Ethnobotanical Inventory of Wild Woody Plants Species of Randyam Mountainous Zone of Bhimber, Azad Jammu and Kashmir Pakistan

Muhammad Ishtiaq, Humaira Khanum, Mehwish Maqbool, Tanvir Hussain, Muhammad Waqas Mazhar, Zel e Arooj and Syed Atiq Hussain

Correspondence
Muhammad Ishtiaq[1,2]*, Humaira Khanum[1], Mehwish Maqbool[1], Tanvir Hussain[1], Muhammad Waqas Mazhar[1], Zel e Arooj[1] and Syed Atiq Hussain[3]
1 Department of Botany, Mirpur University of Science & Technology (MUST), Mirpur-10250 (AJK), Pakistan
2 Department of Botany, Climate Change Research Centre(CCRC), Herbarium and Biodiversity Conservation Laboratory, Azad Jammu and Kashmir University of Bhimber (AJKUoB), Bhimber-10040 (AJK), Pakistan
3 Department of Botany, University of Gujrat, Pakistan
*Corresponding Author: drishtiaq.bot@must.edu.pk

Ethnobotany Research and Applications 27:55 (2024)- http://dx.doi.org/10.32859/era.27.55.1-15
Manuscript received: 12/07/2024 – Revised manuscript received: 06/12/2024 - Published: 08/12/2024

Research

Abstract

Background: Traditional ethnobotanical knowledge (TEK) of wild tree plants (WTPs) of Randyam Mountainous Zone was collected to evaluate economic and medicinal uses with conservation perspectives for sustainable availability.

Methods: This study was conducted in 2018-19 through interactions with indigenous communities. Open-ended and closed-ended interview protocols were employed to gather information. Microstatistical tools: informant consensus factor (ICF), relative frequency of citation (RFC), relative order of priority index (ROP) and use value index (UVI) were applied.

Results: The ethnobotanical data of 21 WTPs from 9 families was collected through filed visits, plant interviews and community participation approach. The results indicated that the highest ICF was 0.91 for skin diseases. *Azadirachta indica* has FL value of 100% which is indicator of common popularity in the area. UVI of *Azadirachta indica* was 0.61 while RFC was 55. ROP of two trees: *Acacia arabica* and *Azadirachta indica* was the highest (100) which was indicator of their prevalent use in ethnomedicines in the study area. The research proved that *Azadirachta indica* has very common use in agriculture and also marketed on commercial scale. WTPs like *Dalbergia sissoo, Pinus roxburghii* and *Senegalia modesta* were used timber and fuel at domestic and commercial level. There is severe biotic pressure on many of the WTPs and there is need to work for their conservation and propagation.

Conclusion: The research strongly recommends for taking immediate measures for protection and conservation of native WTPs of RMZ for sustainable natural resources to cope necessities of indigenous people and keep mitigating drastic impacts of climatic changes.

Keywords: Traditional ethnobotanical knowledge; Preservation, Sustainable use of natural resources; Randyam Mountainous Zone.

Background

Trees serve various purposes, such as providing fuelwood, shade, and materials for agricultural equipment, furniture, and house construction. They also contribute to decoration, serve as sources for war implements, and offer fodder, forage, medicines, and food in the form of fruits (Ajaib *et al.* 2021). As the primary producers, indicators, and protectors of other plant species, such as shrub and herb understory in forests, which are essential for faunal biodiversity, trees are crucial components of any ecosystem (Maqbool *et al.* 2019). Numerous other non-timber forest products (NTFPs) are produced by trees; as a result, a sizeable portion of an ecosphere's or habitat's classification depends on the number and variety of trees present. The pharmacological industries place a high value on the utilization of trees in drug research and development (Shah 2005).

The provinces of Punjab and KPK are geographically connected to Azad Jammu and Kashmir (AJK), situated on Pakistan's eastern and northern sides. AJK's local communities maintain robust connections with diverse ethnic groups in neighboring areas, shaped by their phytogeographic location and religious paradigm. Historically, the Kashmiris' roots trace back to the ancient Indo-Aryan ethnic group called "Dardic," residing along the eastern Afghan border and in northern Pakistan and India. District Bhimber serves as a crucial crossing point between Azad Kashmir and Punjab, often referred to as "Bab-e-Kashmir," translating to "door to Kashmir" (Shah *et al.* 2015; Ishtiaq *et al.* 2013). The predominant traditional ethnic groups in the study area include Jat, Mirza, Malik, Rajpoot, Bhatti, Sheikh, Syed, Awan, and Gujar. A diverse array of languages, including Urdu, English, Dogri, Kashmiri, Potohari, and Saraiki, is widely spoken (Abbasi *et al.* 2011).

The Randyam Mountainous Zone (RMZ) of Bhimber, Azad Jammu and Kashmir, is a biologically rich region harboring diverse wild woody plant species. These species are integral to the lives of local communities, providing essential resources such as medicine, food, fuel, and timber, alongside vital ecosystem services (Batool and Rahman 2023). However, urbanization, deforestation, overexploitation, and climate change are increasingly threatening these natural resources (Ishtiaq *et al.* 2022). Despite their ecological and cultural importance, the ethnobotanical and ethnomedicinal significance of these species remains under-documented. This study aims to address this knowledge gap by cataloguing the wild woody plants of the RMZ and recording their traditional uses, offering valuable insights into their role in the daily lives and health practices of indigenous communities.

Documenting the ethnobotanical knowledge of these species is crucial to preserving the cultural heritage of the RMZ, as traditional plant-based practices face the risk of being lost due to generational changes and modernization. Additionally, wild woody plants are potential reservoirs of bioactive compounds (Nafeesa *et al.* 2021), making them invaluable for future pharmacological research and drug development. Understanding the medicinal, nutritional, and ecological roles of these species can guide sustainable resource management while providing baseline data for conservation strategies. Moreover, the findings of this study can aid policymakers and conservationists in crafting informed measures to protect this biodiversity hotspot, ensuring the long-term availability of these resources for local communities and beyond (Khoja *et al.* 2024).

The study area's traditional lifestyle and economic sustenance heavily rely on the long-term preservation of its forests and wildlife species. However, the burgeoning human population and unsustainable exploitation of resources contribute to a rapid decline in forest cover, leading to the loss of crucial biodiversity and ecosystem services. This environmental challenge is exacerbated by the region's vulnerability to climate change-induced drought (Ishtiaq *et al.* 2012).

The study's primary aim is to conduct an extensive ethnomedicinal profiling and explore ethno-ecological perspectives of wild woody plant species in the Randyam Mountainous Zone (RMZ) of Bhimber, AJK, Pakistan. It seeks to document and analyse local communities' traditional knowledge regarding the medicinal uses of these plants, contributing to a deeper understanding of the nature-culture relationship in the region. Additionally, the research aims to investigate the ecological roles and relationships of these species within their ecosystems, highlighting their broader significance in maintaining environmental balance.

Objectives of the current research included to document ethnomedicinal practices, identifying plant species and their uses, and conducting ethno-ecological mapping for insights into ecological preferences and impacts of human practices. The study serves as a cultural preservation and future research resource. This research will create a comprehensive inventory of wild woody plant species, documenting their ethnobotanical and ethnomedicinal uses through field surveys and interviews with local populations. It will employ quantitative indices such as Relative Frequency of Citation (RFC), Usage Value (UV), and Rank Order Priority (ROP) to assess the significance of these species.

By preserving indigenous knowledge and fostering sustainable practices, the study will contribute to the conservation of biodiversity and the promotion of traditional healthcare systems while laying the groundwork for future ecological and pharmacological research.

Materials and Methods

Study Area

The Randyam Mountainous Zone (RMZ) in Azad Jammu and Kashmir is a picturesque and rugged region bordered by the Neelam Valley to the north, Pir Panjal Mountains to the east, and the Line of Control to the west.

