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# The importance of sharing: wild plant knowledge in three valleys of Northern Pakistan

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**ABSTRACT**

Mountain communities are often defined by their distinctive flora and fauna, and the way local people utilize these natural resources. Our study aims to document the indigenous knowledge of wild flora among the local people of three valleys in Northern Pakistan. The ethnobotanical study was conducted in July and August of 2019 and 2020 in 21 hill villages across Shamshal, Hopper, and Phandar valleys in Gilgit-Baltistan, Northern Pakistan. Semi-structured interviews were conducted with 90 key informants. We collected data on traditional knowledge of wild food plants (WFPs), wild medicinal plants (WMPs), and wild veterinary plants (WVPs) among three selected linguistic and religious groups scattered in different villages of the valleys. We documented 79 wild plant taxa belonging to 68 genera and 33 families utilized in the study area, among which, 50% were used as food, 43% were used for veterinary purposes, and 24% for medicinal applications. The data analysis revealed significant differences among the studied valleys and communities. The highest overlap was recorded between the Wakhi and Burushaski communities with a Jaccard Similarity Index (JI) value of 0.265, while the lowest was between the Burushaski and Khowar communities with a JI value of 0.238.

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## Introduction

Common goods management in biodiversity is becoming crucial in many works addressing traditional/local environmental knowledge (TEK/LEK) and ecological services (Pieroni et al. 2014; Groom et al. 2023). Mountain communities are often characterized by their unique flora and fauna, and how local people have traditionally used these resources (Almada et al. 2016; Ali et al. 2022). Ethnobotanical studies have been instrumental in documenting and understanding TEK related to the use of plants by indigenous communities living in mountainous regions (Kunwar and Bussmann 2008; Uprety et al. 2012; Haq et al. 2022; Sulaiman, Zocchi, et al. 2024). In recent years, the importance of ethnobotanical research has been recognized not only for its role in understanding cultural heritage and traditional knowledge systems but also for its potential to inform conservation efforts, support sustainable resource management, and contribute to the development of new drugs and products (Pieroni 2008; Mustafa et al. 2012; Abbasi et al. 2013; Pieroni et al. 2014; Pieroni, Sulaiman, et al. 2022; Abbas et al. 2016; Aziz et al. 2022; Khadka et al. 2023; Sulaiman, Aziz, et al. 2023; Zocchi et al. 2024).

TEK is often deeply embedded in cultural and social practices and is an important part of the cultural heritage of local communities (Aziz, Ullah, et al. 2020; Pieroni, Sulaiman, et al. 2022). However, in recent years, there has been a growing concern about the erosion of TEK (Mattalia et al. 2021). This erosion can occur for a variety of reasons, including the loss of language and cultural practices, the influence of external factors, such as globalization and urbanization, and environmental changes that disrupt traditional ways of life (Federici 2004; Maffi 2005; Gray et al. 2008; Turner and Turner 2008; McCarter and Gavin 2011; Reyes-García et al. 2013; Karki et al. 2023; Sulaiman, Verner, et al. 2023).

Gilgit-Baltistan is a northern Pakistan region that is recognized for its unparalleled biodiversity (Ishaq et al. 2016), cultural richness, and linguistic diversity (Issa et al. 2023). The flora of Pakistan includes around 6,000 plant species, a significant proportion of which is available in the Gilgit-Baltistan

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region (Abbas et al. 2022). The area is home to a diverse array of plant species used for medicinal, cultural, and religious purposes, also comprising various marginalized linguistic communities that primarily rely on their natural surroundings to meet their basic livelihood needs. The people in this region mainly engage in small-scale pastoral and horticultural activities (National Institute of Pakistan Studies 2002)), and their unique cultural heritage, combined with their natural beauty, attracts a large number of tourists from around the world (us Saqib et al. 2019). Local people in the region belong to three main religious groups (Sunni, Shia, and Ismaili) distributed in the main five linguistic groups of Balti, Shina, Burushaski, Khowar, and Wakhi (Abbas et al. 2022). Despite its remote location, Gilgit-Baltistan remains an important region for Pakistan's economy, providing valuable resources such as precious stones, minerals, and hydroelectricity. Food insecurity is also a persistent challenge in many parts of the world, including Gilgit-Baltistan (Aziz, Abbasi, et al. 2020).

So far, numerous ethnobotanical studies have been conducted in the surrounding region (Bano et al. 2014;Abbas et al. 2017; Zocchi et al. 2022; Gillani et al. 2024), but only a limited number of cross-cultural studies have been carried out in Gilgit-Baltistan. Aziz, Abbasi, et al. (2020) reported 39 wild food plants used in the region, while Abbas et al. (2017) documented 84 medicinal plant species. In particular, the Shimshal village in Gilgit-Baltistan represents a unique case of isolation at high altitudes because of its ancient practice of *Nomus* (in the local Wakhi language), which is still alive. *Nomus* is a self-help, communal mechanism of sharing work in the name of ancestors to build communal infrastructure. The word *Nomus* is probably derived from the Arabic word "*Namous*," which means "values" and "the right religious path" in Arabic. The people of Shimshal are Wakhi, and they speak the Wakhi language. They belong to the Ismaili branch of Shia Islam; the community follows Aga Khan, a spiritual leader (Hunzai 2013).

Ethnic groups usually tend to preserve and showcase their cultural identity to enhance their livelihoods in a multicultural society; this can aid in comprehending the intriguing matter of how traditional plant-based knowledge varies over time and space (Pieroni et al. 2011). Previous research has highlighted two crucial cultural and linguistic boundaries, which have been employed to express human perceptions of the diverse biological world (Sulaiman, Salehi, et al. 2024). Of these two factors, language is particularly significant since it contains a wealth of information about nature, including plants (Liu et al. 2016). This study was conducted within the Khowar, Burushaski, and Wakhi communities residing in several isolated mountain villages in Phander, Hopper, and Shimshal Valley of Gilgit-Baltistan. Khowar, which is mainly spoken in Chitral and its adjacent regions, is an Indo-Aryan language. However, Burushaski is a language primarily spoken in northern Gilgit-Baltistan.

Our study aimed to document the indigenous knowledge of wild flora among Wakhi Shimshalis and two other high valley populations (Hopper and Phandar). The purpose of this documentation was to establish a foundation for possible forthcoming conservation and TEK valorization initiatives in the area. The study particularly aimed:

1. To document the customary utilization of wild plants by various religious and linguistic groups residing in Shimshal Valley, Hopper Valley, and Phander Valley.
2. To gain insight into the possible role played in TEK resilience by communal management of natural resources in Shimshal compared with that of the other two valleys.

## Materials and methods

### Study area and communities

Gilgit-Baltistan (GB) is a sparsely populated region in the far north of Pakistan, covering an area of 72,496 km2 with a population of approximately 1.8 million. The region is divided into various linguistic groups, such as Khowar, Balti, Shina, Burushaski, and Wakhi. It shares its borders with Khyber Pakhtunkhwa Province to the west, Azad Kashmir to the south, the Xinjiang region of the Republic of China to the east and north-east, Afghanistan's Wakhan Corridor to the north, and the Indian-administered state of Jammu and Kashmir to the southeast. The area is characterized by three major mountain ranges, namely the Hindu Kush, the Himalayas, and the Karakoram, and exhibits diverse topography, anthropology, ecology, climate, history, and biodiversity. The climate is highly continental, mainly arid, and experiences little rainfall as the monsoon clouds do not reach the area during early spring and late summer. The vegetation in the region is dominated by several plant genera, such as *Pinus* L., *Betula* L., *Juniperus* L., *Salix* L., *Ribes* L., *Berberis* L., and *Cotoneaster* Medik., with high diversity along the altitudinal gradient (Abbas et al. 2017). The rocky physiography and frequent droughts have led to vegetation exhibiting xerophytic characteristics.

#### Shimshal Valley

Shimshal is a settlement of more than 2,000 people and 250 households in Gojal Tehsil of Hunza District in the Central Karakoram Mountains of Northern Pakistan. It is situated at an altitude of 3,100 meters above sea level and is considered the highest settlement in the Hunza district (Butz 2002). It is also the largest border village in Hunza district, spanning approximately 3,800 km2 and connecting the Gilgit-Baltistan region of Pakistan with China. The villagers depend on crop cultivation and grazing activities. The people of Shimshal belong to the Ismaili sect of Shia Islam and are called "Wakhi," speaking their native language known as Wakhi language. The Shimshal community is an inspiring example of sustainable development and philanthropy, following the principles of "self-help" of *Nomus*. This tradition, which needs to be adopted by other communities of Gilgit-Baltistan, is still very much alive in Shimshal.

