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A quantitative ethnobotanical study of medicinal plants of Khawrihnim village (Indo-Burma biodiversity hotspot) with Mimosaceae, Euphorbiaceae and Verbenaceae as dominant families

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Mizoram is one of the known areas of importance for plant diversity in the Indo-Burma biodiversity hotspot of India. But many remote villages are yet to be documented and need to be explored scientifically for sustainable growth and development. One such village is Khawrihnim, situated at about 23°41'N, 92°36'E, at high-altitude. It is a geographically isolated hill with steep terrains with little external influence and a novel site for ethnobotanical research. The present study, therefore, focuses on exploring the ethnomedical knowledge of Khawrihnim village in terms of cultural significance, cross-cultural relevance, conservation criteria and potential for pharmacological applications. The study was conducted between 2023 and 2024 through semi-structured interviews and guided fieldwork with knowledgeable local informants. The use reports (UR), relative frequency of citation (RFC), relative importance (RI), use value (UV), fidelity level (FL), cultural value (CVe) and consensus index (CI) were calculated using quantitative indices. Conservation status was checked against the IUCN Red List. The study documented total 52 medicinal species of 41 families. *Albizia chinensis* (UR = 170, UV = 1.545), *Alstonia scholaris* (RFC = 0.773, CI = 1.636) and *Achyranthes aspera* (RFC = 0.545, UV = 1.091) were found to be high in medicinal values. It was also observed that the most frequently used part of the plant was the leaf, mostly prepared as decoction. A cross-cultural comparison also indicated significant similarities with the ethnomedical knowledge of adjacent Northeast Indian tribes. Finally, most of the medicinal plants were classified as least concern or not evaluated. However, *Cinnamomum verum* needs to be addressed because of its vulnerable status. Therefore, this work provides new ethnomedical data for an understudied area and a baseline for the prioritization of conservation and pharmacological evaluation.

Keywords: Biodiversity conservation, Ethnobotany, Indigenous knowledge, Medicinal plants, Mizoram, Quantitative indices traditional medicine

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Plants are the basis of most ecosystems, they also served as a source food and medicine, since time immemorial. Today, approximately 75% of the world population depends on plants for primary health care[1]. Ethnobotany is the study of how native cultures and tribes use and understand local plants for food and medicine. This ethnobotanical knowledge is an important part of healthcare in many developing countries, where almost 80% of rural communities rely on plant-based medicines[2]. More than 50,000 species of plants are used for medicinal purposes throughout the world and about a quarter of all modern medicines are derived from traditional botanical knowledge[3]. Recent drug research has increasingly recognized the reduced side effects and accessibility of plant-derived natural chemicals[4], highlighting their advantage. In India, plant-based healing practices are well established among various ethnic populations, especially in Northeast India, which is known for its rich biodiversity[5]. These medicinal plants are still readily available and affordable for the treatment of humans and animals, particularly in low- and middle-income countries[6].

Indigenous communities closely tied to their land and culture continue to provide much of ethnobotanical knowledge[7]. This knowledge however is mainly transmitted orally it is at risk of being lost, especially in remote communities. A large portion also remains undocumented, especially in isolated villages. The Eastern Himalaya, including Mizoram, is a well-

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recognized biodiversity hotspot rich in medicinal species that could support traditional healthcare systems[8,9]. Yet, ongoing development and shifting land use could also threaten both plant diversity and indigenous knowledge[6]. Therefore, documentation and research are a very important topic in the current time

Khawrihnim is a remote, high-altitude community in Mizoram, geographically isolated and mostly inhabited by a small tribal group. The site is important for ethnobotanical studies since the area has well-preserved forest ecosystems. The community is interlinked and has preserved traditional knowledge and botanical practice. Therefore, documentation of this knowledge could provide a basis for future preservation of resources and sustainable development. Local healers and plant users may also have information that might be useful for drug development. The combination of flora and cultural knowledge makes Khawrihnim an important site for ethnobotanical research[10].

Thus, the study is designed to document and quantitatively evaluate the medicinal plant use in Khawrihnim village with an emphasis on dominant plant families, major ailments treated and cultural significance. It is also the first detailed, quantitative survey of medicinal plants of Khawrihnim providing new information on local plant diversity and indigenous knowledge. It is designed to offer a rigorous approach that underpins the scientific validation of traditional remedies and is consistent with global efforts for culturally appropriate sustainable healthcare[11].

The results aim to fill a major regional knowledge gap, reinforce cultural heritage, and draw attention to the importance of conserving biodiversity and safeguarding traditional knowledge from further erosion[12]. This work will also close a big research gap by providing the first quantitative ethnobotanical assessment of therapeutic plants in Khawrihnim with cultural, ecological and conservation perspectives.

Materials and Methods

Description of the study area

The study area Khawrihnim (Latitude 23°37'24.84"N, Longitude 92°37'21.03"E, Altitude 1033 m.) is about 35 km away from Aizawl (Fig. 1). It has rugged terrain, scattered settlement pattern and limited road connectivity that limited industrialization. The village is surrounded by mixed subtropical evergreen forest, bamboo stands and riverine

