Ethnobiological Uses of Plant Species among the three Ethnic Communities in the Administrative District (Kupwara) of Jammu and Kashmir-India: A cross-cultural Analysis

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Abstract

Introduction: In the valley of Kashmir-India, use of flora is not only prioritized over fauna species to get against health disorders but plays a vital role in the cultural aspects. The uses of herbs, particularly those that have a scientific basis as remedy of minor illnesses are progressively appreciated across the modern world.

Methods: The present study was conducted from March 2019 to August 2021 for the collection of medicinally important plants and related traditional knowledge in the frontier administrative district (Kupwara) of Kashmir-India. A simple stratified sampling using semi structured interviews followed by group discussions was employed to achieve the goal.

Results: A total of 53 plant species belonging to 36 families, with Asteraceae as the dominant family (11%) were recorded. The most dominant life form used in the treatment of various ailments were herbs with 42 species (79%), followed by trees (6 species, 11%), shrubs (3, 6%), ferns and fungi (1 species each). Roots were most frequently used (39%), followed by leaves (21%), tuber, stem latex, whole plant (5% each), wood, fruits (3% each), fruit, bark, seed, fruiting body, twig and whole frond (2% each). The ICF (Informant Consensus Factor) values ranged from 0.95 to 0.98, and the highest ICF was recorded for gastrointestinal disorders, liver diseases, bone and joint disorders, dental diseases and kidney problems (0.98 each), while as the lowest values of ICF were recorded for ethno-veterinary diseases (0.95). Gastro-intestinal disorders were treated with most species (22%). Highest Use Value (UV) was recorded for *Artemisia absinthium* while lowest values of UV were recorded for *Eryngium billardieri.* A cross-cultural comparison of plant resources shows that 41 plants were commonly used by all ethnic groups. Upon the similarity of usage, Gujjars and Bakarwals (26%) showed greater similarity, whereas the least overlap was observed between Kashmiri and Bakarwal (9%). Cluster analysis yielded two primary clusters, cluster first included the plant species with medicinal (Med) attributions and Cluster 2 comprised the species with a variety of attributions like food, fodder, spice, black magic (bla-mag); herbal tea (her-tea) and fuel wood (fue-wod)**.** The highest FUV (Family Use Value) was reported for Pinaceae (0.49) followed by Asteraceae (0.47) and Polygonaceae (0.46). The results in

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this study have listed some of the medicinal plants like, *Rhodiola fastigiata, Lilium polyphyllum, Betula utilis* and *Anagallis arvensis* reported for the first time with traditional usage.

Conclusion: The present study reveals the importance of the plants across the frontier administrative district (Kupwara) of Kashmir- India. The use of local plants for medicinal purposes and other traditional uses are being practiced from generations; in this regard species with high UV can be bio-profiled for the possible elucidation of some novel molecule with potent medicinal attribution.

Keywords: Plants, medicinal, Use Value, cross-culture

Background

Humans have been utilizing therapeutic plants since ancient times and there has been documentation of their uses for a long time (Singh *et al* 2020). Traditional medicine is considered as the total knowledge, human abilities and cultural practices of a community based on their beliefs, experience and theories, employed for the treatment or enhancement of both physical as well as mental health (WHO 2002; Haq *et al.,* 2022). Developed countries often have better access to modern medicines, numerous cases allopathic medicines are derived from molecules of natural origin (plant or animal) (Haq *et al.*, 2020; Haq *et al.,* 2021). In spite of this, the developed world progressively appreciates the direct use of herbs, combined with advanced medical treatments, particularly those herbs that have a scientific basis as remedy of minor illnesses (Petrovska, B.B. 2012). Developing countries still largely depend on the utilization of traditional medicine, although the traditional knowledge is being lost in many societies (Chen *et al* 2016; Farooq *et al.,* 2022), meanwhile, the traditional medical systems are often efficacious for the treatment of common diseases (Romero-Daza 2002). In the last few decades, traditional knowledge has become endangered, and many ethnobiologists are of the opinion that such knowledge may disappear (Sen *et al* 2011). Due to the commercial interests and expansion of the population, the plant species are often under severe threat, require quick conservation measures to avoid extinction (Chen *et al.* 2016). This vanishing of species often also leads to the loss of associated traditional knowledge (Lamsal *et al.* 2017). The use of plants as traditional therapeutics offers an alternative in healthcare in developing countries, especially for rural populations (Ekor 2014; Hayt *et al.* 2014; Umail *et al.* 2017; Mahmoodally *et al.* 2018), also herbal treatments are believed to have few side effects and high efficiency (Eddouks *et al.* 2014; Malik *et al.* 2019; Kang *et al.* 2020). Traditional knowledge supports the livelihoods of local indigenous communities and allows interactions of indigenous knowledge, biodiversity, and the environment (Jian chu *et al* 2002).

As per the district Kupwara of Jammu and Kashmir-India is concerned, it is populated by several ethnic groups such as Bakarwal, Gujjars living in different places (Rashanpora Dutt, Sadhna top, Bungus valley, Tee-Pee, Inchas and Budnambal) across the district. The Bakarwal is a nomadic tribe mostly associated with livestock mostly seen in the high-altitude green pastures, Gujjar is another nomadic tribe with strong ethnic identity in the valley, they also live in high altitude areas but are sedentary, associated with cattle and agriculture; Kashmir is the most dominant ethnic group with strong socio-economic profile (Hassan *et al* 2022; Tark and Giri 2017).

The aim of the current research was to contribute to an improved understanding of wild ethnomedicinal plant uses from the remote area (administrative district "Kupwara") of Kashmir Himalayas. The particular goals of the study were to record the use of wild plant resources, with a focus on medical usage, and to compare (quantitatively and qualitatively) the conceivable distinctive uses among previously identified socio-cultural groups (Bakarwals, Gujjars and Kashmiri) living in the region.

Material and Methods

Study area

Kupwara (34°31.5707'N, 74°15.2768'E) (Fig.1) is a medium-sized administrative district of the Kashmir valley with 870354 inhabitants belonging to diverse cultural groups. The district is spread over an area of 2379 km with 368 villages[https://kupwara.nic.in]. District Kupwara lies at an altitude of 1500m above sea level. The region is characterized by dense forests (Himalayan dry-temperate to subalpine forest types) (Haq et al. 2020), rich floral diversity and is home to many medicinal plants. According to Dar *et al.* (2012), 153 (8%) angiosperm taxa found in Kashmir are endemic exclusively to this region. The temperature ranges between -4˚C minimum in winter and up to 32˚C maximum in summers (Aadil *et al.* 2021c). It is the home to many ethnic communities, such as Bakarwals (nomads, occupying the high-altitude regions of Kupwara), Kashmiri (living in the main valleys and are in majority) and Gujjars which are inhibited in the region form centuries. (Haq *et al.* 2022).

