Traditional knowledge of medicinally important plants among the Torwali community of Hinduraj areas of Northern Pakistan

Asghar Ali, Hammad Ullah, Hazrat Sher, Rafiullah, Lal Badshah and Rainer W. Bussmann

Correspondence

Asghar Ali[1*], Hammad Ullah[1], Hazrat Sher[1], Rafiullah[2], Lal Badshah[3] and Rainer W. Bussmann[4]

[1]Department of Botany, Govt. Post Graduate Jahanzeb College Saidu Sharif Swat, Pakistan,
[2]Department of Botany, Govt. Dr. Khan Shaheed Degree College Kabal, Swat, Pakistan
[3]Department of Botany, Phytoecology Lab University of Peshawar, Pakistan
[4]Department of Ethnobotany, Institute of Botany and Bakuriani Alpine Botanical Garden Ilia State University.
[5]Department of Botany, State Museum of Natural History Karlsruhe, Germany

rainer.bussmann@ismnk.de
*Corresponding Author: asghartk@gmail.com

Ethnobotany Research and Applications 29:69 (2024) - http://dx.doi.org/10.32859/era.29.69.1-37
Manuscript received: 11/10/2024 – Revised manuscript received: 04/12/2024 - Published: 07/12/2024

Abstract

Background: This study was designed to explore and document the ethnomedicinally valuable plants of Torwali community of Hinduraj area of District Swat. This area is unique, floristically being closer to the convergence point of three mighty mountainous ranges *viz*. Himalayas, Karakorum and Hindu Kush.

Objectives: This study was designed to document the ethnobotanically valuable plant resources among Torwali community of Hindu Raj area.

Methods: Plant specimens were collected by arranging repeated plant collection trips to the study area. Primary data was collected by interviews, corner meetings and distributing questionnaires. The data acquired was tabulated in Excel sheets and analyzed by using PcOrd version 5.

Results: A total of 110 plant species were documented. Of these 88 species (80%) were used as medicine, 10 species (9.09%) were used as edibles, 8 species (7.27%) were used a spices and condiments, 6 species (5.45%) were utilized as fruits, 5 species (4.54%) were used as veterinary medicine for livestock, 3 species (2.72%) were used as fuelwood, 3 species (2.72%) served as fodder and 3 species (2.72%) were valuable as timber. Families with high family importance values (FIV) were Pinaceae (23.3), Taxaceae (3.3), Colchicaceae (17.54), Alliaceae and Liliaceae (12.5 each) followed by Melanthiaceae and Rosaceae (93.3), Lamiaceae (62.5), Fabaceae (46.6) Solanaceae (40), Polygoniaceae (30) Berberidaceae (25.8), Brassicaceae (22.5), Asteraceae (14.16), Ebenaceae (13.3) and Zygophyllaceae (3.3). *Prunus domestica* and *Ajuga bracteosa* had highest values of Relative Frequency of Citation (RFC) i.e., 0.141 followed by *Malus domestica* and *Malva sylvestris* with RFC value of 0.133 each. As per IUCN criterion and 64 plants (54.14%) were found to be rare, 34 plants (29.82%) were ranked as vulnerable, and 24 species (10.52%) were infrequent. *Morchella conica* and *Valeriana jatamansi* were found to be endangered.

Conclusion: The study area is very rich in terms of ethnobotanical knowledge and the Torwali people have kept this valuable knowledge intact so far. In addition to the medicinal use of local flora, the locals are also utilizing these plants for multiple uses. Anthropogenic stresses such as urbanization, agricultural extension, over grazing, deforestation and landslides are a threat to local flora. *Skimmia laureola, Trillium govanianum*, *Colchicum autumnale, Morchella conica, Paeonia emodi, Podophylum hexandrum* were found to be over exploited. This study strongly recommends ex-situ conservation measures to conserve the plant resources of this locality.

Keywords: Herbal treatment; Conservation status; Traditional recipes; Ethnobotanical indices; Therapeutic classes

Background

Ethnobotany is a reservoir of knowledge regarding people-plant interactions with a history traced back to very early days of human civilizations. It is concerned with the study of uses of plants by ethnic groups across the globe (Gillani *et al.* 2024; Manzoor *et al.* 2023; Mirzaman *et al.* 2023; Hussain *et al.* 2006; Akhtar *et al.* 2013; Ali *et al.* 2018a). Man, in past and even in present, heavily relies on crude medicines obtained from plants and their products (Harari, 2014). The knowledge of medicinally important plants and their uses percolates through generations and ethnobotanical studies aim at preserving and documenting this valuable bulk of knowledge (Shinwari, 2010). The World Health Organization (WHO) has given an estimate that 65-80% of the world population in underdeveloped countries depends on medicinally important plants and crude drugs obtained from them due to their poor economic status and lack of contemporary health facilities (Shinwari *et al.* 2006). Pakistan has plenty of medicinally valuable plants which are used for a variety of purposes by different ethnic groups across the landscape (Khan *et al.* 2014; Ullah *et al.* 2022). Across Pakistan, approximately 5000 angiosperms species are utilized for traditional healing practices and are still preferred over other therapies due to their lesser side effects (Ibrar *et al.* 2007). In global context as well, the field of ethnobotany has attracted investigators to dig deep into the field of medicinally valuable plants to document, catalogue and record the recipes in order to conserve these ancient practices (Azaizeh *et al.* 2003; Erasto *et al.* 2005; Musa *et al.* 2011; Ouhaddou *et al.* 2014; Nguyen *et al.* 2019; Aparicio *et al.* 2021; Asante-Kwatia *et al.* 2021; Haile 2022). Since 2001, plenty of work has been done in Pakistan in the field of ethnobotany and ethnopharmacology (Shuaib *et al.* 2021). Badshah et al. (2010) documented 41 wild plant species from Malana area of Kurram District with *Mentha longifolia, Seripedium kurramensis, Thymus serpyllum, Artemisia absinthium, and Berberis lyceum* as most commonly used medicinal plants. From Dir Kohistan Jan et al. (2011) reported 65 plants with multiple uses of which 47 species were utilized as crude medicine. Noor et al. (2013) documented 26 plants with different utilities from Astore valley of Gigit-Baltistan region. These plants were used by local healers as well as the common folk to cure arthritis, bone fracture, urinary tract infections (UTI's), asthma, diabetes, hypertension and other common ailments. Ahmad et al. (2014) recorded 50 medicinally valuable plants belonging to 35 families from Chail valley of Swat District. They reported *Origanum vulgare, Skimmia laureola* and *Geranium wallichianum* to be most frequently used plants in the locality. From Barawal Bandi locality of Dir District, Hussain et al. (2014) reported 62 plants which were used as food, medicine, shelter etc. Notable plants among them were *Amaranthus viridis, Cynodon dactylon, Coriandrum sativum, Ficus carica, Foeniculum vulgare, Olea ferruginea, Solanum nigrum, and Taraxacum officinalis*. They reported some plants to be effective cure for kidney disorders and spasm. Ali et al. (2016) documented 30 medicinally important plants from Khyber District with Fabaceae and Solanaceae as leading families. These plants were found to be effective in treating stomach related problems and as antipyretic agents. Ali et al. (2018a) documented 174 plants of medicinal importance from Hindukush range of Swat District. These plants were used by the residents of the region to treat digestive disorders, as tonics, analgesics, and anthelminthic agents. A study documented 88 species of medicinal plants belonging to 46 families from Balakot area of Mansehra District. They reported the leaves to be most frequently used plant part from their study area (Irfan *et al.* 2018). Other significant studies on ethnobotany have documented data from Tall-Dardyal, Tirat, Charbagh, Madyan, Kabal, Mankial and Shawar valley of Swat District (Khan *et al.* 2018; Ali *et al.* 2017; Khan *et al.* 2015; Ahmad *et al.* 2013; Ahmad *et al.* 2011; Ahmad *et al.* 2011; Hussain *et al.* 2006) in addition to Hamayun, 2003; Mahmood *et al.* 2011; Abbasi *et al.* 2013a, 2013b; Akhtar *et al.* 2013; Bano *et al.* 2014a, 2014b; Kayani *et al.* 2015 and Rashid *et al.* 2015. Torwali community is named after the Torwali language, and they are still holding strong to ancient subcontinental traditions. Present study was designed:

1. To document the ethnobotanical knowledge of the Torwali Community
2. To record the recipes and methods of preparing crude medicine from the plants
3. To document the Torwali names of the plants collected from the research area

Materials and Methods

Study area and climatology

Tehsil Bahrain is an important tourist destination of the picturesque Swat valley, with a population of 123,200 according to census report of 2017. This beautiful area is located between the coordinates of approximately 34.9048° N latitude and 72.6047° E longitude surrounded by mountains of Hindukush range. The valley is situated at an elevation of around 1,400 m above sea level and spans over an area of approximately 58 km^2. Tehsil Bahrain has a rugged terrain with steep slopes and narrow valleys flanked by mountain peaks. The area experiences four distinct seasons having harsh winters and pleasant summers with a mean temperature of 22^{o}C. In winters the temperatures fall as low as -2^{o}C. The locality receives heavy rainfall in monsoon season during early July and late September with average annual precipitation around 800 mm. Spring season is characterized by agreeable climate, blooming flowers and landscape wrapped in green. The climate of Bahrain is best suited for agriculture and main cash crops include *Triticum aestivum, Oryza sativa* and *Zea mays.* The area is known for its rich biodiversity and unique ethnic composition (Ahmad *et al.* 2014; Ali *et al.* 2017; Ali *et al.* 2018a). The area lacks modern healthcare facilities and there is only one Basic Health Unit (BHU) and that too lacks latest equipment. Usually, those in need of medical attention are rushed to Saidu Sharif Teaching hospital. This is the primary reason that local folk depend on crude drugs obtained from plants of the area. For collecting ethnobotanical data 11 villages of Torwali community were selected for data collection viz. Bahrain, Kaidam, Ayeen, Kambalai, Chail, Ramait, Laikot, Panjigram, Shagai, Cham gharai and Mankiyal (Figure 1).

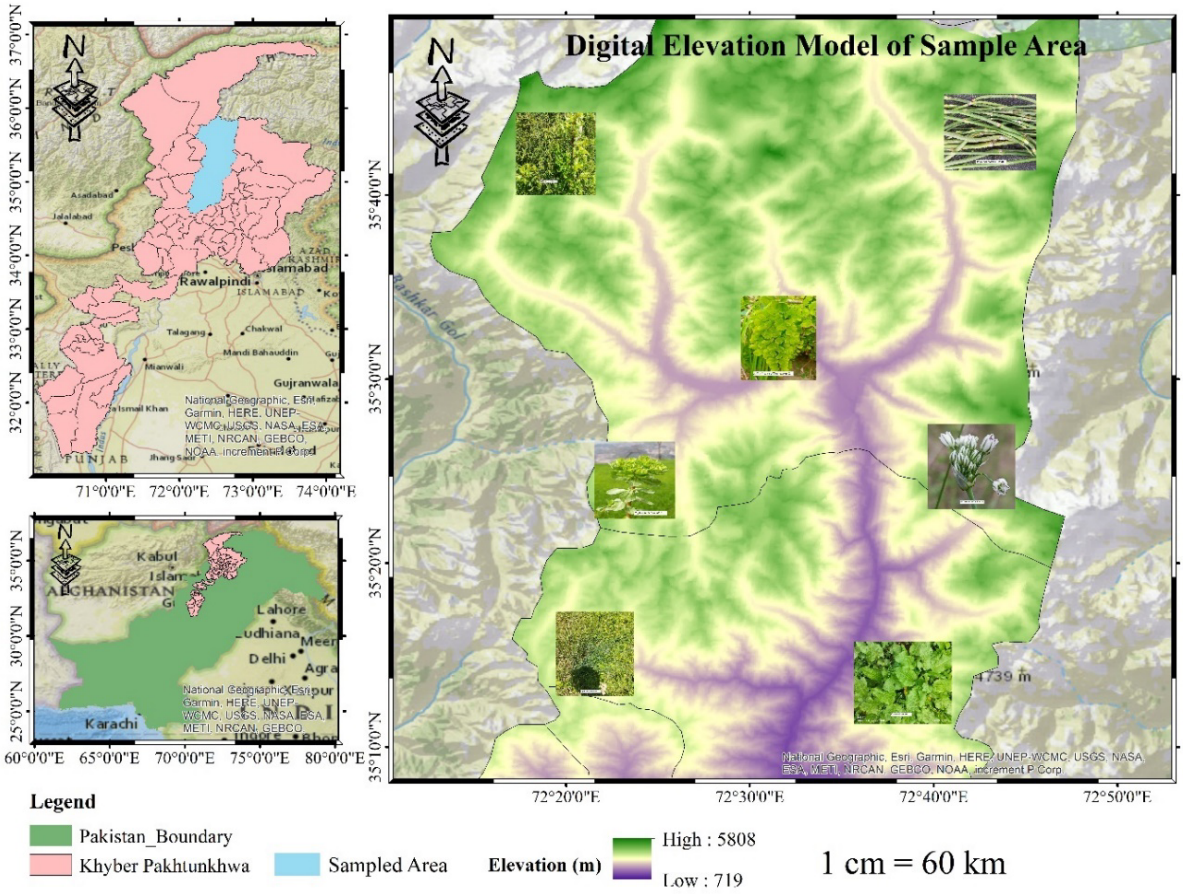

Figure 1. Map of Swat and Digital elevation model of study area.

Ethnic composition of Bahrain area

There are two main tribes inhabiting the Bahrain area i.e., Torwali and Pashtuns. Torwali are the indigenous tribe of the valley which have their distinctive language, culture and customs. Torwali people trace back their origin to Dardic era with very rich history. Yousafzai is the leading subtribe of Pashtuns in the locality. Apart from Torwali and Pashtun tribes the area also has good numbers of Gujjar and Kohistani people (Zubair 2006).

Torwali community and Torwali language

Torwali is from the Dardic family of languages. Torwali people are predominantly inclined towards agriculture and livestock farming. They have a rich tradition of handicrafts including basket weaving, embroidery and to a lesser extent pottery. The Torwali people are very friendly and are known for their hospitality, ability of hard work, loyalty and resilience. Idara Baraye Taleem-o-Taraqi (IBT), headed by Zubair Torwali, has a huge role in reestablishing Torwali as a distinct language. IBFT has developed a standard script for Torwali language and are regularly publishing a quarterly journal *Sarbuland*. It is important to mention that due to the efforts of IBT, Torwali has been recognized as distinct language in 2023 by Government of Islamic Republic of Pakistan (Usman 2021; Zubair 2006).

Data collection

Study was divided into two phases, each corresponding to appropriate season keeping in view the availability of medicinal plants in the locality (Mahmood *et al.* 2011; Bano *et al.* 2014a, 2014b; Ali *et al.* 2018a). Regular field visits were arranged to collect information regarding the valuable plant resources as well as for collection of plant samples from the wild (Nyirenda and Chipuwa, 2024). Most of the plant specimens were gathered during summer and spring season. Data was collected through interviews, corner meetings and questionnaire (White *et al.* 2005). Prior consent of each participant was taken before recording any information. The questionnaire (Supplementary data file I) was properly designed having sections for recording personal information as well as precise details regarding knowledge and utilization of ethnobotanically important plants. A total of 120 questionnaires were distributed among people belonging to different age groups and different income classes. The elderly folk were found to be more knowledgeable regarding medicinally valuable plants (Figure 2). Interviews and corner meetings were arranged with assistance of IBT Bahrain, a nongovernmental organization working for the uplift and conservation of Torwali language. During interviews and corner meetings, the interpreters were provided by IBT. Plant species were duly photographed, collected, identified, mounted, preserved and assigned voucher specimen numbers as per international standards (Nasir & Ali, 1970-1989; Ali & Nasir, 1989-1992; Ali & Qaiser, 1995-2020). All plant specimens were deposited at the Herbarium of Department of Botany, Govt. Post Graduate Jahanzeb College Saidu Sharif, Swat. After data collection extensive literature review was carried out focusing on published data from Khyber Pakhtunkhwa province.

Data analysis

The data collected through questionnaires, interviews and corner meetings was properly tabulated in MS Excel for generating primary data matrices. The interview data was also subjected to thematic analysis (Asghar *et al.* 2018a; Bibi *et al.* 2022). The primary data matrices were imported to PcOrd version 5 for Two-Way cluster analysis and Principal Component Analysis (PCA). Relative frequency of citation (RFC), Family Importance Value (FIV), Use Value (UV) and Fidelity level (FL) of plant species were calculated according to following formulae.

Frequency of citation (FC) is the total number of respondents who had reported the uses of each medicinally valuable plant (Hoffman and Gallaher, 2007).

Relative Frequency of citation **(RFC)** values were calculated as per following formula.

$$RFC = \frac{FC}{n} \; (0 < RFC < 1)$$

Where FC represents the number of informants who reported the use of a specific plant species, and *n* is the total number of informants who participated in the survey (Tardio and Pardo-de Santayana 2008; Vitalini et al. 2013).

Family importance value (FIV) values were computed as follows:

$$FIV = \frac{FC}{n}\ x\ 100$$

"*FC*" represents the frequency of citation of a family. "*n*" is the total number of informants in the survey (Vitalini et al. 2013).

Use value (UV)

The use-value (*UV*) reflects the relative importance of a plant species as reported by the informants. It is calculated as follows:

$$UV = \frac{\sum U}{n}$$

Where *U* refers to number of use reports by each informant for a particular plant and *n* refers to total number of informants. *UV* value helps in determining the plants which are most frequently used for a particular purpose (Philips et al. 1994; Savikin et al 2013).

Fidelity level (FL)

Fidelity level is the % age of informants which used a particular plant species for some purpose. It is calculated as below:

$$FL = \frac{Np}{n}\ x\ 100$$

Where *Np* is number of informants who reported a particular use a plant species and *n* are the total number of informants (Friedman et al. 1986; Alexiades and Sheldon 1996; Hoffman and Gallaher, 2007).

Cluster analysis was carried out following Bibi et al. 2022. The radial diagrams for ethnobotanical indices were prepared using Origin version 11.

Results and Discussion

Demographic characteristics of respondents

In the study, 120 respondents, including farmers, laborer, shopkeepers, government employers, smiths, jobless, scholars and private employees to document information about the medicinal herbs for treating different ailments (Figure 2). The age-based distribution of respondents revealed that most of the respondents were old, i.e., >51 (8 %), > 55 (12 %), > 60 (13 %), and >70 (8 %). Based on education, most were illiterate, i.e., 22 %, followed by under matric (15 %), while the rest were in high schools, higher secondary schools or doing graduation. The study revealed that most of the respondents were from hilly areas with thick vegetation viz. Chail (8 %), followed by Cham garahi (7 %), Kaidam and Mankeya (5 % each) (Fig. 2).