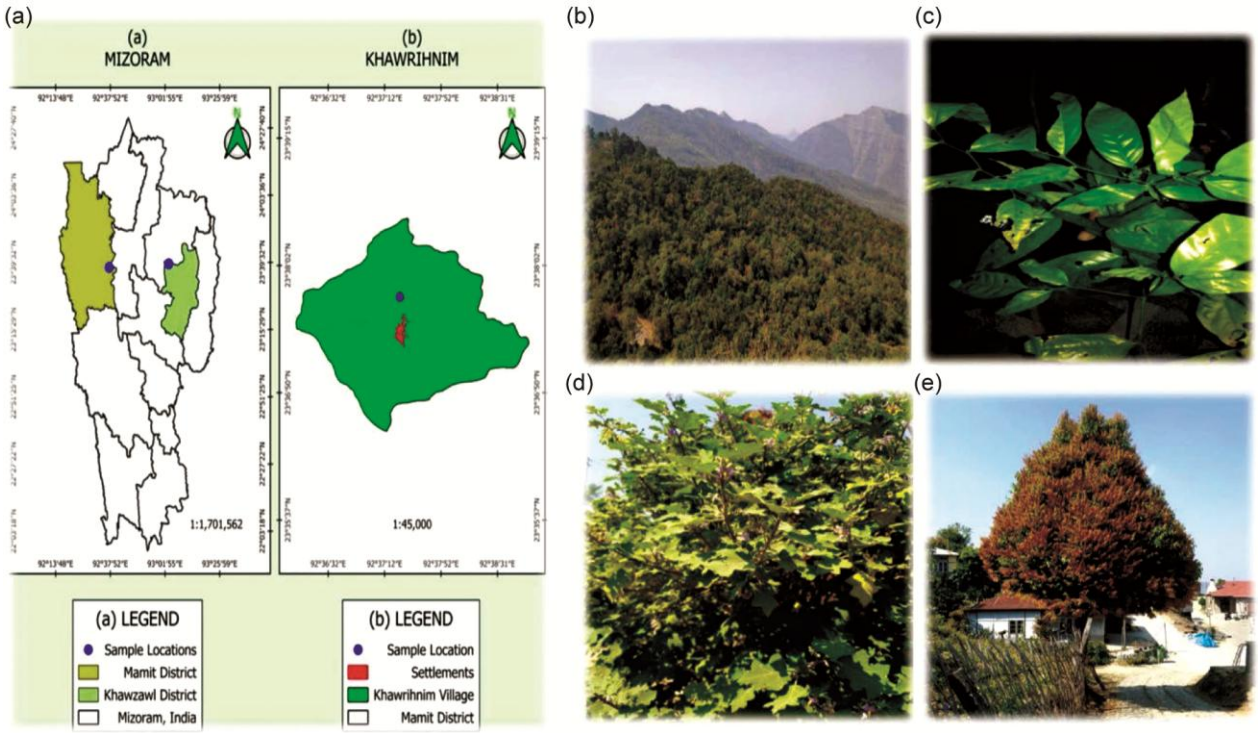

Fig. 1 — (a-e) (a) Location map of Khawrihnim village, (b) view of the surrounding forest, (c) plant collection during field survey, (d) herbarium specimen preparation, and (e) Khawrihnim village photograph. (Map source: Mizoram Remote Sensing Application Centre (MIRSAC) Mizoram Science, Technology & Innovation Council (MISTIC))

vegetation forming a diversity of microhabitats that support a wide range of medicinal and wild edible species.

Khawrihnim was selected for its uniqueness in ecology, cultural continuity, and conservation of traditional knowledge which has been sustained due to low migration and high community cohesion. It is a remote village in Reiek subdivision of Mamit District, Mizoram, with 168 households and a population of about 935, almost entirely of Scheduled Tribe communities. The literacy rate of the community is extremely high at 98.85% and they have a close relationship with their environment. The main occupation is agriculture. Major crops grown are maize, upland rice, banana, beans, yam, and turmeric.

Collection of non-timber forest products (NTFPs) like wild vegetables, edible fruits, firewood, bamboo, and medicinal plants is also practiced. The lack of access to modern health care facilities further reinforces dependence on plant-based remedies.

Fieldwork was carried out during 2023-2024 through recurrent visits to forested areas, home gardens and plant collection sites. Information was collected directly through field interactions with knowledgeable informants who interact routinely with the surrounding forests. Local guides with extensive traditional ecological knowledge assisted in plant species identification, locations of gathering sites and confirmation of ethnomedicinal uses. Household interactions were incorporated but the study was based mainly on field observations, guided walks, specimen collection and documentation of plant-use practices in situ.

Data collection

Data were collected by means of semi-structured interviews, guided forest walks, demonstrations of plant uses and cross-check interviews with multiple informants. Data collected were local plant names, parts used, preparation methods, ailments treated, mode of administration and perceived efficacy. Interviews were conducted in the Mizo language and lasted between 20 and 45 min. With prior informed consent, interviews were audio recorded. Field observations were augmented through discussions with knowledgeable informants during demonstrations pertaining to plant gathering and use[13].

Plant identification

Plant samples were collected and brought to the Pachhunga University College, Aizawl for identification and taxonomic verification by Professor Vanlalhruaii Ralte from Department of Botany. Species identification was based on World Flora Online[14] and Plant Names Index[15]. Voucher specimens were prepared and deposited in the Herbarium of the Department of Botany, Pachhunga University College for proper documentation and future reference.

Data analysis

Data were organized in microsoft excel and each entry included the voucher number, scientific and common names, plant habit, part used, method of preparation, and therapeutic applications. Statistical analyses were performed using SPSS software. Quantitative ethnobotanical analyses were performed using the R package ethnobotany R. The program was used for calculating standard quantitative ethnobotanical indices based on the informant consensus to evaluate the cultural significance of each species. Conservation status assessment was conducted following IUCN[16] criteria.

Quantitative indices[17]

***Use reports* (*UR*)**

UR represents the total number of times a plant species is mentioned for any use. It reflects the overall prominence and recognition of a species within the community. Species with higher UR values are considered more widely utilized. It was calculated using the formula:

$$UR = \sum U_i$$

where = number of use citations reported by informant i.

***Cultural importance indices* (*CI*)**

CI measures how widely known and used a species is across informants. It provides insight into both the spread and versatility of a plant in traditional medicine**.** It was calculated using the formula:

$$CI = \sum \frac{UR_u}{N}$$

Where UR_u = use reports in use category u, N = total number of informants.

***Frequency of citation* (*FC*)**

FC represents the number of informants who mention a species. It indicates the popularity and overall awareness of the plant in the community. It was calculated using the formula:

$$FC = n_s$$

where n_s = number of informants who mentioned the species.

***Number of uses* (*NU*)**

NU is the total of the sum of the different medicinal uses of the species. It's a tribute to the plant's therapeutic versatility. It is calulcated using the formula

$$NU = U_{distinct}$$

***Relative frequency of citation* (*RFC*)**

RFC is the percentage of informants mentioning the species to the total number of informants. This standardizes FC for cross-study comparison. It was calculated as:

$$RFC = \frac{FC}{N}$$

***Relative importance indices* (*RI*)**

RI is a combination of recognition (RFC) and versatility (NU) of a plant. It was calculated by the formula: The index takes into account the popularity and the functional diversity of the species, and helps to identify the plants with wide therapeutic applications. It is calculated using the formula:

$$RI = \frac{RFC + \frac{NU}{NU_{max}}}{2}$$

where UN_{max} is the highest number of uses reported for any species.