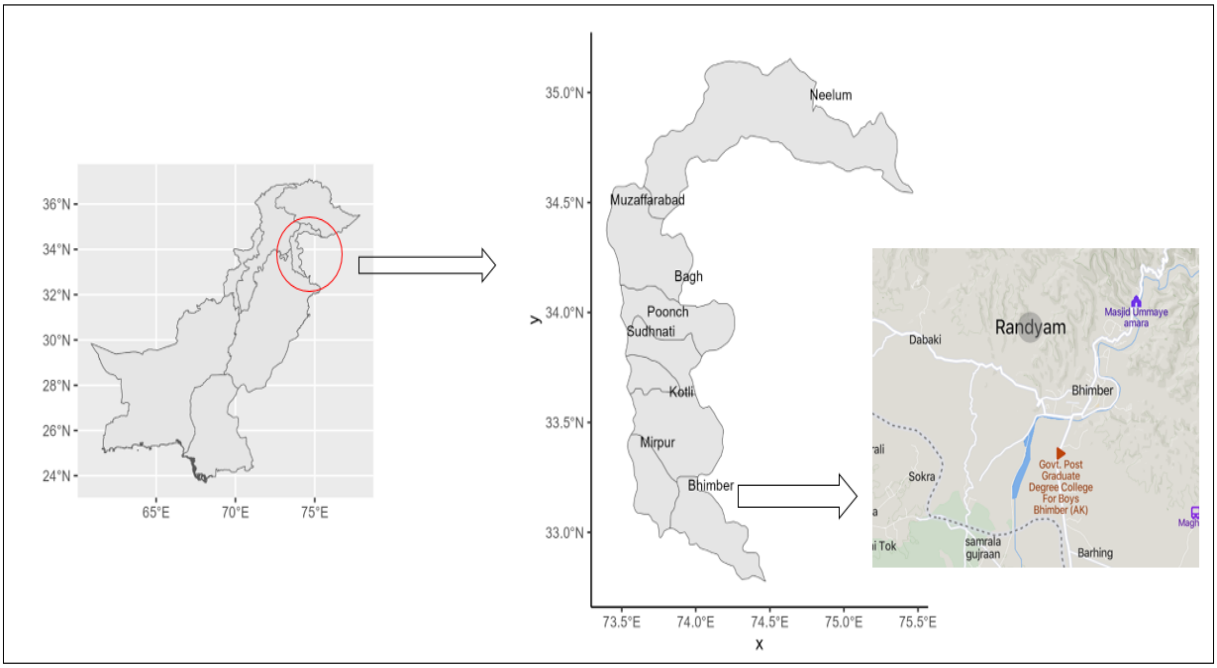

Figure 1. Study area map of Randyam mountainous zone of Bhimber, AJK, Pakistan. Coordinates: 32° 59' 36" N latitude and 74° 2' 44" E longitude

Notable peaks include Mount Randyam, Mount Pirsar, and Mount Kalash, attracting outdoor enthusiasts for activities like hiking and camping. Well-maintained trails such as Randyam-Neelam Valley Trek and Pirsar-Kalash Trek offer exploration opportunities. The region features villages for cultural experiences. With a temperate climate, good rainfall, and attractive seasons, the RMZ is best visited in spring or autumn (Dhiman 2011).

The location is a populated place in Bhimber District, Azad Jammu and Kashmir, Pakistan, characterized by a settlement where people live and work, such as a city, town, or village. Situated in the Azad Kashmir region, this area lies at the geographical coordinates of 32° 59' 36" N latitude and 74° 2' 44" E longitude. The region features a mix of vegetation types, including subtropical dry forests, shrubs, and cultivated agricultural lands, with key species like acacia, shisham, and wild olive dominating the natural flora (Nafeesa *et al.* 2021). The population is largely rural, with residents engaged in farming, livestock rearing, and small-scale trades. The climate is subtropical, with hot summers reaching temperatures of up to 40°C and mild winters where temperatures occasionally drop below 10°C, accompanied by moderate rainfall during the monsoon season. Other notable features include rolling hills, fertile plains, and seasonal streams that contribute to the area's agricultural productivity, while its proximity to the Himalayan foothills enhances its scenic beauty and biodiversity (Ishtiaq *et al.* 2024).

Data analysis and validation

From 2018 to 2019, ethnobotanical data on tree flora in RMZ were collected using the rapid rural appraisal (RRA) method. The RRA approach in ethnobotany is a participatory research method designed to quickly gather information about the relationships between local communities and their use of plants. It is particularly useful in rural or remote areas where detailed, long-term studies may not be feasible. RRA employs a mix of qualitative and semi-quantitative techniques to collect data efficiently while ensuring community involvement (Ghorbani *et al.* 2011). Field trips, employing visual evaluation assessment and a questionnaire proforma, covered diverse locations and seasons. Data from 190 respondents, including older residents, farmers, and fuelwood cutters, were gathered, classifying plants by use and economic value. Collected plants,

identified by taxonomist, were preserved in the herbarium at Mirpur University of Science and Technology. The documentation process followed established protocols, ensuring accuracy and reliability (Ishtiaq *et al.* 2015). The information of respondents has been detailed in table1 (Khoja *et al.* 2024).

Table 1. Demographic statistics of the 190 respondents from the study area

Category	Specifics	Number of Respondents	Percentage (%)
Occupation	Wood sellers	30	15.78
	Herbalists	70	36.84
	Other professions	90	47.36
Ethnic Groups	Sardar	15	7.89
	Sudhan	23	12.11
	Jat	13	6.84
	Malik	25	13.16
	Pashtoon	19	10
	Mirza	22	11.58
	Sheikh	18	9.47
	Syed	16	8.42
	Awan	14	7.37
	Rajpoot	10	5.26
	Gujars	15	7.89
Language	Urdu	50	26.32
	Dogri	35	18.42
	Kashmiri	45	23.68
	Pashto	30	15.79
	Saraiki	30	15.79
Age Group	40-45 years	33	17.36
	46-50 years	36	18.94
	51-60 years	55	28.94
	More than 60 years	66	34.73
Gender	Male	127	66.84
	Female	63	33.16
Education Level	Illiterate	65	34.21
	Primary	33	17.37
	Middle	27	14.21
	Secondary	22	11.57
	Higher Secondary	21	11.05
	Graduation	17	8.94
	Higher Education	5	2.63
Religion	Islam	183	96.32
	Christianity	7	3.68

Ethical Permission

The Departmental Ethical Committee (DEC) granted permission for field research and the collection of wild plants (trees) in the RMZ zones of District Bhimber (AJK) in an official letter (Ref No: 31/DEC/BOT/2015; Date: 20/06/2015) that was countersigned by the Department Head. District Forest Officer (DFO) issued an official field permit (Ref No: DFO/655/2015 Dated: 01/07/2015) to conduct field visits in the RMZ of Bhimber forest area and collect plant (tree) sample. According to the SOPs issued by the appropriate office, the right of obedience to forest rules was strictly adhered to, and DEC instruction was strictly followed as well.

Quantitative Ethnobotanical Analysis

The gathered data underwent tabulation for further statistical analysis, employing various standard quantitative ethnobotanical indices as described below (Ishtiaq *et al.* 2015; Purohit and Vyas 2004). An informant consensus factor (ICF) analysis was conducted for each ailment category to determine informants' agreement on reported "ethnomedicinal uses" for specific disorders. ICF was calculated using the formula:

$$ICF = (Nur - Nt)/(Nur - 1)$$

where "Nt" is the total plant species used, and "Nur" is the number of use citations in each category (Bradacs *et al.* 2011). FL was determined as the percentage of informants claiming a specific use of a plant for a typical condition.

$$FL(\%) = Np/N \times 100$$

where 'Np' is the number of informants claiming a specific use, and 'N' is the total number of informants/interviewees using the plants as ethnomedicine (Rehman *et al.* 2017).