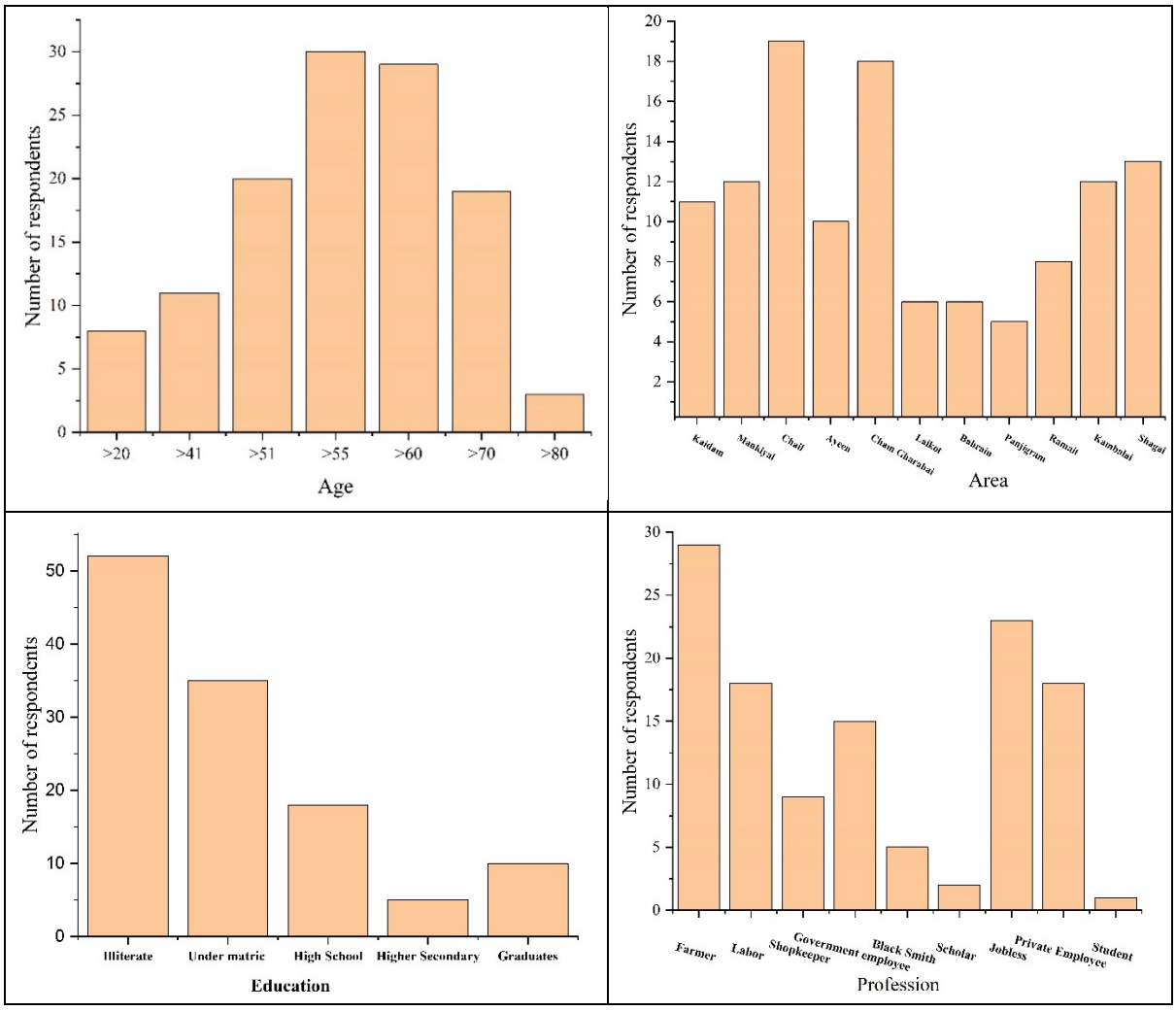

Figure 2. Graphic details of Age, Area, Education, Profession of respondents.

Floristics

The floristic spectrum of the plant species was diverse as presented in Table 1. The species' life cycle was mostly perennial in the groups, i.e., more than 60 % in each group having less cumulative variance % age, indicating low variations compared to annual and biennial life cycles with a higher cumulative variance of 66.5 and 95.37 %, respectively. Similarly, based on the leaf size classes, most species were mesophyll or microphyll, while only three species were nanophylls, i.e., one each in groups III and VII. The cumulative variance was highest for nanophylls, i.e., 138 %, while the lowest was for microphylls, i.e., 29.88 %. The species were mostly herbs that were easily picked and utilized for medicinal purposes, showing less cumulative variance of 38.74 %, indicating their uniform distribution in the studied groups, while the highest cumulative variance was for climber, represented by only one specie in group-VII, followed by 99.15 % cumulative variance for shrubs indicating their uneven distribution in the groups. According to Raunkiaer life form scale, the species reported were mostly phanerophytes, i.e., micro, meso and macrophanerophytes, followed by therophytes. However, the mesophanerophytes showed higher cumulative variance, indicating their uneven distribution in the studied groups. Bano et al. 2014a; Singh et al. 2020 and Bibi et al. 2022 have employed similar approaches for floristic appraisal of the ethnobotanical data from their respective localities.

Table 1. Floristics comparison of the groups separated by wards agglomerative cluster

FF	C	G-I	G-II	G-III	G-IV	G-V	G-VI	G-VII	G-VIII	CV %
LC	A	4	7	6	0	1	3	4	3	66.57
	B	2	2	1	1	1	0	0	0	95.37
	P	9	13	16	15	5	7	5	4	51.93
LSC	L	2	2	1	2	0	2	1	1	54.11
	N	1	0	1	0	0	0	1	0	138.01
	Mic	4	5	6	3	4	4	4	2	29.88
	Mes	4	11	14	11	2	3	2	4	75.43
	Meg	3	0	1	0	1	1	1	0	113.26
Habit	Herb	9	13	12	8	4	9	6	5	38.74
	Shrub	4	8	6	2	1	1	1	0	99.15
	Tree	1	1	5	6	1	1	1	2	91.24
	C	0	0	0	0	0	0	1	0	282.84
RLF	Th	2	5	4	2	0	1	3	1	74.18
	MicP	3	5	2	2	4	3	1	1	53.63
	MesP	1	0	5	0	2	0	2	1	122.55
	MegP	4	6	7	8	1	1	1	2	77.75
	G	2	4	1	1	0	2	2	1	73.09
	HC	1	2	3	3	0	2	0	0	94.73
	Ch	0	0	0	0	0	1	0	0	282.84

Key: LC-Life cycle, LSC-Leaf size class, RLF- Raunkiaer life form, A-Annual, B-Biennial, P-Perennial, L-Leptophyll, N-Nanophyll, Mic-Microphyll, Mes-Mesophyll, Meg-Megaphylls, C-Climber, Th-Therophytes, MicP-Microphanerophytes, MesP-Mesophanerophytes, MegP-Megaphanerophytes, G-Geophytes, HC-Hemicryptophytes, Ch-Chomophytes.

Ethnobotany

The current study, conducted during 2021 and 2023, documented 110 plant species belonging to 60 families. The leading family was Rosaceae with 9 species (14.5%) followed by Lamiaceae (7 spp. 11.29%). Fabaceae and Solanaceae (5 spp. each, 8.06%) while Asteraceae, Brassicaceae, Polygonaceae and Rutaceae were represented by 4 species each (6.45%). Families like Alliaceae, Amaryllidaceae, Apiaceae, Apocynacae, Araliacae, Colchicaceae, Ebenaceae, Euphorbiaceae, Fagaceae, Papaveracae, Pinacae, Scrophulariacae, and Urticaceae had 2 species each (3.22%). Families with a single representative species (1.61%) included Acroaceae, Amaranthaceae, Asparagaceae, Balsaminaceae, Betulacae, Campanulaceae, Caprifoliacae, Cuppressaceae, Datiscaceae, Dennstaedtiaceae, Dioscoraceae, Equisetaceae, Meliaceae, Rhamnaceae, Primulaceae, Fumariaceae, Geraniaceae, Punicaceae, Pteridiaceae, Helvelliaceae, Hypericaceae, Juglandaceae, Lilliaceae, Melanthiaceae, Malvaceae, Moraceae, Orchidaceae, Oxilidaceae, Paeoniaceae, Plumbaginaceae, Portulacaceae, Rubiaceae, Saxifragaceae, Simaroubaceae, Taxaceae, Ulmaceae, Vitaceae, Valerianaceae, and Zygophyllacae (Table 2). These plant species were used by the Torwali people to treat a variety of ailments such as Skin problems (2.34%) (Spiewak, 2000; Mahé *et al.* 2005; Abbasi *et al.* 2010; Umair *et al.* 2017; Aziz *et al.* 2018; Malik *et al.* 2019; Sharif *et al.* 2022), Abdominal Pain (9.37%) (Rahmat *et al.* 2019; Wali *et al.* 2022) (Jeong *et al.* 2012; Mary Helen *et al.* 2012; Khan *et al.* 2021), Anti-Cancerous (1.56%) (Jeong *et al.* 2012; Mary Helen *et al.* 2012; Khan *et al.* 2021), Carminative (1.56%) (Molares and Ladio, 2009; Ahmad *et al.* 2017; Aziz *et al.* 2018), Anti-Hepatitis (3.90%) (Aziz *et al.* 2016; Jahangeer *et al.* 2020; Sharif *et al.* 2022), Diuretic (2.34%)

(Adebayo *et al.* 2004; Sadat-Alhosseini *et al.* 2017; Aziz *et al.* 2018), Weight Gain (3.12%), Antidiarrheal (0.78%) (Aziz *et al.* 2016; Aziz *et al.* 2018), Flu (1.56%) (Kayani *et al.* 2014; Aziz *et al.* 2016; Aziz *et al.* 2018; Sharif *et al.* 2022), Anti-Hypertensive (2.34%) (Meli *et al.* 2009; Ahmad *et al.* 2015; Malik *et al.* 2018), Aphrodisiac (0.78%) (Aziz *et al.* 2018; Sharif et al.,2022), Wound Healer (1.56%) (Mahé *et al.* 2005; Abbasi *et al.* 2010), Anti-diabetic(7.81%) (Yaseen *et al.* 2015; Aziz *et al.* 2018; Tariq *et al.* 2020), Anti-inflammatory (2.34%) (Anwar *et al.* 2007; Aziz *et al.* 2018; Ahmadiani *et al.* 2001; Sharif *et al.* 2022), Kidney Stones (0.78%) (Aziz *et al.* 2018; Sharif *et al.* 2022), Anti-Pyretic (6.25%) (Ahmadiani *et al.* 2001; Aziz *et al.* 2018; Sharif *et al.* 2022), Sciatica (0.78%) (Wali *et al.* 2022), Appetizer (0.78%), Abscess (2.34%) (Spiewak, 2000), Blood Purifier (3.12%) (Aziz *et al.* 2018; Usman *et al.* 2021), Cooling Agent (9.37%) (Aziz *et al.* 2018), Dyspepsia (2.34%) (Hanlidou et al, 2004; Macia *et al.* 2005; Lee *et al.* 2008; Molares and Ladio, 2009; Choudhury *et al.* 2015; Güzel *et al.* 2015; Suleiman 2015; Sadat-Hosseini *et al.* 2017; Umair *et al.* 2017; Abdullah *et al.* 2020), Cardiac Problems (0.78%) (Ahmad *et al.* 2014; Ali *et al.* 2018a; Aziz *et al.* 2018; Chaachouay *et al.* 2022), Liver Disorder (0.78%) (Jahangeer *et al.* 2020), Asthma (2.34%), Analgesic (3.12%) (Nasri and Shirzad, 2013; Hijazi *et al.* 2017; Aziz *et al.* 2018; Shareef *et al.* 2019; Sharif *et al.* 2022), Anti-fungal (2.34%) (Kumar et al. 2006; Ismail *et al.* 2012), Delivery Problems (2.34%) (De Wet and Ngubane, 2014; Bibi *et al.* 2017), Cholera (1.56%) (Aziz *et al.* 2018; Sharif *et al.* 2022), Hypnotic (0.78%) (Emamghoreishi and Heidar-Hamedani, 2006; Khan, 2014), Toothaches (1.56%) (Sharif *et al.* 2022), Anti-periodic (0.78%) and Purgative (1.56%) (Umair *et al.* 2017; Abdullah *et al.* 2020) (Supplementary data file 2; Figure 3 and 10). Majority of the Torwali people lack proper financial resources and they have to rely heavily on crude medicine derived from medicinal plants found in their area.

Ethnobotanical indices

The group-based comparison to evaluate the variations of ethnobotanical indices of the recorded medicinal plant species is presented in Figure 4. The highest frequency of citation was recorded for the plants of Group IV (14.8±1.4), followed by Group VI (12±0), while the lowest was for Group VII (3.7±0.34). The index showed significant variation across the groups having F-value = 333 and P-value ≤ 0.05, while the relative frequency of citation was uniform across the groups showing non-significant variations. Similarly, the Fidelity level displayed the same pattern of variation, having an F-value = 553 and a P value ≤ 0.05. However, the use value did not follow the same pattern, i.e., the highest use value was reported for the plants of Group VII (0.76±0.49), followed by Group I (0.54±0.29). In contrast, the lowest was reported for Group IV (0.22±0.22), showing significant variation (F-value 7.71, P-value < 0.05). The conservation status was highest for the plants of Group VIII and Group I. At the same time, the rest of the groups had low value of conservation status showing significant variation (F-value.2.9, P-value < 0.05). The quantitative ethnobotanical indices of individual plant species in each group are presented in the radial diagram in Figure 6. The citation and fidelity level frequency of all the plant species in group I are the same (6 and 5, respectively) except for *Atropa acuminata* (7 and 6, respectively). Similarly, the relative frequency of citations remains uniform in the group. However, the conservation status and use value vary in the group, ranging from 4 to 1 and 1 to 0.2, respectively. Similarly, groups II and III plant species show the same pattern of ethnobotanical indices variations. However, the plant species of group IV had higher values of ethnobotanical indices, i.e., frequency citation ranged from 14 to 6 and fidelity level 8 to 5, while these plants had a low value of conservation status ranging from 4 to 1. Moreover, groups V-VIII were relatively small groups with fewer plant species with relative frequency of citation ranging from 4 to 7 and fidelity levels of 4 to 1. For all the reported species, use value ranged from 0.11 to 0.83 (Supplementary data file 2).

Plant use categories

Locals of eleven monitoring sites were using these recorded plants for multiple purposes. Our study reveals that 6 species (5.45%) were used are vegetable, 4 species (3.63%) were used as fodder for animals while 80% of the plants were used to treat different ailments. Torwali community has strong belief in the occult hence 3 species (2.72%) were used as repellent for evil eyes and 1 species (0.90%) was used making amulets to be used for magical purposes. Three species (2.72%) were used as fuel wood species.

Medicinal plants

Wild plants are the primary source of medicine in tehsil Bahrain and a huge section of Torwali community depends on medicine obtained and prepared from these medicinal plants. We identified 88 plants with medicinal value which account for 80% of the all the plant species documented. Most commonly used medicinal plants included *Berberis lycium, Dioscorea deltioidea, Paeonia emodi, Colchicum luteum, Colchicum autumnale, Rheum webbianum, Aconitum heterophyllum, Valeriana jatamansi, Achillea millefolium, Ephedra gerardiana, Thymus linearis, Acorus calamus,* and *Bistorta amplexicaulis.* Twelve (9.37%) species of the plants were used to relive abdominal pain. Likewise, 12 species (9.37%) were used as cooling agent and 10 species (7.81%) were used as anti-diabetic plants. Eight (6.25%) species were used by the locals as antipyretics to break fever. Three plants were utilized to treat hypertension, 3 were used as anti-inflammatory agents and 4 plants were found to have blood purifying properties. Ten plant species were used to treat a variety of skin related issues, abscess, antimycotic and smallpox.

Table 2. Medicinal uses and recipes of the plants along with its parts used and FIV

Species	Family	Voucher No.	Local Name	FIV	Parts used	Uses	Recipes
Acorus calamus L.	Acoraceae	HA001HJC	Bai~ - بیئ	5	R	Used as cure for animals' general weakness, abdominal pain, anti-malarial and anti-pyretic.	Used in powder form and taken orally with water.
Adiantum capillus-veneris L.	Adiantaceae	HA0081HJC	Harara - ہارڑا	4.1	WP	Antidiabetic, analgesic, weight loss, anti-fungal, Diuretic	Leaves are dried and then then orally taken with water.
Amaranthus viridis L.	Amaranthaceae	HA0012HJ	Ganhar - گھنار	5.8	S-L	Used as vegetable and edible.	Used in cooked form as vegetable.
Allium cepa L.	Amaryllidaceae	HA0068HJC	Palanco - پلان چو	12.5	L-B	Diuretic, stimulant used for skin disease, used for making spices and condiments. used as vegetables.	Used in vegetable making as well as eaten in raw form.
Allium humile Kunth	Amaryllidaceae	HA003HJC	Zangali Piyaz - زنگلی پیاز/پلا	12.5	R-L	Asthma, stomach disease and aphrodisiac	Used in vegetables cooking or raw form
Allium sativum L.	Amaryllidaceae	HA002HJC	Lehshem لھیشم	12.5	B-L	Anti-hypertensive, digestive disorders and aphrodisiac, used for making spices and condiments, used as vegetable.	Used in cooked or raw form.
Narcissus tazetta L.	Amaryllidaceae	HA004HJC	Guli Nargas - گلی نرگس	5.8	R	Pimples and mastitis	Used in powder form
Coriandrum sativum L.	Apiaceae	HA006HJC	Daniyal - دانیال	**10**	S-L	Diuretic, aromatic, refrigerant, stimulant and tonic.	Green leaves and seed are edible and orally taken with water.
Foeniculum vulgare L.	Apiaceae	HA005HJC	Kagawelanay - کاگاولنے	**10**	L-DF	Carminative, anti-helminthic, expectorant, diuretic, stimulant, sedative and used for chest infections, used in Preparation of condiments and spices.	Green leaves are edible as well as used in powder form and taken orally with Water.
Caralluma edulis (Edgew.) Benth. ex Hook.f.	Apocynaceae	HA007HJC	Pamankay پمنکے	5.8	L	Used as vegetable and edible	Used in Cooked Form.
Hedera nepalensis L.	Araliaceae	HA008HJC	Polol - پولُول	3.3	S-L	Used for abdominal pain, liver disorder, digestive problems, anti- diabetics, diaphoretic and stimulant	Powder are formed and then orally taken with water.
Asparagus gracilis Royle	Asparagaceae	HA0013HJC	Thenodray تندوڑے	5.8	S	As aphrodisiac and for treating urinary disorder.	Used in fresh form.

