closed forest, attains height up to 6 m.	
Silvicultural character:		Moderate light demander, resistant to heavy rain and jhum fire, natural regeneration is not difficult but artificial regeneration is quite difficult.	
Soil (*in situ* condition):		pH=5.6, OC=1.59 %, P=26 kg/ha, K=106 kg/ha. (23° 50'50"N latitude and 93° 3'50"E longitude)	
Associates	:	*Albizia chinensis, Saurauja punduana, Schima wallichii, Eurya acuminata.*	
Uses MZ	:	Crushed bark is applied externally to bad sore.	
EW	:	Seeds are used as purgative (Rastogi & Mehrotra 1996).	

Parabarium hookeri Pierre. (Syn. *P. micranthum* (DC.) Peirre ex Spire., *Ecdysanthera micrantha* A.DC., *E. brachiata* DC.) FA 3:266.1939; FFM:604.1987; IT:465.1906. **(Pl. XVIII, Photo 53)**

Local name	:	Theikelki	
Family	:	Apocynaceae	
Locality	:	Ralvawng (22° 57' 25"N latitude and 92° 51'60"E longitude), Ratu, Darlawn, Sihphir, etc.	
Altitude	:	875 -1070m.	
Description	:	Woody climber; stem grey, exuding milky latex when cut; leaf opposite, elliptic, acuminate, acute, entire, flower small, yellowish – white, axillary in trichotomous cymes, pentamerous, follicles 3 – 4; seeds compressed.	
Phenology	:	Leaf shedding :	Evergreen
		Flowering :	March
		Place of flower:	Terminal
		Fruiting :	April - May

Growth behaviour : Woody climber, grows in a shady forest, attains length up to 4m.

Silvicultural character : Shade bearer, resistant to jhum fire and heavy rainfall, natural and artificial regeneration has no difficulty.

Soil (*in situ* condition): pH=5.5, OC=1.62 %, P =5.6 kg/ha, K= 122 kg/ ha (22° 57'25"N latitude and 92° 51'60"E longitude)

Associates : *Quercus semiserrata, Leea bracteate, Laportea cresulata, Ficus* spp.

Uses : Decoction of bark is used for treating jaundice by taking half cup twice a day.

First time reported

Phyllanthus emblica Linn. (Syn. *Emblica officinalis* Gaertn.). ADPS : 28.1994; AE : 105.1996; CCENI : 103.1994; CMPD : 81.1982; FA 4 : 159.1940; FBI 5 : 289.1886: FFM : 786.1987; GIMP : 106.1956; IMP 3 : 2220.1935; IMPC 4 : 256.1995; IT : 570.1906; MPPI : 221.1986; SGIMP : 27.1969; TIMP 3 : 33.1994. **(Pl. XVIII, Photo 54)**

Local name : Sunhlu
Family : Euphorbiaceae
Locality : Phullen (23° 50' 50"N latitude and 93° 3' 50"E longitude), common everywhere in Mizoram, both wild and cultivated.
Altitude : Up to 1500m.

Description : Small to medium size tree; bark light grey; leaf simple, many, subsessile, closely set along the branchlet, sub-sessile, oblong, acute, rounded; flower greenish yellow, axillary facicled on branchlet, unisexual, males numerous on short slender pedicels. Females few, subsessile; fruit depressed globose, fleshy with six obscure vertical furrows enclosing 6 trigonous seeds.

Phenology : Leaf shedding : November – January
New leaf : March – April
Flowering : March – April

Place of flower: Branchlet
Fruiting : August – November. However, fruiting during October -January is reported by Vergheese (1996).

Growth behaviour : Deciduous tree, grows commonly in open forest, degraded forest and mostly in jhum land, attains height up to 7m.

Silvicultural character: Moderate light demander, resistant to jhum fire, natural and artificial regeneration has no problem.

Soil (*in situ* condition): pH=5.7, OC=1.23 %, P=2.01 kg/ha, K=68 kg/ha. (23° 50'50"N latitude and 93° 3'50"E longitude).

Associates : *Callicarpa arborea, Ficus reliagosa, Aquilaria malaccensis.*

Uses MZ : Crushed bark is used against tetanus. Dried fruit crushed along with dried fruit of *Terminalia bellirica* and is used for kidney trouble.

EW : Root, bark and ripe fruits are astringent, juice of the fruit is used in chronic dysentery (Cauis 1986).

Phyllanthus fraternus Webster (Syn. *P. niruri* Linn., *P. amarus* Schum & Thonn., *Urinaria indica* Burm.). ADPS : 466. 1994; AE : 155. 1996; CIMP 1 : 314.1995; FBI 5 : 298.1886; FM : 176.1981; GIMP : 191.1956; IMP 3:2225.1935; IMPC 4 : 252.1995; MPPI : 222.1986; MPW : 249.1999; TIMP 3 : 52. **(Pl. XIX, Photo 55)**

Local name : Mitthi – sunhlu
Family : Euphorbiaceae
Locality : Farkawn (23° 4' 50"N latitude and 93° 17' 75"E longitude), Ralvawng, Rawpuichhip, Bukpui, etc.
Altitude : 520 -1070m.

Description : Small herb; stem often branch at the base, angular; leaves numerous, sub-sessile, dichotomous, elliptic –oblong, base rounded, short petiole; flower yellowish, axillary or borne on the rachis; fruit sub-globose.

Phenology	:	Leaf shedding :	Annual herb
		New leaf :	March
		Flowering :	August – October
		Place of flower:	Axillary
		Fruiting :	November – March
Growth behaviour	:	Annual herb, grows in open land, mostly near the road side, attains height of 0.25m.	
Silvicultural character:		Moderate light demander, non resistant to jhum fire, resistant to heavy rainfall, natural and artificial regeneration has no problem.	
Soil (*in situ* condition):		pH=4.5, OC=1.59 %, P=0.55 kg/ha, K = 106 kg/ha. (23° 4'50"N latitude and 93° 17'75"E longitude).	
Associates	:	*Chromolaena odorata, Maesa ramentacea,* Grasses.	
Uses MZ	:	Whole plant is crushed and the juice is taken for diabetes and jaundice.	
EW	:	Roots, leaves and young shoots are deobstruent, diuretic and leaves are good for stomachache (Ainslie 1813).	

Picrasma javanica Blume (Syn. *P. nepalensis* Benn., *P. andamanica* Kurz ex Benn.). CIMP 4 : 559.1997; FA 1: 217. 1934; FBI 1 : 520.1872; FFM : 35.1985; GIMP : 192. 1956; IMP 1: 510.1935; IT : 127.1906; NPEI : 165.1991. **(Pl, XIX, Photo 56)**

Local name	:	Thingdamdawi
Family	:	Simaroubaceae
Locality	:	Zotlang (22° 54' 50"N latitude and 92° 45' 50"E longitude), Hmunpui, Zotlang, Lunglei, Sihphir.
Altitude	:	550 - 1300m.
Description	:	Big evergreen tree, bark grey, spotted with white patches; leaf pinnate compound, stipulate; leaflet elliptic, acuminate, acute, stalked, entire; flower dull – white, polygamous , pentamerous in axillary panicle of cyme, fruit drupe, red, ovoid to sub-globose, black when ripe.

Phenology	:	Leaf shedding :	Evergreen
		New leaf :	March - April
		Flowering :	March - April
		Place of flower:	Axillary
		Fruiting :	May - August
Growth behaviour	:	Medium to big tree, grows in a virgin forest, attains height up to 8m.	
Silvicultural character	:	Resistant to jhum fire, heavy rainfall, regenerate naturally.	
Soil (*in situ* condition)	:	pH=5.6, OC=0.66 %, P=2.2 kg/ha, K=54 kg/ha. (22° 54'50"N latitude and 92° 45'50"E longitude).	
Associates	:	*Ficus cunia, Musa* spp, *Hydechium coccineum,* Bamboo.	
Uses MZ	:	Air dried fruit crushed into powder and mixed with water at the rate of one pinch (about 10mg.) for one cup of water is taken in one teaspoon full thrice a day for the treatment of malaria. Decoction of bark is also used by taking one teaspoon thrice a day and also for bathing to treat malaria.	
EW	:	Bark as febrifuge (Kirtikar & Basu 1935). Decoction of bark is used for dysentery (Jain & Borthakur 1980).	

Pramanthes scandens Lour. **(Pl. XIX, Photo 57)**

Local name	:	Kawlhlo
Family	:	Asteraceae
Locality	:	Khawbung (23° 9' 10"N latitude and 93° 13' 50"E longitude), Farkawn, Samthang, etc.
Altitude	:	985 -1340m.
Description	:	A slender climber without tendrils; stem green; branches in any direction from the node; young part slightly pubescent, leaf lanceolate, serrate, short petiole, spirally alternate, simple, flower white panicle with lots of pappus, fruit achene.

Phenology	:	Leaf shedding :	August – October
		New leaf :	March – April
		Flowering :	April – June
		Place of flower:	Terminal
		Fruiting :	July – August
Growth behaviour	:	Climber, grows in dense forest, attains length up to 1.5m.	
Silvicultural character	:	Moderate light demander, non resistant to jhum fire, natural regeneration has no problem.	
Soil (*in situ* condition)	:	pH=5.1, OC=0.87 %, P=9.28 kg/ha, K=201 kg/ha. (23° 9'10"N latitude and 93° 13'50"E longitude).	
Associates	:	*Securinega virosa, Rubus* spp, *Cinnamomum bejolghota, Schima wallichii.*	
Uses MZ	:	Leaves are dried, crushed and taken as a tea for urinary tract infection.	

First time reported

Pseudodrynaria coronans (Wall. ex Mett.) Ching. (Syn. *Drynaria coronans* J. Smith, *Aglaomorpha coronans* (Wall. ex Mett.) Copel.). CIMP 2 : 565.1996. **(Pl. XX, Photo 58)**

Local name	:	Awmvel / Tuaibur
Family	:	Polypodiaceae
Locality	:	Ralvawng (22° 57'N to 22° 57'25"N latitude and 92° 51' 50" E to 92 51'75"E longitude), Ralvawng, Chawnhu, Sihphir, etc.
Altitude	:	870 -1300m.
Description	:	Epiphyte, grows in big tree trunk (*Ilex umbellulata* – Thinguihahni); stem fleshy and produced net of roots to hold fast the host; leaf green, older leaf brown in color; cleft, margin parted, dry leaf, reproduction through spores on the dorsal side of the leaf.
Phenology	:	Epiphyte.

Growth behaviour : Epiphyte, up to 1m. height.

Silvicultural character : Resistant to heavy rain, drought, regenerate naturally, artificial regeneration is easy by cutting stem and knot on the tree trunk and also cultivated on soil.

Uses MZ : Fleshy stem crushed and applied externally for herpes zoaster.

Psidium guajava Linn. AE : 161.1996; CCENI : 174.1994; CIMP 1 : 331.1995; FA 2 : 287.1938; FFM : 391.1984: GIMP : 205.1956; IMP 2 : 1046; IMPC 4 : 371.1995; MPW : 263.1999; SGIMP : 84.1969; TIMP 4 :14.1995. **(Pl. XX, Photo 59)**

Local name : Kawlthei
Family : Myrtaceae
Locality : Lengpui (23° 49' 50"N latitude and 92° 37' 50"E longitude), common everywhere in Mizoram.
Altitude : 148 – 1500m.

Description : Small tree; bark pale pinkish brown, smooth, having grey patches; leaf simple, opposite, oblong or elliptic-oblong, pubescent beneath, peduncles axillary, flower white, fragrant in axillary cyme or two to three together on slender peduncles; fruit globose containing many small hard seeds.

Phenology :
Leaf shedding : Evergreen
New leaf : March – April
Flowering : May
Place of flower: Axillary
Fruiting : June – October

Growth behaviour : Small to medium size tree, attains height up to 7m.

Silvicultural character : Moderate light demander, fruiting requires more light, resistant to jhum fire and heavy rainfall, regeneration by natural as well as artificial methods.

Soil (*in situ* condition): pH=5.7, OC=2.11 %, P=12 kg/ha, K=123 kg/ha.
(23° 49'50"N latitude and 92° 37'50"E longitude).

Associates : *Mangifera indica, Clerodendron colebrookianum, Cinnamomum glanduliferrum.*

Uses MZ : Leaves are crushed and the juice is taken with water to cure diarrhoea and dysentery.

EW : Roots are astringent, constipatory and also used in ulcers and vomiting (Saklani & Jain 1994).

Rhus semialata Murr. (Syn. *R. javanica* Linn. *R. chinensis* Mill.). CCENI : 178.1994; CIMP 1: 348; FA 1 : 331.1934; FBI 2 : 10.1876; FFM : 276.1985; GIMP : 213.1956; IMP 1 : 646.1935. **(Pl. XX, Photo 60)**

Local name : Khawmhma
Family : Anacardiaceae
Locality : Darlawn (24° 1'N latitude and 92° 55' 50"E longitude), Khawbung, Dungtlang, Bukpui, etc.
Altitude : 450 -1300m.

Description : Small deciduous tree; young twig pubescent; bark grey; leaf pinnate, rachis usually narrowly winged, leaflet lateral opposite, sessile, dentate, acuminate, sharply serrate; flower numerous, pale yellowish green, large terminal panicle, fruit drupe.

Phenology :
Leaf shedding : November – February
New leaf : March – April
Flowering : August – September
Place of flower: Terminal
Fruiting : November – March

Growth behaviour : Small tree or shrub, attains height up to 4m. and girth 0.8m.

Silvicultural character: Moderate light demander, non resistant to jhum fire, resistant to heavy rainfall, regeneration natural and artificial methods.

Soil (*in situ* condition): pH=6.5, OC=0.96 %, P=1.38 kg/ha, K=120 kg/ha. (24° 1'N latitude and 92° 55'50"E longitude).

Associates : *Maesa ramentacea, Callicarpa arborea, Schima wallichii.*

Uses MZ : Fruit grinned and mixed with water is taken to cure diarrhoea.

EW : Fruit is given in colic, used galls as expectorant and astringent, and also applied over swellings and wounds (Kirtikar & Basu 1935).

Saraca asoca (Roxb.) De Wilde. (Syn. *S. indica* Linn.). ADPS : 57.1994; CCENI : 184.1994; CIMP 2 : 611.1996; FA 2 : 136.1938; FFM : 325.1985; FTM : 144.1997; GIMP : 221.1956; IMP 2 : 883.1935; IMPC 4:332.1995; IT : 250.1906; MP : 153.1968; SGIMP : 90.1969; TIMP 2 : 45.1992. **(Pl. XXI, Photo 61)**

Local name : Mualhawih
Family : Caesalpiniaceae
Locality : Hmunpui (23° 51' 75"N latitude and 92° 35' 25"E longitude), Chawnhu, Farkawn, S. Lungrang, etc.
Altitude : 148 - 1200m.

Description : Small evergreen tree, bark reddish brown or black; leaf paripinnate, long; leaflet oblong or oblong-lanceolate, very short petiole, opposite, cuspidate; flower dense axillary corymbs, small, red or orange yellow; pod black compressed, tapering at both ends; seed 4-8, ellipsoid-oblong.

Phenology :
Leaf shedding : Evergreen
New leaf : March
Flowering : August– September. It is reported elsewhere that flowering during March–April (Chatterjee & Prakashi 1992).
Place of flower: Axillary
Fruiting : October – November

Growth behaviour : Evergreen tree, grows in shady thick forest, attains height up to 8m., crown dense branches spread horizontally.

Silvicultural character : Non resistant to jhum fire, resistant to heavy rainfall, natural regeneration has problem whereas artificial regeneration can be done without problem.

Soil (*in situ* condition): pH=5.0, OC=0.66 %, P=22 kg/ha, K=54 kg/ha. (23° 51'75"N latitude and 92° 35'25"E longitude).

Associates : *Ficus glomerata, Cyathocalyx mortabaniens, Holigarna longifolia.*

Uses MZ : Decoction of bark is mixed with Citrus root is used to cure stomach problem, dysentery, diarrhoea and urinary tract infection. Dose is one cup of the water thrice a day.

EW : Flowers are used in the treatment of bleeding piles, scabies in children and other skin diseases (Nadkarni 1954, Aujer & Kolammal 1960). Dried bark is used as astringent in treatment of excessive menstruation as a uterine sedative (Jain 1968).

Schima wallichii (DC.) Korth. CCENI : 185.1994; CIMP 3 : 576.1996; CMPD : 36.1982; FA 1 : 120.1934; FBI 1 : 289.1872; FFM : 120.1985; GIMP : 223.1956; IMP 1 : 278.1935; IT : 60.1906; MPPI : 441.1986; TIMP 2 : 135.1992. **(Pl. XXI, Photo 62)**

Local name : Khiang
Family : Theaceae
Locality : Vangtlang (23° 21'75"N latitude and 93° 11'E longitude), found everywhere in Mizoram except in very lower altitude.
Altitude : Up to 1600m.

Description : Evergreen tree; bark dark-grey, inner portion with lustrus hair and which is irritant; leaf oblong or elliptic – oblong, acute, acuminate, rachis at the base with small rotundate stipules; flower small, greenish white trichotomous cyme –like, fruit drupe.

Phenology :
Leaf shed : Evergreen
New leaf : March – April
Flowering : April – May
Place of flower: Axillary
Fruiting : November – February

Growth behaviour : Evergreen tree, attains height up to 8m.

Silvicultural character: Moderate light demander, resistant to jhum fire, natural regeneration is possible but artificial regeneration is difficult.

Soil (*in situ* condition): pH=5.5, OC=1.35 %, P=1.22 kg/ha, K=121 kg/ha. (23° 21'75"N latitude and 93° 11'E longitude)

Associates : *Aporosa octandra, Ilex umbellulata, Wendlandia grandis.*

Uses MZ : Juice of crushed bark is used is applied on cuts and wounds.

EW : Bark is used for curing gonorrhoea (Biswas & Chopra 1982).

Scoparia dulcis Linn. AE : 166.1996; CCENI : 186.1996; CIMP 1 : 365.1995; FA 3 : 380.1939; FJ : 334.1983; FT 2 : 277.1983; FUG 2 : 153.1994; GIMP : 224.1956; IMP 3 : 1823.1935; SGIMP : 91.1969; TIMP 5 : 42.1997.**(Pl. XXI, Photo 63)**

Local name : Perhpawngchaw
Family : Scrophulariaceae
Locality : Dungtlang (23° 11' 25"N latitude and 92° 13' 50"E longitude), Ralvawng, Chawnhu, Kawnpui.
Altitude : 430 – 1200m.