***Use value* (*UV*)**

UV is the average number of uses given by an informant for a species. It shows the relative importance of a plant according to informant knowledge. It was calculated as:

$$UV = \frac{\sum U_i}{N}$$

***Cultural value* (*CVe*)**

CVe is a combination of the diversity of uses, consensus among informants and proportion of uses for a species. It provides a complete measure of the total cultural importance of a species. It was calculated using the formula:

$$CVe = \sum\left(\frac{UR_u}{N} \times \frac{FC}{N} \times \frac{UR_u}{UR_{total}}\right)$$

***Fidelity level* (*FL%*)**

FL is the percentage of informants that mention the species for its principal use relative to the total number of uses. It is a testimony to the reliability and specificity of traditional knowledge for some diseases. It is calculated as:

$$FL(\%) = \frac{N_p}{N_s} \times 100$$

where N_p = number of informants citing the principal use, N_s = total number of informants citing the species.

Quality assurance and Quality control

All fieldwork was conducted under the supervision of local experts with at least 40 years of traditional ecological and landscape knowledge. The interviews were based on a standardised questionnaire, and key information was cross validated through repeated interactions with various informants to ensure reliability.

Plant identification was confirmed with standard floras and the voucher specimens were authenticated and deposited in the Herbarium of the Department of Botany, Pachhunga University College. Two researchers calculated the ethnobotanical indices independently, and the results were compared and checked for consistency.

Data entry, coding and statistical analysis were verified twice to minimise errors. Conservation assessments using the IUCN Red List criteria were undertaken to correctly classify species. All figures, chord diagrams and statistical visualisations were generated using GraphPad Prism and R software to guarantee transparency and reproducibility of the analytical workflow.

Result

Informant characteristics

The survey was conducted among 110 residents of Khawrihnim and is depicted in (Table 1). The findings indicated that, knowledge holders were distributed across age groups and professions and traditional healers accounted for a small percentage (2/110). 53 (51-70 years) were middle aged or older in this group. Most workers were farmers (69), housewives (15), government officials (9) and traditional leaders (6). The findings revealed that the holders of traditional knowledge are the elderly

members of farming communities and this reflects the need for focused recording and preservation efforts.

Medicinal plants characteristics

A total of 52 species of medicinal plants were recorded in the study including 20 trees, 15 shrubs and 17 herbs (Table 2-4). These species belong to 13 families consisting of 17 genera of herbs, 12 families consisting of 14 genera of shrubs and 16 families consisting of 19 genera of trees. The results show that despite its remoteness, Khawrihnim has a rich diversity of medicinal plants.

The survey also recorded the various ethnomedicinal uses like treatment of skin diseases, ulcers, diarrhoea, hypertension, stomach pain, fever, rheumatism and respiratory disorders. Roots, leaves, fruits, flowers, bark or whole plants were employed, while decoction, infusion, paste, powder and extracts were the main preparation methods. These practices illustrate the rich traditional knowledge and diverse use of local plant resources in the community.

Figure 2 (a–c) presented the summary of medicinal plant diversity and use. As shown in (Fig. 2 a) it was observed that herbs are the most frequently used

Table 1 — Socio-demographic characteristics of informants in Khawrihnim village survey

Parameter	Category	Observed	Frequency (%)
Age (in years)	40–50	19	17.27%
	51–60	24	21.82%
	61–70	29	26.36%
	71–80	21	19.09%
	>80	7	6.36%
Occupation	Farmer	69	62.73%
	Traditional leader	6	5.45%
	Government official	9	8.18%
	Housewife	15	13.64%
Total	—	110	100%

Table 2 — List of medicinal tree species documented in Khawrihnim

Family	Scientific Name (SN)	CN/LN	NTFPs Use	Mode of Preparation	Ailments/Diseases
Apocynaceae	*Alstonia scholaris* R.Br.	Thuamriat	B, L	Decoction[i]	Dysentery, hypertension, stomach ulcer, fever
Bignoniaceae	*Stereospermum neuranthum* Kurz	Zih-nghal	W	Wood vinegar obtained from furnace[i]	Chronic ulcer, sores, skin diseases
Bombacaceae	*Bombax ceiba* L.	Phun-chawng	S, B	Bark chewed and juice swallowed[i]	Aphrodisiac, tonsillitis
Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb.	Thing-van-dawt / Tuikuk-re-raw / Charvantai	Fr	Decoction of fruit[i]	Dyspepsia, dropsy, piles, diarrhoea, headache
Euphorbiaceae	*Aporusa octandra* (Buch.-Ham. ex Don) Vick.	Chhawn-tual	S, B	Decoction[i]	Stomach ulcer, gout, rheumatism
Fabaceae	*Erythrina stricta* Roxb.	Fartuahpui	B	Decoction of stem bark[i]	Toothache, stomach ulcer
Lamiaceae	*Callicarpa arborea* Roxb.	Hnahkiah	B	Juice and paste applied[e]	Cuts, wounds
Lauraceae	*Cinnamomum verum* Presl	Thakthing	S, B	Powdered bark mixed with water[i]	Carminative, antiseptic, diarrhoea, spasmodic, astringent
Meliaceae	*Chukrasia tabularis* A. Juss.	Zawngtei	SC	Eaten raw or crushed[i]	Diarrhoea, dysentery
Mimosaceae	*Albizia chinensis* (Osb.) Merr.	Vang	S, B	Juice applied[e]	Cuts, scabies, skin diseases
Mimosaceae	*Albizia procera* (Roxb.) Benth.	Kangtek	S, B	Decoction[i]	Ulcers
Mimosaceae	*Parkia roxburghii* G. Don	Zawngtah	P	Paste applied[e]	Itches, scabies
Moraceae	*Ficus semicordata* var. *conglomerata* (Roxb.) Kurz	Theipui	L	Decoction[i]	Jaundice, hepatitis
Myrtaceae	*Psidium guajava* L.	Kawlthei / Kawi-am / Char-thei	L, F	Leaf juice in water[i]	Dysentery
Phyllanthaceae	*Emblica officinalis* Gaertn.	Sunhlu	S, B, Fr	Decoction of bark and fruit[i]	Diarrhoea, nausea, vomiting
Rubiaceae	*Haldina cordifolia* (Roxb.) Ridsdale	Lungkhup	S, B	Decoction with *Vitex peduncularis*[i]	Fever, febrifuge
Sapindaceae	*Sapindus mukorossi* Gaertn.	Hlingsi	SD, N	Soapnut used as biocide[e]	Leech bite
Simaroubaceae	*Picrasma javanica* Bl.	Thing-damdawi / Khawsik-damdawi-thing	S, B	Decoction[i]	Fever, diabetes, hypertension
Verbenaceae	*Gmelina arborea* Roxb.	Thlanvawng	F	Roasted fruit pulp applied[e]	Itches, sores, rash

