

ORIGINAL ARTICLE



Documentation of tree species within Mizoram Science Centre, Berawtlang, Aizawl, India, with notes on their ethnomedicinal values

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This study provides a first report of the various tree species prevailing in the tropical semi-evergreen forest within Mizoram Science Centre, Berawtlang, Aizawl in relation to their diversity; and also mentions traditional ethnomedicinal and economic uses of the species. A total number of 776 individual trees were assessed within the study site belonging to 74 different species representing 61 genera and 34 families. Among these, 55 tree species have been reported by previous workers to possess indigenous medicinal values. The most abundant tree species at the study site was found to be *Callicarpa arborea* (hnaahkiah) of Verbenaceae comprising 14.30% of the total trees assessed, followed by *Anogeissus acuminata* (zairum) of Combretaceae with 12.62%, and *Schima wallichii* (khiang) of Theaceae with 10.56%. A concise list of the species recorded along with their ethnomedicinal and economic uses have been presented here. The prospect of *in situ* conservation of tree species is briefly highlighted.

Keywords: Tree species, ethnomedicinal trees, *in situ* conservation, Mizoram Science Centre, Documentation.

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Introduction

Among the 36 biodiversity hotspots of the world, Mizoram, one of the northeastern states of India forms a part of the Indo-Myanmar hotspot region. These hotspots are characterized by highest levels of endemism with corresponding high loss of natural habitats.¹ It has been reported that Northeast India has nearly 64% of its total geographical area under forest cover, harboring approximately 7500 angiospermic species.² Mizoram shares international boundaries with Bangladesh in the West, and with Myanmar in the East and South. It also shares interstate borders with Assam, Tripura and Manipur. The forest cover in Mizoram is 18,186 sq km accounting for 86.27% of its total geographical area.³ The state has a rich diversity of flora and fauna with

a wealth of medicinal plants as reported by various workers.^{2,4-6} The natural forests of the tropical and sub-tropical forests of Mizoram are highly overexploited for medicinal plants, collection of fuel wood and timber, and for shifting cultivation.⁷

The study area, Mizoram Science Centre (MSC) campus, which is under the jurisdiction of the Government of Mizoram falls under tropical semi-evergreen forest based on classification by Champion and Seth.⁸ The tropical forests have been described to offer essential ecological services including habitat preservation and species conservation for both flora and fauna, and prevention of soil erosion.⁹ It was assumed that the study site also harbors a diverse number of tree

species in its tropical semi-evergreen forest which may be associated with a wealth of fauna. To confirm this assumption, a detailed documentation of the tree species composition was accomplished as a first step towards understanding the floristic diversity within the area.

This paper presents the prevailing tree species of the area in relation to their diversity and indicates ethnomedicinal and traditional economic uses of the tree species. The area was found to harbor a number of traditionally important medicinal plants, and the mode of utilization of these ethnomedicinal plants as reported by previous studies have been emphasized in this paper. The present study is significant as it is highly anticipated to aid in conservation and management of the area's flora in the future, when plans for augmenting and developing the infrastructure of MSC are designed and formulated. Information generated from this tree species inventory will contribute to enhance our knowledge regarding tropical forest biodiversity of the state.

Materials and Methods

The study site, Mizoram Science Centre, has an area of 23.057 sq km and lies in the eastern part of Aizawl, the capital of Mizoram. It is located between 92°45'53.85"E-92°45'55.74"E longitudes and 23°

43'55.09"N-23°43'53.01"N latitudes (Figure 1). Documentation of the tree species present within the study area was conducted out during March to July 2018. During this period, frequent field surveys of the site (Figure 2) were carried out for collection, identification and documentation. Trees having diameter at breast height (DBH) larger than 5 cm were selected for assessment. Photographs of the plants were taken *in situ* for multiple tree species, and for others, plant parts including branches with leaves, flowers and fruits were collected and photographed for identification purposes. Photographs of the species were taken using Canon 600D camera equipped with 18–135 STM lens. Various local key informants and taxonomists from Pachhunga University College, Aizawl, were employed and consulted in assigning the vernacular names of plant specimens. Descriptions of species were prepared using standard literatures including the books of *Flora of Mizoram Vol II*,¹⁰ and *The Book of Mizoram Plants*.¹¹ Threat assessment of the species was made based on The IUCN Red List of Threatened Species.¹²

Results

Species composition

In this study, a total number of 776 individual

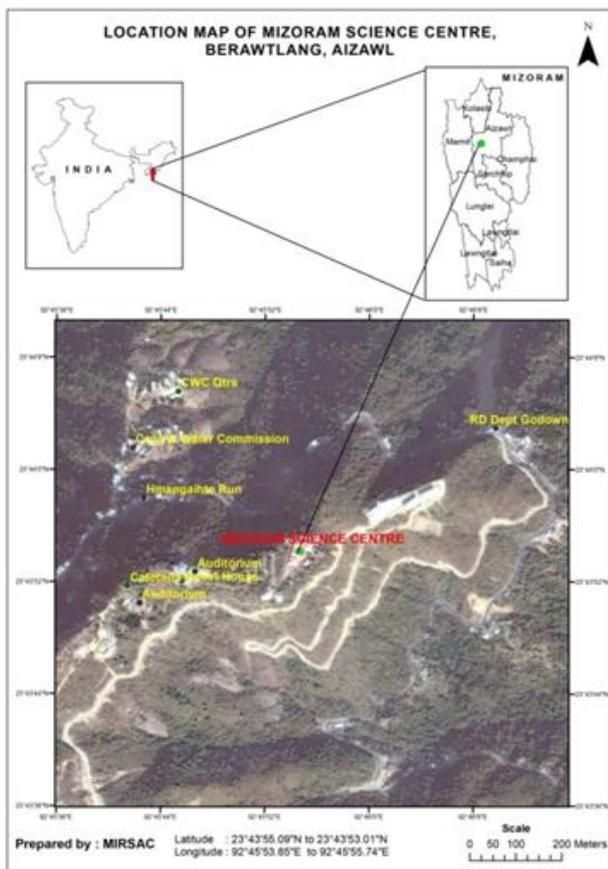


Figure 1 | Location map of Mizoram Science Centre, Berawtlang.