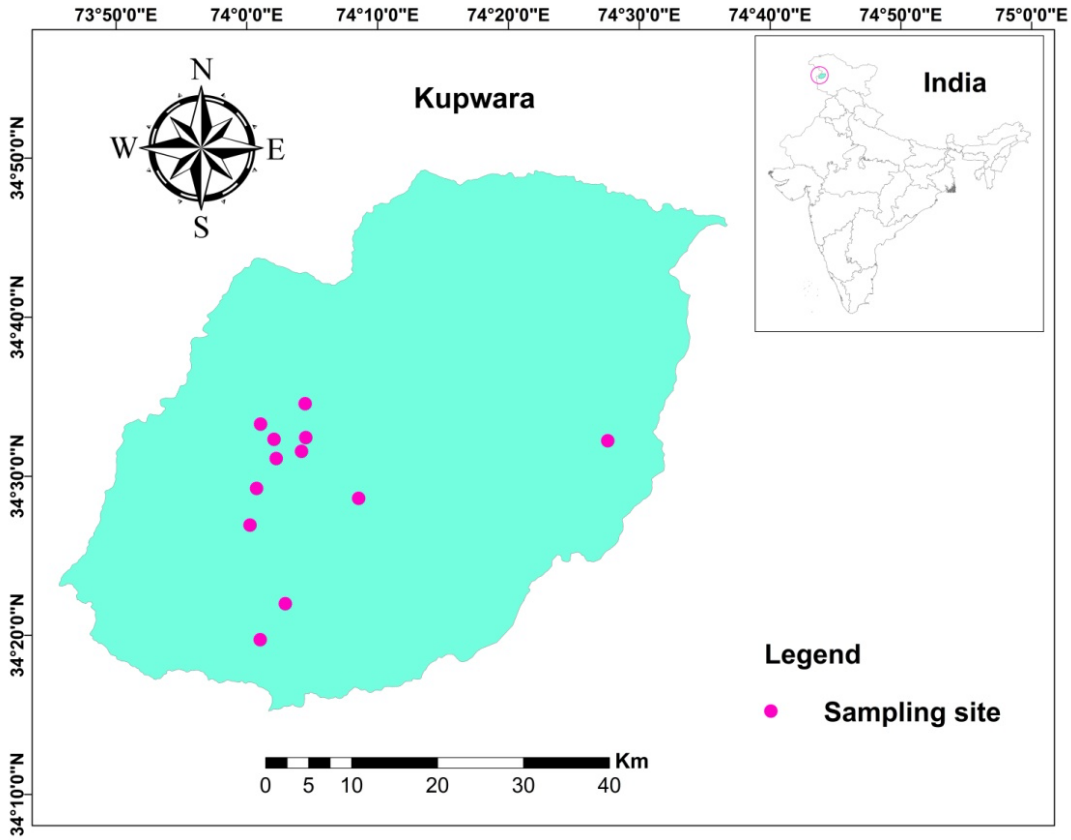

Figure 1. Map of district Kupwara, Jammu and Kashmir, India showing surveyed villages

Ethnobotanical data collection

Extensive surveys were conducted within the study area from March 2019 to August 2021 for the collection of medicinally important plants and the related traditional knowledge. We used simple stratified sampling by employing semi structured interviews followed by group discussions (Hassan *et al* 2022). A total of 40 field visits were carried out in ten villages (*Chowkibal, Sadna-top, Farkan, Tee-Pee, Lolab valley, Langate, Tangdar, Deedkote, Rashanpora-Dutt, Thandipora* and *Budnamal*) (Fig.1). Given that the selected villages are mainly inhabited by Gujjar, and Bakarwal, and Kashmiri, we employed a translator to improve data collection. Bakarwal are nomads they visit the study area in the month of June and mostly exhibit the higher altitudes of the study area, Gujjars mostly live in the study area and visit the higher altitudes along with their livestock in summers, while as Kashmiris are the dominant population in the study area. The information collected was also cross checked with the available literature (Gaiorola *et al.,* 2014; Haq *et al.* 2019a). A proper consent was obtained verbally from all the informants prior to the interviews. Moreover, one individual from each indigenous community, who was well recognizable with the traditions and norms of the community, was taken as a guide in all the field surveys. The Code of Ethics of the International Society of Ethnobiology (available at https://www.ethnobiology.net, accessed on 28 May 2021) was followed during the whole study. All the collected plant specimens from different locations during the field visits were dried and pressed. Additional identification was performed by matching the voucher specimens with previously identified specimens in the Herbarium University of Kashmir, Srinagar (Acronym KASH). All specimens were deposited in KASH. The botanical names of the plant species have been updated according to The Plantlist (www.theplantlist.org).

Data Analysis

We employed ethnobotanical indices including, Use value, Use Frequency, Family Use Value, and Informant Consensus. Cluster analysis was used for different ecological variables and plant compositions (Haq *et al.* 2021).

Use Value (UV) and Use frequency (Fq)
The relative importance of the recorded taxa was calculated through the use value (UV) (Phillips *et al.* 1994). It was calculated through the following formula:

$$UV=\Sigma U/n$$

"U" indicates the number of reports mentioned by informants for a given plant taxa and "n" the total number of informants that participated in the study. The UV value varies between 0 and 1. 0 for a species that was not mentioned and 1 for a species that was mentioned by all the informants.

To elucidate the relative importance of various medicinal plant taxa employed for different human-associated disorders, a quantitative index frequency (%) was employed for the use frequency (Fq), which is expressed in a percentage and calculated by multiplying the use-value mentioned by the informants by 100.

Family Use Value (FUV)
FUV helps to identify and signify the use-value of a given medicinal plant family used as a medicine flora in a particular locality. The family use-value is calculated by employing the formula of Hoffman and Gallaher (Nadaf *et al.* 2019)

$$FUV=\sum UVs/ns$$

Where UVs is the species use value of the plants cited by informants and ns represents the total number of plant taxa documented in the family.

Informant Consensus Factor (ICF)
ICF highlights the plants of particular cultural relevance and agreement in the utilization of taxa. It helps to identify the variability of the medicinal plants and determine the plant taxa of particular interest. The diseases were grouped into categories to analyze ICF, and more ethno-pharmacologically interesting plant taxa might be identified. ICF was calculated using the formula proposed by (Heinrich *et al.* 1998) which is used to test the hypothesis of knowledge homogeny, as follows:
ICF=Nur-Nt/Nur-1

Where Nur is the number of use-reports (citations) in each ailment category and Nt is the number of plant taxa employed for particular ailments. The ICF always ranges from 0 to 1. A high range (nearest to 1) means relatively few taxa are employed by a large number of people, while a low range means participants disagree on the taxa employed within a particular category of diseases (Gazzaneo *et al* 2005). ICF values are always greater when single or few plant taxa are recorded to be used by a maximum number of informants to cure a particular illness.

Results and Discussion

Demographic characteristics of the respondents:
A total of 148 informants (93 men and 55 women) were interviewed. Data was collected from three ethnic groups Gujjars (37.84%), Bakarwals (31.76%) and Kashmiri (30.40%) among which herders accounted for (26.35%) followed by Cultivator/agricultural laborer (16.89%), Skilled/semi-skilled worker (16.22%), Hakeem (traditional healers) (12.84%), Housewives (12.83%), Shopkeepers (9.46%) and Govt. Employees (5.40%). The age of the informants varies from 18 to 95 years. The most important ethnomedicinal knowledge holders were old people (47.97%) followed by middle aged (33.10%) and young (18.91%). The overall education level was poor, young people have higher education than the older ones. Most of the informants were uneducated (50.67%), whereas (27.70%) had primary education, (15.54%) had secondary education only a few informants had higher education (6.08%). Urdu, Kashmiri, Pahari and Gujjare are the four different types of languages spoken in the study area. All the ethnic groups follow Islamic faith (Table 1).

Diversity of ethnomedicinal flora
The ethnomedicinal survey led to the collection of 53 medicinal plants belonging to 36 families. The distribution of medicinal plants was unequal among the families, and most of the medicinal plants belonged to Asteraceae (N=6, 11%), Lamiaceae, Polygonaceae and Apiaceae (N=3, 6% each) followed by Ranunculaceae, Boraginaceae, Berberidaceae, Pinaceae, Geraniaceae and Liliaceae (N=2, 4% each), while as all the remaining families contributed only (N=1, 2% each) (Fig.2). The predominance of families was comparable with investigations carried out in other parts of the Himalayan region which report Asteraceae as the dominant family (Altaf *et al.* 2021; Asif *et al.* 2021;

Nafeesa *et al.* 2021; Singh *et al.* 2017; Aadil *et al* 2021a). Owing to widespread ecological amplitude, the members of the family Asteraceae acclimatize easily and adapt to arid dry habitats rapidly (Haq *et al.* 2021). Pala *et al* (2019) reported Lamiaceae as the leading family from the Eastern Himalaya, which is in line with our results.