Description : Erect, much branched herb, glandular; stem angled; leaf opposite, serrate, rhomboid, tapering at the base into a short petiole; flower whorl and slender white; fruit capsule; seed many, obovoid.

Phenology :
Leaf shedding : partial leaf shedding in the month of February – March.
New leaf : March – April
Flowering : March – May
Place of flower: Axillary
Fruiting : May – December

Growth behaviour : Perennial herb, attains 0.25m. height.

Silvicultural character: Moderate light demander, acceptable to jhum fire, resistant to heavy rainfall and drought, natural regeneration has no difficulty but artificial regeneration is not easy.

Soil (*in situ* condition): pH=6.5, OC=1.23 %, P=12 kg/ha, K=133 kg/ha. (23°11'25"N latitude and 92°13'50"E longitude).

Associates : *Chromolaena odorata, Erigeron* spp. *Sonchus* spp.

Uses MZ : Whole plant crushed and the juice is taken one cup once a day for jaundice and urinary tract infection

EW : Decoction of the root is used for excessive menstruation and infusion of the leaves is used in stomach problem (Kirtikar & Basu 1935) . Tender shoot is used for pneumonia, sinustis and leaves for different kinds of skin diseases (Saklani & Jain 1994).

Securinega virosa (Roxb. ex Willd) Baill. (Syn. *S. obovata* Muell. Arg., *Flueggia microcarpa* Bl., *F. obovata* Baill.). CCENI : 315.1993; CIMP 1 : 368.1995; FA 4 : 160.1940; FBI 5 : 329.1886; FFM : 800.1987; IT : 569.1906. **(Pl. XXII, Photo 64)**

Local name : Saisiak
Family : Euphorbiaceae
Locality : Zemabawk (23° 43'75"N latitude and 92° 45'80"E longitude), Rawpuichhip, Lawngtlai.
Altitude : 560 - 1200m.

Description : Shrub; stem often with spine at the base and angular, reddish-brown; leaf obovate or sub – orbicular, acute, short petiole; flower greenish-yellow in axillary cluster, fruit globose fleshy or pulpy; seed 3 – 6.

Phenology :
Leaf shedding : November – December
New leaf : March – April
Flowering : May – August
Place of flower: Axillary
Fruiting : July – September

Growth behaviour : Shrub, grows in open barren land, attains height up to 2.5m.

Silvicultural character : Light demander, acceptable to jhum fire, natural regeneration is seen but artificial regeneration is difficult.

Soil (*in situ* condition): pH=5.5, OC=1.66 %, P=12 kg/ha, K=156 kg/ha. (23° 43'75"N latitude and 92° 45'80"E longitude).

Associates : *Osbekia rostrata, Mussaenda glabra, Musa* spp.

Uses MZ : The leaves are boiled in the water and is used for bathing for patients suffering from small-pox, measles and scabies.

EW : Fruit for stomachache and digestive disorder (Saklani & Jain 1994).

Solanum khasianum Cl. (Syn. *S. myriacanthum* Dunal., *S. aculeatissimum* Jacq.). CIMP 1 : 377.1995; FA 3 : 371.1939; IT : 490.1906; NPEI : 179.1991; SGIMP : 92.1969. **(Pl. XXII, Photo 65)**

Local name : Rulpuk
Family : Solanaceae
Locality : Zemabawk (23° 43'52"N latitude and 92° 45' 80"E longitude), Sairang, Muallungthu, Tuirial.
Altitude : 465 – 1230m.

Description : Tomentose armed herbs, much branched with spine, whole part covered with hairy prickles; leaf ovate – lanceolate, sub-cordate at base; flower white in axillary cyme, sometimes spinous; fruit globose, greenish spot while young and yellowish when ripe; seed many compressed, smooth.

Phenology :
Leaf shedding : February - March
New leaf : April
Flowering : July – August
Place of flower: Axillary
Fruiting : November – February

Growth behaviour : Herb, grows in open waste land, attains height up to 0.5 m.

Silvicultural character : Light demand is high, resistant to heavy rainfall, regeneration by natural and artificial methods without problem.

Soil (*in situ* condition): pH=5.4, OC=0.70, P=1.76 kg/ha, K=109 kg/ha. (23° 43'52"N latitude and 92° 45' 80"E longitude).

Associates : *Mikania micrantha, Ageretum conyzoides, Centella asiatica.*

Uses MZ : The smoke of burnt fruit is sucked in the mouth to remove tooth-worms.

EW : Ripe fruit made into powder is dissolved in water for mouth wash to kill tooth germs (Megoneitso & Rao 1983).

Candidate Species

Solanum nigrum Linn. (Syn. *Solanum americanum* Mill., *S. rubrum* Mill.). ADPS : 201.1994; CCENI : 190.1994; CIMP 1 : 377.1995; FA 3 : 366.1938; FFM : 648.1987; FUG 2 : 124.1994; IMP 3 : 2234.1935. IMPC 5 : 160.1996; TIMP 4 : 196. 1995. **(Pl. XXII, Photo 66)**

Local name : Anhling
Family : Solanaceae
Locality : Sairang (23° 48' 50"N latitude and 92° 58'E longitude), Chaltlang, Kawnpui, Bukpui.
Altitude : 460 -1231m.

Description : An annual herb; stem pubescent; leaf ovate – lanceolate, acuminate, sinuate, base cuneate, petiolate; flowers 3 – 8 in sub-umbellate cymes, white, cluster and small; fruit globose berries, purplish black or reddish; seeds many, discoid.

Phenology :
Leaf shedding : January - February
New leaf : March – May
Flowering : May – July
Place of flower: Axillary
Fruiting : May – July

Growth behaviour : Annual herb, grows in blank patches of dense forest, attains height up to 0.5m.

Silvicultural character : Moderate light demander, acceptable to jhum fire, resistant to heavy rainfall, regenerate naturally.

Soil (*in situ* condition): pH=5.6, OC=1.22 %, P=17 kg/ha, K=121 kg/ha. (23° 48'50"N latitude and 92° 58'E longitude).

Associates : *Spilanthes oleracae, Ageretum conyzoides, Mangifera indica.*

Uses MZ : Infusion of the plant is taken to cure stomach ulcer. The local people taken as vegetables and because of which there is no prescribed dose.

EW : Fruits are used in fever, diarrhoea, eye; juice of the leaves is used for treatment of chronic enlargement of liver (Kirtikar & Basu 1935). The leaves are used as poultice for rheumatic and gouty joints and skin diseases and the root bark is useful in hepatitis (Sala 1996).

Stephania japonica (Thunb.) Miers (Syn. *S. hernandifolia* (Willd.) Walp.). CCENI : 194.1994; CIMP 1 : 388. 1995; FA 1 : 51.1934; FBI 1 : 103.1872; FFM : 81.1985; GIMP : 234.1956; IMP 1: 92.1935; IMPC 2 : 280.1994; IT : 23.1906; TIMP 1 : 134.1991. **(Pl. XXIII, Photo 67)**

Local name : Hnahbial
Family : Menispermaceae
Locality : Farkawn (23° 4' 50"N latitude and 93° 18'E longitude), Sihphir, Phuaibuang, Saitual.
Altitude : Up to 1320m.

Description : Slender climber without tendrils; whole plant pubescent, branches striate or ribbed; stem green, cylindrical; leaf alternate, simple, peltate or orbicular, long petiole, lamina heart–shaped, entire, obtuse; flower yellow, umbellate on very slender axillary pedicles; fruit globose, red when ripe.

Phenology	:	Leaf shedding :	partial shedding in November
		New leaf :	March – April
		Flowering :	March – April
		Place of flower:	Axillary
		Fruiting :	May – June
Growth behaviour	:	Climbing herb, grows in a moist and shady place, attains length up to 1.5 m.	
Silvicultural character	:	Shade bearer, acceptable to jhum fire, resistant to heavy rainfall, natural regeneration has no difficulty but artificial regeneration is very difficult.	
Soil (*in situ* condition)	:	pH=5.5, OC=0.66 %, P=0.56 kg/ha, K=72 kg/ha. (23° 4'50"N latitude and 93° 18'E longitude).	
Associates	:	*Chromolaena odoraam, Callicarpa arborea, Bidens biternata, Quercus* spp.	
Uses	MZ :	Root is chewed raw or boiled with water and is used to cure diarrhoea.	
	EW :	Decoction of root is useful in spermatorrhoea; infusion of roots mixed with powder dried ginger effective in piles; paste of the leaves externally used in boils (Chatterjee & Prakashi 1991). Leaf with honey is used for diarrhoea and urinary complaints; root is also used for heart trouble (Saklani & Jain 1994).	

Sterculia villosa Roxb. CCENI : 194.1994; CIMP 3 : 610.1996; FA 1 : 151.1934; FBI 1 : 355.1872; FFM : 151.1985; NPEI : 180. 1991. **(Pl. XXIII, Photo 68)**

Local name	:	Khaupui
Family	:	Sterculiaceae
Locality	:	Hmunpui (23° 51' 75" N latitude and 92° 35' 10" E longitude), Saitual, Sihphir, Zotlang, etc.
Altitude	:	560m - 1300m.
Description	:	Large deciduous tree; bark dark grey, rough, with leaf scars; leaf long petioled, broad, palmatifid, lobed; flowers in pubescent panicles, yellowish with pink at the centre; follicle tomentose, legume.

Phenology	:	Leaf shedding :	October – November
		New leaf :	February – April
		Flowering :	January – May
		Place of flower:	Terminal
		Fruiting :	June
Growth behaviour	:	Grows in shade locality, attaining up to the height of 4 m.	
Silvicultural character:		Shade bearer, resistant to jhum fire, no problem in natural and artificial regeneration.	
Soil (*in situ* condition):		pH=5.5, OC=0.72 %, P=72 kg/ha, K=102 kg/ha. (23° 51' 75"N latitude and 92° 35'10"E longitude).	
Associates	:	*Saraca asoca, Parkia roxburghii, Ficus* spp.	
Uses MZ	:	Bark is boiled with leaves of *Citrus limon* (Ser fang) and the water is taken and also used for gargle to cure throat problem especially for tonsillitis and pharynxitis. Dose depend on the seriousness of the diseases.	
EW	:	Root is made into a paste with sugar and given orally for blood dysentery (Molla & Roy 1985). Stem bark is made into a paste and applied locally for hydrocele (Jain & Borthakur 1980).	

Stereospermum colais (Buch.- Ham. ex Dilwyn) Mabb. (Syn. *S. chelonoides* auct. Non (Linn. f.) DC., *S. personatum* (Hassk.) Chatt., *S. tetragonum* DC.). ADPS : 364.1994; CCENI : 195.1994; CIMP 3 : 610.1996; FA 3 : 404.1939; FBI 4 : 382.1884; FFM : 658.1987; FT 2 : 97.1983; GIMP : 234.1956; IMP 3 : 1846.1935; IMPC 5 : 192.1996; IT : 495.1906; TIMP 5 : 46.1997. **(Pl. XXIII, Photo 69)**

Local name	:	Zinghal
Family	:	Bignoniaceae
Locality	:	Rualalung (22° 39' 60"N latitude and 92° 40'60"E longitude), Thingdawl, Kawnpui.
Altitude	:	148 - 1240m.

Description	:	Large deciduous tree; branches and leaves pubescent; bark thick and grey, rough; leaf imparipinnate, leaflet thin coriaceous, obovate to lanceolate, acute or rounded, entire and shortly serrate, lenticellate; flower yellow, fragrant, reddish vein in terminal cymose panicle; fruit spirally twisted, seed winged.
Phenology	:	Leaf shedding : October – January New leaf : March – April Flowering : April – May Place of flower: Terminal Fruiting : November – February
Growth behaviour	:	Deciduous tree, grows in dense forest, attains height up to 8 m., and 1m. girth.
Silvicultural character	:	Moderate light demander, resistant to jhum fire, natural and artificial regeneration has difficulty.
Soil (*in situ* condition)	:	pH=5.5, OC=0.86 %, P=12.3 kg/ha, K=201 kg/ha. (22° 39' 60"N latitude and 92° 40' 60"E longitude).
Associates	:	*Cordia dichotoma, Callicarpa arborea, Schima wallichii.*
Uses MZ	:	Bark boiled with water and the water is used for rheumatism; the same water is also used for scabies by washing the body.
EW	:	Flowers relieves difficult breathing, and also used in bleeding diseases and diarrhoea; fruit is useful in hiccough and blood diseases (Kolammal 1978, Kurup *et al* 1979).

Tetrameles nudiflora R. Br. FA 2 : 335.1938; FBI 2 : 657.1876; FFM : 425.1985; IT : 346.1906. **(Pl. XXIV, Photo 70)**

Local name	:	Thingdawl
Family	:	Tetramelaceae
Locality	:	Rawpuichhip (23° 47'50"N latitude and 92° 33'80"E longitude), Khawzawl, Ratu, Bukpui, Lungsen, etc.
Altitude	:	555 - 1200m.

Description	:	Big tree; bark light grey, smooth; leaf broadly ovate, alternate, orbicular, serrate, base cordate; flower small, yellow, sessile, many flowers in a panicle, appearing before the leaf; fruit round, glandular.
Phenology	:	Leaf shedding : October – March New leaf : April – May Flowering : March – May Place of flower: Terminal Fruiting : May – June
Growth behaviour	:	Deciduous tree, grows in open patch of forest area, attains height up to 12m. and girth 2m.
Silvicultural character	:	Light demand is high, acceptable to jhum fire, resistant to heavy rainfall, natural and artificial regeneration has no difficulties.
Soil (*in situ* condition)	:	pH=5.6, OC=0.66 %, P=21 kg/ha, K=08 kg/ha. (23° 47' 50"N latitude and 92° 33'80"E longitude).
Associates	:	*Schima wallichii, Parkia roxburghii*, Bamboo.
Uses MZ	:	Milky sap exude from cutting of the stem is applied externally to cure cuts and wounds.

First time reported

Vitex peduncularis Wall. ex Schauer. AE : 189.1996; CCENI : 204.1994; CIMP 1 : 431.1995; FA 3 : 485.1939; FFM : 692.1987; FT 2 : 118.1983; GIMP : 257.1956; IMP 3 : 1941, IT : 505.1906. **(Pl. XXIV, Photo 71)**

Local name	:	Thingkhawilu
Family	:	Verbenaceae
Locality	:	Chawnhu (22° 29' 50"N latitude and 92° 53' 55"E longitude), Ralvawng, Hmunpui, Kolasib.
Altitude	:	450 -1200m.
Description	:	Large tree; stem fluted at base; bark dark grey, young part pubescent, leaf pinnately compound, leaflet lanceolate or oblanceolate, acuminate, base cuneate; flower yellowish–white, in axillary peduncle; fruit obovoid or globose, black when ripe.

Phenology	:	Leaf shedding :	October – January
		New leaf :	March – April
		Flowering :	April – May
		Place of flower:	Axillary
		Fruiting :	July – September
Growth behaviour	:	Deciduous tree, grows in open patches of forest, attains height up to 11m. and girth with 1m.	
Silvicultural character	:	Moderate light demander, resistant to jhum fire, natural and artificial regeneration has no problem.	
Soil (*in situ* condition)	:	pH=5.6, OC 1.6 %, P=0.56 kg/ha, K=72 kg/ha. (22° 29'50"N latitude and 92° 53'55"E longitude).	
Associates	:	*Castanopsis tribuloides, Ostodes paniculata, Polygonum glabrum.*	
Uses MZ	:	Decoction of bark and leaves are boiled with water and the steam is inhaled for the treatment of malaria and black water fever.	
EW	:	Decoction of leaves for blood purification (Vergheese 1996).	

Candidate Species

Vitis peduncularis Wall. FBI 1 : 635.1872. **(Pl. XXIV, Photo 72)**

Local name	:	Pasaltakaza	
Family	:	Verbenaceae	
Locality	:	Chawnhu (22° 29' 50" N latitude and 92° 53' 55" E longitude), Ralvawng, Hmunpui, etc.	
Altitude	:	450 -1100m.	
Description	:	Small to big tree, bark brown with a thick red one, leaf alternate, elliptic, acuminate, attenuate, stalked , serrate, flower is not studied.	
Phenology	:	Leaf shedding :	November
		New leaf :	March – April
		Flowering :	not available
		Fruiting :	not available

Growth behaviour : Tree, grows in thick forest; attains height up to 12m.

Silvicultural character : Moderate light demander, resistant to jhum fire, natural regeneration has no problem but artificial regeneration is difficult.

Soil (*in situ* condition): pH=5.0, OC=0.50 %, P=52 kg/ha, K=270 kg/ha. (22° 29'50"N latitude and 92° 53'55"E longitude).

Associates : *Wendlandia grandis, Schima wallichii, Castanopsis tribuloides.*

Uses MZ : Decoction of bark is used to cure stomach ulcer by taking one cup twice a day with full stomach; decoction of bark is used to remove retain placenta by taking one bottle after delivery.