[e] *indicated external,* [i] *indicated internal,* S=stem, B=bark, L=Leaves, SC=Seed=coat, Fr=Fruit, P=Pod, SD=Seed, N=nut, W=Wood

plants followed by trees and shrubs reflecting accessibility and ease of collection. As shown in (Fig. 2 b), leaves are the most used plant part, followed by roots, bark and stems used less while fruits, flowers, rhizomes and seeds are minimal which is in line with sustainable harvesting.

Finally, the results showed (Fig. 2b) the dominant plant families in the order Mimosaceae, Euphorbiaceae, Verbenaceae, Apocynaceae, Rubiaceae, and Lamiaceae. These families contribute significantly to the medicinal plant richness of Khawrihnim, emphasizing the community dependance on these taxa for traditional healthcare.

Quantitative indices

Quantitative indices in ethnobotany provide an objective, quantifiable, and comparable data of traditional knowledge. These indices are detailed in (Supplementary Table S1-3 and Fig. 3-4). *Albizia chinensis* showed the highest UR (170) and a high UV (1.545) among tree species, indicating strong recognition in local medicine.

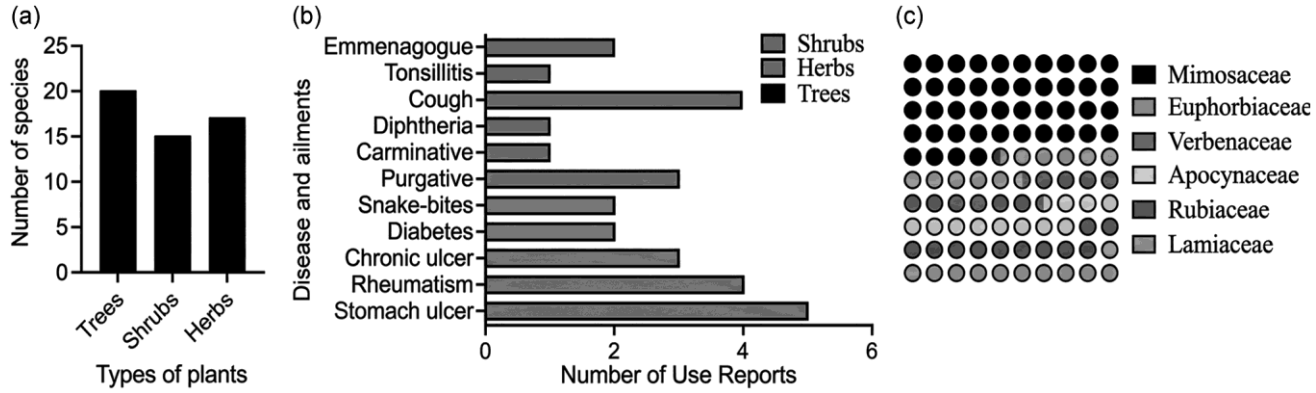

Fig. 2 — (a) Use reports by plant type, and (b) medicinal plant families

Table 3 — List of medicinal shrub species documented in Khawrihnim forest of Mizoram

Family	Scientific Name (SN)	CN/LN	NTFPs Use	Mode of Preparation	Ailments/Diseases
Acanthaceae	*Justicia adhatoda* L.	Kawl-dai / Kawl-dai-par-var	L	Crushed juice applied[e]; decoction[i]	Cuts, wounds, cough, bronchitis, asthma
Apocynaceae	*Catharanthus roseus* (L.) G. Don	Kumtluang	L, F	Decoction[i]	Hypertension, cancer
Asteraceae	*Chromolaena odorata* (L.) R.M. King & H. Rob.	Tlang-sam / Pholeng	L	Crushed juice applied[e]	Cuts, wounds, haemostatic
Elaeagnaceae	*Elaeagnus cordata* Schumach.	Sarzukpui	R	Infusion[i]	Removal of retained placenta
Euphorbiaceae	*Securinega virosa* (Roxb.) Baill.	Saisiak	L	Leaves boiled in water for bathing[e]	Skin diseases, measles
Fabaceae	*Crotalaria juncea* L.	Tumthang	L	Leaves boiled in water[i]	Purgative, emmenagogue
Lamiaceae	*Clerodendrum viscosum* Vent.	Phuihman-chhia	R, L	Infusion[i]; leaf juice applied[e]	Febrifuge, skin diseases, vermifuge
Malvaceae	*Hibiscus rosa-sinensis* L.	Midum pangpar / China pangpar	F	Flower soaked in water[i]	Fever, febrifuge (children)
Melastomataceae	*Melastoma malabathricum* L.	Builukham	L	Leaves boiled in water[i]	Diarrhoea, dysentery
Melastomataceae	*Osbeckia nepalensis* Hook.f.	Bulukhampa	R	Decoction of root[i]	Kidney problems
Oleaceae	*Lepionurus sylvestris* Blume	An-pang-thuam	L	Leaves boiled in water[i]	Diphtheria
Rubiaceae	*Hedyotis scandens* D. Don	Kelhnamtur / Laikingtuibur	L, R	Decoction[i]	Fever, jaundice, kidney problems
Solanaceae	*Datura metel* L.	Tawtawrawtpar	L	Dried crushed leaves applied[e]	Asthma, headache
Solanaceae	*Solanum indicum* L.	Tawkte	F	Cooked berries[i]	Hypertension
Solanaceae	*Solanum torvum* Sw.	Tawkpui	S	Crushed seeds applied on teeth[i]	Toothache, tooth decay

[e] *indicated external,* [i]*indicated internal,* L=Leaves, F=Flower, Fr=Fruit, S=Seeds, R=Roots

Similarly, *Alstonia scholaris* also showed high relevance, with an RFC of 0.773 and a CI of 1.636. In case of shrubs, *Catharanthus roseus* and *Chromolaena odorata* showed high RFC and UV values, indicating common use and wide applications. *Achyranthes aspera* was the most cited herb (RFC = 0.545; UV = 1.091), confirming is importance in traditional medicine. FL values above 70% were found in some species with a high consensus among the informants for certain therapeutic uses. The high CVe and CI values in several taxa further indicate their continued cultural significance and centrality in the traditional healthcare system of the community.