Table 1. Demographic characteristics of informants.

Demographic features	**Number**	**Percentage**
Language	Urdu, Kashmiri, Pahari, Gujjar	
Ethical groups	Kashmiri, Bakarwal, Gujjar	
Education		
Uneducated	75	50.67
Primary education	41	27.70
Secondary education	23	15.54
Higher education	9	
Age range		
Young (18-26)	28	18.91
Middle (27-50)	49	33.10
Old (51-95)	71	47.97
Profession		
Hakeem (traditional healers)	19	12.84
Skilled/semi-skilled worker	24	16.22
Cultivator/agricultural laborer	25	16.89
Herders	39	26.35
Govt. Employees	8	5.40
Housewives	19	12.83
Shopkeepers	14	9.46
Gender		
Male	93	62.84
Female	55	37.16
Religion	Islam	100
Ethnic Groups		
Gujjar	56	37.84
Bakarwals	47	31.76
Kashmiri	45	30.40

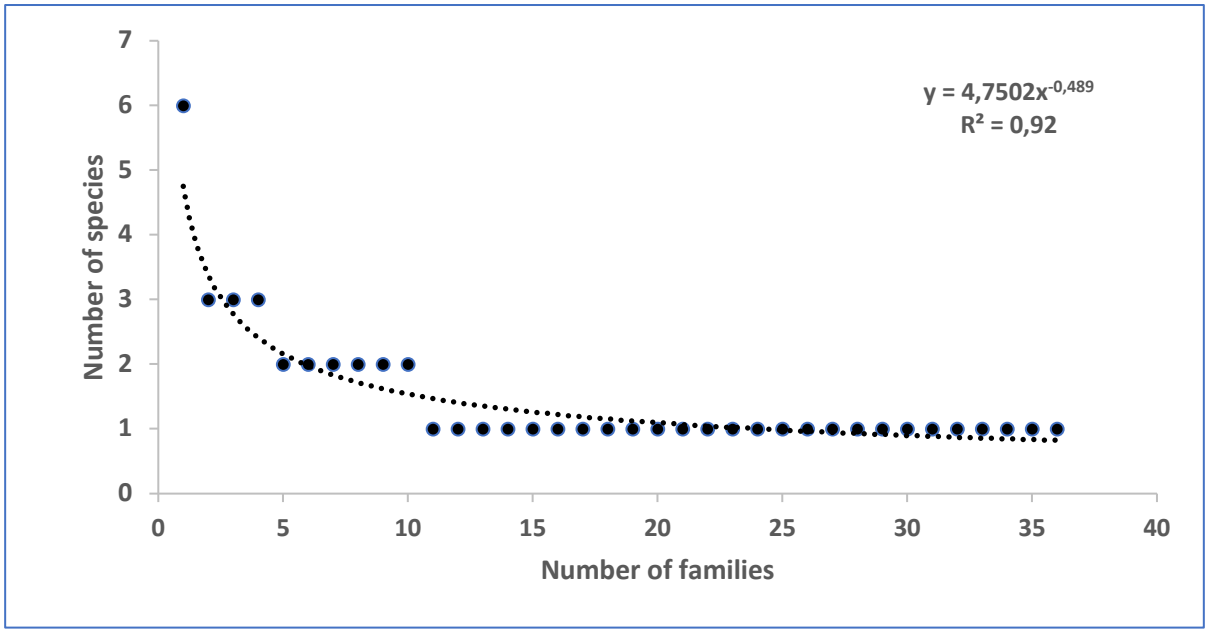

Figure 2. Species family relationship of plant resources used in different ethnic groups.

Life form and parts used

In the current study the most dominant life forms used in the treatment of various ailments were herbs (42 species,79%), followed by trees (6 species, 11%), shrubs (3 species, 6%) and ferns and fungi (1 species each, 2%) Figure 3a. The reason behind the use of herbs might be due to the presence of high content of bio-active compounds in them (Khoja *et al.* 2022) and also their medicinal action is more effective than other forms of plant (Adnan *et al.* 2014). Various plant parts such as roots, leaves, bark, seeds, whole-frond, fruiting-body, stem-latex, rhizome, twigs and wood of the documented species were found to be utilized by the people as medicine/drugs. Most of the plant parts were used in the form of paste. Roots were most utilized with 37% of usage, followed by leaves (22%), rhizome (7%), tuber, stem-latex, bark, whole plant (5% each), wood, fruits (3% each), seed, fruiting-body, twig and whole-frond (2% each) (Fig.3b). The most common and viable strategies of preparations include using raw, drying the plants, crushing the min to powder, then boiled to obtain decoction, tea and infusion, other preparations include extract, juice, and paste (Table2). The plant preparations were often stored in glass bottles or other containers and used in off-seasons or during heavy snowfall in winters. Roots generally are often the most favored part of plants used as they often comprise a higher concentration of bioactive constituents (Uprety *et al.* 2010; Yousuf *et al.* 2020; Hassan *et al.* 2021). According to (Aadil *et al.* 2021b) grinding, boiling and smashing are the most common ways of extraction of active ingredients in major parts of the world.

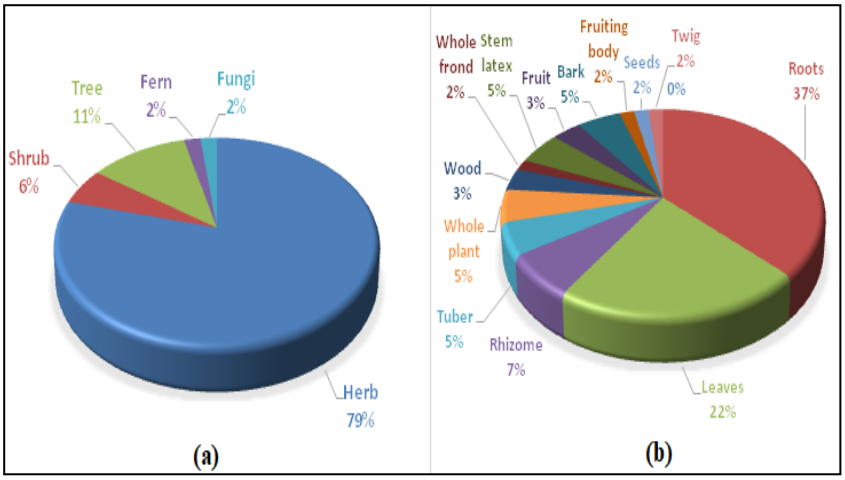

Figure 3. **(a)** Percentage distribution of species according to their life form; **(b)** Percentage of different plant parts used in the study area.

Informant Consensus Factor (ICF) and Disease Category

The ICF demonstrates the ascension among informants on the utilization of plants for a particular disease category, and it highlights taxa that have treatment potential for specific purposes. It has been observed that distinctive disease categories depended on the availability of the plant taxa within the study area. In the current study, we grouped all types of diseases based on human-system associated disorders into 9 categories, which are presented in Table 3. The results of the ICF values ranged from 0.95 to 0.98. The highest value of ICF was recorded for gastrointestinal disorders, liver-diseases, bone and joint disorders, dental diseases and kidney problems (0.98 each) followed by dermatological, respiratory diseases, wound healing and other diseases (0.95 each), while as lowest values of ICF were recorded for ethno-veterinary diseases (0.95). (Table.3)

Gastrointestinal disorders were treated with most species (22%), followed by bone and joint diseases (16%), kidney diseases were found to be treated by least number of species (Fig. 4). This distribution of applications is in accordance with other studies, e.g., Kaur *et al.* 2020; Miya *et al.* 2020; Monigatti *et al.* 2013. The plants "*Artemisia absinthium*, *Ligularia jacquemontiana, Aconitum heterophyllum, Ajuga parviflora, Thymus linearis, Fritillaria roylei, Urtica dioica, Skimmia anquetillia, Selinum vaginatum, Salix alba, Rhodiola fastigiata, Plantago major, Malva neglecta, Cedrus deodara,* and *Acorus calamus"* used for the treatment of gastro-intestinal diseases were most frequently reported by the informants.

