Ethnobotanical knowledge and utilization patterns of plant species in two districts of Jammu and Kashmir, India

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Research

Abstract

Background: Despite the rich floristic diversity of the Kashmir Himalaya, comprehensive information encompassing multiple categories of plant use remains limited. The present study aimed to document the floristic diversity, ethnobotanical uses, plant parts utilized, conservation status, and quantitative importance of useful plant species in the region.

Methods: Ethnobotanical surveys were conducted between 2018 and 2024 using open-ended semi-structured interviews with 75 respondents representing different age groups, genders, educational backgrounds, and occupations. Plant specimens were collected and identified following standard taxonomic procedures. Quantitative ethnobotanical analysis was performed using Frequency of Citation (FC) and Relative Frequency of Citation (RFC).

Results: Overall, seventy-seven medicinal plant species distributed in 40 families were found to be used by communities for treating over 67 diseases. The most commonly used medicinal plants included *Prunus africana* (12), *Hoslundia opposita* (11), *Bidens pilosa* (11), *Conyza sumatrensis* (9) and *Ageratum conyzoides* (9). The family of Asteraceae and Fabaceae made up most of the medicinal plant species used by the natives. The most used plant parts are the leaves, and boiling water is the main solvent used in the preparation of these herbal remedies, which are taken mainly orally.

Conclusions: The study highlights the rich ethnobotanical heritage of the Kashmir Himalaya and demonstrates the continued dependence of local communities on plant resources for healthcare and livelihood support.

Keywords: Kashmir Himalaya; Ethnobotany; Threatened species; Utilization pattern; Conservation

Background

Ethnobotany is defined as the scientific study of the relationships between people and plants, focusing on how human societies perceive, classify, and utilize plant resources in their daily lives (Banerjee 2024; Schunko *et al.* 2025). It represents an interdisciplinary field that integrates botany, anthropology, ecology, and traditional knowledge systems to understand the dynamic interactions between biological diversity and cultural practices. The scope of ethnobotany is broad and it encompasses the diverse utilization patterns of plant resources by local communities, including food and forage species, plants used in religious and cultural rituals, natural dyes, fiber-yielding plants, timber and construction materials, toxic and pesticidal species, and plants used for household and agricultural purposes (Siraj 2022). By capturing this wide spectrum of plant use, ethnobotany provides a holistic understanding of the role of plants in sustaining human societies and maintaining cultural heritage (Mishra & Kumar 2025). The need for ethnobotanical studies has become increasingly important in the context of rapid environmental change, biodiversity loss, and the erosion of traditional knowledge systems (Sharma *et al.* 2024a). Many plant species that are integral to local livelihoods are under pressure due to overexploitation, habitat degradation, and changing land-use patterns. Ethnobotanical research helps in documenting this indigenous knowledge before it is lost and also supports the identification of species with high conservation and economic value. Such studies provide essential baseline information for biodiversity conservation, sustainable utilization, and the development of community-based resource management strategies (Banerjee 2024; Schunko *et al.* 2025). However, the loss of traditional knowledge due to cultural assimilation, urbanization, and changing lifestyles among younger generations is accelerating the erosion of ethnobotanical knowledge systems. In addition, overharvesting of high-demand species, particularly medicinal plants, poses significant threats to natural populations (Hussain *et al.* 2024; Singh & Yadav 2024; Rana *et al.* 2026). Further, ethical concerns related to intellectual property rights and benefit-sharing with indigenous communities also remain critical issues (Radha *et al.* 2023; Ijinu *et al.* 2023). Thus, these challenges highlight the urgent need for systematic, ethically grounded, and conservation-oriented ethnobotanical studies.

The Indian Himalayan Region (IHR) is globally recognized as a biodiversity hotspot, characterized by exceptionally high plant diversity and a rich reservoir of traditional ecological knowledge (Mehta *et al.* 2023; Negi *et al.* 2026). The Kashmir Himalaya represents one of the most floristically diverse regions of the northwestern Himalaya, supporting a rich assemblage of medicinal, edible, fodder, and culturally significant plant species (Dar & Khuroo 2020). The pronounced variation in altitude, climate, and habitat types across the IHR has resulted in diverse vegetation patterns, which in turn sustain a wide range of ethnobotanical practices and plant-human interactions (Wani *et al.* 2022; Wani *et al*. 2023). The region is inhabited by diverse ethnic communities that have developed extensive traditional knowledge regarding plant utilization over generations. Despite this richness, most ethnobotanical studies conducted in the Kashmir Himalaya have largely focused on ethnomedicinal plant uses (Khan *et al.* 2004; Malik *et al.* 2011; Wani & Pant 2020; Khan *et al.* 2022; Mir *et al.* 2022; Khoja *et al.* 2022; Islam *et al.* 2023; Mir *et al.* 2024). In contrast, other dimensions of ethnobotanical knowledge, including the use of plants for food, fodder, fuelwood, timber, ritualistic purposes, fibres, dyes, and various material applications, have received relatively limited scientific attention. This narrow focus has resulted in an incomplete understanding of the broad spectrum of plant use diversity and the multifunctional role of plant resources in supporting rural livelihoods and cultural practices in the region. To address this knowledge gap, the present study provides a comprehensive documentation of the floristic diversity and ethnobotanical knowledge of the Kashmir Himalaya, encompassing the diversity of plant uses, plant parts utilized, and the conservation status of useful plant species. The findings are expected to contribute to biodiversity conservation, sustainable resource management, and the preservation of traditional knowledge in the region.