ABBREVIATION USED :

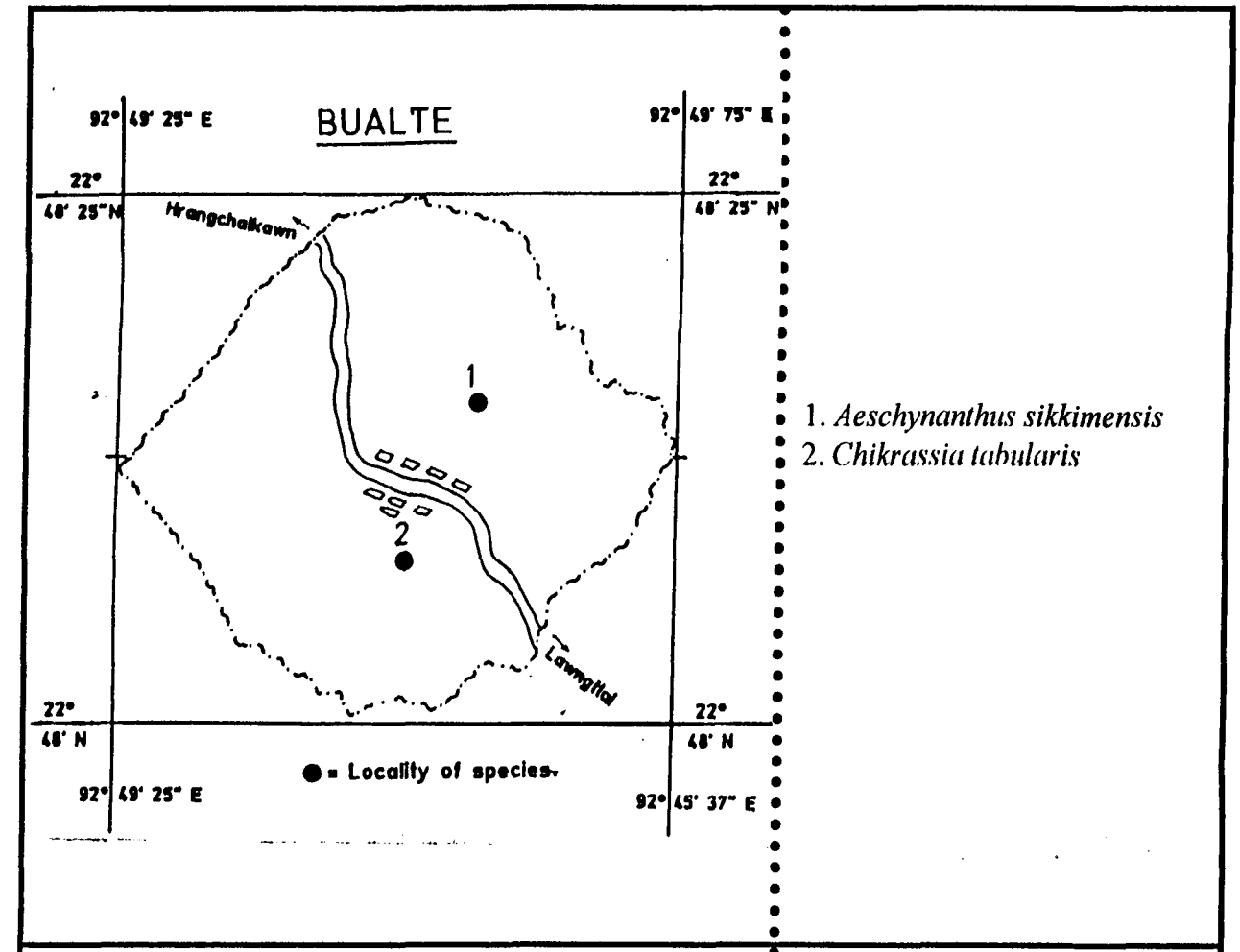
AE	=	*Applied Ethnobotany*
ADPS	=	*Ayurvedic Drugs and Their Plant Sources*
CCENI	=	*Cross–Cultural Ethnobotany of Northeast India*
CMPD	=	*Common Medicinal Plants of Derjeeling & Sikkim*
CIMP	=	*Compendium of Indian Medicinal Plants*
FA	=	*Flora of Assam*
FBI	=	*Flora of British India*
FFM	=	*Forest Flora of Meghalaya*
FJ	=	*Flora of Jowai*
FM	=	*Flora Medica*
FT	=	*The Flora of Tripura State*
FTM	=	*Handbook of Forest Tree of Mizoram*
FUG	=	*Flora of The Upper Gangetic Plain*
GIMP	=	*Glossary of Indian Medicinal Plants*

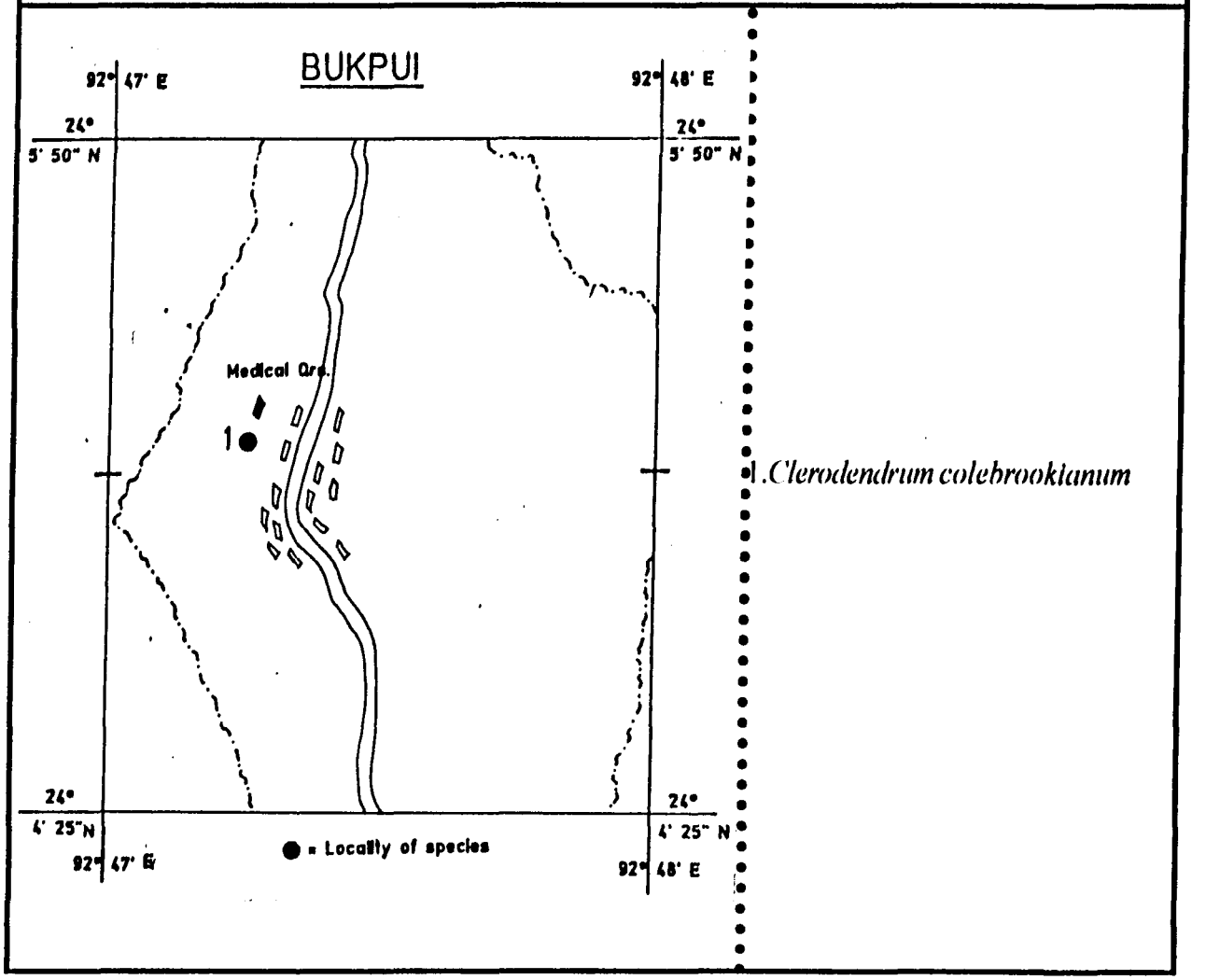
IMP	=	*Indian Medicinal Plants*
IMPC	=	*Indian Medicinal Plants – a compendium of 500 species*
IT	=	*Indian Trees*
MP	=	*Medicinal Plants*
MPPI	=	*The Medicinal & Poisonous Plants of India*
MPW	=	*Medicinal Plants of the World*
NPEI	=	*Notable Plants in Ethnomedicine of India*
SGIMP	=	*Supplement to Glossary of Indian Medicinal Plants*
TIMP	=	*The Treatise of Indian Medicinal Plants*

5.2 DELINEATION OF MAP :

After collection of the plant samples, the forest beat was surveyed thoroughly to check the distribution patterns of plants. The adjacent forest beats were also covered to ascertain the range of distribution and degree of abundance of the plant species. The range of distribution was recorded. The topo sheets covering that particular area were collected, latitude and longitude were measured to delineate on the map to show the place of availability of the plants. In course of study the following topographical map sheets numbers were used : 83 D/15, 83 D/16, 83 D/18, 84 A/9, 84 A/10, 84 A/11, 84 A/12, 84 A/13, 84 A/14, 84 A/15, 84 A/16, 84 B/9, 84 B/10, 84 B/13, 84 B/14, 84 B/15, 84 E/1, 84 E/2, 84 E/4, 84 F/1.