Figure 2 | Satellite image of Mizoram Science Centre, Berawtlang.

trees were assessed within the study site which belongs to 74 different species representing 61 genera and 34 families. Among these, 55 species were previously reported by various workers to possess medicinal values. Table 1 provides a detailed account of the different tree species documented from the study area with their economic uses.

Ethnomedicinal plants

The ethnomedicinal tree species with their medicinal usage as reported by previous works are as follows:

Acer oblongum Wall. ex DC. Family: Aceraceae. **Mizo Name:** Thing-phing-phi-hlip. **Mode of Use:** Decoction of leaves and bark used against fever, stomach problem, food poisoning and retained placenta.¹¹

Alangium chinense (Lour.) Harms. Family: Alangiaceae. **Mizo Name:** Ar-sa-rim-nam. **Mode of Utilization:** Roots and stems are used as carminative and blood tonic, for treating wounds, rheumatism etc.¹¹

Albizia chinensis (Osb) Merr. Family: Mimosaceae. **Mizo Name:** Vang. **Mode of Utilization:** A brew of the bark is used in cuts, scabies and various dermal problems.^{2,11}

Albizia odoratissima (L.f.) Benth. Family: Mimosaceae. **Mizo Name:** Thing-ri. **Mode of Utilization:** Bark and leaves are used against certain ailments.¹¹

Albizia procera (Roxb.) Benth. Family: Mimosaceae. **Mizo Name:** Kang-țêk. **Mode of Utilization:** Decoction of bark taken against pinworms/threadworms etc. Poultrices are prepared from leaves to treat ulcers.^{2,4,11}

Alstonia scholaris (L.) R. Br. Family: Apocynaceae. **Mizo Name:** Thuam-riat. **Mode of Utilization:** Decoction of the bark and leaves are taken to treat headache, influenza, bronchitis, and pneumonia. Bark decoction is used for treating hypertension, asthma, fever, typhoid, malaria, stomach ulcer, diarrhea and dysentery. Milky juice obtained from bark is applied to snake-bites, cuts, sores and other skin diseases.^{2,11}

Anogeissus acuminata (Roxb. ex DC) Guill. Family: Combretaceae. **Mizo Name:** Zai-rum. **Mode of Utilization:** Decoction of bark taken as hemostatic agent, for stomach problems, diarrhoea, fever, beriberi, also applied on skin problems like measles, chicken-pox including sprains and burns. Leave infusion is used in hypertension.^{2,4,5,11}

Aporosa octandra (Buch.-Ham. ex D. Don) Vickery. Family: Euphorbiaceae. **Mizo Name:** Chhâwn-tual. **Mode of Utilization:** Stem-bark decoction is taken against stomach ulcer, gout, rheumatism, diarrhea and dysentery. Young leaves decoction is also taken for stomach ailments.^{2,5,6,11}

Areca catechu Linn. Family: Arecaceae. **Mizo Name:** Kuhva-kung. **Mode of Utilization:** Seeds are taken against intestinal worms. A powdered mixture of the nuts with bulb of *Aginata indica* L., root of *Cissisrepanda* Vahl. and leaves of *Piper betle* L. are made into pills and taken during menstrual periods by Bru people.^{2,11}

Artocarpus heterophyllus Lam. Family: Moraceae. **Mizo Name:** Lâm-khuang. **Mode of Utilization:** Root decoction used against asthma, diarrhoea, fever and sterility in women. Leaves are useful against fever, skin diseases, wounds, boils, etc. The milky juice is useful for herpes eruptions.^{4,11}

Artocarpus lakoocha Roxb. Family: Moraceae. **Mizo Name:** Thei-tât. **Mode of Utilization:** Seed used as laxative. Crushed bark juice is applied on pimples, face acne and crack skin. Bark powder is applied on sores to extract excretion.^{2,4,11}

Bauhinia variegata L. Family: Caesalpiniaceae. **Mizo Name:** Vau-be. **Mode of Utilization:** Bark/leaves decoction taken orally against diabetes, menstrual disorders, intestinal worms, diarrhoea, piles and dysentery.^{2,11}

Bischofia javanica Blume. Family: Euphorbiaceae. **Mizo Name:** Khuang-thli. **Mode of Utilization:** Juice of tender leaves taken orally against tonsillitis, cholera and sores. Its stem and bark has medicinal uses. Roots are used for treating chronic rheumatic pain and malaria.^{2,5,11}

Bombax insigne Wall. Family: Bombacaceae. **Mizo Name:** Pâng. **Mode of Utilization:** Bark decoction with that of *Mangifera indica* (equal parts) is used for tonsillitis and other throat infections.^{4,5,11}

Callicarpa arborea Roxb. (Figure 3A). Family: Verbenaceae. **Mizo Name:** Hnah-kiah. **Mode of Utilization:** Bark and leaves decoctions are used against diabetes, and various forms of stomach ailments including internal bleeding. Decoction of mixture of leaves with leaves of *Byttneria pilosa*, stem-bark of *Ficus semicordata* and whole plant of *Phyllanthus fraternus* used for jaundice and hepatitis.^{2,4,11}

Castanopsis tribuloides (Sm.) A. DC. (Figure 3B).