Materials and Methods

Study area

The Union Territory of Jammu and Kashmir is situated in the northwestern part of the Indian Himalayan Region (IHR) and is characterized by remarkable physiographic, climatic, and ecological diversity (Fig. 1). The region encompasses a wide range of landscapes, extending from subtropical foothills to alpine meadows, with elevations ranging from approximately 300 m to over 5,400 m above sea level. This pronounced altitudinal variation has resulted in diverse vegetation types and exceptionally high biological diversity, making Jammu and Kashmir one of the most important floristic regions of the Himalaya (Haq *et al.* 2020). The region also supports several indigenous and rural communities, whose livelihoods are closely associated with natural resources, particularly wild plant species used for food, medicine, fodder, fuelwood, and other household requirements. The Kashmir Himalaya, forming the central part of the Union Territory, lies between the Pir Panjal Range in the southwest and the Greater Himalayan Range in the northeast. It comprises the Kashmir Valley and its surrounding mountain systems and is recognized as one of the richest centres of plant diversity in the northwestern Himalaya. The region experiences a temperate climate with four distinct seasons and receives precipitation in the form of both rainfall and snowfall (Shafiq *et al.* 2019; Hamid & Samantaray 2025). Variations in altitude, topography, soil characteristics, and climatic conditions have created a mosaic of habitats, including temperate broad-leaved forests, coniferous forests, subalpine forests, scrublands, alpine meadows, wetlands, and grasslands (Wani & Pant 2023). These diverse ecosystems support a rich flora, including numerous endemics, medicinal, aromatic, edible, and threatened plant species (Dar & Khuroo 2013).

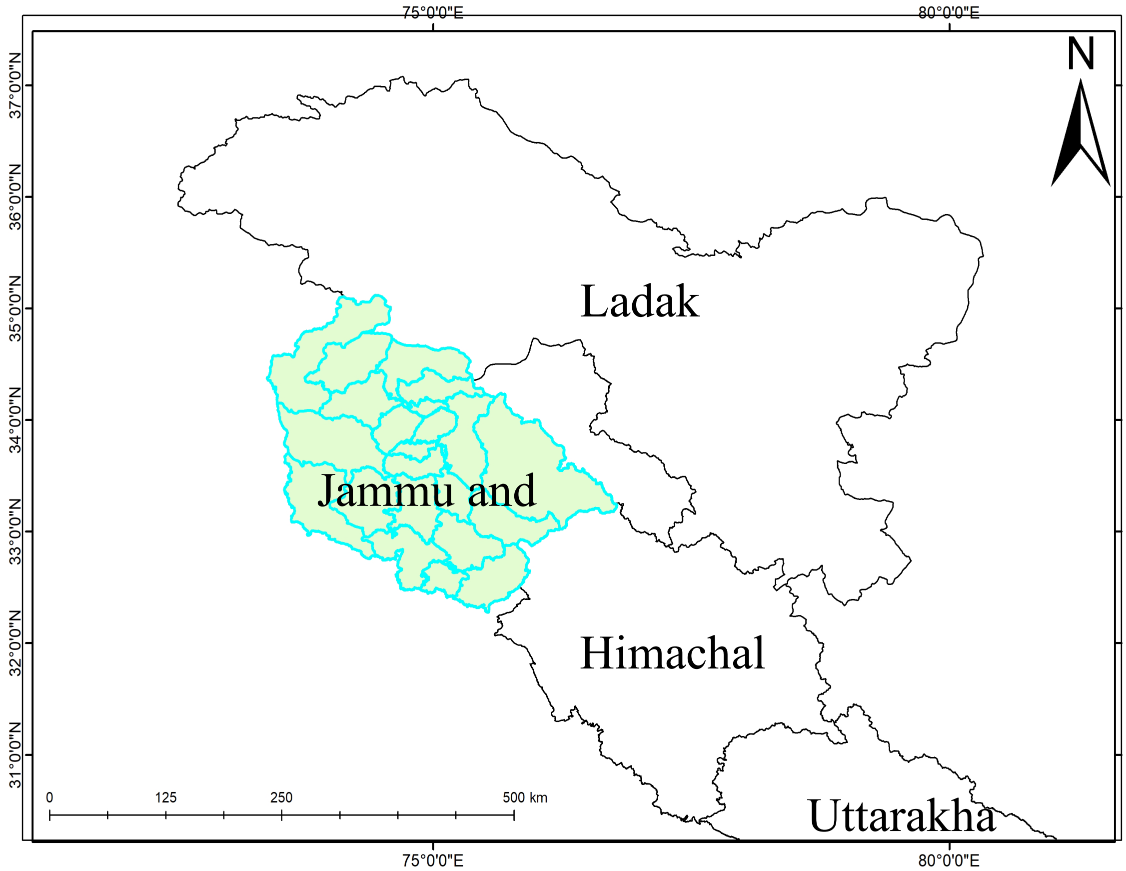

Figure 1. Map showing the location of the study area

Data collection and analysis

Extensive field surveys were conducted between 2018 and 2024 across the Shopian and Budgam districts of the Kashmir Himalaya to document the diversity and traditional utilization of ethnobotanically important plant species. During these surveys, plant specimens were collected, photographed, and relevant field observations were systematically recorded. Ethnobotanical information was obtained from 75 respondents selected through a convenience sampling approach based on their accessibility and willingness to participate. The study was conducted in accordance with the ethical principles for research involving human participants and the ethical guidelines of the International Society of Ethnobiology (ISE) Code of Ethics. Prior to the interviews and discussions, the objectives of the study were clearly explained to all participants, and oral informed consent was obtained from each participating informant. Participation was entirely voluntary, and participants were informed of their right to decline or withdraw from the study at any stage without any consequences. The respondents represented both males and females, belonging to different age groups, educational backgrounds, and occupations to capture a broad range of traditional knowledge. Ethnobotanical information was gathered through open-ended semi-structured interviews, which provided a flexible framework for documenting indigenous knowledge while ensuring that comparable information was collected from all participants. The questionnaires were originally developed in English and were orally translated into the local language when required. The interviews focused on the local uses of plant species, the plant parts utilized, and their different ethnobotanical applications. Collected plant specimens were processed following standard herbarium techniques, including pressing, drying, mounting, and preservation, in accordance with the procedures described by Jain and Rao (1976). Species identification was carried out using standard taxonomic literature, and the accepted scientific names and nomenclature were verified using the Plants of the World Online (POWO) database. The conservation status of each species was determined using the International Union for Conservation of Nature (IUCN) Red List categories, including Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Least Concern (LC), and Data Deficient (DD). Species not evaluated in the IUCN database were categorized as Not Evaluated (NE).