Achilea millefolium L.	Asteraceae	HA0011HJC	Qarqara - قرقرا	14.6	WP	Sudden Pain, abdominal Pain and anti-inflammatory	Powder is made and then taken orally with water or tea
Cichorium intybus L.	Asteraceae	HA0010HJC	Han si shah - ہن سی شا	14.6	L	Anti-pyretic and used as vegetable.	Used in fresh form or cooked as vegetable.
Tagetes minuta L.	Asteraceae	HA009HJC	Kashmaala - کشمالا	14.6	F	Used for aromatic and aesthetic purposes	Dried and then used.
Impatiens bicolor Royle	Balsaminaceae	HA0017HJC	Hatrang ہاترنگ	3.3	F-L	Used in wound healings, skin disorders, digestive disorders, used as pain killer.	Used in dried form.
Berberis lyceum Royle	Berberidaceae	HA0014HJC	Owyel hesh niya - اُوجیل ہیِژنأ -	25.8	R-B	Wounds healings, hepatitis and oral Diseases.	Taken as fresh for wound healing and applied or powder are orally taken with water.
Berberis vulgaris L.	Berberidaceae	HA0015HJC	Kishen heshniya - کیِشین - ہیِژنأ -	25.8	R-B	Wounds healings, cooling agent and anti-diabetics.	Taken as fresh for wound healing and applied or powder are orally taken with water.
Podophyllum hexandrum Royle	Berberidaceae	HA0016HJC	Mogo ƈo مگوچو	25.8	R	Anti-anemic, general weakness and skin disease, wound healer.	Fresh leaves are applied on wounds and also taken Orally with Water.
Betula utilis D.Don	Betulaceae	HA0018HJC	Bhush - بُھش	3.3	B	Used for magical purposes and for amulets.	Fresh leaves are sun dried and then used.
Brassica campestris L. var. *rapa*	Brassicaceae	HA0022HJC	Tepar - ٹیپر	22.5	L-F	Used as vegetable	Cooked as vegetable and then used.
Lepidium sativum L.	Brassicaceae	HA0019HJC	Halam - ہلم	22.5	S	Used in delivery cases, abdominal pain and for gastric pain.	Seeds are taken orally with water or tea.
Nasturtium officinale R.Br.	Brassicaceae	HA0021HJC	Tarmeera ترمیرا	22.5	L	Used as vegetable and edible, used for stomach problems, also used for curing animal ailments.	Either cooked or dried and the used.
Raphanus sativus L.	Brassicaceae	HA0020HJC	Aexean - أخأن	22.5	WP-L	Carminative and diuretic cures piles and also utilized in the treatment of urinary tract infections (UTI).	Edible in fresh form.
Campanula latifolia L.	Campanulaceae	HA0023HJC	Bangra - بھنگرا	0.25	R-L	For pregnancy and delivery problems.	Used in dried and powder form and orally taken with water.
Valeriana jatamansi Jones.	Caprifoliaceae	HA00109HJC	Banafsha بنفشا	5	R-L-F	Anti-pyretic and flu, goiter in animal, medicine preparation and used for trade.	Used in dried or fresh form and taken orally with water.
Valeriana officinalis L..	Caprifoliaceae	HA0024HJC	Mush-ki-Bala - مشک بالا	9.1	Rh	Anti-hypertensive, sedative and anti-spasmodic.	Powdered rhizome is taken with water.

Colchicum autumnale L.	Colchicaceae	HA0027HJC	Shain - شین	17.5	C-R	Healing and for gaining body mass also given to patient of spleen enlargement.	Used in fresh as well as dried form.
Colchicum luteum Baker	Colchicaceae	HA0026HJC	Leez - لیز	17.5	C	Used for gout also used as carminative.	Orally taken with water or tea.
Juniperus communis L. var. *saxatilis* Pallas	Cupressaceae	HA0199HJC	Ghugur گھوگور	6.6	F-L	Measles, body itching and for evil eyes.	Dried, powdered and taken orally with water or milk.
Datisca cannabina L.	Datiscaceae	HA0028HJC	Karbail - کربیل	3.3	R-L	Anti-helminthic and used for purifying human abdomen.	Orally given in tea or flour.
Pteridium aquilinum (L) Kuhn	Dennstaedtiaceae	HA0029HJC	Kenji - کینجی	7.5	Leaves	Used as vegetable.	Used as vegetable
Dioscorea deltoidea Wall. ex Kunth	Dioscoreaceae	HA0030HJC	Khanees - کنیز	5	R-Rh	Used for making halwa and are also edible, cure for urinary disorder, anti-helminthic, expectorant.	Orally given in halwa or flour.
Diospyrus kaki L.	Ebenaceae	HA0032HJC	Lahur Aalok - لہور آلوک	13.3	F-W	Fruits are edible and wood is used for fuel.	Used in fresh form and as edible.
Diospyrus lotus L.	Ebenaceae	HA0031HJC	Aalok - آلوک	13.3	F-B-S	Used as fuel wood, for abdominal pain and constipation.	Seeds are grinded to powder and then orally taken with water.
Equisetum arvense L.	Equisetaceae	HA0035HJC	Bandakay بندکئی	4.1	S	Stimulant, sex tonic and considered effective in removal of kidney stones	Edible in fresh form or dried to make powder
Euphorbia helioscopia L.	Euphorbiaceae	HA0034HJC	Hath Pash - ہات پاش	10	L-La	Poisonous, skin problems, cholera and cure for periods (Menses)	Topically applied on wounds.
Ricinus communis L.	Euphorbiaceae	HA0033HJC	Haranda ہارنڈا	10	S	Purgative, laxative, anti-dysenteric, cure for respiratory problems.	Dried and then grinded to powder and then orally given.
Cassia fistula L.	Fabaceae	HA0042HJC	Landes - لانڈیز	46.6	S	Used in diarrhea and pain in children	Soaked in tea and then given orally to children.
Indigofera gerardiana. Wall.ex Benth.	Fabaceae	HA0046HJC	Kaithi - کیتھی	46.6	R	Anti-fungal, digestive disorders and chronic pain.	Roots are orally taken with water.
Trifolium repens L.	Fabaceae	HA0045HJC	Shautal شوتل	46.6	L-S	Used as fodder for cattle's and edible.	Edible in raw form for cattle's and in cooked form for humans.
Trigonella foenum gracecum L.	Fabaceae	HA0047HJC	Malkhozy - ملخوزے	46.6	L-Se	Seeds and Leaves are edible.	Used in cooked form.
Vigna mungo (L.) Hepper	Fabaceae	HA0044HJC	Maii - مَے	46.6	Se	Used as pulses.	Used in cooked form.

Vigna unguiculata (L.) Walp	Fabaceae	HA0043HJC	Kulat - کُولات	46.6	Se	Used as pulses.	Used in cooked form.
Quercus dilatata Royle	Fagaceae	HA0049HJC	Tor bai تور بی	12.5	B-F	Anti-inflammatory and anti-diarrheal, construction purposes, fuel wood, used for making agriculture tools.	Powder are made which are then used.
Quercus incana W. Bartram	Fagaceae	HA0050HJC	Bai - بے	12.5	F	Respiratory problems, fuel wood, antidiarrheal and for gaining body mass. construction purposes, used for making agriculture tools.	Powder are used and taken orally with water.
Geranium wallichianum D. Don ex Sweet.	Geraniaceae	HA0057HJC	Ratanjhok رتن جھوک	5	R	Used for making Confect (Halwa).	Orally taken in the form of confect.
Hypericum perforatum L.	Hypericaceae	HA0059HJC	Nil chei نیل چیئ	5.8	L-S	Used for making green tea.	Orally taken.
Juglans regia Royle	Juglandaceae	HA0060HJC	Aashoo - آشو	6.6	F	Fruits are edible, fuel wood, used for making furniture.	Orally eaten as fruit.
Ajuga bracteosa Wall ex. Benth	Lamiaceae	HA0062HJC	Maaẓab - ماڑاب	64.5	L-R	Anti-diabetics, anti-hypertensive, blood purifier, skin problems and acts as a cooling agent.	Green leaves are soaked in water and then the water is orally taken.
Isodon rugosus (Wallich ex Benth). Hara	Lamiaceae	HA0067HJC	Solol - سولول	64.5	L-R	Tooth aches, anti-diabetic and hepatitis C.	Dried leaves are used.
Mentha arvensis L.	Lamiaceae	HA0064HJC	Podina پودنیا	64.5	L	Antiemetic, digestive problems and anti-coughing agent, used in condiments and spices.	Green leaves are eaten as well as used in dried form.
Mentha longifolia (L.) Huds.	Lamiaceae	HA0063HJC	Bain - بین	64.5	L	Anti-diarrheal, anti-pyretic, anti-coughing and acts as cooling agent, used in preparation of condiments and spices.	Powder are used and taken orally.
Mentha spicata L.	Lamiaceae	HA0065HJC	Podina پودنیا	64.5	L	Abdominal pain and pneumonia.	Dried and fresh leaves are orally administered.
Salvia lanata Royle	Lamiaceae	HA0061HJC	Matar niya - مترنأ.	64.5	R	Anti-pyretic, coughing and aches, used for children health, used as vegetable sedative, anti-emetic, wounds healing and cure for cholera	Powder as well as in fresh form it is used.
Thymus linearis L.	Lamiaceae	HA0066HJC	Spergai سپیرگی	64.5	Se	Used as herbal tree and fodder, also used for curing animals' ailments.	Dried seeds are orally taken with water.

Punica granatum L.	Lythraceae	HA0082HJC	Aanar - آنار	4.1	F-S	Used in chest infection, fruits are edible, helps in weight loss, and used in preparation of condiments and Spices.	Fresh as well as dried cover are used with water.
Malva sylvestris L.	Malvaceae	HA0070HJC	Shen - شین	13.3	L-S	Edible and used as vegetable.	Fresh leaves are cooked and then eaten.
Trillium govaniannum Wall. ex Royle	Melanthiaceae	HA0069HJC	Shedil niya - شیدل نیا	4.1	R	Increase lactation and used for general body weakness.	Powder are used.
Melia azadirachta L.	Meliaceae	HA0036HJC	Bakarny بھکانے	5	S	Asthma, skin diseases and anti-malarial	Grinded to powder and then used orally with water.
Ficus carica L.	Moraceae	HA0071HJC	Faag - پھاگ	10	F-La	Fruits are edible, used for abscess, anti-fungal used for stomach disorders, tooth pain and also effective against piles.	Fresh as well as dried fruits are eaten, and latex are topically applied on skin.
Morchella conica L.	Morchellaceae	HA00558HJC	Gezee گھیزی	10	M	High valued edible fungi. Also used in combination with other medicinal plants	Used in Medicines.
Cypripedium cordigerum D.Don	Orchidaceae	HA0072HJC	Ashan - آشان	10	F	Fruits are edible, used for digestive problems and anti-spasmodic.	Used in dried form.
Oxalis corniculata L.	Oxalidaceae	HA0073HJC	Cheege چیگی	5.8	L-R-Bu	Hepatitis C for stomach aches, diuretics, anti-helminthic and acts as cooling agent.	Eaten orally.
Paeonia emodi Royle	Paeoniaceae	HA0076HJC	Fhun Mamek - پُھون مأبیک	10	R	Back aches, Used for general weakness, for muscles aches, hepatitis and joint pain.	Used in dried form.
Corydalis stewartii Fedde.	Papaveraceae	HA0075HJC	Mamera - مامیرا	21.6	R	GIT disorder, anti-hypertensive and induced sleep.	Powder are orally taken with water.
Fumaria indica L.	Papaveraceae	HA0056HJC	Phaphrha پھاپھڑا	10	L	Anti-pyretic, abdominal pain, anti-diarrheal and used as cure for influenza.	Leaves are used in fresh or dried form and taken orally with water.
Papaver somniferum L.	Papaveraceae	HA0074HJC	Qashqash - قشقاش	21.6	S-Ca	Used for diarrhea analgesic, used for flu, attracts honeybees for nectar.	Powder are made which are then taken orally with tea.
Cedrus deodara (Roxb.) G Don	Pinaceae	HA0077HJC	Lo - - لو	23.6	Gu-B-O	Acts as cooling agent, anti-cancerous and blood purifier, fuel wood, field fencing, used for making furniture.	As medicine used in powdered form
Pinus wallichina A. B. Jack	Pinaceae	HA0078HJC	Che - چے	23.6	G-W	Fuel wood, anti-diabetic, wound healing, for pimples and antiseptic.	Gum is dried and powdered
Limonium cabulicum (Boiss) Kuntze,	Plumbaginaceae	HA0079HJC	Tehin niya - تھین نأ	10	R-L	Diarrhea, abdominal pain as cure for respiratory problems, anti-diabetics and acts as cooling agent.	Powder are taken orally with water.

Bistorta amplexicaulis D. Don	Polygonaceae	HA0037HJC	ʒen - - زّین	30	R	Used for increasing Sexual stamina of males, acts as cooling agents, also used for curing animals' ailments	Orally taken in dried form with green tea.
Rheum webbianum Royle	Polygonaceae	HA0038HJC	Chotiyal چوٹیا	30	L-R	Pain reliever, anti-diabetic, hyperlipidemia and acts as blood purifier.	Orally taken with water or tea.
Rumex dentatus L.	Polygonaceae	HA0039HJC	Owol - اوول	30	L	Wounds healing and skin disorders, used as vegetable.	Used in cooked or raw form.
Rumex hastatus L.	Polygonaceae	HA0040HJC	Chegi چیگی	30	L-R	Anti-hypertensive, throat pain and bloody dysentery, used as vegetable.	Used in cooked or raw form.
Portulaca oleracea L.	Portulacaceae	HA0080HJC	Loon - لونأ	8.3	WP	Used as cure for hepatitis C.	Cooked and then eaten.
Primula denticulata Sm.	Primulaceae	HA0048HJC	Mammera - مامیرا	13.5	Bu-L	Eye disorder such as glaucoma.	Orally taken with water.
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae	HA0086HJC	Shin Nae - شِن نأ	25.8	R	Used for gaining body mass, mythological plant.	Used in fresh form and taken with water.
Aconitum violaceum Jacq ex Stapf	Ranunculaceae	HA0085HJC	Zahar - زاہر	25.8	R	Anti-diabetic and acts as cooling agent.	Grinded to powder and then orally taken with milk.
Caltha alba Camb. var. *alba* Camb. ex Jacquem.) Hook.f. & Thoms	Ranunculaceae	HA0084HJC	Maşan - مشان	25.8	F-L	Used for gastric and abdominal pain.	Used in dried form and orally taken with water.
Ranunculus arvensis L.	Ranunculaceae	HA0083HJC	Kam posho - کم پُشُو	25.8	Rh-Se	Body aches, fever and respiratory problems.	It is used in dried form.
Ziziphus jujuba Mill	Rhamnaceae	HA0041HJC	Sezeen سیزِین	7.5	F	Fruits are edible, urinary problems, cure for infertility, sedative and delivery problems.	Used in dried or green form and orally eaten.
Malus domestica (Suckow) Borkh.	Rosaceae	HA0095HJC	Bhowi - بھوئی	93.3	F	Edible fruit rich source of Iron	Used in fresh form and orally eaten.
Prunus armeniaca L.	Rosaceae	HA0096HJC	Khubanai خوبانے	93.3	F	Fruits edible, sold at market.	Orally Eaten.
Prunus domestica L.	Rosaceae	HA0097HJC	Alichi - الیچے	93.3	F	Fruits edible, sold at market.	Orally eaten.
Prunus persica (L) Batsch	Rosaceae	HA0099HJC	An~ - آں	93.3	F	Fruits edible, sold at market, health tonic.	Orally Eaten.
Pyrus communis L.	Rosaceae	HA0094HJC	Nashpatai - ناشپاتی	93.3	F-W	Fruits are edible and wood is used for fuel.	Used in fresh form.
Pyrus pashia Buch. Ham. ex D. Don	Rosaceae	HA0092HJC	Shamdian شمدأن	93.3	R	Wounds healer and for gaining body weight.	Fresh fruits are edible.
Rosa brunonii Lindl.	Rosaceae	HA0098HJC	Zangali Gulab - زنگلی گلاب	93.3	L	Aesthetic purposes, and used for fencing, attracts honeybees for nectar.	Orally eaten.
Rosa indica L.	Rosaceae	HA0093HJC	Gulab Se poshu - گلاب سی پوشُو	93.3	F	Eye disorder, purgative and emollient, attracts honeybees for nectar.	Used in dried or soaked form.