A. *Callicarpa arborea* (hnahkiah)



B. *Castanopsis tribuloides* (thingsia)



C. *Flueggea virosa* (saisiak)



D. *Haldina cordifolia* (lungkhup)



E. *Mesua ferrea* (herhse)



F. *Milletia pachycarpa* (rulei)



G. *Oroxylum indicum* (archangkâwm)



H. *Rhus chinensis* (khawmhma)

I. *Schima wallichii* (khiang)J. *Sterculia villosa* (khaupui)**Figure 3 |** Interesting tree species (A–J) at Mizoram Science Centre Campus.

Family: Fagaceae. **Mizo Name:** Thing-sia. **Mode of Utilization:** Stem juice is applied in mouth infection in children.¹¹

Cerasus cerasoides (Buch.-Ham. ex D. Don) S. Y. Sokolov. Family: Rosaceae. **Mizo Name:** Tlai-zawng. **Mode of Utilization:** Bark decoction is used against fever.^{2,11}

Cinnamomum tamala (Buch.-Ham.) T. Nees & Eber. Family: Lauraceae. **Mizo Name:** Tespata/Hnah-rimtui. **Mode of Utilization:** Grinded bark is mixed with water and used for diabetes.^{2,6,11}

Cordia fragrantissima Kurz. Family: Boraginaceae. **Mizo Name:** Muk. **Mode of Utilization:** Decoction of the bark/leaves is prescribed for expelling small pieces of retained placenta.¹¹

Derris robusta (Roxb. ex DC) Benth. Family: Fabaceae. **Mizo Name:** Thing-kha. **Mode of Utilization:** Bark decoction is taken against hypertension and diabetes.¹¹

Engelhardia spicata Lesch ex Blume. Family: Juglandaceae. **Mizo Name:** Hnûm. **Mode of Utilization:** Root decoction is taken against diarrhea and dysentery.^{2,11}

Erythrina stricta Roxb. Family: Fabaceae. **Mizo Name:** Far-tuah. **Mode of Utilization:** Bark

decoction is used against stomach ulcer and kidney disorder. Powdered bark is used in snakebite, fever, asthma, nausea, rheumatism, skin irritation, leprosy, epilepsy and as an astringent.^{2,11}

Ficus hirta Vahl. Family: Moraceae. **Mizo Name:** Sazu- thei-pui. **Parts Used:** Roots are believed to have medicinal properties.¹¹

Ficus hispida L. f. Family: Moraceae. **Mizo Name:** Paih-te-mai-an. **Mode of Utilization:** The bark, fruit and seeds are used in cases of jaundice, anaemia and fever. Leave decoction is used for inflamed kidneys and urinary disorder. Juice obtained from leaves heated on fire is used for eye ailments.¹¹

Ficus prostrata (Wall. ex Miq.) Buch.-Ham. ex Miq. Family: Moraceae. **Mizo Name:** Thei-tit. **Mode of Utilization:** Juice from roots the white latex are used in snake bites.^{4,11}

Ficus retusa L. Family: Moraceae. **Mizo Name:** Ri-hnim. **Mode of Utilization:** Pultice of leaves and bark are used in rheumatism. Juice of leaves is used for abdominal pain, and bark juice for hepatic diseases.¹¹

Ficus semicordata Buch.-Ham ex Sm. Family: Moraceae. **Mizo Name:** Thei-pui. **Mode of Utilization:** Leave decoction taken against jaundice and hepatitis. Boils are treated with

white latex obtained from the tree.^{2,5,11}

Firmiana colorata Roxb. Family: Sterculiaceae. **Mizo Name:** Khau-khim. **Mode of Utilization:** Infusion of the bark cooked with bark of *Citrus medica* is taken against tonsillitis.¹¹

Flueggea virosa (Roxb. ex Willd.) Voigt. (Figure 3C). Family: Euphorbiaceae. **Mizo Name:** Sai-siak. **Mode of Utilization:** All plant parts are used as for eczema, rheumatoid arthritis etc. Leave decoction is used as bathing water for chicken-pox, measles, scabies and skin itching.^{2,4,11}

Glochidion sphaerogynum (Müll. Arg.) Kurz. Family: Euphorbiaceae. **Mizo Name:** Thing-pawn-chhia/Dawn-dung. **Mode of Utilization:** Branches and leaves are used as medicine for influenza, eczema, etc.¹¹

Gmelina arborea Roxb. Family: Verbenaceae. **Mizo Name:** Thlan-vawng. **Mode of Utilization:** Fruit pulp is roasted and applied on skin ailments like rash, sores and itches.^{4,11}

Haldina cordifolia (Roxb.) Ridsdale. (Figure 3D). Family: Rubiaceae. **Mizo Name:** Lungkhup. **Mode of Utilization:** Bark is used against ulcers, fever, strangury, and dermal problems. Decoction of stem bark with that of *Vitex peduncularis* is taken orally against fever. Preparations from roots are used in diarrhoea and dysentery.^{2,11}

Lagerstroemia speciosa (L.) Pers. Synonym: *Lagerstroemia flos-reginae* Retz. Family: Lythraceae. **Mizo Name:** Thla-do/Chawnpui. **Mode of Utilization:** Stem-bark decoction is useful for diabetes, coronary diseases, dysentery and diarrhoea. Root extract of the tree is used against jaundice.^{2,4,11}

Lannea coromandelica (Houtt.) Merr. Synonym: *Lannea grandis* Engler. Family: Anacardiaceae. **Mizo Name:** Tawi-taw-suak/Zawng-tawi-taw. **Mode of Utilization:** Juice both applied externally and taken orally as analgesic for bodyache and against fish allergy.^{2,11}

Litsea monopetala (Roxb.) Pers. Family: Lauraceae. **Mizo Name:** Nau-thak. **Parts Used:** The roots, bark and leaves of *Litsea monopetala* have medicinal uses.¹¹

Macaranga indica Wight. Family: Euphorbiaceae. **Mizo Name:** Hnah-khâr/Khâr-paw. **Mode of Utilization:** Gum is externally applied on sores. Different plant parts are used in numerous traditional medicines.¹¹

Mangifera indica Linn. Family: Anacardiaceae.

