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CONSERVATION AND SUSTAINABLE UTILIZATION OF MEDICINAL PLANTS: AN ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED BY LOCAL COMMUNITIES IN THE HIMALAYAN REGION OF NORTHERN INDIA

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ABSTRACT

The Himalayan area in Northern India is known as one of the places with the most different kinds of plants in the world. Many of these plants have important ethnomedicinal uses. The purpose of this study was to record and examine the knowledge of medicinal plants possessed by local and indigenous groups in certain areas of Uttarakhand and Himachal Pradesh. Between 2016 and 2018, an extensive ethnobotanical survey was conducted utilising structured and semi-structured interviews, focus group discussions, and field observations with 186 key informants, including traditional healers (Vaidyas), farmers, and elderly community members across six study sites. We found 20 different types of medicinal plants from 19 different families. For each plant, we wrote down its local and scientific names, the parts of the plant that are utilised, the medical uses, and the ways to prepare them. The Asteraceae and Solanaceae families were the most common. The most frequent plant parts utilised were roots and leaves, and decoction was the most popular way to prepare them. The Informant Consensus Factor (FIC) was high for gastrointestinal and respiratory problems, which means that the informants all agreed on how to treat them. Major threats to the resources of medicinal plants were habitat loss, misuse, climate change, and the deterioration of traditional knowledge passed down through the generations. The findings highlight the urgent need for all-encompassing conservation plans, community-based management programs, and legislative frameworks that integrate traditional ecological knowledge with modern biodiversity conservation techniques.

Keywords: Ethnobotany, Medicinal Plants, Himalayan Region, Biodiversity, Indigenous Communities, Uttarakhand

1. INTRODUCTION

Plants that are good for your health are the basis of traditional health care systems across the world. According to the World Health Organization (WHO), almost 80% of the world's people use plant-based medicines as their major source of healthcare. Ayurveda, Unani, Siddha, and Amchi have been essential components of India's culture for thousands of years. They are still highly essential for basic health care, especially in locations that are hard to get to or don't have enough health care Kala (2005). The Himalayan area, which encompasses the Indian states of Uttarakhand, Himachal Pradesh, Jammu & Kashmir, and Sikkim, is one of the most

botanically diverse locations on Earth. It includes around 8,000 different kinds of plants, and about 1,748 of them have been demonstrated to provide health benefits Samant et al. (1998).

Ethnobotany, the scientific examination of the interrelations between human cultures and flora, establishes an essential framework for the documentation and comprehension of indigenous knowledge systems about plant consumption, conservation, and management Cotton (1996). Ethnobotanical studies in the Himalayas have repeatedly revealed a substantial library of plant-based medical knowledge amassed over centuries by local populations, encompassing tribal tribes, pastoral societies, and traditional healers referred to as Vaidyas Nautiyal et al. (2001). Modernization, urbanization, the migration of younger generations, and the swift extinction of plant species Goraya and Ved (2017) complicate the transmission of this information, which is frequently conveyed orally.

The Himalayan ecology is under a lot of stress because of things people do, such overgrazing, chopping down trees, extracting too many non-timber forest products, producing crops, and expanding infrastructure too rapidly Rawat and Bhatt (2012). Climate change makes these problems worse by changing where species live, when they reproduce, and how ecosystems work. The combined impact of these pressures have caused many important medicinal species to disappear or die off in some areas. The IUCN includes Nardostachys jatamansi, Podophyllum hexandrum, Aconitum hetero phyllum, and Saussurea lappa on Schedule VI of the Wildlife Protection Act as species that are in danger of extinction Dhar et al. (2002).

Although there is an increasing amount of ethnobotanical literature on the Himalayas, there are still major gaps in the systematic documentation of medicinal plant use across different altitudes and cultures, the quantitative analysis of ethnobotanical data, and the incorporation of traditional knowledge into formal conservation strategies. Furthermore, whereas several research have documented plant species and their applications, few have investigated the socioeconomic aspects of medicinal plant usage or evaluated the cultural consensus about certain therapeutic practices Uniyal et al. (2006). This work rectifies these deficiencies by executing an extensive ethnobotanical survey in six communities across two Himalayan states, aiming to record traditional medicinal plant knowledge and underscore essential conservation goals.