Sorbaria tomentosa (Lindl.) Rehder	Rosaceae	HA0091HJC	Kraithi کریٹھی	93.3	R-L-Ba	Anti-diabetic, acts as cooling agent, respiratory disorder and typhoid.	Used in dried form.
Rubia cordifolia L.	Rubiaceae	HA0087HJC	Lhegir Na- لھیگیر نا	8.3	R	Skin Disorders and for Gaining body weight.	Powder are taken orally with water.
Citrus medica L.	Rutaceae	HA0089HJC	Neembo نیمبو	21.66	F	Used in foods and edible.	Used in fresh form.
Skimmia laureola DC	Rutaceae	HA0088HJC	Namey نمے	21.66	L	Used for evil eyes and for diarrhea, used for animals' ailments.	Used in dried form.
Zanthoxylum armatum DC.	Rutaceae	HA0090HJC	Teemo - تیِمو	21.66	Se-F	Blood purifier and acts as cooling Agent.	Dried grain is orally taken with meal.
Saxifraga stenophylla Royle	Saxifragaceae	HA00102HJC	Mergaya - میرگیا	4.1	F	Sacred plant and used for removal of kidney stones.	Orally taken in dried form with water or tea.
Verbascum densiflorum L.	Scrophulariaceae	HA00101HJC	Khar Ghwag	15.3	R	Wound healing and for general body aches	Taken orally in dried form with water and applied topically on wound in fresh form.
Verbascum thapsus L.	Scrophulariaceae	HA00100HJC	Khar Dhak - خردھک	15.3	L	Wounds healer and for body aches	Taken orally in dried form with water and applied topically on wound in fresh form.
Alianthus altissimia Mill	Simaroubaceae	HA00103HJC	Bhakanae - بھکانے	5.8	W-L	Used as fuel wood	Fuel wood.
Lycopersicum esculentum Mill.	Solanaceae	HA0053HJC	Badegan بادیگن	40	F	Edible used in vegetables, used for making Spices and condiments.	Can be used in cooked or fresh form.
Atropa acuminata Royle	Solanaceae	HA0051HJC	Garad - گرڑ	40	WP	Mind relaxing and eye disorders.	Grinded to powder and then used.
Capsicum annum L.	Solanaceae	HA0052HJC	Marchakay مرچکئی	40	F	As appetizer and used for increasing digestion.	Can be used in cooked or raw form.
Solanum tuberosum L.	Solanaceae	HA0054HJC	Alo - الو	40	T	Used as cash crops and sold at market, used as vegetable.	Used in cooked form as vegetable.
Withania coagulans (Stocks) Dunal in DC	Solanaceae	HA0055HJC	Bahed - بھیِد	40	L-R	Anti-inflammatory and used for joint pain.	Powder is orally taken with water.
Taxus wallichiana Zucc.	Taxaceae	HA00104HJC	Thoon تُھون	3.3	Se	Anti-cancerous and used for asthma treatment, fuel wood.	Grinded to powder and then orally taken with water.
Ulmus wallichiana Planch	Ulmaceae	HA00105HJC	Ko - کو	5.8	W	Used as fuel wood.	Used as fuel wood.
Debrigeesia saliciflolia D. Don	Urticaceae	HA00106HJC	Dhut Joli دُھت جولی	13.3	L	Anti-fungal and anti-microbial.	Topically applied or orally taken with tea.
Urtica dioica L.	Urticaceae	HA00107HJC	Jhown جھون	13.3	L-R	Abdominal pain and diarrhea.	Cooked as vegetable.

Vitis vinifera L.	Vitaceae	HA00108HJC	Daash - داش	4.1	F	Fruits are edible.	Eaten as fruit.
Peganum harmala L.	Zygophyllaceae	HA00110HJC	Spelani سپلینی	3.3	Se-L	Antiseptic, hypnotic, anti-emetic and anti-spasmodic.	Dried seeds are orally taken.

Key: R-Root, Leaves-L, Bulb-B, Dried fruit-DF, Seed-Se, Whole plant-WP, Flower-F, Stem-S, Bark-B, Rhizome-Rh, Corm-C, Wood-W, Latex-La, Buds-Bu, Tuber-T, Mycelium-M, Capsule-Cu, Gum-Gu, Oil-O

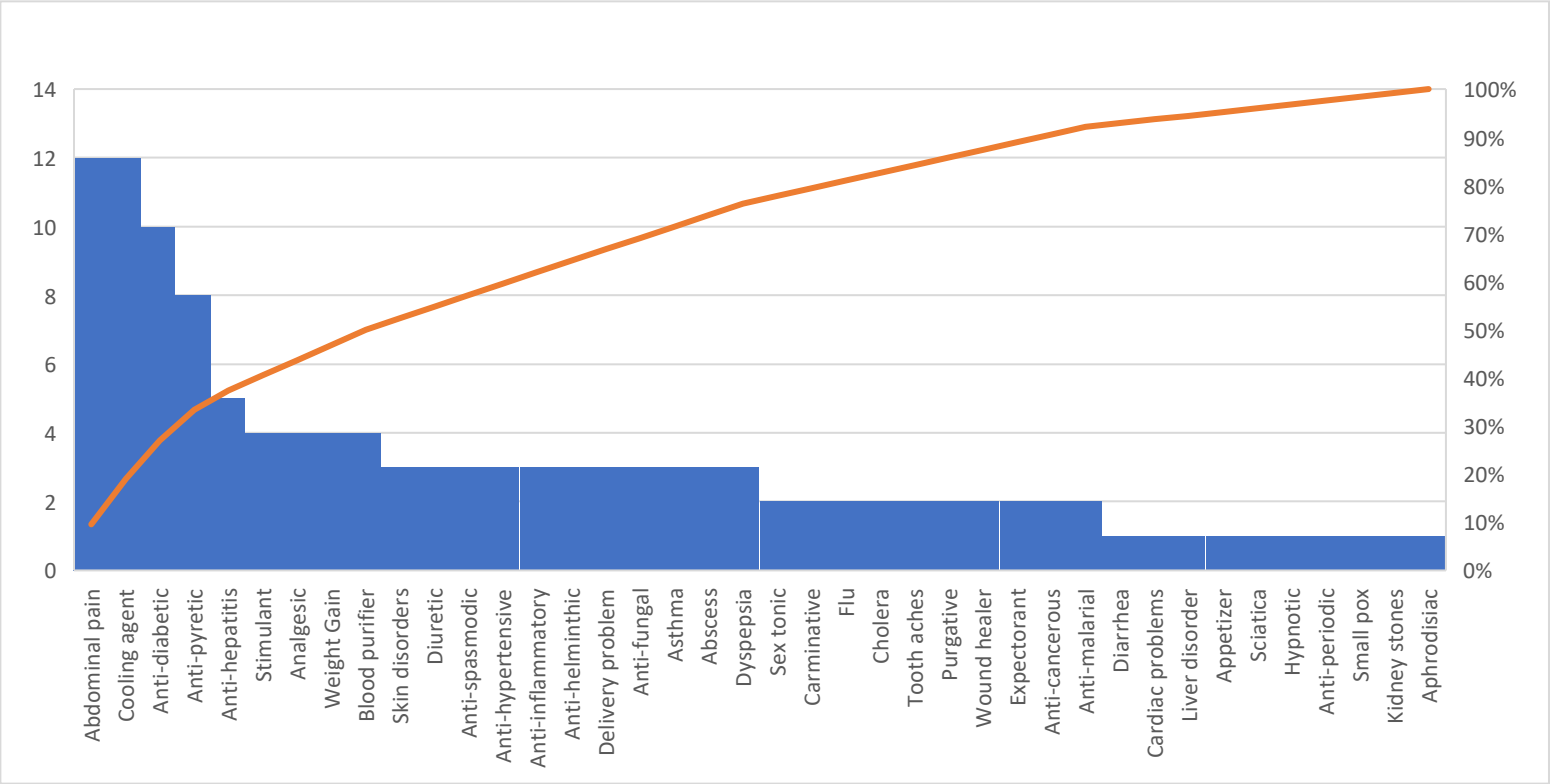

Figure 3. Therapeutic categories

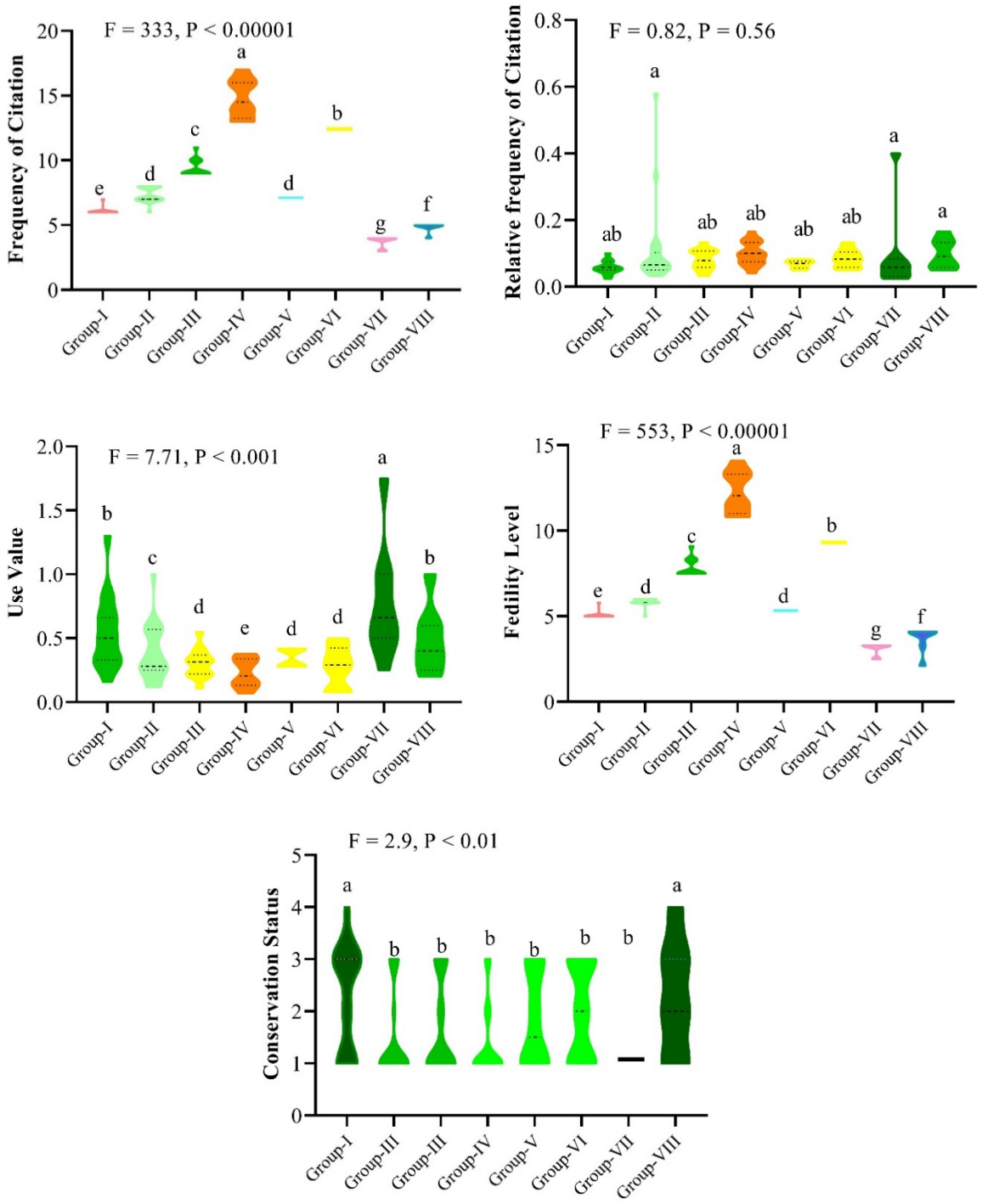

Figure 4. Comparison of the quantitative ethnobotanical indices of different groups segregated in eight groups by Ward's agglomerative cluster

Fodder species

For the livestock, Torwali people depend largely on fodder species whose availability becomes a serious issue in winters and early spring season. Our results revealed that 4 plant species (3.63%) were heavily utilized as fodder. Locals raise livestock such as cows, buffaloes, sheep and goat, which they take to high mountains in the summer season. In the grazing areas the locals construct unique huts called "*Baanda*" by using only mud and stone. They also collect fodder species from grazing pastures for winter when plant growth is scarce due to thick snow cover.

Fuelwood species

Among the documented plants 3 species (2.72%) served as sources of fuelwood in the area. Other noteworthy fuelwood species found in the study area included *Quercus dilatata, Pinus wallichiana, Cedrus deodara, Juglans regia, Taxus wallichiana.* Of these *Quercus dilatata, Pinus wallichiana*, and *Cedrus deodara* are facing tremendous pressure due to their over exploitation. The demand for fuelwood increases markedly at the onset of winter season.

Plants for timber

Current study revealed that 4 species (3.63%) were used for extracting wood for construction purposes. These included species like *Cedrus deodara, Taxus wallichiana, and Quercus incana and Quercus dilatata.* Demand for timber is ever increasing and this is leading to uncontrolled deforestation in the area.

Wild vegetables

Majority of the people residing in Torwali area are poor and their primary reliance for sustenance is on wild vegetables which are consumed in raw as well as cooked form. In our study we found 10 species (9.09%) which were consumed as vegetables. Among frequently consumed wild vegetables were *Malva sylvestris, Amaranthus viridis, Salvia lanata, Rumex hastatus, Rumex dentatus*, *Allium cepa, Allium sativum, Brassica campestris* and *Brassica oleracea*.

Plants used as veterinary medicine

Our findings revealed that 5 plant species (4.54%) were used by the Torwali people to treat a variety of veterinary diseases. These plant species included *Thymus linearis, Skimmia laureola, Bistorta amplexicaulis,* and *Nasturtium officinale.* Locals engaged in rearing livestock collect these plants during the growing season and store them for use in future.

Plants for apiculture

Apiculture is gaining popularity in the Tehsil Bahrain and adjoining areas due to increasing demand and price of pure honey. We documented 4 species (3.63%) which were cultivated and utilized for honeybees. Traditional beekeeping practices involve cultivating colonies of honeybees in earthen pots and hollowed logs affixed in house mud walls. These days honeybees are kept in wooden boxes and are periodically carried to places in the wild with good growth of *Papaver somniferum, Rosa brunonii, and Rosa indica*. The harvested honey is stored and then sold in nearby markets.

Fruit species

Six plant species (5.45%) were important as they yield edible fruits. These included *Prunus armeniaca, Diospyrus kaki, Prunus domestica, Diospyros lotus, Juglans regia,* and *Prunus persica*. Torwali people not only consume these fruits but also sell them in local and regional markets contributing to socioeconomic uplift of the locality. Of these *Juglans regia, Malus domestica, Prunus domestica,* and *Prunus persica* are special for their quality, nutrition value, good yield and attractive price. Deforestation is posing a big threat to population density of these wild edibles. *Diospyros lotus* is diminishing fast as it is being used as rootstock for grafting *Diospyros kaki*.

Spices and condiments

In culinary practices of Torwali people spices and condiments have an important place. This study documented 7 species (5.83%) being utilized as spices, condiments and flavoring agents. These included *Allium cepa, Allium sativum, Foeniculum vulgare, Lycopersium esculentum, Mentha longifolia, Mentha arvensis* and *Punica granatum.* Demand for these aromatic plants extends beyond the Torwali areas as these plants also make it to the nearby spice markets of Madyan as well as Mingora from where they make it other parts of the country.

Sacred and mythological plants

Torwali community holds intriguing mythical beliefs and customs associated with certain plants of the locality. These plants are collected, prepared and utilized by local *shamans* who are known to have acquired the related knowledge from their forefathers. These *shamans* believe that *Aconitum heterophyllum, Skimmia laureola* and *Saxifraga stenophylla* have magical powers. According to a local belief, consuming *Aconitum heterophyllum* will increase the body weight of underweight individuals. For this particular purpose, the one who wants to consume *Aconitum heterophyllum* will have to talk with the very plant before consuming it or it will lead to further weight loss and even demise. Elderly women burn the leaves and small branches of *Skimmia laureola* to fumigate their homes. These fumes are believed to have magical powers and can repel evil eyes.

Plants for making furniture

Three plant species (2.72%) were found to be used for making furniture. The furniture items made in the Torwali area are also transported for sale to other parts of the Khyber Pakhtunkhwa. Most commonly used plant species in this regard were *Cedrus deodara* and *Juglans regia*. Local carpenters are highly skilled, and their items attract a huge number of tourists during

the summer season. Growing demand of furniture has put a big pressure of population density of *Cedrus deodara* and *Juglans regia* and this is one of the reasons behind the thinning forests in the study area.

Plants for making agricultural tools

Agriculture is the most important source of livelihood for the Torwali people and in this area still the old agricultural practices are in use. We found 3 species (2.72%) employed in crafting agricultural tools. Of these *Quercus* sp. were highly valued due to their hard and durable wood.

Plants for fencing

Field fencing is a common practice in various regions of Bahrain valley especially around settlements, crop fields and tracts in the hills. These fences help in protecting the cash crops from grazing and browsing animals. Two species (1.81%) viz. *Cedrus deodara* and *Rosa brunonii* were commonly used in making fences across the Torwali area.

Two-way cluster analysis

Two-way cluster analysis of the ethnobotanically valuable plants of Torwali community was carried out following (Ali et al, 2018b; Singh *et al.* 2020; Bibi *et al.* 2022). Two-way cluster analysis classified the ethnobotanically valuable plants of Torwali community into eight groups on the basis of UV, RFC, CS, FC and FI (Figure 5, 6). Group-I included *Acorus calamus*, *Coriandrum sativum*, *Campanula latifolia*, *Foeniculum vulgare*, *Rumex dentatus*, *Achillea millefolium*, *Bistorta amlexicaulis*, *Diospyrus lotus, Raphanus sativus, Aconitum heterophyllum, Atropa acuminata* and *Morchella conica*. Group-II comprised of *Aconitum violaceum*, *Caltha alba*, *Colchicum autumnale*, *Brassica campestris*, *Datisca cannabina*, *Allium cepa*, *Salvia lanata*, *Allium sativum, Papaver somniferum*, *Nasturtium officinale*, *Capsicum annum, Debrigeasia salicifolia*, *Citrus medica*, *Taxus wallichiana*, *Thymus linearis*, *Vitis vinifera*, *Caralluma edulis*, *Withania coagulense, Rheum webbiana*, *Sorboria tomentosa*, *Equisetum arvense*, *Vigna mungo* and *Vigna unguiculate*. Group-III included *Adiantum capillus-veneris*, *Indigofera gerardiana*, *Pyrus pashia*, *Impatiens bicolor*, *Rumex hastatus, Punica granatum, Skimmia laureola, Verbascum densiflorum, Juniferous communis, Rosa indica, Berberis lyceum, Pyrus communis, Rubia cordifolia, Dioscorea deltoidea, Ricinus communis, Cassia fistula, Plectranthus rugosus, Saxiferaga flagellaris* subsp. *stenophylla, Urtica dioica*, *Fumaria indica, Prunis persica, Lycopersicum esculentum, Isodon rugosus*. Group-IV comprised of *Ajuga bracteosa, Primula denticulata, Paeonia emodi, Colchicum autumnale, Verbascum thapsus, Ziziphus jujuba, Ficus carica, Pinus wellichina, Prunus armeniaca, Solanum tuberosum, Trillium govaniannum, Quercus dilatata, Mentha longifolia and Rosa brunonii.* Group-V had *Alianthus altissimia, Ranunculus arvensis, Amaranthus viridis, Malva sylvestris, Valeriana jatamansi, Melia azedarichta and Ulmus wallichiana*. Group-VI included *Betula utilis, Narcissus tazetta, Zanthoxylum armatum, Plectranthus rugosus, Euphorbia helioscopia, Lipidium sativum and Hedera nepalesis.* Group-VII contained *Allium humile, Asparagus gracilis, Trifolium repens, Berberis lyceum, Juglans regia and Diospyrus kaki*. Last one was Group-VIII, including *Cedrus deodara, Limonium cabulicum, Cypripedium cordigerum, Portulaca oleracea, Coriandrum sativum, Podophylum hexandrum, Geranium wallichianum, Hypericum perforatum, Mentha arvensis and Oxalis corniculata*.