Table 2. Ethnomedicinal usage of different plant species of the District Kupwara.

Botanical name Family Voucher No.	Common name	Life form	Part used	Preparation and application	Disease cured	Other economic applications	Ethnic groups			UV	Use frequency (Fq, %)	Earlier reports
							Guj	Bak	Kas			
Aconitum heterophyllum Wall. Ranunculaceae [4049-KASH]	Patrees/itees	Herb	Roots and leaves	Dried roots are crushed into powder and taken along with water for 2-3 days orally. *Paste of leaves is applied externally	Abdominal pain, **Stomach cramps**, *skin rashes and *wound healing.		Y	Y	Y	0.51	50.67	Shyaula *et al* 2012, Haq *et al* 2021.
Aconitum chasmanthum Stapf ex Holmes Ranunculaceae	Mohand	Herb	Roots	Roots are dried and put into small pot along with honey and kept underground for 6 months before use and taken orally for 2-5 days. Dried roots are placed inside cavities.	**Asthma** and Toothache.		Y	Y		0.33	33.11	Shyaula *et al* 2012, Khoja *et al* 2022a.
Acorus calamus L. Acoraceae [4119-KASH]	Vai/ vai gander	Herb	Rhizome	Dried roots are crushed into powder and taken along with sugar and water orally early in the morning	Abdominal pain and Stomach cramps.		Y	Y	Y	0.44	43.92	Mukherjee *et al* 2007, Aadil *et al* 2021.
Ajuga parviflora Benth Lamiaceae [4095-KASH]	Jain adam	Herb	Leaves	Leaves are crushed along with water and kept outside for night & taken early in the morning	Abdominal pain **Helminthic.**		Y	Y	Y	0.42	41.89	Aadil *et al* 2021a, Khoja *et al* 2022a.
Achillea millefolium L. Asteraceae [4097-KASH]	Phail gass	Herb	Leaves	Leaves are crushed into paste which is applied on affected areas externally	Snake bite	Aerial part is used as fodder	Y		Y	0.38	37.83	Aadil *et al* 2021a, Haq *et al* 2021.
Anagallis arvensis L. Primulaceae [4239-KASH]	Dawamool	Herb	Roots	Dried roots are placed inside cavities	**Toothache**				Y	0.20	19.59	Haq *et al* 2020.
Angelica glauca Edgew. Apiaceae [4111-KASH]	Choud/ choora	Herb	Roots	Roots are dried first later on crushed into powder and mixed with flour and given orally. *One teaspoon of root powder is taken orally along with water.	Blot, *Fever	Roots are used as flavoring agent.	Y	Y	Y	0.42	42.56	Kunwar *et al.* 2016, Abbas *et al* 2017.
Arisaema jacquemontii Blume Araceae	Sarfe makai	Herb	Tuber	Tubers are dried first then crushed into powder and mixed with maize or wheat flour to make small balls and taken orally,	Blot and ***burns**.		Y	Y		0.34	34.46	Roshan *et al* 2017, Amjad *et al* 2017.

				*Paste of roots is directly applied on infected parts.								
Arnebia benthamii (Wall. ex G. Don.) Johnst. Boraginaceae [4096-KASH]	Khazaban/ gowzaban	Herb	Leaves & roots	Leaves and roots are boiled in water and taken orally early in the morning.	**Dry throat,** diarrhea, cough and cold.		Y	Y	Y	0.49	48.65	Rana *et al* 2012, Khoja *et al* 2022a.
Artemisia absinthium L. Asteraceae [4224-KASH]	Tethwan	Herb	Leaves	Leaves are crushed into powder and taken along with water and sugar early in the morning.	Abdominal pain and Helminthic.	Aerial part is used as fodder	Y	Y	Y	0.56	56.08	Nigam *et al* 2019, Haq *et al* 2021, Al-Shamaony *et al.* 1994.
Atropa acuminata Royle ex Lindl Solanaceae [4252-KASH]	Brand	Herb	Leaves	Dried leaves are powdered and mixed with ghee/butter, forming the paste, which is applied on affected areas externally	Rheumatic pain		Y	Y		0.36	35.81	Hussain *et al* 2009, Asif *et al* 2021.
Berberis lycium Royle Berberidaceae [4102-KASH]	Kawdach/ Chxmachang	Shrub	Bark of roots	The bark of the root is dried and crushed to make powder, which is taken orally with warm water	General weakness and jaundice.	Fruits are eaten raw. Areal part is used as fuel wood	Y	Y		0.37	37.16	Malik *et al* 2019, Aadil *et al* 2021.
Bergenia ciliata (Haw.) Sternb. Saxifragaceae [4213-KASH]	Palfort/ Butpewaa	Herb	Roots	The root is dried & crushed to make powder, which is boiled and taken orally. *Paste of roots is applied externally	Lung diseases **cough and cold** *wound healing.	Roots are used to make herbal tea	Y	Y	Y	0.46	45.94	Ahmad *et al* 2019, Asif *et al* 2021.
Betula utilis D. Don Betulaceae [4015-KASH]	Burz	Tree	Wood/Bark	Glass made from the wood is used to drink warm water early in the morning. The infusion of barks is taken orally.	**Asthma**, Cough and Cold.	Wood is used as fuel wood & bark is used as paper.	Y			0.21	20.94	Abbas *et al.* 2011, Farooq *et al* 2022.
Bistorta amplexicaulis (D.Don) Greene Polygonaceae [4108-KASH]	Manchri- chai/ Masloom	Herb	Roots	Roots are dried and boiled in water to make tea.	Fever.	Roots are used to make herbal tea	Y	Y		0.45	45.27	Aadil *et al* 2021, Haq *et al* 2022.
Cuscuta reflexa Roxb. Convolvulaceae [4082-KASH]	Kukliport	Herb	Whole plant	Whole plant is dried and crushed into powder and mixed with mustard oil and applied externally.* the paste of the plant is applied externally	Hair-fall and dandruff, ***Skin rashes**.		Y		Y	0.39	39.19	Kumar and Choyal 2012, Haq *et al* 2022a.