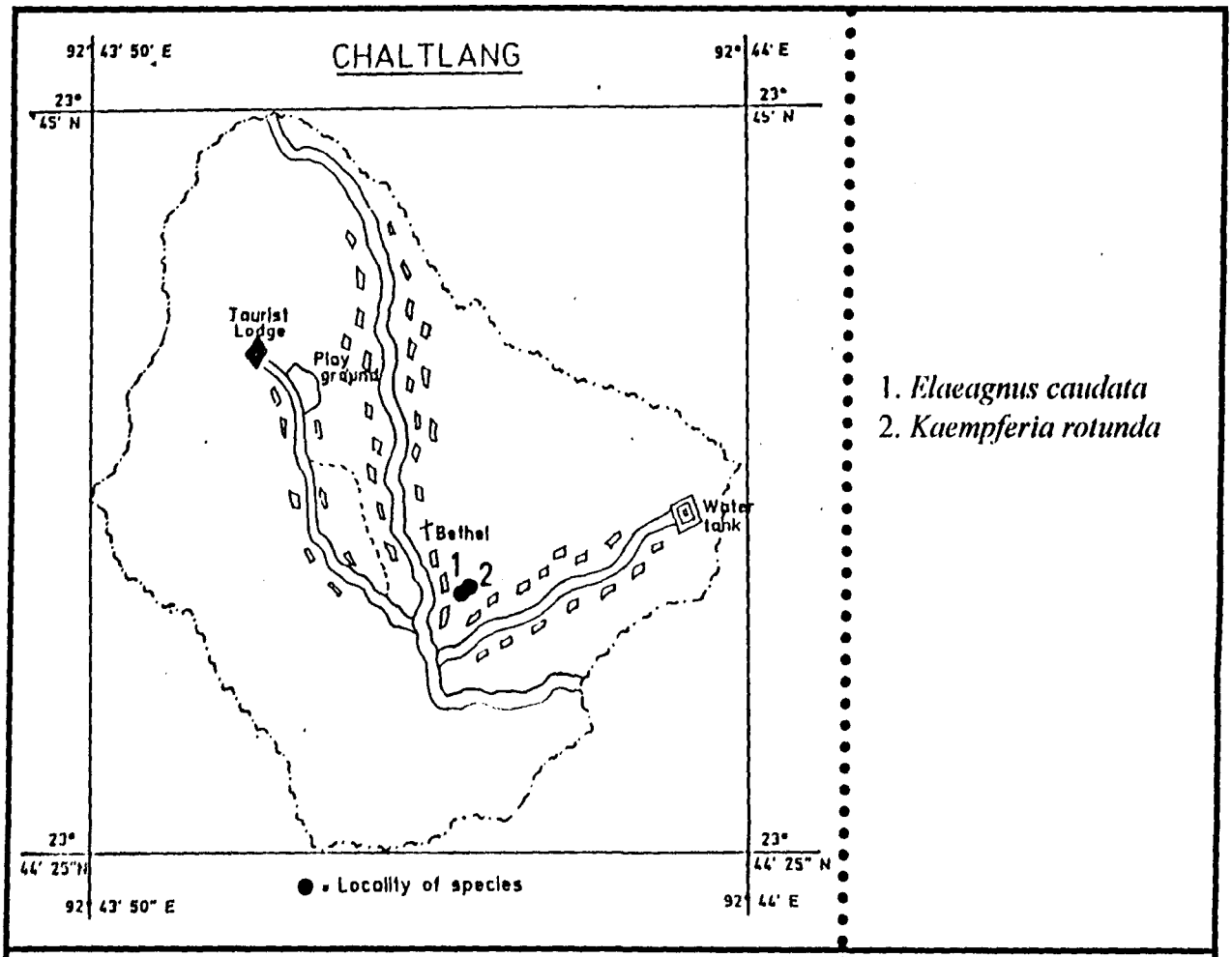
Map No. 2

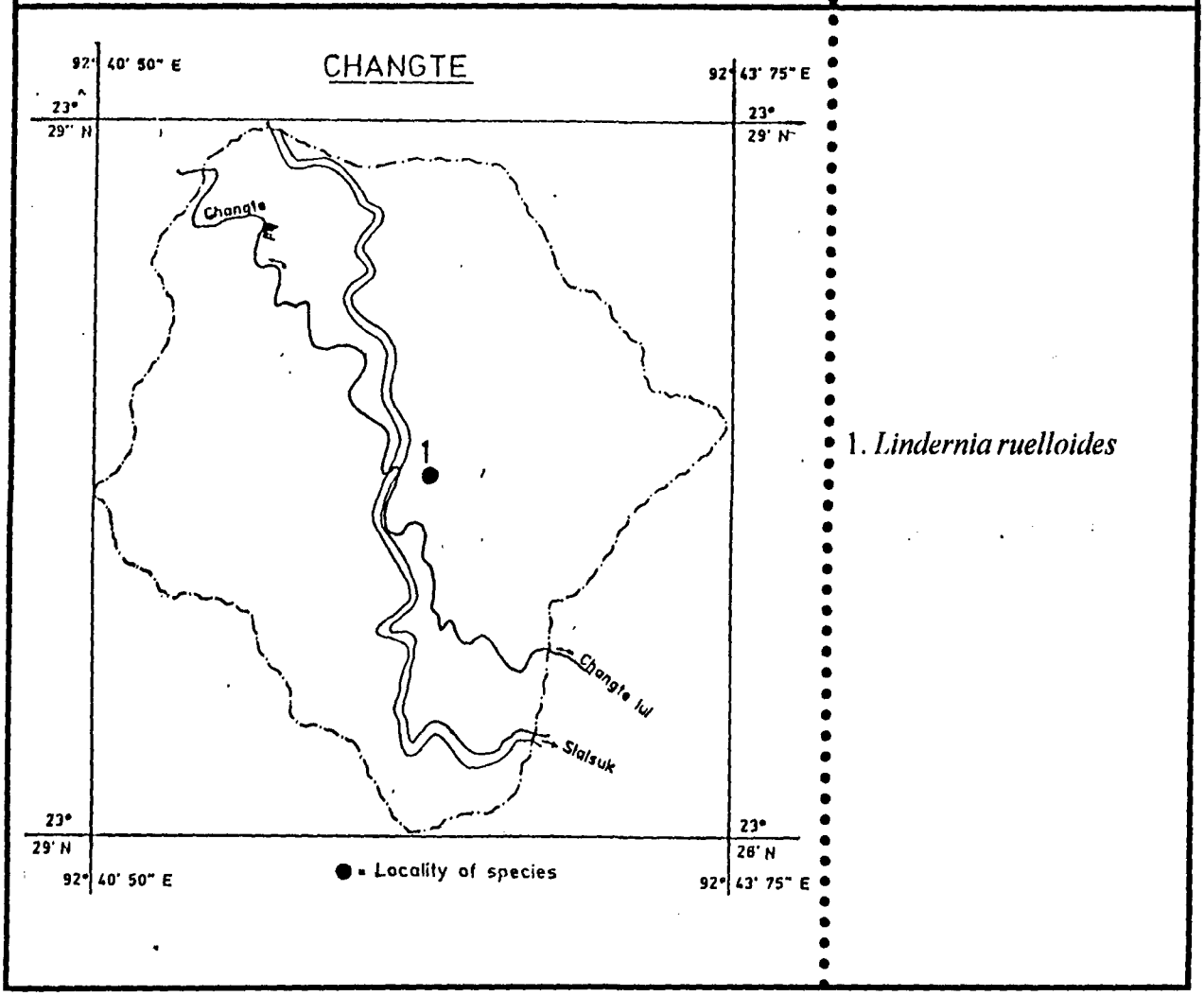




Map No. 3

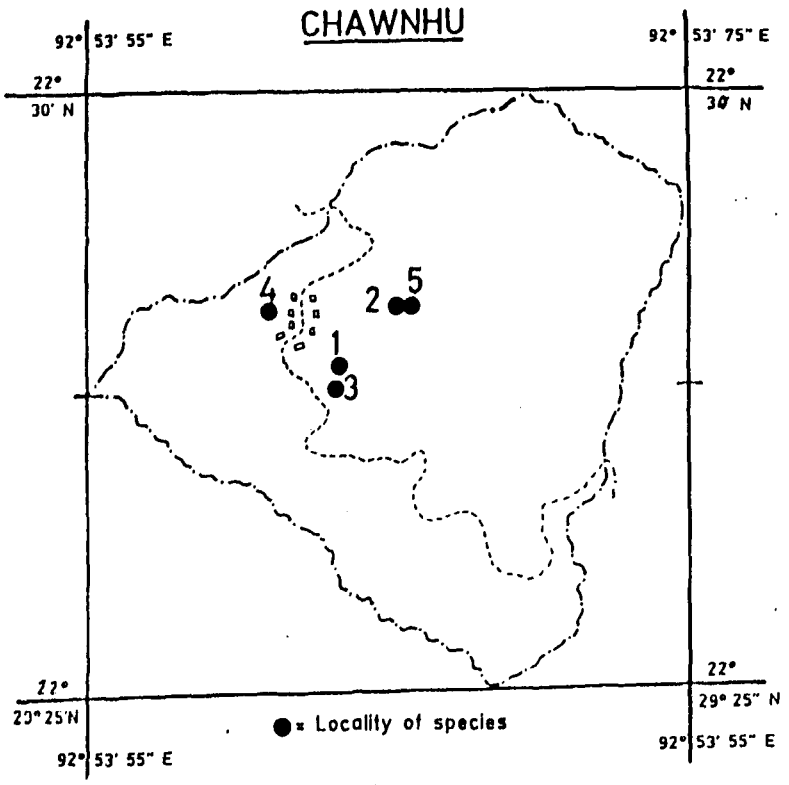
Map No.4



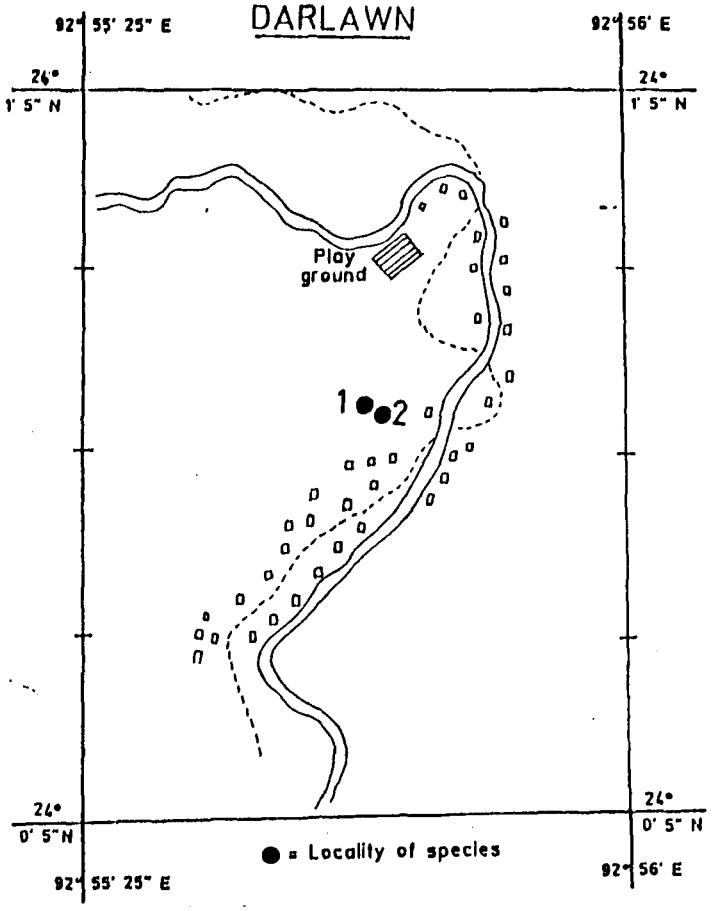


Map No. 5

Map No. 6



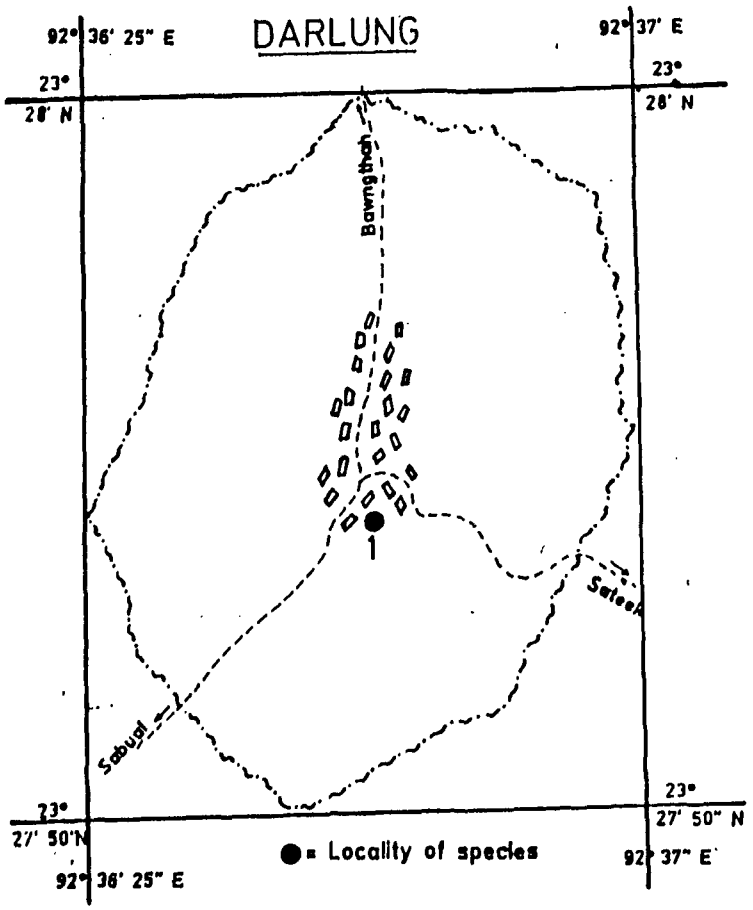
1. *Ampelocissus latifolia*
2. *Aporosa octandra*
3. *Jasminum dispermum*
4. *Vitex peduncularis*
5. *Vitis peduncularis*



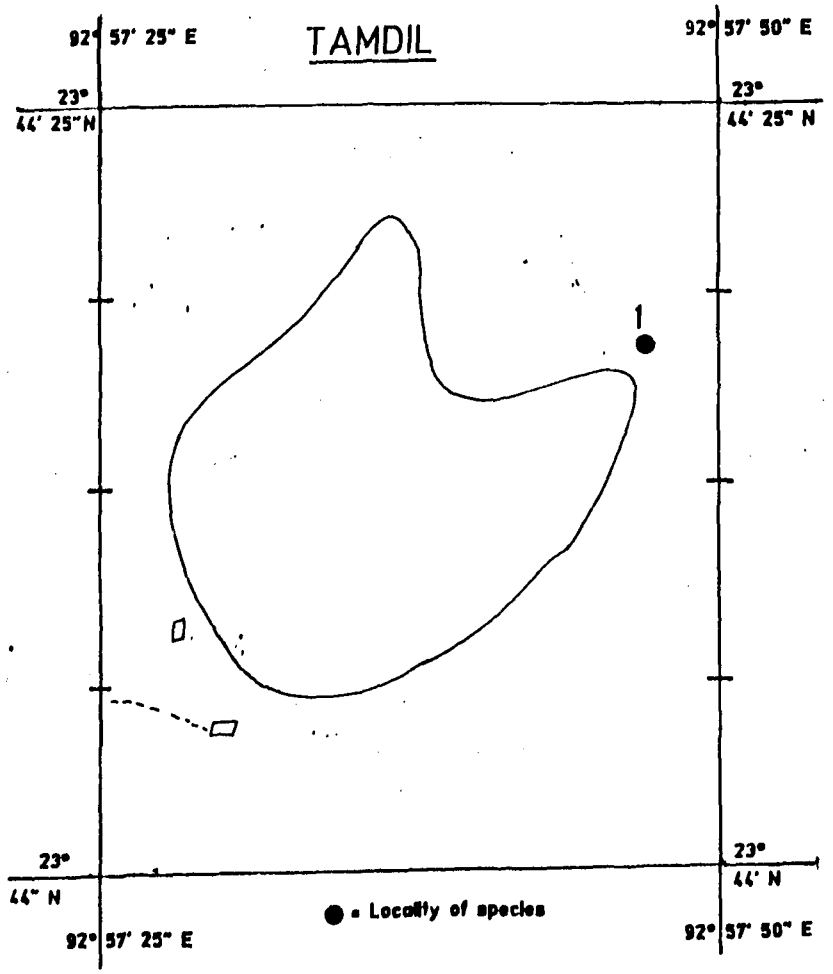
1. *Callicarpa arborea*
2. *Rhus semialata*

Map No. 7

Map No. 8



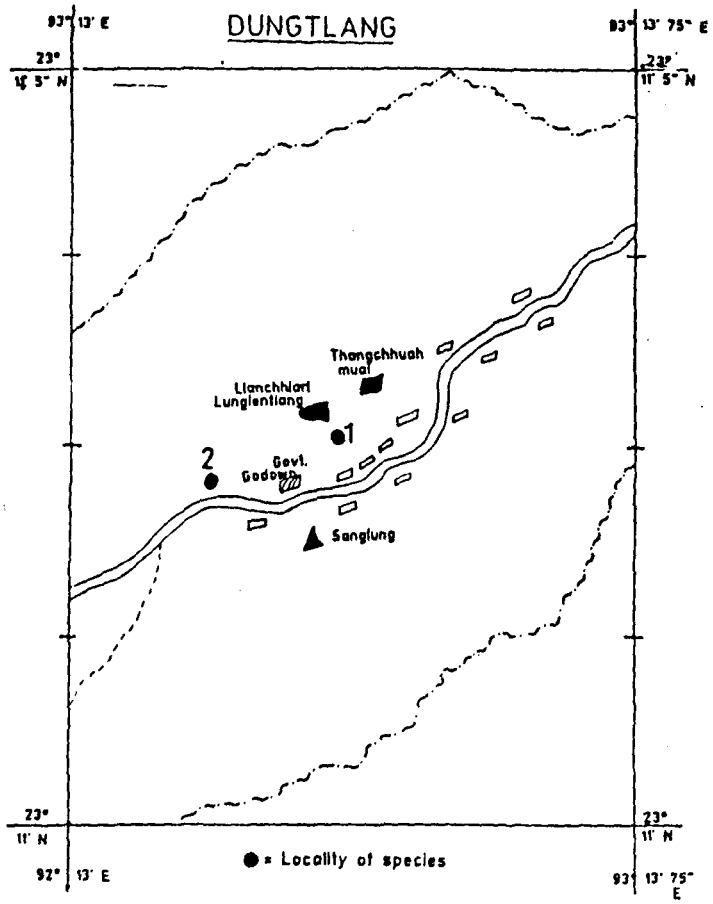
1. *Alstonia scholaris*



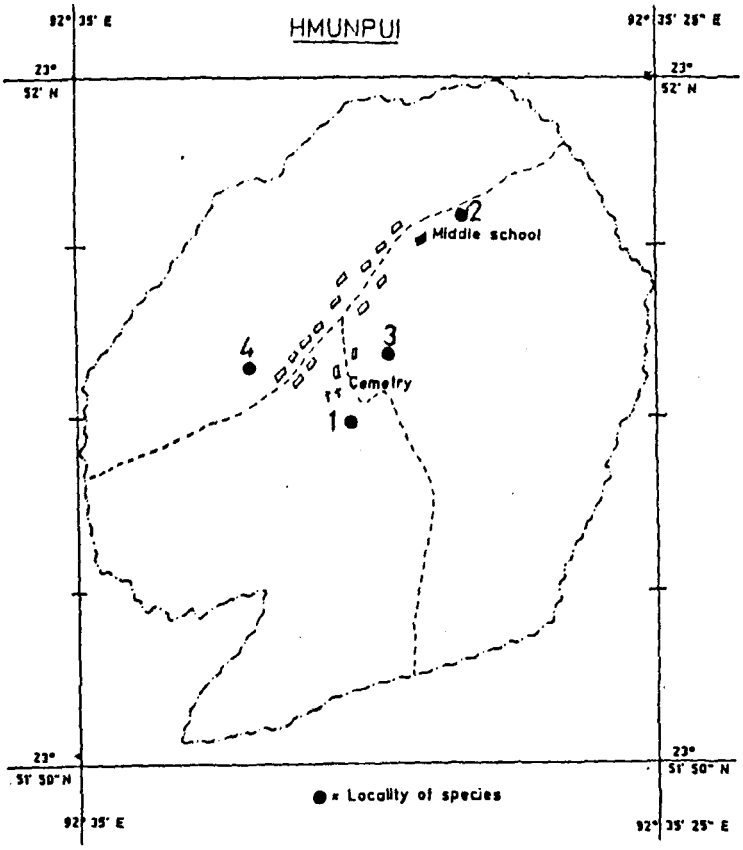
1. *Dendrocnide sinuata*

Map No. 9

Map No. 10



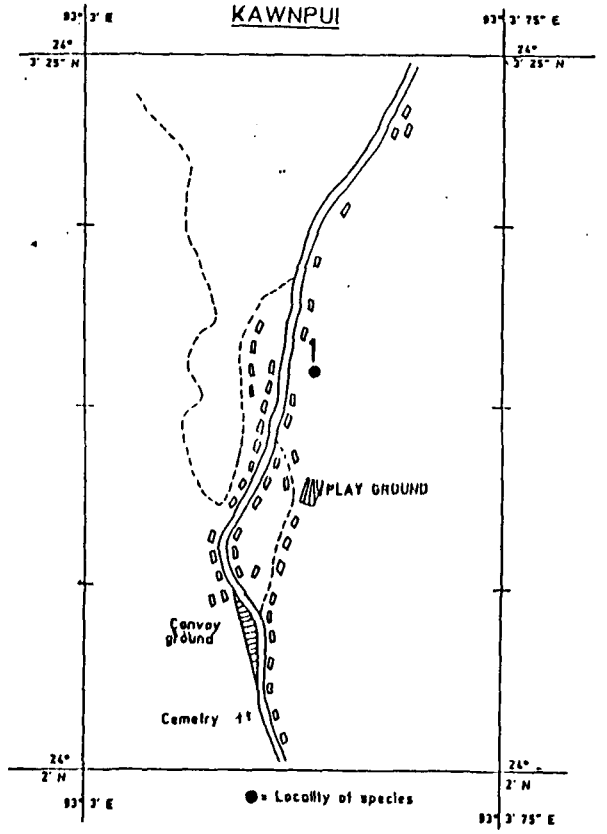
1. *Mikania micrantha*
2. *Scoparia dulcis*



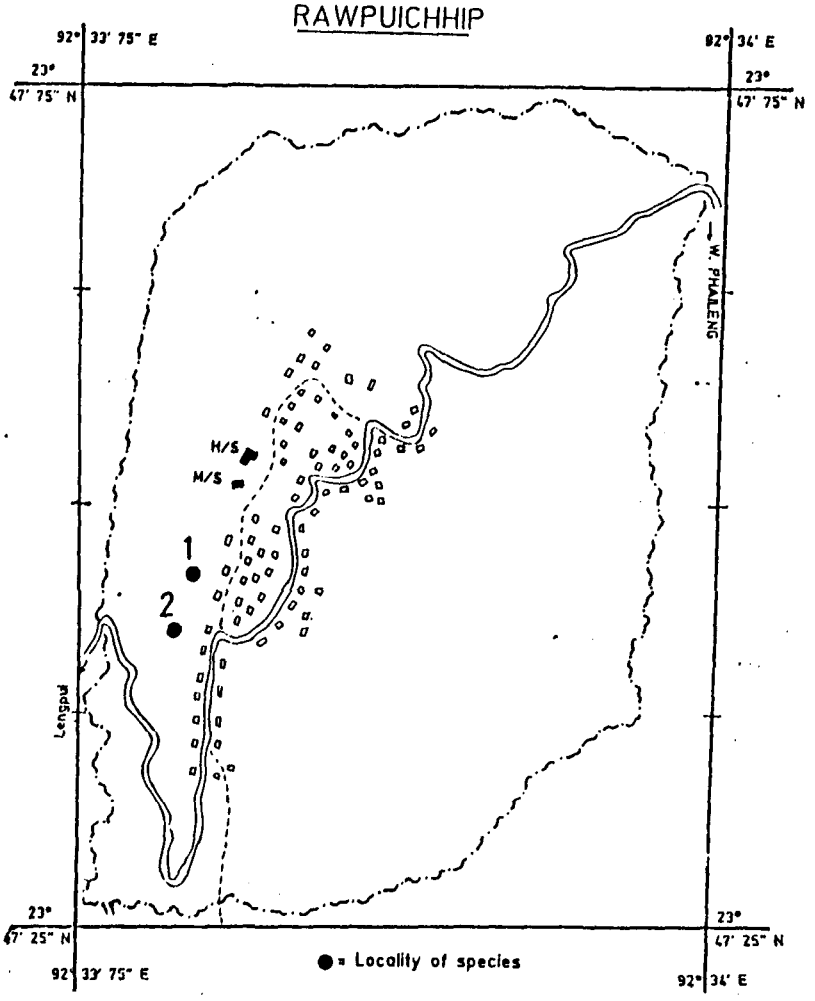
1. *Gmelina arborea*
2. *Oroxylum indicum*
3. *Saraca asoca*
4. *Sterculia vilosa*

Map No. 11

Map No. 12



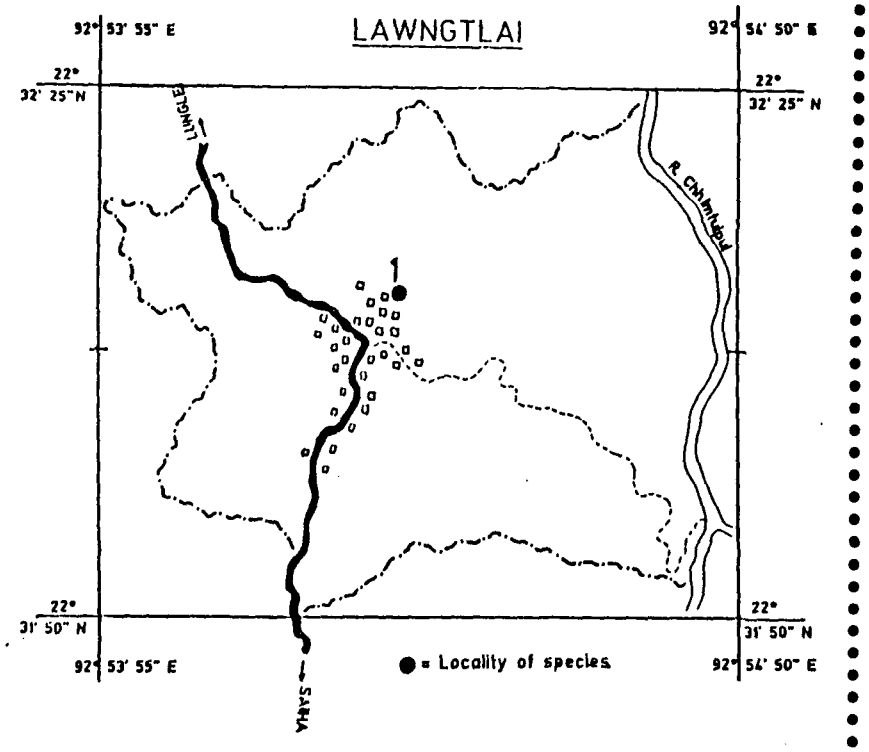
1. *Dysoxylum gobara*



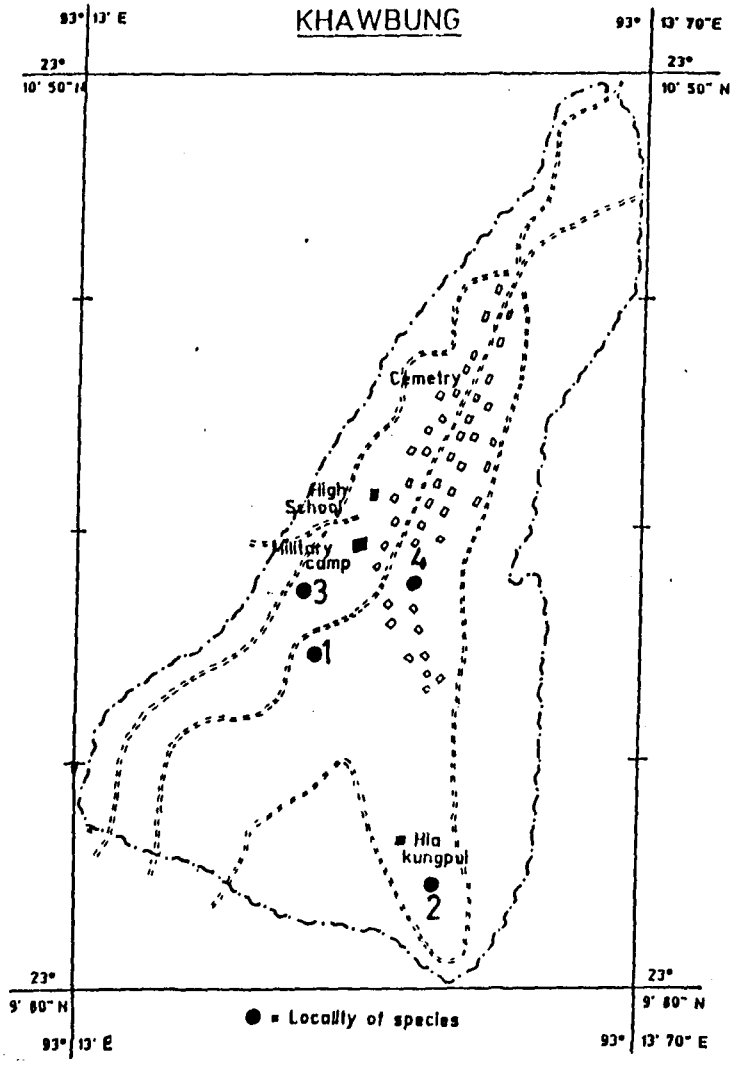
1. *Garcinia sopsopia*
2. *Tetrameles nudiflora*

