RESEARCH ARTICLE

Threats to the Plants with Medicinal Value in Anantnag District of Kashmir Valley

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DOI: 10.18811/ijpen.v10i03.16

Abstract

Today's severe human involvement has put millions of species at risk of extinction. The growing popularity of herbal remedies has boosted interest in ethnobotanical and ethno-medicinal studies on herbal products. As a result of the rising demand, medicinal plants are currently facing significant pressure. Plant-based goods are utilized not only in conventional therapy but also as a basic ingredient in contemporary medications. The growing human population and the growing demand for medical plants put a persistent strain on available resources, causing some wild species to continuously decline and eventually go extinct. At the same time, natural wild flora is disappearing at an alarming rate. In the present study area, overgrazing contributed 50%, Climate Change 27% and Tourist flow 29% to the threats to medicinal plants, apart from being continuously used for treating various diseases. So, in various regions of the world, multiple proposals have been made for the protection of medicinal plant species. This covers efforts like botanical gardens and gene banks in ex-situ conservation as well as *in-situ* conservation through the establishment of preservation areas and cultivation. The elements that can be used as preventive strategies to stop these actions or that can provide information about how detrimental they are to the sustainability of medicinal plants in a certain area need to be looked into urgently. To preserve this priceless legacy, it is crucial to work towards the protection and sustainable use of medicinal plant resources. A lot of work has been conducted in this area. However, no such work has been done in the Anantnag district on threats to medicinal plants. The main objective of the study is to identify the threats to medicinal plants in the Anantnag district of Kashmir Valley.

Keywords: Threats, Overgrazing, Climate change, Phalgam.

Highlights

- Natural wild flora is disappearing at an alarming rate. In the present study area, overgrazing contributed 50%, climate change 27% and tourist flow 29% to the threats to medicinal plants, apart from being continuously used for treating various diseases.
- To preserve this priceless legacy, it is crucial to work towards the protection and sustainable use of medicinal plant resources.
- Climate change is considered a major threat to the survival of medicinal plants in Pahalgam Valley.

International Journal of Plant and Environment (2024); **ISSN:** 2454-1117 (Print), 2455-202X (Online)

Introduction

Human involvement has put millions of species at risk of extinction. The growing popularity of herbal remedies has boosted interest in ethnobotanical and ethno-medicinal studies on herbal products. As a result of the rising demand, medicinal plants are currently facing significant pressure. Plant-based goods are utilized not only in conventional therapy but also as a basic ingredient in contemporary medications. Half or more of the world's population lacks access to proper healthcare today. One possible explanation is that low-income individuals cannot afford or do not have access to contemporary medical treatment (Stryamets *et al*., 2021).

One of the most difficult environmental issues is biodiversity loss, which is also being seen as a primary cause of the Anthropocene (Diaz *et al*., 2018). Given that medicinal plants play vital roles in global healthcare, especially in developing nations, there is a growing focus on the conservation and sustainable use of these biodiversity components, which significantly contribute to the provision of ecosystem goods and services (Asif *et al*., 2021). Twenty-one percent of the world's medicinal plant species are classified as endangered by the IUCN (Asif *et al*., 2021). Many species of medicinal plants are currently classified as vulnerable or endangered, and shortly, a few species may be eligible for this designation if adequate scientific data are available (Rahman *et al*., 2015). Due to factors such as small population size, restricted distribution range, habitat specificity, destructive harvesting practices, heavy livestock grazing, high utilization values, climate change, habitat loss, ongoing development activities, and genetic drift, the majority of medicinal plant species found in natural ecosystems are facing increasing threats in recent times (Haq *et al*., 2021). Few studies have examined the landscape-level impacts of climate change on medicinal plants and the threats these plants confront. Quantitative details on the range, population status, and preferred microhabitats of Phalgam's high-altitude medicinal plants are mostly unknown. Some of the most useful medical plants in the world have become extinct

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How to cite this article: Nisar, A., Mir, A. Q., Anuradha, J., Sanjeevi, R. (2024). Threats to the Plants with Medicinal Value in Anantnag District of Kashmir Valley. International Journal of Plant and Environment. 10(3), 138-144.