Cedrus deodara (Roxb.) Pinaceae [4228-KASH]	Deodar	Tree	Wood?/Bark	Oil is extracted by burning resinous wood of stem locally called DEODAR and applied externally on infected areas. *small amount of oil is mixed with a glass of water and added sugar is taken orally. bark is boiled in water which upon cooling is crushed into paste and applied externally.	Toothache, **foot and mouth disease in cattle** and *Helminthic, Boils.	Wood is used as fuel wood	Y	Y	Y	0.49	48.65	Medinipur and Benga 2019, Aadil *et al* 2021.
Cynoglossum glochidiatum Wall. Ex Benth. Boraginaceae [4083-KASH]	Cheur	Herb	Roots	Paste made from roots is applied externally	Skin diseases.			Y		0.20	19.59	Aadil *et al* 2021a, Hassan *et al* 2022.
Eryngium billardieri F. Delaroche Apiaceae [4247-KASH]	Dawa-mool	Herb	Roots	Dried roots are eaten raw early in the morning	**Jaundice**.				Y	0.17	16.89	Aadil *et al* 2021a.
Equisetum arvense L. Equisetiaceae [4232-KASH]	Gandamgud	Fern	Whole frond	*Whole frond is crushed along with water and kept outside for whole night and taken orally early in the morning. Whole frond is crushed into powder and taken along with water orally.	***Kidney stones** and abdominal pain.	Whole frond is used in tooth cleaning	Y		Y	0.36	35.81	Khoja *et al* 2022, Abdullah *et al* 2020.
Euphorbia wallichii Hook.f. Euphorbiaceae [4216-KASH]	Herib	Herb	Stem latex	Stem latex is applied externally on affected areas	Skin warts and ***foot corn**.		Y	Y		0.47	47.29	Jan *et al* 2021b, Haq *et al* 2020.
Fragaria nubicola (Hook.f) Lindl. Rosaceae [4087-KASH]	Gounch/ Ringrish	Herb	Roots	Roots are crushed into paste and applied externally	**Wound healing**.	Tea is made from the roots	Y	Y	Y	0.32	32.43	Thakur *et al* 2020, Hussain *et al* 2012.
Ficus carica L. Moraceae [4088-KASH]	Anjeer	Tree	Stem latex	Stem latex is applied externally on affected areas	**Skin rashes** and boils.	Fruits are eaten raw wood is used as fuel wood		Y	Y	0.28	28.38	Bouyahya *et al* 2016, Jan *et al* 2021.
Fritillaria roylei Hook. Liliaceae	Sheetkhar	Herb	Tuber	Tubers are crushed into powder and boiled in water which is used to cook rice	Abdominal bloating, rheumatism.		Y	Y	Y	0.51	50.67	Haq *et al* 2021, Asif *et al* 2021.

Geranium wallichianum Oliv. Geraniaceae [4112-KASH]	Ratanjog/ rati-booti	Herb	Roots	Dried roots are boiled in water and the extract is used to cook rice, which is taken along with dhesi ghee twice a day	Rheumatism and general weakness.	Roots are used to make tea	Y	Y	Y	0.46	45.94	Qureshi *et al* 2009, Aadil *et al* 2021.
Geranium pretense L. Geraniaceae [4098-KASH]	Ratanjog	Herb	Roots	Dried roots are boiled in water and the extract collected is used to cook rice which is taken twice a day.	Joint diseases and **arthritis.**	Roots are used to make tea		Y		0.21	20.95	Aadil *et al* 2021b, Kunwar *et al* 2021.
Hypericum perforatum L. Hypericaceae [4089-KASH]	Chaikul/ julab di jadi	Herb	Roots	Dried roots are crushed into powder and taken early in the morning	Diarrhea		Y		Y	0.34	34.46	Jan *et al* 2021b, Aadil *et al* 2021.
Herniaria hirsuta L. Caryophyllaceae	Chikal	Herb	Whole plant	Whole plants are dried and crushed into powder and mixed with egg and taken early in the morning for 4-5 days	Fever and **dizziness**.	Areal part is used to make herbal tea	Y	Y		0.33	33.78	Aadil *et al* 2021b.
Jurinea dolomiaea Boiss, Asteraceae [4090-KASH]	Doop/ gogle doup	Herb	Roots	Dried roots are crushed into powder and mixed with mustard oil and applied externally on affected areas	Skin diseases and wound healing	Roots are used in black magic	Y	Y	Y	0.50	50.00	Haq *et al* 2020 Asif *et al* 2021, Haq *et al* 2021.
Juglans regia L. Juglandaceae	Doon/ khooda	Tree	Fruit / leaves and bark	Young fruits are crushed into paste and applied externally on affected areas. *Oil extracted from seeds is applied externally. Green Leaves are crushed and applied on effected teeth.	Foot and mouth diseases of cattle, ***rheumatism** and Toothache.	Seeds are eaten raw Bark is used to clean teethes.	Y	Y		0.42	42.56	Delaviz *et al* 2018, Mohomoodally *et al* 2018.
Ligularia jacquemontiana (Decne.) Asteraceae [4214-KASH]	Mapat kuth/ mustham	Herb	Roots	Dried roots are taken early in the morning along with warm water	Helminthic and abdominal pain		Y	Y		0.41	41.22	Aadil *et al* 2021a, Jan *et al* 2021.
Lilium polyphyllum D.Don Liliaceae	Pland	Herb	Tuber	Dried tubers are boiled in water and taken empty stomach	**Abdominal bloating**.			Y	Y	0.39	39.19	Aadil *et al* 2021a.
Malva neglecta Wallr. Malvaceae [4114-KASH]	Souchal	Herb	Leaves/ roots	Fresh leaves are crushed into juice and taken twice a day.* roots are crushed into paste and applied externally.	Abdominal pain, **blot** *Boils.	Leaves are used as vegetable			Y	0.24	23.64	Riyaz *et al* 2021, Malik *et al* 2019.

Morchella esculenta Fr. Morchellaceae [4215-KASH]	Gucchi	Fungi	Fruiting body	Fruiting body is dried and crushed and applied on affected areas	Wound healing	Fruiting body is used to make vegetable	Y		Y	0.28	27.70	Wagay *et al* 2019, Aadil *et al* 2021a.
Origanum vulgare L. Lamiaceae [4100-KASH]	Meth	Herb	Seeds	Seeds are crushed into powder and mixed with egg white and pasted on paper and applied on affected areas	Factures	Seeds are used as spice	Y	Y	Y	0.45	45.27	Jan *et al* 2021a, Mir *et al* 2021.
Oxalis corniculata L. Oxalidaceae [4113-KASH]	Cxemachang	Herb	Whole plant	Whole plant is dried and boiled in water to make tea which is taken early in the morning. * Paste of leaves is applied topically on effected portion.	General weakness and ***itchy skin.**		Y	Y		disea ses,	39.19	Aadil *et al* 2021a, Haq *et al* 2020.
Podophyllum hexandrum (Royle) T.S Ying Berberidaceae [4218-KASH]	Wanwagun/ Bangagun	Herb	Rhizome	Rhizome is crushed into powder and taken along with warm water	Tumors and rheumatic pain.	Fruits are eaten raw as well as in black magic	Y		Y	0.35	34.46	Chaurasia *et al* 2012, Nafeesa *et al* 2021.
Phytolacca acinosa Roxb. Phytolaccaceae [4253-KASH]	Hapat brand/ brand	Herb	Leaves	Leaves are crushed to make paste which is applied externally on infected portion	Foot and mouth disease.		Y	Y		0.26	25.67	Kumar *et al* 2021. Aadil *et al* 2021b.
Plantago major L. Plantaginaceae [4118-KASH]	Gull	Herb	Roots	Dried roots are boiled in water and taken orally early in the morning	Abdominal bloating.	Leaves are used to make vegetable	Y		Y	0.32	31.76	Haq *et al* 2021, Jan *et al* 2021a.
Polygonatum verticillatum (L.) All. Asparagaceae [4230-KASH]	Salamesri/ salapmesri	Herb	Roots	Dried roots are crushed into powder and taken along with warm water for 2-5 days.	**Leukorrhea** and gynecological disorders.		Y	Y		0.40	40.54	Aadil *et al* 2021b, Aasif *et al* 2021.
Pinus wallichiana A. B. Jacks Pinaceae [4227-KASH]	Kayur	Tree	Stem latex	Latex extracted from the stem is mixed with salt and applied externally.	Wound healing and **boils**	Wood is used as fuel wood	Y	Y	Y	0.49	49.32	Kaushik *et al* 2013, Pala *et al* 2019.
Rheum webbianum Royle Polygonaceae [4212-KASH]	Pambchalan/ chityal	Herb	Roots	Roots are boiled in water which is used to cook rice which is eaten for 2-3 days along with dhesi ghee. *Root is crushed into powder and mixed with water and directly applied on infected areas.	Rheumatism, *skin burns and *wound healing.	Leaves are used to make vegetable	Y	Y	Y	0.48	48.65	Asif *et al* 2021, Aadil *et al* 2021b.

