



# Indigenous traditional knowledge of riparian medicinal flora utilized by ethnic communities along the Beas River in Himachal Pradesh, India

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## Correspondence

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## Research

### Abstract

**Background:** The indigenous flora plays a crucial role in both the cultural heritage and customs of Himalayan local societies, while also playing a significant role in supporting their livelihoods. Local communities in the region rely extensively on a diverse range of wild berries, food, therapeutic plants, and more to fulfill their daily needs. The primary means of sustenance for these tribal communities heavily relies on natural resources, leading to their extensive traditional knowledge.

**Methods:** The ethnomedicinal data was gathered using field surveys, open discussions, and semi-structured questionnaires by ethnic communities. Interviews were conducted with 217 local respondents, comprising 92 women and 125 men. Quantitative ethnobotanical tools, including use value, and informant consensus factor, were applied to analyze the generated data.

**Results:** In the ethnobotanical study, 67 floras spanning 47 families were reported from interviews with local informants, which revealed the usage of therapeutic plants to treat 73 diseases across 11 ailment categories. The highest ICF value (1) is observed in excretory disorders, followed by circulatory disorders (0.94). In our study, *Murraya koenigii* (0.79) and *Mallotus philippensis* (0.77) showed the highest value of use value.

**Conclusion:** This research illustrates that the variety of indigenous plants utilized by the residents of Himachal Pradesh is evident not just in the number of species but also in the manifold purposes they serve. Consequently, there is a crucial requirement to document this indigenous information and conduct thorough phytochemical explorations to assess potentially active compounds in herbs, providing evidence of their efficacy.

**Keywords:** Asteraceae, economic value, quantitative tools, excretory disorders

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## Background

In the contemporary era, nature stands as the foremost wellspring of inspiration for humanity, concurrently serving as a remedy for numerous health issues (Guzel *et al.* 2015). Approximately, 71 percent of newly approved drugs since 1981 can be traced back to natural products, either directly or indirectly (Guzel *et al.* 2015). Ethnomedicinal studies serve as highly dependable guides for individuals in effectively harnessing the rich affluence of plant-derived resources provided by the environment (Zhou *et al.* 2023). About 80 percent of the global population relies on plant-based remedies to fulfill its primary healthcare requirements (Bibi *et al.* 2014). Residents of rural areas possess valuable knowledge about plant uses, opting for therapeutic plants due to their easy accessibility and cost-effectiveness in contrast to expensive pharmaceuticals. People in isolated areas have identified the folk properties of therapeutic plants against specific ailments through their traditional experiences (Teklehaymanot & Giday 2007). The ethnobotanical evaluation of medicinal plant species holds significance in terms of conservation and protection efforts. Additionally, such assessments prove valuable in the development of herbal drugs (Yaseen *et al.* 2015). India possesses one of the most significant biodiversities globally, along with an extensive range of traditional knowledge that merits preservation and scientific validation (Khani *et al.* 2023). The country's herbal tradition plants incorporate numerous indigenous as well as from various global regions (Bordoloi *et al.* 2023). For centuries, Indian therapeutic plants have been employed in empirically curing numerous ailments and engaging in magical-religious practices (Inatimi *et al.* 2022). The state Himachal Pradesh, frequently called the "Abode of Snow," is a captivating region for botanical enthusiasts situated in the northwestern Himalayas, altitudes range from 350 meters to 7,000 meters and covers an area of 55,673 square kilometers, has fostered a diverse and vibrant array of plant life (Walia 2006). It hosts about 3,295 species, constituting 7.32% of the total. Remarkably, around 95% of this flora is exclusive to the state, showcasing a high level of endemism (Gupta *et al.* 2014). Reflective of the northwestern Himalayan flora, the remaining 5%, totaling around 150 species, consists of exotic flora in Himachal Pradesh. It is inhabited by various ethnic populace, which are partially dependent on therapeutic plants for the formulation of thousands of herbal remedies (Jreat, 2004).

Riparian regions are distinctive environments found alongside rivers and streams, consisting of communities of plants and animals whose presence can be linked either directly or indirectly to factors influenced by the stream (Richardson & Moore 2010). In terms of functionality, these areas represent three-dimensional zones where terrestrial and aquatic ecosystems interact directly (Richardson *et al.* 2005). These areas of the Beas River extend from the Rohtang Pass and Beas Kund to the Kangra district of Himachal Pradesh. Only a few traditional studies have been conducted on the Riparian zone (Karakose 2022) of the Beas River, and a significant portion of the area is yet to be explored ethnobotanically. As ethnic communities primarily depend on vegetation for their wellness and nutritional needs, it is important to document the traditional information about wild herbs and assess the healing potential of botanical drugs (Ahirwar & Khan 2023; Panmei *et al.* 2019). These findings suggest that traditional herbal medicinal knowledge serves as a genuine resource for innovation and economic development (Manzoor *et al.* 2023). Nations like India must identify the value and utilization of their biological diversity (Izah 2022). Ethnobotany can be regarded as a practical tool in the exploration of flora genetic resources for pharmaceutical industries (Izah 2022; Latorre *et al.* 2023). The present research was carried out to document therapeutic floras and traditional healing applications among ethnic communities.

## Material and Methods

### Study Area

The recent research was conducted in the riparian region of the Beas River in Himachal Pradesh, India. The Beas basin starts in the Shivalik Hills of Himachal Pradesh. Stretching over 460 km, it has two main origins: Beas Rishi located on the Rohtang Pass (4350 m), and Beas Kund (4060 m) on the south, located within the caverns of the North-Western Himalaya. These two origins converge at the Palchan area close to Manali, marking the inception of the Beas River. In Himachal Pradesh, the river covers an approximate length of 256 km, while in Punjab, it spans 214 km. The complete catchment region of the basin is 38,030 km<sup>2</sup>, with 12,130 km<sup>2</sup> in state and 25,900 km<sup>2</sup> in Punjab, but we study only the Himachal Pradesh region of the Beas basin (Aggarwal *et al.* 2016). The region within the Beas basin covers an expanse of 12,130 square kilometers, situated between latitudes 31°41' N to 32°46' N and longitudes 75°84' E to 77°88' E, as shown in Figure 1. This region is primarily home to semi-pastoral Gujjars and nomadic shepherds known as Gaddis. This riparian region is rich in floral diversity, with vegetation such as Northern Dry Mixed Deciduous forests, Moist Deodar Forests, ban oak forests, western Mix Coniferous Forests, moist Temperate deciduous forests, and Dry alpine scrub.