Mizo Name: Thei-hai. **Mode of Utilization:** Young leaves decoction is taken orally for diabetes and diarrhoea, ash of dried leaves is used to treat hiccough. Fruit contains vitamins A, B and C.¹¹

Mesua ferrea Linn. (Figure 3E). Family: Clusiaceae. **Mizo Name:** Herh-se. **Mode of Utilization:** Infusion of flowers used for dysentery, bleeding piles and cough. Flowers and leaves used as astringent and against snakebite and scorpion sting. Fruit is crushed and applied on scabies and cuts.^{2,4,6,11}

Millettia pachycarpa Benth. (Figure 3F). Family: Fabaceae. **Mizo Name:** Ru-lei/ Ru-zal. **Mode of Utilization:** Root infusion applied on toothache, wounds, swellings and sprains, scabies and itches.^{5,6}

Oroxylum indicum (L.) Benth. ex Kurz. (Figure 3G). Family: Bignoniaceae. **Mizo Name:** Ar-chang-kâwm. **Mode of Utilization:** Seeds and bark are used as analgesic and to reduce inflammation. Root bark decoction is used in fevers, various stomach disorders, cancer, asthma, cough, hiccup etc. Bark poultice is applied to bone and skin diseases. Leave decoction is used in headache, flatulence, ulcers, cancer etc. and the fruits for cramp, pulmonary diseases, bronchitis, digestive disorders, leucoderma, piles, etc. Goiter is treated with roasted pod.^{2,6,11}

Parkia timoriana (DC.) Merr. Family: Mimosaceae. **Mizo Name:** Zawng-tah. **Mode of Utilization:** Tender leaves and seeds are used against food allergy, indigestion, dysentery and diarrhea. The bark and fruits are taken during menstruation against excessive bleeding. The green rind of the pod is juiced and applied to wounds and itches.^{2,11}

Persea Americana Mill. Family: Lauraceae. **Mizo Name:** Butter thei. **Mode of Utilization:** Infusion of leaves is used against stomach ulcer. The fruits, flowers and seeds of *Persea Americana* are also used as medicines.¹¹

Phyllanthus emblica L. Family: Phyllanthaceae. **Mizo Name:** Sun-hlu. **Mode of Utilization:** Crushed bark juice is used in pulmonary diseases, diarrhea and dysentery. Bark infusion is applied on rash or sores. Water from soaked pounded fruits is taken for retained placenta and also on skin eruptions due to food allergy. Liquid prepared from boiling of the fruits is taken for diabetes. Dried fruits are taken for queasiness, diarrhoea and dysentery.^{2,4,6,11}

Polyalthia longifolia (Sonner.) Thwaites. Family:

Table 1 | List of tree species documented from Mizoram Science Centre.

SL No.	Scientific name (with family)	Vernacular name	Habit	Total no. of individuals	% of total no. of trees	Uses ¹¹	Threat assessment ¹²
1	<i>Acer oblongum</i> Wall. ex DC. (Aceraceae)	Thinghingphihlip	Deciduous tree	1	0.128	Firewood, fodder	NA
2	<i>Alangium chinense</i> (Lour.) Harms (Alangiaceae)	Arsarimnam	Small tree	2	0.25	Firewood, fruits eaten by bears and birds	NA
3	<i>Albizia chinensis</i> (Osbeck) Merr. (Mimosaceae)	Vang	Deciduous tree	49	6.31	Firewood, charcoal, fodder, fruits eaten by squirrels	NA
4	<i>Albizia odoratissima</i> (L.f.) Benth. (Mimosaceae)	Thingri	Deciduous tree	24	3.09	Furniture, firewood, charcoal, fodder	NA
5	<i>Albizia procera</i> (Roxb.) Benth. (Mimosaceae)	Kangtêk	Deciduous tree	24	3.09	Furniture, firewood, fodder, fruits eaten by birds and rodents	NA
6	<i>Alstonia scholaris</i> (L.) R. Br. (Apocynaceae)	Thumriat	Deciduous tree	1	0.128	Furniture, coffins, charcoal, firewood	Least concern
7	<i>Anogeissus cuminata</i> (Roxb. ex DC) Guill. (Combretaceae)	Zainum	Deciduous tree	98	12.62	Fuelwood, charcoal, housing	NA
8	<i>Aporosa octandra</i> (Buch.-Ham. ex D. Don) Vickery (Euphorbiaceae)	Chhâwntual	Evergreen tree	2	0.25	Firewood, edible leaves and fruits	NA
9	<i>Araucaria cookii</i> R.Br. ex D. Don (Araucariaceae)	Fârzârmawi	Evergreen tree	4	0.51	Furnitures, various construction items	NA
10	<i>Areca catechu</i> Linn. (Arecaceae)	Kuhva	Tall palm	1	0.128	Edible nuts and shoots, ornamental	NA
11	<i>Artocarpus heterophyllus</i> Lam. (Moraceae)	Lamkhuang	Evergreen tree	1	0.128	Furniture, housing, edible fruits and seeds	NA
12	<i>Artocarpus slakoocha</i> Roxb. (Moraceae)	Theitât	Deciduous tree	1	0.128	Furniture, firewood, fodder, edible fruits	NA
13	<i>Balakata baccata</i> (Roxb.) (Euphorbiaceae)	Thingvawkpui	Evergreen tree	2	0.25	Firewood, plywood, edible fruits	NA
14	<i>Bauhinia variegata</i> L. (Caesalpinaceae)	Vaube	Deciduous tree	2	0.25	Firewood, charcoal, vegetable, fodder	NA
15	<i>Bischofia javanica</i> Blume (Euphorbiaceae)	Khuangthii	Deciduous tree	1	0.128	Furniture, firewood, fodder, edible fruits	NA