Map No. 13

Map No. 14



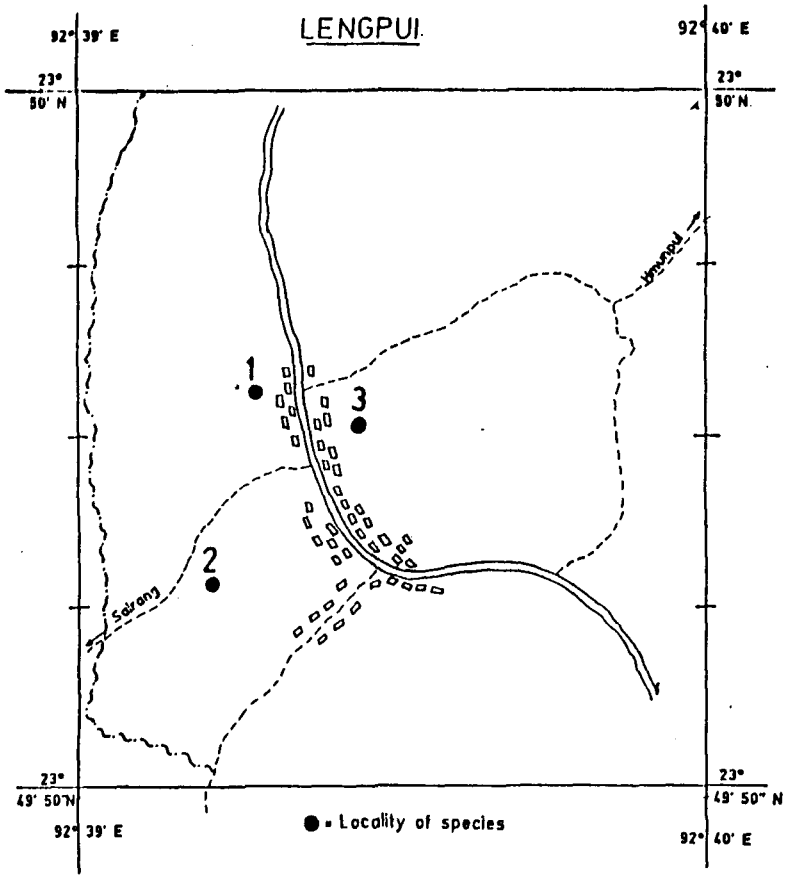
1. *Cassia alata*



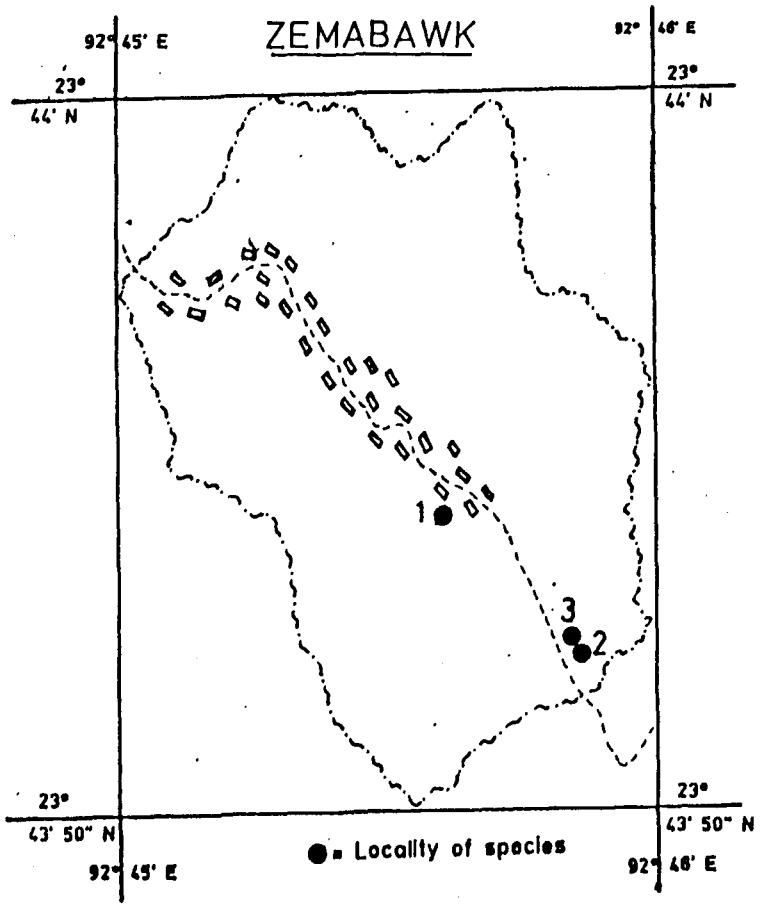
1. *Artemisia indica*
2. *Chromolaena odorata*
3. *Hedyotis scandens*
4. *Pramanthes scandens*

Map No. 15

Map No. 16



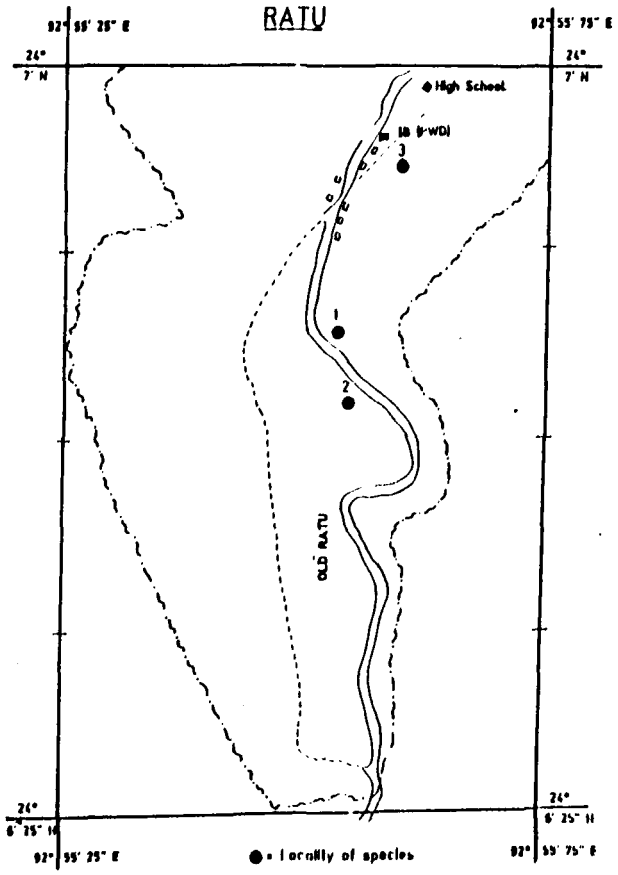
1. *Alocasia fornicata*
2. *Blumea laciniata*
3. *Psidium guajava*



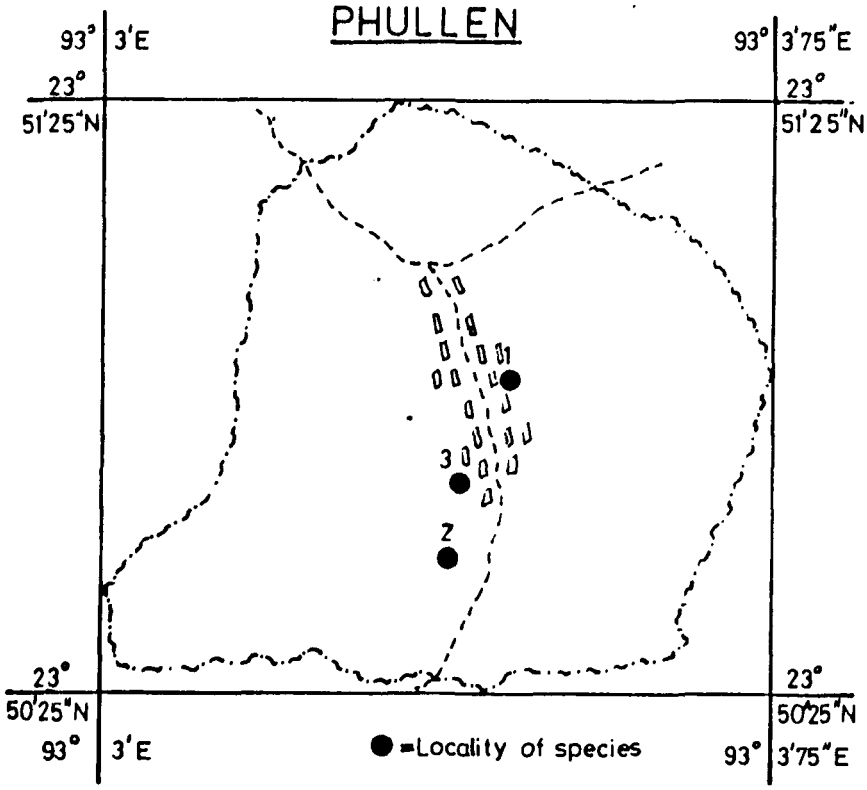
1. *Musseanda roxburghii*
2. *Securinega virosa*
3. *Solanum khasianum*

Map No. 17

Map No. 18



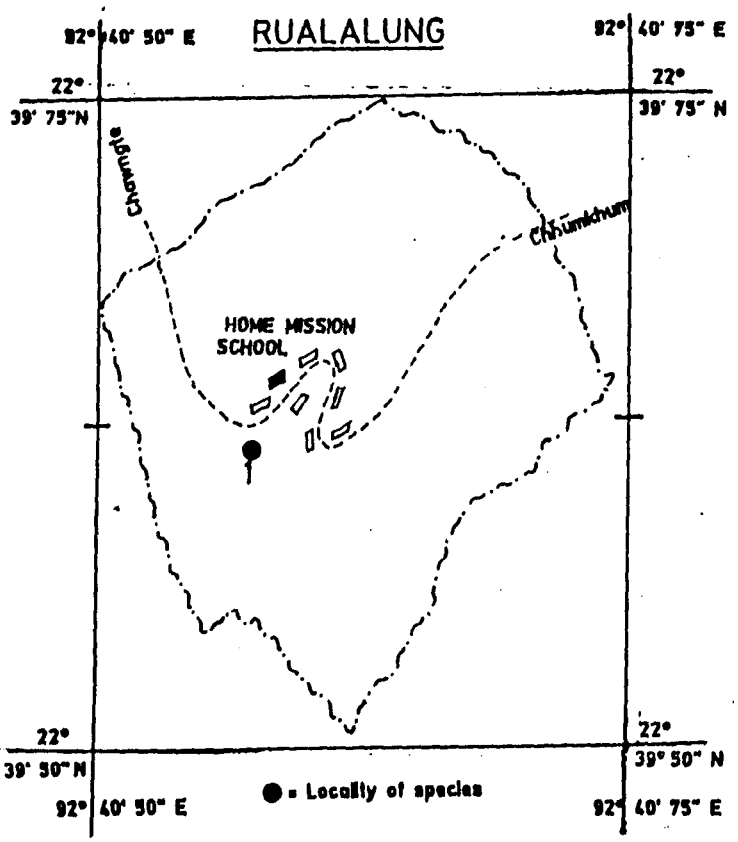
1. *Bidens biternata*
2. *Lobelia angulata*



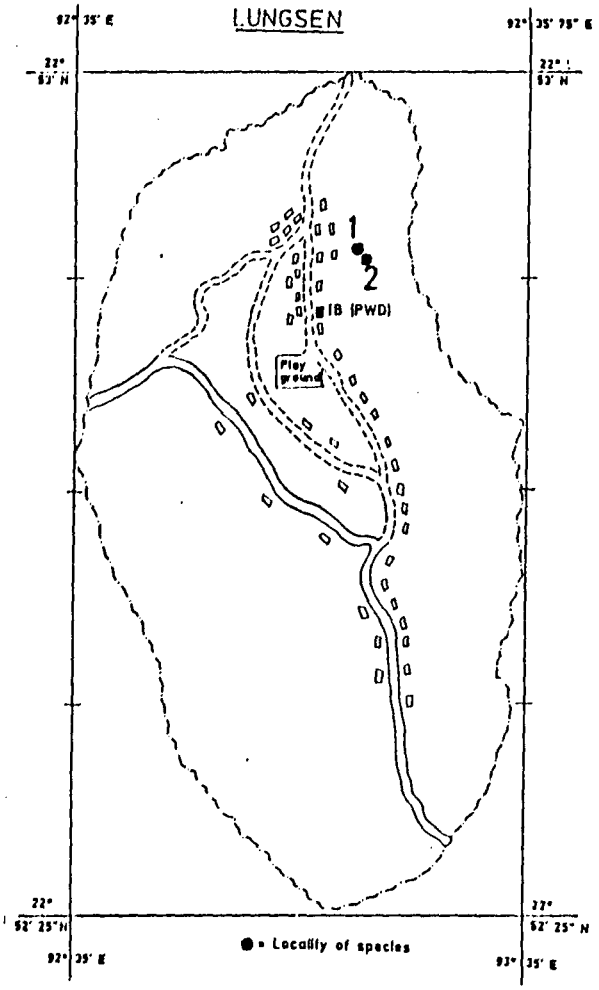
1. *Momordica charantia*
2. *Ostodes paniculata*
3. *Phyllanthus emblica*

Map No. 19

Map No. 20



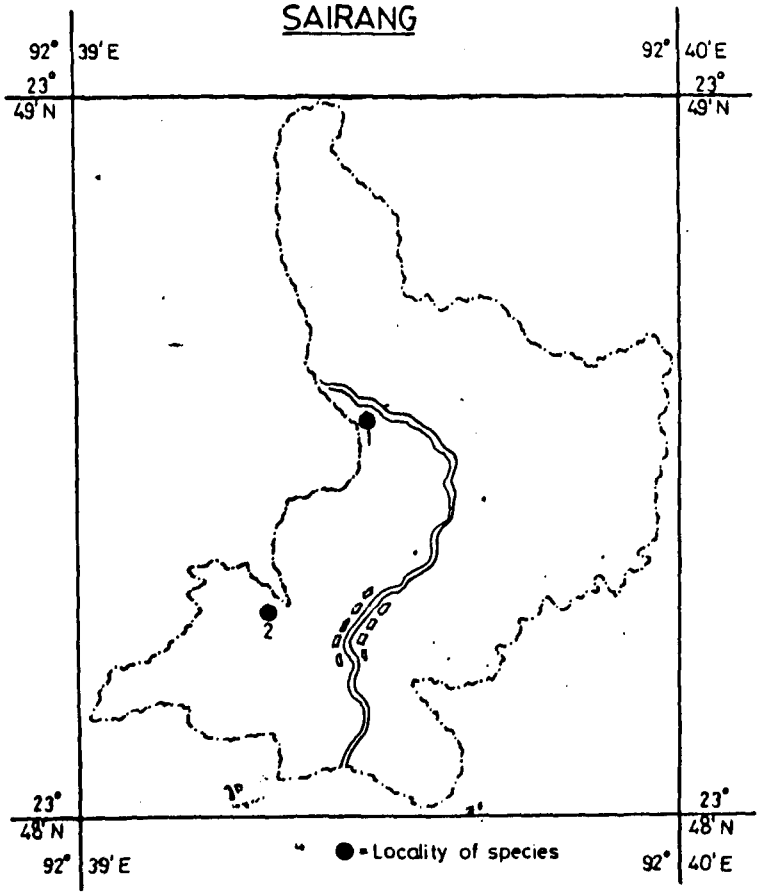
1. *Stereospermum colais*



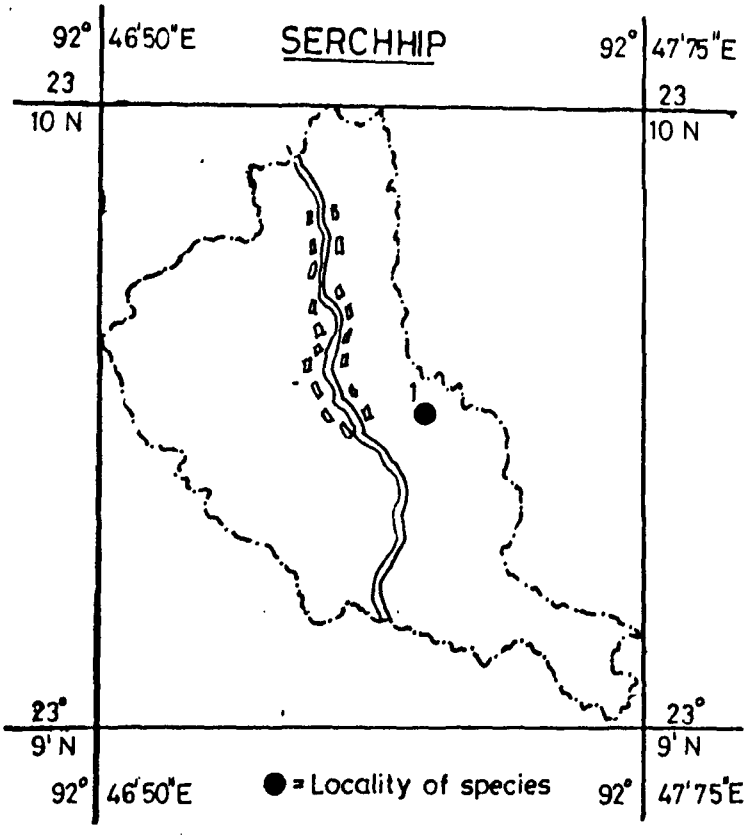
1. *Ficus benjamina*
2. *Mangifera indica*