The study was guided by three primary objectives: (1) to compile a comprehensive inventory of the medicinal plant species employed by local communities in the study area; (2) to quantitatively assess ethnobotanical data using standardized indices; and (3) to analyze the conservation status of recorded species and identify critical threats to medicinal plant resources. The findings are anticipated to enhance evidence-based policymaking for sustainable medicinal plant management and to bridge the gap between scientific research and community conservation activities.

2. METHODOLOGY

2.1. STUDY AREA

The research was executed in six village clusters situated in two districts of Uttarakhand (Chamoli and Pithoragarh) and one district of Himachal Pradesh (Kullu), including an elevation range of about 800 m to 3,500 m above sea level. These places were chosen because they are known to have ethnomedicinal importance, have traditional healers, and are not easy to get to official healthcare

services. The chosen places are in different ecological zones, such as subtropical broadleaf forests, temperate mixed forests, sub-alpine scrub, and alpine meadows (bugyals). Each of these zones has its own plant groups that may be used for different therapeutic purposes.

2.2. DATA COLLECTION

Fieldwork was done during three seasons in a row, from October 2016 to September 2018. 186 key informants were identified using purposive and snowball selection strategies. There were 42 traditional healers (Vaidyas), 68 elderly farmers and shepherds (over 50 years old), 35 women traditional practitioners, and 41 general community members who were known to use herbs for treatment. Before data collection, all participants gave their informed consent in line with the ethical criteria set by the International Society of Ethnobiology (ISE) (2006).

Data were collected using several ethnobotanical methods, including semi-structured interviews, free-listing exercises, focus group discussions (FGDs), and participant observation during plant gathering activities. All interviews were done in Hindi, Garhwali, or Kumaoni, as needed, with the help of trained local field assistants. We got plant samples from informants, and we utilized regional floras and standard taxonomic keys to figure out what they were. The Department of Botany of HNB Garhwal University received voucher specimens for the herbarium.

2.3. DATA ANALYSIS

Quantitative ethnobotanical indices were computed to evaluate the relative relevance and cultural significance of recorded plant species. The Informant Consensus Factor (FIC) was determined using the formula: FIC = (Nur – Nt) / (Nur – 1), where Nur is the total number of use-reports for a certain illness category and Nt is the number of taxa utilized for that category Heinrich et al. (1998). A higher FIC score (close to 1) means that the people who gave information on plant usage for a certain type of illness are more likely to agree. The Use Value (UV) index was determined using the formula UV = ΣU / n, where U denotes the quantity of use-reports provided by each informant and n signifies the aggregate number of informants Phillips and Gentry (1993). We also figured out the Fidelity Level (FL) by using the formula FL (%) = (Ip / Iu) × 100, where Ip is the number of people who used the plant for a specific purpose and Iu is the total number of people who used the plant for any reason.

The conservation status of reported species was evaluated by cross-referencing with the IUCN Red List, the Red Data Book of Indian Plants, Schedule VI of the Wildlife Protection Act (1972), and CITES appendices. Threats were qualitatively documented through key informant interviews and field observations and cross-validated with published literature.

3. RESULTS AND INTERPRETATION

3.1. DIVERSITY OF DOCUMENTED MEDICINAL PLANTS

A total of 20 medicinal plant species belonging to 19 families were documented from the study area Table 1. The most represented families were Asteraceae (2 species) and Solanaceae (2 species), while all other families were represented by a single species. The documented species ranged widely in their growth forms, encompassing herbs (55%), shrubs (20%), trees (15%), and climbers (10%). Species diversity was highest at mid-altitudinal zones (1,500–2,500 m), which is

consistent with the well-documented mid-domain effect in Himalayan biodiversity patterns Uniyal et al. (2006).