16	<i>Bombax insigne</i> Wall. (Bombacaceae)	Pâng	Deciduous tree	3	0.38	Packing cases, fodder, fruits and seeds eaten by squirrels	NA
17	<i>Callicarpa arborea</i> Roxb. (Verbenaceae)	Hnahkiah	Evergreen tree	111	14.30	Fencing, charcoal, firewood, fodder, leaves used for fermenting cooked soyabean	NA
18	<i>Carya sp.</i> (Juglandaceae)	Hnâm-reuh	Deciduous tree	1	0.128	Firewood, construction, edible seeds	Least concern
19	<i>Castanopsis tribuloides</i> (Sm.) A.DC. (Fagaceae)	Thingsia	Evergreen tree	4	0.51	Firewood, charcoal, house posts, edible nuts	NA
20	<i>Cerasus cerasoides</i> (Buch.-Ham. ex D.Don) S.Y.Sokolov (Rosaceae)	Tlaizawng	Deciduous tree	2	0.25	Edible fruits, firewood, fodder	Least concern
21	<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees&Eberm. (Lauraceae)	Tespata	Evergreen tree	1	0.128	Leaves for flavouring, firewood, fruits eaten by birds and bears	NA
22	<i>Colona floribunda</i> (Wall. ex Kurz) Craib (Tiliaceae)	Hnahthap	Deciduous tree	42	5.41	Firewood, leaves eaten by some animals	NA
23	<i>Cordia fragrantissima</i> Kurz. (Boraginaceae)	Muk	Deciduous tree	1	0.128	Firewood, gun-stocks, edible young leaves, fruits eaten by bears and birds	NA
24	<i>Dalbergia obtusifolia</i> (Baker) Prain (Fabaceae)	Bianghrei	Evergreen tree	2	0.25	Firewood	NA
25	<i>Delonix regia</i> (Hook.) Raf (Caesalpiniaceae)	April	Deciduous tree	5	0.64	Ornamental, firewood	Least concern
26	<i>Derris robusta</i> (DC.) Benth. (Fabaceae)	Thingkha	Deciduous tree	43	5.54	Fuelwood, charcoal, fodder, fruits eaten by deer and squirrels	NA
27	<i>Engelhardtia spicata</i> Lechen ex Blume (Juglandaceae)	Hnâm	Deciduous tree	2	0.25	Fodder, fruits eaten by birds	Least concern
28	<i>Eriobotrya bengalensis</i> (Roxb.) Hook.f. (Rosaceae)	Nghal-chhun	Evergreen tree	1	0.128	Firewood, charcoal, fodder, fruits eaten by birds and animals	NA
29	<i>Erythrina stricta</i> Roxb. (Fabaceae)	Fartuah	Deciduous tree	4	0.51	Fodder	NA
30	<i>Euphorbia cotinifolia</i> Linn. (Euphorbiaceae)	Hnahsen	Deciduous tree	2	0.25	Ornamental, leaves are used as fish poison	NA
31	<i>Ficus auriculata</i> Lour. (Moraceae)	Thei-bâl	Evergreen tree	2	0.25	Fruits eaten by wild animals, fodder	NA
32	<i>Ficus hirta</i> Vahl. (Moraceae)	Sazutheipui	Small deciduous tree	7	0.90	Leaves taken as vegetable and used for fermenting cooked soyabean	NA

33	<i>Ficus hispida</i> L.f. (Moraceae)	Paihtemaian	Tree	2	0.25	Firewood, fodder, edible fruits and tender leaves	NA
34	<i>Ficus prostrata</i> (Wall. Ex Miq.) Buch.-Ham. ex Miq. (Moraceae)	Theitit	Deciduous tree	6	0.77	Firewood, edible fruits, fodder	NA
35	<i>Ficus retusa</i> L. (Moraceae)	Rihnim	Evergreen tree	1	0.128	Ornamental, edible fruits, fodder	NA
36	<i>Ficus semicordata</i> Buch.-Ham ex Sm. (Moraceae)	Theipui	Evergreen tree	7	0.90	Shade tree, firewood, bark fibre used for ropemaking, edible young fruits	NA
37	<i>Ficus</i> sp. (Moraceae)	Hmâwng	Evergreen tree	1	0.128	Firewood, shade tree	-
38	<i>Firmiana colorata</i> (Roxb.) R. Br. (Sterculiaceae)	Khaukhim	Deciduous tree	3	0.38	Fodder, edible seeds	NA
39	<i>Flueggea virosa</i> (Roxb. ex Willd.) Royle (Euphorbiaceae)	Saisiak	Small tree or large shrub	1	0.128	Edible fruits, firewood, fence-posts	NA
40	<i>Glochidion sphaerogynum</i> (Mull.Arg.) Kurz (Euphorbiaceae)	Thingpawncchia	Evergreen tree	4	0.51	Firewood	NA
41	<i>Gmelina arborea</i> Roxb. (Verbenaceae)	Thlanvawng	Deciduous tree	9	1.16	Furniture etc., flowers as vegetables, fodder, fruits and flowers eaten by birds and animals	NA
42	<i>Gmelina oblongifolia</i> Roxb. (Verbenaceae)	Vawngthla	Deciduous tree	2	0.25	House posts, leaves as vegetables, fruits eaten by birds	NA
43	<i>Grevillea robusta</i> A.Cunn. ex R. Br. (Proteaceae)	Silver oak	Evergreen tree	1	0.128	Furniture, flooring, firewood, charcoal	NA
44	<i>Haldina cordifolia</i> (Roxb.) Ridsdale (Rubiaceae)	Lungkhop	Deciduous tree	4	0.51	Furniture, house-posts, firewood, fodder	NA
45	<i>Homalium ceylanicum</i> (Gardner) Benth.subsp.minutiflorum (Kurtz.) Mitra. (Samydaceae)	Thinglung	Evergreen tree	2	0.25	Firewood, charcoal, building	NA
46	<i>Lagerstroemia speciosa</i> (L.) Pers. (Lythraceae)	Thlado	Deciduous tree	2	0.25	Building, furniture, firewood etc.	NA
47	<i>Lannea coromandelica</i> (Houtt.) Merr. (Anacardiaceae)	Zawngtawitaw	Deciduous tree	22	2.83	Furniture, firewood, house-posts, leaves as vegetables, fodder, fruits eaten by birds and animals	NA