Map No. 21

Map No. 22



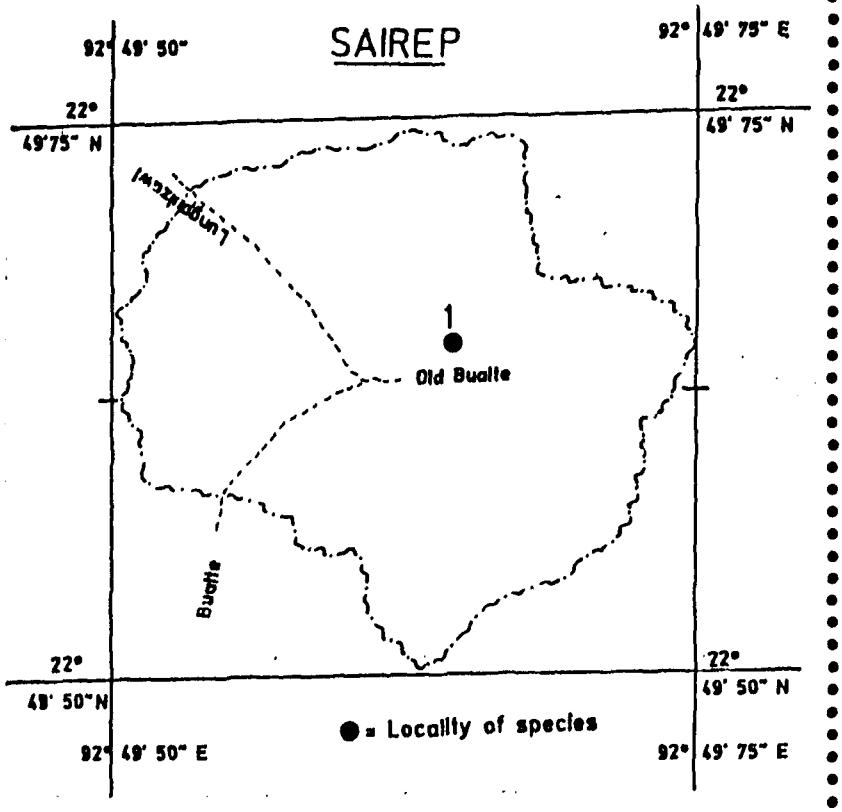
1. *Mimosa pudica*
2. *Solanum nigrum*



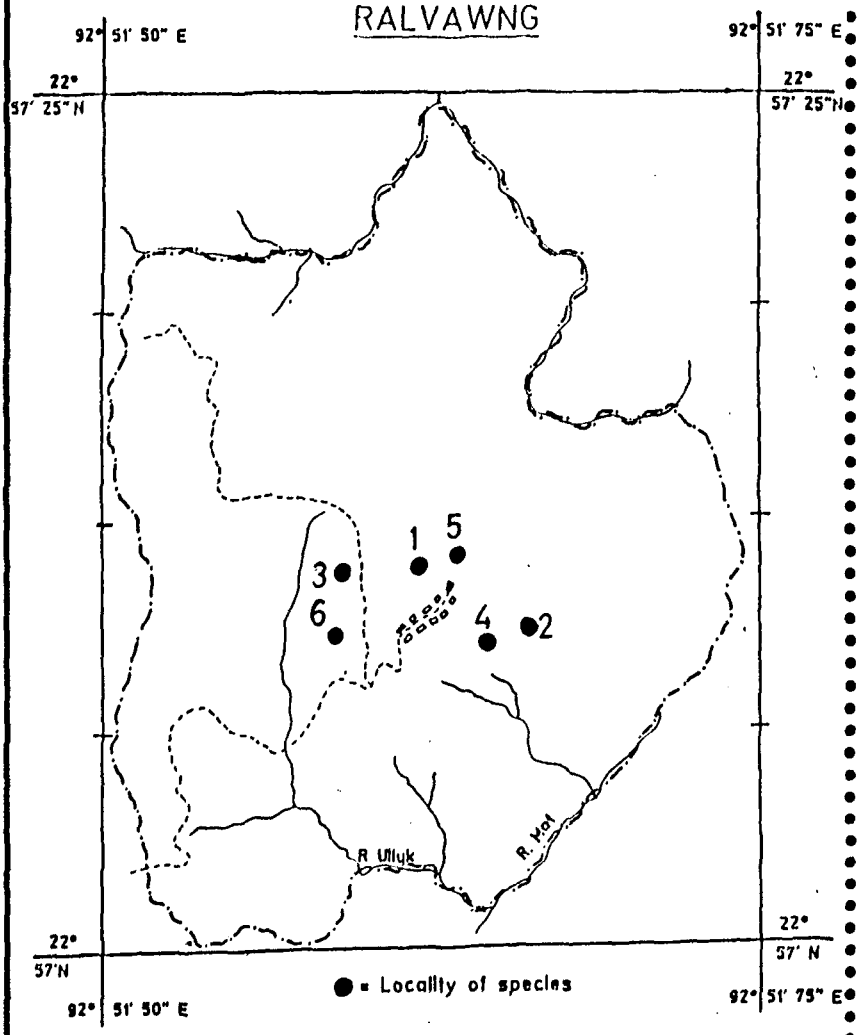
1. *Blumea lanceolaria*

Map No. 23

Map No. 24



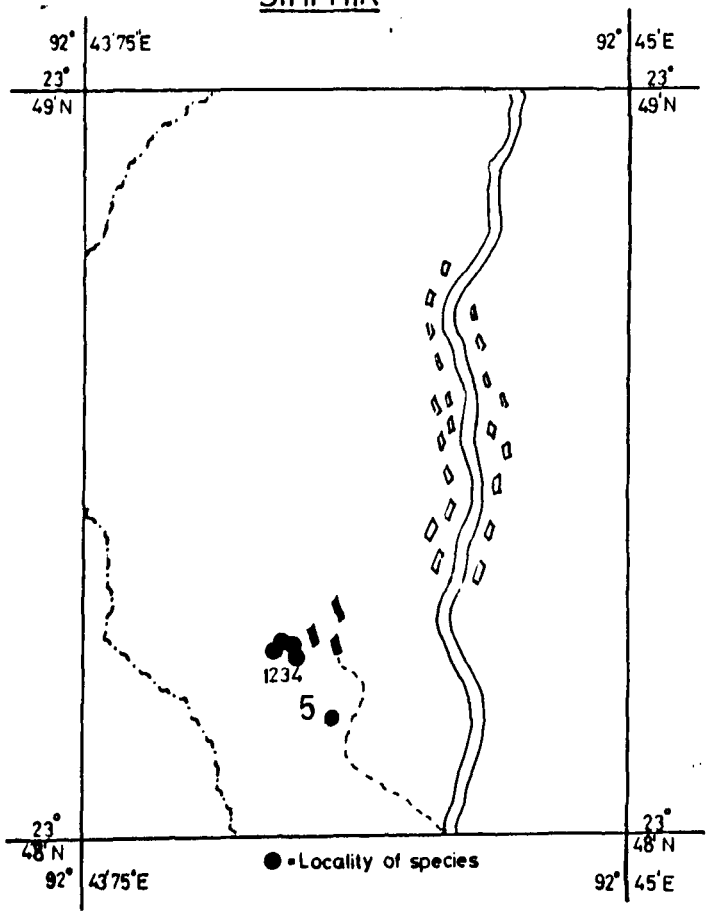
1. *Gynocardia odorata*



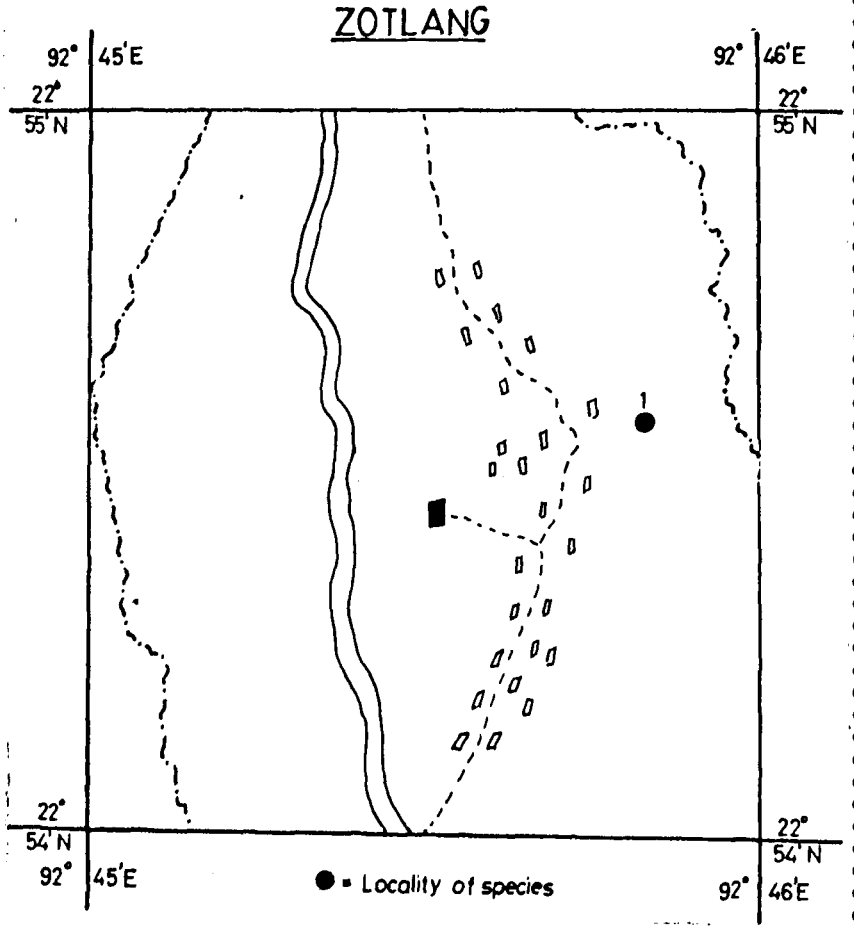
1. *Adina cordifolia*
2. *Chonemorpha fragrans*
3. *Ilex umbellulata*
4. *Lannea coromandelica*
5. *Parabarium hookeri*
6. *Psuedodrynaria coronans*

Map No. 25

Map No. 26



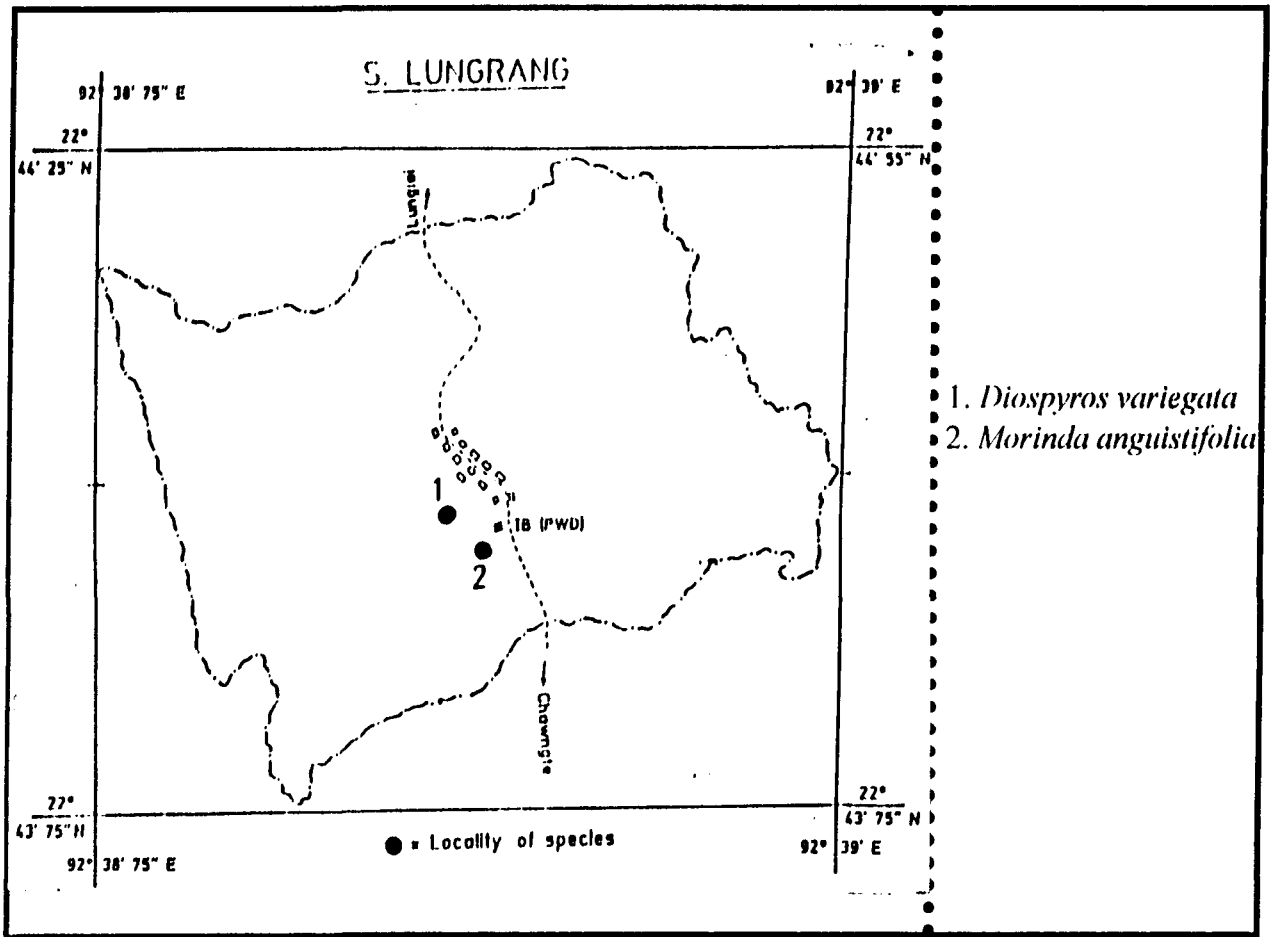
1. *Cinnamomum bejolghota*
2. *Cinnamomum verum*
3. *Justicia zeylanica*
4. *Mallotus roxburgianus*
5. *Costus speciosus*



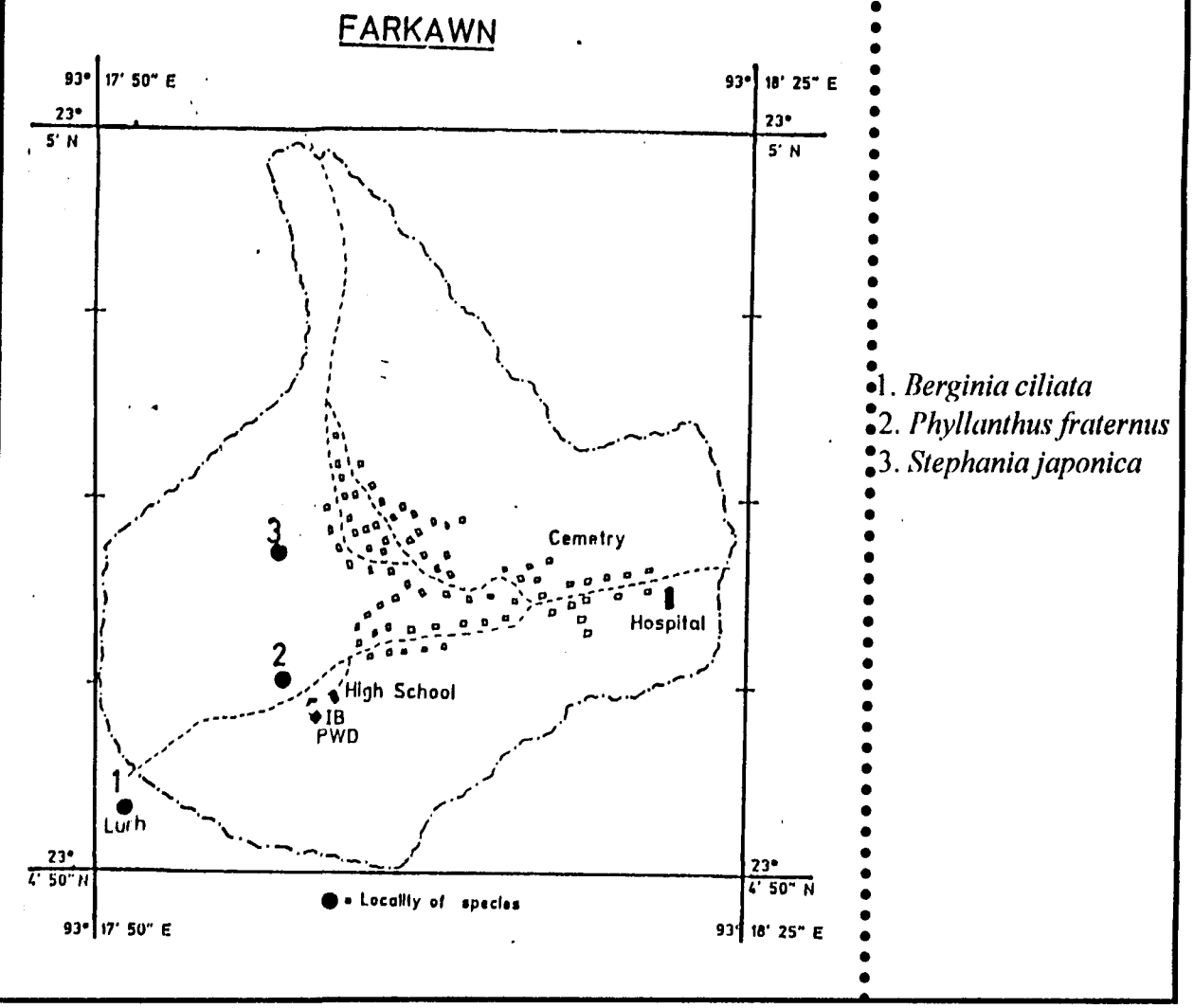
1. *Picrasma javanica*

Map No. 27

Map No. 28



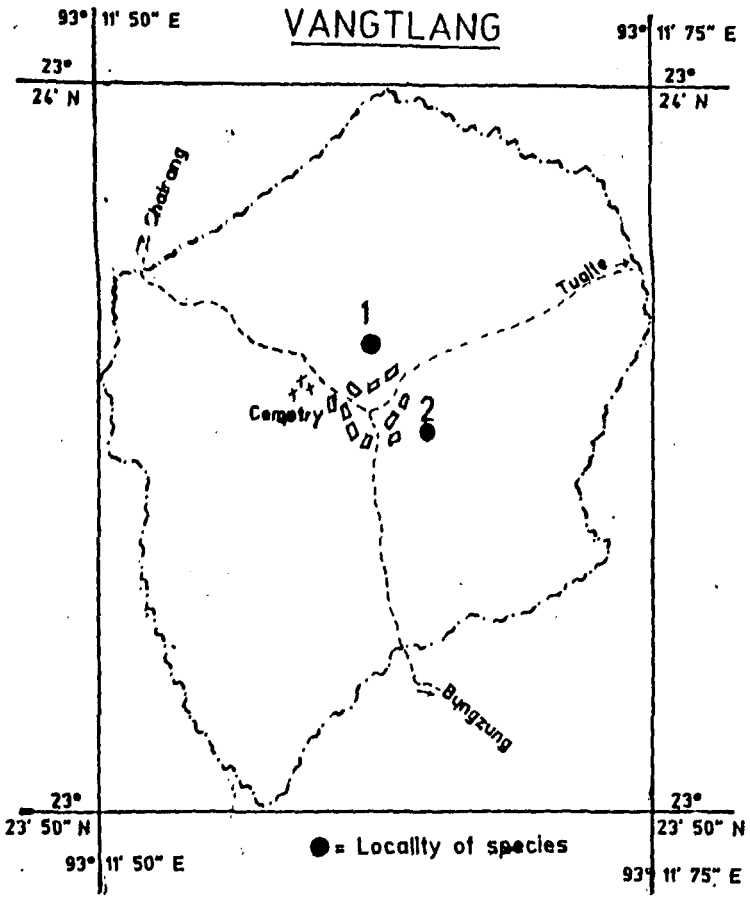
1. *Diospyros variegata*
2. *Morinda anguistifolia*