Quantitative ethnobotanical analysis

To evaluate the relative importance of the recorded plant species, Frequency of Citation (FC) and Relative Frequency of Citation (RFC) were calculated following standard ethnobotanical approaches (Hoffman & Gallaher 2007; Lawal *et al.* 2022; Ralte *et al.* 2024). FC represents the number of respondents who mentioned a particular plant species during the interviews, irrespective of the number of uses reported. RFC was used to determine the frequency with which each species was cited by the respondents and was calculated using the following equation:

$$RFC = FC/N$$

where RFC is relative frequency of citation, FC is the frequency of citation of a given species and N is the total number of respondents interviewed. The RFC values range from 0 to 1, with higher values indicating that a greater proportion of respondents recognized or reported the use of a particular plant species.

Results

Socio-demographic characteristics of respondents

A total of 75 respondents participated in the ethnobotanical survey, comprising 43 males (57.3%) and 32 females (42.7%). The respondents represented a wide age range, with 32 individuals (42.7%) aged above 60 years, followed by 21 (28.0%) in the 41-60 years age group and 18 (24.0%) in the 20-40 years category. The remaining 4 respondents (5.3%) were below 20 years of age. The respondents exhibited diverse educational backgrounds. Thirty-four respondents (45.3%) were illiterate, 18 (24.0%) had completed higher secondary education (intermediate), 14 (18.7%) were having education up to college level (graduate), and the remaining 9 (12.0%) had education up to below secondary level. Farming was the predominant occupation, accounting for 41 respondents (54.7%). This was followed by business (n = 16; 21.3%) and government employment (n = 12; 16.0%). The remaining 6 respondents (8.0%) were engaged in other occupations, including daily wage labour, carpentry, barbering, and other local trades (Table 1).

Table 1. Socio-demographic profile of the respondents interviewed during the ethnobotanical survey in the Shopian and Budgam districts of Jammu and Kashmir, India

Variable	Category	Respondents (n)	Percentage (%)
Gender	Male	43	57.3
	Female	32	42.7
Age group (years)	<20	4	5.3
	20-40 years	18	24.0
	41-60 years	21	28.0
	>60	32	42.7
Education Level	Illiterate	34	45.3
	Below secondary	9	12.0
	Higher secondary	18	24.0
	College level	14	18.7
Occupation	Farming	41	54.7
	Business	16	21.3
	Government employment	12	16.0
	Others	6	8.0

Diversity of plant resources

A total of 90 plant species, representing 79 genera and 45 families, were recorded from the study area (Table 2). Asteraceae was the most species-rich family (n = 10 species), followed by Lamiaceae (n = 8). Fabaceae, Rosaceae, and Salicaceae were equally represented by 5 species each. Other relatively important families included Amaranthaceae, Solanaceae, Plantaginaceae and Malvaceae (n = 3 species each), while nine families were represented by two species and 27 families were represented by single species. The most species-rich genus was *Populus* (n = 3 species) followed by several genera represented by two species each, including *Prunus*, *Salix*, *Plantago*, *Amaranthus*, *Helianthus*, *Morus*, *Malva*, *Hedera*, and *Trifolium*. Lifeform of the documented plants was dominated by herbs (67.78%), followed by trees (20%), shrubs (7.78%), and climbers (4.44%) (Fig. 2). Based on IUCN Red List categories, the majority of species were classified as Not Evaluated (NE; n = 43) followed by Least Concern (LC; n = 37), Endangered (EN; n = 4) and Vulnerable (VU; n = 3), Data Deficient (DD; n = 2) and species Critically Endangered (CR; n = 1) (Fig. 3). The threatened species includes *Aconitum heterophyllum*, *Angelica glauca*, *Dolomiaea costus*, *Fritillaria cirrhosa*, *Picrorhiza kurroa*, *Podophyllum hexandrum*, *Trillium govanianum* and *Ulmus wallichiana*.

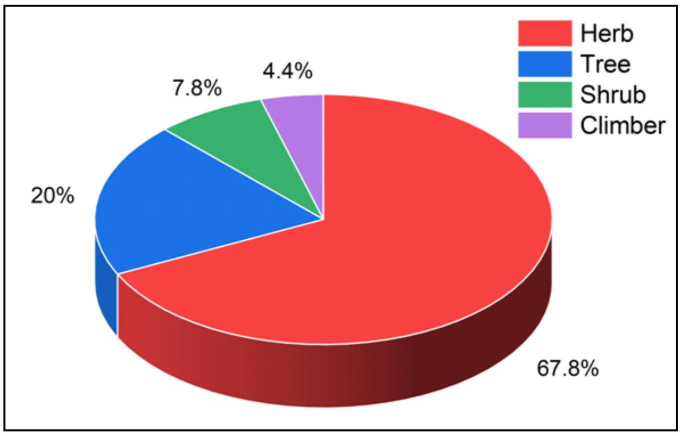

Figure 2. Habit of the plant species documented from two districts of Jammu and Kashmir, India

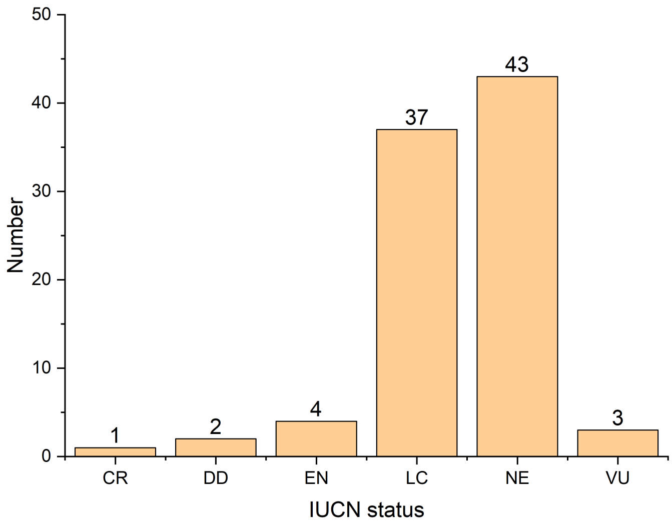

Figure 3. Conservation status of the plant species documented from two districts of Jammu and Kashmir, India