Submitted: 11/05/2024 **Accepted:** 11/07/2024 **Published:** 30/11/2024

due to climate change. Everyone is highly concerned about the plight of medicinal plants in the Kashmir valley and India, especially because anthropogenic activities have played a role in their reduction. Consequently, more research into this area is needed to ensure the preservation of the region's rich medicinal plants since its scope has grown. Warming temperatures and shifting weather patterns have caused certain natural plants, like MAPs, to bloom sooner and move their ranges. At first, changing phenologies and ranges may not appear significant, yet they pose serious threats to the survival of many species. In addition, they are indicators of how the environment may alter as a result of global warming. Along with climate change comes the prediction of more severe weather, and the adaptability and survival of plant species may depend in part on how well they handle these kinds of conditions. There is a dearth of research on how atmospheric CO_2 enrichment affects certain plant chemicals with direct therapeutic significance. According to research conducted by Stuhlfauth *et al*. in 1987, the medicinal plant woolly foxglove (*Digitals lanata)* EHRH) increased its dry weight production of the cardiac glycoside digoxin—a compound used to treat cardiac insufficiency—by 63% in controlled, well-watered conditions in a phytotron and by 83% in water-stressed conditions. In light of this dire situation, medicinal plant conservation must receive immediate research attention. Medicinal plant species with a restricted range and small environmental restrictions must prioritize adopting the proper scientific methodology to focus conservation efforts at the regional level (Singh *et al*., 2023). Under such an approach, local shortage and habitat vulnerability would have to be given second priority, with the highest weight going to the regional level. In addition to providing people with access to inexpensive therapy, medicinal plants also provide tremendous chances for innovation and alternative cures in the form of revenue and employment. Herbal remedies and other plant-based medicines have long histories of use in both conventional and alternative medicine. In particular, two important research topics were intended to be addressed by this study: (i) In the area, what are the most pressing dangers to the chosen valuable medicinal plants? (ii) how serious are these dangers?

Methodology

Study Area

This research was place at the popular tourist destination Pahalgam in the Indian state of J&K's District Anantnag. Pahalgam is well-known as a destination for adventurers, nature lovers, and those seeking religious pilgrimage. Adventure and nature tourism have made Phalgam renowned. Among the many ecotourism destinations in J&K, these two stand head and shoulders above the rest, drawing visitors from all walks of life. Because of the abundance of medicinal plants in the Phalgam region, scientists have been interested in learning more about it. In addition to their useful rhizomes and tubers, the various species are very localized, easily trampled, and eaten by livestock.

Pahalgam

Pahalgam, a popular tourist destination in India's J&K state of Anantnag, was the site of the current investigation. Anantnag District Headquarters is 45 km northeast of this hill station. Located at an elevation of 8989 feet (2740 meters) between 34001′N and 75011′E latitudes and 34001′N and 75019′E longitude, it is situated on the banks of the Lidder River. With an overall literacy rate of 35% and a total population of 5922 (census 2001), the gender breakdown is as follows: 56% male and 44% female. Perhaps India's finest health resort is Pahalgam, the Valley of Shepherds, which was formerly a popular filming location and a major draw for tourists. The world-renowned Amaranth Yatra also uses it as a base camp. From Pahalgam to Chandanwari, the drive is around 16 km; from there, it's another 19 km to the sacred Amaranth cave, where the path becomes higher but is still manageable by foot or pony. The route to the holy site is rather flat. Because of its pine trees, snow-capped mountains, pleasant weather, and expansive pastures and meadows, the valley gives the impression of being spectacular. The torrential flow of water in the Lidder River enhances the breathtaking grandeur of nature, and Pahalgam borders it.