Rhodiola fastigiata (Hk. f. et Thoms.) Crassulaceae [4091-KASH]	Hasbi-di-jadi	Herb	Leaves	Leaves are crushed into paste which is mixed with water and taken orally	**Diarrhoea**			Y		0.34	34.46	Zhuang *et al* 2019.
Rumex nepalensis Spreng. Polygonaceae	Abij/ hola	Herb	Roots	Dried roots are semi crushed and boiled in water. The same water is used to cook rice. *The paste of leaves is mixed with cow milk and applied externally	Arthritis and rheumatic pain, ***Skin scars.**	Leaves are used to make vegetable	Y		Y	0.46	46.62	Jan *et al* 2021b, Khoja *et al* 2022a.
Saussurea costa (Falc.) Lipsch. Asteraceae [4211-KASH]	Kuth/ Kooth	Herb	Roots	Dried roots are boiled in water and The same water is used to cook rice which is eaten for 2-3 days along with dhesi ghee. *Small amount of roots is placed under infected tooth	Rheumatic pain, factures and ***Toothache**		Y	Y	Y	0.51	50.67	Pandey *et al* 2007, Aadil *et al* 2021.
Salix alba L. Salicaceae	Veer	Tree	Twig	Juice extracted from fresh twig is taken orally early in the morning	Stomach cramps, **indigestion** and toothache.	Leaves are used as fodder; twigs are also used as brushes for tooth cleaning		Y	Y	0.46	45.95	Kekuda *et al* 2017, Haq *et al* 2022.
Selinum vaginatum C.B. Clarke Apiaceae [3811-KASH]	Budjeath	Herb	Roots	Roots are crushed into powder and boiled in water which is taken orally early in the morning	Abdominal pain, **diarrhea** and indigestion		Y	Y		0.38	38.51	Aadil *et al* 2021a, Khoja *et al* 2022.
Skimmia anquetilia N.P. Taylor & Airy Shaw Rutaceae [4120-KASH]	Nair-pan	Shrub	Leaves	Dried leaves are boiled in water upon cooling it is taken orally twice a day	Asthma and stomach cramps.	Aerial part is used as fuel wood		Y	Y	0.43	43.24	Aadil *et al* 2021a.
Taraxacum officinale (L.) Weber ex F.H. Wigg Asteraceae	Hand	Herb	Rhizome/ leaves	Fresh rhizome is boiled in water and taken orally. *Dried leaves are boiled in water and crushed into paste which is applied externally.	Jaundice ***joint dislocation** and tonic.	Leaves are used to make vegetable	Y	Y	Y	0.47	47.29	Menković *et al* 2011, Jan *et al* 2021.
Thymus linearis Benth Lamiaceae [4107-KASH]	Javind/ jungle javend	Herb	Leaves	Leaves are boiled in water to make tea.	Indigestion and abdominal pain.	Leaves are used to make herbal tea	Y	Y	Y	0.49	48.65	Qadir *et al* 2016, Singh *et al* 2017.

Urtica dioica L. Urticaceae [4219-KASH]	Soi	Herb	Roots	Dried roots are boiled in the water and the extract collected is applied directly on effected parts. *Roots are boiled in water and the extract is taken orally, one spoon early in the morning.	Arthritis, ***Diarrhea** and **induce fertility**.	Leaves are used to make vegetable			Y	0.35	35.13	Dhouibi *et al* 2020, Umair *et al* 2017.
Viburnum grandiflorum Wall. ex DC Viburnaceae [4241-KASH]	Kilmish/kulmanch	Shrub	Roots	Dried roots are boiled in water and then taken with food	Rheumatic pain.	Fruits are eaten raw; wood is used as fuel wood	Y		Y	0.36	35.81	Jan *et al* 2021b, Asif *et al* 2021.
Verbascum thapsus L Scrophulariaceae [4242-KASH]	Sarfe gogij	Herb	Leaves	Leaves are crushed into powder and boiled in water which upon cooling is taken orally. *Leaves are crushed into powder and mixed and applied externally.	**Blot** and *skin burns.	Aerial part is used as fuel wood	Y	Y		0.34	33.78	Ali *et al* 2012, Hassan *et al* 2022.

Guj (Gujjar), Bak (Bakarwal), Kas (Kashmiri)
G (Gujjar), B (Bakarwal), K (Kashmiri)[Presented against the diseases]
Y (Reported by ethnic group).
Diseases represented **bold** are novel.

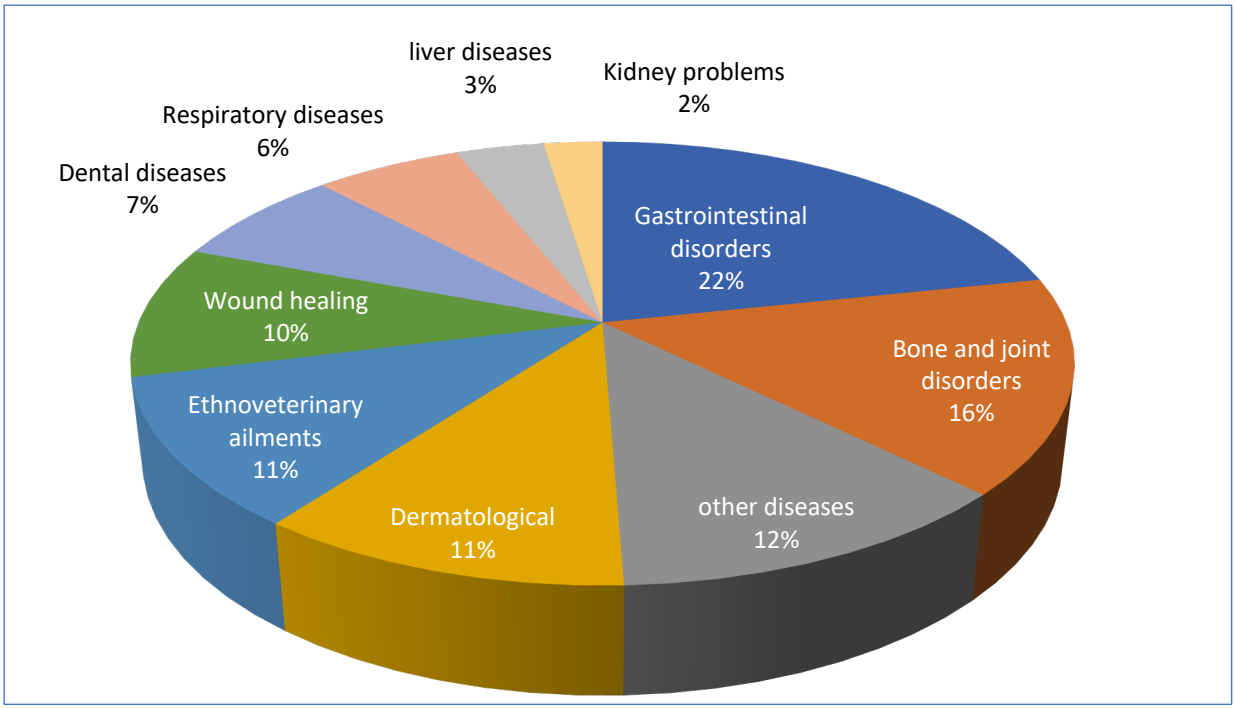

Figure 4. Percentage of plants used for treatment of various disorders in the district Kupwara.

