# Comparative ethnobotanical analysis of medicinal plants in the Western Tien Shan Transboundary Region using an integrated approach: A comparison with the Nurata Range

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## Research

## Abstract

*Background:* Mountain ecosystems of Central Asia represent key centers of biological and cultural diversity, yet comparative quantitative assessments of medicinal plant use across ecologically contrasting mountain systems remain limited. This study aims to evaluate the ethnobotanical significance of medicinal plants in the Western Tien Shan transboundary region and compare the results with the Nurata Range using an integrated assessment model.

*Methods:* Medicinal plant species were selected based on documented traditional use and confirmed occurrence within each region. A total of 185 species from Western Tien Shan and 110 species from Nurata were evaluated using the Ethnobotanical Value Index (EVI), calculated as the mean of five equally weighted parameters: use diversity, chemical richness, plant part diversity, preparation diversity, and additional functional value. Floristic similarity between regions was assessed using the Jaccard similarity coefficient.

*Results:* Western Tien Shan exhibited higher species richness, while Nurata showed a higher mean EVI value (2.97 vs. 2.32), indicating stronger knowledge concentration. A greater proportion of high-EVI species (≥3.0) was recorded in Nurata, whereas Western Tien Shan displayed a more dispersed distribution across value categories. Jaccard analysis (J = 0.45) revealed moderate similarity, with 91 shared species and substantial regional differentiation.

*Conclusion:* The findings demonstrate that species richness and ethnobotanical use intensity represent distinct structural dimensions of traditional knowledge systems. The integrated EVI framework provides a quantitative basis for prioritizing

medicinal plant species and supports conservation-oriented management strategies in transboundary mountain ecosystems of Central Asia.

*Keywords:* Ethnobotany; Medicinal plants; Western Tien Shan; Nurata Range; Ethnobotanical Value Index (EVI); Transboundary mountain ecosystems; Central Asia; Floristic similarity; Traditional knowledge systems.

## Background

Medicinal plants have constituted an integral component of healthcare systems since the earliest stages of human civilization (Kosimov *et al.* 2026). Across diverse geographic regions, traditional medical knowledge systems have developed in close association with local floristic resources and have been transmitted over centuries through oral traditions, practical experience, and cultural continuity (Khojimatov *et al.* 2025). Modern ethnobotany seeks to systematically document this historical heritage, evaluate it using quantitative indicators, and interpret it within an ecological framework (Bussmann *et al.* 2016). In particular, assessing the functional significance of medicinal plants not merely descriptively but through integrated quantitative indices has become an increasingly important scientific direction (Khojimatov *et al.* 2025).

In recent decades, global biodiversity loss, increasing anthropogenic pressure on mountain ecosystems, and the gradual erosion of traditional knowledge systems have intensified the need for comprehensive studies of medicinal plant resources (Bussmann *et al.* 2007). Mountain regions represent not only centers of floristic diversity but also important reservoirs of cultural and ecological knowledge (Khojimatov *et al.* 2026). In Central Asia, one of the most significant mountain systems is the Western Tien Shan, a transboundary region encompassing territories of Uzbekistan, Kazakhstan, and Kyrgyzstan (Tojibaev 2010).

The Western Tien Shan is characterized by pronounced vertical zonation, a high level of endemism, and complex landscape mosaics (Tojibaev 2010). More than 1,800 vascular plant species have been recorded in the region, a substantial proportion of which possess medicinal value (Khojimatov 2008; Khojimatov *et al.* 2026). Previous research has primarily focused on resource assessment, raw material harvesting, and anthropogenic impacts (Khojimatov *et al.* 2026). However, integrated approaches aimed at quantitatively evaluating the ethnobotanical value of medicinal plants remain insufficiently developed.

The transboundary status of the Western Tien Shan has facilitated interactions among different ethnic groups and cultural traditions, contributing to the formation of a multilayered ethnobotanical knowledge system. The region's complex geomorphological structure, sharp ecological gradients, and clearly expressed vertical zonation directly influence floristic differentiation and species-level functional adaptation (Tojibaev 2010).

Recent fundamental studies recognize the Western Tien Shan as one of Uzbekistan's key transboundary biodiversity centers, emphasizing that its contemporary floristic composition and ecological stability are closely linked to climatic and anthropogenic factors (FL-9024093685 2025). These factors shape regional variation in medicinal plant use, preparation methods, and application patterns (Kosimov *et al.* 2026).