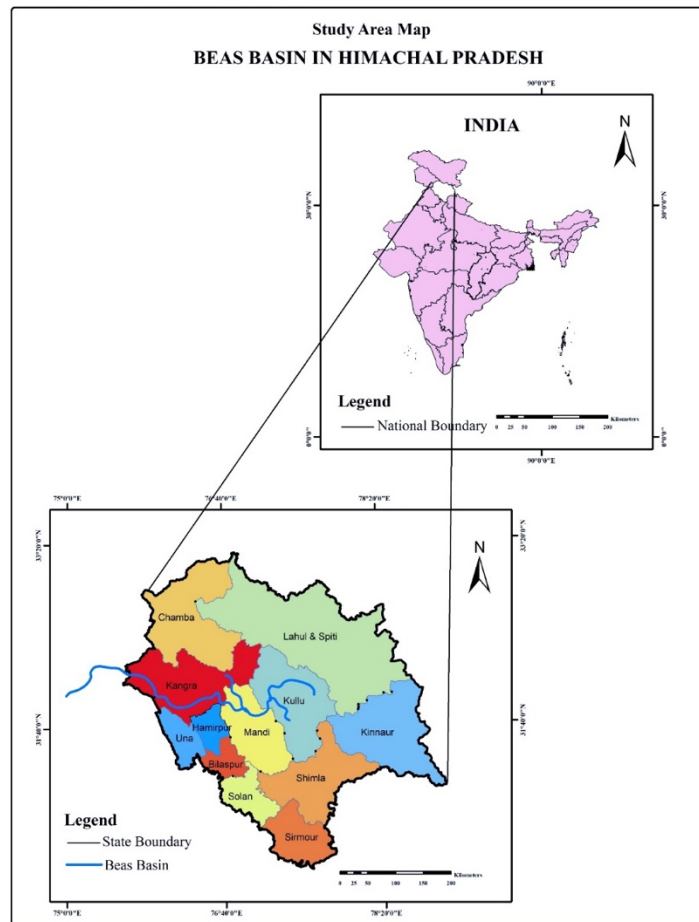


Figure 1. Study area Beas Basin

#### Ethnobotanical data collection

An ethnobotanical study was conducted around the riparian vegetation of the Beas basin in Himachal Pradesh for one year from 2022 to 2023 to collect and document the information related to the utilization of therapeutic floras. A total of 20 field visits were made and the sample was collected by random sampling method. For the ethnomedicinal data collection, informants were selected using the snowball method, field surveys, semi-structured questionnaires (Jain and Mudgal 1999), and interviews with ethnic communities. The questionnaires were formulated based on the methodologies employed by various taxonomists. They encompassed the following details: (a) vernacular name, (b) plant parts utilized, (c) mode of administration, and (d) medicinal applications. Interviews were conducted with 217 local respondents, comprising 92 women and 125 men. The age range of the participants was between 40 and 80 years old. The data facilitated our analysis of the pattern of ethnobotanical knowledge transfer across various age groups. Demographic attributes are documented in Table 1. In addition to the previously mentioned information, scientific names, vernacular names, habits, parts utilized, and ethnobotanical indices were also recorded.

Plant specimens were gathered in triplicate, either during the flowering or fruiting stages. Subsequently, these collected specimens undergo drying and preservation by the herbarium techniques advocated by Jain and Rao, 1977. Furthermore, photographs of each plant were captured for documentation purposes. The identification of plant specimens involved referencing flora, such as the Flora of India (Hajra et al. 1996), Flora of Himachal Pradesh (Chowdhery & Wadhwa 1984), Flora of Mandi (Singh, P.B. 2018), and 'Flora of Kullu District' (Dhaliwal and Sharma 1999) and also consulting from the Himalayan Forest Research Institute (HFRI), Shimla. The online databases "The World Flora Online" (The World Flora Online 2023) and "Plants of the World Online" (Plants of the World Online 2023) were used to confirm the names of the species and families.

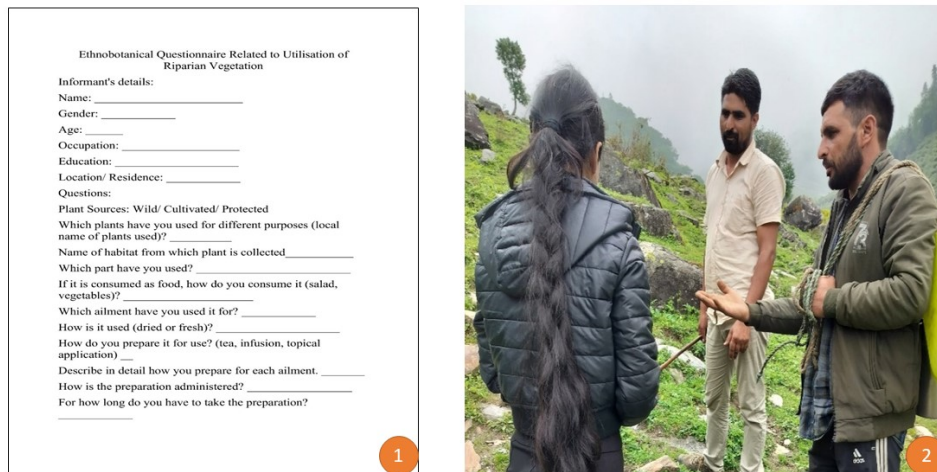


Figure 2. 1. Questionnaire. 2. Interviews with local people

Table 1. Demographic attributes

Demographic features			
		Number	Proportion(%)
<b>Gender</b>	Female	92	42.39
	Male	125	57.6
<b>Age</b>	40-55	50	30.41
	56-65	172	79.26
	66-80	93	42.85
<b>Vocation</b>	Farmer	135	62.21
	Tribal	97	44.7
	Civil employ	55	25.34
<b>Education</b>	Illiterate	120	55.29
	Matriculate	91	41.93
	Graduate	23	10.59

### Data analysis

Extensive data analysis was conducted, utilizing various ethnobotanical tools such as use value, and informant consensus factor.

**Informant consensus factor (ICF)** is characterized by the extent of diversity in the number of therapeutic plants employed by physicians to cure a particular ailment type (Ghorbani 2005). It is calculated by:

$$ICF = \frac{Nur - N}{Nur - 1}$$

where Nur represents the number of references used for every ailment group and N signifies the number of herbs used shown in Table 2 (Zhou *et al.* 2023). The ICF value falls within the range of 0 to 1, with higher values signifying a stronger accord among respondents regarding the use of specific floras (Ghorbani 2005; Trotter & Logan 2019; Umair *et al.* 2017).