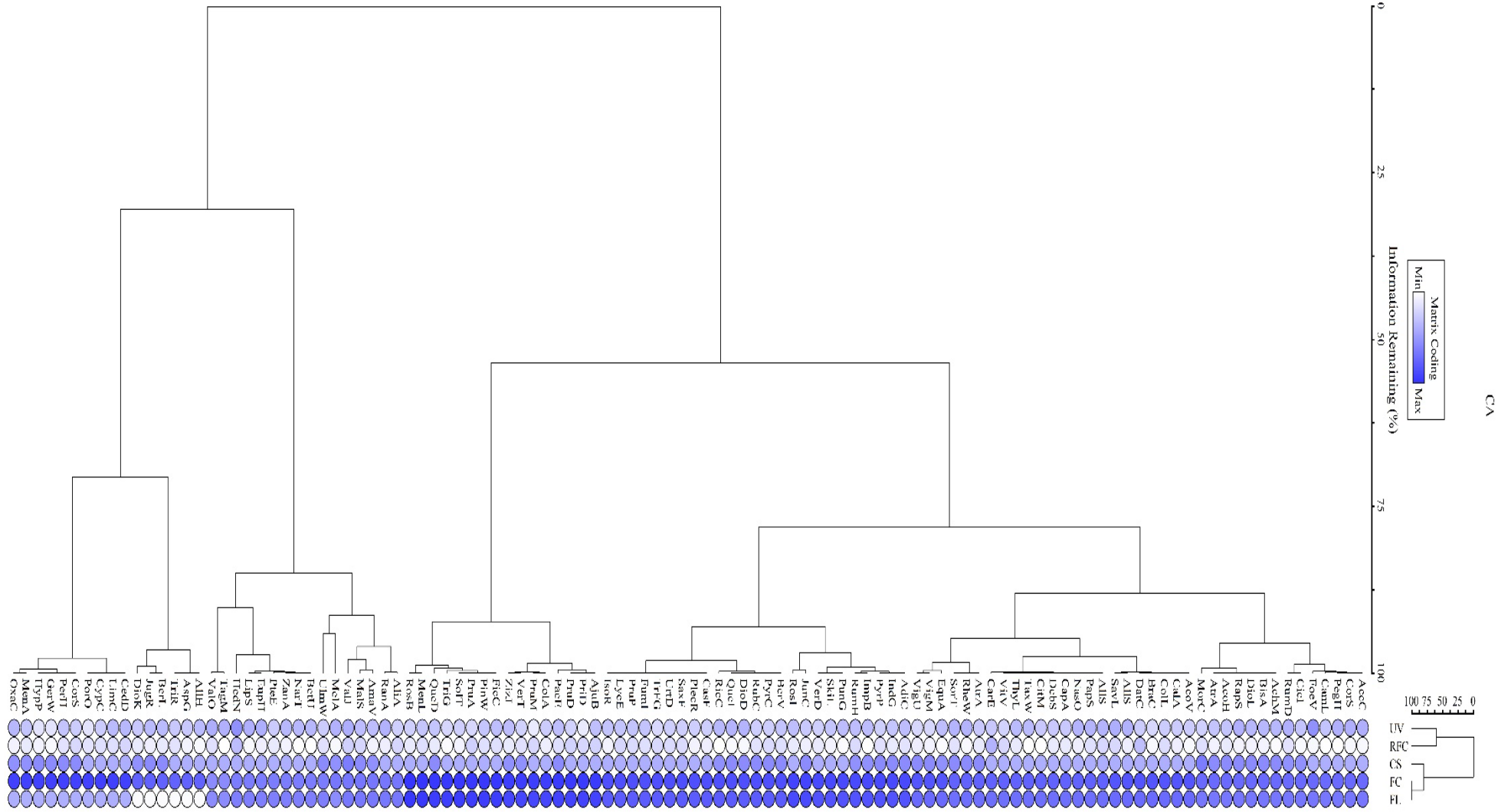

Figure 5. Two-way Cluster dendrogram separating 110 plants into clusters.

Note: Plant codes are the same as that in Supplementary data file 1

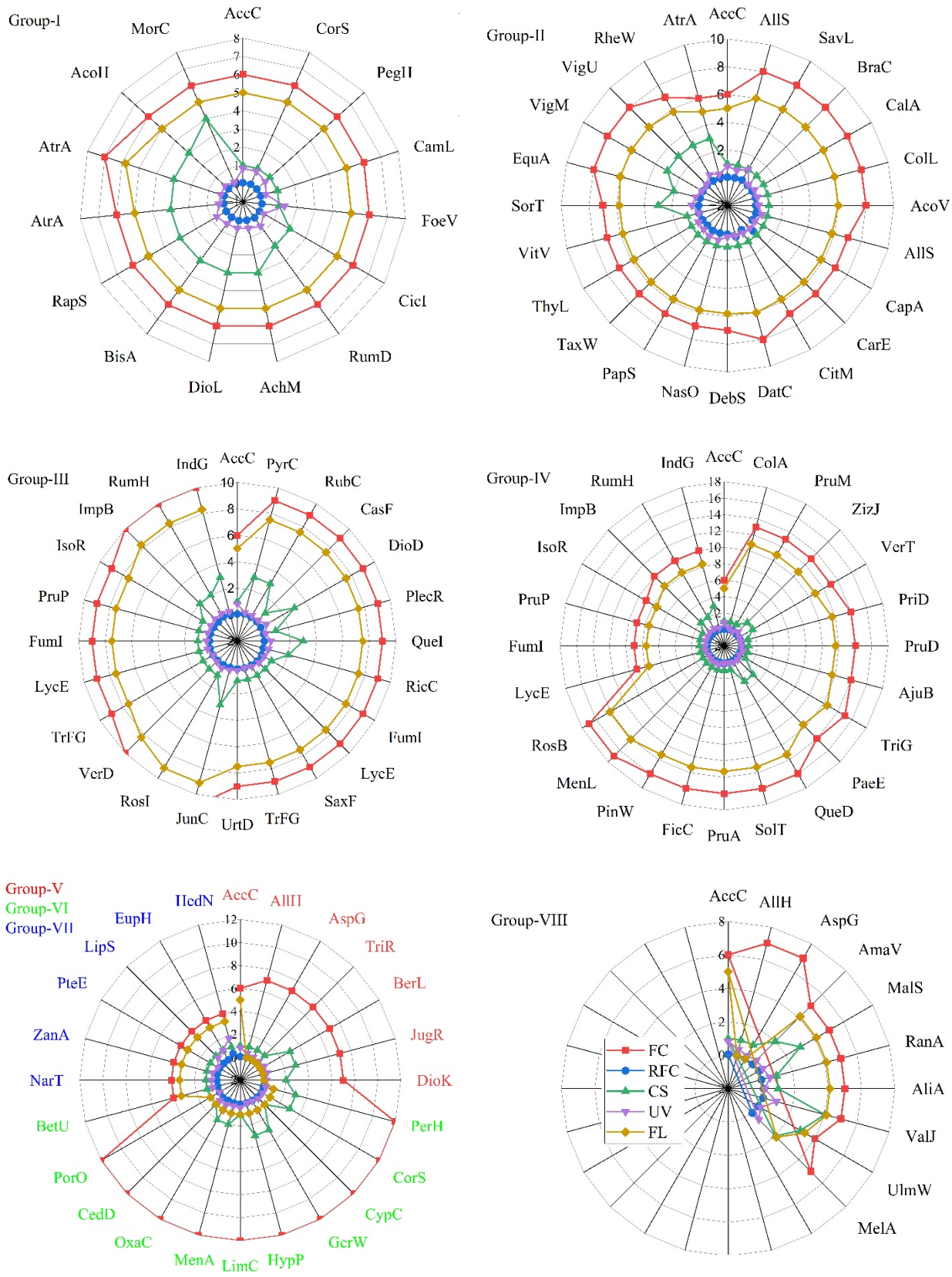

Figure 6. Radial diagrams showing Group base quantitative ethnobotanical indices of different plant species reported in the study area

Principal Component Analysis

The PCA biplot distributed the plant studied and the ethnobotanical indices, revealing the effectiveness of these ethnobotanical indices. The total variance of 100 % is distributed in the five axes of the ordination, having the highest variance reported for axis 1 (38.87), followed by axis 2 (23.62), and the lowest was on axis 5 (6.39). The eigenvector of the first five axes revealed the highest eigenvector for frequency of citation on axes 1 and 5, i.e., 0.64 and 0.75, respectively. Similarly, the relative frequency of citation and conservation status has the highest eigenvectors on axis 2 (0.66 and 0.64, respectively) and axis 3 (0.69 and 0.71, respectively). However, the use value and fidelity level have higher eigenvectors on three principal components axis, i.e., axis 1 (0.48 and 0.58 respectively), axis 4 (0.73 and 0.55 respectively) and 5 (0.31 and 0.57 respectively). The ethnobotanical indices, eigenvalues and axis of principal components show a perfect inverse relation. The highest eigenvalue of 1.81 was demonstrated by axis 1, followed by the axis having an eigenvalue of 1.25. Similarly, this decreasing trend of eigenvalue continues, and the axis with the lowest eigenvalue is 0.30 (Table 3, Figure 7).

Table 3. PCA axis summaries (Eigen blues and variance) with First five eigen vectors of Quantitative ethnobotanical indices

PCA axis summaries					QEBI	Eigen Vector of PCA				
AXIS	Eigen value	% of Variance	Cum.% of Var.	Broken stick Eigenvalue		1	2	3	4	5
1	1.94	38.87	38.87	2.28	UV	0.48	0.34	0.013	0.73	0.31
2	1.18	23.62	62.50	1.28	RFC	0.02	0.66	0.69	0.26	0.04
3	0.88	17.70	80.20	0.78	CS	0.09	0.64	0.71	0.26	0.02
4	0.67	13.40	93.61	0.45	FC	0.64	0.001	0.07	0.11	0.75
5	0.31	6.39	100.0	0.20	FL	0.58	0.17	0.002	0.55	0.57

Note: QEBI (Quantitative ethnobotanical indices)

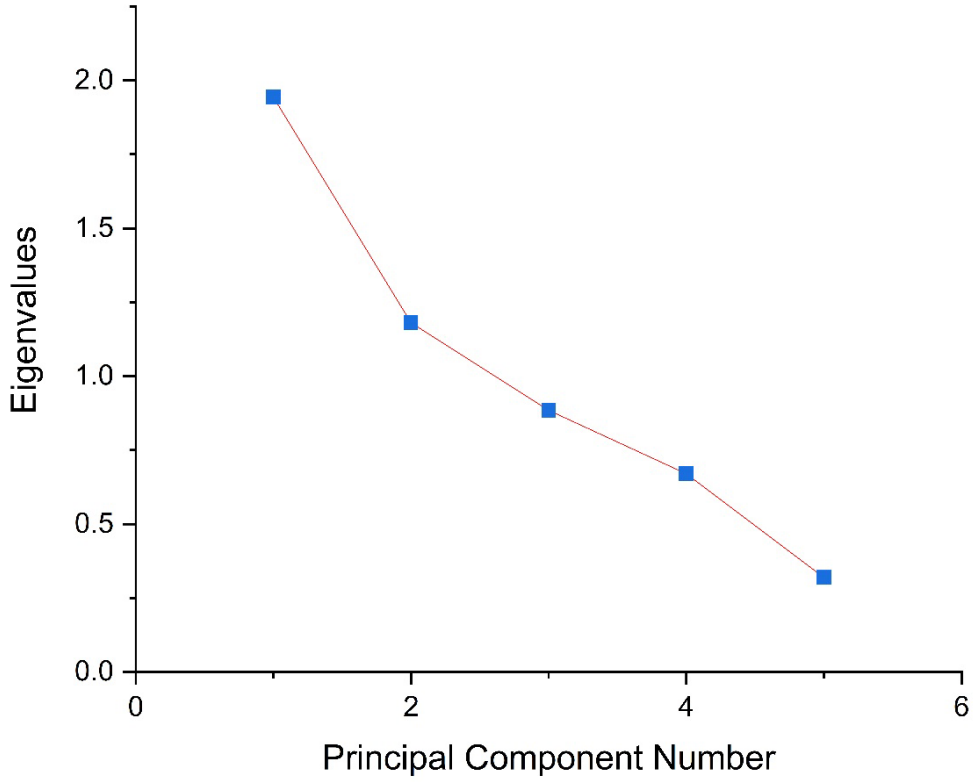

Figure 7. Relationship of Eigenvalues and Principal Component number.

Family importance value

Family importance value reflects the overall importance of a particular plant family. Our findings revealed that among gymnosperms, Pinaceae exhibited highest FIV i.e., 23.6, followed by Cupressaceae (6.6) and Taxaceae (3.3). Within monocotyledons leading families were Colchicaceae (17, 5), Alliaceae and Lilliaceae each with FIV of 12.5. In angiosperms, Rosaceae had highest FIV i.e., 93.3 followed by Lamiaceae (64.5), Fabaceae (46.6) Solanaceae (40), Polygonaceae (30) Berberidaceae and Ranunculaceae (25.8), Brassicaceae (22.5), Papaveraceae and Rutaceae (21.6), Scrophulariaceae (15.3), Asteraceae (14.6), Ebenaceae (13.3) and Zygophyllaceae with FIV value of 3.3 (Figure 8, 9).

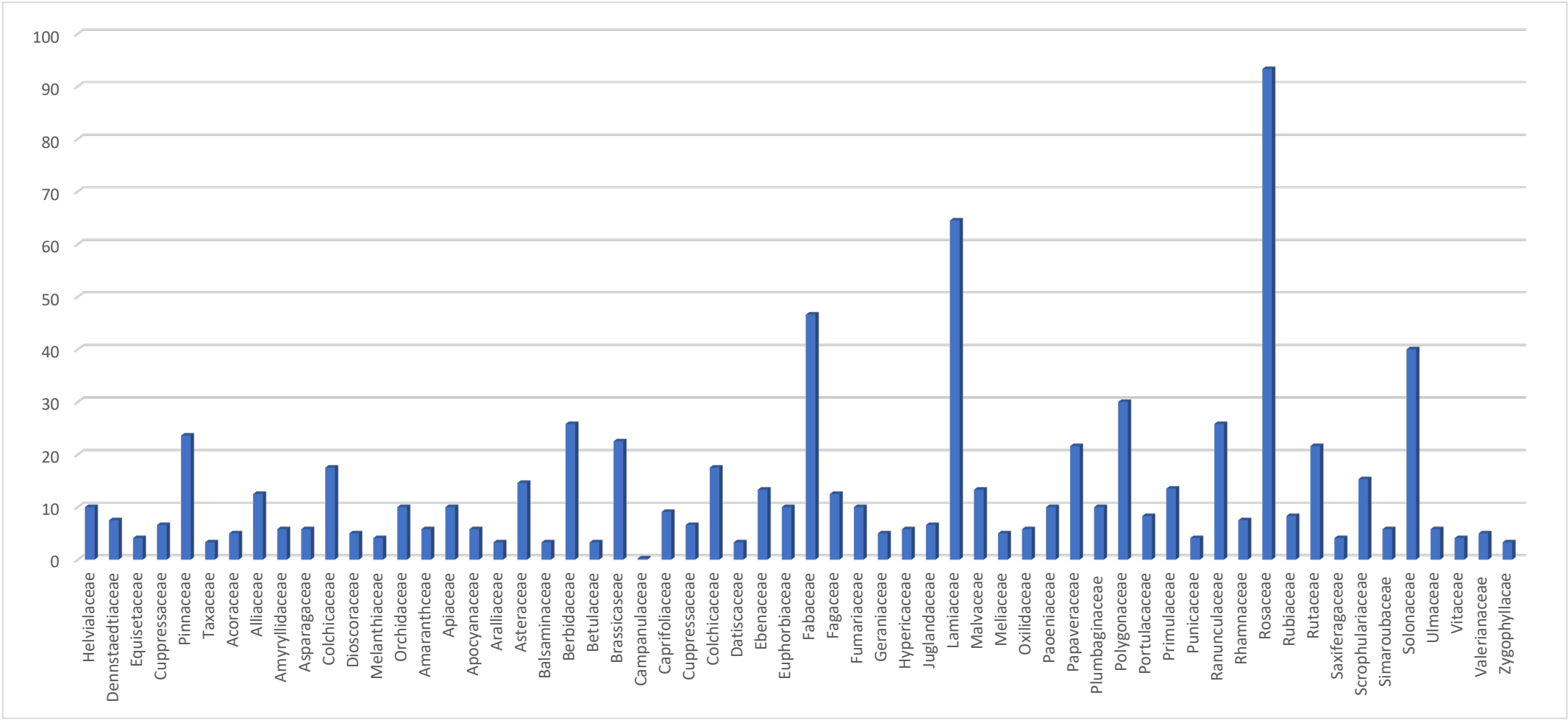

Figure 8. Family Importance Values of the recorded plant families.