Another important mountain system in Central Asia is the Nurata Range, characterized by semi-arid climatic conditions, the presence of relict floristic elements, and relatively conservative traditional usage patterns. In this region, medicinal plant use has largely developed under the influence of local ecological conditions and historical socio-cultural processes, differing substantially from the transboundary Western Tien Shan system. A comparative analysis of these two mountain systems therefore provides an opportunity to identify regional differences in medicinal plant prioritization and functional significance (Kosimov *et al.* 2026).

Most ethnobotanical studies conducted to date have been descriptive and limited to single regions or administrative units. While such studies provide valuable regional data, they often do not allow for systematic comparison between ecologically contrasting mountain systems or for quantitative evaluation of regional prioritization patterns (Tayjanov *et al.* 2021). In particular, comparative research integrating medicinal plant resources across transboundary mountain systems and ecologically distinct regions remains limited.

From this perspective, evaluating the ethnobotanical significance of medicinal plants through integrated quantitative indicators—including use diversity, chemical richness, diversity of utilized plant parts, spectrum of preparation methods, additional functional value, and interregional similarity metrics—requires a comprehensive methodological framework. Such

an approach enables the identification of priority species, clarification of their cultural-ecological relevance, and detection of structural differences between regions.

The aim of this study is to assess the ethnobotanical significance of medicinal plants in the Western Tien Shan transboundary region using an integrated approach and to compare the results with data from the Nurata Range. The study further examines interregional similarity and differentiation patterns, the influence of ecological gradients, and structural characteristics of traditional knowledge systems. This framework provides a methodological basis for improving the understanding of regional ethnobotanical resources and supports the development of sustainable medicinal plant management strategies in transboundary mountain ecosystems of Central Asia.

## Materials and Methods

### Research area

This study was conducted in two ecologically and floristically contrasting mountain systems: the Western Tien Shan transboundary region and the Nurata Range (Figure 1). These regions differ significantly in landscape structure, climatic conditions, biodiversity levels, and traditional medicinal plant use patterns. The Western Tien Shan was selected as the primary study area, while the Nurata Range served as the comparative region.

The research was based on data collected in 2025 within the framework of the fundamental project FL-9024093685 entitled "Biodiversity Centers of Transboundary Regions of Uzbekistan and Their Current Status."

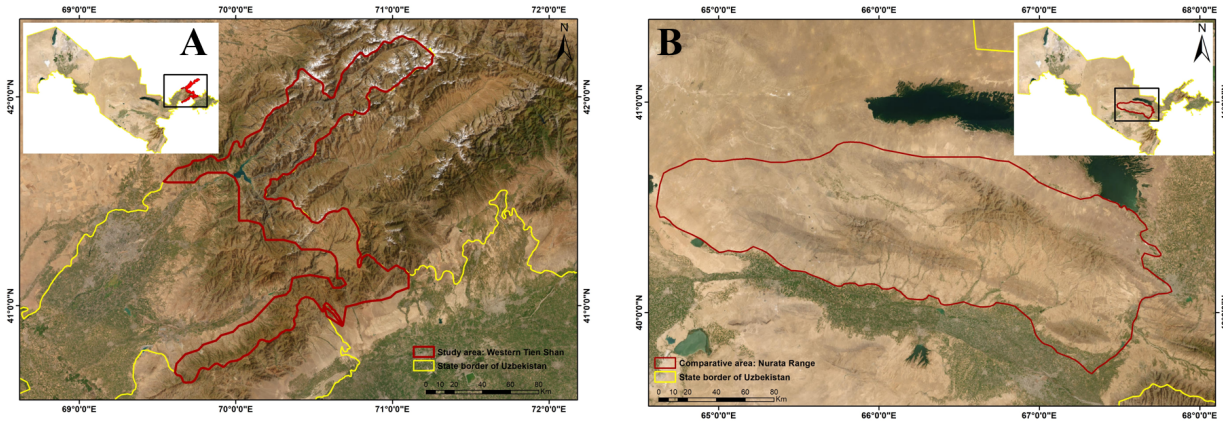


Figure 1. Geographic location of the study areas in Uzbekistan. (A) Western Tien Shan transboundary region. (B) Nurata Range comparative area. Yellow line indicates the state border of Uzbekistan; red line indicates the study area boundaries.

### Western Tien Shan (Transboundary Region)

The Western Tien Shan is one of the most important biodiversity centers in Central Asia, forming a transboundary mountain system across Uzbekistan, Kazakhstan, and Kyrgyzstan (Tojibaev 2010). Within this study, foothill, mid-mountain, and high-mountain ecosystems located in the Uzbek part of the Western Tien Shan were investigated.