#### Hopper Valley

Hopper Valley is one of the most beautiful, green and attractive tourist attractions located 10 km from Nagar Khas, the capital city of Nagar Valley. Due to complex treks, famous glaciers and other tourist attractions, this valley has many potential for tourists. The three most famous glaciers are Hopper Glacier (2,438 m), Barpo Glacier (3,344 m) and Meyer Glacier (3,400 m) (Roomi et al. 2023). Apart from these, the entire population of Hopper Valley speaks the Burushaski language. Due to the constructed road network, the valley provides an attractive area for the emerging construction and agriculture sectors. However, due to a lack of urban amenities and poor infrastructure, the valley is not commercialized like other areas of Gilgit-Baltistan. The climate of this region is very distinct and exhibits different seasons throughout the year. Winter season is the dominant and longest season of the year.

### *Phander Valley*

Phandar Valley, located in the Gupis-Yasin District of Gilgit-Baltistan, is a picturesque township easily accessible from both Chitral's and Gilgit's sides. The valley has a moderate climate at altitudes ranging from 2,438 to 2,926 m.a.s.l (Muhammad et al. 2022). The region receives a maximum of 800 mm of rainfall annually, making it an ideal location for agriculture and fishing. The majority of the population in Phandar Valley speaks Khowar, an Indo-Aryan language spoken mainly in Chitral. The valley is home to four lakes, with Phandar Lake being the largest and most popular among tourists. The lake is a major source of flowing water in the area, and it is used for fishing, drinking, and agricultural activities (Muhammad et al. 2022). The economy in Phandar Valley is generally weak, and local people mostly depend on tourism, fishing, and government jobs (mostly army recruitment). There is no available data on the population status in Hopper and Phander Valleys; however, it is estimated to be around 2,000 to 3,000 for each.

### *Data collection and data analysis*

The field study for this ethnobotanical survey was conducted in July and August of 2019 and 2020 in 21 hill villages across Shamshal, Hopper, and Phandar valleys in Gilgit-Baltistan, Northern Pakistan (Figure 1 and Table 1). Snowball sampling and semi-structured interviews were applied to interview 90 key informants, 30 from each valley (Dolores and Tongco 2007). The primary criteria for selecting an informant was that he/she often uses wild plants. The age of the study participants ranged between 26 and 82 years, with a mean of 59. We involved females in the interviews wherever possible considering local norms and cultural issues (Table 1). Agricultural practices (pastoralism and horticulture) were the main subsistence activities for the majority of our study participants in the three studied communities. We collected information and traditional knowledge about wild food plants (WFPs), wild medicinal plants (WMPs), and wild veterinary plants (WVPs) among three selected linguistic and religious groups scattered in different villages of the valleys. We considered all "wild plants" as emically understood by indigenous peoples, without considering any "attic" about the plants (i.e. non-native plants, semi-domesticated species, and plants that have reverted to a wild state if considered "wild" by local people).

The Code of Ethics of the International Society of Ethnobiology was strictly followed (ISE (International Society of Ethnobiology) 2008). Verbal consent was obtained from each participant before the interview was conducted. Interviews and discussions were conducted in local languages and translated into Urdu with the help of translators. Plants were collected, photographed, taxonomically identified, and deposited in the Herbarium of the Department of Botany at the Quaid-i-Azam University, Islamabad, Pakistan. Botanical nomenclature followed the international plant database World Flora Online (World Flora Online 2023), and the Angiosperm Phylogeny Website (Angiosperm Phylogeny 2023). The collected data were organized and classified into four different sets of data. The first one comprises all the identified taxa; the second set contains wild food plant taxa, the third contains wild medicinal plant taxa, and the fourth comprises veterinary taxa. Data were analyzed qualitatively and quantitatively; however, the analysis focused on the overall comparison between the studied groups rather than the possible socioeconomic differences between the study participants. Proportional Venn diagrams and the Jaccard Similarity Index were utilized to compare the four datasets for each linguistic group.

## Results and discussion

### *Diversity of wild plants and their uses*

We documented 79 wild plant taxa belonging to 68 genera and 33 families utilized in the study area (Table 2). Among these families, Asteraceae and Poaceae were the most prevalent, with 13 and six taxa, respectively. Other subdominant families include Fabaceae and Polygonaceae (five taxa each); Amaryllidaceae, Apiaceae, and Rosaceae (four taxa each); and Amaranthaceae, Brassicaceae, Lamiaceae, and Grossulariaceae (three taxa each). Approximately, 48% of the families had minimal representation, with only one taxa each. The Asteraceae family is prominent in the flora of Pakistan due to its widespread distribution throughout the country, making it one of the largest families (Abbas et al. 2017). Previous studies conducted in the territory of Gilgit-Baltistan have also identified Asteraceae as a leading family (Abbasi et al. 2013; Bano et al. 2014; Hussain et al. 2021). However, according to Khan's research (Khan 2007), Rosaceae is the most prevalent family in various valleys of the Himalayas and Karakoram mountain ranges. Asteraceae species have ethnomedicinal and nutritional values with several species in the Himalayas and worldwide (Chawla et al. 2008; Rokaya et al. 2014; Pieroni et al. 2023).

These findings demonstrate the region's significant indigenous knowledge, diverse selection, and richness of medicinal flora. *Elymus* L. was the leading genera with four species, while *Allium* L., *Berberis* L., and *Ribes* L. followed with three species each. Leaves were the most commonly utilized plant part, accounting for 50% of the total usage, followed by the whole plant (24.39%), stems (20.73%), fruits (13.41%), flowers (10.97%), seeds (8.53%), and roots (6.09%). Leaves are a readily available and abundant resource in many remote areas, making them an important source of food and nutrition for


**Figure 1.** Study area locations within the map of Pakistan; tringle refers to Shimshal valley, circle refers to Hopper valley, and square refers to Phander valley (the map was edited through ArcGIS software).

indigenous communities (Turner et al. 2011; Pieroni and Quave 2014). In addition to being a source of energy and nutrients, leaves can also provide medicinal benefits, such as treating various ailments and illnesses (Horackova et al. 2023; Shah et al. 2023). In many cases, consuming leaves may be a sustainable and environmentally friendly way to meet the dietary needs of indigenous communities, as it does not require the use of expensive or resource-intensive farming practices. The use of leaves is an encouraging asset to promote the sustainable harvest of plants (Asase et al. 2005).

By relying on local resources, indigenous communities can also maintain a closer connection to their cultural traditions and heritage. Food usage accounted for 50% (40 species) of the recorded species, while 43% (34 species) were utilized for veterinary purposes and 24% (19 species) for medicinal applications (Table 2). The Wakhi community had the highest number of recorded taxa (56%), followed by the Khowar community (45%), while the Burushaski community had the lowest number of recorded taxa (43%). The vast majority of the reported species are native to the study area; however, around 21% of the reported taxa (e.g. *Saussurea simpsoniana* (Fielding & Gardner) Lipsch., *Persicaria* (L.) Mill. and *Lonicera* L.) are not.

### *Wild food plants (WFPs)*

The majority of the wild food plants (WFPs) documented were consumed either in their raw form as snacks (23 species; 57%) or cooked and consumed as vegetables (16 species; 40%). However, some species were consumed in both forms of snacks and cooked, such as *Allium rotundum* L., and *Allium vineale* L. The consumption of raw snacks is a fascinating phenomenon. It is a notable aspect of food culture that falls within the realm of food anthropology, which emerged primarily with the development of mobile pastoralism (Pieroni et al. 2019). This finding aligns with previous ethnobotanical