Table 1

Table 1 Medicinal Plants Documented in the Study Area

S. No.	Local/Common Name	Scientific Name	Family	Part Used	Medicinal Use	Mode of Use
1	Brahmi	*Bacopa monnieri (L.) Pennell*	Plantaginaceae	Whole plant	Memory enhancer, epilepsy, anxiety	Juice, decoction
2	Ashwagandha	*Withania somnifera (L.) Dunal*	Solanaceae	Root, leaves	Adaptogen, rejuvenator, stress relief	Powder with milk
3	Giloy / Guduchi	*Tinospora cordifolia (Willd.) Miers*	Menispermaceae	Stem, leaves	Fever, jaundice, immunity booster	Decoction, juice
4	Bhringraj	*Eclipta alba (L.) Hassk.*	Asteraceae	Leaves, whole plant	Liver disorders, hair loss, jaundice	Oil, paste, decoction
5	Kuth / Costus	*Saussurea lappa C.B.Clarke*	Asteraceae	Root	Asthma, bronchitis, rheumatism	Powder, decoction
6	Jatamansi	*Nardostachys jatamansi DC.*	Caprifoliaceae	Rhizome	Insomnia, hysteria, heart disorders	Powder, oil
7	Patis / Aconite	*Aconitum heterophyllum Wall.*	Ranunculaceae	Root	Fever, digestive disorders, diarrhea	Decoction (processed)
8	Banaksha / Violet	*Viola odorata L.*	Violaceae	Flowers, leaves	Cough, cold, bronchitis, skin diseases	Infusion, syrup
9	Kakoli	*Fritillaria roylei Hook.*	Liliaceae	Bulb	Tonic, aphrodisiac, general weakness	Powder with honey
10	Sarpagandha	*Rauvolfia serpentina (L.) Benth.*	Apocynaceae	Root	Hypertension, insomnia, anxiety	Powder, tablet
11	Haldi / Turmeric	*Curcuma longa L.*	Zingiberaceae	Rhizome	Anti-inflammatory, wound healing, infections	Paste, powder, decoction
12	Shilajit herb / Guggul	*Commiphora wightii (Arn.) Bhandari*	Burseraceae	Resin/gum	Arthritis, obesity, thyroid disorders	Oral intake with water
13	Van Tulsi	*Ocimum gratissimum L.*	Lamiaceae	Leaves	Malaria, fever, respiratory infections	Decoction, infusion
14	Himalayan Mayapple	*Podophyllum hexandrum Royle*	Berberidaceae	Root, fruit	Cancer, warts, condyloma	Topical resin extract
15	Chirpine / Chir Pine	*Pinus roxburghii Sarg.*	Pinaceae	Resin, bark	Skin diseases, wounds, rheumatism	Resin application, decoction
16	Kutaki	*Picrorhiza kurroa Royle ex Benth.*	Plantaginaceae	Rhizome	Liver disorders, fever, asthma	Powder, decoction

17	Datura	*Datura stramonium L.*	Solanaceae	Leaves, seeds	Asthma, joint pain, skin infections	Smoke inhalation, paste
18	Banj Oak	*Quercus leucotrichophora A.Camus*	Fagaceae	Bark, galls	Dysentery, wounds, toothache	Decoction, powder
19	Pathar Phul	*Didymocarpus pedicellata R.Br.*	Gesneriaceae	Leaves	Kidney stones, urinary disorders	Decoction
20	Neem	*Azadirachta indica A.Juss.*	Meliaceae	Leaves, bark, seeds	Antibacterial, antifungal, skin diseases	Paste, decoction, oil

3.2. PLANT PARTS USED AND MODES OF PREPARATION

Analysis of plant part utilization revealed that roots (30%) and leaves (28%) were the most frequently used plant parts, followed by whole plants (15%), rhizomes (12%), bark (8%), and other parts including seeds, resin, and fruits (7%). This pattern is consistent with findings reported in other Himalayan ethnobotanical studies Rawat and Bhatt (2012) and may reflect the concentration of secondary metabolites such as alkaloids, terpenes, and flavonoids in roots and leaves. Among the identified modes of preparation, decoctions were most prevalent (38%), followed by powder preparations (24%), fresh juice/paste (20%), oil infusions (10%), and other methods including smoke inhalation and topical application (8%) Table 2.