The Valley of Shepherds has escaped the devastation that modernity has wrought. This area is a fishing paradise, where even a novice may reel in a Rainbow trout from one of the fast-moving streams. Horseback riding, golfing, fishing, trekking, birdwatching, rafting, skiing, and many more leisure opportunities are available. The area around Pahalgam is rich in tourist attractions, such as the Betaab valley, Hajjan, the undulating Baisaran meadow, Shikargah, and Aru. Famous glaciers for tracking include Lidderwat, Chandanwari, and Kolhai. Among the eight villages that make up the Pahalgam tourism site is Mamal, home to what is supposedly Kashmir's oldest Shiva temple, which dates back to the fifth century.

Data Collection

Before conducting field surveys in the Kashmir Himalaya, an extensive literature study was conducted to identify the most important medicinal plant species recorded in the region. The first stage included gathering data on the taxonomy, distribution, and frequency of these species via literature research and specimen examination at the University of Kashmir Herbarium (KASH). The places and timing of medicinal plant surveys in the field were planned based on the preliminary information that was gathered. From 2022 to 2023, we conducted comprehensive field surveys throughout the chosen sample locations throughout the year. We made sure to cover every location where these species thrive in our field surveys.

Questionnaire survey

A semi-structured questionnaire was used to obtain information from local inhabitants about the status of medicinal and aromatic plants in the Phalgam region. They evaluated the areas where they occur, the plant parts that are used, and the socioeconomic problems. We requested the locals to enumerate the most popular medicinal plants in their hamlet that are in high demand. More than 80% of the responders mentioned therapeutic plants, and these were regarded as highly utilized species. About 60 participants knowing medicinal plants participated in this survey. Hotel owners, traditional healers, Vaidyas, and peasants from different communities in the high-altitude Pahalgam region, aged between 30 and 60, who possessed solid knowledge of traditional herbal medicine,

were the main interview subjects. Three-quarters of the locals surveyed were female, and the remaining 65% were men. To gather information on medicinal plant commerce, government policy, revenue collection, and priority species, we called and visited several agencies, including the (DFO) and the Phalgam Forest Department.

Results

The growing human population and the growing demand for medical plants put a persistent strain on available resources, causing some wild species to continuously decline and eventually go extinct. At the same time, natural wild flora is disappearing at an alarming rate.

In the present study area, overgrazing contributed 50%, climate change 27% and tourist flow 29% to the threats to medicinal plants, apart from being continuously used for treating various diseases (Fig. 1). So, in various regions of the world, multiple proposals have been made for the protection of medicinal plant species. This covers efforts like botanical gardens and gene banks in *ex-situ* conservation as well as in-situ conservation through the establishment of preservation areas and cultivation.

Leaves flowers and fruits are the most important parts of plants that are being used for the treatment of different ailments in the study area. As indicated in Table 1 and Fig. 2, leaves of different plants are mostly used for the treatment of diseases in Phalgam.