RPL values, ranging from 0 to 1, represent the popularity of a plant for a specific condition. It is calculated by the ratio of (Iu / people who reported using a specific plant). A species is popular (P) if reported by 25 or more people, and unpopular (UP) if fewer than 25 (Ju *et al.* 2013).

ROP, the adjustment between FL and RPL, is calculated by the formula:

$$ROP = FL \times RPL$$

The highest ROP indicates the most popular plant for treating a particular condition (Rehman *et al.* 2017).

Use value index was formulated using:

$$UVI = {(\sum Ui)}/{N}$$

where UV is the species' relative use value, U is the number of uses listed by each informant, and N is the overall number of informants reporting that species (Ju *et al.* 2013).

RFC investigates the significance of a species in the area.

$$RFC = FC/N$$

where RFC > 1 indicates importance. FC is the number of informants reporting a specific species, and N is the total number of informants in the survey (Mughisha *et al.* 2014).

Results and Discussion

Ethnobotanical profiling of wild tree species of the area

Plants are inevitable for survival of the mankind and other species on this planet. The current study reveals the significance of the wild tree plants (WTPs) of the study area of AJK, Pakistan. To collect the data regarding the phytosociology, ethnobotanical and ethnomedicinal uses of WTPs three informant groups were engaged for a comprehensive understanding. In the study thirty wood sellers provided perspectives on market dynamics, while 90 indigenous community members offered insights into traditional and cultural significance. Additionally, 70 traditional herbal practitioners contributed specialized knowledge on medicinal properties, emphasizing the importance of these plant resources in traditional healthcare practices (Ahmed *et al.* 2013). The survey highlights the significant role of the male community in direct interactions with tree flora, involving cutting, transporting, and selling trees for fuelwood, fruits, and timber. This showcases the economic importance of these activities, linking plant species to local economies with broader implications for livelihoods and sustainability (Tabuti *et al.* 2013). The study gathered information on 21 tree species from 9 families in the District Bhimber of AJK, sourced from various locations like communities, timber stocks, and retail and furniture manufacturing facilities. Notably, north-facing mountains exhibited greater plant diversity than south-facing ones, possibly due to higher altitude, moisture content, and humidity (Yang *et al.* 2020; Porras *et al.* 2020). The dominant families were Moraceae and Mimosaceae, contributing five species each, shaping the region's plant diversity (Figure 2). These families demonstrated adaptability to the local climate and environmental conditions (Yang *et al.* 2020). The study reveals diverse uses of wild tree species in the RMZ of Bhimber, Pakistan (Figure 3; Table 2). Notably, 19% serve as animal feed, emphasizing their crucial role in sustaining livestock and agricultural practices. Fuelwood, constituting 31%, reflects their vital role in meeting local energy needs for cooking and

heating. Additionally, 9% are utilized for timber and construction, contributing to traditional building practices. The allocation of 9% for manufacturing highlights their role in crafting various products, supporting local economies.

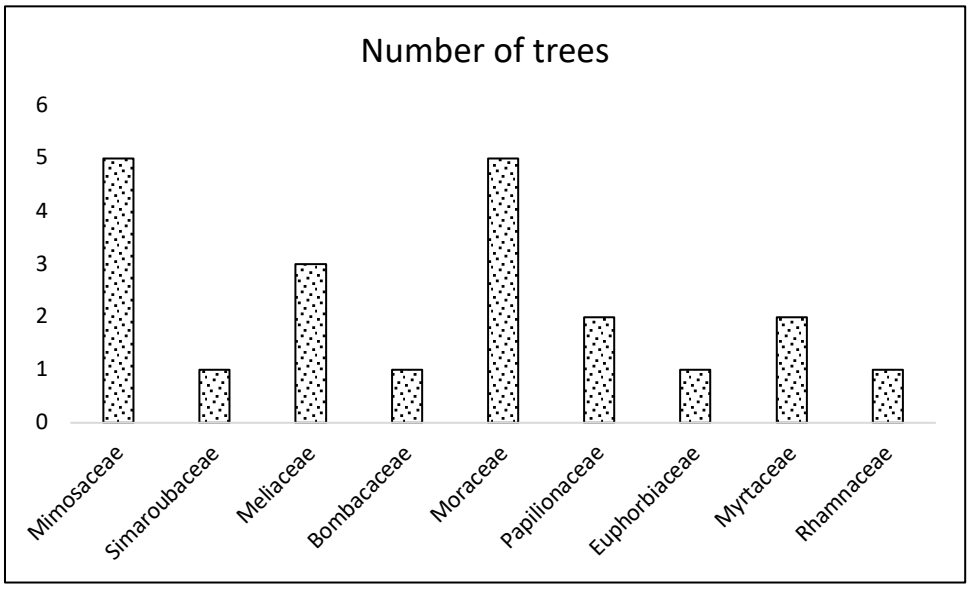

Figure 2. Bar chart showing family wise floristic composition of Wild Woody Plants Species of Randyam Mountainous Zone of Bhimber (AJK) Pakistan.

Smaller percentages, such as 2% for beekeeping, 8% for insect repellents, and 9% for veterinary medicines, showcase their ecological and ethnomedicinal value. These findings underscore the diverse and integral contributions of wild tree species in the region (Pala *et al.* 2020; Singh *et al.* 2022).

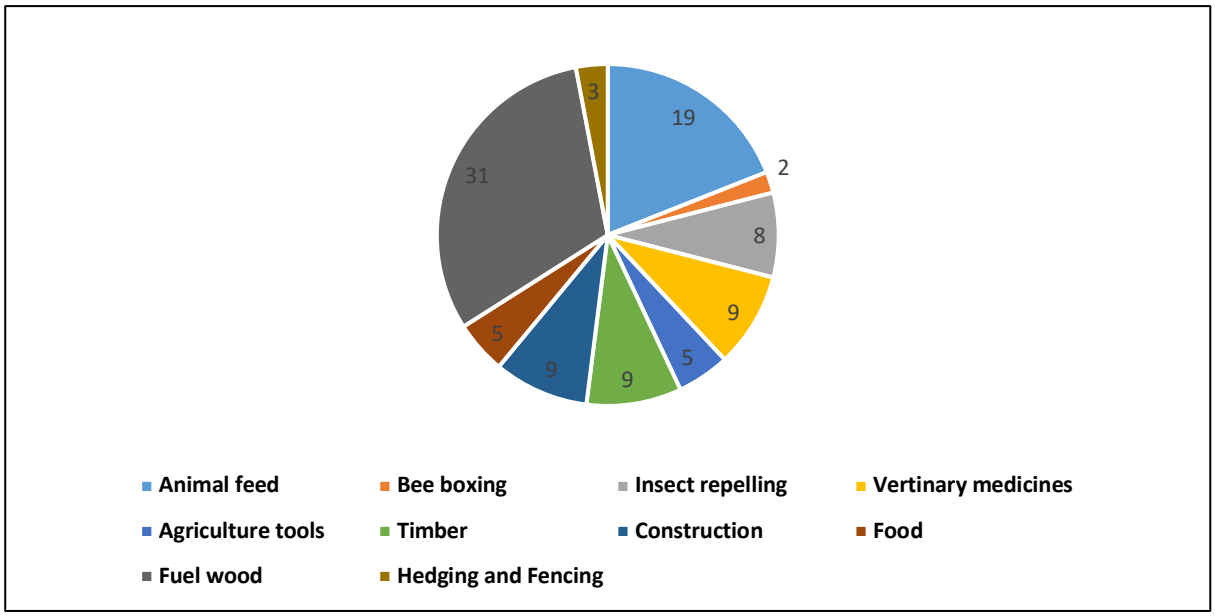

Figure 3. Percentage contribution of different plants for ethnobotanical and ethnomedicinal purposes from RMZ of District Bhimber AJK, Pakistan.