Conservation status and cross-cultural analysis

Conservation assessment showed that most medicinal plant species fall in IUCN categories of Least Concern (LC) or Not Evaluated (NE), indicating no immediate global extinction risk, as shown in (Fig. 5) and detailed in (Supplementary Table S1-3). The result also showed many commonly used species are not at risk of extinction around the world, but taking bark, roots, and stems too often may cause local populations to decline. Leaf use was the most common practice, suggesting generally sustainable harvesting.

Species such as *Cinnamomum verum* were categorized as Vulnerable (VU), requiring local monitoring, awareness activities, and possible inclusion in community-based conservation. A combined prioritization matrix (ethnobotanical importance × IUCN status) would help identify species for community-led monitoring and propagation and underscores the need for targeted conservation strategies for culturally significant plants. A clear dominance of specific plant families, particularly Mimosaceae, Euphorbiaceae, and Verbenaceae, was observed, suggesting phylogenetically conserved ethnomedicinal preferences within the community.

Table 4 — List of medicinal herbs species documented in Khawrihnim forest of Mizoram

Family	Scientific Name (SN)	CN/LN	NTFPs Use	Mode of Preparation	Ailments/Diseases
Amaranthaceae	*Achyranthes aspera* L.	Bu-chhawl / Ui-hlo	WP, L	Crushed juice[i]	Dysentery, piles, skin eruptions, wounds, ulcers, worms
Apiaceae	*Centella asiatica* (L.) Urban	Lambak / Darbengbur / Hnahbial	WP	Infusion[i]	Cholera, diuretic, gastroenteritis, hypertension, fever, stomachache, eye-ache, skin diseases
Apiaceae	*Eryngium foetidum* L.	Bahkhawr	WP	Crushed plant[i]	Stomach disorders, condiment
Araceae	*Amorphophallus paeoniifolius* (Dennst.) Nicolson	Telhawng	Rh	Powdered rhizome mixed with water[i]	Piles, dysentery, rheumatism
Araceae	*Homalomena aromatica* Schott	Anchiri	Rh	Powdered rhizome[i]	Mosquito repellent
Asteraceae	*Ageratum conyzoides* L.	Vailenhlo	L, R	Crushed juice[i]	Cuts, wounds, haemostatic, antilithic
Asteraceae	*Mikania micrantha* Kunth	Japanhlo	L	Crushed juice applied[e]	Cuts, wounds, haemostatic
Costaceae	*Costus speciosus* (J. Koenig) Sm.	Sumbul	Rh	Decoction[i]	Kidney disorders, birth control, kidney stones
Cucurbitaceae	*Benincasa hispida* (Thunb.) Cogn.	Maipawl	F	Decoction of fruit[i]	Dysentery
Euphorbiaceae	*Acalypha indica* L.	Chhawntan	L	Juice/paste applied[e]	Laxative, jaundice, scabies, rashes, syphilis, snakebite, centipede bites
Fabaceae	*Entada phaseoloides* (L.) Merr.	Kawihrui	Sd	Powdered seed[e]	Inflammation, ulcers
Gnetaceae	*Gnetum scandens* Roxb.	Pelh	Fr, R	Decoction[i]	Rheumatism
Menispermaceae	*Tinospora cordifolia* (Willd.) Hook.f. & Thomson	Hrui-van-kai / Van-kai-hrui / Hnah-mam	L, S	Decoction[i]	Dysentery, rheumatism, gout, fever, dyspepsia
Musaceae	*Musa* spp.	Changel	Sp	Sap applied[e]	Snakebite, insect bites
Smilacaceae	*Smilax ovalifolia* Roxb. ex D. Don	Kaihapui	R	Decoction[i]	Dysentery, rheumatism
Zingiberaceae	*Curcuma longa* L.	Aieng	Rh	Decoction[i]	Chronic ulcer, inflammation
Zingiberaceae	*Zingiber officinale* Roscoe	Sawhthing	Rh	Crushed rhizome with water[i]	Diphtheria, cough, flatulence

[e] indicated external, [i] indicated internal, WH=Whole plant, L=Leaves, R=Roots, Rh=Rhizome, Fr=Fruit, Sd=Seed, Sp=Sap, S=Stem

Cross-cultural comparisons also showed that many high-value medicinal plant species in Khawrihnim are also known among other ethnic groups in Northeast India such as the Mizo, Mara, Chakma, Tripuri, Hmar, Khasi, Garo and Lepcha communities[9]. The species *Albizia chinensis*, *Alstonia scholaris*, *Tinospora cordifolia* and *Catharanthus roseus* are also most frequently reported in other studies from Mizoram, which suggests an ethnomedicinal traditions across the Eastern Himalaya[9]. This convergence highlights common ethnomedical priorities and ecological availability, and the value of cross-tribal comparisons in identifying culturally important species with pharmacological potential.