Table 3. Recorded ICF for ethnomedicinal diseases

Disease categories	**No. of plant taxa employed (nt)**	**Number of use reports (nur)**	**ICF**
Bone and joint disorders	10	571	0.98
Dermatological	12	366	0.97
Dental diseases	3	137	0.98
Ethno-veterinary diseases	12	225	0.95
Gastrointestinal disorders	19	814	0.98
Kidney problems	2	51	0.98
Liver diseases	3	89	0.98
Other diseases	10	311	0.97
Respiratory diseases	5	125	0.97
Wound healing	7	219	0.97

Use value (UV)

In our study, UV varied from 0.17 to 0.56 (Table2). Maximum UV was recorded for *Artemisia absinthium* while lowest values of UV were recorded for *Eryngium billardieri.* Some of the other plants with high UV values are *Aconitum heterophyllum, Fritillaria roylei* and *Saussurea costa* (0.51 each), *Jurinea dolomiaea* (0.50), *Pinus wallichiana, Arnebia benthamii, Thymus linearis* (0.49 each), *Rheum webbianum* (0.48). The maximum values of UV of medicinal plants can be attributed to their common distribution and the well familiarity of medicinal usage by the local people. Highest use value of *Artemisia absinthium* is because it's commonly available and has many medicinal properties. The highest use report reflects a higher demand in curing various diseases, increasing the surplus demand of the medicinal plants becomes the main cause of extinction in their natural habitat (Singh *et al* 2021),

Cross-Cultural Analysis

The Venn diagram (Figure 5a) shows that the maximum number of plant uses was reported by the Gujjars, while the Kashmiri reported a minimum number of plant uses. A cross-cultural comparison of plant resources howed that 41 plants were commonly used by all ethnic groups. (Gairola *et al* .2014) also reported the cross-cultural usage of plants from the Himalayas. Plants common among all cultures mainly had medicinal value, although certain plants were common because of their religious uses. For instance, on sacred religious days like Eid, *Jurinea dolomiaea* was utilized as incense (locally known as doop or goguldoop) in residences and religious locations like shrines. A

similar usage of plant resources for religious and ritual beliefs was reported by (Amjad *et al.* 2017) from Pakistan, (Hassan *et al.* 2022) from Kashmir Himalayas and (Sharm *et al.* 2012) from Assam, India.
Upon the similarity of usage, Gujjars and Bakarwals (26%) showed greater similarity, whereas the least overlap was observed between Kashmiri and Bakarwal (9%) (Figure 5b). This can be ascribed to the socio-cultural practice, geography, and language; further the Gujjar and Bakarwal are exogamous to each other which allow the frequent flow of knowledge between two ethnic groups.

Gujjars and Bakarwals reported more medicinal plants compared to Kashmiris (figure 5b), because they prefer plant-based remedies over modern medicine, also, it is important to note that as they have less access to modern health care facilities, which leads to overharvesting of high-altitude medicinal plants. However, unsustainable use of rare plant species by Gujjar and Bakarwal community may be a threat to the conservation of biodiversity. The traditional knowledge of medicinal plants in the Kashmiri community seems to be gradually disappearing because of easy access to modern health care, which may lead to the disappearance of ethnomedicinal knowledge from the community.

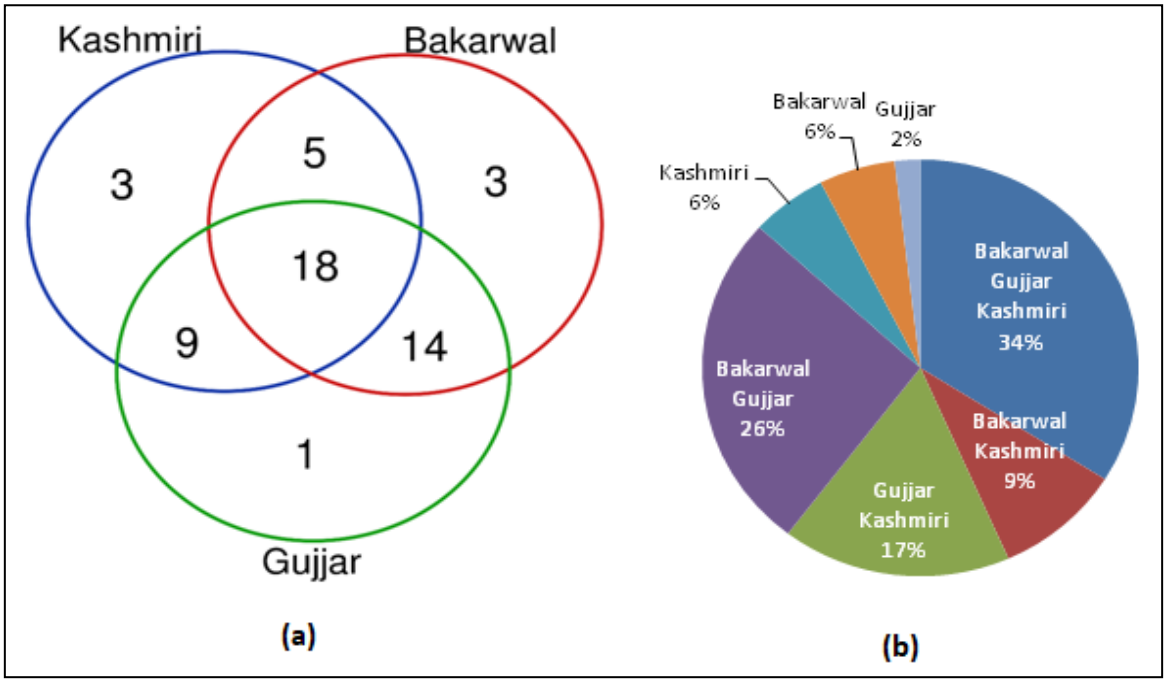

Figure 5. Venn diagram showing the overlap of ethnobotanical usage of plants in different ethnic groups in district Kupwara.

Classification of ethnobotanical usage
Based on Sorensen's similarity index upon usage of the documented species, the Cluster Analyses indicated substantial clusters of ethnoveterinary illnesses. Cluster 1 included the plant species with medicinal (Med) attributions. The prime species included *Berberis lyceum, Ficus carica, Juglans regia, Malva neglecta, Podophyllum hexandrum, Salix alba, Artemisia absinthium, Achillea millefolium, Angelica glauca, Origanum vulgare, Podophyllum hexandrum, Jurinea dolomiaea, Bergenia ciliata, Bistorta amplexicaulis, Fragaria nubicola, Geranium wallichianum, Geranium pratense, Pinus wallichiana,* and *Cedrus deodara* Cluster 2 comprised the species with a variety of attributions like food, fodder, spice, black-magic (bla-mag); herbal tea (her-tea) and fuel wood (fue-wod)**.** Species like *Berberis lyceum, Ficus carica, Juglans regia, Malva neglecta, Podophyllum hexandrum,* are used as food, *Salix alba, Artemisia absinthium, Achillea millefolium* are the few species which are used as fodder, *Angelica glauca, Origanum vulgare* as spice or flavoring agent, *Podophyllum hexandrum* and *Jurinea dolomiaea* are used against black magic. Species which are used to make herbal tea include *Bergenia ciliata, Bistorta amplexicaulis, Fragaria nubicola, Geranium wallichianum, Geranium pratense* and *Pinus wallichiana, Ficus carica, Cedrus deodara, Berberis lycium,* are used as fuel. Similar classifications were found in previous studies, i.e., Asif *et al.* (2021) reported five groups of wild plants from tribal communities in the tehsil of Karnah (Jammu and Kashmir), India. Haq *et al.* (2020) classified the wild plants of district Reasi into four plant usage groups. Haq *et al.* (2022a) from Western Himalayas. Rivera *et al.* (2007) reported eight major clusters while evaluating the ethnouses of plant species in the mountains of Castilla-La Mancha (Spain).