Table 2. Ethnobotanical Perspectives of Wild Woody Species from RMZ by using Quantitative Ethnobotanical Indices and Statistical Tools

Botanical Names	Family	Ethnobotanical uses	RF	RFC	UV	UVi	N	NA	FL	RPL	ROP
Bombax ceiba L	Bombacaceae	The wood is used for making furniture and construction materials; the fibers from the flowers are used to stuff cushions and mattresses.	40	0.62	55	0.85	89	76	85	0.8	68
Emblica officinalis L.	Euphorbiaceae	The wood is used for making furniture and tools; the fruit is used in making soaps.	31	0.48	45	0.69	43	25	58	0.5	29
Acacia arabica L.	Fabaceae	The wood is used for furniture, flooring, and crafting; the gum is used in adhesives.	43	0.66	23	0.35	76	76	100	1	100
Acacia nilotica (L.) Delile.	Fabaceae	The wood is used for fuel, construction, and as timber; the gum is used in varnishes and as a binding agent.	39	0.6	42	0.65	63	62	97	0.9	87.3
Albizia julibrissin Durazz.	Fabaceae	The wood is used for furniture and tools; the flowers are used in religious ceremonies and as a dye.	27	0.42	16	0.25	76	69	90	0.9	81
Albizia lebbeck L.	Fabaceae	The wood is used in construction, the seeds are used as fodder for livestock, and the bark is used in making ropes.	33	0.51	21	0.32	59	56	94	0.9	84.6
Albizia procera L.	Fabaceae	The wood is used for making furniture; the bark is used to make ropes; the tree is used as fodder for animals.	29	0.45	25	0.38	56	51	91	0.9	81.9
Butea monosperma (Lam.) Kuntze	Fabaceae	The wood is used in construction and making agricultural tools; the flowers are used in religious rituals and as a dye for clothing.	42	0.65	54	0.83	57	41	71	0.7	49.7
Dalbergia sissoo L.	Fabaceae	The wood is used for making furniture, flooring, and musical instruments.	25	0.38	59	0.91	59	35	59	0.5	29.5
Azadirachta indica (A.) Juss.	Meliaceae	The wood is used for timber; the leaves are used to make insect repellent; the seeds are used for extracting oil.	55	0.85	35	0.54	78	78	100	1	100
Cedrela toona Roxb.	Meliaceae	The wood is used for making furniture and for construction; the bark is used for making dye.	38	0.58	33	0.51	63	42	66	0.6	39.6
Melia azedarach (L.) Pers.	Meliaceae	The seeds are used for making insecticides; the wood is used for furniture and as a timber source.	24	0.37	46	0.71	49	15	30	0.3	9
Broussonetia papyrifera L.	Moraceae	The wood is used for making paper; the leaves are used as fodder for livestock.	52	0.8	31	0.48	68	59	86	0.8	68.8

Ficus bengalensis L.	Moraceae	The wood is used in construction; the leaves are used as fodder for livestock; the tree is used for its fruit.	34	0.52	45	0.69	57	28	49	0.4	19.6
Ficus elastica Roxb.	Moraceae	The wood is used for furniture; the fruit is eaten, and the leaves are used as fodder for cattle.	20	0.31	43	0.66	40	13	32	0.3	9.6
Ficus palmata Forssk.	Moraceae	The fruit is eaten, the leaves are used as fodder, and the wood is used in construction.	22	0.34	32	0.49	65	25	38	0.3	11.4
Ficus religiosa L.	Moraceae	The wood is used in making furniture and for religious purposes; the leaves and fruit are used in ceremonies.	24	0.37	31	0.48	46	20	43	0.4	17.2
Eucalyptus citriodora Hook	Myrtaceae	The wood is used for making furniture, and the leaves are used for extracting essential oil.	39	0.6	43	0.66	39	21	53	0.5	26.5
Eugenia jambolana L.	Myrtaceae	The fruit is consumed raw or used in preserves; the wood is used for making furniture.	19	0.29	28	0.43	63	35	55	0.5	27.5
Ziziphus mauritiana Lam	Rhamnaceae	The wood is used in construction; the fruit is consumed and used for making jams; the leaves are used as fodder for livestock.	18	0.28	38	0.58	55	16	29	0.2	5.8
Ailanthus altissima (Mill.) Swingle	Simaroubaceae	The wood is used in construction, for making furniture, and as plywood; the bark is used for tanning leather.	38	0.58	33	0.51	49	44	89	0.8	71.2

Table 3. Ethnomedicinal profiling of wild woody taxa from RMZ calculated using ethnobotanical indices and statistical tools

Botanical Names	**Part used**	**Ethnomedicinal Use**	**FC**	**RFC**	**UV**	**UVi**	**Np**	**FL (%)**	**RPL**	**ROP=FL× RPL**
Acacia arabica L.	Bark, Gum, Leaves	It is used for healing wounds and treating fever, cough, cold, and toothache.	33	0.51	28	0.43	12	34.2	1	34.2
Acacia nilotica (L.) Delile.	Gum, Bark, Seeds	It's employed for treating foot infections, toothaches, and sexual disorders.	28	0.43	21	0.32	5	14.3	0.8	11.4
Ailanthus altissima (Mill.) Swingle	Bark, Leaves	This plant is known to relieve headaches, rheumatism, and skin diseases.	27	0.42	22	0.34	8	22.5	0.6	13.5
Albizia julibrissin Durazz.	Bark, Flowers, Leaves	The plant is utilized to address insomnia, digestive issues, anticancer properties, and diarrhea.	23	0.35	27	0.42	9	25.7	1	25.7
Albizia lebbeck L.	Bark, Flowers, Leaves	It's used to manage asthma, kidney diseases, and arthritis.	21	0.32	18	0.28	2	5.71	0.9	5.1
Albizia procera L.	Bark, Leaves	This plant assists in treating kidney diseases, possesses anticancer potential, and aids digestive disorders.	30	0.46	29	0.45	6	17.1	0.3	5.1

Azadirachta indica (A.) Juss.	Leaves, Bark, Seeds, Oil	The plant's properties are beneficial for wound healing.	45	0.69	31	0.48	4	11.4	0.6	6.8
Bombax ceiba L	Flowers, Bark	It's employed to alleviate symptoms such as cough, fever, menstrual pain, flu, and sore throat.	29	0.45	30	0.46	3	8.57	1	8.5
Broussonetia papyrifera L.	Bark, Leaves	This plant acts as a tonic and helps with skin disorders, dysentery, and diarrhea.	30	0.46	23	0.35	8	22.5	0.5	11.2
Butea monosperma(Lam.) Kuntze	Flowers, Leaves, Gum	It's used for treating eye-related conditions, diabetes, and kidney disorders.	25	0.38	41	0.63	6	17.1	0.6	10.2
Cedrela toona Roxb.	Bark	The plant is beneficial for healing wounds, acting as a tonic, and managing dysentery and skin diseases.	22	0.34	24	0.37	7	20	0.9	18
Dalbergia sissoo L.	Bark	It's utilized to cure skin diseases, abscesses, act as a blood purifier, antiseptic, and for dental care.	20	0.31	26	0.4	2	5.71	0.2	20.5
Emblica officinalis L.	Fruit, Leaves, Seeds	This plant is used to treat stomach diseases, diabetes, kidney disorders, asthma, and jaundice.	28	0.43	54	0.83	8	22.5	0.4	9
Eucalyptus citriodora Hook	Leaves, Oil	It's employed to alleviate symptoms like cold, cough, flu, pneumonia, and fever.	28	0.43	42	0.65	6	17.1	0.7	11.9
Eugenia jambolana L.	Fruit, Seeds, Leaves	The plant is known to address dysentery, possess anticancer and antioxidant properties.	22	0.34	57	0.88	9	25.7	0.9	23.1
Ficus bengalensis L.	Bark, Leaves, Fruit	It's used for curing skin diseases, diabetes, acting as a tonic, and for managing toothaches.	25	0.38	55	0.85	3	8.57	0.3	2.5
Ficus elastica Roxb.	Leaves	This plant is effective against chest infections, constipation, oral infections, and gastrointestinal issues.	31	0.48	22	0.34	5	14.3	0.5	7.15
Ficus palmata Forssk.	Leaves, Fruit	It's employed to treat conditions like asthma, digestive problems, skin diseases, and diabetes.	29	0.45	37	0.57	15	42.8	0.6	25.6
Ficus religiosa L.	Leaves, Bark, Roots	This plant is beneficial for addressing dysentery, promoting wound healing, managing fever.	22	0.34	39	0.6	18	51.4	0.9	46.2
Melia azedarach (L.) Pers.	Leaves, Bark	It's used for wound healing, managing anemia, and addressing jaundice.	28	0.43	61	0.94	3	8.57	1	8.57
Ziziphus mauritiana Lam	Fruit, Leaves, Seeds	This plant possesses anticancer properties, acts as a tonic, purifies blood, and helps manage fever.	26	0.4	45	0.69	8	22.5	1	22.5