**Table 1.** Characteristics of the study area and study participants.

| Location/language | Sampled villages | Elevation (meters above sea level) | Total number of interviewees | Number of interviewees (male/ female) | Religion | Subsistence activities |
|---|---|---|---|---|---|---|
| Shimshal valley/Wakhi | Amin abad | 1563 | | 4 M/ 2 F | Ismaili (sub-sect of Shia Muslims) | Pastoralism, horticultural, tourism, and jobs in cities |
| | Center Shimshal | 3065 | | 4 M/ 2 F | | |
| | Farmanabad | 2160 | 30 | 4 M /2 F | | |
| | Khizar abad | 1842 | | 4 M/ 2 F | | |
| | Shimshal pass | 4715 | | 4 M/ 2 F | | |
| Hopper valley/ Burushaski | Boalter | 2743 | | 5 M / 0 F | Shia Muslims | Pastoralism, horticultural, jobs in tourism sector, and jobs in cities |
| | Brushal | 2749 | | 5 M / 0 F | | |
| | Goshoshal | 2850 | | 5 M / 0 F | | |
| | Hakalshal | 2790 | | 5 M / 0 F | | |
| | Hamdar | 3360 | 30 | 5 M / 0 F | | |
| | Holshal | 2700 | | 2 M / 0 F | | |
| | Ratal | 2800 | | 3 M / 0 F | | |
| Phander valley/ Khowar | Centre Phander | 2895 | | 5 M / 0 F | 80 % Ismaili (sub-sect of Shia Muslims), and 20 % Sunni Muslims | Pastoralism, fishing, jobs in services sector (tourism, shops), and government jobs (mainly in the army) |
| | Chahche | 2682 | | 4 M / 0 F | | |
| | Guloh | 2774 | | 5 M / 0 F | | |
| | Golaghmuli | 2973 | | 4 M / 0 F | | |
| | Golaghturi | 3050 | 30 | 4 M / 0 F | | |
| | Hundarap | 2947 | | 2 M / 0 F | | |
| | Harangal | 2970 | | 2 M / 0 F | | |
| | Sarbal | 2935 | | 2 M / 0 F | | |
| | Tharolti | 3210 | | 2 M / 0 F | | |

research that has noted the prevalence of snacks in local diets (Łuczaj and Kujawska 2012; Mattalia et al. 2020; Aziz, Ullah, et al. 2020; Aziz, Abbasi, 2020). Our findings are consistent with the previous research conducted in North Waziristan, Pakistan (Khalid et al. 2023). The Khowar mentioned the highest number of WFPs ($n = 28$), trailed by Wakhi ($n = 24$), whereas Burushaski had the lowest number of WFPs ($n = 14$). The preparation of most WFPs is generally uncomplicated, involving a basic process of washing, cutting, boiling, and frying in oil along with onions, tomatoes, and chili peppers. Out of the reported taxa, only *Carum carvi* L. was used for seasoning. In contrast, the five species, *Anthemis arvensis* L., *Arnebia euchroma* (Royle) I.M.Johnst., *Mentha royleana* Wall. ex Benth., *Primula farinosa* L., and *Rosa nanothamnus* Boulenger., were used as herbal ingredients in green tea.

The people of Gilgit-Baltistan have a rich knowledge of the local flora and fauna, and their traditional knowledge of WFPs has been passed down through generations. Vertical transfer of traditional ecological knowledge (TEK) across generations is a crucial element in numerous cultures across the globe (Berkes et al. 1995). However, there has been a significant decline in the transmission of TEK between generations in recent times (Khalid et al. 2023). This can be attributed to various factors, such as the growing influence of Western culture (Morin-Labatut and Akatar 1992). Younger generations, who are exposed to Western concepts and principles, may be less keen to learn and practice TEK. Additionally, urbanization has caused the displacement of numerous indigenous and traditional communities from their ancestral lands, resulting in a breakdown in the transfer of TEK as the younger generations are not able to learn from their elders in the same manner as they would if they were still living in their traditional communities (McDaniel and Alley 2005; Aziz, Abbasi, et al. 2020). Adopting modern technologies and practices and changing traditional lifestyles also contribute to the decline in TEK transfer (Abbas et al. 2017). As more modern ways of life replace traditional ones, there may be a reduced need for certain types of ecological knowledge, resulting in a decline in its transmission across generations. Promoting sustainable practices and conservation efforts is important to ensure the continued availability of WFPs in the region. Unfortunately, the erosion of traditional knowledge regarding the usage of WFPs in Gilgit-Baltistan is a growing concern. The region is undergoing rapid modernization and urbanization, and as a result, younger generations are losing touch with their traditional ways of life, including their knowledge of WFPs. Additionally, the increasing availability of processed foods and imported produce reduces the demand for local wild plant-based products. Furthermore, the changing climate also affects the availability and diversity of wild plants in the region, as well as their traditional harvesting times (Hussain et al. 2021). This leads to a loss of knowledge about the timing of harvest, storage, and preservation of WFPs and also affects the availability of certain species

The erosion of traditional knowledge regarding the usage of WFPs in Gilgit-Baltistan has serious implications for the food security and health of the local communities as they are considered an important source of nutrition, especially in times of food scarcity (Ahmad and Pieroni 2016; Sulaiman et al. 2022). The loss of traditional knowledge about WFPs can have a negative impact on the cultural identity and heritage of the people of Gilgit-Baltistan. Some local organizations and individuals are making efforts to document and preserve the traditional knowledge regarding the usage of WFPs in the region. These efforts include the establishment of community-based conservation initiatives, the development of educational programs, and the promotion of sustainable harvesting practices. It is important to support and expand these initiatives to ensure the continued availability and usage of WFPs in Gilgit-Baltistan.

## *Wild medicinal plants (WMPs)*

Rural communities living in high mountain areas face significant challenges, as they must work tirelessly to survive within the social hierarchies of their surroundings. Unfortunately,

**Table 2.** Wild plants used among three communities in Northern Pakistan.

| Scientific name; family name; Voucher code | Local names | Part used | Uses: mode of consumption | Studied communities | | | Quotation |
|---|---|---|---|---|---|---|---|
| | | | | Wakhi | Burushaski | Khowar | |
| *Aconitum* sp. pl.; Ranunculaceae; ISL-25 | Hosman (B) | Whole plant without roots | V: fodder | _ | + | _ | *** |
| *Agrostis stolonifera* L.; Poaceae; ISL-21191 | Ghoz (W) | Stem spikes, leaves | V: fodder | + | _ | _ | *** |
| *Allium carolinianum* DC.; Amaryllidaceae; ISL-133 | Pataghashu (B), Latrruk (K), Niltirk (W) | Leaves, flower | F: cooked | + | + | + | *** |
| *Allium rotundum* L. and possibly other *Allium* sp. pl.; Amaryllidaceae; ISL-1711, ISL-1556 | Katch peuk (W), Katch (K) | Leaves | F: raw snacks, cooked | + | _ | + | *** |
| *Allium vineale* L.; Amaryllidaceae; ISL-1559 | Khash (B) | Leaves, stem, corm | F: raw snacks, cooked | _ | + | _ | *** |
| *Anaphalis nepalensis* (Spreng.) Hand.-Mazz.; Asteraceae; ISL-518 | Rumay shandoye (K) | Whole plant without root | V: fodder | _ | _ | + | * |
| *Anethum graveolens* L.; Apiaceae; ISL-957 | Kakol (K) | Seeds | F: raw snacks | _ | _ | + | *** |
| *Anthemis arvensis* L.; Asteraceae; ISL-534 | Shondonbit (W) | Leaves, flower, whole plant without root | F: leaves and flowers; green tea; M: dried plant powder add in soup to treat pneumonia; V: fodder | + | _ | _ | * |
| *Arnebia euchroma* (Royle) I.M.Johnst.; Boraginaceae; ISL-88 | Pusk (W), Tairshoron (B) | Whole plant | F: roots are used to make a tea; M: dry powder is mixed with milk or oil for cough, headache, diarrhoea, stomach ache and kidney pain; flower infusion is used for jaundice | + | + | _ | ** |
| *Artemisia gmelinii* Weber ex Stechm. and possibly other *Artemisia* sp. pl.; Asteraceae; ISL-109, ISL-501 | Pichan (W), Ravid (W) | Whole plant without root | V: fodder, galactagogue and increasing meat quality is considered highly nutritious for cattle | + | _ | _ | *** |
| *Astragalus tibetanus* Bunge.; Fabaceae; ISL-573 | Khor zhop (W) | Whole plant without root | V: fodder | + | _ | _ | ** |
| *Aquilegia fragrans* Benth.; Rananculaceae; ISL-32 | Berish gumburi (B) | Whole plant without root | V: fodder | _ | + | _ | * |
| *Bassia prostrata* (L.) Beck.; Amaranthaceae; ISL-14 | Keuric (W) | Leaves, stem | V: fodder | + | _ | _ | *** |
| *Berberis chitria* Buch.-Ham. ex Lindl.; Berberidaceae; ISL-760 | Gacha (B), Chonj (K) | Fruits, roots | F: raw snacks; M: decoction is used to treat cough and bone fracture | _ | + | + | *** |
| *Berberis* sp. pl.; Berberidaceae; ISL-101 | Zolg (W) | Seeds | F: raw snacks | + | _ | _ | *** |
| *Bergenia stracheyi* (Hook.f. & Thomson) Engl.; Saxifragaceae; ISL-1713 | Saspar (B), Bisapor (K) | Roots, leaves | M: roots used to toothache; the dried powder of roots and leaves are applied on wounds; anti diarrhoea | _ | + | + | * |
| *Brassica rapa* L.; Brassicaceae; ISL-130 | Solmush (W) | Leaves, flowers | F: cooked | + | _ | _ | *** |
| *Cannabis sativa* L.; Cannabaceae; ISL-2577 | Thunj (B) | Seeds | F: seeds are mixed with dry fruits; M: extracted seed oil is anti-allergic | _ | + | _ | *** |
| *Capparis spinosa* L.; Capparaceae; ISL-SM26 | Kawir (K) | Flowers | M: flowers infusion is used for jaundice | _ | _ | + | * |
| *Carum carvi* L.; Apiaceae; ISL-3 | Garbat (B), Hilashu (K), Nurtuk (W) | Seeds | F: used as spices | + | + | + | * |
| *Chenopodium album* L.; Amaranthaceae; ISL-122 | Shelit (W) | Leaves, stem | F: cooked | + | _ | _ | * |