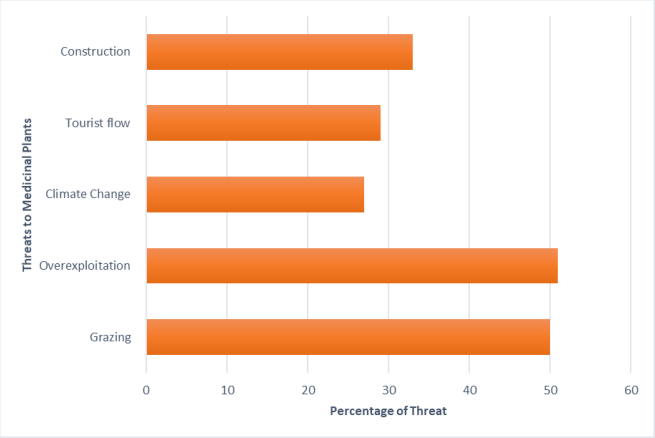

Fig. 1: Various threats to medicinal plants in Phalgam

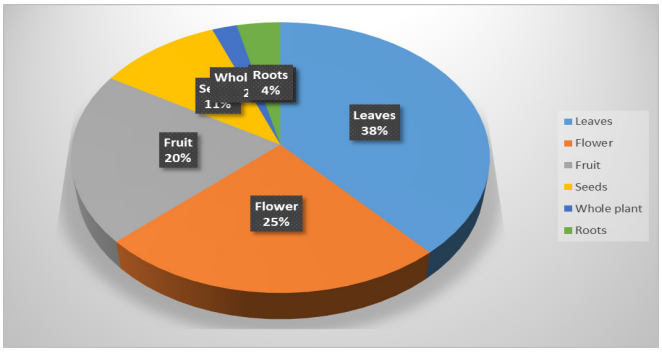

Fig. 2: Parts of plant used for treatment

Table 1: Parts of plant used for treatment

S. No.	*Medicinal plant parts*	*No. of persons aware*	*Percentage (%)*
1	Leaves	73	73
2	Flower	47	47
3	Fruit	39	39
4	Seeds	20	20
5	Whole plant	4	4
6	Roots	7	7

Table 2: Diseases that are being treated by medicinal plants

S. No.	Diseases	No of persons aware	Percentage (%)
1	Skin infection	5	5
2	Cold	57	57
3	Back pain	42	42
4	Frost bites	25	25
5	Diabetes	13	13
6	Hair fall	19	19
7	Liver infection	5	5
8	Increase in eye sight	3	3
9	Respiratory infection	8	8
10	Birth control	10	10
11	Dry cough	14	14
12	Ear ache	2	2
13	Fever	7	7
14	Piles	4	4
15	Joint pain	3	3
16	Diarrhea	2	2
17	Ulcers	1	1
18	Blood purifier	1	1

Medicinal plants offer a variety of methods for treating diseases, each utilizing different parts of the plant and preparation techniques to harness their therapeutic properties. Herbal infusions and teas are among the most common methods, where dried plant materials are steeped in hot water to extract beneficial compounds, providing relief for conditions like digestive issues and stress. Tinctures and extracts are more concentrated preparations made by soaking plant materials in alcohol or other solvents, which are used for their potent effects in treating chronic illnesses and enhancing immune function. Powders and capsules offer a convenient way to consume medicinal plants, providing consistent dosing for conditions such as metabolic disorders and inflammation.

Topical applications include oils and salves, where medicinal plants are infused into carrier oils or made into topical preparations, useful for skin conditions and muscle pain. Poultices and compresses involve applying mashed or ground plant material directly to the skin to treat wounds or reduce inflammation. Syrups and elixirs combine plant extracts with sweeteners, making them palatable and effective for treating