Utilization pattern of plant resources

Regarding plant parts used, leaves were the most frequently utilized plant part (n = 38 species), followed by undergrounds parts including roots, rhizomes and tubers (n = 21) and aerial parts (n = 14). Other plant parts included whole plant (n = 12), fruits and seeds (n = 16), wood/stem (n = 11), and flowers (n = 2) (Fig. 4). Medicinal use of the plants was dominant (n = 49 species), followed by edible (n = 22), fodder (n = 18), ornamental (n = 13), fuelwood (n = 6) and timber (n = 5) uses (Fig. 5). Ethnoveterinary uses (n = 4), beverages (n = 3), fencing (n = 2), and religious uses (n = 1) were also recorded. Out of the total flora, 23 species were multipurpose, while as rest of the species were used for a single purpose only. A total of 8 threatened species (EN, VU, and CR categories combined) were recorded. All threatened species were used for medicinal purposes, with additional uses including edible (n = 2), fodder (n = 1), fuelwood (n = 1), and ornamental (n = 1). In threatened taxa, underground parts including roots, rhizomes and tubers were the most frequently used plant parts (n = 4 species), followed by leaves/aerial parts (n = 3), fruits (n = 2), wood (n = 1), and both bulb and seeds (n = 1 each) (Fig. 6).

Quantitative ethnobotanical indices

Frequency of Citation (FC)

The Frequency of Citation (FC) of the recorded plant species ranged from 4 to 72 (Table 2). The highest FC was recorded for *Taraxacum sect. Taraxacum* (FC = 72), followed by *Dolomiaea costus* (FC = 69), *Calendula officinalis* (FC = 61), *Robinia pseudoacacia* (FC = 57), *Angelica glauca* (FC = 55), and *Canna indica* (FC = 54). Other frequently cited species included *Morus alba* (FC = 53), *Mentha spicata*, *Populus alba*, *Salix disperma*, and *Ulmus wallichiana* (FC = 51 each), followed by *Aconitum heterophyllum* (FC = 48), *Poa annua* and *Rheum webbianum* (FC = 47 each), and *Coriandrum sativum* and *Juglans regia* (FC = 46 each). The lowest FC was recorded for *Cannabis sativa* (FC = 4), followed by *Bistorta amplexicaulis*, *Datura stramonium*, and *Phytolacca acinosa* (FC = 9 each), while *Arctium lappa* and *Hypericum perforatum* were cited by 11 respondents each.

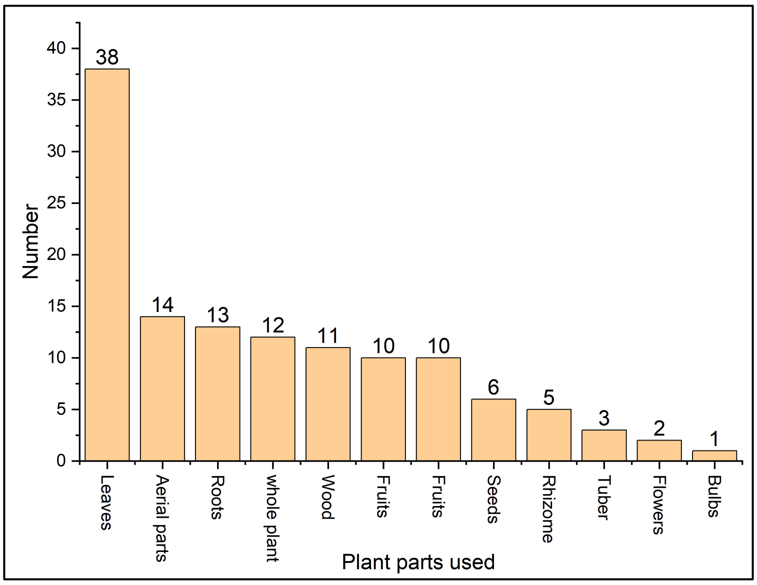

Figure 4. Utilization pattern of the different plant parts for various ethnobotanical purposes in Jammu and Kashmir, India

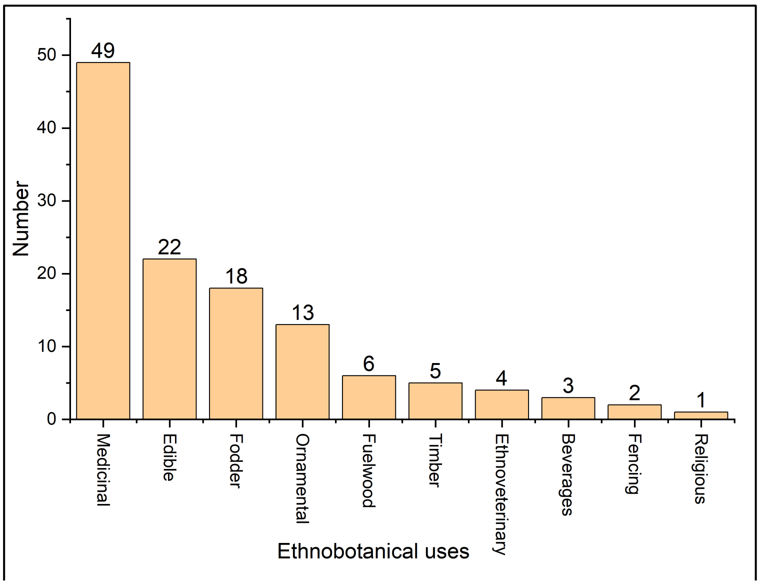

Figure 5. Ethnobotanical uses of the plant species documented from two districts of Jammu and Kashmir, India

Relative Frequency of Citation (RFC)

The Relative Frequency of Citation (RFC) values ranged from 0.05 to 0.96 (Table 2). The highest RFC was recorded for *Taraxacum sect. Taraxacum* (RFC = 0.96), followed by *Dolomiaea costus* (RFC = 0.92), *Calendula officinalis* (RFC = 0.81), *Robinia pseudoacacia* (RFC = 0.76), *Angelica glauca* (RFC = 0.73), and *Canna indica* (RFC = 0.72). High RFC values were also observed for *Morus alba* (RFC = 0.71), *Mentha spicata*, *Populus alba*, *Salix disperma*, and *Ulmus wallichiana* (RFC = 0.68 each), followed by *Aconitum heterophyllum* (RFC = 0.64), *Poa annua* and *Rheum webbianum* (RFC = 0.63 each), and *Coriandrum sativum* and *Juglans regia* (RFC = 0.61 each). The lowest RFC was recorded for Cannabis sativa (RFC = 0.05), followed by *Bistorta amplexicaulis*, *Datura stramonium*, and *Phytolacca acinosa* (RFC = 0.12 each), while *Arctium lappa* and *Hypericum perforatum* exhibited an RFC of 0.15.