The altitudinal gradient ranges from approximately 800 m to over 4,000 m above sea level. The relief is characterized by complex geomorphological features, including deep river valleys, steep slopes, subalpine and alpine meadows, forested zones, and rocky massifs. Such landscape mosaicism contributes to ecological differentiation and supports high species richness of medicinal plants (Geographical Atlas of Uzbekistan 2012).

The climate is continental, with annual precipitation varying between 400 and 900 mm depending on elevation and slope exposure. Temperature regimes change markedly with altitude, resulting in pronounced vertical zonation. Mesophytic, xeromesophytic, and alpine plant communities are widely distributed, many of which include species of medicinal importance (Tojibaev 2010).

Due to its transboundary status, the region is inhabited by diverse ethnic groups. Historically, local communities have relied on wild plant resources for healthcare, food, and household purposes. Consequently, the system of medicinal plant use has developed as a multilayered structure shaped by ecological gradients and cultural knowledge exchange (Khojimatov 2024).

**Nurata Range (Comparative Region)**

The Nurata Range is a semi-arid mountain system located in central Uzbekistan between the Kyzylkum Desert and the Zarafshan Valley. Its altitudinal range extends from 500 to 2,100 m above sea level and is characterized by comparatively drier ecological conditions than the Western Tien Shan (Kosimov *et al.* 2026).

The climate is sharply continental and arid, with high summer temperatures and limited precipitation, while winters are relatively cold. Vegetation cover is dominated by xerophytic and xeromesophytic species, with foothill and low-mountain ecosystems bordering desert landscapes. The mosaic structure of these ecosystems supports the development of medicinal plants representing diverse life forms (Zakirov 1969).

For this study, previously published ethnobotanical data from the Nurata Range were recalculated using the same scoring system applied in the present analysis (Kosimov *et al.* 2026). This ensured methodological consistency and allowed direct quantitative comparison with the Western Tien Shan.

**Selection Criteria for Medicinal Plant Species**

The primary data source was a national ethnobotanical database comprising 374 medicinal plant species traditionally used in Uzbekistan.

Approximately 100 species were selected for the Western Tien Shan region based on the following criteria:

1. The natural distribution of the species is associated with Western Tien Shan ecosystems.
2. The species is actively used by local communities within the region.
3. Sufficient information is available regarding its medicinal applications, chemical composition, plant parts used, and preparation methods.
4. Species identification has been confirmed using herbarium materials and modern taxonomic references.

Species lacking sufficient ethnobotanical or ecological information were excluded from the analysis. The previously selected species from the Nurata Range were reassessed according to the same criteria, ensuring methodological consistency for interregional comparison.

**Ethnobotanical Data Collection**

Data were collected between 2022 and 2025 through field observations, semi-structured interviews, scientific literature, and publicly available sources. Interviews were conducted with local community members, traditional healers, and plant collectors.

For each species, the following information was recorded: scientific name, local name, plant parts used, medicinal applications, preparation and administration methods, and additional functional value. All data were systematized and summarized in standardized tables.

A total of 38 local informants participated in the interviews (22 males and 16 females; age range 35–78 years). Informants included traditional healers, plant gatherers, and experienced local residents. Verbal informed consent was obtained from all participants, and the study was conducted in accordance with international ethical standards for ethnobotanical research (Martin 1995).

***Integrated Ethnobotanical Assessment (EVI)***

To evaluate the relative ethnobotanical importance of medicinal plants, the integrated assessment model previously applied to the Nurata Range was retained (Kosimov *et al.* 2026). This ensured methodological consistency and allowed direct comparison between regions.

Five parameters were evaluated: Use diversity (U), Chemical richness (C), Diversity of plant parts used (P), Diversity of preparation and administration methods (R), Additional functional value (A)

The Ethnobotanical Value Index (EVI) was calculated as:

$$EVI = (U + C + P + R + A) / 5$$

Each parameter was scored on a scale from 1 to 5. A minimum score (1) indicated limited expression of the parameter, while a maximum score (5) reflected high expression. This standardized scoring system ensured balanced weighting of all parameters and facilitated consistent interregional comparison.

***Assessment of Interregional Similarity***

Floristic similarity between the Western Tien Shan and the Nurata Range was assessed using the Jaccard similarity coefficient:

$$J=a / (a+b+c)$$

where:

a-represents the number of species occurring in both regions,

b-represents species occurring only in the Western Tien Shan,

c-represents species occurring only in the Nurata Range.