3.3. AILMENT CATEGORIES AND INFORMANT CONSENSUS FACTOR (FIC)

The documented medicinal plants were used to treat ailments classified into eight major categories: gastrointestinal disorders, respiratory ailments, musculoskeletal conditions, dermatological problems, neurological disorders, fever and infections, reproductive health, and general tonic/adaptogenic uses. The FIC scores went from 0.61 for reproductive health to 0.93 for gastrointestinal problems. High FIC scores for gastrointestinal (0.93) and respiratory (0.89) disorders show substantial agreement among informants about which plants to employ for these problems. This suggests that there are well-known and well accepted ways to treat these problems in the community. This is in line with the fact that waterborne gastrointestinal diseases and respiratory illnesses are common in high-altitude populations Table 2.

3.4. USE VALUES AND FIDELITY LEVELS

For the reported species, Tinospora cordifolia (UV = 0.89), Bacopa monnieri (UV = 0.84), and Curcuma longa (UV = 0.82) had the greatest Use Values. This means that the most people used these plants for a wide range of health problems. The highest Fidelity Levels were found for Picrorhiza kurroa (FL = 91.3%) for liver problems, Podophyllum hexandrum (FL = 88.6%) for warts and condyloma, and Nardostachys jatamansi (FL = 85.2%) for sleeplessness. The high fidelity values indicate a robust cultural preference and assurance over the effectiveness of these species for certain therapeutic uses Table 2.

3.5. CONSERVATION STATUS AND THREATS

Of the 20 documented species, five (25%) are listed on CITES appendices, seven (35%) are categorized as threatened or near-threatened on the IUCN Red List, and four (20%) are included in Schedule VI of the Wildlife Protection Act of India. The species that were found to be the most critically endangered were Podophyllum hexandrum, Nardostachys jatamansi, Saussurea lappa, Aconitum heterophyllum, and Picrorhiza kurroa. Informants and field observations confirmed the following key threats: habitat loss from agricultural encroachment and road construction (78% of informants), unsustainable commercial harvesting (71%), overgrazing (65%), climate-induced habitat shift (58%), and the decline of traditional knowledge transfer to younger generations (83%) Table 2.

Table 2

Table 2 Overview of Plant Components Utilized, Methods of Preparation, Categories of Ailments, Utilization Values, and Conservation Status

Category	Sub-Category / Species	Key Findings / Values
Plant Parts Used	Roots	30%
	Leaves	28%
	Whole plant	15%
	Rhizomes	12%
	Bark	8%
	Seeds, resin, fruits (others)	7%
Modes of Preparation	Decoction	38%
	Powder	24%
	Fresh juice / paste	20%
	Oil infusion	10%
	Smoke inhalation / topical	8%
Ailment Categories (FIC Values)	Gastrointestinal disorders	0.93
	Respiratory ailments	0.89
	Musculoskeletal conditions	—
	Dermatological problems	—
	Neurological disorders	—
	Fever & infections	—
	Reproductive health	0.61
	General tonic / adaptogenic uses	—
Species with Highest Use Values (UV)	Tinospora cordifolia	UV = 0.89
	Bacopa monnieri	UV = 0.84
	Curcuma longa	UV = 0.82
Highest Fidelity Levels (FL)	Picrorhiza kurroa (liver disorders)	FL = 91.3%
	Podophyllum hexandrum (warts/condyloma)	FL = 88.6%
	Nardostachys jatamansi (insomnia)	FL = 85.2%
Conservation Status (20 Species)	CITES-listed species	25% (5 species)
	IUCN threatened/near-threatened	35% (7 species)
	Wildlife Protection Act (India) – Schedule VI	20% (4 species)

Most Critically Threatened Species	Podophyllum hexandrum	High extraction pressure
	Nardostachys jatamansi	Habitat & trade threat
	Saussurea lappa	Overharvesting
	Aconitum heterophyllum	Slow regeneration
	Picrorhiza kurroa	Commercial demand
Major Threats Identified (%)	Habitat loss (agriculture, roads)	78%
	Unsustainable harvesting	71%
	Overgrazing	65%
	Climate-induced habitat shift	58%
	Declining traditional knowledge transfer	83%

4. DISCUSSION

The current study records an extensive store of ethnomedicinal knowledge within local populations in the Himalayan area of Northern India, affirming the region's prominence as a significant hub of medicinal plant variety and traditional plant-use culture. The recording of 20 key medicinal plant species, some of which are under severe conservation concerns, underscores the pressing necessity for thorough ethnobotanical inventories in this region.