**Use value (UV)** serves as a useful instrument in evaluating the importance of local floras. It indicates the frequency of usage of particular floras among respondents, where  $U_i$  signifies the number of utilization recorded by every respondent, and  $U$  represents the total number of respondents (Bhat *et al.* 2012). It is measured by (Yaseen *et al.* 2015):

$$UV = U_i/U_t$$

The use value spans from 0 to 1 value, where elevated UV values signify increased significance of herbs, while lower values suggest diminished significance (Agize *et al.* 2022; Mahmood *et al.* 2013; Sujarwo & Caneva 2016).

Table 2: Informant consensus factor

Illness Groups	Diseases	Use Citation (N <sub>ur</sub> )	Number of species (N <sub>t</sub> )	Informant Consensus factor (ICF)
<b>Skin Disorders</b>	Skin infections, leukoderma, cuts, wounds, boils, eczema, skin lesions, tonic for hair loss, warts, hair fall, thick hairs, scabies, leprosy, redness/swelling due to fungal infections, swelling and injury	109	17	0.85
<b>Digestive disorders</b>	Digestion, ulcers, diarrhea, vomiting, constipation, intestinal parasite, stomachic, gastric troubles, dysentery, stomach ulcers, colic pain, purgative, dyspepsia	124	26	0.79
<b>Ear, Nose, teeth, and throat disorders</b>	Earaches, Teeth infection, toothache, sinusitis, Phlegm, mouth inflammation	88	6	0.94
<b>Infectious diseases</b>	Headaches, Jaundice, Migraine, Cold, Chronic fever, Hemicrania, flu, Cholera, Malaria, Malarial fever	103	16	0.85
<b>Metabolic disorders</b>	Diabetes, Blood purification	99	11	0.89
<b>Muscular and joint disorders</b>	Rheumatism, Gout, Arthritis, Backache, Epilepsy, Muscular pain, Fractured bones, Body pain	101	11	0.90
<b>Nervous system disorder</b>	Memory loss	65	1	1
<b>Sexual disorders</b>	Menstrual cramps, regulate menstruation, Leucorrhoea, Gonorrhoea, Enhance lactation	85	5	0.95
<b>Respiratory system disorders</b>	Cough, Asthma, Bronchitis, Whooping cough	100	21	0.79
<b>Excretory disorders</b>	Urolithiasis, Diuretic problems, Abdominal disorder, Piles	95	4	0.96
<b>Circulatory disorders</b>	Weakness of the heart, Heatstroke, Anemia, Body heat	97	4	0.96



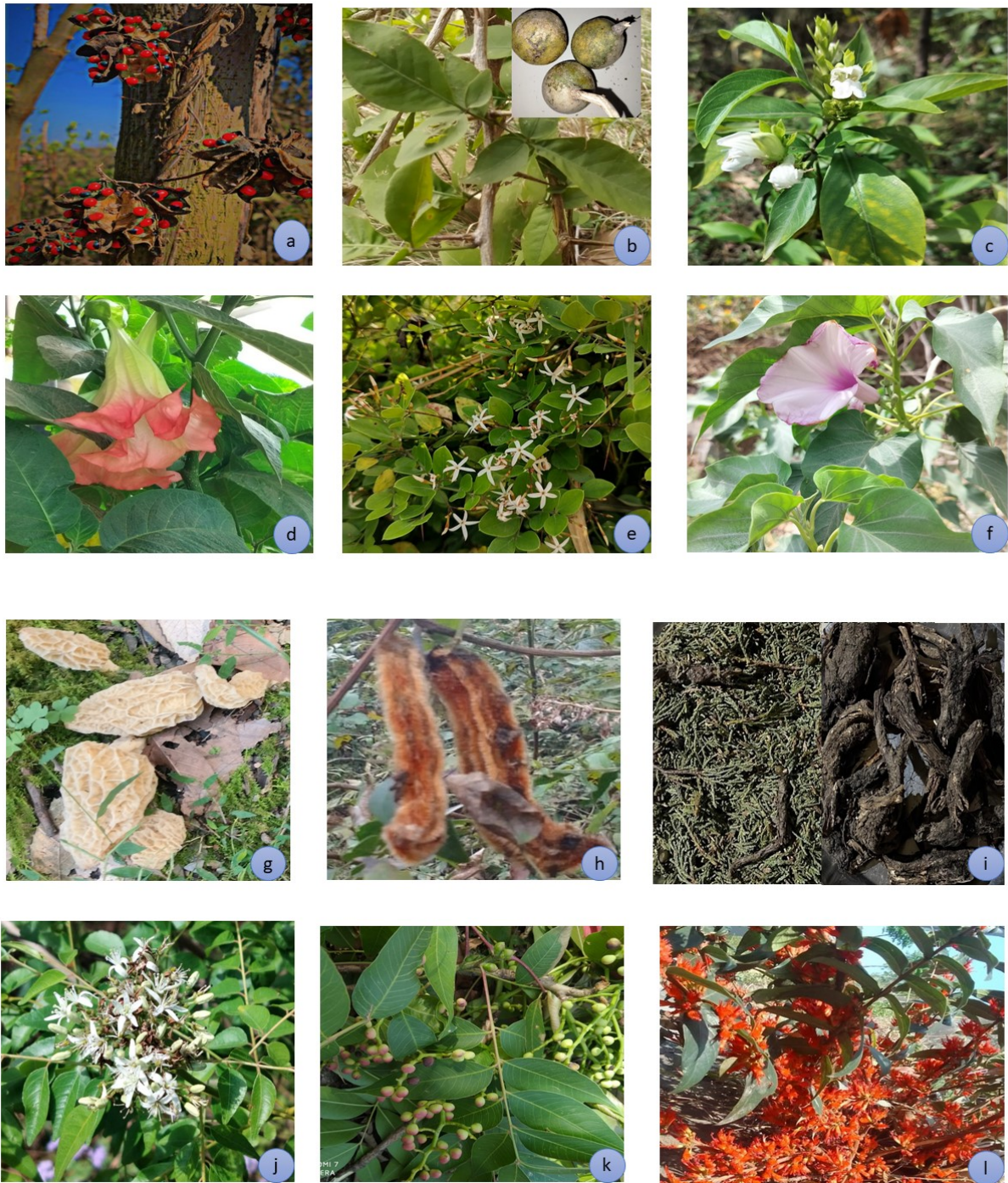


Figure 3. Some medicinal plants: a. *Abrus precatorius* b. *Aegle marmelos* c. *Adhatoda vasica* d. *Brugmansia suaveolens* e. *Carissa opaca* f. *Ipomoea carnea* g. *Morchella esculenta* h. *Mucuna pruriens* i. Dried *Jurinea macrocephala* j. *Murraya koenigii* k. *Pistacia integerrima* l. *Woodfordia fruticosa*

## Results

A total of 67 plant species, associated with 47 families and 65 genera, have been recorded. The provided information for every herb includes scientific name, vernacular name, family, habit, use value, and medicinal uses (Table 3). The vastly dominant families are Asteraceae (5), Fabaceae (4), Solanaceae (4), Lamiaceae (4), Rutaceae, Acanthaceae, Menispermaceae, Brassicaceae, Euphorbiaceae, Malvaceae, and Polygonaceae, each with one species shown in Figure 7. According to the Bibi et al. (2018) among the many Indian tribes, the Asteraceae family is the most often used plant family for therapeutic purposes.