This index allowed quantitative evaluation of floristic similarity and differentiation in ethnobotanical composition between the two mountain systems.

## Results

**Species Richness and Overall Ethnobotanical Indicators**

A total of 185 medicinal plant species from the Western Tien Shan transboundary region were evaluated using the integrated EVI model, while 110 species were analyzed in the comparative region of the Nurata Range.

In terms of species richness, the Western Tien Shan exhibited a markedly higher number of medicinal plant species.

The mean EVI value was higher in the Nurata Range (2.97) compared to the Western Tien Shan (2.32). Furthermore, the dispersion of EVI values was greater in the Western Tien Shan, indicating a wider distribution of ethnobotanical scores among species. In contrast, EVI values in the Nurata Range were distributed within a narrower range.

**Distribution of Species Across EVI Categories**

Medicinal plant species were classified into three categories based on their Ethnobotanical Value Index (EVI): low (<2.0), medium (2.0–2.99), and high (≥3.0). This classification allowed assessment of both the intensity of traditional use and the degree of multifunctionality of each species.

In the Nurata Range, out of 110 analyzed species, 46 (42%) belonged to the high EVI group, 52 (47%) to the medium group, and 12 (11%) to the low group.

In contrast, in the Western Tien Shan transboundary region, among 185 species, 56 (31%) were classified as high, 74 (40%) as medium, and 55 (29%) as low (Figure 2).

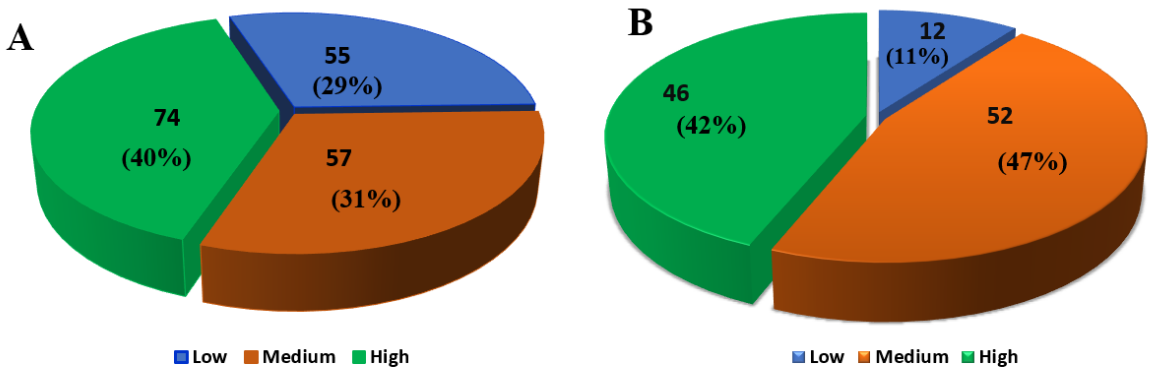


Figure 2. Distribution of medicinal plant species across EVI categories in (A) Western Tien Shan and (B) Nurata Range. Low (<2.0), Medium (2.0–2.99), and High (≥3.0) groups represent increasing levels of ethnobotanical importance.

Interregional comparison shows that the proportion of highly valued species is relatively greater in the Nurata Range. This suggests that medicinal plant use in this region is more concentrated around a limited number of priority species.

In the Western Tien Shan, despite higher overall species richness, the proportion of low EVI species is substantial (29%). This indicates that although medicinal plant diversity is broad, not all species are used intensively or multifunctionally. Consequently, the distribution of ethnobotanical value is more dispersed in this region.

**High-EVI Species (Top–20 Analysis)**

The Top–20 species were ranked in descending order according to their EVI values and represent approximately 10–12% of the total species list (Table 1). This selection was intended to highlight ethnobotanically prioritized and multifunctionally important species.

In both regions, species with EVI values ranging between 3.6 and 3.8 were classified as highly significant. These species are characterized by broad usage diversity, rich chemical composition, and multifunctionality, and they occupy a central role in traditional medical systems.

Among the species identified within the high-EVI group in both the Nurata Range and the Western Tien Shan, the following were particularly prominent:

1. *Juglans regia,*
2. *Rosa canina,*
3. *Plantago lanceolata,*
4. *Portulaca oleracea,*
5. *Populus nigra,*
6. *Rheum maximowiczii.*

The consistent high ranking of these species in both regions indicates that they form a regional ethnobotanical core.