Discussion

Ethnobotanical knowledge is shared among the community members of the Khawrihnim village, but

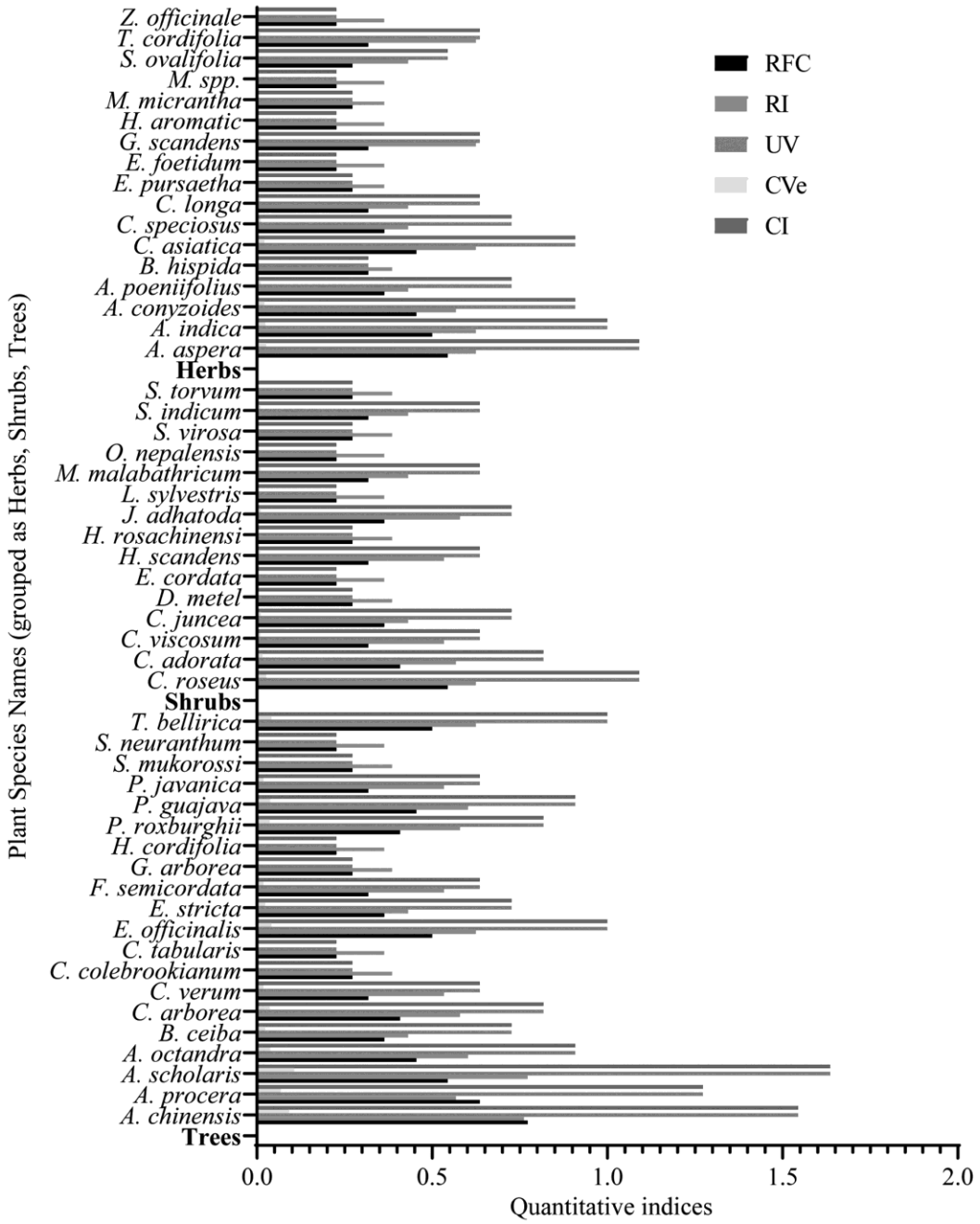

Fig. 3 — Quantitative ethnobotanical indices (RFC, RI, UV, CVe, and CI). RFC = Relative Frequency of Citation; RI = Relative Importance Index; UV = Use Value; CVe = Cultural Value; CI = Cultural Importance Index

few traditional healers have a specialized knowledge. Most of the respondents were middle-aged or older. This is in line with the notion that traditional knowledge increases with age. The dominance of farmers indicates the importance of close interaction with local flora for the transmission of knowledge. The involvement of leaders, legislators and housewives suggested that ethnomedical knowledge transcends professional boundaries, enhancing cultural continuity[18].

The reported diversity of medicinal plants reflects the rich botanical wealth of the region, despite being a