Table 3. Therapeutic uses of wild plants with Use value

Scientific name/ Altitudinal range (m)	Local name	Family	Habit/ Habitat	Part used	Methods of preparation	Therapeutic Uses	Use citation (Ui)	Use value (UV)
<b>Angiosperms</b>								
<i>Abrus precatorius</i> L.	Ratti	Fabaceae	Tree/ Wild	Root, Seed	Paste	The root paste is employed on the skin to reduce skin infections. Seed powder is used to kill the pest. Root infusion is drunk two times a week to treat leukoderma.	114	0.52
<i>Aegle marmelos</i> (L.) Correa	Belpatri	Rutaceae	Tree/ Wild	Leaf, Fruit	Paste, Decoction, Extract	Leaf paste is employed to relieve wounds, cuts, and ulcers. Leaf infusion is given half of a glass in the morning to treat cholera, abdominal disorders, diarrhea, vomiting, and weakness of the heart. The fruit extract is used to make a juice which is utilized as a tonic to cure digestion, constipation, and intestinal parasites and is also useful in various diseases like stomachic, diarrhea, gastric troubles, and dysentery.	152	0.70
<i>Aesculus indica</i> (Wall. ex Camb.) Hook.	Khanor	Hipocastanaceae	Tree/ Wild	Bark	Extract	Extract is prepared from bark and taken after meal to treat rheumatism.	72	0.33
<i>Adhatoda vasica</i> L.	Basuti	Acanthaceae	Shrub/ Wild	Leaf, Whole plant	Decoction	Leaves are utilized to ripen the berries. Infusion of the whole plant is utilized to reduce bleeding piles. 1-2 spoons of leaf juice is given with honey to make a better feel from cough and cold.	121	0.55
<i>Agave americana</i> L.	Rambaan	Asparagaceae	Herb/	Sap,	Infusion	Sap is boiled to cure diabetes.	99	0.45

			Wild	Flower				
						The flower is boiled to make an infusion and given at night to cure cough.		
<b><i>Alnus nitida</i> (Spach) Endl.</b>	Kosh	Betulaceae	Tree/ Wild	Bark	Paste	The paste of the bark is employed to relieve swelling, injury, and body pain.	97	0.44
<b><i>Arundo donax</i> (L.) Bor.</b>	Baranal	Poaceae	Herb/ Wild	Root	Decoction	Root is crushed and makes a decoction and drunk a day to cure headaches.	89	0.41
<b><i>Bacopa monnieri</i> (L.) Wettst</b>	Choti- brahmi	Plantaginaceae	Herb/ Wild	Whole plant	Extract	Fresh raw leaves are given before a meal to enhance the loss of memory. The extract of entire plant is utilized to make juice to treat heatstroke.	109	0.50
<b><i>Barleria cristata</i> L.</b>		Acanthaceae	Shrub/ Wild	Whole plant, Bark	Decoction	Infusion of the entire herb is utilized to cure diabetes, cough, and anemia. The powder of dried bark is employed to the gums to reduce toothache.	120	0.55
<b><i>Berberis aristata</i> DC</b>	Kashmal	Berberidaceae	Shrub/ Wild	Root, Leaf	Decoction, Powder	Root decoction is taken after meal to treat malaria. The leaf is crushed, and the powder is combined with warm water to prepare a tonic to cure backache. The root powder is employed on the skin to heal internal wounds. The root powder is applied to the mouth to relieve mouth inflammation.	135	0.62



<b><i>Boerhavia diffusa</i> L.</b>	Punarnava	Nyctaginaceae	Herb/ Wild	Whole plant	Powder, Decoction	The powder of the whole plant is consumed by the local people to cure asthma. Decoction of the entire herb is given early in the morning to treat urolithiasis.	103	0.47
<b><i>Brugmansia suaveolens</i> (Humb. &amp; Bonpl. ex Willd.) Bercht. &amp; J. Presl</b>		Solanaceae	Shrub/ Wild	Bark, Leaf	Powder, Decoction	The dried powder of bark is utilized to relieve stomach pain. The leaves is crushed and prepare a decoction is taken during menstruation to relieve menstrual cramps.	101	0.46
<b><i>Butea monosperma</i> (Lam.) Taub.</b>	Palash	Fabaceae	Tree/ Wild	Flower, Leaf	Extract, Powder	Dried flowers are extracted in milk and jaggery is added and given for 20 days to relieve body heat and chronic fever. Flowers are immersed in water for a night and consume a cup of this infusion on an empty stomach for two weeks for the treatment of leucorrhoea. Leaf powder is combined with water and given once a day to cure diabetes.	158	0.72
<b><i>Calotropis gigantea</i> L.</b>	Safed Aak	Asclepiadaceae	Shrub/ Wild	Bark, Leaf	Powder	Bark powder is combined with mustard oil to massage the joints to relieve leprosy. Dried leaves are warm with ghee and bandaged on the chest of the born baby to cure cough and cold.	119	0.54
<b><i>Canna indica</i> L.</b>	Hardarshan	Cannaceae	Herb/ Wild	Seed, root	Juice, decoction	Juice of seed is given to the ear to relieve the pain. Root decoction is drunk with water to reduce fever and dyspepsia.	105	0.48