The locals sell wild medicinal plants (WMPs) to herbalists (hakeems) and market vendors to generate income, in addition to using them at home as food supplements and tonics. It was also found that older individuals possess greater knowledge of medicinal plants and traditional ethnomedicine (TEMs) compared to younger generations. This is attributed to their extended time spent with ancestors and reliance on TEMs for treating illnesses (Papageorgiou *et al.* 2020). Hakeems with 10–15 years of experience were identified as having the highest level (33%) of traditional ethno-medical knowledge. Interestingly, illiterate individuals in the research area demonstrated greater familiarity with TEMs than their educated counterparts, likely because they practice traditional cultural rituals more fervently and consistently. On the other hand, highly educated individuals showed a reduced reliance on traditional ethno-medical knowledge and practices (Qunilan 2022), likely due to their preference for allopathic treatments, which are perceived as offering faster relief and are more affordable for them. Indigenous communities, particularly the elderly and illiterate, tend to have greater traditional ecological knowledge (TEK) and rely more on TEMs, driven by their belief in the curative properties of WMPs and the absence of adverse effects.

Quantitative data analysis:

For the purpose of calculating ICF, different EB uses were divided into 6 groups according to the uses indicated by locals (Figure 4). These groups included fodder, fuel, building, furniture, producing items, and adornment. ICF results revealed that wood is mostly used for fuel and construction purposes, as well as for a variety of commodities and veterinary applications, with plant sources being used for lumber and feed coming in second and third place, respectively. While lower ICF values were determined for activities including making baskets, threshing wheat, using agricultural equipment, preparing roti, and picking wild fruit. According to the ICF results, wood emerges as a highly versatile resource (Ishtiaq *et al.* 2012; Awan *et al.* 2021).

The findings from the ICF analysis highlight the diverse roles plants play in the lives of local communities in the RMZ. Wood emerged as a highly versatile resource, widely used for fuel and construction, emphasizing its importance for basic energy and infrastructure. Additionally, plants are utilized for lumber, animal feed, and various household applications. Lower ICF values for activities such as basket making, wheat threshing, and roti preparation suggest these uses are less central to the community's needs compared to major applications like fuel and fodder (Ishtiaq *et al.* 2024). The analysis also revealed a higher reliance on plant-based remedies for treating ailments such as asthma, eye disorders, and skin diseases, which are prevalent due to lifestyle and environmental factors in the region. These health concerns are likely linked to the locals' close interaction with rugged terrains and exposure to natural elements (Khanum *et al.* 2024). Previous ethnobotanical studies (Khoja *et al.* 2024; Ishtiaq *et al.* 2024; Nafeesa *et al.* 2021), including those identifying *Emblica officinalis* and *Eugenia jambolana* as medicinal plants for diabetes treatment (Panda *et al.* 2023), align with these findings, emphasizing the enduring dependence of mountainous communities on plants to meet their basic needs. The study underscores the critical need for conservation, sustainable management, and preservation of the ethnomedicinal knowledge of wild plant species, ensuring their continued benefit to local communities and biodiversity.

The analysis also reveals the prominence of plant sources for lumber and animal feed. Lumber serves as a vital material for construction, furniture, and various other applications, contributing to the physical development and well-being of communities. It's noteworthy that the study identifies lower ICF values for certain activities. These activities include making baskets, threshing wheat, using agricultural equipment, preparing roti (a type of bread), and picking wild fruit. The lower ICF values for these activities could suggest that they are less central to the cultural and practical aspects of the community, compared to the more substantial uses like fuel, construction, and animal feed (Ishtiaq *et al.* 2012). Further quantitative indices and and significance assessment of the WTPs of RMZ has been provided in table 2. *Acacia arabica* (Kikar) is recognized for its versatile wood applications, with a high RFC of 0.66 and a remarkable FL of 100, signifying its widespread acknowledgment among locals. *Acacia nilotica* (Jangle Kikar) is valued for its wood, reflected in a substantial UV of 42 and an ROP of 87.3. *Ailanthus altissima* (Toon) and *Albizia julibrissin* (Jangle Shree) serve diverse purposes, particularly wood-related, with varying degrees of popularity and significance. *Azadirachta indica* (Neem) stands out with an impressive RFC of 0.85, highlighting its paramount importance in the region for both wood and fodder. *Bombax ceiba* (Simbal) is notable for its cotton and wood uses, substantiated by a high UV of 55. *Broussonetia papyrifera* (Jangle Toot) and *Butea monosperma* (Chechra) are crucial for wood and fodder, emphasizing their relevance in the local context.

Ethnomedicinal profiling of the wild trees

The ICF analysis (Figure 5) revealed that the highest number of plant species was utilized to treat asthma, eye disorders, and skin diseases in the RMZ region, indicating the prevalence of these conditions. This could be attributed to the native population's frequent exposure to fields and wild places while working to support their homes (Amjad *et al.* 2020; Altaf *et al.* 2017). Fever, cough, wounds, jaundice, stomachache, diarrhoea, and renal illnesses were identified as the most common ailments in the region, with jaundice having the highest ICF at 0.91, followed by wounds, skin conditions, and stomachaches at 0.89, 0.86, and 0.85,

respectively. The elevated utilization of plant species for asthma, eye disorders, and skin diseases underscores the significance of these health issues in the region, reflecting the community's reliance on traditional plant-based remedies. The observed health conditions align with the lifestyle and environmental factors of the native population, emphasizing the role of traditional knowledge in addressing health risks associated with their close interaction with the environment (Amjad *et al.* 2020; Altaf *et al.* 2017). The ICF values for specific ailments provide insights into the depth of traditional knowledge and the consensus within the community regarding the effectiveness of certain plant species for particular health conditions. The high ICF values indicate a collective understanding within the community about the efficacy of specific plants, highlighting the cultural heritage and communal wisdom associated with these remedies (Amjad *et al.* 2020; Altaf *et al.* 2017; Irfan *et al.* 2013).