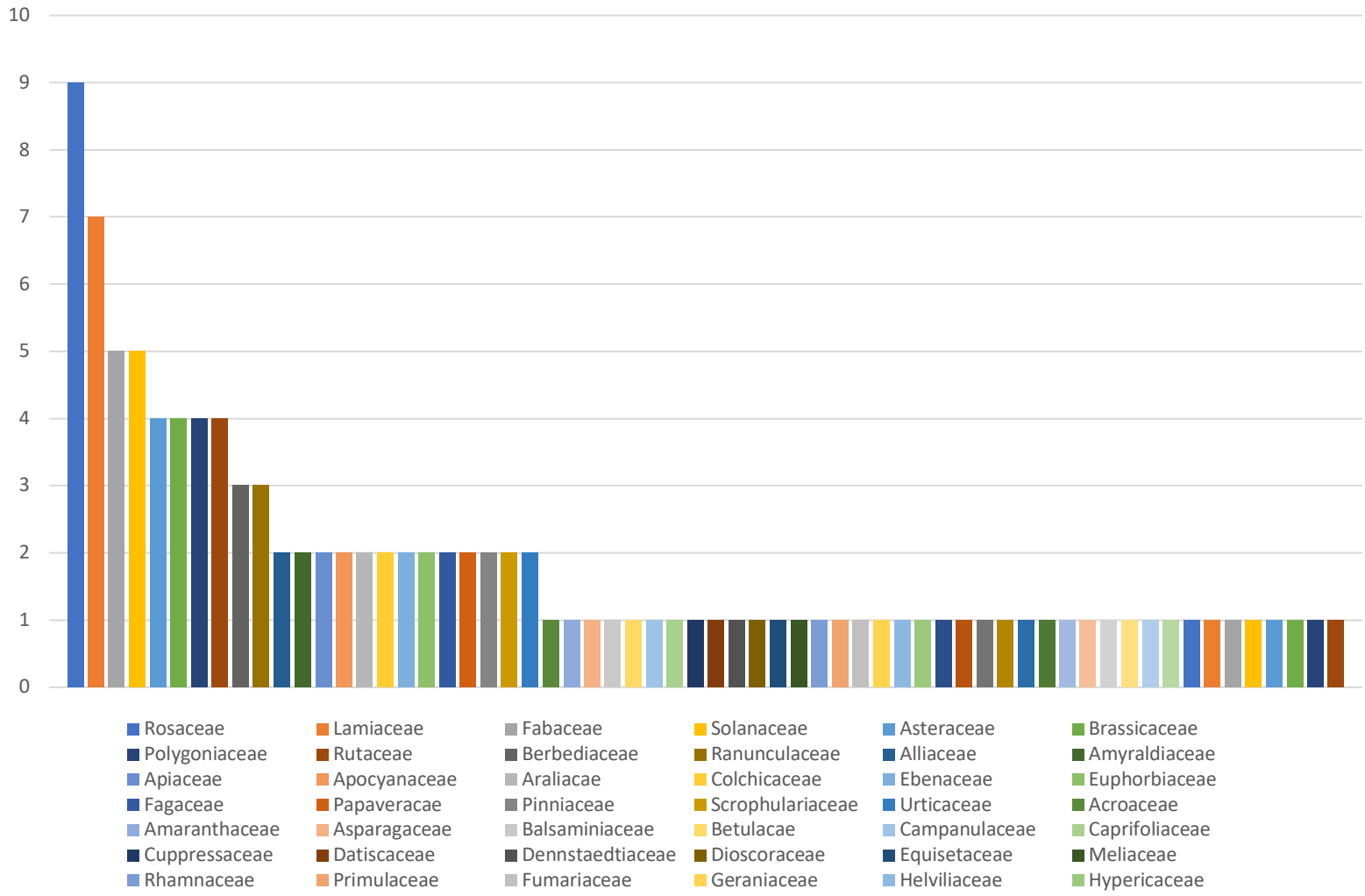

Figure 9. Distribution of plant species by family

Relative Frequency of Citation

Prunus domestica and *Ajuga bracteosa* had highest value for RFC (0.141). For *Malus domestica, Malva sylvestris* and *Cedrus deodara* the RFC value was 0.133. *Allium cepa* had third highest RFC value i.e., 0.125 while *Prunus armeniaca*, *Corydalis stewartii*, *Salvia lanata*. *Trigonella foenum-gracecum* had an RFC value of 0.11 each.

Fidelity level

Higher fidelity level indicates higher usage of a plant by an ethnic group (Usman *et al.* 2021). In our study the fidelity levels ranged from 0.04 to 14.1. Highest FL values were recorded for *Mentha longifolia* and *Rosa brunonii* (FL 14.1), followed by *Pinus wallichina, Quercus dilatate, Ficus carica, Prunus armeniaca* and *Solanum tuberosum* (FL 13.3). Other notable mentions included *Trillium govaniannum* (FL 12.5), *Ajuga bracteosa, Paeonia emodi, Primula denticulate* and *Prunus domestica* (FL 11.6).

Plant part used

Based on mentions of the respondents, roots were the most used plant part (14, 11.6%) followed by leaves and fruits (13, 10.8%). Likewise leaves and roots (7, 5.8%), seeds (6, 5%), stem and roots (4, 3.3%). In many cases more than one part of a plant was utilized such as leaves and roots (7, 5.8%), leaves and fruit (2, 2, 1.6%), leaves and seed (2, 1.6%), Root and bark (2, 2, 1.6%), resin and oil (2, 2, 1.6%), stem and leaves (3, 2.5%). Figure 9 displays the details of different plant parts used singly or in combination with other plant parts (Fig. 10).

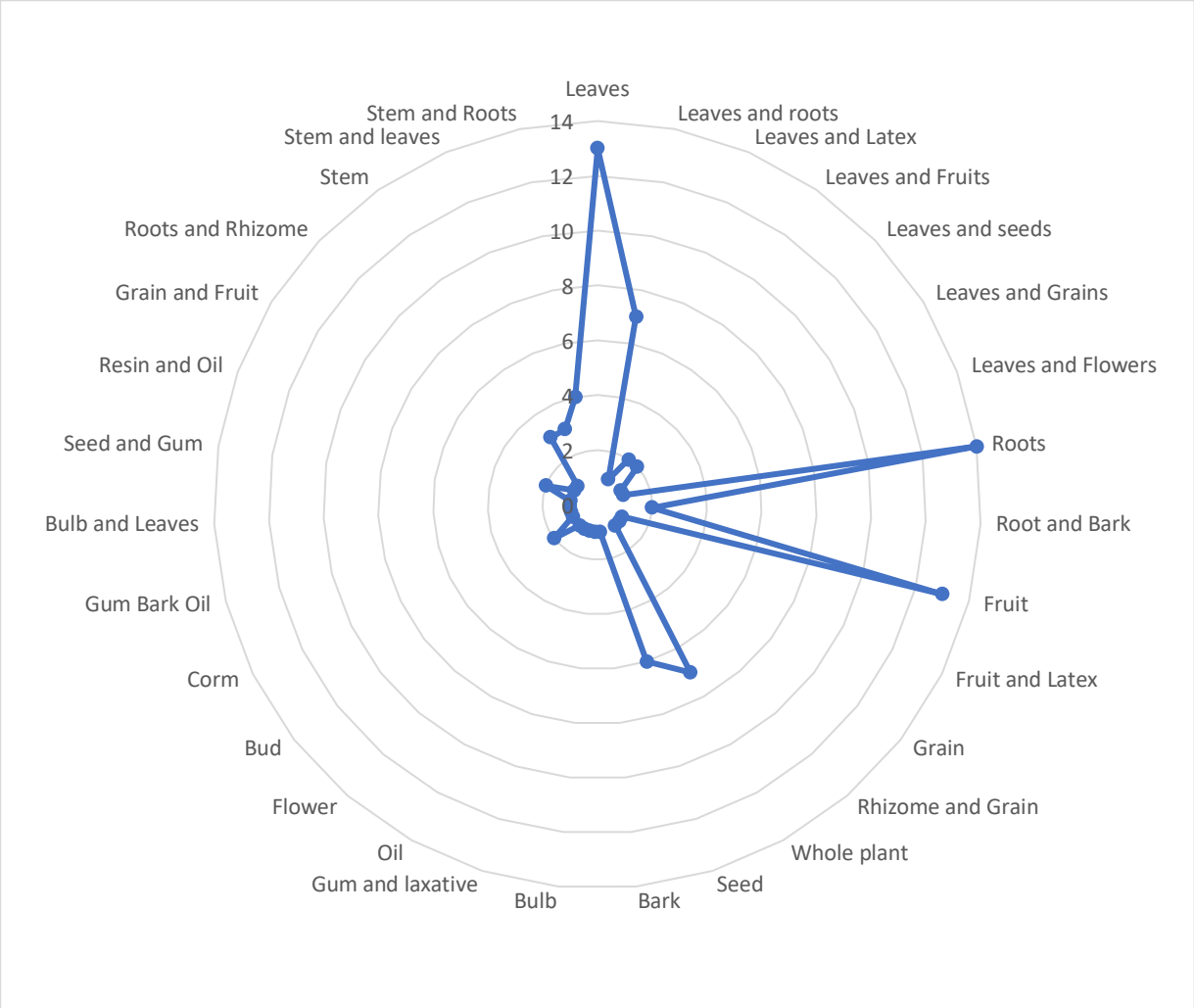

Figure 10. Plant part/s utilized for various purposes.

Conclusion

Our ethnobotanical investigation revealed that people of Torwali community possess significant knowledge regarding folk use of plants for multiple purposes. The locals have kept intact this valuable body of information and have transmitted it

through generations irrespective of age and gender. Still the older people were found to have more knowledge regarding ethnomedicinal uses of plants and most of them remembered the methods of preparation of different recipes. Torwali community is using these medicinal plants to treat different ailments as well they have found other uses of the local flora too. However, rapid urbanization, construction of living units, agricultural extension, over grazing, deforestation, floods, landslides and ill-managed tourism are the factors telling upon the population density of these valuable plant resources. During the corner meetings, some respondents also pointed out the overexploitation of some of the medicinal plants such as *Skimmia laureola, Trillium govanianum*, *Colchicum autumnale, Morchella conica, Paeonia emodi, Podophyllum hexandrum* because of their high monitory value in the local medicinal plant market. Based on findings of this study we recommend immediate measures for ex-situ conservation of the plant resources in study area. Present study may be used as a baseline for further investigations at molecular level to unlock the true potential of medicinal plants for pharmacological utilization.

Declarations

List of Abbreviations: Not applicable

Data availability: All the data is included in the manuscript, tables, figures and supplementary data files I and II and can be provided by the corresponding author upon request.

Ethics, Approval and Consent to participate: All the participants were briefed before the interviews or corner meetings regarding the scope of research and consent for publication was taken.

Declaration of conflicting interests: The authors declare that they have no potential conflicts of interests related to research, writing and publication of this article.

Funding: Not applicable

Author's contribution: AA designed the study and remained engaged in all stages of the research from data collection to the preparation of the final manuscript; ***AA*** and ***HU*** collected the preliminary field data; ***LB, HS*** and ***HU*** tabulated the data and identified plant specimens; ***RU*** carried out the data analysis, identified the dried medicinal plant specimens and reviewed the first draft; ***LB*** and ***RB*** contributed in designing the study, helped in developing the questionnaire, ***LB*** and ***RU*** conducted interviews; ***AA*** and ***RB*** repeated the quantitative analysis, corrected the taxonomy of the manuscript and helped in preparation of the final draft.

Literature cited

Abbas W, Hussain W, Hussain W, Badshah L, Hussain K, Pieroni A. 2020. Traditional wild vegetables gathered by four religious' groups in Kurram District, Khyber Pakhtunkhwa, North-West Pakistan. Genetic Resources and Crop Evolution 67:1521-1536.

Abbasi AM, Khan MA, Khan N, Shah MH. 2013a. Ethnobotanical survey of medicinally important wild edible fruits species used by tribal communities of lesser Himalayas-Pakistan. Journal of Ethnopharmacology 148:528-536. 10.1016/j.jep.2013.04.050

Abbasi AM, Khan MA, Shah MH, Shah MM, Pervez A, Ahmad M. 2013b. Ethnobotanical appraisal and cultural values of medicinally important wild edible vegetables of lesser Himalayas-Pakistan. Journal of Ethnobiology and Ethnomedicine 9:66. 10.1186/1746-4269-9-66

Abbasi AM, Khan M, Ahmad M, Zafar M, Jahan S, Sultana S. 2010. Ethnopharmacological application of medicinal plants to cure skin diseases and in folk cosmetics among the tribal communities of North-West Frontier Province, Pakistan. Journal of Ethnopharmacology. 128(2):322-353.

Abdullah SMK, Kashif RA, Haq ZU, Ahmad Z, Haq AU, Haq MA. 2020. Ethnobotanical Appraisal of Medicinal Plants from Bajaur; A Remote Area of the Khyber Pakhtunkhwa Province of Pakistan. in: Abbasi AM, Bussmann RW (eds) Ethnobiology of Mountain Communities in Asia. 277.

Adebayo M, Adeboye J, Ajaiyeoba E. 2004. Preliminary phytochemical investigation and diuretic studies of *Alstonia boonei* stem bark in male Wistar rats. Journal of Natural Remedies 4:179-182. doi: 10.18311/jnr/2004/184

Ahmad L, Semotiuk A, Zafar M, Ahmad M, Sultana S, Liu QR. 2015. Ethnopharmacological documentation of medicinal plants used for hypertension among the local communities of Dir Lower, Pakistan. Journal of Ethnopharmacology 175:138-146. doi: 10.1016/j.jep.2015.09.014

Ahmad I, Khan N, Anjum F. 2011. Medicinal plant resources for economic development of rural community in Mankiyal, District Swat. World Environment Day 16th June 2011. 54-63

Ahmad KS, Hamid A, Nawaz F, Hameed M, Ahmad F, Deng J, Akhtar N, Wazarat A, Mahroof S. 2017. Ethnopharmacological studies of indigenous plants in Kel village, Neelum Valley, Azad Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 13:68.

Ahmad M, Sultana, S., Hadi, S. F., Hadda, T. B., Rashid, S., Zafar, M., Khan, M. A., Khan, M.P.Z., and Yaseen, G. (2014). An ethnobotanical study of medicinal plants in high mountainous region of Chail valley (District Swat-Pakistan). Journal of Ethnobiology and Ethnomedicine.10(36):1-18 doi: 10.1186/1746-4269-10-36

Ahmad N, Anwar S, Fazal H, Abbasi BH. 2013. Medicinal plants used in indigenous therapy by people of Madyan Valley in district Swat, Pakistan. International Journal of Medicinal and Aromatic Plants 3(1):47-54.

Ahmad I, Ibrar M, Ullah B, Ali N. 2011. Ethnobotanical Study of Tehsil Kabal, Swat District, KPK, Pakistan Journal of Botany 368572. doi:10.1155/2011/368572.

Ahmadiani A, Javan M, Semnanian S, Barat E, Kamalinejad M. 2001. Anti-inflammatory and antipyretic effects of *Trigonella foenum*-graecum leaves extract in the rat. Journal of Ethnopharmacology 75:283-286. doi: 10.1016/S0378-8741(01)00187-8

Akhtar N, Rashid A, Murad W, Bergmeier E. 2013. Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. Journal of Ethnobiology and Ethnomedicine 9:25. 10.1186/1746-4269-9-25

Alexiades MN, Sheldon JW. 1996. Selected guidelines for ethnobotanical research: a field manual. New York Botanical Garden; United States of America. 1996.

Ali A, Badshah L, Hussain F. 2018a. Ethnobotanical appraisal and conservation status of medicinal plants in Hindukush Range, District Swat, Pakistan. Journal of Herbs, Spices & Medicinal Plants 24(4):332-355.

Ali A, Badshah L, Hussain F. 2018b. Vegetation structure and threats to montane temperate ecosystems in Hindukush Range, Swat, Pakistan. Applied Ecology and Environmental Research 16(4):4789-4811. doi: 10.15666/aeer/1604_47894811

Ali K, Shuaib M, Hussain Z, Sajjad W, Ali F, Fazil M. 2016. Ethnobotanical assessment of the medicinal flora of Khyber agency, Pakistan. Pakistan Journal of Weed Science Research 22(4).

Ali M, Begum R, Ali K, Nisar M, Khan W, Hassan N, Uddin N, Wadood SF, Zaman SU, Rahman IU, Khan N. 2017. Journal of Biodiversity and Environmental Sciences 11(3):91-101.

Ali SI, Nasir YI. (Eds.) 1989-1993. Flora of Pakistan Nos, 191-193. Department of Botany, University of Karachi, Pakistan.

Ali SI, Qaiser M. (Eds.) 1993-2020. Flora of Pakistan (1-220). Department of Botany, University of Karachi, Pakistan.

Anwar F, Latif S, Ashraf M, Gilani AH. 2007. *Moringa oleifera*: A food plant with multiple medicinal uses. Phytotherapy Research 21:17-25. doi: 10.1002/ptr.2023

Aparicioa H, Hedbergb I, Bandeirac S, Ghorbanid A. 2021. Ethnobotanical study of medicinal and edible plants used in Nhamacoa area, Manica province Mozambique. South African Journal of Botany 139:318-328. doi: 10.1016/j.sajb.2021.02.029.

Asante-Kwatia E., Mensah AY, Fob EA. 2021. An Ethnobotanical Study on Medicinal Plants Used as Antidote for Snakebite and as Snake Repellent in the Ejisu-Juabeng District of Ghana. Research Journal of Pharmacognosy (RJP) 8(4):53-62. doi: 10.22127/RJP.2021.293888.1731.

Azaizeh HS, Fulder SK, Khalil OS. 2003. Ethnobotanical knowledge of local Arab practitioners in the Middle Eastern region. Fitoterapia 74:98-108. doi: 10.1016/ S0367-326X (02)00285-X

Aziz MA, Adnan M, Khan AH, Rehman AU, Jan R, Khan J. 2016. Ethno-medicinal survey of the important plants practiced by indigenous community at Ladha subdivision, South Waziristan agency, Pakistan. Journal of Ethnobiology and Ethnomedicine 12:53. doi: 10.1186/s13002-016-0126-7

Badshah L, Hussain F, Ibrar M. 2010. An ethnobotanical study on the usage of wild medicinal herbs from Malana hills Parachinar Kurram Agency. International Journal of Biology and Biotechnology 7(3):267-271.

Bano A, Ahmad M, Ben Hadda T, Saboor A, Sultana S, Zafar M. 2014a. Quantitative ethnomedicinal study of plants used in the Skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. Journal of Ethnobiology and Ethnomedicine 10:43 doi: 10.1186/1746-4269-10-43

Bano A, Ahmad M, Zafar M, Sultana S, Rashid S, Khan MA. 2014b. Ethnomedicinal knowledge of the most commonly used plants from Deosai Plateau, Western Himalayas, Gilgit Baltistan, Pakistan. Journal of Ethnopharmacology 155:1046-1052. doi: 10.1016/j.jep.2014.05.045

Bibi F, Abbas Z, Harun N, Perveen B, Bussmann RW. 2022. Indigenous knowledge and quantitative ethnobotany of the Tanawal area, Lesser Western Himalayas, Pakistan. PLoS ONE 17(2):e0263604. doi: 10.1371/journal. pone.0263604

Bibi T, Ahmad M, Baloch IA, Muhammad S, Manzoor R. 2017. Ethnomedicinal uses of plants for childbirth and postpartum recovery in District Pashin, Northern Balochistan, Pakistan. Int. Journal of Biology, Pharmacy and Allied Sciences 6(9):1730-1760

Chaachouay N, Azeroual A, Bencharki B, Zidane L. 2022. Herbal medicine used in the treatment of cardiovascular diseases in the Rif, North of Morocco. Frontiers in Pharmacology 11(13):921918. doi: 10.3389/fphar.2022.921918.