<i>Cassia fistula</i> L.	Amaltash	Fabaceae	Tree/ Wild	Fruit, root, seed	Extract	Fruit is eaten and helps in reducing diabetes. The extract of root is given with water to cure migraine. Roast seed is used as a substitute for coffee.	104	0.47
<i>Cassia occidentalis</i> L.	Ailun	Fabaceae	Shrub/ Wild	Whole plant, Root	Extract, Decoction	Extract of the entire herb is utilized to treat diarrhea, constipation, fever, dysentery, and eczema. Decoction of root is given on an empty stomach to cure gastric complaints, and whooping cough, and also enhance lactation	160	0.73
<i>Carissa opaca</i> L.	Garnu	Apocynaceae	Shrub/ Wild	Fruit, Root	Extract	Fruit is edible and helps in reducing diabetes. Root extract is employed as emollients in the wound area of animals.	91	0.41
<i>Cirsium wallichii</i> DC.	Barsanda, Bursa	Asteraceae	Herb/ Wild	Root	Powder	Powder from the root is combined with water, simmered for a few minutes, and drunk on an empty stomach to treat gastric problems.	86	0.39
<i>Cissampelos pareira</i> L. var. <i>hirsute</i> (Buch. ex. DC.) Formen	Brava	Menispermaceae	Climber/ Wild	Leaf, Root, Whole plant	Paste, Decoction	Root paste is employed on the wounds to heal and stop bleeding. The paste of the leaf is employed as an emollient to cure scabies. The infusion of the entire herb is drunk two times to reduce fever, diarrhea, and cough, and diarrhea.	114	0.52
<i>Colebrookea oppositifolia</i> Smith	Gadoos	Lamiaceae	Shrub/ Wild	Leaf, Stem	Decoction, Powder	Leaf decoction is utilized to treat dysentery.	109	0.50

						The powder of stem is taken with warm water to cure epilepsy.		
<b><i>Coronopus didymus</i> (L.) Smith</b>	Garhbini	Brassicaceae	Herb/ Wild	Leaf	Powder, Paste	The powder is obtained from leaves which is utilized to cure asthma and headache. The leaf paste is employed to wound healing.	117	0.53
<b><i>Cyperus rotundus</i> L.</b>	Mutha, Motha	Cyperaceae	Herb/ Wild	Root	Paste	A root paste is employed to the Wounds to heal and stop bleeding.	79	0.36
<b><i>Cynoglossum zeylanicum</i> Thunb. ex Lehm.</b>	Kachi	Boraginaceae	Herb/ Wild	Root	Decoction	The root decoction is simmered in water and taken one teaspoon daily at night to cure indigestion and stomach pain. The powder of dried root is employed on the cuts.	115	0.52
<b><i>Elaeagnus umbellata</i> Thunb.</b>	Genhi	Elaeagnaceae	Shrub/ Wild	Seed	Powder	The dried seed powder is given with lukewarm water to relieve from cough.	87	0.40
<b><i>Eucalyptus umbellata</i> Domin</b>	Safeda	Myrtaceae	Tree/ Wild	Leaf	Powder	The powder is obtained from the leaves which is combined with mustard oil and is employed on the joints to treat rheumatism. The infusion of the leaf is utilized to reduce flu.	107	0.49
<b><i>Eupatorium adenophorum</i> Spreng.</b>	Kali bansuti	Asteraceae	Herb/ Wild	Root	Powder	Ash of the root is given with honey to cure cough and cold.	95	0.43
<b><i>Euphorbia prostrata</i> Aiton</b>	Dudhali	Euphorbiaceae	Herb/ Wild	Rhizome	Decoction	Decoction of the rhizome is drunk orally in the morning to cure constipation and phlegm.	98	0.45
<b><i>Fagopyrum esculentum</i> Moench</b>	Phaphru	Polygonaceae	Herb/ Wild	Leaf	Cooked	Leaves are prepared to make a 'saag' (spinach) in an iron container, which is provided to anemic patients and also cures old constipation.	100	0.46

<b><i>Fumaria indica</i> (Hauskn.) Pugsley</b>	Pitpapra	Fumariaceae	Herb/ Wild	Whole plant	Decoction	The infusion of the entire plant is given on an empty stomach to reduce vomiting and also cure fever.	92	0.42
<b><i>Geranium nepalense</i> Sweet</b>		Gentianaceae	Herb/ Wild	Root	Powder	The powder is obtained from the dried root that is mixed with warm water and drunk a day to cure stomach problems.	88	0.40
<b><i>Grewia optiva</i> J.R. Drumm.</b>	Bheul	Malvaceae	Tree/ Wild	Fruit, Leaf, Bark	Infusion	The ripened fruit is edible. The infusion of leaves and bark is applied to the hair as a substitute for shampoo. The bark fiber is used to make a rope.	108	0.49
<b><i>Impatiens balsamina</i> DC.</b>		Balsaminaceae	Herb/ Wild	Flower, Leaf	Juice	A dye is derived from both the flowers and leaves. The juice that has been prepared from leaves is utilized in place of henna to dye finger and toenails red.	68	0.31
<b><i>Ipomoea carnea</i> Jacq.</b>	Ghaudan	Convolvulaceae	Shrub/ Wild	Leaf, Latex	Paste	A leaf paste is employed to a sore (redness, swelling) that occurs between the toes and fingers due to a fungal infection. The plant's latex is applied directly to relieve boils on the skin. It is also utilized to alleviate stomachaches, muscular pain, and swelling.	165	0.76
<b><i>Jurinea macrocephala</i> DC.</b>	Gugle Dhoop	Asteraceae	Herb/ Wild	Root, Whole plant	Decoction	Root decoction is utilized to relieve colic pain. The entire plant is dried and utilized as an incense.	120	0.55
<b><i>Leucas lanata</i> Benth.</b>	Dhurlughas	Lamiaceae	Herb/ Wild	Whole plant, Leaf	Extract, Paste	The extract of the whole plant is made of juice and drunk orally to	126	0.58

						cure headaches and stomachaches. The leaf paste is employed on the cuts and wounds to heal wounds.		
<b><i>Mallotus philippensis</i> (Lam.) M. Arg.</b>	Kambal	Euphorbiaceae	Tree/ Wild	Glands, Hairs, Leaf, Root	Powder, Paste	The powder of glands and hairs from the fruit is boiled in one glass of milk and add honey on it taken early in the morning once a day to kill intestinal worms. The leaf paste is employed on the wound and ulcer to give relief from pus and discharge from the wounds. Red dye is obtained from the root of the plant.	168	0.77
<b><i>Malva neglecta</i> Wallr.</b>	Sunch	Malvaceae	Shrub/ Wild	Leaf	Decoction	Decoction is made from leaves and drunk two times in a day to cure cough and asthma.	77	0.35
<b><i>Medicago polymorpha</i> L.</b>	Khukhani	Fabaceae	Herb/ Wild	Leaf	Infusion	Young leaves are cooked in water and made infusion to cure constipation and indigestion.	87	0.40
<b><i>Mucuna pruriens</i> (L.) DC.</b>	Gajlbael	Fabaceae	Climbing shrub/ Wild	Root	Powder	Powder of root is utilized to make an infusion and taken in the morning to cure purgative.	71	0.32
<b><i>Murraya koenigii</i> (L.) Spreng. (500-2000)</b>	Gandhelu	Rutaceae	Shrub/ Wild	Fruit, Stem, Leaf	Fresh leaves, Powder	Fruit is edible and helps in reducing diabetes. Stem is utilized as a tool for brushing teeth and also get rid of infections on teeth. The young shoot of leaves is used to make chutney and fresh leaves are used as flavor in Curry. The fresh leaves are simmered in the coconut oil to get rid of hair fall.	172	0.79
<b><i>Myrica esculenta</i> Buch-Ham. ex D. Don</b>	Kaphal	Myricaceae	Tree/ Wild	Fruit, Bark	Powder	Fruits are edible and useful in dysentery.	112	0.51