48	<i>Lithocarpus dealbatus</i> (Hook.f. & Thomson ex Miq.) Rehder (Fagaceae)	Fah	Evergreen tree	3	0.38	Firewood, leaves as vegetable, edible fruits	NA
49	<i>Lithocarpus obscurus</i> C.C.Huang&Y.T.Chang (Fagaceae)	Thingpuithing-hnahhlai	Evergreen tree	1	0.128	Firewood, charcoal, building, fruits eaten by wild animals	NA
50	<i>Litsea monopetalata</i> (Roxb.) Pers. (Lauraceae)	Nauthak	Evergreen tree	12	1.54	Firewood, fruits eaten by bears and birds, fodder	NA
51	<i>Macaranga denticulata</i> (Blume) Mull.Arg. (Euphorbiaceae)	Hnahkhârpa	Evergreen tree	5	0.64	Firewood, construction, fodder, fruits eaten by birds	NA
52	<i>Macaranga indica</i> Wight (Euphorbiaceae)	Hnahkhâr	Evergreen tree	3	0.38	Firewood, fruits eaten by birds	Data deficient
53	<i>Mangifera indica</i> Linn. (Anacardiaceae)	Theihai	Evergreen tree	12	1.54	Furniture, firewood, construction, edible fruits eaten raw or pickled	NA
54	<i>Mesua ferrea</i> Linn. (Clusiaceae)	Herhse	Evergreen tree	2	0.25	Firewood, charcoal, seed oil for lubricating, soapmaking and burning, seeds eaten by animals, State tree of Mizoram	NA
55	<i>Millettia pachycarpa</i> Benth. (Fabaceae)	Rulei	Deciduous climbing shrub	1	0.128	Seeds as insecticide, roots as fish poison, bark fibre for ropemaking	NA
56	<i>Oroxylum indicum</i> (L.) Kurz (Bignoniaceae)	Archangkâwm	Small deciduous tree	9	1.16	Firewood, charcoal, bark and fruit for tanning and dyeing, fodder	NA
57	<i>Parkia timoriana</i> (DC.) Merr. (Mimosaceae)	Zawngtâh	Deciduous tree	2	0.25	Firewood, pods and tender leaves as vegetables, fruits and seeds eaten by birds and animals	NA
58	<i>Persea Americana</i> Mill. (Lauraceae)	Butterthei	Evergreen tree	2	0.25	Edible fruits, extracted oil for cosmetics and salad oil	NA
59	<i>Phoebe hainesisana</i> Brandis (Lauraceae)	Buleng	Evergreen tree	1	0.128	Furniture, building, fruits eaten by birds and animals	NA
60	<i>Phyllanthus emblica</i> L. (Phyllanthaceae)	Sunhlu	Deciduous tree	14	1.80	Edible fruits eaten raw or preserved	NA
61	<i>Polyalthia longifolia</i> (Sonner) Thwaites (Annonaceae)	False Ashoka/Polyalthia	Evergreen tree	14	1.80	Edible ripe fruits, ornamental, wood for drums, packing cases etc.	NA

62	<i>Psidium guajava</i> Linn. (Myrtaceae)	Kâwlthei	Evergreen or sub-deciduous tree	2	0.25	Fuelwood, edible fruits	NA
63	<i>Rhus chinensis</i> Mill. (Anacardiaceae)	Khawmhma	Deciduous tree	22	2.83	Charcoal, fence-posts, edible fruits	NA
64	<i>Rhynchoctechum ellipticum</i> (Wall. ex D.Dietr.) A. DC. (Gesneraceae)	Tiarrep	Erect undershrub	3	0.38	Edible fruits, leaves as vegetables and fermenting cooked soyabean	NA
65	<i>Schima wallichii</i> Choisy (Theaceae)	Khiang	Evergreen tree	82	10.56	Firewood, building etc., edible tender leaves, fodder, seeds eaten by birds	Least concern
66	<i>Spondia spinnata</i> (L.f.) Kurz (Anacardiaceae)	Tawitaw	Deciduous tree	4	0.51	Firewood, edible ripe fruit eaten raw or pickled and eaten by animals	NA
67	<i>Sterculia villosa</i> Roxb. (Sterculiaceae)	Khaupui	Deciduous tree	9	1.16	Seeds eaten roasted or fried, fruits eaten by birds and animals, nectar sucked by birds	NA
68	<i>Stereospermum tetragonum</i> DC. (Bignoniaceae)	Zihngal	Deciduous tree	22	2.83	Furniture, firewood, building, fodder, fruits eaten by birds	NA
69	<i>Syzygium cumini</i> (L.) Skeels (Myrtaceae)	Lênhmui	Evergreen tree	6	0.77	Firewood, plywood etc., edible fruits	NA
70	<i>Toona ciliata</i> M.Roem. (Meliaceae)	Tei	Deciduous tree	8	1.03	Furniture, boat building, housing, firewood, fodder	Least concern
71	<i>Trema orientalis</i> (L.) Blume (Ulmaceae)	Belphuar	Evergreen tree	13	1.67	Gunpowder charcoal, fodder, fruits eaten by birds and animals	Least concern
72	<i>Vitex glabrata</i> R. Br. (Verbenaceae)	Thingkhawilu	Deciduous tree	2	0.25	Firewood, charcoal, edible fruits	NA
73	<i>Vitex quinata</i> (Lour.) F.N. Williams (Verbenaceae)	Thlengreng	Deciduous tree	1	0.128	Firewood, buildings, fruits eaten by birds	NA
74	<i>Wendlandia budleioides</i> Wall. Ex Wight & Arn. (Rubiaceae)	Batling	Evergreen tree	8	1.03	Gunpowder charcoal, firewood, fencing posts, edible flowers as vegetable	NA