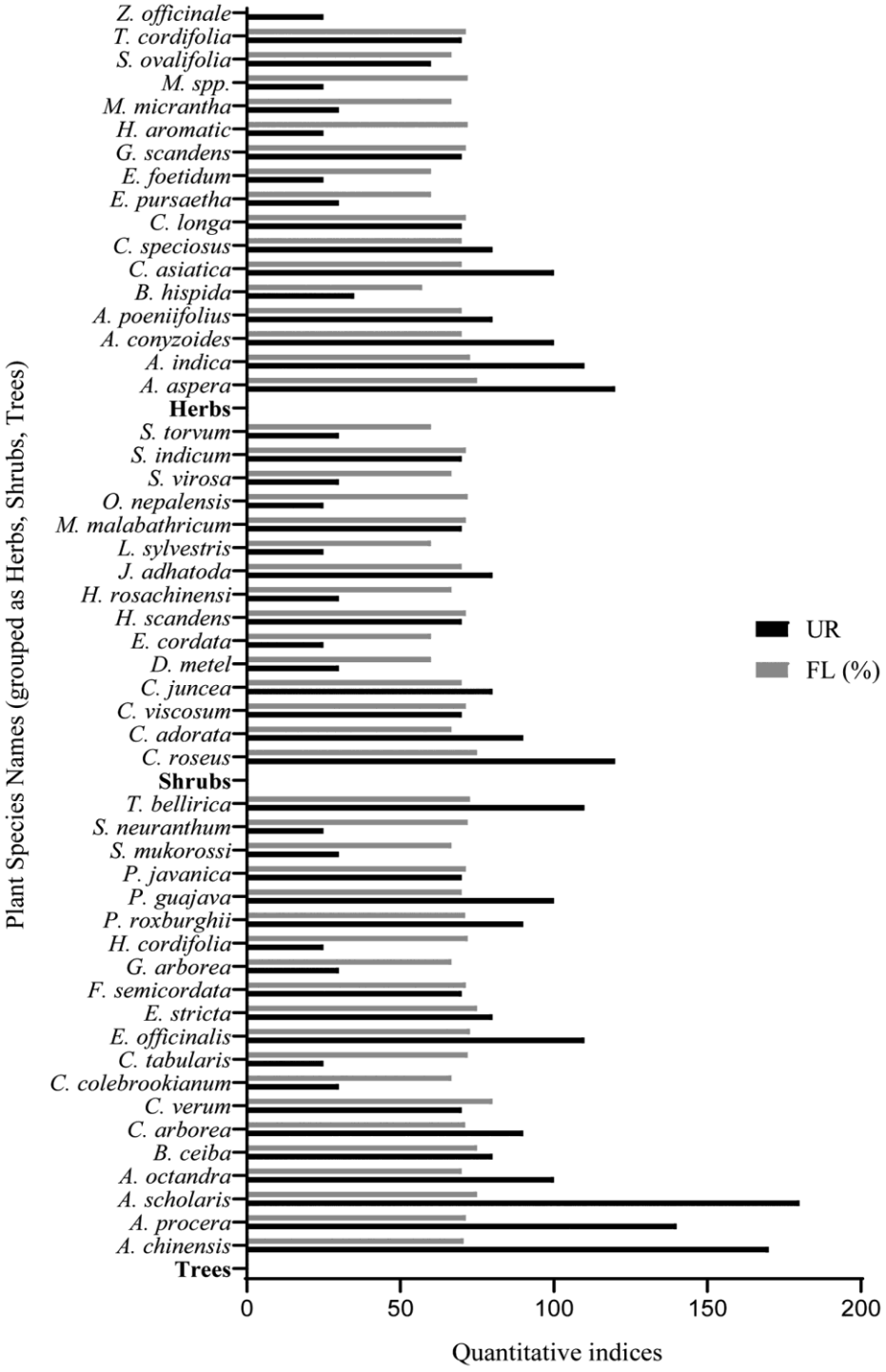

Fig. 4 — Quantitative ethnobotanical indices (UR and FL). UR = Use Reports; FL = Fidelity Level

small community. These observations correlate with studies that identify families such as Euphorbiaceae and Mimosaceae as common sources of traditional medicine[19]. The findings agree with other studies reporting the dominance of herbs and shrubs in traditional therapeutic systems, probably because they are readily available and abundant. From respiratory to digestive and musculoskeletal disorders, the range of ailments treated reflects the versatility of plant-based remedies. Similar patterns have been reported in multi-regional studies[20] emphasizing the importance of families such as Lamiaceae, Asteraceae and Fabaceae for the treatment of common ailments.

The most common preparation method was decoction which is in accordance with indigenous practices and is preferred for efficient extraction of bioactive compounds[21]. Leaves were the most used part of the plants due to their availability, sustainability and high concentrations of antibacterial, antioxidant and antidiabetic metabolites[22]. This pattern is consistent with results from Southeast Asia and India where leaf use is dominant[23]. However, the lack of standard preparation methods among healers is a barrier to reproducibility, underscoring the need for documentation and standardisation[24].

The global trend of leaves is due to their phytochemical richness, ease of collection and low environmental impact. Similar dominance of decoction and leaf use in traditional medicine was reported by Maiyo *et al.*[25] in Kenya. Similarities were also observed by Muthukrishnan *et al*.[26] in India. The preference for fresh materials implies low processing, which may affect therapeutic potency and sustainability[27].

The high UR and CI values of *Albizia chinensis* and *Alstonia scholaris*, are consistent with their pharmacological efficacy and indicative of the importance of medicinal plants in local healthcare. The high CI and UV exhibited by *Catharanthus roseus* also confirmed its role in management of infections and chronic disorders[28]. High values of UV, CI and FL indicate trusted species that deserve phytochemical and pharmacological investigation. The study also reveals that the main therapeutic focus of traditional medicine in Khawrihnim is gastrointestinal disorders, using key species such as *Alstonia scholaris*, *Centella asiatica*, *Tinospora cordifolia* and *Achyranthes aspera* to treat diarrhoea, dysentery and stomach-related ailments

Cultural significance and frequency of use across herbs, shrubs and trees are revealed through quantitative indices such as RFC, RI, UV, CVe and CI (Fig. 4-6). These indices are useful for prioritizing species for pharmacological study, for conserving biodiversity[29] and for preserving indigenous knowledge. The habit-wise classification of the medicinal plants reveals the importance of specific conservation measures in view of human-induced pressures and habitat loss. The frequency of leaves and decoction shows cultural preferences among Mizo, Mara, Hmar and Lai tribes with similar trends among Khasi, Garo, Nyishi, Apatani, Monpa and Lepcha communities[30]. High FL values for hypertension, digestive, and dermatological ailments reflect strong cultural consensus and empirical validation[31].

The study highlights the need for focused conservation, especially for culturally significant species that have not been globally assessed. In summary, the quantitative indices indicate that medicinal plants are a fundamental part of the community's biocultural heritage and are crucial for the conservation of biodiversity and indigenous knowledge systems[32]. Traditional plant-based remedies are still extensively used; however, modernization, better healthcare and socio-cultural dynamics may influence the transmission of ethnomedicinal knowledge. Younger generations tend to be less involved in traditional practices which can lead to a slow erosion of knowledge transfer. This further highlights the importance of documentation, community awareness and the integration of traditional knowledge into local education systems to ensure its preservation[33,34].

Limitations and future recommendations

This study is the first quantitative ethnobotanical assessment of Khawrihnim. However, it has

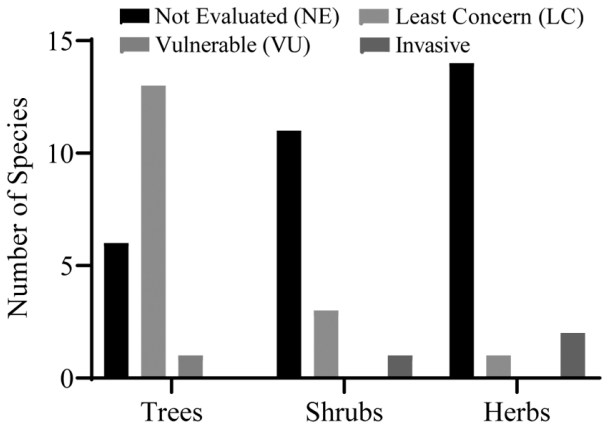

Fig. 5 — IUCN status distribution of Khawrihnim medicinal plants

limitations. The research data were self-reported by informants and may be subject to recall bias or selective dissemination. The availability of plants during different seasons may have limited the reporting of species used in particular months. Taxonomic identification was complete but phytochemical or pharmacological validation wasn't. These IUCN conservation assessments are global, and may not accurately reflect local population dynamics, particularly for species vulnerable to site-specific harvesting pressures.