These species share several defining characteristics:

1. Multidirectional therapeutic use – applied in respiratory, gastrointestinal, inflammatory, metabolic, and immune-related disorders.
2. Rich secondary metabolite composition – including flavonoids, phenolic compounds, essential oils, and other bioactive constituents.
3. Use of multiple plant organs – leaves, fruits, roots, bark, or seeds.
4. Additional functional value – some species are also used as food or preventive remedies.

These combined properties contribute to their elevated EVI scores and reinforce their role as multifunctional medicinal resources within traditional healthcare systems.

Although the Western Tien Shan contains a greater absolute number of high-EVI species, in the Nurata Range these species are more concentrated within the local use system and demonstrate more stable ethnobotanical importance. This reflects structural differences in regional knowledge systems.

**Interregional Model Differences**

The results indicate that the structure of medicinal plant use differs substantially between the Western Tien Shan and the Nurata Range.

In the Western Tien Shan, the number of medicinal species (n = 185) is higher; however, the average EVI value is lower than in the Nurata Range. Conversely, in the Nurata Range (n = 110), despite lower species richness, the proportion of high-EVI species is relatively greater.

This pattern suggests two distinct ethnobotanical models:

1. Western Tien Shan – species richness dominant model, characterized by high diversity of medicinal taxa;
2. Nurata Range – knowledge concentration dominant model, characterized by concentrated traditional knowledge and intensive use of selected species.

In the Western Tien Shan, ecological gradients and vertical zonation contribute to broad floristic diversity. However, EVI distribution indicates that not all species are used intensively or multifunctionally. Ethnobotanical value therefore exhibits a dispersed pattern.

Table 1. Top–20 medicinal plants based on EVI values in the Western Tien Shan transboundary region (Uzbekistan)