(*Continued*)

**Table 2.** Continued.

| Scientific name; family name; Voucher code | Local names | Part used | Uses: mode of consumption | Studied communities | | | Quotation |
|---|---|---|---|---|---|---|---|
| | | | | Wakhi | Burushaski | Khowar | |
| *Cichorium intybus* L.; Asteraceae; ISL-797 | Iskanachi (K) | Whole plant | M: decoction; antiseptic | _ | _ | + | * |
| *Cicer microphyllum* Benth.; Fabaceae; ISL-92 | Yukshas (W) | Leaves | V: fodder | + | _ | _ | * |
| *Convolvulus* sp.; Convolvulaceae; ISL-133 | Polinjoshu (K) | Leaves, stem | V: fodder | _ | _ | + | * |
| *Cotoneaster horizontalis* Decne.; Rosaceae; ISL-788 | Mikeen (K) | Fruits | F: raw snacks | _ | _ | + | *** |
| *Corydalis crassifolia* Royle; Papaveraceae; ISL-2433 | Yomush (W) | Leaves | F: cooked | + | _ | _ | *** |
| *Cousinia thomsonii* C.B.Clarke; Asteraceae; ISL-577 | Jacheer (B) | whole plant without root | M: decoction, kidney infection | _ | + | _ | *** |
| *Dasiphora fruticosa* (L.) Rydb.; Rosaceae; ISL-588 | Zart sprag (W) | Whole plant without root | V: fodder | + | _ | _ | ** |
| *Delphinium brunonianum* Royle; Ranunculaceae; ISL-42 | Yaroghen(W), Mahoti (B) | Flowers | V: dry flowers are mixed with wheat flour and eaten for hair loss in cattle; dry flowers are mixed with milk or oil against skin diseases | + | + | _ | *** |
| *Elaeagnus rhamnoides* (L.) A.Nelson.; Elaeagnaceae; ISL-328 | Chasghanu (B), Boring (K), Zakh (W) | Fruit, leaves | F: raw snacks; V: fodder | + | + | + | *** |
| *Elymus alpina* (Drobow) Tzvelev; Poaceae; ISL-05 | Chonshika (B) | Stem spikes, leaves | V: fodder | _ | + | _ | ** |
| *Elymus dahuricus* Griseb.; Poaceae; ISL-79 | Parol (B) | Stem spikes, leaves | V: fodder | _ | + | _ | ** |
| *Elymus himalayanus* (Nevski) Tzvelev; Poaceae; ISL-1718 | Kishansir (W) | Spikes, stem | V: fodder | + | _ | _ | *** |
| *Elymus mutabilis* L.; Poaceae; ISL-598 | Sari shlka (B) | Stem spikes, leaves | V: fodder | _ | + | _ | ** |
| *Ephedra* sp.; Ephedraceae; ISL-7019 | Ghatshikka (B) | Whole plant | M: decoction is used for kidney stone | _ | + | _ | *** |
| *Ephedra gerardiana* Wall. ex Stapf.; Ephedraceae; ISL-899 | Sopat (B), Somani (K), Yemuk (W) | Whole plants | F: fruits; raw snacks; M: powder is applied for bone fracture; decoction used for internal wounds; V: decoction for internal wounds | + | + | + | *** |
| *Erigeron* sp. pl.; Asteraceae; ISL-239 | Batashandoye (B) | Leaves | V: fodder | _ | + | _ | * |
| *Eremurus stenophyllus* (Boiss. & Buhse) Baker; Asphodelaceae; ISL-20091 | Shoye shakh (K) | Leaves | F: cooked | _ | _ | + | *** |
| *Geranium magnificum* Hyl.; Geraniaceae; ISL-327 | Boashikha (B) | Flowers, stem, leaves | V: fodder | _ | + | _ | *** |
| *Fagopyrum esculentum* Moench; Polygonaceae; ISL-867 | Burwai (W) | Leaves, stem | F: cooked | + | _ | _ | * |
| *Hedysarum falconeri* Baker; Fabaceae; ISL-19 | Shelam (W), Holchin (B) | Leaves | V: fodder | + | + | _ | *** |
| *Heracleum pinnatum* C.B. Clarke.; Apiaceae; ISL-1048 | Oshaye (K) | Fruits | F: raw snacks | _ | _ | + | ** |
| *Hyoscyamus niger* L.; Solanaceae; ISL-844 | Bangi deewana (K) | Leaves | F: cooked | _ | _ | + | * |
| *Inula* sp.; Asteraceae; ISL-34 | Nerk (W) | Leaves | M: infusion against constipation | + | _ | _ | * |

(*Continued*)

Table 2. Continued.

| Scientific name; family name; Voucher code | Local names | Part used | Uses: mode of consumption | Studied communities | | | Quotation |
|---|---|---|---|---|---|---|---|
| | | | | Wakhi | Burushaski | Khowar | |
| *Krascheninnikovia ceratoides* (L.) Gueldenst.; Amaranthaceae; ISL-2211 | Charay (B), Charay (K), Shitan (W) | Whole plant without root | V: fodder | + | + | + | *** |
| *Lactuca dissecta* D.Don.; Asteraceae; ISL-88 | Chisk (W), Marmokshika (B) | Flower, stem, leaves | V: fodder | + | + | _ | ** |
| *Lepidium draba* L.; Brassicaceae; ISL-15 | Kitch (W) | Leaves | F: cooked; M: decoction; used against cough, diarrhoea, skin disease, headache, backache, asthma, pneumonia, Jaundice, tuberculosis, kidney pain and fever | + | _ | _ | *** |
| *Lonicera pyrenaica* L.; Caprifoliaceae; ISL-1021 | Baskar (B), Ispain (K) | Fruits, leaves, shoots | F: raw snacks; V: fodder | _ | + | + | ** |
| *Lonicera* sp. pl., Caprifoliaceae; ISL-1015 | Low mikeen (K) | Fruits | F: raw snacks | _ | _ | + | * |
| *Matthiola flavida* Boiss.; Brassicaceae; ISL-54 | Rushika (B) | Leaves, stem | M: the dried powder of leaves and stem is topically applied on wound for healing | _ | + | _ | ** |
| *Medicago sativa* L.; Fabaceae; ISL-1084 | Shipit (B), Konah (K), Oyerk (W) | Stem, leaves | F: cooked ; V: fodder | + | + | + | *** |
| *Mentha royleana* Wall. ex Benth.; Lamiaceae; ISL-1987 | Bain K, Godonj (W) | Leaves | F: raw snacks, also used to make a green tea | + | _ | + | * |
| *Minuartia kashmarica* L.; Caryophyllaceae; ISL-1327 | Muswak (K) | Roots | M: brush the tooth to get relief from a toothache | _ | _ | + | * |
| *Morus* sp.; Moraceae; ISL-401 | Shaloye (K) | Fruits | F: raw snacks | _ | _ | + | ** |
| *Nepeta floccosa* Benth.; Lamiaceae; ISL-1974 | Bozlanj (W) | Leaves | F: cooked | + | _ | _ | ** |
| *Oxyria digyna* (L.) Hill.; Polygonaceae; ISL-729 | Shut shakh (K) | Leaves | F: raw snacks | _ | _ | + | *** |
| *Oxytropis arctica* R.Br.; Fabaceae; ISL-53 | Heryutu (B) | Leaves | V: fodder | _ | + | _ | * |
| *Oxytropis platonychia* Bunge; Fabaceae; ISL-57 | Karapchan (W) | Whole plant without root | V: fodder as galactagogue and increasing meat quality considered highly nutritious for cattle | + | _ | _ | *** |
| *Oxytropis* sp.; Fabaceae; ISL-49 | Ghushun zhop (W) | Roots | F: raw snacks | + | _ | _ | *** |
| *Papaver nudicaule* L.; Papaveraceae; ISL-176 | Gul marwoye (W) | Whole plant without root | V: fodder | + | _ | _ | * |
| *Pedicularis verticillata* L.; Orobanchaceae; ISL-191 | Lilyo (B) | Whole plant | V: fodder; against animal fever | _ | + | _ | *** |
| *Persicaria* sp. pl.; Polygonaceae; ISL-856 | Barjokoshika (B) | Seeds, leaves | V: fodder | _ | + | _ | * |
| *Persicaria vivipara* (L.) Ronse Decr.; Polygonaceae; ISL-821 | Vingaskos (W) | Seeds | F: raw snacks | + | _ | _ | *** |
| *Piptatherum* sp.; Poaceae; ISL-427 | Chegh (W) | Whole plant without root | V: fodder | + | _ | _ | ** |
| *Plantago ovata* Forssk.; Plantaginaceae; ISL-2705 | Zibgilg (W), Perisho (B) | Leaves, seeds | M: dried leaves are applied on the skin for abscess drainage, and seeds are directly taken for diarrhoea | + | + | _ | * |
| *Potentilla reptans* L.; Rosaceae; ISL-685 | Swit pisk (W) | Whole plant | V: fodder | + | _ | _ | ** |
| *Primula farinosa* L; Primulaceae; ISL-09 | Ponar (B), Soju ponar (K), Banafsha (W) | Flower, leaves | F: flowers, tea; M: the dew in the morning time on leaves and flowers is used against eyes inflammation | + | + | + | *** |