Future studies should include longitudinal surveys in different seasons to document changes in availability and use by plants over time. The combination of phytochemical screening and pharmacological assays can aid in the validation of

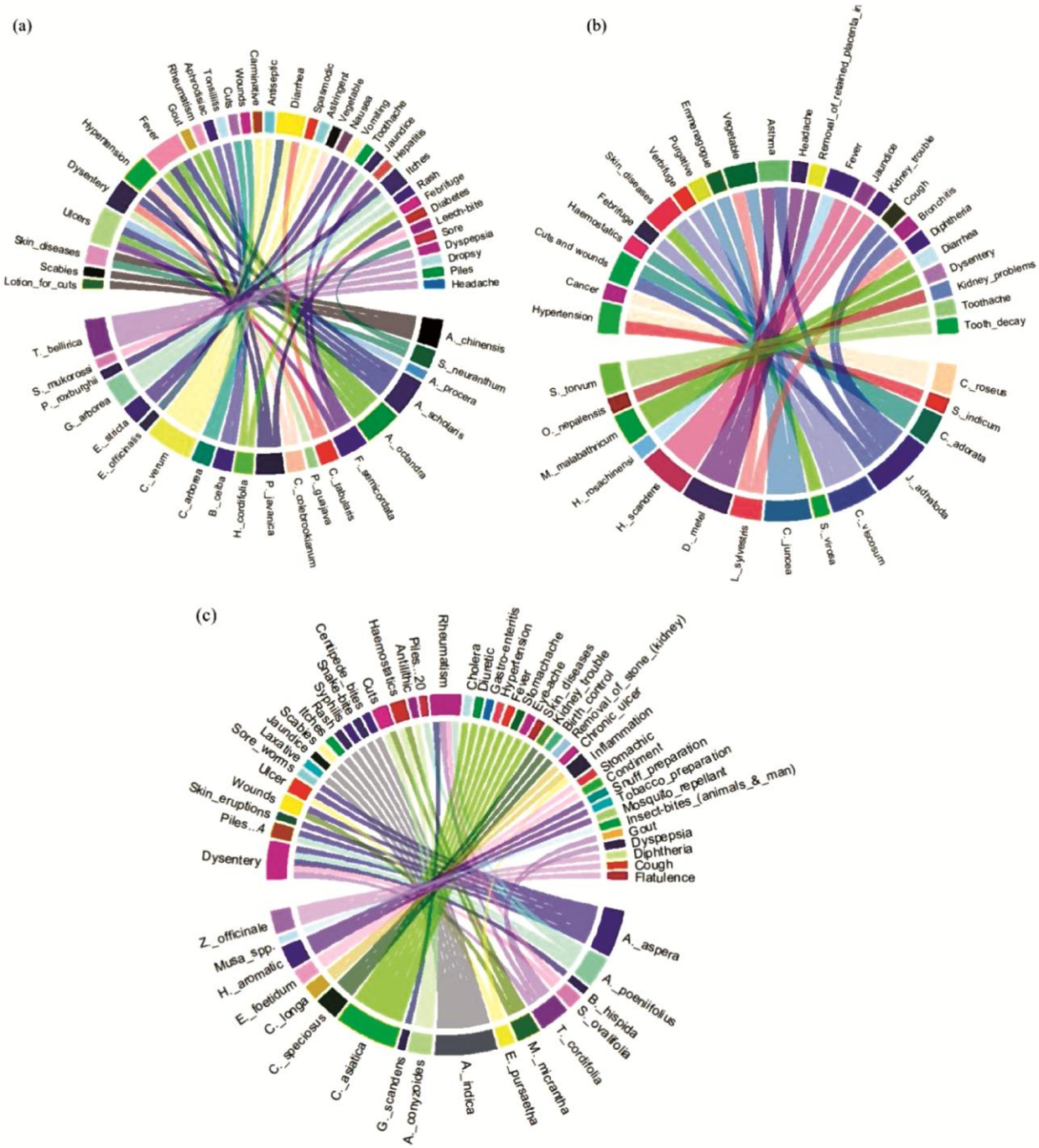

Fig. 6 — R-chord depicts the quantitative ethnobotanical indices of (a) trees, (b) shrubs and (c) herbs

culturally important species for their medicinal potential. Community-based monitoring groups are needed to verify population status of regularly harvested taxa, especially NE or local risk species. Comparisons between nearby villages may reveal ethnomedical trends and improve conservation. Finally, documentation and school-based awareness campaigns could help to preserve traditional knowledge that is at risk from cultural change and modernization.

Conclusion

The ethnobotanical survey of Khawrihnim village indicates a high diversity of medicinal plants with 52 species belonging to 41 families, emphasizing the ecological, cultural, and therapeutic linkages between the community and its forests. Species like *Albizia chinensis*, *Alstonia scholaris* and *Achyranthes aspera* are quantitatively important as they showed high values in UR, RFC, UV, CI and FL. The presence of leaves and decoctions indicates sustained cultural preferences and generally sustainable harvesting practices. The cross-cultural comparisons indicate that the medicinal knowledge of Khawrihnim is part of a wider Eastern Himalayan ethnomedical tradition. Most species are listed as LC or NE but *Cinnamomum verum* needs attention as it is listed as VU. This study adds new records from a poorly studied area and highlights the value of indigenous knowledge systems. Future research should include phytochemical validation of culturally important species and conservation and sustainable management to protect biological resources and cultural heritage.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_25(7)(2026)640-652_SupplData.pdf

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Author Contributions

HS, Z, BL, VR, HL and PCV contributed equally to conceptualisation, methodology, investigation, formal analysis, data curation, writing – original draft and writing – review & editing. All authors have read and approved the final manuscript.

Ethics Approval

All human subject procedures were approved by appropriate institutional and national ethical standards. Permission was sought from the community leaders of Khawrihnim to carry out the survey.

Informed Consent

All participants gave informed consent. Participation was voluntary and confidentiality was guaranteed.

Conflict of Interest

The authors declare no competing interests.

Data Availability

Data will be made available by the corresponding author upon request.

Use of Artificial Intelligence

The authors used Grammarly exclusively to enhance the grammar, spelling, punctuation, and readability of the manuscript. No artificial intelligence tools were employed to generate scientific content, analyze data, interpret results, or draw conclusions.

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