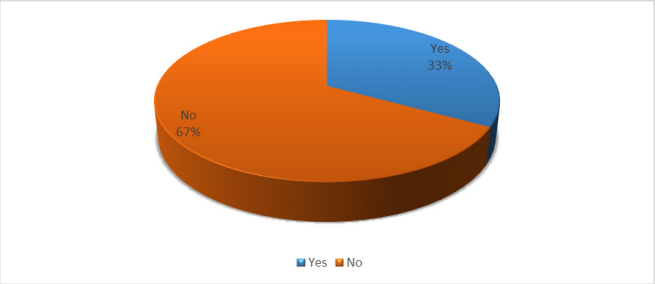

Fig. 3: Knowledge about climate change

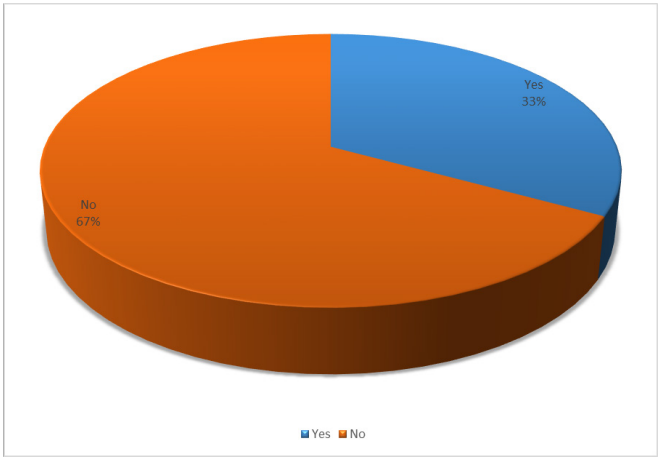

Fig. 4: Climate change threat to medicinal plants

coughs and sore throats. Traditional remedies and formulations, often derived from cultural practices, blend various plant species to address specific ailments according to historical usage. Each of these methods leverages the diverse therapeutic properties of medicinal plants, offering a broad spectrum of treatments for various health conditions. As indicated in Table 2, colds, back pain, frostbite, diabetes, hair fall, liver infection, increase in eyesight, respiratory infection, birth control, dry cough, etc, are the diseases that the different medicinal plants in the area are treating.

Climate change significantly affects medicinal plants and the traditional knowledge associated with their use, with wide-ranging consequences for both plant health and cultural practices. For medicinal plants, shifting climate conditions alter their growth environments, affecting their potency and chemical profiles. Changes in temperature and precipitation can lead to reduced effectiveness or even the loss of certain medicinal properties, making these plants less reliable for therapeutic use. Additionally, disruptions to natural habitats and the introduction of new pests and diseases further threaten the health and availability of these plants. As a result, the medicinal resources that communities rely on are becoming increasingly unstable.

Traditional knowledge about medicinal plants is also at risk due to climate change. As the availability and effectiveness of these plants change, traditional practices and the wisdom associated with them may diminish. Communities that depend on these plants for health and cultural rituals may struggle to maintain their traditional knowledge and practices if the plants become scarce or ineffective. This disruption threatens to erode cultural heritage and the transmission of valuable knowledge across generations. In response, there is a growing need to integrate scientific research with traditional practices to adapt to these changes, ensuring that both the plants and the associated knowledge can be preserved and effectively utilized in a changing climate. Only 33% of the population have knowledge about climate change (Fig. 3) and a similar number of people agreed that climate change may impact the growth and distortion of medicinal plants in the area, as shown in Fig. 4.

Discussion

Medicinal plants face numerous threats that jeopardize their availability and efficacy. Habitat loss due to deforestation, land conversion, and urbanization significantly diminishes the natural environments where these plants thrive. This destruction not only leads to the loss of plant species but also disrupts ecosystems, affecting the delicate balance necessary for their growth. The resultant decline in biodiversity and potential extinction of plants undermine the traditional and medicinal value they offer. Climate change poses another critical challenge, altering temperature and precipitation patterns essential for the growth and chemical composition of medicinal plants. Shifts in climate can impact plant health, reduce their medicinal efficacy, and force them to migrate to new areas, disrupting traditional harvesting practices. These changes can also lead to unpredictable fluctuations in the availability of key medicinal plants. Overharvesting and pollution further exacerbate the situation. Unsustainable harvesting practices deplete plant populations faster than they can regenerate, while pollution from industrial activities contaminates air, water, and soil, affecting plant health and medicinal properties. The combined effects of these threats not only risk the extinction of valuable plant species but also compromise the safety and effectiveness of the medicinal products derived from them. Addressing these issues requires coordinated conservation efforts, sustainable practices, and increased awareness to ensure the preservation of medicinal plants for future generations. Certain commercially valuable species of wild medicinal plants are seriously threatened by overexploitation by humans for local use, which also jeopardizes the habitats of these species. Due to their therapeutic significance, all of these plant species are overfished, whether by legal or illicit means, in the wild for domestic consumption as well as for sale in regional, national, and worldwide markets (Bhat *et al*., 2021). One of the main dangers to these plant species is the excessive extraction of different plants (*Aconitum heterophyllum, Saussurea costus, and Picrorhiza kurroa*) by locals for medicinal applications and export to outside the region (Asif *et al*., 2021). A growing number of landslides occurring on mountain slopes poses a threat to the Kashmir Himalaya's medicinal flora, including *Ajuga integrifolia*. Certain plant species, such *Anemone rupicola* and *Corydalis cashmeriana*, enjoy muddy, wet locations that are vulnerable to landslides, which pose a serious threat to these species' survival. Landslides were shown to have the greatest impact on the endemic *C. cashmeriana* population in the area during the current investigation (Shafiq *et al*., 2019). According