(*Continued*)

Table 2. Continued.

| Scientific name; family name; Voucher code | Local names | Part used | Uses: mode of consumption | Studied communities | | | Quotation |
|---|---|---|---|---|---|---|---|
| | | | | Wakhi | Burushaski | Khowar | |
| *Saussurea simpsoniana* (Fielding & Gardner) Lipsch.; Asteraceae; ISL-19 | Memonsprag (W), Gilass (B) | Whole plant | M: decoction; against asthma | + | + | _ | * |
| *Seriphidium leucotrichum* (Krasch.) Y.R.Ling.; Asteraceae; ISL-118 | Tipisk (W), Khakhaleech (K) | Leaves, stem | V: fodder; used against intestinal worms | + | _ | + | ** |
| *Rhamnus crocea* Nutt.; Rhamnaceae; ISL-21 | Grakon (K), Kinger (W) | Fruits | F: raw snacks | + | _ | + | ** |
| *Rheum ribes* L.; Polygonaceae; ISL-93 | Chotal (B), Ispor (K), Shopodh (W) | Stem | F: raw snacks | + | + | + | *** |
| *Ribes alpinum* L.; Grossulariaceae; ISL-5001 | Chilanju (K) | Fruits | F: raw snacks | _ | _ | + | * |
| *Ribes rubrum* L.; Grossulariaceae; ISL-498 | Ghangu (K) | Fruits | F: raw snacks | _ | _ | + | ** |
| *Ribes glaciale* Wall.; Grossulariaceae; ISL-991 | Shato (K), Yenut (W) | Fruits | F: raw snacks | + | _ | + | ** |
| *Rosa nanothamnus* Boulenger.; Rosaceae; ISL-578 | Shao (B), Thorni (K), Chareer (W) | Root bark, young stem | F: root bark; black tea, young stem; raw snacks | + | + | + | *** |
| *Rumex crispus* L.; Apiaceae; ISL-40 | Sirkonzu (K) | Leaves | F: cooked | _ | _ | + | * |
| *Taraxacum campylodes* G.E. Haglund.; Asteraceae; ISL-508 | Terhting (W), Targhut (B), Phu (K) | Leaves, flowers | F: leaves are cooked; M: dried flowers powder is applied for wound healing; V: fodder | + | + | + | *** |
| *Thymus linearis* Benth.; Lamiaceae; ISL-MBL-08 | Tumoro (B), Seu (K), Chumoro (W) | Stem, leaves, flowers | M: green tea is used for fever cough, flu, and stomach ache | + | + | + | *** |
| *Urtica dioica* L.; Urticaceae; ISL-29 | Yoming (K) | Leaves | F: cooked | _ | _ | + | * |

W: Wakhi, B: Burushaski, K: Khowar, F: food use, V: veterinary use, M: medicine use, +: reported, -: not reported, *: rarely quoted, **: commonly quoted, and ***: highly quoted.

this struggle often leaves them vulnerable to a variety of illnesses. Although those who reside in less developed and elevated regions may have a more advanced understanding of how to utilize native flora for medicinal purposes when compared to urban populations, the prevalence of modernization and easy access to allopathic medicines are contributing to the decline of traditional knowledge among these communities (Abbas et al. 2017). The inhabitants of the studied communities reported 19 taxa used against 23 ailments. In general, cough, diarrhea, and external and internal wounds were reported to be treated by the highest diversity of plants (four species), followed by jaundice with three plants, pneumonia, headache, stomach ache, kidney pain, bone fracture, toothache, asthma, and fever with two plants. On the other hand, a maximum of 11 diseases/ailments were documented as treated by a single plant taxon. The Burushaski community reported the highest number of WMPs ($n = 13$) followed by Wakhi ($n = 10$) while the least number of WMPs were used by Khowar ($n = 9$). According to the findings, most of the reported wild medicinal plants (WMPs) were utilized to address prevalent or routine health issues, i.e. diarrhea, fever, cough, stomach-related issues, flu, and internal and external wounds. According to reports, the communities utilized the ingredients of the plant to address significant and severe health conditions. These included tuberculosis, kidney stones, bone fractures, jaundice, and kidney infections. *Berberis chitria* Buch.-Ham. ex Lindl., *Ephedra gerardiana* Wall. ex Stapf., *Primula farinosa*, *Taraxacum campylodes* G.E.Haglund., and *Thymus linearis* Benth. were the most common WMPs among the three communities. *Lepidium draba* L. was used to treat the highest diversity of problems (11 ailments), followed by *Arnebia euchroma* and *Thymus linearis,* which were used to treat six and four ailments, respectively. Cough, stomach problems and external and internal wounds were common ailments treated with WMPs among all the groups. Kidney infection and diarrhea were also commonly treated with wild plants among Wakhi and Burushaski communities. *Delphinium brunonianum* Royle, *Lepidium draba*, and *Plantago ovata* Forssk. were reported to be used against skin disorders, which is probably due to the intensive ultraviolet radiation and poorly managed public sanitation may be accountable for the prevalence of dermal problems. *Anthemis arvensis*, *Lepidium draba*, *Arnebia euchroma*, *Berberis chitria*, and *Thymus linearis* were used to treat respiratory disorders, which is possibly due to the prolonged harsh and hostile weather and allergies make dwellers vulnerable to respiratory infections. *Thymus linearis* is intensively collected in Hopper valley, and is sold along with *Cannabis sativa* L. oil in the valley for anti-allergic purposes. *Berberis chitria* and *Ephedra gerardiana* were reported to be used for bone and joint ailments, which could be associated with the difficult topography and laborious lifestyle. Our findings are in line with Abbas et al. (2017), who reported the same results from the Shigar Valley, Baltistan region of Karakoram range-Pakistan. Most medicinal preparations were given *via* two methods: orally as medication and topically for treating eye, skin, and dental ailments. The vast majority of the treatments were derived from a single species, and they were typically prepared using common methods such as grinding into a powder, steeping in hot water as an infusion, boiling as a decoction, or simply chewing on raw parts of the plant.