						The dried powder of bark is given with warm water to cure cough, diarrhea, asthma, and sinusitis.		
<b><i>Nasturtium officinale</i> R. Br.</b>	Suteresi	Brassicaceae	Herb/ Wild	Leaf	Juice	The leaves are eaten as a vegetable (saag). The juice of leaves is employed on the scalp of the hair for the growth of thick hairs.	96	0.44
<b><i>Opuntia dillenii</i> (Ker-Gawl.) Haw.</b>	Nagphani	Cactaceae	Shrub/ Wild	Fruit, Leaf	Paste	Baked fruit is consumed by local people during whooping cough. The leaf is warmed and applied on the boils to discharge pus. The leaf paste is employed to cure inflammation.	128	0.58
<b><i>Phoenix sylvestris</i> (L.) Mill.</b>	Khajur	Arecaceae	Tree/ Wild	Fruit, Stem	Juice	Fruit is edible and helps to relieve diabetes. The juice of the stem is used to cure diuretic problems.	99	0.45
<b><i>Physalis minima</i> L.</b>	Patakiri, Rashbari	Solanaceae	Herb/ Wild	Fruit, Flower, Whole plant	Decoction	Fruit and flowers decoction is taken to reduce stomach pain and constipation.	89	0.41
<b><i>Pistacia integerrima</i> J. L. Stewart ex Brandis) Rech. F.</b>	Kakarsinghi	Anacardiaceae	Tree/ Wild	Galls (present on leaves and petioles), Bark	Extract	Galls are roasted and taken with honey to cure asthma and diarrhea. The bark extract is simmered in water and given 4-5 spoons in the morning to cure jaundice.	109	0.50
<b><i>Pyrus pashia</i> Buch. -Ham. ex D. Don</b>	Kainth	Rosaceae	Tree/ Wild	Fruit, Leaf	Extract	Ripen fruit is eaten for the treatment of constipation. The extract of the leaf is used to make a tonic for hair loss.	102	0.47
<b><i>Rhododendron campanulatum</i> D. Don.</b>	Shalgar	Eriaceae	Shrub/ Wild	Leaf	Powder, Juice	Powder of leaves is snuffed to cure colds and headaches.	92	0.42



						Juice of leaves is taken for two weeks to cure rheumatism.		
<b><i>Roylea cinerea</i> Baill.</b>	Karnait	Lamiaceae	Shrub/ Wild	Leaf	Decoction	The decoction of leaves is drunk in one glass for three days to cure malarial fever.	85	0.39
<b><i>Rumex nepalensis</i> Spreng.</b>	Malori	Polygonaceae	Herb/ Wild	Leaf, Twig	Paste	The paste of leaf is employed on the skin to treat lesions. Leaf paste is employed to cure syphilitic ulcers.	95	0.43
<b><i>Salvia coccinea</i> Buc'hoz ex Etl.</b>	Ram tulasi	Lamiaceae	Herb/ Wild	Whole plant	Decoction	Decoction of the entire herb is given early in the morning to treat dysentery, diarrhea, and stomachache, and regulate menstruation.	123	0.56
<b><i>Sida rhombifolia</i> L.</b>	Bal	Malvaceae	Shrub/ Wild	Root, Leaf	Paste, Decoction	The paste of root is used as an emollient and employed on the joints to cure gout and rheumatism. The decoction of leaves is drunk once a day to cure diabetes.	127	0.58
<b><i>Solanum nigrum</i> L.</b>	Makoi	Solanaceae	Herb/ Wild	Root, Leaf	Juice extract	The juice is extracted from roots to cure asthma. Leaves are crushed and then baked and applied to the warts.	101	0.46
<b><i>Solanum viarum</i> Dunal</b>	Jangli bhindi	Solanaceae	Shrub/ Wild	Fruit, Seed	Decoction	Decoction of fruit is drunk two times a day to cure arthritis and rheumatism. Ashes of fruit and seed are applied to the teeth to relieve toothache.	131	0.60
<b><i>Spilanthes acmella</i> L.</b>	Karkara	Asteraceae	Herb/ Wild	Flower	Powder, Decoction	The flower powder is employed on the teeth to treat toothache. Decoction of flowers is drunk in the morning to cure dysentery, cold, and fever.	129	0.59

<b><i>Stephania glabra</i> (Roxb.) Miers.</b>	Bis-khapar	Menispermaceae	Climber/ Wild	Root	Powder	The root powder is given with warm water to cure stomach pain.	83	0.38
<b><i>Taraxacum officinale</i> Weber</b>	Kanphul	Asteraceae	Herb/ Wild	Root, Leaf, Whole plant	Powder, Paste, Decoction	The powder is obtained from root, which is given with warm water to purify the blood. The paste of leaf is employed on the boils to remove the pus and heal the wounds. The infusion of the entire plant is utilized to treat gastric problems, headaches, and dysentery.	130	0.59
<b><i>Tecoma stans</i> (L.) Juss. ex. H.B.K.</b>		Bignoniaceae	Tree/ Wild	Leaf, Root	Decoction	Leaves and roots decoction is utilized to cure stomach ulcers and reduce stomach pain. Leaf decoction is drunk after meals to treat dysentery.	93	0.42
<b><i>Woodfordia fruticosa</i> Kurz.</b>	Dhai	Lythraceae	Shrub/ Wild	Root, Leaf	Paste	The paste of the root is employed on the body to relieve muscular pain. The young shoot of leaves is taken to purify blood.	91	0.41
<b><i>Ziziphus jujuba</i> Mill.</b>	Ber	Rhamnaceae	Shrub/ Wild	Fruit, Bark	Powder	Fruit is edible and helps to reduce diabetes. The powder of dried bark is applied to the boils to get relief from pus. The powder of root is boiled with cow's milk to treat dysentery.	118	0.54
<b>Gymnosperms</b>								
<b><i>Abies pindrow</i> Spach.</b>	Rai	Pinaceae	Tree/ Wild	Bark	Extract	The extract of bark is utilized to treat cough and bronchitis. Leaf powder is utilized to cure fever, and asthma.	122	0.56