Choudhury PR, Choudhury MD, Ningthoujam SS, Mitra A, Nath D, Talukdar AD. 2015. Plant utilization against digestive system disorder in Southern Assam, India. Journal of Ethnopharmacology 175:192-197. doi: 10.1016/j.jep.2015.09.020

De Wet H, Ngubane SC. 2014.Traditional herbal remedies used by women in a rural community in Northern Maputal and (South Africa) for the treatment of gynecology and obstetrics complaints. South African Journal of Botany 94:129-139

Emamghoreishi M, Heidar-Hamedani G. 2006. Sedative-Hypnotic activity of extracts and essential oil of *Coriander* seeds. IJMS 31(1):22-27

Erasto P, Adebola PO, Grierson DS, Afolayan AJ. 2005. An Ethnobotanical Study of Plants Used for The Treatment of Diabetes in The Eastern Cape Province, South Africa. African Journal of Biotechnology. Academic Journals 4(12):1458-1460, http://www.academicjournals.org/AJB.

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. Journal of Ethnopharmacology 16:275-287. pmid:3747566

Gillani SW, Ahmad M, Ahmad M, Ahmad M, Zafar M, Haq SM, Waheed M, Manzoor M, Shaheen H, Sultana S, Rehman FU, Makhkamov T. 2024. An Insight into Indigenous Ethnobotanical Knowledge of Medicinal and Aromatic Plants from Kashmir Himalayan Region. Ethnobotany Research and Applications 28:1-21.

Güzel Y, Güzel M, Miski M. 2015. Ethnobotany of medicinal plants used in Antakya: A multicultural district in Hatay Province of Turkey. Journal of Ethnopharmacology 174:118-152. doi: 10.1016/j.jep.2015.07.042

Haile AA. 2022. Ethnobotanical study of medicinal plants used by local people of Mojana Wadera Woreda, North Shewa Zone, Amhara Region, Ethiopia. Asian Journal of Ethnobiology (1):35-43. doi: 10.13057/asianjethnobiol/y050104.

Hamayun M. 2003. Ethnobotanical studies of some useful shrubs and trees of District Buner, NWFP, Pakistan. Ethnobotanical Leaflets 12.

Hanlidou E, Karousou R, Kleftoyanni V, Kokkini S. 2004. The herbal market of Thessaloniki (N Greece) and its relation to the ethnobotanical tradition. Journal of Ethnopharmacology 91:281-299. doi: 10.1016/j.jep.2004.01.007

Harari YN. 2014. Sapiens A brief history of humankind. McClelland & Stewart, Random House of Canada Limited, Penguin Random House Company. Canada

Hijazi MA, El-Mallah A, Aboul-Ela M, Ellakany A. 2017. Evaluation of Analgesic Activity of *Papaver libanoticum* Extract in Mice: Involvement of Opioids Receptors. Evidence-based Complementary and Alternative Medicine 8935085. doi:10.1155/2017/8935085

Hoffman B, Gallaher T. 2007. Importance Indices in Ethnobotany. Ethnobotany Research and Applications 5:201-218. doi:10.17348/era.5.0.201-218

Hussain F, Islam M, Zaman A. 2006. Ethnobotanical profile of plants of Shawar valley, district Swat, Pakistan. International Journal of Biology and Biotechnology 3(2):301-307.

Hussain W, Ullah A, Hussain J, Hussain S, Shinwari ZK, Ibrar M. 2014. Ethno-medicinal plants of Tahsil Barawal Bandi Dir Upper Khyber Pakhtunkhwa Pakistan. Journal of Applied Pharmaceutical Science 4(7):94-97.

Ibrar M, Hussain F, Sultan A. 2007. Ethnobotanical studies on plant resources of Ranyal Hills, District Shangla, Pakistan. Pakistan Journal of Botany 39(2):329-337

Irfan M, Nabeela IK, Kamil M, Ullah S, Khan S, Shah M, Ali A, Rehman SU, Ali R, Ali D, Kausar R, Jan G, Murad W. 2018. Ethnobotanical survey of the flora of tehsil Balakot, district Mansehra, Khyber Pakhtunkhwa, Pakistan. Journal of Applied Environmental and Biological Sciences 8(8):1-13.

Ismail M, Hussain J, Khan AU, Khan AL, Ali L, Khan FU, Khan AZ, Niaz U, Lee, J. 2012. Antibacterial, antifungal, cytotoxic, phytotoxic, insecticidal, and enzyme inhibitory activities of *Geranium wallichianum*. Evidenced Based Complementary and Alternative Medicine doi: 10.1155/2012/305906

Jahangeer K, Mahmood Z, Khursheed Z, Ali U, Ismaeel S. 2020. Medicinal plants and their Anti-inflammatory effects in Hepatic disorders. Pakistan Journal of Biochemistry & Biotechnology 1(2). doi: 10.52700/pjbb.v1i2.17

Jan G, Khan MA, Farhatullah JF, Ahmad M, Jan M, Zafar M. 2011. Ethnobotanical studies on some useful plants of Dir Kohistan valleys, KP, Pakistan. Pakistan Journal of Botany 43(4):1849-1852.

Jeong TY, Park BK, Cho JH, Kim YI, Ahn YC, Son CG. 2012. A prospective study on the safety of herbal medicines, used alone or with conventional medicines. Journal of Ethnopharmacology 143(3):884-888.

Kayani S, Ahmad M, Sultana S, Shinwari ZK, Zafar M, Yaseen G, Hussain M, Bibi T. 2015. Ethnobotany of medicinal plants among the communities of Alpine and Sub-alpine regions of Pakistan. Journal of Ethnopharmacology 164:186-202. doi: 10.1016/j.jep.2015.02.004

Kayani S, Ahmad M, Zafar M, Sultana S, Khan MP, Ashraf MA, Hussain J, Yaseen G. 2014. Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies-Abbottabad, Northern Pakistan. Journal of Ethnopharmacology 156:47-60. doi: 10.1016/j.jep.2014.08.005

Khan AA, Ali F, Ihsan M, Hayat K, Nabi G. 2015. Ethnobotanical study of the medicinal plants of Tehsil Charbagh, district Swat, Khyber Pakhtunkhwa, Pakistan. American Eurasian Journal of Agriculture and Environmental Sciences 15:1464-1474.

Khan A, Ali S, Murad W, Hayat K, Siraj S, Jawad M, Khan RA, Uddin J, Al-Harrasi A, Khan A. 2021. Phytochemical and pharmacological uses of medicinal plants to treat cancer: A case study from Khyber Pakhtunkhwa, North Pakistan. Journal of Ethnopharmacology 281(5):114437 doi: 10.1016/j.jep.2021.114437

Khan H. 2014. Medicinal Plants in Light of History: Recognized Therapeutic Modality. Journal of Evidence-Based Complementary and Alternative Medicine 19(3):216-219. doi:10.1177/2156587214533346

Khan I, AbdElsalam NM, Fouad H, Tariq A, Ullah R. 2014 Application of ethnobotanical indices on the use of traditional medicines against common diseases. Journal of Evidence-Based Complementary and Alternative Medicine 635371. doi: 10.1155/2014/635371.

Khan WM, Shah SZ, Khan MS. 2016. Ethnobotanical relevance of the weed flora of Tall Dardyal, Tehsil Kabal, district Swat, Pakistan. Pakistan Journal of Weed Science Research 22:125-145.

Kumar VP, Chauhan NS, Padh H, Rajani M. 2006. Search for antibacterial and antifungal agents from selected Indian medicinal plants. Journal of Ethnopharmacology 107(2):182-188.

Lee S, Xiao C, Pei S. 2008. Ethnobotanical survey of medicinal plants at periodic markets of Honghe Prefecture in Yunnan Province, SW China. Journal of Ethnopharmacology 117:362-377. doi: 10.1016/j.jep.2008.02.001

Macía MJ, García E, Vidaurre PJ. 2005. An ethnobotanical survey of medicinal plants commercialized in the markets of La Paz and El Alto, Bolivia. Journal of Ethnopharmacology 97:337-350. doi: 10.1016/j.jep.2004.11.022

Mahé A, Faye O, N'Diaye HT, Ly F, Konare H, Keita S, Traoré A, Hay R. 2005. Definition of an algorithm for the management of common skin diseases at primary health care level in sub-Saharan Africa. Transactions of the Royal Society of Tropical Medicine and Hygiene 99(1):39-47.

Mahmood A, Riffat N, Zabta K, Aqeel M. 2011. Ethnobotanical survey of plants from Neelum, Azad Jammu and Kashmir, Pakistan. Pakistan Journal of Botany 43:105-110.

Malik K, Ahmad M, Bussmann RW, Tariq A, Ullah R, Alqahtani AS, Sahat AA, Rashid N, Zafar M, Sultana S, Shah SN. 2018. Ethnobotany of Anti-hypertensive plants used in Northern Pakistan. Frontiers in Pharmacology 9:789, 30087613 doi: 10.3389/fphar.2018.00789

Malik K, Ahmad M, Zafar M, Ullah R, Mahmood HM, Parveen B, Rashid N, Sultana S, Shah SN, Lubna. 2019. An ethnobotanical study of medicinal plants used to treat skin diseases in northern Pakistan. BMC Complementary and Alternative Medicine 19(1):210. doi: 10.1186/s12906-019-2605-6.

Manzoor M, Ahmad M, Zafar M, Gillani SW, Shaheen H, Pieroni A, Al-Ghamdi AA, Elshikh MS, Saqib S, Makhamov T, Khaydarov K. 2023. The local medicinal plant knowledge in Kashmir Western Himalaya: a way to foster ecological transition via community-centered health seeking strategies. Journal of Ethnobiology and Ethnomedicine 19:56 2023 doi.org/10.1186/s13002-023-00631-2.

Mirzaman Z, Kayani S, Manzoor M, Jameel MA, Waheed M, Gillani SW, Babar CM, Rainer WB. 2023. Ethnobotanical study of Makra Hills district Muzaffarabad, Azad Jammu and Kashmir, Pakistan. Ethnobotany Research and Applications, 26, 1–17.

Mary HP, Vargheese TA, Jj JK, Abiramy M, Sajina N, Jaya SS. 2012. Phytochemical analysis and anticancer activity of essential oil from *Myristica fragrans*. International Journal of Current Pharmaceutical Review and Res*earch* 2:188.

Meli J, Benedicta N, Chungag T, Mope JGD, Samuel KJS. 2009. Perceptions of the etiology and treatment of hypertension among some traditional healers in Cameroon. Open Health Journal 2:39-43.

Molares S, Ladio A. 2009. Chemosensory perception and medicinal plants for digestive ailments in a Mapuche community in NW Patagonia, Argentina. Journal of Ethnopharmacology 123:397-406. doi: 10.1016/j.jep.2009.03.033

Musa SM, Abdelrasool FE, Elsheikh AE, Ahmed LAMN., Mahmoud ALF, Sakina M., Yagi SY. 2011. Ethnobotanical study of medicinal plants in the Blue Nile State, South-eastern Sudan. Journal of Medicinal Plants Research 5(17):4287-4297, http://www.academicjournals.org/JMPR ISSN 1996-0875.

Nasir E, Ali SI. (Eds.) 1970-1989. Flora of Pakistan, Islamabad, Karachi, Pakistan.

Nasri H, Shirzad H. 2013. Toxicity and safety of medicinal plants. Journal of Herbal Medicine Pharmacology 2(2):21-22.

Nguyen HS, Xia NH, Chu TV, Sam HV. 2019. Ethnobotanical study on medicinal plants in traditional markets of Son La province, Vietnam. Forest and Society 3(2):171-192. doi: 1024259/fs.v.3i2.6005.

Noor A, Khatoon S, Ahmed M, Razaq A. 2013. Ethnobotanical Study on Some Useful Shrubs of Astore Valley, Gilgit-Baltistan, Pakistan. Bangladesh Journal of Botany 43(1):19-25.

Nyirenda J, Chipuwa M. 2024. An ethnobotanical study of herbs and medicinal lants used in Western Copperbelt, Central and Northern provinces of Zambia. Phytomedicine Plus 4(1):100514. doi: 10.1016/j.phyplu.2023.100514

Ouhaddou H, Boubaker H, Msanda F, Mousadik AE. 2014. An Ethnobotanical Study of Medicinal Plants of the Agadir Ida Ou Tanane Province (Southwest Morocco). Journal of Applied Biosciences 84:7707-7722. doi: 10.4314/jab.v84i1.5.

Phillips O, Gentry AH., Wilkin P, Galvez-Durand B. 1994. Quantitative ethnobotany and Amazonian conservation. Conservation Biology 8:225-248.

Rahmat W, Rahman K, Raja NI, Qureshi R, Bussmann RW. 2019. A quantitative medico-botanical expedition of Fairy Meadows National Park, Diamir, Gilgit Baltistan, Pakistan. Ethnobotany Research and Applications 18:1-30.

Rashid S, Ahmad M, Zafar M, Sultana S, Ayub M, Khan MA, Yaseen G. 2015. Ethnobotanical survey of medicinally important shrubs and trees of Himalayan region of Azad Jammu and Kashmir, Pakistan. Journal of Ethnopharmacology 166:340-351. doi: 10.1016/j.jep.2015.03.042

Sadat-Hosseini M, Farajpour M, Boroomand N, Solaimani-Sardou F. 2017. Ethnopharmacological studies of indigenous medicinal plants in the south of Kerman, Iran. Journal of Ethnopharmacology 199:194-204. doi: 10.1016/j.jep.2017.02.006

Savikin K, Zdunic G, Menkovic N, Zivkovic J, Cujic N, Terescenko M, Bigovic D. 2013. Ethnobotanical study on traditional use of medicinal plants in South-Western Serbia, Zlatibor district. Journal of Ethnopharmacology 146:803-810.

Shareef H, Naeem S, Zaheer E. 2019. Comparative analgesic activity of selected medicinal plants from Pakistan. Proceedings of the Pakistan Academy of Science B. Life and Environmental Science 56(3):57-67 Special issue.

Sharif A, Shah NA, Rauf A, Hadayat N, Gul A, Nawaz G, Sakhi S, Iqbal M, Khan MR, Shah AA, Zam N, Iftikar H, Shah SA, Bahadur S, Hussain F, Shuaib M. 2022. Ethnomedicinal uses of plants for various diseases in the remote areas of Changa Manga forest, Pakistan. Brazillian Journal of Biology 84. doi: 10.1590/1519-6984.255916

Shinwari ZK. 2010. Medicinal plants research in Pakistan. Journal of Medicinal Plant Research 4:161-176.

Shinwari ZK Rehman M, Watanabe T, Yoshikawa Y. 2006. Medicinal and Aromatic Plants of Pakistan (A Pictorial Guide). Kohat University of Science and Technology, Kohat, Pakistan.

Shuaib M, Hussain F, Rauf A, Jan F, Romman MR, Parvez A, Zeb A, Ali S, Abidullah S, Bahadur S, Shah AA, Azam N, Dilbari S, Begum K, Khan HS, Sajjad S, Muhammad I, Shah NA. 2021. Traditional knowledge about medicinal plant in the remote areas of Wari Tehsil, Dir Upper, Pakistan. Brazilian Journal of Biology 83. doi: 10.1590/1519-6984.246803.

Singh B, Singh B, Kishore A, Singh S, Bhat MN, Surmal O, Musarella CM. 2020. Exploring plant-based ethnomedicine and quantitative ethnopharmacology: Medicinal plants utilized by population of Jasrota Hill in Western Himalaya. Sustainability 12:7526. doi:10.3390/su12187526

Spiewak R. 2000. Occupational skin diseases among farmers. Lublin: Occupational and Para-Occupational Diseases in Agriculture. Institute of Agricultural Medicine 42-152.

Suleiman MH. 2015. An ethnobotanical survey of medicinal plants used by communities of Northern Kordofan region, Sudan. Journal of Ethnopharmacology 176:232-242. doi: 10.1016/j.jep.2015.10.039

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of southern Cantabria (northern Spain). Economic Botany 62:24-39.

Tariq A, Sadia S, Fan Y, Ali S, Amber R, Mussarat S, Ahmad M, Murad W, Zafar M, Adnan M. 2020. Herbal medicines used to treat diabetes in Southern regions of Pakistan and their pharmacological evidence. Journal of Herbal Medicin.. doi: 10.1016/j.hermed.2019.100323

Ullah A, Khan N, Rahman A, Ullah R. 2022. Folk benefits from the indigenous angiosperms flora of Sheikh Buddin National Park Dera Ismail Khan, Pakistan Sarhad Journal of Agricultur 38(3):902-911.

Umair M, Altaf M, Abbasi AM. 2017. An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. Plos One. doi: 10.1371/journal.pone.0177912

Usman M, Ditta A, Ibrahim FH, Murtaza G, Rajpar MN, Mehmood S, Saleh MNB, Imtiaz M, Akram S, Khan WR. 2021. Quantitative ethnobotanical analysis of medicinal plants of high temperature areas of Southern Punjab, Pakistan. Plant 10(10). doi: 10.3390/plants10101974

Usman N. 2021. Linguistic Diversity in Pakistan. American Pakistan Foundation, Karachi.

Vitalini S, Iriti M, Puricelli C, Ciuchi D, Segale A, Fico G. 2013. Traditional knowledge on medicinal and food plants used in Val San Giacomo (Sondrio, Italy) An alpine ethnobotanical study. Journal of Ethnopharmacology 145:517-529.

Wali R, Khan MF, Mahmood A, Mahmood M, Qureshi R, Ahmad KS, Mashwani ZU. 2022. Ethnomedicinal appraisal of plants used for the treatment of gastrointestinal complaints by tribal communities living in Diamir district, Western Himalayas, Pakistan. PLoS One 8-17(6): e0269445. doi: 10.1371/journal.pone.0269445.

White PCL, Jennings NV, Renwick AR, Barker NHL. 2005. Review: Questionnaires in ecology: A review of past use and recommendations for best practice. Journal of Applied Ecology 42:421-430. doi: 10.1111/j.1365-2664.2005.01032.x

Yaseen G, Ahmad M, Zafar MSS, Kayani S, Ceto AA, Shaheen S. 2015. Traditional management of diabetes in Pakistan: Ethnobotanical investigation from traditional health practitioners. Journal of Ethnopharmacology 91-117. doi: 10.1016/j.jep.2015.07.041

Zubair T. 2006. Vestiges of Torwali culture. Idara Braye Taleem-o-Taraqi doi:10.13140/RG.2.1.2272.1049

Supplementary data file 1 - Questionnaire

GOVT POST GRADUATE JAHANZEB COLLEGE SAIDU SHARIF SWAT
DEPARTMENT OF BOTANY

Questionnaire for ethnobotanical data collection Date: ___/___/_____

Name: _____ F/Name: _____Gender: _____ Age: ____ Qualification: _____ Q/No: _____

Profession: _____Village: _____ Cell #: _____ NIC #: _____ Status as a plant collector: Regular / Occasional What is your main purpose of plant collection?