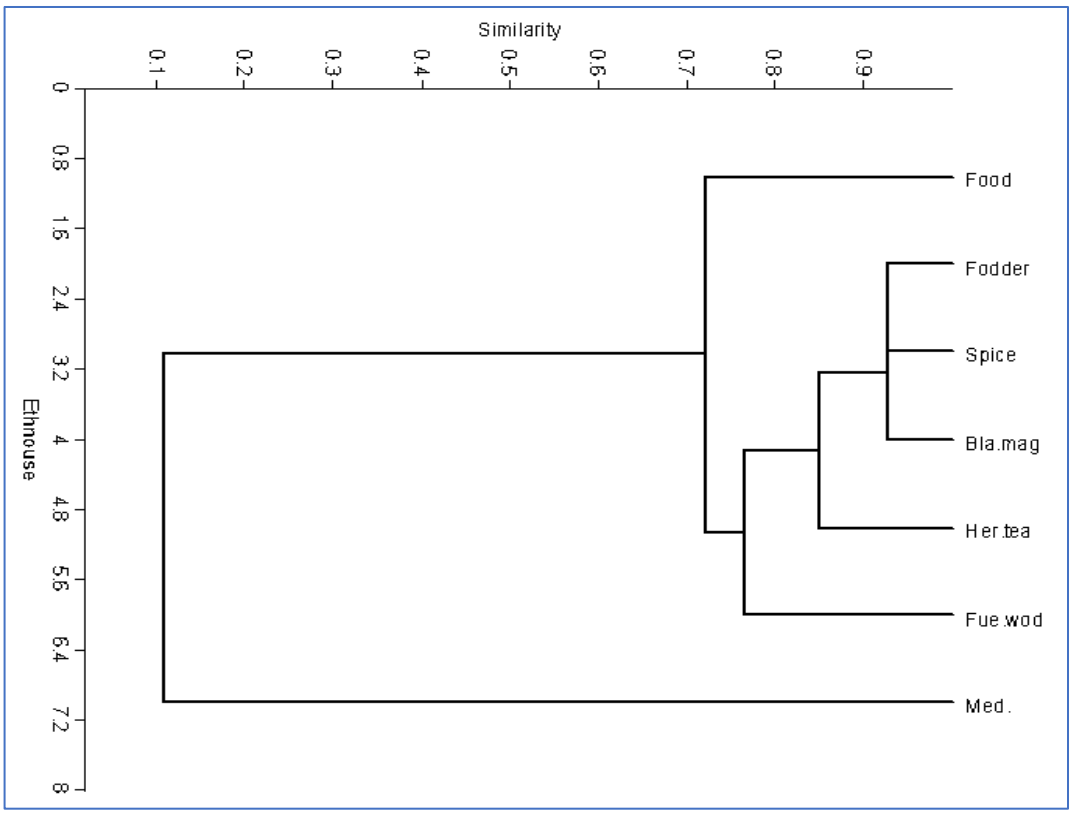

Figure 6. Cluster diagram of the different provisioning services based on plant usage patterns in the district Kupwara Jammu and Kashmir, India.

Family use value (FUV):

Family use value (FUV) represents them most biologically significant plant family of any particular region. In the present study, the use value of families represented by more than one plant taxa were calculated and are listed in Table 4. The highest FUV was reported for Pinaceae (0.49) followed by Asteraceae (0.47) and Polygonaceae (0.46). The species belonging to these families were of particularly high value in folklore medicine, and therefore mentioned by a large number of informants. Lowest values of FUV were reported in families like Apiaceae (0.27), Geraniaceae (0.33) and Boraginaceae (0.34). Families like Acoraceae, Araceae, Solanaceae, Saxifragaceae, Betulaceae, were recorded as monotypic families i.e., represented by only one plant species. Even though there are six plant species from the Asteraceae family that are used to make herbal remedies, and representative taxa in the family were *Achillea millefolium* L., *Artemisia absinthium* L., *Jurinea dolomiaea* Boiss, *Ligularia jacquemontiana* Decne. *Saussurea costa* (Falc.) Lipsch and *Taraxacum officinales* (L.)Weber ex F.H. Wigg. Due to the considerable importance in folkloric medicine, these taxa were also reported in other studies (Bhat *et al* 2021; Nadaf *et al.* 2019).

In this study some medicinal uses for *Rhodiola fastigiata, Lilium polyphyllum, Betula utilis* and *Anagallis arvensis* were reported for the first time (Table 2) with novel uses written in bold letters. The phytochemical composition and pharmacological analysis of these plants should be evaluated for the possible elucidation of some novel molecule.

Conclusions

Present study confirmed that local flora has a significant value in the lives of the people across the three selected ethnic groups (Gujjar, Bakarwal and Kashmiri). People are still reliant on plant resources for their basic requirements like medicine, and food. The study further confirmed the degradation of conventional knowledge among the younger generation and the elders of all communities are the prime asset (traditional knowledge) holders. The present study reinforced the idea that the utility of plants in a community culture is linked to local availability, life forms and seasonal diseases. The plant species which are having most high UV needs to be evaluated for phytoconstituents due to possible elucidation of some novel molecule with potent medicinal attribution which in turn can help to get against the pathogen resistance which is an alarming issue in the modern medicine.

Table 4. Family use value FUV of the documented species from the district Kupwara.

Family	Taxon	Total use reports (URs)	Use value (UVs)	Family use value (FUV)
Ranunculaceae	*Aconitum heterophyllum* Wall., *Aconitum chasmanthum* Stapf ex Holmes,	124	0.81	0.42
Lamiaceae	*Ajuga parviflora* Benth *Origanum vulgare* L. *Thymus linearis* Benth	201	1.36	0.45
Asteraceae	*Achillea millefolium* L. *Artemisia absinthium* L. *Jurinea dolomiaea* Boiss, *Ligularia jacquemontiana* Decne. *Saussurea costa* (Falc.) Lipsch. *Taraxacum officinales* (L.)Weber ex F.H. Wigg	419	2.83	0.47
Boraginaceae	*Arnebia benthamii* (Wall. ex G. Don.) Johnst *Cynoglossum glochidiatum* Wall. ex Benth	100	0.69	0.34
Berberidaceae	*Berberis lycium* Royle *Podophyllum hexandrum* (Royle) T.S. Ying	106	0.72	0.36
Polygonaceae	*Bistorta amplexicaulis* (D.Don) Greene *Rheum webbianum* Royle *Rumex nepalensis* Spreng.	208	1.39	0.46
Pinaceae	*Cedrus deodara* (Roxb.) *Pinus wallichiana* A. B. Jacks	145	0.98	0.49
Apiaceae	*Eryngium billardieri* F. Delaroche *Selinum vginatum* C.B.Clarke	84	0.55	0.27
Liliaceae	*Fritillaria roylei* Hook. *Lilium polyphyllum* D.Don	133	0.82	0.41
Geraniaceae	*Geranium wallichianum* Oliv. *Geranium pratense* L.	99	0.67	0.33

Declarations

Ethics approval and consent to participate: All the participants provided prior informed consent before the interviews.

Availability of data and materials: Data is available from the first author.

Competing interests: The authors declare that they have no competing interests.

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Author contributions: AAK collected data. AAK, SAHA, RAM writing original draft, visualization, supervision, and RWB revised the manuscript. All authors read and approved the final manuscript.

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