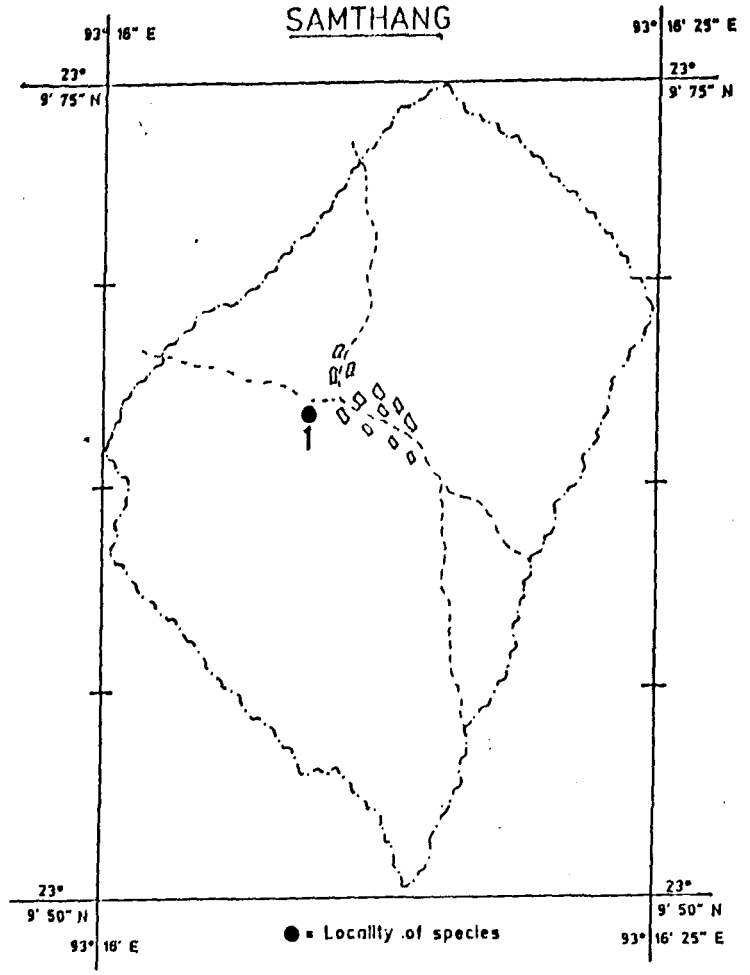
1. *Berginia ciliata*
2. *Phyllanthus fraternus*
3. *Stephania japonica*

Map No. 29

Map No. 30



1. *Engelhardtia spicata*
2. *Schima wallichii*



1. *Osbekia rostrata*

Map No. 31

5.3 SCREENING OF CANDIDATE PLANT SPECIES HAVING PHARMACEUTICAL POTENTIAL FOR CHEMICAL ANALYSIS :

Ethnomedicinal survey gives an idea of pharmaceutical potential of a species or in other words ethnomedicinal survey is an indicator of presence of biologically active substance.

In the present survey of medicinal plants of Tropical and Sub-tropical semi-evergreen Forest of Mizoram, 68 plant species has been recorded with pharmaceutical potential.

The scanning of literature were carried out to ascertain the ethnomedicinal claim for the uses as informed by the traditional healers and users.

In the second phase, literature is scanned to know whether or not any chemical compounds had been isolated from the medicinal plant species growing in the Tropical and Sub-tropical semi-evergreen Forest of Mizoram. This scanning helped in determining the medicinal plant species which is not subjected for biological assays (Table 4). Total 18 species were selected as candidate plant species suitable for chemical analysis to identify the active compound.

Out of 18 species, 3 species were selected for the chemical analysis by the Chemistry Division of Forest Research Institute, Dehra Dun. The chemical analysis of the candidate plant species were done in collaboration with Dr. R. Dayal, Centre of Advance Study, Chemistry Division of Forest Research Institute, Dehra Dun.

5.4 CHEMICAL ANALYSIS :

Sixty eight plant species has been recorded with pharmaceutical potential in the present study. Out of sixty eight, eighteen species are selected as candidate plant species suitable for chemical analysis to identify the active compound.

The below mentioned three plants species are selected for chemical analysis :

- ***Garcinia sopsopia*** Mabb. (**Vawmva**)
- ***Mallotus roxburghianus*** Muell.- Arg. (**Zawngtenawhlung**)
- ***Vitex peduncularis*** Wall. (**Thingkhawilu**)

5.4.1 *Garcinia sopsopia*

Preperation of Extractives of Bark :

The bark of *Garcinia sopsopia* was cut into small pieces and extracted sequentially with benzene and methanol in a soxhlet apparatus. The solvents were recorded on water bath and the yield of the extractives (benzene and methanol) was found to be 2.0 % and 11.0 % respectively.

Thin Layer Chromatography of Brak Extractives :

TLC examination of benzene extract of *Garcinia sopsopia* bark in 4% methanol-dichloromethane showed the presence of two compounds (Rf 0.63 and 0.41) of which the former gave pink spot on spraying with 5 % sulphuric acid and thus could be a terpenoid and the later (Rf 0.41) gave yellow spot on spraying with 5 % sulphuric acid and gave + ive ferric chloride reaction indicating to be a flavanoid.

TLC examination of methanol extract of the bark in ethyl acetate : methanol : water (40 : 6.6 : 5.4) showed the presence of two compounds (Rf 0.83 and 0.32). Compound with Rf 0.32 gives brown spot on spraying with sulphuric acid.

It can be concluded from the above studies that the extractives of the above plants consist mainly of terpenoids, polyphenols (including flavanoids) and other waxy materials not detected by thin layer chromatography.

5.4.2 *Mallotus roxburghianus*

Preparation of Extractives of Leaves and Bark:

The air dried leaves (500g) and bark (1 kg) were cut into small pieces respectively. The leaves and barks were extracted separately and sequentially with petroleum ether and methanol in a soxhlet apparatus. Removal of the solvents on water bath yielded extractives as mentioned in the table (Table 5) given below :

(Table 5) : Percentage of Different Extractives of *Mallotus roxburghianus*

Part	Petroleum extract (%)	Methanol extract (%)
Leaves	3.70	3.90
Bark	0.60	12.0

Thin Layer Chromatography of Bark Extractives :

TLC of petroleum ether extract of the bark in different solvents did not show any spot while TLC of methanol extract in ethyl acetate-methanol-water (40 : 6.6 : 5.4) showed the presence of three compounds (Rf 0.83, 0.80 &

0.78) on exposure to Iodine and all of them gave positive ferric chloride test. Thus the compounds are polyphenolic in nature.

Thin Layer Chromatography of Leaves Extractives :

TLC of petroleum ether extract of *Mallotus roxburghianus* leaves in 3% methanol-dichloromethane showed the presence of three compounds (Rf 0.90, 0.70 & 0.40) which gave colored spots on spraying with alcoholic ferric chloride thus indicated the presence of three phenolic compounds in the extracts.

TLC of methanol extract of the leaves in ethyl acetate : methanol : water (40 : 6.6 : 5.4) showed the presence of three compounds as detected by exposing the plate to iodine vapors (Rf 0.87, 0.85 & 0.81). Compounds having Rf 0.87 gave positive alcoholic ferric chloride reaction and pale yellow color on spraying with 5 % sulphuric acid indicating it to be a flavanoid.

5.4.3 *Vitex peduncularis*

Isolation of essential oil from leaves:

The air dried leaves of *Vitex peduncularis* were cut into small pieces and hydrodistilled in a cleavenger apparatus for 4hrs. The essential oil thus obtained was extracted with diethyl ether (2 x 50ml). The ethereal layer was dried over anhydrous sodium sulphate for half an hour and ether distilled off. The yield of the essential oil in the leaves on moisture free basis was found to be 0.008 %.

Preparation of Leaves Extractives:

The air dried and powdered leaves (500g) were extracted with petroleum ether, acetone and methanol respectively. Removal of the solvents on water bath yielded 2.7%, 5% and 7% of the different extracts.

Thin Layer Chromatography (TLC) of the Leaves Extractives :

Petroleum ether and acetone extracts of the leaves showed similar spots on TLC and therefore mixed together. β-sitosterol and its glucoside (Rf 0.44 in 10 % MeOH-$CHCl_3$) were detected in the combined extract by comparing with authentic samples. The TLC examination of methanol extract also showed the presence of β-sitosterol glucoside.

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Table 2. Family wise composition of plant species.

Family	No. of species		Family	No. of species
Acanthaceae	1		*Melastomaceae*	1
Anacardiaceae	3		*Meliaceae*	2
Apiaceae	1		*Menispermaceae*	1
Apocynaceae	3		*Mimosaceae*	1
Aquifoliaceae	1		*Moraceae*	1
Araceae	1		*Myrtaceae*	1
Asteraceae	7		*Oleaceae*	1
Bignoniaceae	2		*Polypodiaceae*	1
Caesalpiniaceae	2		*Rubiaceae*	4
Cluciaceae	1		*Saxifragaceae*	1
Costaceae	1		*Scrophulariaceae*	2
Cucurbitaceae	1		*Simaroubaceae*	1
Ebenaceae	1		*Solanaceae*	2
Elaeagnaceae	1		*Sterculiaceae*	1
Euphorbiaceae	6		*Tetramelaceae*	1
Flacourtiaceae	1		*Theaceae*	1
Gesneriaceae	1		*Urticaceae*	1
Juglandaceae	1		*Verbenaceae*	5
Lauraceae	2		*Vitaceae*	1
Lobeliaceae	1		*Zingiberaceae*	1

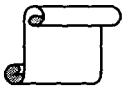
Table 3. Plant species having medicinal value reported for the first time

Sl.No.	Botanical name	Local name	Family	Uses
1	*Aeschynanthus sikkimensis* Stampf. syn. *A. maculata*	Bawltehlantai	Gesneriaceae	Flower chewed raw for tonsilitis Decoction of fleshy root bulb is used to cure inguinal lymphodeupathy and breast cancer
2	*Alocasia fornicata* (Roxb.) Schott.	Baibing	Araceae	Juice is applied on snake bite
3	*Aporosa octandra* (Buch. Ham. ex D.Don) Vick. Syn. *A.dioca* (Roxb.) Muell. Arg. *A. roxburghii* Baill.	Chhawntual	Euphorbiaceae	Decoction of bark for stomachache
4	*Dysoxylum gobara* (Buch. Ham.) Merr. Syn. D. procerum	Thingthupui	Ebenaceae	Decoction of leaf for stomachache and chronic ulcer
5	*Garcinia sopsopia* Mabb.	Vawmva	Clusiaceae	Bark made into powder is used in snake bite
6	*Jusminum dispermum* Lour.	Hruidamdawi	Olaceae	Leaf juice is taken for diarrhoea and dysentery
7	*Lindernia ruelloides* (Colsm.) Mukherjee syn *Bonnya reptans* Spreng. *Ilysanthes reptans* Urban	Thasuih	Scrophulariaceae	Whole plant crushed is used externally for cramp
8	*Mallotus roxburghianus* Muell. Arg.	Zawngtenawhlung	Euphorbiaceae	Decoction of leaves is used to cure diabetes Infusion of bark is good for hypertension
9	*Osbekia rostrata* D. Don.	Builukhampa	Melastomaceae	Root extract is used for renal and genito-urinal disorder
10	*Parabarium hookeri* Pierre. Syn *P. micranthum* (DC) Pierre.	Theikelki	Apocynaceae	Decoction of bark is used to cure juandice and latex is applied to wounds
11	*Pramanthes scandens* Lour.	Kawlhlo	Asteraceae	Dried leaves taken with water for urinary tract infection
12	*Tetrameles nudiflora* R. Br.	Thingdawl	Tetramelaceae	Sap is used externally for cuts and wounds

Table 4 : Candidate plant species (having pharmaceutical potential) suitable for chemical analysis to identify the active compound.

Sl.No.	Botanical name	Local name	Family	Uses
1.	*Aeschynanthus sikkimensis* Stampf. syn. *A. maculata* Cl.	Bawltehlantai	Gesneriaceae	Flower chewed raw for tonsilitis. Decoction of fleshy root bulb against burst inguinal lymphodeuopathy and breast cancer.
2.	*Alocasia fornicata*(Roxb.)Schott.	Baibing	Araceae	Juice is applied on snake bite.
3.	*Aporosa octadra* (Buch.- Ham. ex D.Don) Vick. syn.*A.dioica*(Roxb.)Muell.- Arg. *A.roxburghii* Baill.	Chhawntual	Euphobiaceae	Decoction of brak for stomachache.
4.	*Blumea laciniata* (Roxb.) DC	Khuanglawi	Asteraceae	Roots are used in snakr bite
5.	*Blumea lanceolaria* (Roxb.) syn. *Gynura conyza* Sp.	Buarze	Asteraceae	Decoction of leaf for stomachache and chronic ulcer.
6.	*Dysoxylum gobara*(Buch.- Ham)	Thingthupui	Ebenaceae	Decoction of leaves for diarrhoea & dysentery.
7.	*Engelhardtia spicata* Lescheni. ex Blume.syn.*E.colebrookianam* Lindl. ex Wall.	Hnum	Juglandaceae	Decoction of bark for diarrhoea & dysentery. Juice of root is used for scabies.
8.	*Garcinia sopsopia* Mabb.	Vawmva	Clusiaceae	Bark made into powder is used in snake bite.
9.	*Hedyotis scandens* Roxb. *Oldenlandia scandens* K.Schum.	Kel hnamtur	Rubiaceae	Decotion of leaf for urinary tract infection. Root colic and for rheumatism.

Sl. No.	Botanical name	Local name	Family	Uses
10.	*Jusminum dispermum* Lour.	Hrui damdawi	Oleaceae	Leaf juice is taken for diarrhoea and dysentery.
11.	*Lindernia ruelloides* (Colsm.) Mukherjee.syn. *Bonnya reptans* Spreng.*Ilysanthes reptans* Urban.	Thasuih	Scrophulariaceae	Whole plant crushed is used externally for cramp.
12.	*Mallotus roxburghianus* Muell. Arg.	Zawngtenawhlung	Euphorbiaceae	Decoction of leaves is used against diabetes. Infusion of bark is good for hypertension.
13.	*Osbekia rostrata* D.Don.	Builukhampa	Melastomaceae	Root extract is used for renal and genito-urinary disorder.
14.	*Parabarium hookeri* Pierre. syn. *P.micranthum* (DC.) Pierre ex Spire.	Theikelki	Apocynaceae	Decoction of bark is used against jaundice. Latex is applied to wounds.
15.	*Pramanthes scandens* Lour.	Kawlhlo	Asteraceae	Dried leaves taken with water for urinary tract infection
16.	*Solanum khasianum* Cl.	Rulpuk	Solanaceae	Smoke of burnt fruits or seeds is used for removing tooth worms from the mouth.
17.	*Tetrameles nudiflora* R.Br.	Thingdawl	Tetramelaceae	Sap is used externally for cuts and wounds.
18.	*Vitex peduncularis* Wall.	Thingkhawilu	Verbenaceae	Decoction of bark and leaves is used for pneumonia black water fever.

CHAPTER 6  DISCUSSION & CONCLUSION

DISCUSSION AND CONCLUSION

Numerous ethnobotanical studies aimed at identifying new pharmaceutical products have been initiated in recent times. Ethnobotany has once again become a recognised tool in the search for new pharmaceuticals (Balick 1994).

The ethnobotanical studies help in exploring ethno-biomedical reserve. The objective is : (i) to conserve biological resources and traditional medical system and (ii) to acquaint the pharmaceutical and herbal industries to screen the ethno-medicinal plants in order to search new drugs (Lalnundanga & Jha 2000).

Too often the exploitation of wild harvested resources has led to their severe degradation. Thus biodiversity and cultural conservation should be two of the most important objectives of the ethnobotanist (Balick 1994).

Many of the medicines used in the modern world contain bioactive compounds derived from natural products. Cox (1994) has mentioned " Historically, ethnobotanical leads have resulted in three different types of drug discovery : (i) unmodified natural products where ethnobotanical use suggested clinical efficacy; (ii) unmodified natural products of which the therapeutic efficacy was only remotely suggested by indigenous plant use ; and (iii) modified natural or synthetic substances based on a natural product used in folk medicine.

At present, many pharmaceutical firms are taking interest in acquiring as many of the plants on this planet for their screening programmes as is possible. The major thrust from an industrial point of view is to find biologically active molecules with the intent of attaining the structure in an attempt to enhance activity or

decrease toxicity, such molecules will be candidates for strong patent position that are necessary to recoup the cost of development.

In the present study, sixty eight plant species were identified as potential medicinal plants from the Tropical and Sub-tropical Semi-evergreen Forest of Mizoram. Earlier 230 plants were recorded from Wet Evergreen Forest having medicinal value. Out of 230 plants 61 were recorded for the first time (Lalramnghinglova & Jha 1998). It has been observed that most of the people of the rural area depends upon traditional medicines. Lalramnghinglova (1998) has reported that about 99 % of the interior rural population relies on herbal medicines and about 98 % of raw drugs are harvested from the wild plant resources.