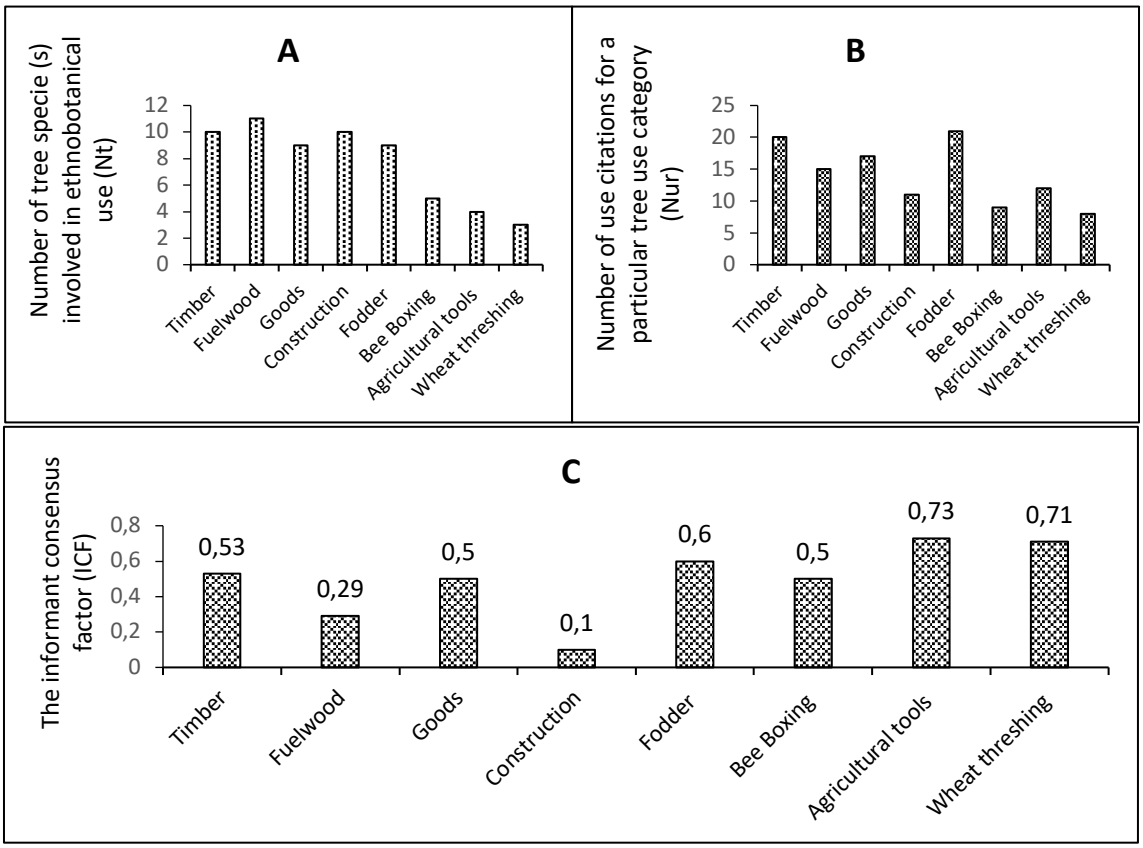

Figure 4. Bar charts illustrating number of tree species for an ethnobotanical use, their use citation and informant consensus value in Subfigures A, B, and C respectively

The remoteness and rugged terrain of the research area, together with the absence of basic amenities and a dearth of western medications and pharmaceuticals, may contribute to the high occurrence of these illnesses (Maqbool *et al.* 2019). Due to the fact that locals frequently conduct farmer-related operations in forested and hilly rivers, the wounds occurrence ratio in the RMZ area was determined to be extremely high. Skin allergies or skin conditions are brought on by prolonged exposure to the elements, dust, or mowing of the grass (Iqbal *et al.* 2023). These results are consistent with earlier studies on ethnobotanical investigations carried out across the country (Amjad *et al.* 2020; Altaf *et al.* 2017; Irfan *et al.* 2013). The study provides further insights into the quantitative indices and significance assessment of Wild Woody Plant Species (WTPs) in the Randyam Mountainous Zone (RMZ) of Bhimber, AJK, as detailed in Table 3. The determined Use Value (UV) values highlight *Melia azedarach, Eugenia jambolana, Ficus bengalensis,* and *Emblica officinalis* as plants with the highest UV values, indicating their significant utilization in ethnobotanical practices. The Relative Frequency of Citation (RFC) values varies among species, with *Albizia lebbeck* having the lowest RFC at 0.28, while *Emblica officinalis* boasts the highest RFC at 0.83, emphasizing their common presence in Traditional Ethnomedicines (TEMs) within the study area. Morus nigra stands out as a highly significant plant with the highest Frequency of Citation (FL) at 51.4% and the highest Relative Percentage of Occurrence (ROP) at 34.2%, indicating its widespread use in traditional remedies. *Melia azedarach* and *Ziziphus jujuba* follow closely with notable FL values of 42.8%, showcasing their specific applications in treating skin ailments and diabetes, respectively. These findings underscore the ethnomedicinal value of these plants, reflecting a well-established community knowledge about their effectiveness and emphasizing the deep connection between traditional knowledge, plant diversity,

and community well-being, consistent with findings from other ethno-medical research projects in Pakistan and AJK (Iqbal *et al.* 2023; Maqbool *et al.* 2019).

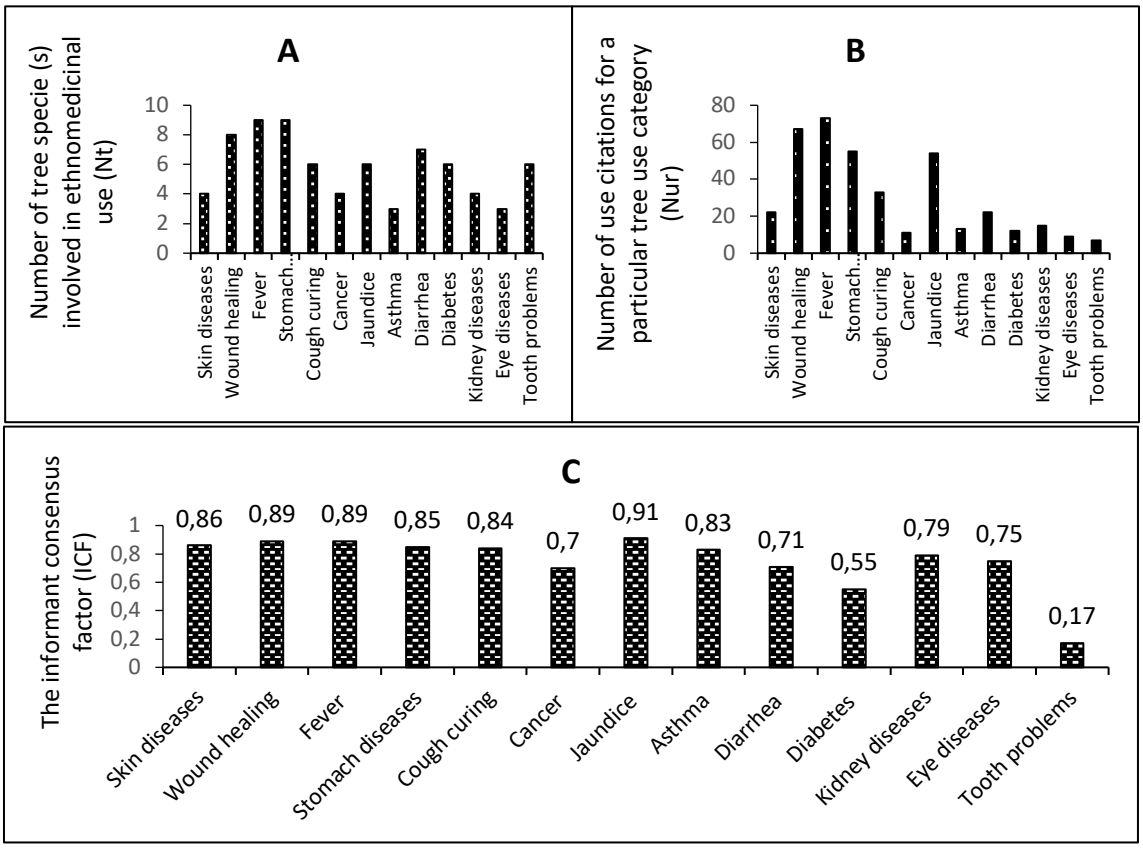

Figure 5. Bar charts illustrating number of tree species for an ethnobotanical use, their use citation and informant consensus value in Subfigures A, B, and C respectively