For domestic consumption _____

For commercial purpose _____

- Have you ever used crude medicine/medicinal plant to treat any ailment? Yes / No
- Is there any use of medicinal plants at your household? Yes / No
- Tell us about medicinal plants in your knowledge, used to cure ailments. Document the data in table below.
-

	Local name	**Binomial**	**Habit**	**Locality**	**Part used**	**Uses**	**Method of administration**	**Recipe**
1								
2								
3								
4								
5								
6								
7								
8								
9								

Local name must be in local language (Pashto, Urdu or English name may also be added after the name of a plant in local language); Binomials may be added to the column after identification, Habit- ***H*** for Herb, ***S*** for Shrub and ***T*** for Tree; Locality includes name of the village or mountain as well as Information such as Agriculture field, Rock surface, Near stream, Graveyard, Sandy soil etc.; Part used-***R*** for roots, *S* for stem, ***L*** for leaves, ***I*** for inflorescence, ***La*** for latex, ***B*** for bark; Uses include medicinal as well as other uses; Method of administration- oral, exogenous etc.

- What is your source of information about these medicinally important plants?

_____
_____

- What people of the locality prefer, crude medicinal plants or allopathic treatment?

_____
_____

- Is there a hospital or Basic Health Unit in your village? If the answer the No, what is the closest available health care facility?

_____

- Are there any local healers/Hakims in your village? Names should be mentioned.

1._____
2. _____
3. _____

- While choosing a therapy for any ailment, is price of the medicine a deciding factor?

_____
_____

- Is there any shop in your locality from where one can purchase medicinal plants?

_____
_____

- Which wild plants are used as food by the local folk? Fruits, Vegetables and Medicinal plants included

_____
_____

- Are there some plants in the locality with unique uses?

_____
_____

- Names of plants which are considered sacred in your locality.

_____
_____

- In addition to plants, is there any use of animals or animal parts as medicine? Name of the ailment should also be noted.

_____

_____

_____

- Are there any medicinal plants in your area which people collect for commercial purposes?

_____

_____

- Names of plants which are poisonous.

_____

_____

- Plants in your locality associated with some local legend or myth.

_____

_____

Supplementary data file 2. Check List of plant species along with taxonomic attributes (Quantitative ethnobotanical indices, family, Raunkiaer life form and Leaf size classes).

Scientific name	Family	PC	FC	RFC	FIV	UV	FL	CS	LC	Habit	RLF	LSC
Acorus calamus L.	Acoraceae	AccC	6	0.05	5	0.83	5	R	P	H	MicP	L
Adiantum capillus-veneris L.	Adiantaceae	AdiC	10	0.083	4.1	0.4	8.3	V	P	H	G	Mic
Amaranthus viridis L.	Amaranthaceae	AmaV	7	0.058	5.8	0.4	4.1	I	A	H	MegP	L
Allium cepa L.	Amaryllidaceae	AllC	15	0.125	12.5	0.57	5.8	R	B	H	MicP	Mic
Allium humile Kunth	Amaryllidaceae	AllH	7	0.05	12.5	0.42	0.04	R	P	H	MicP	Mic
Allium sativum L.	Amaryllidaceae	AllS	8	0.06	12.5	0.62	6	R	P	H	MicP	Mic
Narcissus tazetta L.	Amaryllidaceae	NarT	4	0.03	5.8	0.5	3.3	R	A	H	Th	L
Coriandrum sativum L.	Apiaceae	CorS	6	0.05	**10**	0.83	5	R	A	H	Th	Mes
Foeniculum vulgare L.	Apiaceae	FoeV	6	0.05	**10**	1.3	5	R	A	H	Th	Mic
Caralluma edulis (Edgew.) Benth. & Hook. f.	Apocynaceae	CarE	7	0.58	5.8	0.28	5.8	R	P	H	MicP	L
Hedera nepalensis L.	Araliaceae	HedN	4	0.4	3.3	1.75	3.3	R	P	C	MicP	Mes
Asparagus gracilis Royale.	Aspoledaceae	AspG	7	0.058	5.8	0.28	0.04	R	P	H	Th	Mic
Achilea millefolium L.	Asteraceae	AchM	5	0.041	14.6	0.5	5	V	P	S	MegP	Mes
Cichorium intybus L.	Asteraceae	CicI	6	0.05	14.6	0.33	5	I	P	H	MicP	Mic
Tagetes minuta L.	Asteraceae	TagM	3	0.025	14.6	0.66	2.5	R	A	H	MesP	N
Impatiens bicolor Royle	Balsaminaceae	ImpB	4	0.033	3.3	0.4	8.3	I	P	H	MicP	N
Berberis Lycium Royle	Berberidaceae	BerL	9	0.075	25.8	0.42	0.04	V	P	S	MicP	Mes
Berberis vulgaris L.	Berberidaceae	BerV	12	0.1	25.8	0.33	7.5	V	P	S	MicP	Mes
Podophylum hexandrum Royale.	Berberidaceae	PerH	10	0.083	25.8	0.33	1	V	P	H	HC	L
Betula utilis D. Don	Betulaceae	BetU	4	0.033	3.3	0.5	3.3	R	P	T	MegP	Meg
Brassica campestris L.	Brassicaceae	BraC	6	0.05	22.5	0.12	6	R	A	H	MegP	Mes
Lepidium sativum L.	Brassicaceae	LipS	6	0.05	22.5	0.75	3.3	R	A	H	Th	Mic
Nasturtium officinale R.Br.	Brassicaceae	NasO	8	0.06	22.5	0.57	5.8	R	P	H	MicP	Mic
Raphanus sativus L.	Brassicaceae	RapS	7	0.058	22.5	0.66	5	V	B	H	G	Meg
Campanula latifolia L.	Campanulaceae	CamL	3	0.025	0.25	0.33	5	R	P	S	MicP	Mes
Valeriana jatamansi Jones.	Caprifoliaceae	ValJ	6	0.05	5	1	4.1	E	P	H	G	Mic
Valeriana officinalis L	Caprifoliaceae	ValO	11	0.091	9.1	1	2.5	R	P	H	G	Mic
Colchicum autumnale L.	Colchicaceae	ColA	13	0.103	17.5	0.25	6	R	P	H	Th	Mes
Colchicum luteum baker	Colchicaceae	ColL	8	0.066	17.5	0.23	10.8	R	P	H	Th	Mes
Junperus communis L. var. *saxatilis* Pallas	Cupressaceae	JunC	8	0.066	6.6	0.27	9.1	V	P	S	MegP	L
Datisca cannabina L.	Datiscaceae	DatC	4	0.333	3.3	0.25	6	R	A	S	MegP	Mes

Pteridium equilinum (L) Khun	Dennstaedtiaceae	PteE	9	0.075	7.5	0.25	3.3	R	P	H	MesP	Mic
Dioscorea deltoidea Wall. ex Kunth, Enum	Dioscoreaceae	DioD	6	0.05	5	0.55	7.5	V	A	H	Cry	Mes
Diospyrus kaki L.	Ebenaceae	DioK	9	0.075	13.3	0.28	0.04	I	P	T	MegP	Mes
Diospyrus lotus L.	Ebenaceae	DioL	7	0.058	13.3	0.5	5	V	P	T	MegP	Mes
Equisetum arvense L.	Equistaceae	EquA	5	0.041	4.1	0.37	6	I	A	H	H	Mes
Euphorbia helioscopia L.	Euphorbiaceae	EupH	8	0.066	10	1	3.3	R	A	H	Th	Mic
Ricinus communis L.	Euphorbiaceae	RicC	4	0.033	10	0.44	7.5	I	P	S	MesP	Meg
Cassia fistula L.	Fabaceae	CasF	8	0.066	46.6	0.22	7.5	R	P	H	MegP	Mic
Indigofera heterantha Wall. ex Brandis	Fabaceae	IndG	9	0.075	46.6	0.3	8.3	V	P	S	MicP	Mes
Trifolium repens L.	Fabaceae	TriR	10	0.083	46.6	0.28	0.04	R	A	H	G	Mic
Trigonella foenum-gracecum L.	Fabaceae	TrFG	14	0.11	46.6	0.11	7.5	R	A	H	MicP	Mes
Vigna mungo (L.)	Fabaceae	VigM	7	0.058	46.6	0.12	6	V	B	S	Th	Mes
Vigna unguiculata (L.) Walp.	Fabaceae	VigU	8	0.066	46.6	0.12	6	V	A	S	Th	Mic
Quercus dilatata Royale.	Fagaceae	QueD	9	0.075	12.5	0.31	13.3	V	P	T	MegP	Mes
Quercus incana W.Bartram	Fagaceae	QueI	6	0.05	12.5	0.55	7.5	V	P	T	MegP	Mes
Geranium wallichianum D. Don ex Sweet.	Geraniaceae	GerW	6	0.05	5	0.08	1	V	P	H	MicP	Mes
Hypericum perforatum L.	Hypericaceae	HypP	7	0.058	5.8	0.08	1	V	P	H	MicP	Mic
Juglans regia Royale.	Juglandaceae	JugR	8	0.066	6.6	0.42	0.04	V	P	T	MegP	Meg
Ajuga bracteosa Wall ex. Benth	Lamiaceae	AjuB	17	0.141	64.5	0.35	11.6	R	P	H	Th	Mic
Isodon rugosus (Wall. ex Benth.) Hara	Lamiaceae	IsoR	7	0.058	64.5	0.33	7.5	R	P	S	MicP	Mes
Mentha arvensis L.	Lamiaceae	MenA	9	0.075	64.5	0.33	1	I	P	H	H	L
Mentha Longifolia (L.) Huds.	Lamiaceae	MenL	12	0.1	64.5	0.29	14.1	R	P	H	H	L
Mentha spicata L.	Lamiaceae	MenS	7	0.058	64.5	0.22	7.5	R	P	S	MicP	Mes
Salvia lanata Royle	Lamiaceae	SavL	14	0.116	64.5	1	6	R	P	H	H	Mes
Thymus linearis L.	Lamiaceae	ThyL	9	0.075	64.5	0.42	5.8	R	A	H	G	Mic
Punica granatum L.	Lythraceae	PunG	5	0.041	4.1	0.4	8.3	R	P	T	MegP	Mes
Malva sylvestris L.	Malvaceae	MalS	16	0.133	13.3	0.4	4.1	V	A	H	Th	Mes
Trillium govanianum (Wall. ex Royle) Illus.	Melanthiaceae	TriG	5	0.041	4.1	0.13	12.5	R	P	H	MicP	Mic
Melia azeadirachta L.	Meliaceae	MelA	6	0.05		0.6	?	I	P	H	MesP	Mes
Ficus carica L.	Moraceae	FicC	12	0.1	10	0.37	13.3	R	P	T	MegP	Mes
Morchella conica Pers.	Morchellaceae	MorC	12	0.1	10	0.16	5	E	A	***	G	***
Peganum harmala L.	Nitrariaceae	PegH	4	0.033	3.3	0.66	5	R	P	H	HC	L
Cypripedium cordigerum D.Don	Orchidaceae	CypC	12	0.1	10	0.25	1	R	P	H	MicP	Mes
Oxalis corniculata L.	Oxalidaceae	OxaC	7	0.058	5.8	0.47	1	I	A	H	Ch	Mic

Paeonia emodi Royale.	Paeoniaceae	PaeE	12	0.1	10	0.357	11.6	V	P	H	HC	Mes
Corydalis stewartii Fedde.	Papaveraceae	CorS	14	0.116	21.6	0.25	1	V	A/B	H	Th	Mic
Fumaria indica Pugsley L.	Papaveraceae	FumI	12	0.1	10	0.33	7.5	R	A	H	Th	Mic
Papaver somniferum L.	Papaveraceae	PapS	12	0.1	21.6	0.57	5.8	R	A	H	Th	Mes
Cedrus deodara G. Don f.	Pinaceae	CedD	16	0.133	23.6	0.5	1	R	P	T	MegP	Mic
Pinus Willichina A. B. Jack	Pinaceae	PinW	12	0.1	23.6	0.31	13.3	R	P	T	MegP	L
Limonium cabulicum (Boiss) o. Kuntze, Rev.gen	Plumbaginaceae	LimC	12	0.1	10	0.41	1	R	P	S	G	Meg
Bistorta amplexicaulis (D. Don) Greene	Polygonaceae	BisA	7	0.058	30	0.5	5	V	P	H	Th	N
Rheum webbianum Royale.	Polygonaceae	RheW	6	0.05	30	0.57	5.8	V	P	H	G	Meg
Rumex dentatus L.	Polygonaceae	RumD	10	0.083	30	0.66	5	I	A	H	Th	Mic
Rumex hastatus L.	Polygonaceae	RumH	13	0.108	30	0.4	8.3	I	A	H	Th	Mic
Portulaca oleracea L.	Portulacaceae	PorO	10	0.083	8.3	0.08	1	R	A	H	G	Mic
Primula denticulata Sm.	Primulaceae	PriD	16	0.133	13.5	0.07	11.6	R	P	H	G	Mes
Aconitum heterophyllum Wall. ex Royle	Ranunculaceae	AcoH	9	0.075	25.8	0.33	5	V	B	H	MesP	Mic
Aconitum violaceum Jacq ex Stapf	Ranunculaceae	AcoV	6	0.05	25.8	0.25	6	R	B	H	G	Mic
Caltha alba Camb.var. *alba* Camb. ex Jacquem.	Ranunculaceae	CalA	8	0.066	25.8	0.25	6	R	P	H	MicP	Mes
Ranunculus arvensis L.	Ranunculaceae	RanA	8	0.066	25.8	0.6	4.1	R	A	H	Th	Mes
Ziziphus jujuba Mill	Rhamnaceae	ZizJ	9	0.075	7.5	0.38	10.8	I	P	S	MegP	Mes
Prunus armeniaca L.	Rosaceae	PruA	14	0.166	93.3	0.12	13.3	R	P	T	MegP	Mes
Prunus domestica L.	Rosaceae	PruD	17	0.141	93.3	0.14	11.6	R	P	T	MegP	Mes
Malus domestica (Suckow) Borkh.	Rosaceae	PruM	16	0.133	93.3	0.07	10.8	R	P	T	MegP	Mes
Prunus persica (L) Batsch	Rosaceae	PruP	13	0.108	93.3	0.33	7.5	R	P	T	MegP	Mes
Pyrus communis L.	Rosaceae	PyrC	13	0.108	93.3	0.22	7.5	V	P	T	MegP	Mes
Pyrus pashia Buch	Rosaceae	PyrP	11	0.091	93.3	0.2	8.3	V	P	T	MegP	Mes
Rosa brunonii Lindl.	Rosaceae	RosB	9	0.075	93.3	0.17	14.1	R	P	H	MesP	Mic
Rosa indica L.	Rosaceae	RosI	9	0.075	93.3	0.36	9.1	R	P	H	MesP	Mic
Sorbaria tomentosa (Lindl.) Rehder	Rosaceae	SorT	10	0.083	93.3	0.57	5.8	V	P	S	G	L
Rubia cordifolia L.	Rubiaceae	RubC	10	0.083	8.3	0.22	7.5	V	P	H	Th	Mic
Citrus medica L.	Rutacaeae	CitM	4	0.033	21.66	0.28	5.8	R	P	S	MicP	Mes
Skimia laureola DC	Rutaceae	SkiL	7	0.058	21.66	0.3	8.3	R	P	H	HC	Mes
Zanthoxylum armatum DC.	Rutaceae	ZanA	7	0.058	21.66	0.5	3.3	R	P	S	G	Mes
Saxifraga flagellaris Willd. ex Sternb. subsp. *stenophylla*	Saxifragaceae	SaxF	5	0.41	4.1	0.22	7.5	R	A	H	H	Mic
Verbascum densiflorum L.	Scrophulariaceae	VerD	9	0.075	15.3	0.2	8.3	R	B	S	Th	Mes
Verbascum thapsus L.	Scrophulariaceae	VerT	10	0.083	15.3	0.15	10.8	I	B	S	Th	Mes

Alianthus altissimia Mill	Simaroubaceae	AliA	7	0.058	5.8	0.2	4.1	R	P	T	MicP	Mic
Atropa acuminata Royle	Solanaceae	AtrA	7	0.058	40	0.33	5	V	P	S	MegP	Meg
Capsicum annum L.	Solanaceae	CapA	9	0.075	40	0.28	5.8	R	A	H	Th	Mes
Lycopersicum esculentum Mill.	Solanaceae	LycE	16	0.133	40	0.33	7.5	R	A	H	Th	Mes
Solanum tuberosum L.	Solanaceae	SolT	7	0.058	40	0.18	13.3	R	P	H	HC	Mes
Withania coagulans (Stocks) Dunal in DC	Solanaceae	WthC	9	0.075	40	0.28	5.8	V	P	S	MegP	Meg
Taxus wallichiana Zucc.	Taxaceae	TaxW	4	0.033	3.3	0.42	5.8	R	P	T	MegP	Meg
Ulmus wallichiana Planch	Ulmaceae	UlmW	7	0.058	5.8	0.25	3.3	V	P	T	MegP	Mes
Debrigeasia saliciflolia D.Don	Urticaceae	DebS	9	0.075	13.3	0.28	5.8	R	P	S	MegP	Mes
Urtica dioica L	Urticaceae	UrtD	7	0.058	13.3	0.22	7.5	R	P	H	G	Mes
Vitis vinefera L.	Vitaceae	VitV	5	0.041	4.1	0.14	5.8	R	P	S	MegP	Meg

Note: H-Herb, S-Shrub, T-Tree, Climber-C, **CS**-Conservation status, R-Rare, Vulnerable-V, Infrequent-I, Endangered-E, RLF- Raunkiaer life form, LSC-leaf size class, PC-plant code, LC-Life cycle, A-annual, B-biennial, P-perennial, LSC-leaf size class, (Life form) G-geophyte, Th-Therophyte, H-Hemicryptophyte, Ch-Chamaephyte, Np-Nanophanerophyte, MicP- Microphanerophyte, Mesp-Mesophanerophyte, Megp Megaphanerophyte, L-Leptophyll, N-Nanophyll, Mic-Microphyll, Mes-Mesophyll, Mac-Macrophyll, Meg-Megaphyll, UV-Use value, FC-Frequency of citation, RFC-Relative frequency of citation, CS-Conservation status, FL-Fidelity level