to people's perspectives and the results of our field study, the seven main threat types to plants in this region are road building, overexploitation/illegal trade, tourists, agricultural operations, fragmentation of habitat, grazing, and lack of knowledge. The three main variables that posed the greatest harm in this zone were construction (33%), overexploitation (51%) and grazing (50%). Grazing and over-exploitation were shown to be the most distracting elements when all of these variables were contrasted and examined separately to determine the detrimental impacts of each 166-threatening aspect. The area is also home to several development projects, which cause landslides, soil erosion, and, ultimately, damage to the local vegetation. The most vulnerable species were determined to be *Angelica glauca, Rheum australe, Nardostachys jatamansi, and Aconitum heterophyllum*, with relative vulnerability scores of 27, 27, 26, and 25 based on the fast vulnerability/threat assessment. Additional species with a high degree of sensitivity are *Allium stracheyi, Fritillaria roylei, Aconitum balfourii, Rheum moorcroftianum, Dactylorhiza hatazirea, and Picrorhiza kurroa. Ophiocordyceps sinensis*, which was just deemed vulnerable, should be classified as highly threatened. The least vulnerable species in the area were *A. rumicifolium, A. wallichi, H. salicifolia, E. himalaica, H. niger, and J. dolomiaea*.

The four categories of plant parts used (18%), distribution (15%), habitat (13%), and extraction trend (12%) were shown to be the main threat factors for MAPs in the area, according to threat scores. The plant parts that were most often used were the roots and rhizomes. One of the current dangers to these species is the illicit trade in medicinal plants, which includes *Aconitum heterophyllum, Angelica glauca, Ophiocordyceps sinensis,* and *Trillium govanianum*. This trade has accelerated recently. These species are in danger of going extinct due to overcollection for personal and commercial gain. *T. govanianum* was once harvested at such a startling rate that it is now considered endangered in the Himalayan.

The most common plant parts utilized in this research were leaves (27.60%), followed by the complete plant (20.76%), roots (16.11%), fruit (7.57%), flowers (6.63%), seeds (6.20%), aerial section (5.25%), rhizome (4.22%), blub (1.63%), and stem (1.46%). Contributions from all other plant components were below 1%. Our findings were consistent with previous research that had employed leaves as its primary plant component, both in the Kashmir Himalaya and elsewhere (Ullah *et al*., 2013; Dutt *et al*., 2015). According to researchers, leaves are often used in folk remedies due to their accessibility and high secondary metabolite content (Ghorbani, 2005). The collected plant material is directly or indirectly affected by its phytochemical composition, so the timing of its collection at a specific growth stage is crucial for its medicinal properties. The production and accumulation of flavonoids were shown to exhibit significant heterogeneity between plant development stages (Kanta *et al*., 2018).

The majority of herbal treatments were prepared using decoction (20%), according to the current research. Previous research from other regions of the globe has shown similar findings. According to Jan *et al*., (2021), decoction is the most common method of preparing herbs used in ethnobotanical research. This is because it is a simple and effective approach to consuming the herb medication. The majority of the 687 preparations (59.17%) in this research were taken orally, while a significant portion (40.83%) were used topically to treat a variety of illnesses. Research by Rahman *et al*., (2018) confirms that indigenous communities throughout the globe use oral use of herbal remedies. Research has shown that topical use of herbal medicines is an effective way to cure a wide range of external conditions, such as skin problems, wounds, poison stings, muscle discomfort, rheumatism, and many more (Kumar *et al*., 2013).

Climate change has a profound impact on the distribution of medicinal plants in Kashmir, a region known for its rich biodiversity and traditional herbal medicine. The effects are multifaceted, influencing the availability and health of these plants in several ways.

Changes in temperature and precipitation directly affect the growth conditions for medicinal plants in Kashmir. The region's cold winters and variable rainfall patterns are crucial for the survival and growth of many medicinal species. Warmer temperatures can lead to shifts in plant growing seasons, potentially disrupting the life cycles of plants that are adapted to specific climatic conditions. Reduced or altered rainfall can affect soil moisture levels, which are critical for the health of these plants (Tewari *et al*., 2017).