<i>Juniperus communis</i> L.	Hapusha, Juniper	Cupressaceae	Shrub/ Wild	Fruit, Bark	Decoction, Powder	Bark decoction is utilized to cure asthma and Hemicrania. The bark powder is utilized in mucous discharges such as gonorrhoea, and leucorrhoea. Fruit is used as a spice for food.	129	0.59
<i>Taxus baccata</i> L.	Rakhal	Taxaceae	Tree/ Wild	Bark, Leaf	Paste, Extract	The paste of bark is prepared and employed as a plaster to treat fractured bones. The leaf extract is utilized to treat asthma, bronchitis, and poisonous insect bites.	119	0.54
<b>Pteridophytes</b>								
<i>Asplenium dalhousiae</i> Hk.		Aspleniaceae	Herb fern/ Wild	Root,	Decoction	Decoction of the root is given to infants as a ghutti.	87	0.40
<i>Coniogramme intermedia</i> <i>Hieron. var. glabra</i>		Polypodiaceae	Herb/ Wild	Frond	Cooked	Fronds are boiled and eaten as vegetable.	81	0.37
<b>Fungi</b>								
<i>Morchella esculenta</i>	Gucchi	Morchellaceae		Whole plant	Powder	The powder of the entire herb is drunk with water to treat stomach problems, colds, coughs, and fevers, and powder is also employed to wounds.	134	0.61

## Discussions

The riparian vegetation along the Beas River in the state of Himachal Pradesh exhibits a significant diversity of medicinal plants. This riparian region of the Beas River is relatively insufficiently documented, yet the plants in this area are utilized for various purposes, such as medicinal, culinary, and dyeing purposes, among others. In the ethnobotanical study, 67 floras spanning to 47 families were reported from interviews with local informants, which revealed the usage of therapeutic plants to treat 73 diseases across 11 ailment categories. The findings indicated that most participants fell within the age range of 40 to 80, suggesting that older individuals were the main custodians of traditional knowledge compared to other age groups. Remarkably, a study in the district of Mastung of Balochistan province, Pakistan, by Bibi et al. (2014) revealed a total of 102 plant species utilized for medicinal purposes, belonging to 47 families.

### Plants utilized for economic purposes

Himachal Pradesh boasts a wealth of medicinal resources, with our study identifying commercially valuable floras in the research area. The most commercially significant plants are *Jurinea macrocephala* (117/Kg), *Myrica esculenta* (250-300/kg), *Pistacia integerrima* (400/kg), and *Morchella esculenta* (7500/Kg) shown in Table 3 (Chauhan 1999; Rana et al. 2019). Local inhabitants harvest commercially medicinal plants from their natural habitat, selling them to local traders to derive financial benefits (Balemie & Kebebew 2006). Numerous plant species are characterized as threatened condition including *Berberis aristata*, and *Jurinea macrocephala*, so it is necessary to conserve and preserve these plants for future generations.

Table 4. Plants utilized for economic purposes and also their trade value in Himachal Pradesh

Scientific name	Local name	Parts used	Trade value in Kg
<i>Jurinea macrocephala</i> DC.	Dhoop	Root	116/Kg
<i>Morchella esculenta</i> L.	Gucchi	Entire plant	7400/Kg
<i>Myrica esculenta</i> Buch. -Ham. ex D. Don	Kaphal	Fruit	50-100/kg
<i>Pistacia integerrima</i> J.L. Stewart ex Brandis	Kakarsinghi	Galls	200-400/kg

### Quantitative analysis

In the quantitative ethnobotanical indices, the consensus among respondents regarding the utilization of medicinal floras for various diseases was quantifiably examined (Kayani et al. 2015; Sharma et al. 2023). To establish this consensus, all cured ailments were categorized into 11 groups. In the present studies, the ICF values range from 0.58 to 1. The highest ICF value (1) is observed in nervous system disorders, followed by circulatory disorders (0.94). In our study, *Murraya koenigii* (0.79) and *Mallotus philippensis* (0.77) showed the maximum value of use value. The reasons behind the high UV could be attributed to the broad distribution and the ingrained aboriginal cultural practices of curing numerous illnesses using these particular floras. It was challenging to align the quantitative data of the region, especially in riparian vegetation along the Beas River of Himachal Pradesh, because this is the first quantitative ethnobotanical report of the area.

### Plant parts utilized by local people

In processing crude drugs from 16 plant components, the vastly utilized plant components were the leaf, root, flower, whole plant, fruit, and seeds, accounting for 31, 23, 5, 13, 13, and 5 instances, respectively shown in Figure 4. The most common therapeutic plant part utilized in this ethnobotanical study is leaf (31). As indicated by numerous reports, the leaf is the most prevalent component utilized in ethnopharmacological applications (Al-Fatimi 2019; Gumisiriza et al. 2019). The use of leaves as the primary part has also been documented in other ethnobotanical studies conducted in Pakistan, China, India, Thailand, Bangladesh, the Peruvian Amazon, and Colombia (Kadir et al. 2013; Islam et al., 2014). Information from field discussions and comparable reports suggests that local healers predominantly utilize leaves to their fullest extent due to accessibility, abundance, effective utilization, and a focus on conservation considerations (Panmei et al. 2019).

### Methods of preparation and habits

Ethnic communities prepared medicinal herbs in seven different forms, which included paste (15), extract (12), decoction (26), powder (23), infusion (3), juice (6), and vegetable (2) shown in Figure 5. Decoction (26), powder (23), and paste (15) were the most prevalent forms of crude drugs. Local informants in Himachal Pradesh held the belief that the concentration of medicinal plant extracts improves, along with enhanced taste and efficacy, through the process of decoction. According to several reports, decoction stands out as the most prevalent method for preparing herbal medicine (Bibak 2017; Miara et al. 2018; Nasab & Khosravi 2014). They exhibited various growth habits, including trees, shrubs, herbs, and climbers (Figure 6). The most prominent growth form is an herb (27).