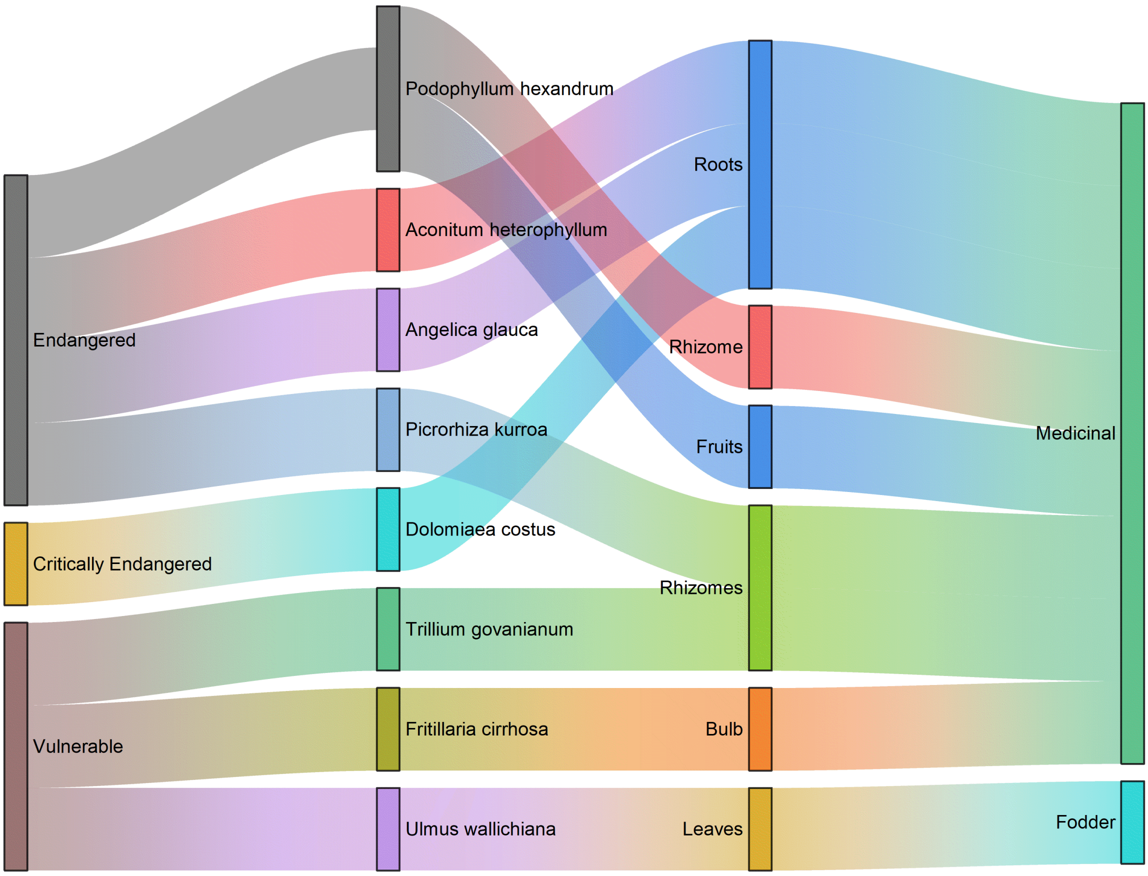

Figure 6. Sankey diagram showing the relation between the threatened species, their uses and parts used

Discussion

The present study documented a rich ethnobotanical flora comprising 90 plant species belonging to 79 genera and 45 families, reflecting the considerable ecological heterogeneity of the study area. Comparable levels of ethnobotanical plant diversity have been reported from other parts of the Kashmir Himalaya (Singh *et al.* 2016; Jeelani *et al.* 2013; Bhat *et al.* 2021; Haq *et al.* 2023; Gillani *et al.* 2024; Mir *et al.* 2024) as well as from other regions of the Himalaya (Kumar *et al.* 2011; Abbasi *et al.* 2013; Singh *et al.* 2014; Sharma *et al.* 2024b). The high diversity of useful plant species in the Himalayan region is largely attributed to its broad altitudinal gradients, heterogeneous habitats, and varied climatic conditions, which create a wide range of ecological niches and support diverse plant communities (Das *et al.* 2020). The dominance of Asteraceae and Lamiaceae Fabaceae and Rosaceae is consistent with their cosmopolitan distribution and ecological adaptability. The families have been reported to be dominant in the Himalayan region by other studies also (Rai & Moktan 2022; Haq *et al.* 2024; Thapliyal *et al.* 2024). The dominance of families such as Asteraceae, Lamiaceae, Fabaceae, and Rosaceae may be attributed to their broad geographic distribution, high species richness, and well-established ethnobotanical importance. These families are recognized globally for their medicinal value, with Asteraceae and Lamiaceae being particularly rich in essential oils and bioactive compounds that underpin their widespread use in traditional medicine (Shaheen *et al.* 2017). Similarly, Rosaceae is characterized by a high abundance of phenolic compounds, which possess strong antioxidant properties and contribute to both its medicinal and nutritional significance (Miller & Ruiz-Larrea 2002; Hameed *et al.* 2022; Razola-Díaz *et al.* 2024).