### Wild veterinary plants (WVPs)

Traditional herbal remedies play a crucial role in caring for domestic animals in many rural areas around the globe, highlighting the significance of ethnoveterinary medicine in these areas (Hassanali et al. 2005; Aziz et al. 2018). In Pakistan, individuals living in remote and marginalized regions, especially those who continue to practice pastoralism, possess valuable ethnoveterinary knowledge and frequently utilize it to treat their animals (Aziz, Khan, et al. 2020). A total of 34 species relevant to the veterinary field were documented, serving the dual purpose of animal treatment and feeding (Table 1). Nearly all reported ethnoveterinary taxa (30 taxa) were used for feeding purposes. It has been found that the reported taxa were used to treat a maximum of seven diseases or ailments, with the most frequently reported ones being intestinal worms, internal body wounds, constipation, antiseptic, fever, hair loss in cattle, energy production, galactagogue, and skin diseases. *Krascheninnikovia ceratoides* (L.) Gueldenst., *Medicago sativa* L., and *Taraxacum campylodes* were the most frequently used wild veterinary plants (WVPs) among the studied groups. While some of the most commonly used WVPs were different among the three communities, i.e. *Oxytropis platonychia* Bunge, *Hedysarum falconeri* Baker, *Bassia prostrata* (L.) Beck., *Artemisia* L., and *Agrostis stolonifera* L. were used frequently only among Wakhi while *Aconitum* L., *Pedicularis verticillata* L., *Hedysarum falconeri*, and *Geranium magnificum* Hyl. were used frequently only among Burushaski. Most of the WVPs were used for fodder and, to a lesser extent, wounds, intestinal worms, and skin diseases.

### Cross cultural analysis

The ethnobotanical knowledge of the three communities investigated exhibited notable differences. While there are only 11 taxa shared among the three groups, the Wakhi and Burushaski communities display the most significant overlap, with a total of 17 shared species. The Burushaski and Khowar communities had the lowest similarity, with only 14 shared taxa, resulting in a JI of 0.24 (Figure 2). Moreover, Burushaski and Khowar mentioned 15 and 18 plant taxa, respectively, that were not shared with the other groups. Notably, Wakhi

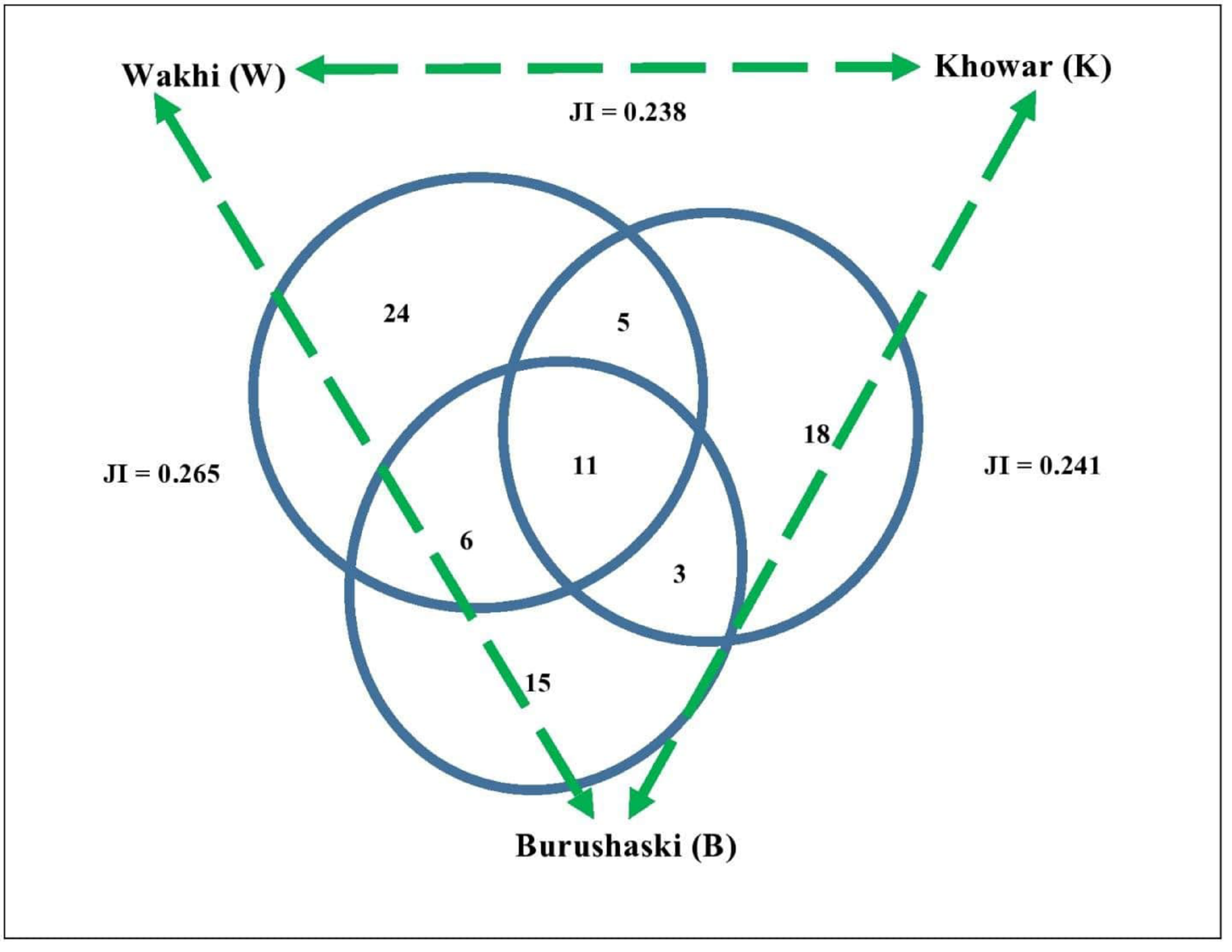


Figure 2. Venn diagram shows the total number of quoted plant taxa among the studied groups and the relevant Jaccard Similarity Index (JI).

reported the highest number of unique plant taxa (24 taxa). Out of the 79 identified taxa, 37 were frequently quoted by the study participants across all the observed groups. The dissimilarities in the use of plants may be related to the geographical status of the area, the historical stratification process of the communities, sociocultural adaptation, and ecological interactions of the community with the environment (Abbas et al. 2016). On the other hand, some similarities in plant use may result from sociocultural negotiations within different communities. The Wakhi people, who migrated to the area in the nineteenth century, later than the other communities, might have brought some unique TEK to these areas, which has been vertically transferred to the present day.

The analysis of the studied groups revealed that more than one-fifth of their WFPs are commonly shared. Among the studied groups, Khowar stood out with the highest number of unique WFPs, utilizing 13 idiosyncratic plants. In contrast, Burushaski had a much smaller number, with only two idiosyncratic WFPs reported. This may be related to the geographical status of the area, with the availability of more food plants, as the Khowar community lives in the Phander Valley, which has more water resources and flat land that allows the cultivation of food plants. The Wakhi group also reported a substantial number of unique WFPs, totaling 10, which may be related to the cultural practices brought into the area during their migration in the nineteenth century. The most resemblance was found between the Burushaski and Wakhi groups, achieving a JI of 0.357 (Figure 3). Similarly, the Burushaski and Khowar groups displayed high similarities, obtaining a JI of 0.354. However, the Wakhi and Khowar groups exhibited comparatively fewer shared WFPs, resulting in a JI of 0.307, suggesting a more distinct dietary profile between these two groups. This may be related to the religious similarities as the Burushaski and Wakhi group communities follow Ismaili Shia Muslims, the similarities in geography in which they live, and the generating opportunities they have now. However, the similarities between the Burushaski and Khowar groups may be related to their history of living in similar geographic areas, relatively better than the Wakhi group, and 80% similarities in religion.