As temperatures rise and precipitation patterns change, the natural habitats of medicinal plants in Kashmir are shifting. Plants that are adapted to cooler, high-altitude environments may migrate to higher elevations in search of suitable conditions. This can lead to a loss of suitable habitats for certain species and the potential disappearance of some medicinal plants from lower elevations. Additionally, some plant species may become vulnerable or extinct if they cannot migrate or adapt quickly enough to changing conditions. Climate change can exacerbate the spread of pests and diseases that affect medicinal plants. Warmer temperatures and changing weather patterns can expand the range of pests and pathogens, introducing new threats to Kashmir's medicinal flora. Increased pest and disease pressure can weaken plants, reduce their medicinal efficacy, and further threaten their survival. The changes in plant distribution and health can also impact the broader ecosystem. Medicinal plants often play a crucial role in maintaining ecological balance, supporting various animal species, and contributing to soil health. The disruption of these plants can affect the entire ecosystem, leading to cascading effects on biodiversity and ecosystem services (Ratha *et al.,* 2012).

The shift in medicinal plant distribution and availability has significant implications for traditional medicine practices in Kashmir. Local communities rely on these plants for their medicinal properties and cultural practices. As the distribution of these plants changes, there may be a decline in the availability of key species, affecting traditional healing practices and potentially leading to a loss of cultural knowledge related to their use. To mitigate these impacts, it is crucial to implement conservation strategies that include protecting critical habitats, monitoring changes in plant distributions, and supporting research on how medicinal plants respond to climate change. Integrating traditional knowledge with modern scientific approaches can also help in developing adaptive strategies to ensure the continued availability and effectiveness of medicinal plants in Kashmir amidst a changing climate.

Conclusion

The medicinal plants of the Pahalgam Valley are under severe threat due to human activities such as deforestation, overharvesting, and overgrazing. This has led to significant biodiversity loss, affecting tree diversity and causing habitat loss for numerous herbs. Critical plant species like A*bies pindrow, Cedrus deodara, Pinus wallichiana,* and *Picea smithiana* are essential for local communities for constructing homes and providing fuel. Addressing these challenges requires a multifaceted approach that includes conservation efforts, sustainable harvesting practices, pollution control, and integrating climate adaptation strategies. Policymakers must focus on protecting natural habitats by establishing conservation areas, enforcing sustainable land-use practices, and creating protected zones to prevent habitat destruction and overexploitation. Research on how medicinal plants respond to climate change can inform adaptive management practices, and collaboration among scientists, local stakeholders, and policymakers is crucial for developing adaptive management plans. Raising awareness and promoting sustainable practices among communities are vital for fostering shared responsibility for conservation efforts. Educating local populations about the impacts of climate change on medicinal plants and encouraging sustainable harvesting methods can contribute to the long-term preservation of these resources. By taking these coordinated actions, policymakers can ensure the continued availability of medicinal plants, supporting the resilience of both ecosystems and local communities in the face of climate change.

Conflict of interest

None

References

Asif, M., Kazmi, J. H., & Tariq, A. (2021). Traditional ecological knowledge based indicators for monitoring rangeland conditions in Thal and Cholistan Desert, Pakistan. Environmental Challenges, 13, 100754. https://doi.org/10.1016/j.cotox.2022.02.006.

Bhat, M. N., Singh, B., Surmal, O., Singh, B., Shivgotra, V., & Musarella, C. M. (2021). Ethnobotany of the Himalayas: Safeguarding Medical Practices and Traditional Uses of Kashmir Regions. Biology, 10(9), 851.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R. T., Molnár, Z., & Shirayama, Y. (2018). Assessing nature's contributions to people. Science, 359(6373), 270-272.