Table 2. List of the plant species documented during the ethnobotanical surveys in two districts of Jammu and Kashmir, India (LC = Least Concern; NE = Not Evaluated; DD; Data Deficient; VU = Vulnerable; EN = Endangered; CR = Critically Endangered)

Species	Voucher No.	Family	Habit	IUCN status	Part(s) used	Uses	FC	RFC
Abutilon indicum (L.) Sweet	CBS_S053	Malvaceae	Herb	LC	Roots; Leaves; Seeds	Medicinal	21	0.28
Acer caesium Wall. ex Brandis	CBS_S081	Sapindaceae	Tree	LC	Leaves	Fodder	17	0.23
Achillea millefolium L.	CBS_S010	Asteraceae	Herb	NE	Leaves	Medicinal	32	0.43
Aconitum heterophyllum Wall. ex Royle	CBS_S070	Ranunculaceae	Herb	EN	Roots	Medicinal	48	0.64
Acorus calamus L.	CBS_S001	Acoraceae	Herb	NE	Rhizomes	Medicinal; Ornamental	38	0.51
Aesculus indica (Wall. ex Cambess.) Hook.	CBS_S082	Sapindaceae	Tree	LC	Leaves	Fodder	37	0.49
Ajuga integrifolia Buch.-Ham. ex D.Don	CBS_S044	Lamiaceae	Herb	NE	Roots	Medicinal	12	0.16
Amaranthus retroflexus L.	CBS_S002	Amaranthaceae	Herb	NE	Leaves	Medicinal; Edible	41	0.55
Amaranthus spinosus L.	CBS_S003	Amaranthaceae	Herb	NE	Aerial parts	Ethnoveterinary	28	0.37
Angelica glauca Edgew.	CBS_S005	Apiaceae	Herb	EN	Roots	Medicinal	55	0.73
Arctium lappa L.	CBS_S011	Asteraceae	Herb	NE	Roots	Medicinal	11	0.15
Arisaema jacquemontii Blume	CBS_S007	Araceae	Herb	LC	Tubers	Medicinal	32	0.43
Artemisia absinthium L.	CBS_S012	Asteraceae	Herb	NE	Leaves	Medicinal	32	0.43
Berberis lycium Royle	CBS_S020	Berberidaceae	Shrub	LC	Roots; Fruits	Medicinal; Edible	33	0.44
Bergenia ciliata (Haw.) Sternb.	CBS_S083	Saxifragaceae	Herb	LC	Leaves	Medicinal; Ethnoveterinary	19	0.25
Betula utilis D.Don	CBS_S022	Betulaceae	Tree	LC	Leaves; Wood	Fodder; Fuelwood	34	0.45
Bistorta amplexicaulis (D.Don) Greene	CBS_S066	Polygonaceae	Herb	NE	Rhizome	Beverages	9	0.12
Calendula officinalis L.	CBS_S013	Asteraceae	Herb	NE	Whole plant	Ornamental	61	0.81
Canna indica L.	CBS_S028	Cannaceae	Herb	NE	Whole plant	Ornamental	54	0.72
Cannabis sativa L.	CBS_S026	Cannabaceae	Herb	NE	Leaves	Ethnoveterinary	4	0.05
Capsella bursa-pastoris (L.) Medik.	CBS_S024	Brassicaceae	Herb	NE	Roots; Leaves	Medicinal; Edible	25	0.33
Celosia argentea L.	CBS_S004	Amaranthaceae	Herb	LC	Whole plant	Ornamental	35	0.47
Celtis australis L.	CBS_S027	Cannabaceae	Tree	LC	Leaves	Fodder	21	0.28
Cichorium intybus L.	CBS_S014	Asteraceae	Herb	NE	Roots; Leaves	Medicinal; Edible	22	0.29
Coriandrum sativum L.	CBS_S006	Apiaceae	Herb	NE	Leaves	Ethnoveterinary	46	0.61
Corylus jacquemontii Decne.	CBS_S023	Betulaceae	Tree	DD	Seeds	Edible	13	0.17
Crataegus songarica K.Koch	CBS_S071	Rosaceae	Shrub	LC	Leaves	Fodder	17	0.23
Cuscuta reflexa Roxb.	CBS_S030	Convolvulaceae	Climber	LC	Whole plant	Medicinal	23	0.31
Datura stramonium L.	CBS_S085	Solanaceae	Herb	LC	Seeds	Medicinal	9	0.12
Dioscorea deltoidea Wall. *ex Griseb.*	CBS_S032	Dioscoreaceae	Climber	DD	Tubers	Edible	21	0.28