Wild food plants often offer valuable nutrients and micronutrients that are essential for the community's health and well-being (Vinceti et al. 2012). Many of these plants are rich sources of vitamins, minerals, and antioxidants, contributing to a balanced diet in a region where limited access to diverse food options. The Karakoram region is rich in biodiversity, and numerous edible plants naturally grow in the area (Hussain et al. 2021). These wild food resources are often readily available and require minimal effort to harvest compared to cultivating crops in challenging terrain. Shimshal is

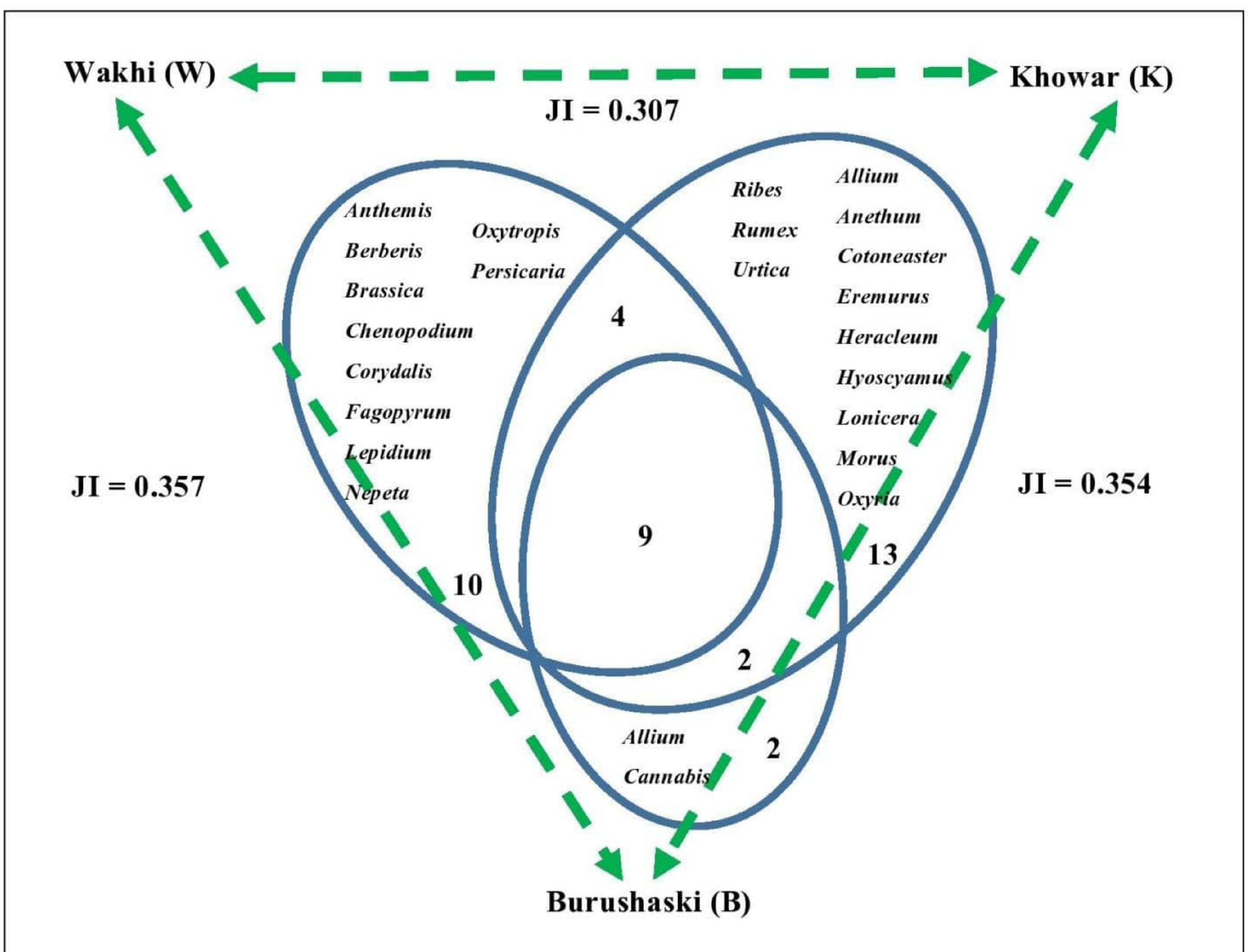


Figure 3. Venn diagram shows WFPs taxa reported by the studied groups and the relevant Jaccard Similarity Index (JI).

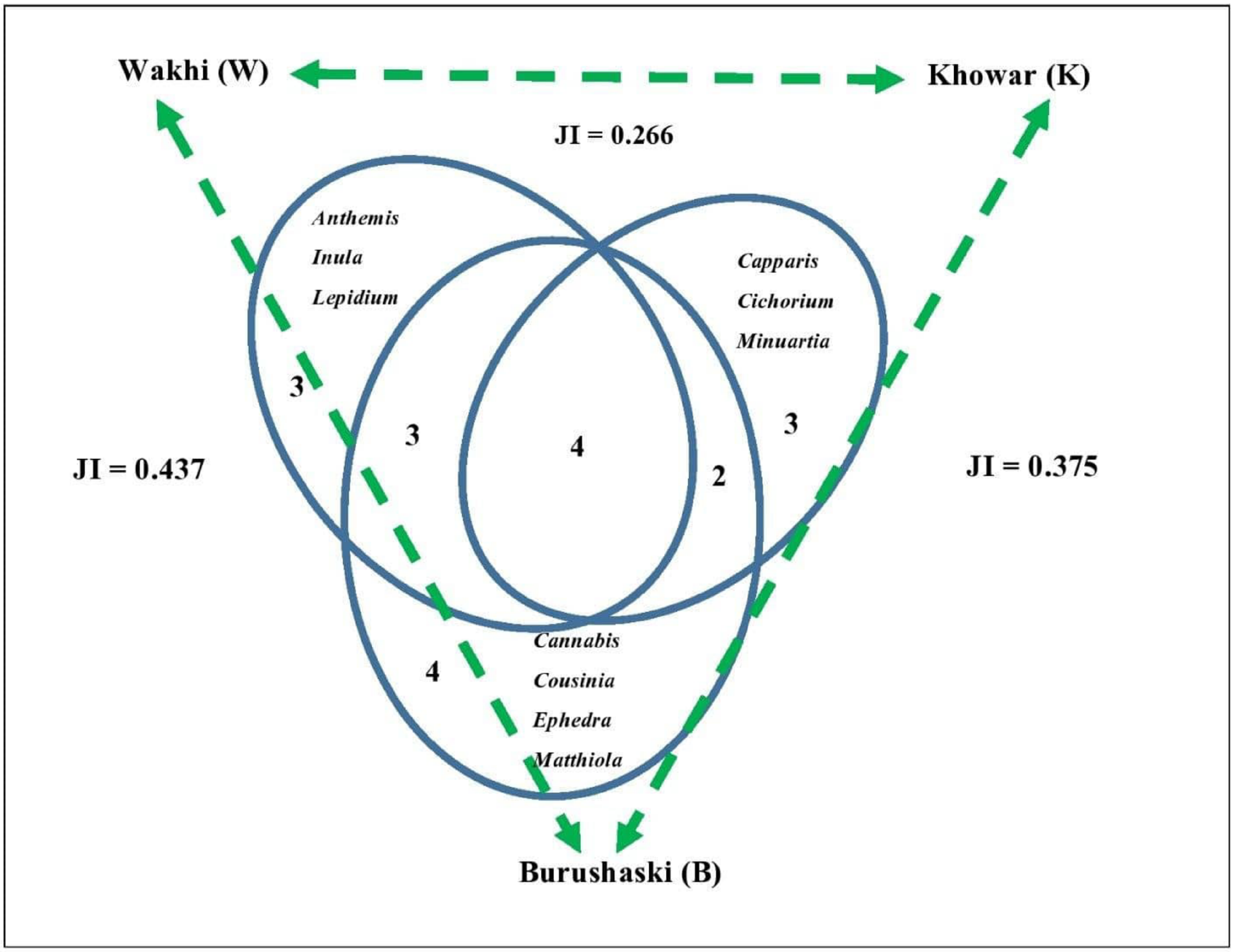


**Figure 4.** Venn diagram shows WMPs taxa reported by the studied groups and the relevant Jaccard Similarity Index (JI).

a high-altitude region in the Karakoram mountains of Pakistan, where the harsh climate and rugged terrain make traditional agriculture challenging (Khan et al. 2009).

The results demonstrated that over 20% of their WMPs were commonly shared. Among the groups, the Burushaski group stood out, utilizing four unique WMPs. In contrast, the Wakhi and Khowar groups reported three distinct WMPs each. Burushaski and Wakhi groups had the highest resemblance, with a JI of 0.437 (Figure 4). Similarly, the Burushaski and Khowar groups showed considerable similarity, achieving a JI of 0.375. However, the Wakhi and Khowar groups had fewer shared WMPs, resulting in a JI of 0.266. Being autochthonous, Burushaski may have unique traditional medicinal plants-related knowledge compared to Wakhi and Khowar. The use of medicinal plants is shaped by the society's local cultural, religious, and historical differences (Sher et al. 2016). Figure (4) illustrates an almost similar distribution in the number of unique WMPs among the three ethnic groups compared to WFPs, which may reflect the distinguishment in food cultures among the studied groups compared to folk medicine knowledge. These differences may be explained by the fact that food is driven by preferences, which may result in a richer diversity of used species, while medicine is driven by necessity.