Dutt, H. C., Bhagat, N., & Pandita, S. (2015). Oral traditional knowledge on medicinal plants in jeopardy among Gaddi shepherds in hills of northwestern Himalaya, J&K, India. Journal of Ethnopharmacology, 168, 337-48. https://doi.org/10.1016/j.jep.2015.03.076.

Ghorbani, A. (2005). Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran (Part 1): general results. Journal of Ethnopharmacology, 102(1), 58-68. https://doi.org/10.1016/j.jep.2005.05.035.

Ghorbani, A., Wieringa, J. J., de Boer, H. J., Porck, H., Kardinaal, A., & van Andel, T. (2018). Botanical and floristic composition of the Historical Herbarium of Leonhard Rauwolf collected in the Near East (1573–1575). Taxon, 67(3), 565-580.

Haq, S. M., Yaqoob, U., Calixto, E. S., Rahman, I. U., Hashem, A., Abd_Allah, E. F., Alakeel, M. A., Alqarawi, A. A., Abdalla, M., Hassan, M., Bussmann, R. W., Abbasi, A. M., Rahman, S. U., & Ijaz, F. (2021). Plant Resources Utilization among Different Ethnic Groups of Ladakh in Trans-Himalayan Region. Biology, 10(9), 827.

Jan, M., Mir, T. A., Ganie, A. H., & Khare, R. K. (2021). Ethnomedicinal use of some plant species by Gujjar and Bakerwal community in Gulmarg Mountainous Region of Kashmir Himalaya. Ethnobotany Research and Applications, 21, 1–23.

Kanta, C., Sharma, I., & Shiekh, M. (2018). Ethnobotanical studies on medicinal plants of Langate area, Kupwara, Jammu and Kashmir, India. Journal of Medicinal Plants Studies, 6, 94–7.

Kumar, R., & Bharati, K. A. (2013). New claims in folk veterinary medicines from Uttar Pradesh, India. Journal of Ethnopharmacology, 146(2), 581–93. https://doi.org/10.1016/j.jep.2013.01.030.

Rahman, A. H. M. M., & Jamila, M. (2015). Ethnobotanical Study of Chappai Nawabganj District, Bangladesh. Lambert Academic Publishing, Germany.

Rahman, I. U., Afzal, A., Iqbal, Z., Ijaz, F., Ali, N., & Bussmann, R. W. (2018). Traditional and ethnomedicinal dermatology practices in Pakistan. Clinics in Dermatology, 36(3), 310–319.

Ratha, K. K., Sruajani, M. S., Arya, J., & Joshi, G. (2012). Impact of climate change on diversity of Himalayan medicinal plant: a threat to Ayurvedic system of medicine. International Journal of Research in Ayurveda and Pharmacy, 3(3), 327–31.

Shafiq, M. U., Islam, Z. U., Abida, A. W., Bhat, M. S., & Ahmed, P. (2019). Recent trends in precipitation regime of Kashmir valley, India. Disaster Advances, 12, 1–11.

Singh, S. (2023). A review on some medicinal plant species with the most traditional medicinal usage in India. International Journal of Biological Innovations, 5(1), 55-62.

Stryamets, N., Mattalia, G., Pieroni, A., Khomyn, I., & Sõukand, R. (2021). Dining Tables Divided by a Border: The Effect of Socio-Political Scenarios on Local Ecological Knowledge of Romanians Living in Ukrainian and Romanian Bukovina. Foods, 10(1), 126.

Stuhlfauth, T., Klug, K., & Fock, H. P. (1987). The production of secondary metabolites by Digitalis lanata during CO2 enrichment and water stress. Phytochemistry, 26(2), 735-739.

Tewari, V. P., Verma, R. K., & Von Gadow, K. (2017). Climate change effects in the Western Himalayan ecosystems of India: evidence and strategies. Forest Ecosystems, 4(1), 1–9.

Ullah, M., Khan, M. U., Mahmood, A., Malik, R. N., Hussain, M., & Wazir, S. M., et al. (2013). An ethnobotanical survey of indigenous medicinal plants in Wana district south Waziristan agency, Pakistan. Journal of Ethnopharmacology, 150(3), 918–24.