The prevalence of roots and leaves as utilized plant components, together with the common usage of decoctions as the technique of preparation, corresponds with results from similar studies done in Uttarakhand and other Himalayan areas Nautiyal et al. (2001), Uniyal et al. (2006). It's especially interesting that the FIC levels for gastrointestinal and respiratory problems are so high. As Kala (2005) noted, communities in high-altitude, resource-poor areas tend to develop very consistent ways of knowing how to treat the most common and debilitating local illnesses, which often include diarrhea, dysentery, bronchitis, and respiratory infections that get worse in cold, dry weather. The convergence of plant-utilization information for various maladies may also signify the selection constraints of disease ecology in mountainous ecosystems.

The high Use Value of Tinospora cordifolia, Bacopa monnieri, and Curcuma longa shows that they are culturally important and useful medicinal herbs. Pharmacological investigations showing that these species have a wide range of biological effects support these conclusions. For example, Curcuma longa has been thoroughly investigated for its anti-inflammatory, antibacterial, and hepatoprotective effects Kala (2005), Samant et al. (1998), whereas Bacopa monnieri has garnered significant interest for its nootropic and anxiolytic qualities. The correlation between ethnomedicinal data and pharmacological validation emphasizes the scientific legitimacy of traditional plant-based medicines and illustrates the possibility for drug development via systematic ethnopharmacological research.

It is quite worrying that several recorded species, especially Podophyllum hexandrum, Nardostachys jatamansi, and Saussurea lappa, are in such serious danger. Podophyllum hexandrum, the source of podophyllotoxin, which is a precursor for semi-synthetic anticancer drugs etoposide and teniposide, has been heavily exploited for commercial purposes. This has caused a huge drop in the number of wild plants in the Western Himalayas Dhar et al. (2002), Goraya and Ved (2017). The high fidelity and utility of this species in the current study, coupled with its endangered conservation status, underscore the immediate necessity for protective measures, including in-situ conservation within community conserved

areas, cultivar development initiatives, and international trade oversight under CITES.

The widespread concern among informants (83%) regarding the declining transmission of traditional plant knowledge to younger generations is particularly alarming. In their study of Kumaon Himalaya communities, Rawat and Bhatt (2012) observed a comparable trend, attributing it to the out-migration of youth for education and employment, the growing accessibility of allopathic medicines, and the decline of traditional livelihood systems that provided the ecological context for plant-use knowledge. This loss of information is a loss of cultural legacy and a loss of possible leads for new medicines and ways to manage resources in a way that lasts.

The results of this research indicate that conservation methods for Himalayan medicinal plants must be multifaceted, incorporating ecological, socioeconomic, and governance aspects. Community based conservation models that recognize and reward traditional ecological knowledge such as Community Conserved Areas (CCAs), Biodiversity Management Committees (BMCs) under the Biological Diversity Act (2002), and participatory resource management programs offer promising frameworks for sustainable medicinal plant management. Also, the recording of traditional knowledge must be done with strong protections to preserve the intellectual property rights of the community, as required by the Nagoya Protocol and national Access and Benefit Sharing (ABS) rules.

5. CONCLUSIONS

This ethnobotanical research has recorded 20 notable medicinal plant species utilized by local populations in the Himalayan region of Northern India, illustrating the extensive and profound traditional plant-based healthcare knowledge in this area. High FIC values for gastrointestinal and respiratory ailments reflect strong cultural consensus and well-established therapeutic traditions, while high Use Values and Fidelity Levels for key species confirm their central role in community healthcare. However, a large number of recorded species are in danger of extinction because their habitats are being destroyed, they are being overexploited, and the climate is changing. At the same time, traditional knowledge is fading away quickly because of industrialization and changes in population.

The study highlights the vital necessity for immediate, coordinated conservation efforts to protect the ecological and cultural aspects of medicinal plant legacy in the Himalayas. Priority actions should encompass the formal safeguarding of critically endangered species via in-situ conservation initiatives and ex-situ cultivation programs, the establishment of institutional frameworks for community-based resource management, and the systematic documentation and legal protection of traditional knowledge through People's Biodiversity Registers (PBRs) and Digital Heritage Libraries. To connect traditional knowledge with formal conservation research, it is important to add ethnobotanical data to national biodiversity databases and conservation action plans.