Out of the reported sixty eight medicinal plants, only four species are used in combination with other species to prepare natural drugs whereas Lalramnghinglova & Jha (1999) have reported 15 ethnomedicinal plant species of the Wet Evergreen Forest of Mizoram which are used in combination with other plants or plant parts to prepare natural drugs .

In Mizoram, forests are fast depleting and invaluable genetic resources are rapidly being lost. The most serious threat to this effect is slash – and – burn method of agriculture. Jha (1997 a & b) also reported the same reasons for depletion of forests. Other threats to the habitat destruction are extraction of timber, fuel wood, construction materials, plantations and even landslides (Lalramnghinglova 1998). Proper management of genetic resources and careful adoption of conservation strategies can only pave the way towards economic sustainability of local communities. Infrequent harvests of small amount of biomass do not have much effect on the individuals or population, but bulk removal of biomass from the wild is

disastrous; even if the amount is small, frequent removal of biomass results in local extractions (Bennet 1992). The study area do lack conservation measures due to want of proper conservation strategies. The overexploitation and reluctant attitude of the forest dwellers towards conservation of forest resulted in the loss of many species. *Scoparia dulcis* L. an important medicinal plant is very scarce in its natural habitat. The *in-situ* and *ex-situ* conservation along with judicious exploitation of wild ethnobiomedical reserve is the need of the day. The conservation of ethno-biomedicinal reserve, specially, hot spots like Ralvawng, Chawnhu, Khawbung and Sihphir Reserve forests of study area are essential to save the genetic resources. This needs designing of suitable conservation strategies to pave the ecological sustainability of local ethnic groups.

The plant samples collected from the ethno-biomedical resources of Tropical and Sub-tropical Semi-evergreen Forest of Mizoram covers about 36 major diseases. The inhabitants also have knowledge of medicinal plants which are used to cure other diseases which are available in places beyond the range of the present study. The medicinal plants available in Tropical Wet Evergreen forest used by the inhabitants of the study area are not reported here in order to avoid duplication of contribution made by Lalramnghinglova & Jha (1999). The diseases and the plants or plant parts used to cure diseases are mentioned under paranthesis : Diarrhoea (*Berginia ciliata, Chikrassia tabularis, Diospyros variegata, Engelhardtia spicata, Jusminum dispermum, Mangifera indica, Mikania micrantha, Psidium guajava, Rhus semialata, Stephania japonica.*); Dysentery (*Berginia ciliata, Diospyros variegata, Engelhardtia spicata, Jusminum dispermum, Mikania micrantha, Psidium guajava*); Stomach ulcer (*Adina cordifolia, Aporosa octandra, Artemisia indica, Chonemorpha*

fragrans, Morinda anguistifolia, Saraca asoca, Solanum nigrum); Stomachache (*Blumea lanceolaria, Dysoxylum gobara, Lannea coromandelica, Vitis peduncularis*); Gastric problem (*Chikrassia tabularis*); Tonsilitis (*Aeschynanthus sikkimensis, Ilex umbellulata*); Sore throat (*Gynocardia odorata, Kaempferia rotunda, Sterculia vilosa*); Cuts & Wounds (*Callicarpa arborea, Chromolaena odorata, Schima wallichii, Tetrameles nudiflora*); Rheumatism (*Oroxylum indicum, Stereospermum colais*); Cough (*Cinnamomum verum*); to stop vomiting (*Cinnamomum verum*); Malarial fever (*Ficus benjamina, Justicia zeylanica, Picrasma javanica, Vitex peduncularis*); Black water fever (*Vitex peduncularis*); to remove tooth worms (*Solanum khasianum*); Heart disease (*Centella asiatica*); Hypertension (*Clerodendrum colebrookianum*); Venereal disease(*Costus speciosus*); Ring worms (*Cassia alata, Morinda anguistifolia*); Kidney trouble (*Mimosa pudica*); to dissolve stone in gall bladder (*Mimosa pudica*); Renal disorder and genito-urinary problem(*Osbekia rostrata*); to dissolve stone in kidney (*Hedyotis scandens*); Urinary tract infection (*Hedyotis scandens, Pramanthes scandens*); Diabetes (*Mallotus roxburghianus, Mangifera indica, Phyllenthus fraternus*); to remove retained placenta (*Dendrocnide sinuata, Eleagnus caudata*); Jaundice (*Momordica charantia, Parabarium hookeri, Phyllenthus fraternus, Scoparia dulcis*); Bad sore (*Ostodes paniculata*), Fester (*Lobelia angulata*); Breast cancer (*Aeschynanthus sikkimensis*); Burst inguinal lymphodeuopathy (*Aeschynanthus sikkimensis*).

The analysis of the findings reveals that in cases of many ethomedicinal plants, the uses suggested by the workers from outside Mizoram do not match with the plants used in Mizoram. The ethnomedicinal plants of these categories are : *Adina cordifolia, Ampelocissus latifolia, Artemisia indica, Berginia*

ciliata, Bidens biternata, Blumea laciniata, Blumea lanceolaria, Cassia alata, Centella asiatica, Chenomorpha fragrans, Chromolaena odorata, Chikrassia tabularis, Cinnamomum bejolghota, Clerodendrum colebrookianum, Costus speciosus, Eleagnus caudata, Ficus bemjamina, Gmelina arborea, Gynocardia odorata, Hedyotis scandens, Ilex umbellulata, Justicia zeylanica, Kaempferia rotunda, Lindernia ruelloides, Mimosa pudica, Momordica charantia, Morinda anguistifolia, Musseanda roxburghii, Ostodes paniculata, Phyllenthus emblica, Picrasma javanica, Rhus semialata, Schima walichii, Scoparia dulcis, Securinega virosa, Sterculia vilosa, Stereospermum colais and *Vitex peduncularis.*

The medicinal uses of plants which show similarities fully or partially with the uses reported by the ethnobotanists elsewhere are : *Alstonia scholaris, Callicarpa arborea, Cinnamomum verum, Lannea coromandelica, Lobelia angulata, Mangifera indica, Mikania micrantha, Oroxylum indicum, Phyllenthus fraternus, Psidium guajava, Saraca asoca, Solanum khasianum, Solanum nigrum* and *Stephania japonica;* whereas twelve plants reported for the first time having ethnomedicinal values are : *Aeschynanthus sikkimensis, Alocasia fornicata, Aporosa octandra, Dysoxylum gobara, Garcinia sopsopia, Jasminum dispermum, Lindernia ruelloides, Mallotus roxburghianus, Osbekia rostrata, Parabarium hookeri, Pramanthes scandens* and *Tetrameles nudiflora.*

Ethnomedicinal survey clearly indicates pharmaceutical potential of plant species collected from the Tropical and Sub-tropical Semi-evergreen Forest.

The present study would lead to selection of desired plants for specific diseases. The ability to correlate ethnomedicinal reports with corresponding scientific studies could help in the selection of right plants for in-depth study for drug

discovery. According to Pei – Gen (1994) medicinal practice has taught us to appreciate that ethno-pharmacological information is an important source for new drug development. Because medicinal plants have been used for centuries and tested by millions of people, there has been ample opportunity to find satisfactory medical agents. Ethno-pharmacological investigation, as therapeutical research, will provide more useful clues for new drug development as well as lead to better use of resources. The potential success of the ethnomedicinal approach to drug discovery can no longer be questioned due to historical and current discoveries to test its powers (Cox 1994).

The scanning of literature to ascertain ethnomedicinal claim for use and to discover whether or not any chemical compounds had been isolated from the medicinal plants collected from the study area shows that out of sixty eight plant species, eighteen are not subjected to biological assays. Thus eighteen plants are recorded as candidate plant species having pharmaceutical potential for chemical analysis (Table 4).

The chemical analysis of three candidate plant species viz. *Garcinia sopsopia* Mabb., *Mallotus roxburghianus* Muell. and *Vitex peduncularis* Wall. were carried out. The *Garcinia sopsopia* extractives shows presence of Terpenoids, Polyphenols (including Flavanoids). The *Mallotus roxburghianus* contains Polyphenolic compounds and are confirmed to be a flavanoids. The air dried leaves of *Vitex peduncularis* shows presence of ß-sitosterol glucoside. However, the above chemical analysis needs in-depth study to establish relation with the traditional uses of plant or plant parts.

The data gathered after chemical analysis would provide the basis for selection of plants with a high degree of expectation that they would contain novel bio-active compounds if subjected to experimental studies (Farnsworth 1994).

Most publication regarding ethnomedicinal research lack information to delineate the exact places where plants are available. Delineation would help the concerned workers in locating the place of availability of plants. Because of this, an attempt has been made to delineate the place of availability of ethnomedicinal plants *in situ* condition. The distribution patterns and range of distribution was recorded. The place of availability of the ethnomedicinal plants are demarcated on the map (Map No. 2 to Map No. 31). In order to attain the accuracy, latitude and longitude were measured and written on the map.

The soil sample (*in situ* condition) were analysed to get a rough idea about the nutrient status and pH level of the site. This would help in propagation of the desired ethnomedicinal plants.

CONCLUSION :

In a phytogeographically rich state like Mizoram where rural people still rely upon traditional medicines, there is an urgent need for scientific guidance so that people can cultivate and prepare their own remedies from living plants; this would also be a great help for pharmaceutical and herbal industries in their search for new potential drugs. Thus, the present study on medicinal plants has been undertaken with a view to conserve the traditional principles and techniques of important medicinal plants; to improve the economic status of land races on a sustainable basis; to help in quick identification of hotspots for conservation; screening of important medicinal plants for phytochemical analysis and for the establishment of living pharmacy.

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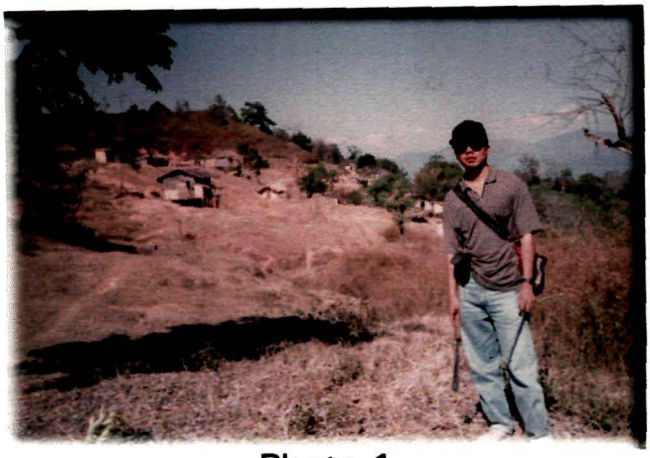
Plate No. I



Scholar in the field Photo 1

Scholar with the informant Photo 2

Scholar studying plant species (*in situ*) Photo 3

Plate No. II

Collection of Plant Sample Photo 4

Drying of Plant Sample(a) Photo 5

Drying of Plant Sample(b) Photo 6

Plate No. III

Aeschynanthus sikkimensis
(Bawltehlantai) - Wild Photo 7

Aeschynanthus sikkimensis
(Bawltehlantai) - Cultivated Photo 8

Alocasia fornicata
(Baibing) Photo 9

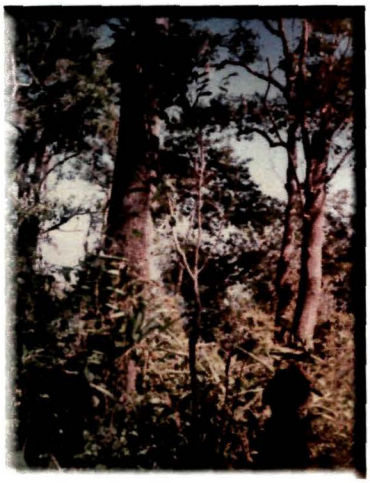
Plate No. IV

Alstonia scholaris
(Thuamriat)

Photo 10

Ampelocissus latifolia
(Hruipawl)

Photo 11



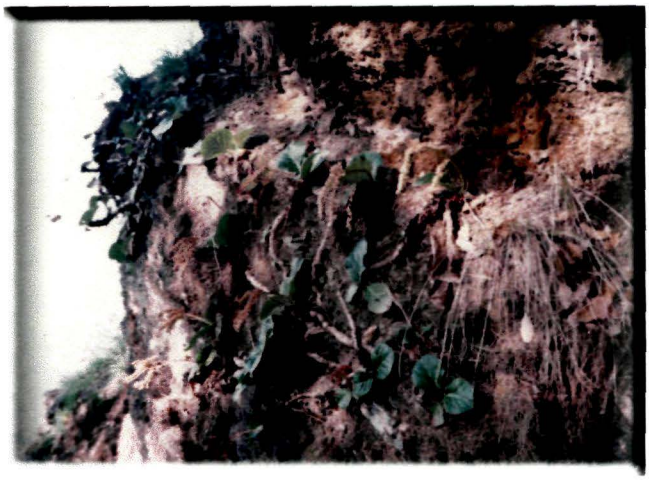
Aporosa octandra
(Chhawntual)

Photo 12

Plate No. V

Artemisia indica
(Sai)

Photo 13



Berginia ciliata
(Khamdamdawi)

Photo 14

Bidens biternata
(Vawkpuithal)

Photo 15

Plate No. VI

Blumea laciniata
(Khuanglawi) Photo 16

Blumea lanceolaria
(Buarze) Photo 17

Callicarpa arborea
(Hnahkiah) Photo 18

Plate No. VII

Cassia alata
(Tuihlo)

Photo 19

Centella asiatica
(Lambak)

Photo 20

Chonemorpha fragrans
(Theikelki suak)

Photo 21

Plate No. VIII

Chromolaena odorata
(Tlangsam) Photo 22

Cinnamomum verum
(Thakthing) Photo 23

Clerodendrum colebrookianum
(Phuihnam) Photo 24

Plate No.IX

Costus speciosus
(Sumbul) Photo 25

Dendrocnide sinuata
(Thakpui) Photo 26

Diospyros variegata
(Raisentur) Photo 27

Plate No. X

Diospyros variegata
(Raisentur) - Root

Photo 28

Dysoxylum gobara
(Thingthupui)

Photo 29

Elaeagnus caudata
(Sarzuk)

Photo 30

Plate No. XI

Engelhardtia spicata
(Hnum)

Photo 31

Ficus benjamina
(Zamanhmawng)

Photo 32

Garcinia sopsopia
(Vawmva)

Photo 33

Plate No. XII

Gmelina arborea
(Thlanvawng)

Photo 34

Gynocardia odorata
(Saithei)

Photo 35

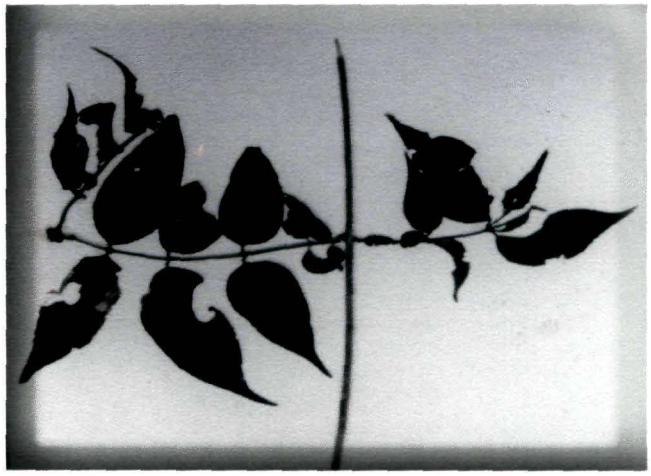
Hedyotis scandens
(Kelhnamtur)

Photo 36

Plate No. XIII

Ilex umbellulata
(Thinguihahni)

Photo 37



Jusminum dispermum
(Hruidamdawi)

Photo 38

Justicia zeylanica
(Kawldai)

Photo 39

Plate No. XIV

Kaempferia rotunda
(Tuktinpar) Photo 40

Lindernia ruelloides
(Thasuih) Photo 41

Lobelia angulata
(Choakathi) Photo 42

Plate No. XV

Mallotus roxburghianus
(Zawngtenawhlung)

Photo 43

Mangifera indica
(Theihai)

Photo 44

Mikania micrantha
(Japanhlo)

Photo 45

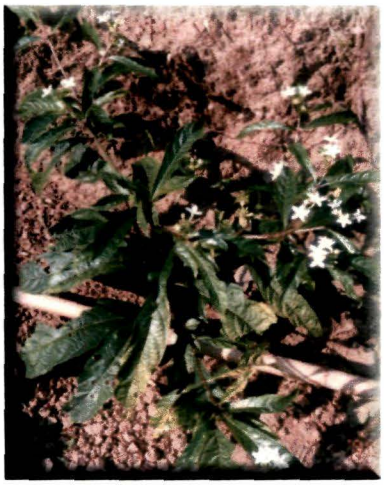
Plate No. XVI

Mimosa pudica
(Hlonuar)

Photo 46

Momordica charantia
(Changkhate)

Photo 47



Morinda anguistifolia
(Lum)

Photo 48

Plate No. XVII

Musseanda roxburghii
(Vakeb) Photo 49

Oroxylum indicum
(Archangkawm) Photo 50

Osbekia rostrata
(Builukhampa) Photo 51

Plate No. XVIII

Ostodes paniculata
(Beltur) Photo 52

Parabarium hookeri
(Theikelki) Photo 53

Phyllanthus emblica
(Sunhlu) Photo 54

Plate No.XIX

Phyllanthus fraternus
(Mitthi sunhlu) Photo 55

Picrasma javanica
(Thingdamdawi) Photo 56

Pramanthes scandens
(Kawlhlo) Photo 57

Plate No. XX

Pseudodrynaria coronans
(Awmvel)

Photo 58

Psidium guajava
(Kawlthei)

Photo 59

Rhus semialata
(Khawmhma)

Photo 60

Plate No. XXI

Saraca asoca
(Mualhawih) Photo 61

Schima wallichii
(Khiang) Photo 62

Scoparia dulcis
(Perhpawngchaw) Photo 63

Plate No. XXII

Securinega virosa
(Saisiak) Photo 64

Solanum khasianum
(Rulpuk) Photo 65

Solanum nigrum
(Anhling) Photo 66

Plate No. XXIII

Stephania japonica
(Hnahbial)

Photo 67

Sterculia villosa
(Khaupui)

Photo 68

Stereospermum colais
(Zinghal)

Photo 69

Plate No. XXIV

Tetrameles nudiflora
(Thingdawl)

Photo 70

Vitex peduncularis
(Thingkhawilu)

Photo 71

Vitis peduncularis
(Pasaltakaza)

Photo 72

Brief Bio-data of Shri Lalnundanga

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Service	:	Lecturer
Teaching experience	:	7 years

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