Dipsacus inermis Wall.	CBS_S029	Caprifoliaceae	Herb	NE	Leaves	Edible; Fodder	41	0.55
Dolomiaea costus (Falc.) Kasana & A.K.Pandey	CBS_S015	Asteraceae	Herb	CR	Roots	Medicinal	69	0.92
Euphorbia helioscopia L.	CBS_S034	Euphorbiaceae	Herb	NE	Aerial parts	Medicinal	14	0.19
Fragaria nubicola (Lindl. ex Hook.f.) Lacaita	CBS_S072	Rosaceae	Herb	NE	Fruits	Edible	34	0.45
Fritillaria cirrhosa D.Don	CBS_S052	Liliaceae	Herb	VU	Bulb	Medicinal	41	0.55
Geranium wallichianum D.Don ex Sweet	CBS_S040	Geraniaceae	Herb	LC	Aerial parts	Medicinal	18	0.24
Hedera helix L.	CBS_S008	Araliaceae	Climber	LC	Whole plant	Ornamental	21	0.28
Hedera nepalensis K.Koch	CBS_S009	Araliaceae	Climber	LC	Whole plant	Ornamental	26	0.35
Helianthus annuus L.	CBS_S016	Asteraceae	Herb	NE	Whole plant	Ornamental	31	0.41
Helianthus tuberosus L.	CBS_S017	Asteraceae	Herb	NE	Tubers	Medicinal; Edible	15	0.20
Hyoscyamus niger L.	CBS_S086	Solanaceae	Herb	LC	Leaves; Seeds	Medicinal	33	0.44
Hypericum perforatum L.	CBS_S042	Hypericaceae	Herb	LC	Aerial parts	Medicinal; Fodder	11	0.15
Juglans regia L.	CBS_S043	Juglandaceae	Tree	LC	Wood; Leaves; Fruits	Timber; Medicinal; Edible	46	0.61
Lamium album L.	CBS_S045	Lamiaceae	Herb	NE	Roots; Leaves	Medicinal	23	0.31
Lysimachia arvensis (L.) U.Manns & Anderb.	CBS_S069	Primulaceae	Herb	NE	Leaves	Medicinal	15	0.20
Malva cachemiriana (Cambess.) Alef.	CBS_S054	Malvaceae	Herb	NE	Flowers; Whole plant	Medicinal; Ornamental	15	0.20
Malva neglecta Wall.	CBS_S055	Malvaceae	Herb	LC	Leaves	Edible	31	0.41
Marrubium vulgare L.	CBS_S046	Lamiaceae	Herb	LC	Aerial parts	Medicinal	12	0.16
Medicago polymorpha L.	CBS_S035	Fabaceae	Herb	NE	Aerial parts	Medicinal; Fodder	36	0.48
Mentha spicata L.	CBS_S047	Lamiaceae	Herb	NE	Leaves	Beverages; Edible	51	0.68
Morus alba L.	CBS_S057	Moraceae	Tree	LC	Leaves; Fruits; Wood	Fodder; Edible; Ornamental; Fencing	53	0.71
Morus nigra L.	CBS_S058	Moraceae	Tree	LC	Leaves; Fruits; Wood	Fodder; Edible; Ornamental; Fencing	45	0.60
Nasturtium officinale W.T.Aiton	CBS_S025	Brassicaceae	Herb	LC	Leaves	Medicinal	18	0.24
Nepeta cataria L.	CBS_S048	Lamiaceae	Herb	NE	Aerial parts	Medicinal	13	0.17
Origanum vulgare L.	CBS_S049	Lamiaceae	Herb	LC	Aerial parts	Medicinal	12	0.16
Papaver somniferum L.	CBS_S059	Papaveraceae	Herb	NE	Seeds; Aerial parts	Medicinal; Edible; Fodder	12	0.16
Parrotiopsis jacquemontiana (Decne.) Rehder	CBS_S041	Hamamelidaceae	Shrub	LC	Wood	Fuelwood	21	0.28
Phytolacca acinosa Roxb.	CBS_S060	Phytolaccaceae	Herb	LC	Roots	Medicinal	9	0.12
Picrorhiza kurroa Royle	CBS_S061	Plantaginaceae	Herb	EN	Rhizomes	Medicinal	26	0.35
Plantago lanceolata L.	CBS_S062	Plantaginaceae	Herb	NE	Leaves	Medicinal	15	0.20

Plantago major L.	CBS_S063	Plantaginaceae	Herb	LC	Leaves	Medicinal	16	0.21
Platanus orientalis L.	CBS_S064	Platanaceae	Tree	LC	Wood; Whole plant	Timber; Fuelwood; Religious	39	0.52
Poa annua L.	CBS_S065	Poaceae	Herb	LC	Aerial parts	Fodder	47	0.63
Podophyllum hexandrum Royle	CBS_S021	Berberidaceae	Herb	EN	Rhizome; Fruits	Medicinal	38	0.51
Populus alba L.	CBS_S076	Salicaceae	Tree	NE	Wood	Timber	51	0.68
Populus deltoides W.Bartram ex Marshall	CBS_S077	Salicaceae	Tree	NE	Wood	Timber	41	0.55
Populus nigra L.	CBS_S078	Salicaceae	Tree	NE	Wood	Timber	34	0.45
Portulaca oleracea L.	CBS_S068	Portulacaceae	Herb	LC	Leaves	Edible	36	0.48
Prunella vulgaris L.	CBS_S050	Lamiaceae	Herb	LC	Aerial parts	Medicinal	32	0.43
Prunus armeniaca L.	CBS_S073	Rosaceae	Tree	NE	Wood; Leaves; Fruits; Seeds	Fuelwood; Fodder; Edible; Medicinal	41	0.55
Prunus cerasoides Buch.-Ham. ex D.Don	CBS_S074	Rosaceae	Tree	LC	Wood	Fuelwood	18	0.24
Rheum webbianum Royle	CBS_S067	Polygonaceae	Herb	NE	Roots; Leaves	Medicinal; Edible	47	0.63
Rhododendron campanulatum D.Don	CBS_S033	Ericaceae	Shrub	NE	Leaves	Beverages	12	0.16
Robinia pseudoacacia L.	CBS_S036	Fabaceae	Tree	LC	Wood; Leaves	Fuelwood; Fodder	57	0.76
Rubus ellipticus Sm.	CBS_S075	Rosaceae	Shrub	LC	Fruits	Edible	21	0.28
Salix alba L.	CBS_S079	Salicaceae	Tree	NE	Leaves; Wood	Fodder; Fuelwood	44	0.59
Salix disperma Roxb. ex D.Don	CBS_S080	Salicaceae	Tree	NE	Whole plant	Ornamental	51	0.68
Solanum nigrum L.	CBS_S087	Solanaceae	Herb	LC	Leaves; Fruits	Medicinal	23	0.31
Tagetes erecta L.	CBS_S018	Asteraceae	Herb	NE	Whole plant	Ornamental	31	0.41
Taraxacum sect. Taraxacum F.H.Wigg.	CBS_S019	Asteraceae	Herb	NE	Leaves	Medicinal; Edible	72	0.96
Thuja occidentalis L.	CBS_S031	Cupressaceae	Shrub	LC	Whole plant	Ornamental	23	0.31
Thymus linearis Benth.	CBS_S051	Lamiaceae	Herb	NE	Leaves; Flowers	Medicinal	12	0.16
Trifolium pratense L.	CBS_S037	Fabaceae	Herb	NE	Aerial parts	Fodder	39	0.52
Trifolium repens L.	CBS_S038	Fabaceae	Herb	NE	Aerial parts	Fodder	43	0.57
Trigonella foenum-graecum L.	CBS_S039	Fabaceae	Herb	NE	Leaves	Medicinal; Edible	39	0.52
Trillium govanianum Wall. ex D.Don	CBS_S056	Melanthiaceae	Herb	VU	Rhizomes	Medicinal	41	0.55
Ulmus wallichiana Planch.	CBS_S088	Ulmaceae	Tree	VU	Leaves	Fodder	51	0.68
Urtica dioica L.	CBS_S089	Urticaceae	Herb	LC	Leaves; Roots	Medicinal	31	0.41
Verbascum thapsus L.	CBS_S084	Scrophulariaceae	Herb	NE	Aerial parts	Medicinal	18	0.24
Viburnum grandiflorum Wall. ex DC.	CBS_S090	Viburnaceae	Shrub	NE	Fruits	Medicinal; Edible	27	0.36