Due to significant biotic pressures from the diverse uses of trees by locals, several species are now at risk. The study identified *Butea monosperma, Terminalia belerica, Terminalia chebula, Cassia fistula,* and *Cedrela toona* as facing considerable conservation threats, corroborating earlier studies (Thakur *et al.* 2021; Khanum *et al.* 2024). This pattern may have ecological implications, reflecting the adaptability of certain tree families to the region's climate, soil, and environmental factors (Mazhar *et al.* 2022). The multifunctional uses of identified tree species underscore their vital role in local livelihoods. From food sources (fruits and vegetables) to construction materials, fuelwood, and even sports goods manufacturing, these species contribute significantly to both subsistence and economic activities. Notably, the majority of tree species are primarily used as fuelwood, fulfilling critical energy needs in rural communities (Nagar *et al.* 2022). However, this heavy reliance poses sustainability challenges, potentially endangering these species over time. Species like *Dalbergia sissoo, Bauhinia variegata,* and *Azadirachta indica*, recognized for their multipurpose uses, exemplify their indispensable role in addressing community needs and promoting resource sustainability (Singh *et al.* 2024).

While the study on the traditional ethnobotanical knowledge (TEK) of the WTPs in the RMZ provides valuable insights, there are several limitations that should be considered. The study focuses specifically on the RMZ, which may limit the generalizability of the findings to other regions or ecosystems. The TEK of WTPs in different geographic locations may vary, and the conclusions drawn from this study may not be applicable beyond the study area. The selection of informants and participants may introduce sampling bias. If certain groups or individuals were overrepresented or underrepresented in the study, it could affect the comprehensiveness and accuracy of the traditional knowledge gathered. Furthermore, the ethnobotanical knowledge can change over time due to cultural shifts, globalization, and other factors. The study provides a snapshot of TEK at a specific point in time, and the dynamic nature of this knowledge may not be fully captured. Addressing these limitations in future research endeavors would contribute to a more comprehensive understanding of traditional ethnobotanical knowledge.

Conclusion

It is concluded that the everyday lives of the native population are significantly impacted by the tree flora of the RMZ areas in District Bhimber. These tree species provide many of the essentials needed to support their way of life. In various localities and ethnic cultures, many of these species are frequently employed in a variety of traditional ethnomedicinal (TEM) and ethnobotanical (EB) applications. Results from the relative frequency of citation (RFC) and usage value (UV) analyses indicate that *Eugenia jambolana* L. is the least used plant for ethnobotanical purposes in the research area, followed by *Broussonetia papyrifera* L. The families Moraceae and Mimosaceae were found to be under less biotic pressure compared to *Butea monosperma*, *Terminalia belerica,* and *T. chebula,* which are experiencing rapid population declines. Two species, *Azadirachta indica* (A.) Juss. and *Acacia arabica* L., scored 100 on the Rank Order Priority (ROP) quantitative index, which ranges from 5 to 100. *Acacia nilotica* (Linn.) Delile, a species often used for timber, ranked second with an ROP value of 83.7. Many of these tree species have significant potential for use in drug development. There is an urgent need to cultivate these trees in nurseries and plant them in situ to restore the tree flora, which will ultimately benefit both emergency and ongoing ecosystem and human services. Preserving the tree flora in the study region is essential, as it provides indigenous communities with a variety of herbal and ethnobotanical remedies for treating numerous illnesses.

Declarations

***Ethic statement**:* Prior verbal consent was taken from all the participants.

***Data availability**:* The original data has been presented in the article.

Funding: This research did not receive funding.

***Contribution of Authors**:* TH, MI, MM, HK and MWM designed the study; SAH and HK conducted the fieldwork, ZA, MI, HK and MWM conducted the main statistical analysis; MWM wrote the manuscript, MWM, HK, MI, MM, ZA and SAH revised the data analysis and the manuscript; all authors read, corrected, and approved the manuscript.

***Conflict of interest**:* Not applicable

Acknowledgements

The authors are thankful to the local people of the area who graciously participated in the interview and provided data of ethnomedicines. The project is not supported by any funding agency. The authors of MUST and AJKUoB are highly thankful to Turkish Cooperation and Coordination Agency (TIKA), Islamabad for providing resources and funding for establishment of Climate Change Research Centre (CCRC), Herbarium and Biodiversity Conservation Laboratory in Department of Botany of MUST, with facilities of research on Climate changes and sustainable agriculture development.

Literature cited

Abbasi MA, Arshad S, Riaz T, Zafar A, Aziz R, Siddiqui SZ, Shahzadi T, Ajaib M. 2011. In vitro Assessment of Relief to Oxidative Injury by different samples of *Xanthoxylum armatum*. Asian Journal of Chemistry 23:3353-3356.

Ahmed E, Arshad M, Saboor A, Qureshi R, Mustafa G, Sadiq S. 2013. Ethnobotanical appraisal and medicinal use of plants in Patriata, New Murree, evidence from Pakistan. Journal of Ethnobiology and Ethnomedicine 9:13.

Ajaib M, Ishtiaq M, Bhatti KH, Hussain I, Ghani A, Mehwish M, Tanveer H, Waheeda M, Azeem M, Khan SR, Sumera T, Rohina B. 2021. Inventorization of Traditional Ethnobotanical Uses of Wild Plants of Dawarian and Ratti Gali Areas of District Neelum, Azad Jammu and Kashmir Pakistan. PlosOne. 16(7):e0255010. doi: 10.1371/journal.pone.0255010

Altaf M, Javid A, Umair M, Iqbal KJ, Rasheed Z, Abbasi AM. 2017. Ethnomedicinal and cultural practices of mammals and birds in the vicinity of river Chenab, Punjab-Pakistan. Journal of Ethnobiology and Ethnomedicine 13:1-24.

Amjad MS, Zahoor U, Bussmann RW, Altaf M, Gardazi SMH, Abbasi AM. 2020. Ethnobotanical survey of the medicinal flora of Harighal, Azad Jammu & Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 16:1-28.

Awan AA, Akhtar T, Ahmed MJ, Murtaza G. 2021. Quantitative ethnobotany of medicinal plants uses in the Jhelum valley, Azad Kashmir, Pakistan. Acta Ecologica Sinica 41:88-96.

Batool S, Rahman GU. 2023. Mapping the Past: Preliminary assessment of survey of archaeological sites and monuments in District Bhimber, AJ&K (2020-21). Annals of Human and Social Sciences 4:665-675.

Bradacs G, Heilmann J, Weckerle CS. 2011. Medicinal plant use in Vanuatu: A comparative ethnobotanical study of three islands. Journal of Ethnopharmacology 137:434-448.

Dhiman AK. 2011. A Bibliometric Study of Ethnobotany Journal–1999 to 2008. Indian Journal of Information and Services 5:44-55.

Ghorbani E, Khodamoradi M, Bozorgmanesh M, Emami A, Bolandnazar A, Sadighi M, Badragheh A, Oladele OI, Mahudinga KP, Bakhtiar F, Abedi M. 2011. Comparing Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) methods in rural research. Life Science Journal 8:1-6.

Iqbal KJ, Umair M, Altaf M, Hussain T, Ahmad RM, Abdeen SMZU, Pieroni A, Abbasi AM, Ali S, Ashraf S, Amjad N. 2023. Cross-cultural diversity analysis: traditional knowledge and uses of freshwater fish species by indigenous peoples of southern Punjab, Pakistan. Journal of Ethnobiology and Ethnomedicine 19:1-17.

Irfan M, Ullah F, Haq IU. 2013. Ethnomedicinal and Traditional uses of the Flora of District Lower Dir, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 26:1-22.