Annonaceae. **Mizo Name:** Polyalthia. **Mode of Utilization:** Bark is used to reduce fever (febrifuge).¹¹

Psidium guajava Linn. Family: Myrtaceae. **Mizo Name:** Kâwl-thei/Kawi-âm. **Mode of Utilization:** The bark and tender leaves are taken for diarrhoea and dysentery. The juice obtained from grinding bark, leaves and ripe fruits are useful for boils and sores. Toothache is treated with paste of bark.¹¹

Rhus chinensis Mill. (Figure 3H). Family: Anacardiaceae. **Mizo Name:** Khawm-hma. **Mode of Utilization:** Fruit decoction is used for indigestion, diarrhoea and dysentery. Water from boiled leaves is used as bathing water against measles, crushed leaves juice is applied to rash or sores.^{2,11}

Rhynchosyche ellipticum (Wall. ex D. Dietr.) A. DC. Family: Gesneraceae. **Mizo Name:** Tiar-rep. **Mode of Utilization:** Leave decoction is used in cancer treatment.¹¹

Schima wallichii Choisy. (Figure 3I). Family: Theaceae. **Mizo Name:** Kiang. **Mode of Utilization:** Fruit is powdered and applied on scorpion sting, centipede and spider bites, etc. Sap of the bark is taken for chronic ulcer and applied on snake bites, cuts and wounds. Leave decoction is taken orally for intestinal tapeworms and to relieve flatulence.^{2,4,11}

Spondias pinnata (L.f.) Kurz. Family: Anacardiaceae. **Mizo Name:** Tawi-taw/Tei-taw. **Mode of Utilization:** Decoction of stem-bark and leaves is taken for rheumatism, diarrhoea, dysentery and fish allergy. The bark if grinded and the juice is applied to cuts.^{4,11}

Sterculia villosa Roxb. (Figure 3J). Family: Euphorbiaceae. **Mizo Name:** Khau-pui. **Mode of Utilization:** Bark decoction is used in tonsillitis, cholera, dysentery and diarrhoea. Bark fibre juice is taken against threadworm infection.¹¹

Stereospermum tetragonum DC. Family: Bignoniaceae. **Mizo Name:** Zih-nghal. **Mode of Utilization:** Tender leaves and bark are used against fever, stomachache, etc. Decoctions of leaves and root are used as febrifuge and anthelmintic, leave juice is useful for itches.^{2,4,6,11}

Syzygium cumini (L.) Skeels. Family: Myrtaceae. **Mizo Name:** Lên-hmui/Hmui-pui. **Mode of Utilization:** Oral medicines include infusion of fruit and decoction of stem-bark and seeds. Seed is taken for diabetes and bark for fever, throat infection, ulcers, jaundice, urinary disorder,

respiratory disorders and chronic dysentery.^{2,11}

Toona ciliata M. Roem. Family: Meliaceae. **Mizo Name:** Tei-pui. **Mode of Utilization:** Stem-bark decoction is taken against for fever, stomach ailments, itching, etc. Extract from flowers are used for treating female menstrual disorders.^{2,11}

Trema orientalis (L.) Blume. Family: Ulmaceae. **Mizo Name:** Bel-phuar. **Mode of Utilization:** Infusion of root-bark and leaves is used against muscle pain, epilepsy and diarrhea.^{2,11}

Vitex glabrata R. Br. Family: Verbenaceae. **Mizo Name:** Thing-khawi-lu-nu/Thing-ar-ek. **Mode of Utilization:** Bark and root has astringent properties. Extract from bark of **Vitex glabrata** is used against typhoid fever.^{4,11}

Discussion

The present study is the first botanical exploration of the tropical semi-evergreen forest at Mizoram Science Centre campus, Berawtlang, Aizawl. In this regard, there is no available record of a similar type of study being undertaken in other science centres in the country. A total of 74 different tree species representing 61 genera and 34 families were recorded in this study, which is lower in comparison to 125 tree species representing 90 genera and 34 families recorded for tropical moist forest of Reiek, Mizoram. However, it was found that the two sites have 29 tree species in common.⁷ Our results reveal that the most abundant tree species at the study site is *C. arborea* (Hnahkiah) of Verbenaceae comprising of 14.30% of the total trees assessed, followed by *A. acuminata* (zairum) of Combretaceae with 12.62%, *S. wallichii* (kiang) of Theaceae with 10.56%, *A. chinensis* (vang) of Mimosaceae with 6.31%, *D. robusta* (thingkha) of Fabaceae with 5.54% and *C. floribunda* (hnahtap) of Tiliaceae with 5.41%. All these dominant species are characterized by edible fruits, seeds, leaves and flowers which form regular food sources for various species of fauna as recorded in **Table 1**, and thus can be attributed to play a vital role in higher biodiversity and community stability in the area.