| **Voucher number** | **Species (Scientific name)** | **Family** | **Local name** | **Parts used** | **EVI value** | U | C | P | R | A | **Main medicinal uses** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **O'ETB23** | *Daucus carota* L. | Apiaceae | Sabzi | Roots, seeds | 3.6 | 5 | 5 | 3 | 3 | 3 | Vitamin deficiency, metabolic disorders; diuretic and anti-inflammatory uses. |
| **O'ETB54** | *Artemisia scoparia* Waldst. & Kit. | Asteraceae | Yantoq shuvoq | Aerial parts | 3.8 | 5 | 5 | 3 | 3 | 3 | Digestive and hepatic disorders; antimicrobial uses. |
| **O'ETB73** | *Betula pendula* Roth | Betulaceae | Qayin | Leaves, buds, bark | 3.8 | 5 | 5 | 3 | 3 | 3 | Diuretic, anti-inflammatory; kidney and urinary tract disorders. |
| **O'ETB86** | *Capparis spinosa* L. | Capparaceae | Kovul | Roots, fruits, buds | 3.6 | 5 | 5 | 3 | 2 | 3 | Liver and spleen disorders; anti-inflammatory and tonic uses. |
| **O'ETB90** | *Colchicum kesselringii* Regel | Colchicaceae | Savrinjon | Corms, seeds | 3.6 | 5 | 5 | 3 | 3 | 3 | Rheumatism and joint diseases; analgesic uses. |
| **O'ETB267** | *Medicago lupulina* L. | Fabaceae | Beda | Roots, aerial parts | 3.6 | 5 | 5 | 2 | 3 | 3 | Digestive disorders; tonic uses. |
| **O'ETB273** | *Melilotus officinalis* (L.) Lam. | Fabaceae | Qashqarbeda | Roots, aerial parts | 3.6 | 5 | 5 | 2 | 3 | 3 | Circulatory disorders; anticoagulant and sedative uses. |
| **O'ETB274** | *Trifolium pratense* L. | Fabaceae | Sebarga | Roots, aerial parts | 3.6 | 5 | 5 | 2 | 3 | 3 | Respiratory and inflammatory conditions; mild sedative uses. |
| **O'ETB124** | *Juglans regia* L. | Juglandaceae | Yong'oq | Leaves, flowers, fruits, seeds, oil | 3.8 | 5 | 5 | 3 | 3 | 3 | Gastrointestinal disorders, metabolic diseases, skin conditions; antimicrobial and anti-inflammatory uses. |
| **O'ETB148** | *Althaea armeniaca* Ten. | Malvaceae | Gulxayri | Roots, leaves, flowers | 3.6 | 5 | 5 | 3 | 3 | 3 | Respiratory tract diseases; demulcent and anti-inflammatory uses. |
| **O'ETB173** | *Plantago lanceolata* L. | Plantaginaceae | Mixchup | Leaves, seeds, roots | 3.6 | 5 | 5 | 3 | 3 | 3 | Wound healing, respiratory infections; antimicrobial uses. |
| **O'ETB174** | *Platanus orientalis* L. | Platanaceae | Chinor | Leaves, bark | 3.6 | 5 | 5 | 3 | 3 | 3 | Inflammatory and skin diseases; antiseptic uses. |
| **O'ETB180** | *Rheum maximowiczii* Losinsk. | Polygonaceae | Rovocha | Roots, rhizomes | 3.6 | 5 | 5 | 3 | 3 | 2 | Digestive disorders; mild laxative and detoxifying uses. |
| **O'ETB323** | *Rumex confertus* Willd. | Polygonaceae | Otquloq | Roots, leaves | 3.6 | 5 | 5 | 3 | 3 | 2 | Digestive and skin diseases; blood-purifying uses. |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **O‘ETB182** | *Portulaca oleracea* L. | Portulacaceae | Semizo‘t | Leaves, shoots, seeds, flowers | 3.8 | 5 | 5 | 3 | 3 | 3 | Gastrointestinal disorders, vitamin deficiency; antioxidant and anti-inflammatory uses. |
| **O‘ETB197** | *Prunus domestica* L. | Rosaceae | Olcha | Fruits, leaves, bark | 3.6 | 5 | 5 | 3 | 2 | 3 | Digestive disorders; mild laxative and tonic uses. |
| **O‘ETB330** | *Rosa canina* L. | Rosaceae | Namatak | Fruits, flowers | 3.6 | 5 | 5 | 3 | 3 | 3 | Vitamin deficiency, immune support; antioxidant and tonic uses. |
| **O‘ETB336** | *Rubus caesius* L. | Rosaceae | Maymunjon | Fruits, leaves | 3.6 | 5 | 5 | 2 | 3 | 3 | Gastrointestinal disorders; antioxidant uses. |
| **O‘ETB363** | *Populus nigra* L. | Salicaceae | Qora terak | Buds, leaves, bark | 3.8 | 5 | 5 | 3 | 3 | 3 | Respiratory diseases, inflammation; analgesic and wound-healing uses. |
| **O‘ETB212** | *Urtica dioica* L. | Urticaceae | Gazandao‘t | Leaves, aerial parts | 3.6 | 5 | 5 | 2 | 3 | 3 | Anemia, metabolic disorders; tonic and anti-inflammatory uses. |

In contrast, in the Nurata Range, although overall medicinal species richness is lower, a substantial proportion of species belongs to the high-EVI group. This reflects concentration of traditional knowledge and multifunctional use around specific taxa. Thus, interregional differences are evident not only in floristic richness but also in the structural organization of ethnobotanical knowledge and intensity of use.

**Interregional Floristic Similarity (Jaccard Index)**

To assess floristic similarity between the Western Tien Shan and the Nurata Range, the Jaccard similarity coefficient was calculated (formula provided in Materials and Methods) (Figure 3).