Ishtiaq M, Hussain I, Bhatti KH, Maqbool M, Shafique Ahmed K, Ajaib M, Ullah Shah A, Mushtaq W, Hussain T, Ghani A, Khanum H. 2022. Study of impacts of brickkiln emanations on soil quality of agriculture lands in selected areas of District Bhimber, Azad Jammu and Kashmir, Pakistan. PLoS One 17:e0258438.

Ishtiaq M, Mahmood A, Maqbool M. 2015. Indigenous knowledge of medicinal plants from Sudhanoti District (AJK), Pakistan. Journal of Ethnopharmacology 168:201-207.

Ishtiaq M, Mehwish M, Hussain T, Shah A. 2013. Role of indigenous knowledge in biodiversity conservation of an area: a case study on tree ethnobotany of Soona valley, district Bhimber Azad Kashmir, Pakistan. Pakistan Journal of Botany 45:389-399.

Ishtiaq M, Mehwish M, Tanveer H. 2012. Interrelationship of Cultural Diversity and Biodiversity and its impact on Conservation, District Bhimber Azad Kashmir, Pakistan. Pakistan Journal of Botany 45:245-256.

Ishtiaq M, Mumtaz AS, Hussain T, Ghani A. 2012. Medicinal plant diversity in the flora of Leepa Valley, Muzaffarabad (AJK), Pakistan. African Journal of Biotechnology 11:3087-3098.

Ishtiaq M, Sardar T, Hussain I, Maqbool M, Mazhar MW, Parveen A, Ajaib M, Bhatti KH, Hussain T, Gul A, Azeem M. 2024. Traditional ethnobotanical knowledge of important local plants in Sudhnoti, Azad Kashmir, Pakistan. Scientific Reports 14:22165.

Ju Y, Zhuo J, Liu B, Long C. 2013. Eating from the wild: diversity of wild edible plants used by Tibetans in Shangri-la region, Yunnan, China. Journal of Ethnobiology and Ethnomedicine 9:28.

Khanum H, Ishtiaq M, Maqbool M, Hussain I, Bhatti KH, Mazhar MW, Gul A. 2024. Evaluating the conservation value and medicinal potential of wild herbaceous flora in the Sanghar Mountains of District Bhimber, AJK, Pakistan. Ethnobotany Research and Applications 27:1-41.

Khoja AA, Hamid M, Hamid B, Waheed M, Jameel MA, Bussmann RW, Haq SM. 2024. Himalayan Apiaceae - A comprehensive ecological and ethnobotanical evaluation. Ethnobotany Research and Applications 27:1-18.

Maqbool M, Ajaib M, Ishtiaq M, Azam S, Hussain T. 2019. Ethnomedicinal Study of Plants Used in Phytotherapeutics among Indigenous Communities of District Bhimber, Azad Kashmir and Migrants to United Kingdom. Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences 56:57-76.

Maqbool M, Ajaib M, Khizar HB, Ishtiaq M, Humaira K, Tanveer H, Ghani A, Waheeda M. 2019. Traditional Knowledge Based Inventory of Wild Plants of Watala National Park and Allied Villages from District Bhimber of Azad Jammu and Kashmir, Pakistan. Applied Ecology and Environmental Research 7:12023-12055.

Mazhar MW, Akram R, Shahid A. 2022. Foliar application of iron glutamate improves yield and growth of tomatoes compared to iron sulphate and L-glutamate. International Journal of Vegetable Science 28:511-520.

Mugisha MK, Asiimwe S, Namutebi A, Borg-Karlson AK, Kakudidi EK. 2014. Ethnobotanical study of indigenous knowledge on medicinal and nutritious plants used to manage opportunistic infections associated with HIV/AIDS in western Uganda. Journal of Ethnopharmacology 155:194-202.

Mushtaq W, Ishtiaq M, Maqbool M, Ajaib M, Hussain T, Mazhar MW, Sardar T. Exploration of antidiabetic potential of traditional ethno-medicinal plant Viscum cruciatum Sieber ex Boiss. (Loranthaceae) from Rawalakot District, Poonch, Azad Jammu and Kashmir, Pakistan. Pak. J. Bot 56:6.

Nafeesa Z, Haq SM, Bashir F, Gaus G, Mazher M, Anjum M, Rasool A, Rashid N. 2021. Observations on the floristic, life-form, leaf-size spectra and habitat diversity of vegetation in the Bhimber hills of Kashmir Himalayas. Acta Ecologica Sinica 41:228-234.

Nagar B, Rawat S, Pandey R, Kumar M, Alatalo JM. 2022. Fuelwood and fodder consumption patterns among agroforestry-practicing smallholder farmers of the lower Himalayas, India. Environment, Development and Sustainability 24:5594-5613.

Pala NA, Banday M, Islam MA, Rashid M, Malik ZA, Bussmann RW. 2020. Ethnobotanical utilization of forest resources in Sindh Forest of Kashmir Himalaya, India. Ethnobotany Research and Applications 21:1-18.

Panda C, Sharma P, Dixit US, Pandey LM. 2023. Potential and prospective of traditional Indian medicinal plants for the treatment of diabetes. Journal of Biologically Active Products from Nature 13:316-360.

Papageorgiou D, Bebeli PJ, Panitsa M, Schunko C. 2020. Local knowledge about sustainable harvesting and availability of wild medicinal plant species in Lemnos Island, Greece. Journal of Ethnobiology and Ethnomedicine 16:1-23.

Porras G, Chassagne F, Lyles JT, Marquez L, Dettweiler M, Salam AM, Samarakoon T, Shabih S, Farrokhi DR, Quave CL. 2020. Ethnobotany and the role of plant natural products in antibiotic drug discovery. Chemical Reviews 121:3495-3560.

Purohit S, Vyas S. 2004. Medicinal Plant Cultivation: A Scientific Approach: Including Processing and Financial Guidelines. Agrobios (India).

Quinlan MB. 2022. Ethnomedicines: Traditions of medical knowledge. A Companion to Medical Anthropology:315-341.

Rehman MN, Ahmad M, Sultana S, Zafar M, Edwards S. 2017. Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan. Revista Brasileira de Farmacognosia 27:751-775.

Shah A, Rahim S, Bhatti KH, Khan A, Din N, Imran M, Mohsin M, Ishtiaq M, Nabila A, Ansari A, Hussain S, Zafar M, Mushtaq M, Mumtaz E, Iqbal J. 2015. Ethnobotanical study and conservation status of trees in the district Sargodha, Punjab, Pakistan. Phyton-International Journal of Experimental Botany 84:34-44.

Shah MA. 2005. Ethnomedicinal study of the plants of Tehsil Bhakkar, Punjab, Pakistan. Ethnobotany 17:171-175.

Singh H, Hussain J, Bagri AS, Rawat V, Rawat DS, Tiwari JK. 2022. The Uses, preference, cultural importance and informant consensus factor of tree species in Uttarakhand: A case study from Bhilangana Watershed (Western Himalaya, India). Ecological Questions 33:1-15.

Singh K, Nasir M, Vaishnav V, Gehlot A. 2024. Tree species composition in traditional agroforestry systems in various agroclimatic regions of India. In: Sustainable Forest Resources Management. 383-404. Apple Academic Press.

Tabuti J, Lye K, Dhillion S. 2013. Traditional herbal drugs of Bulamogi, Uganda: plants, use and administration. Journal of Ethnopharmacology 88:19-44.

Thakur TK, Patel DK, Dutta J, Kumar A, Kaushik S, Bijalwan A, Fnais MS, Abdelrahman K, Ansari MJ. 2021. Assessment of decadal land use dynamics of upper catchment area of Narmada River, the lifeline of Central India. Journal of King Saud University-Science 33:101322.

Yang J, El-Kassaby YA, Guan W. 2020. The effect of slope aspect on vegetation attributes in a mountainous dry valley, Southwest China. Scientific Reports 10:16465.