Moraceae family has the highest number of species type represented by 9 different species. Seven species of the genus *Ficus* of Moraceae family have been recorded in the study site, which is comparable to eight *Ficus* spp. recorded for tropical moist forest of Reiek, Mizoram.⁷ In many tropical forests, the *Ficus* spp. are found to be key components with a variety of fauna feeding on their fruits.⁷ Other studies have also reported the dominance of Euphorbiaceae and Moraceae in tropical forests including Northern and Eastern Ghats.^{7,13,14} The family Verbenaceae was found to contribute the maximum number of individuals with

125 trees belonging to 5 species. Similar to the findings of this study, the dominance of angiosperms was reported among the plant species recorded within the Mizoram University Campus, Tanhril, Mizoram, followed by pteridophytes and gymnosperms.¹⁵ Angiosperms also accounted for 87% of the total species recorded in 'The Book of Mizoram Plants (Sawmliana, 2003)'.¹¹ A floristic survey of tropical semi-evergreen forest of Reiek (10 sq. km) in Mamit District of Mizoram has shown the presence of 20 and 18 tree species in the canopy layers of the undisturbed zone and disturbed zone respectively. However, the species composition of this forest shows dissimilarity with our study site with only three species in common, viz. *C. tribuloides*, *S. wallichii* and *S. cumini*.¹⁶

The top five most abundant tree species of the study site were reported to have ethnomedicinal uses. Among the medicinal plants recorded, Moraceae contributed the maximum number with 7 species and Euphorbiaceae family contributed 5 species. The World Health Organization (WHO) has estimated that traditional medicinal practices are still utilized by around 80% of the global population.¹⁷ In Mizoram, documentation of traditional medicinal practices of the native tribal people started some 30 years back.^{18,19,20} Since then, other workers have contributed with more comprehensive reports on ethnomedicinal plants usage in different parts of the region.^{2,4-6,11} A large percentage of the population may still be using the traditional herbal medicine. A recent study documented 56 species of medicinal plants used by the local people residing within Aizawl City, the capital of Mizoram.⁶ In recent years, a number of workers have pursued phytochemical screening of the medicinal plants of Mizoram for identifying new drug sources from these phytochemicals.²¹⁻²³ An analysis of the methanolic extracts of the leaves of *C. arborea* Roxb revealed that it could be a potential source of natural antioxidants.²¹

Another study on twenty traditional medicinal plants used in Mizoram showed that the medicinal properties of these plants may be attributed to the presence of several secondary metabolites such as tannins, alkaloids, saponins, flavonoids, cardioglucosides, phlobatannins and terpenoids in varying degrees in the tested species.²² The phytochemicals present in the extracts of *Solanum khasianum*, *Dillenia pentagyna* and *Croton caudatus* used as traditional anticancer medicinal plants in Mizoram were found to show potent anticancer activity on Dalton's lymphoma, MCF-7 and HeLa cell lines.²³ Conservation of the traditional medicinal knowledge is, thus, particularly crucial for promoting the pharmacological applications of these plants. In order to prevent traditional knowledge from disappearing, a multilevel approach may be taken including training of local practitioners, *ex situ* and *in situ* conservation of medicinal plants in botanical

gardens and similar protected areas.¹⁷

Species protection and in situ conservation

Green plants assume preeminence among all life forms owing to the indispensable role they play for the sustenance of life on earth. Their unique capacity to capture and convert sunlight into chemical energy remains the fundamental source of energy for other higher groups of organisms. In essence, even the enormous reserves of non-renewable petroleum products can be attributed to past photosynthesis. Since time immemorial, plants have been a source of various products including energy-giving foods and flavorings, medicines, coloring materials, cosmetics, perfumes, fibres and fabrics, construction materials for housing and transportation, firewood and fuel wood, and a wide range of other miscellaneous products.²⁴ Even today in our modern world, plants continue to provide us the three basic necessities of life - food, shelter and clothing, along with many other life essentials.²⁴

On the other hand, forest and forest resources have been drastically exploited by various anthropogenic activities over the past centuries. This overexploitation of plant resources has grave impact on the natural ecosystem balance and also ushers in global climate havoc parallel to it. It has, therefore, become a major agenda worldwide to safeguard and conserve our natural resources. The 2017 assessment of forest cover in Mizoram by Forest Survey of India detected a net decrease of 531 sq km which was mainly attributed to developmental activities and shifting cultivation.³ Protected areas such as biosphere reserves, parks and sanctuaries, *in situ* gene banks and other restricted places provide protection and *in situ* conservation to important plant species but the existing protected areas alone are not adequate for species conservation.²

In Mizoram, the protected areas cover an area of 1240.75 sq km which is 5.88% of its total geographical area, and include Dampa Tiger Reserve, Murlen National Park, Phawngpui National Park, Ngengpui Wildlife Sanctuary, Khawnglung Wildlife Sanctuary, Lengteng Wildlife Sanctuary, Tawi Wildlife Sanctuary, Thorangtlang Wildlife Sanctuary, Pualreng Wildlife Sanctuary and Tokalo Wildlife Sanctuary.²⁵ The present study site can also be regarded as a valuable conservation site, where the plant species are not threatened with destructive anthropogenic activities. Additionally, these protected areas may serve as a source for biotechnological interventions to promote micropropagation of selected species.² Threat assessments¹² in this study revealed that majority of the species have not yet been assessed, while 9 species falls under the Least Concern category. Judicious utilization and conservation of economically important species must therefore, simultaneously be observed to prevent them from becoming endangered and rare.

Further species diversity studies of other plant forms including herbs, grasses, climbers etc. are crucial to be carried out within the site for enhanced knowledge of the prevailing flora. This will provide a comprehensive backbone of valuable information for management and conservation of available plant resources of the region as a whole.

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