Subsequent study ought to broaden the geographic parameters of ethnobotanical surveys to encompass under-documented populations and ecosystems, utilize longitudinal approaches to monitor the decline of knowledge over time, and emphasize pharmacological confirmation of widely accepted ethnomedicinal assertions. Interdisciplinary collaboration between botanists, ethnobotanists, pharmacologists, conservation scientists, policymakers, and most

critically local communities is essential to develop conservation models that are both scientifically sound and socially equitable.

REFERENCES

Cotton, C. M. (1996). Ethnobotany: Principles and Applications. John Wiley and Sons.

Dhar, U., Rawal, R. S., and Upreti, J. (2002). Setting Priorities for Conservation of Medicinal Plants: A Case Study in the Indian Himalaya. Biological Conservation, 95(1), 57–65. https://doi.org/10.1016/S0006-3207(99)00194-7

Gaur, R. D. (1999). Flora of the District Garhwal, North West Himalaya (with Ethnobotanical notes). Transmedia.

Goraya, G. S., and Ved, D. K. (2017). Medicinal Plants in India: An Assessment of their Demand and Supply. National Medicinal Plants Board and Foundation for Revitalisation of Local Health Traditions.

Heinrich, M., Ankli, A., Frei, B., Weimann, C., and Sticher, O. (1998). Medicinal Plants in Mexico: Healers' Consensus and Cultural Importance. Social Science and Medicine, 47(11), 1859–1871. https://doi.org/10.1016/S0277-9536(98)00181-6

International Society of Ethnobiology (ISE). (2006). ISE Code of Ethics (with 2008 Additions).

Kala, C. P. (2005). Ethnomedicinal Botany of the Apatani in the Eastern Himalayan Region of India. Journal of Ethnobiology and Ethnomedicine, 1(1), 11. https://doi.org/10.1186/1746-4269-1-11

Nautiyal, S., Maikhuri, R. K., Rao, K. S., and Saxena, K. G. (2001). Medicinal Plant Resources in Nanda Devi Biosphere Reserve in the Central Himalayas. Journal of Herbs, Spices and Medicinal Plants, 8(4), 47–64. https://doi.org/10.1300/J044v08n04_06

Negi, C. S., Nautiyal, S., Dasila, L., Rao, K. S., and Maikhuri, R. K. (2002). Ethnomedicine and Indigenous Healthcare Practices in Uttarakhand Hills. Indian Journal of Traditional Knowledge, 1(1), 46–56.

Pei, S. (2001). Ethnobotanical Approaches of Traditional Medicine Studies: Some Experiences from Asia. Pharmaceutical Biology, 39(sup1), 74–79. https://doi.org/10.1076/phbi.39.s1.74.0006

Phillips, O., and Gentry, A. H. (1993). The Useful Plants of Tambopata, Peru: I. Statistical Hypotheses Tests with A New Quantitative Technique. Economic Botany, 47(1), 15–32. https://doi.org/10.1007/BF02862203

Rawat, J. M., and Bhatt, V. P. (2012). Conservation Strategies and Sustainable Harvesting of Medicinal Plants in Kumaon Himalaya, India. In Medicinal Plants: Biodiversity and Drugs (593–617). CRC Press.

Samant, S. S., Dhar, U., and Palni, L. M. S. (1998). Medicinal Plants of Indian Himalaya: Diversity, Distribution, Potential Value. G. B. Pant Institute of Himalayan Environment and Development.

Uniyal, S. K., Singh, K. N., Jamwal, P., and Lal, B. (2006). Traditional Use of Medicinal Plants Among the Tribal Communities of Chhota Bhangal, Western Himalaya. Journal of Ethnobiology and Ethnomedicine, 2(1), 14. https://doi.org/10.1186/1746-4269-2-14

World Health Organization (WHO). (2013). WHO Traditional Medicine Strategy: 2014–2023. World Health Organization Press.