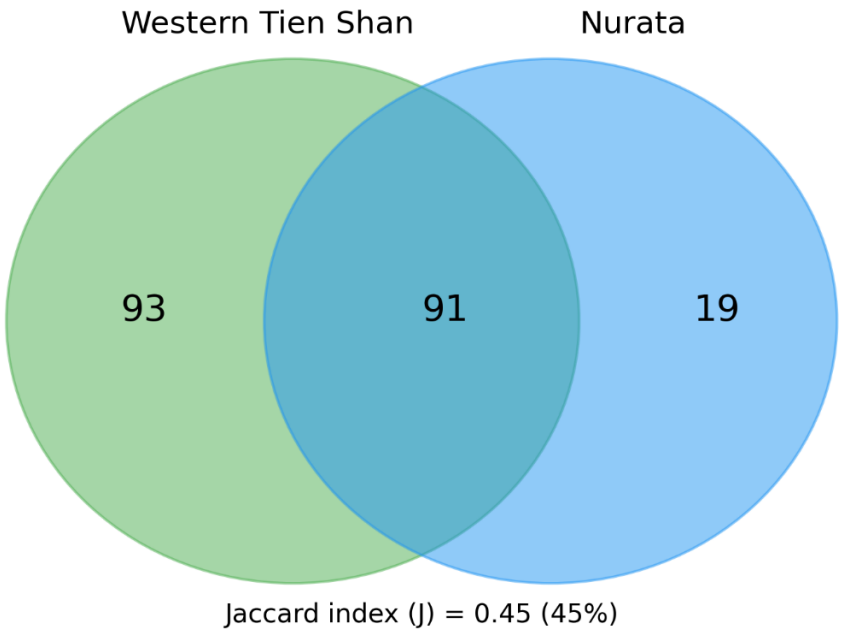


Figure 3. Floristic overlap of medicinal plant species between the Western Tien Shan and the Nurata Range based on the Jaccard similarity index (J = 0.45).

The analysis revealed:

1. 91 species common to both regions (a)
2. 19 species exclusive to the Nurata Range (b)
3. 93 species exclusive to the Western Tien Shan (c)

Based on these values, the Jaccard coefficient was:
J=0.45 indicating a 45% similarity between the two regions.

This value reflects a moderate level of floristic similarity in medicinal plant composition. Nearly half of the species occur in both mountain systems, confirming the existence of a shared Central Asian ethnobotanical core.

At the same time, the presence of 93 exclusive species in the Western Tien Shan and 19 in the Nurata Range demonstrates significant floristic differentiation. This differentiation can be attributed to contrasting ecological gradients, altitudinal zonation, landscape heterogeneity, and regional variation in traditional knowledge systems.

The Jaccard results support the structural differences identified in Section 4.4: while the Western Tien Shan exhibits broader floristic diversity, ethnobotanical importance is more dispersed; in the Nurata Range, despite lower species richness, high-value species are more concentrated.

## Discussion

This study enabled a comparative assessment of the ethnobotanical significance of medicinal plants in the Western Tien Shan transboundary region and the Nurata Range using an integrated methodological framework. The results demonstrate substantial interregional differences in both floristic richness and ethnobotanical concentration.

**Species Richness and the Role of Ecological Gradients**

The greater medicinal plant diversity observed in the Western Tien Shan is primarily associated with its complex geomorphological structure, broad altitudinal gradient, and diverse moisture regimes. As one of the key biodiversity centers of Central Asia, the region encompasses alpine, subalpine, mid-mountain, and foothill zones. Such pronounced vertical zonation promotes ecological differentiation and contributes to increased species richness.

In contrast, the Nurata Range developed under semi-arid climatic conditions, resulting in comparatively lower floristic diversity. Nevertheless, the relatively high proportion of species with elevated ethnobotanical importance in Nurata suggests that traditional knowledge systems in this region are concentrated around a limited number of priority taxa.

**Ethnobotanical Concentration and Use Intensity**

The higher mean EVI value observed in the Nurata Range (2.97) suggests greater intensity and multifunctionality of medicinal plant use despite lower species richness. In other words, medicinal plant use in Nurata appears to form a relatively well-defined “ethnobotanical core.”

In the Western Tien Shan, the lower mean EVI value (2.32) may be explained by higher floristic diversity. Although many medicinal species occur in this region, not all are used with equal intensity. This pattern can be interpreted through a species richness–use intensity trade-off, whereby increasing species diversity may correspond to reduced average intensity of use per species.

Similar patterns have been documented in other mountain systems. Studies from the Andes and Amazon regions indicate that biodiversity hotspots often exhibit a balance between species richness and cultural use concentration (Bussmann & Sharon 2016). These findings support the notion that ecological gradients interact with traditional knowledge systems to shape ethnobotanical structures in mountain ecosystems.

**Universality of High-EVI Species**

Several species including Juglans regia, Rosa canina, Plantago lanceolata, Portulaca oleracea, and Populus nigra ranked highly in both regions. Their consistent prominence indicates the presence of a shared regional ethnobotanical core across Central Asian mountain systems.

These species are characterized by multifunctional therapeutic applications, the use of multiple plant organs, and rich secondary metabolite composition. They are commonly applied across diverse disease categories and exhibit high versatility in preparation methods. Such properties explain their elevated EVI scores and confirm their role as key medicinal resources within traditional healthcare systems.

The recurrence of these taxa in both mountain systems highlights structural continuity in regional ethnobotanical knowledge, despite ecological differences.