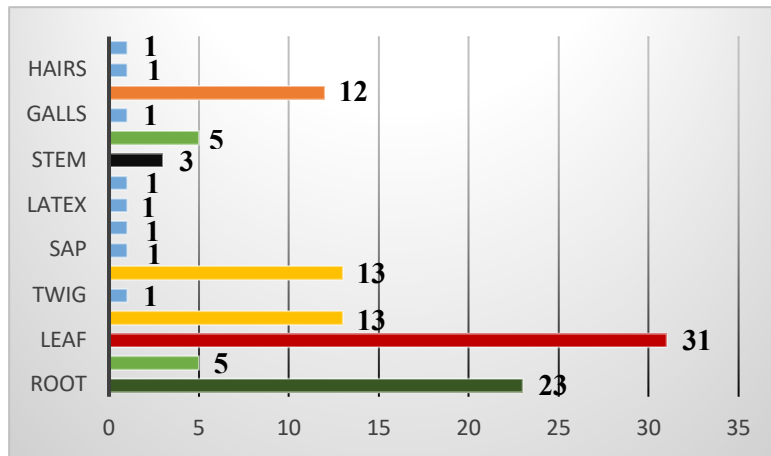


Figure 4. Plant parts utilized

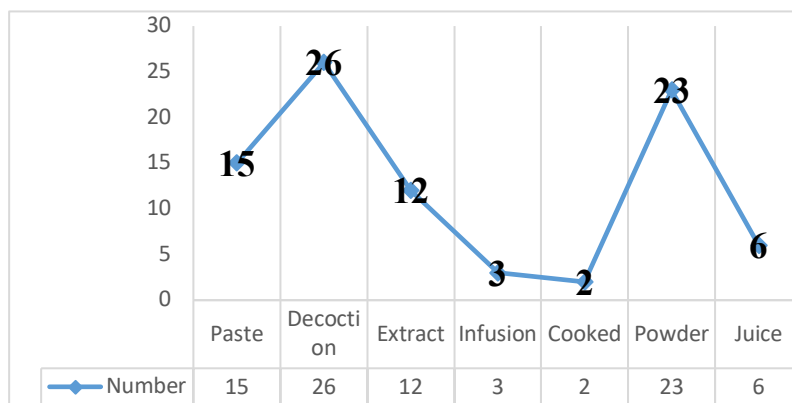


Figure 5. Methods of preparation

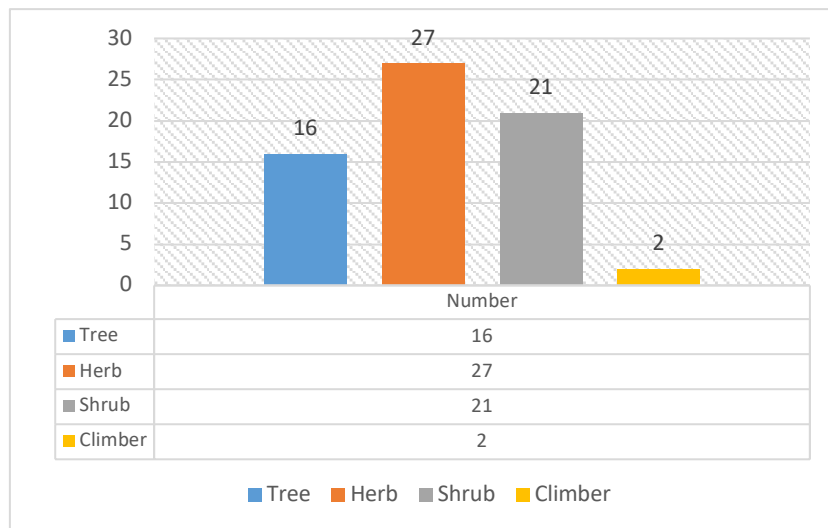


Figure 6. Growth forms

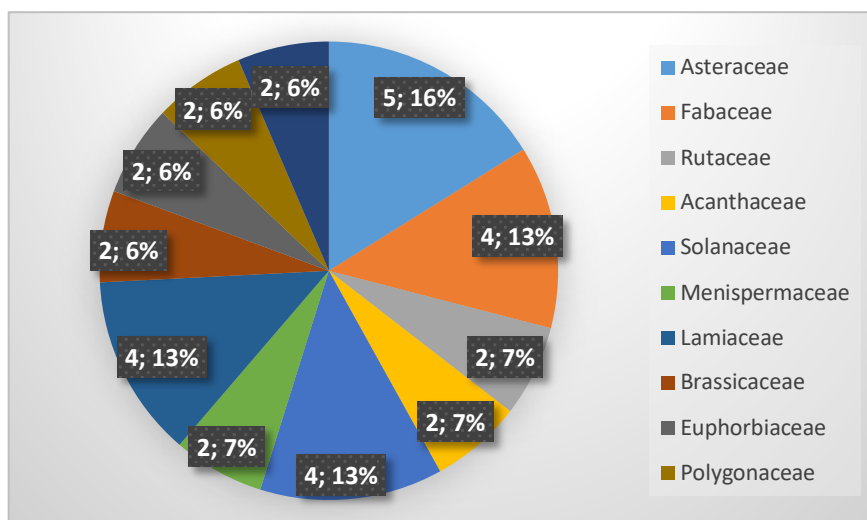


Figure 7. Dominant families

## Conclusion

This research illustrates that the variety of indigenous plants utilized by the residents of Himachal Pradesh is evident not just in the number of species but also in the manifold purposes they serve. These include functions such as medicinal applications, animal fodder, edible purposes, societal uses, paper manufacturing, tool production, dye extraction, and various other aspects. The ethnobotanical survey documented 67 floras from 65 genera, spanning 47 families in Himachal Pradesh, and a diverse range of associated traditional knowledge was also recorded. The current research has unveiled the profound ethnobotanical knowledge held by the local community. The understanding and utilization of therapeutic floras for treating diverse ailments are integral to the life and culture of the populace, necessitating the preservation of this indigenous knowledge. However, this traditional knowledge passed down orally from one generation to the next, is rapidly diminishing. Consequently, it is crucial to document this indigenous information and conduct thorough phytochemical explorations to assess potentially active compounds in floras, providing evidence of their efficacy.

## Declarations

**List of abbreviations:** UV (Use value), ICF (Informants Consensus Factor), N (Total informants), Nur (Number of use citations), Nt (Number of taxa).

**Ethics approval and consent to participate:** All participants provided their informed consent beforehand.

**Consent for publication:** All individuals depicted in the images have given their informed consent for their images to be published.

**Data and material Availability:** The datasets and materials used in this study are available from the author upon reasonable request.

**Conflict of interests:** The writers assert that they do not have any identifiable conflicting interests that might have impacted the research presented in this manuscript.

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**Authors' contributions:** Neha Thakur: carried out field survey, wrote original draft, statistics analysis. Nitesh Kumar: Identification of the plants. Sanjeev Kumar: Designed the study, editing the manuscript.

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