The investigation further demonstrated that a noteworthy proportion exceeding 10% of WVPs were shared among the three ethnic groups. The Wakhi community emerged prominently within the analyzed groups, by exhibiting the highest number of unique WVPs, incorporating 14 idiosyncratic plant species (Figure 5). Similarly, the Burushaski group reported a considerable amount of WVPs (10 idiosyncratic plants). In contrast, the Khowar group had a significantly lower number of WVPs, comprising only two idiosyncratic plant species within their traditional pharmacopeia. This may be due to the fact that these people are engaged in a different form of economic activities compared to the Burushaski and Wakhi groups. However, more people in Wakhi and Burushaski communities are engaged in pastoralism, which requires more ethnoveterinary knowledge.

### *Possible role of "Nomus" in shaping Shimshalis ethnobotany*

The Wakhi people of Shimshal Valley have historically been semi-nomadic and some families continue to engage in seasonal migrations between high-altitude summer pastures and lower-altitude winter settlements (Kreutzmann 2012). During these migratory journeys, access to cultivated crops is limited, leading to a greater reliance on WFPs found along their migratory routes. Additionally, the short growing season and limited arable land restrict the cultivation of crops. As a result, the Wakhi people turn to wild food plants as an essential food source

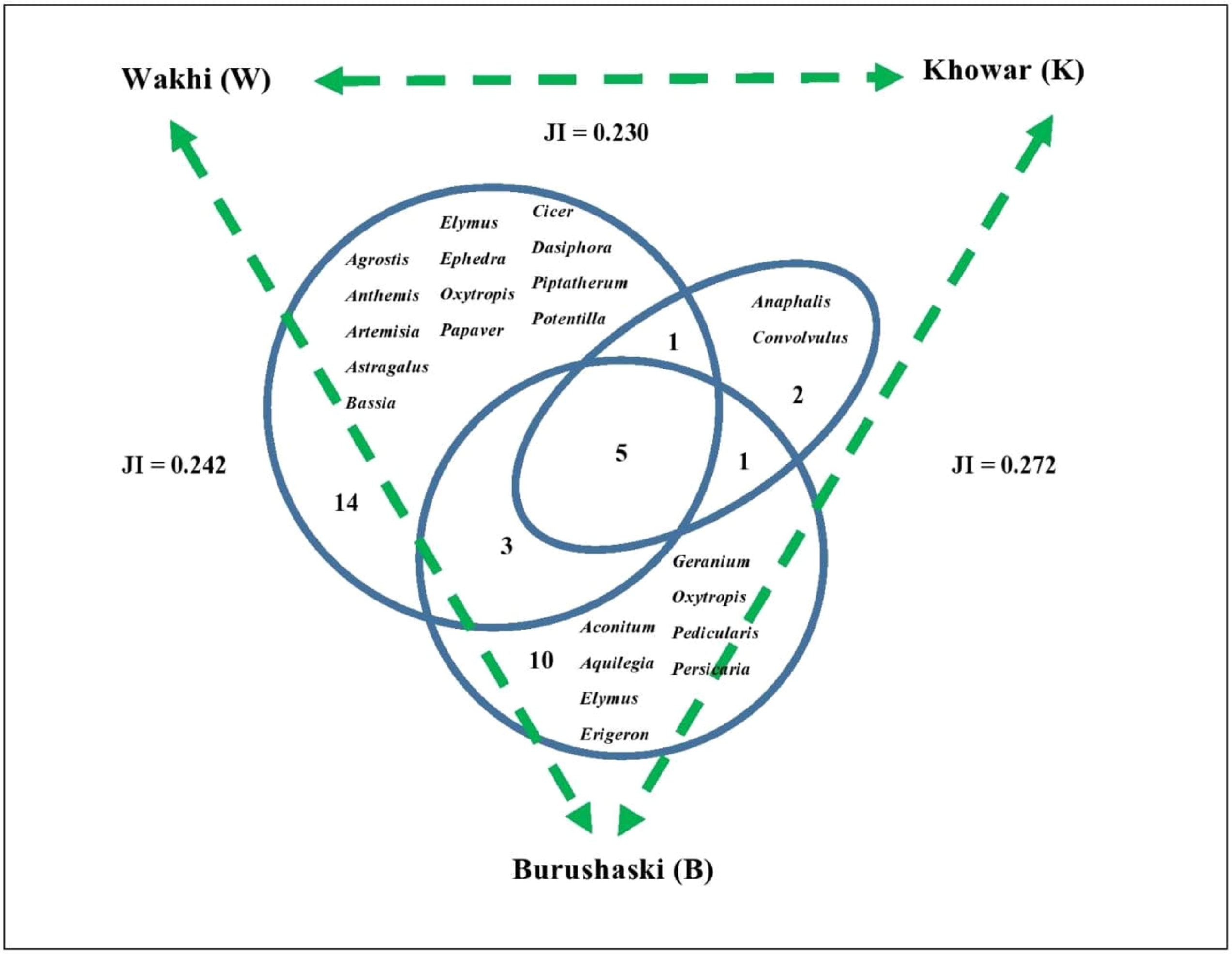


Figure 5. Venn diagram shows WVPs taxa reported by the studied groups and the relevant Jaccard Similarity Index (JI).

*Nomus*, originating from the Wakhi language, embodies the concept of expressing empathy toward humanity. The historical roots of the *Nomus* tradition extend back at least a century or more. This cultural practice remains confined within the boundaries of the Shimshal Valley, with its precise inception and developmental timeline shrouded in uncertainty. Nonetheless, it has persisted within Shimshal for an indeterminate duration, tracing back to the collective memories of its inhabitants. Fundamentally, the tradition operates as a structured mechanism wherein affluent individuals within the community sponsor construction endeavors, such as bridges, trails, or walls. This patronage involves the contribution of resources, sustenance, and even personal labor, all with the intent of venerating the memory of a family member, regardless of their mortal or immortal status. Simultaneously, this engagement seeks to invoke divine blessings. The Wakhi community in Shimshal, like many other remote communities around the world, relies heavily on wild plants due to various socioeconomic and geographical factors (Abbasi et al. 2013; Ahmad et al. 2014; Abdullah et al. 2021). The Wakhi community has a long-standing tradition of foraging and utilizing wild plants, and they practice sustainable foraging techniques to ensure the long-term availability of WFPs and WVPs. These practices have been passed down through generations, forming an integral part of their cultural heritage. The knowledge of wild plant identification, harvesting methods, and food preparation has been developed and preserved for centuries. The reliance on WFPs and WVPs has served the Wakhi community well over generations. However, it is essential to recognize the challenges they face in the modern world, including climate change, loss of biodiversity, and external economic pressures. *Nomus'* rule in Shimshal may have shaped a "sharing culture" that may be quintessential in the transmission and "circulation" of LEK and, therefore for the resilience of ethnobotanical practices (Prakofjewa et al. 2023). This may have been, in turn, the result of extreme Shimshal isolation. Hence, the effect of adaptation to isolation may have influenced the emergence of *Nomus* and may also be the ultimate reason for a higher resilience of LEK systems among the Wakhis of Shimshal.

## Conclusion

The present study investigated traditional knowledge of wild flora among local people in the Shamshal, Hopper, and Phandar valleys in Northern Pakistan. We documented 79 wild plant taxa belonging to 68 genera and 33 families utilized in the study area. Wild food plants dominated the reported species (50%), followed by plants used for veterinary purposes (43%). Our results highlighted the significant differences among the studied valleys and communities, particularly between the Wakhi and Burushaski communities, which may be related to the geographical status of the area and the availability of wild food plants. This study discussed the possible role of Wakhi's *Nomus* on the biocultural heritage related to wild food plant foraging and its sustainability. Efforts to preserve traditional knowledge, promote sustainable practices, and improve livelihood opportunities can help ensure the well-being of the local communities and their unique cultural heritage. Future studies should consider the reported plant species, particularly the highly quoted ones that could hold high economic value, as they may be crucial in the rural development of the study area.

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## Ethical declaration

Informed consent was obtained prior to the interviews. The Code of Ethics of the International Society of Ethnobiology was followed. The data that support the findings of this study are presented in the article.

## Author contributions

Conceptualization: A.P. and N.S.; Study design and methodology: A.P., A.M., and A.M.A.; Investigation: A.R.; Data curation and analysis: A.A.S. and M.A.; Writing the original draft: A.A.S and M.A.A; Review and editing: N.S., D.K., and A.P.; Funding acquisition: A.P.; N.S. prepared the final version of the manuscript, submitted it, and later prepared the revised version. All authors have read and agreed to the published version of the manuscript.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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