**Floristic Similarity and Regional Specificity**

The Jaccard similarity coefficient (J = 0.45) indicates a moderate level of overlap in medicinal plant composition between the Western Tien Shan and the Nurata Range. The presence of 91 shared species reflects historical and ecological connectivity within Central Asian Mountain floras.

At the same time, the substantial number of region-specific species (93 exclusive to the Western Tien Shan and 19 exclusive to Nurata) demonstrates pronounced floristic differentiation. These differences can be attributed to contrasting ecological gradients, altitudinal zonation, and landscape heterogeneity. Furthermore, the transboundary nature of the Western Tien Shan may facilitate knowledge exchange among multiple ethnic groups, potentially broadening the spectrum of medicinal plant use. Thus, interregional variation reflects not only ecological divergence but also differences in cultural adaptation and knowledge transmission.

**Methodological Significance of the Integrated Approach**

The application of the Ethnobotanical Value Index (EVI) enabled a multidimensional evaluation of medicinal plant importance. By incorporating use diversity, chemical richness, diversity of plant parts utilized, preparation methods, and additional functional value, the model provided a more comprehensive assessment than single-indicator approaches.

This integrated framework allowed identification of structural differences between species richness and use intensity patterns, thereby moving beyond descriptive ethnobotanical inventories toward quantitative comparative analysis. The results demonstrate the methodological potential of EVI for regional and transboundary studies.

**Conservation and Practical Implications**

Species with high EVI values are likely subject to greater harvesting pressure due to their intensive local use. In particular, species for which underground organs are utilized may be ecologically vulnerable. Therefore, high-EVI taxa should be prioritized for monitoring and resource assessment.

While the higher species richness of the Western Tien Shan may provide resource diversification, the concentration of use around fewer species in the Nurata Range may increase pressure on specific taxa. These findings underscore the need for regionally differentiated conservation strategies and sustainable harvesting frameworks.

**Study Limitations**

Although the scoring system used in this study allowed standardization of parameters, certain indicators were derived from literature sources and informant-based data, which may introduce elements of subjectivity. Information regarding chemical composition was primarily synthesized from published studies rather than laboratory analyses.
Future research incorporating phytochemical validation and population-level ecological assessments could further refine the EVI model and enhance its predictive accuracy.

## Conclusion

This study enabled a comparative evaluation of the ethnobotanical significance of medicinal plants in the Western Tien Shan transboundary region and the Nurata Range using an integrated methodological framework. The findings reveal substantial structural differences between the two regions in terms of floristic richness and use intensity.

The Western Tien Shan demonstrated higher medicinal plant diversity (185 species), confirming its role as a biodiversity hotspot. In contrast, the Nurata Range exhibited a relatively higher proportion of species with elevated ethnobotanical value (≈42%), indicating that traditional knowledge in this region is concentrated around a narrower but intensively utilized set of medicinal resources. These results confirm that species richness and use intensity are not synonymous concepts, but rather independently structured phenomena shaped by regional ecological and cultural factors.

The Jaccard similarity coefficient (J = 0.45) indicates a moderate level of floristic overlap between the two mountain systems, while simultaneously demonstrating the formation of region-specific ethnobotanical cores. This pattern suggests that medicinal plant use in Central Asian Mountain regions has developed through a complex interaction of historical, ecological, and cultural processes.

The integrated Ethnobotanical Value Index (EVI) model proved to be an effective quantitative tool for assessing the multidimensional functional importance of medicinal plants. The approach provides a scientifically grounded basis for interregional comparison, identification of priority species, and development of conservation and monitoring strategies.

Overall, the comparative analysis of the Western Tien Shan and the Nurata Range confirms the theoretical and practical relevance of applying an integrated ethnobotanical model for evaluating medicinal plant resources in Central Asian Mountain ecosystems. The proposed framework offers a practical decision-support tool for prioritization and conservation planning in transboundary mountain ecosystems.

## Declarations

**Ethics approval and consent to participate:** All ethnobotanical research activities conducted within this study complied with internationally accepted ethical guidelines for ethnobotanical research. Information obtained from local inhabitants was

used exclusively in aggregated and anonymized form for scientific purposes. Oral informed consent was obtained from all participants prior to data collection.

**Consent for publication:** Not applicable.

**Availability of data and materials:** The ethnobotanical data supporting the findings of this study are stored by the authors and are available from the corresponding author upon reasonable request.

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

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**Authors' contributions:** All authors contributed to the conception and design of the study. Data collection and analysis were performed collaboratively. All authors participated in manuscript preparation, critically revised the text, and approved the final version of the manuscript.

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