The predominance of herbs observed in the present study is consistent with findings from numerous ethnobotanical investigations conducted across the globe. Herbaceous species commonly dominate Himalayan and montane ecosystems due to their adaptability to short growing seasons, diverse microhabitats, and frequent natural or anthropogenic disturbances that favor fast-growing life forms (Chondol *et al.* 2023). Their abundance is further enhanced by their easy accessibility and the ease with which their soft tissues can be processed and prepared for various traditional uses (Wani *et al.* 2021). The predominance of leaves as the most frequently utilized plant part may be attributed to their high concentrations of bioactive secondary metabolites, including alkaloids, flavonoids, terpenoids, and phenolic compounds, which contribute to their therapeutic properties (Roy *et al.* 2022; Twaij & Hasan 2022; Monib *et al.* 2024). Similar patterns of leaf use have been documented in numerous ethnobotanical studies (Ishtiaq *et al.* 2024; Ullah *et al.* 2024; Kalita *et al.* 2024; Misganaw *et al.* 2025). In addition, harvesting leaves is generally considered less destructive than collecting underground or woody plant parts, as moderate leaf harvesting typically allows plants to survive and regenerate, thereby promoting more sustainable utilization. Underground plant parts including roots, rhizomes and tubers were also frequently utilized plant parts, likely because they contain high concentrations of pharmacologically active phytochemicals (Asif *et al.* 2021). However, the extraction of underground plant parts is inherently destructive and can adversely affect plant survival, regeneration, and long-term population persistence, particularly in slow-growing species. Consistent with this concern, the present study revealed that the underground parts (roots, rhizomes, or bulbs) of most threatened species were harvested for ethnobotanical purposes. Such destructive harvesting practices are likely to have contributed to the population decline of these species and underscore the need for sustainable harvesting practices and targeted conservation interventions.

Medicinal use emerged as the dominant utilization category, followed by edible and fodder uses, indicating a strong dependency of local communities on plant resources for primary healthcare and subsistence needs. The presence of multipurpose species further underscores the multifunctional role of native flora in supporting livelihoods, especially in rural and montane systems where alternative resources are limited. Importantly, all threatened species were recorded to have medicinal value, suggesting a direct link between ethnobotanical importance and conservation status. The frequent use of roots and rhizomes in these taxa highlights an additional layer of vulnerability, as harvesting of subterranean parts can severely impact regeneration and long-term population viability (Sharma & Kala 2022). This dual pressure of biological threat status and utilization intensity emphasizes the need for targeted conservation and sustainable harvesting strategies. The FC and RFC analyses provide valuable insights into the prominence and recognition of useful plant species among local communities. Species with high FC and RFC values are generally those that are widely recognized and frequently utilized, reflecting their importance in fulfilling the daily needs of local people. Such species often possess multiple ethnobotanical applications, are readily accessible, or have long-standing cultural significance, resulting in their widespread citation by respondents. The high citation frequencies of these plants may be attributed to their broad utility, ease of recognition, and continued reliance by local communities. In contrast, species with low FC and RFC values were mentioned by comparatively fewer respondents. Lower citation frequencies may reflect restricted distribution, lower utilization, reduced accessibility, specialized applications, or a gradual decline in traditional knowledge associated with these species (Arshad *et al.* 2022; Jabeen *et al.* 2024). In some cases, the limited citation of certain taxa like *Cannabis sativa* may also be related to legal restrictions, or reduced dependence on particular plant resources owing to changing socioeconomic conditions. The observed variation in FC and RFC values demonstrates differences in the level of familiarity and utilization of plant species among the respondents (Srinivasan *et al.* 2022).

Conclusion

The present study provides a comprehensive documentation of the ethnobotanical diversity of the Kashmir Himalaya, recording 90 useful plant species belonging to 79 genera and 45 families. The findings demonstrate that local communities continue to maintain a strong dependence on plant resources for healthcare, food, fodder, fuelwood, timber, ornamental purposes, and other livelihood needs. The predominance of medicinally important and multipurpose species highlights the multifunctional role of native flora in supporting the socioeconomic well-being of rural communities. The study also revealed that several threatened species remain under continuous utilization, particularly for medicinal purposes, with roots and rhizomes being the most frequently harvested plant parts. Such harvesting practices may adversely affect the regeneration and long-term persistence of natural populations, emphasizing the need for conservation-oriented management. Furthermore, the high citation frequency of several species reflects their widespread recognition and continued importance in the traditional knowledge system of the region. Overall, the study establishes a valuable baseline for understanding the diversity, utilization patterns, and conservation status of ethnobotanically important plants in the Kashmir Himalaya. The documented information can support future biodiversity conservation, sustainable harvesting programmes, and community-based resource management while contributing to the preservation of indigenous knowledge. Future studies should focus on the phytochemical and pharmacological validation of highly cited species, long-term monitoring of threatened taxa, and the development of cultivation and domestication strategies to reduce harvesting pressure on wild populations.

Declarations

List of abbreviations: FC - Frequency of Citations; RFC - Relative Frequency of Citations; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LC = Least Concern; DD - Data Deficient; NE = Not Evaluated

Ethics approval and consent to participate: The study was conducted in accordance with the ethical principles for research involving human participants and the ethical guidelines of the International Society of Ethnobiology (ISE) Code of Ethics. Prior to the interviews and discussions, the objectives of the study were clearly explained to all participants, and oral informed consent was obtained from each participating informant. Participation was entirely voluntary, and participants were informed of their right to decline or withdraw from the study at any stage without any consequences.

Consent for publication: All authors have read and approved the manuscript and agreed to its submission for publication.

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