



An Ethnobotanical Survey of Plants Used by Communities around Jaunsar-Bawar Region of Uttarakhand, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The Jaunsar Bawar region of Uttarakhand, India, is well-known for its rich biodiversity and cultural history, which is inseparably, connected through traditional ecological knowledge (TEK) and ethnobotanical traditions. This work explores the ethnobotanical knowledge and practices amongst the indigenous communities residing in the JaunsarBawar region, of 11 villages in three tehsils: Kalsi, Tyuni, and Chakrata of Uttarakhand state of India. With extensive field studies, literature reviews, surveys using standard questionnaires, and semi-structured interviews with local inhabitants including Vaidyas, Hakeem, and forest government officials, the study tends to document the rich biodiversity of the region and comprehend the relationship between humans and plants. It documents and explores the traditional usage of 65 plant species of different growth habits

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and forms for medicine, timber, food, fodder, culinary, rituals, and other purposes. Insights of the study aid in the documentation of local plant species and indigenous wisdom of plant use across generations in the tribal region.

Keywords: Ethnobotany; traditional knowledge; floral diversity; Himalaya; Jaunsar Bawar.

1. INTRODUCTION

The forest has long been a major source of many resources and services required for human well-being in India and around the world [1]. According to the Census [2], 67.99 % of the population of the Uttarakhand state reside in rural regions and depend entirely or in part on neighboring forests for their daily needs of major forest produce and Non timber forest product (NTFP) species. John Harshberger described ethnobotany as the study of plants used by prehistoric and indigenous people in 1896. It is the study of the interaction between humans and plants, which includes the customs and knowledge of various societies regarding the use of plants for food, medicine, and other services [3]. Tribal societies have used indigenous knowledge acquired from their forefathers for ages in several aspects of their everyday lives [4]. These indigenous and local populations' skills and experiences benefit the world at large and can serve as a helpful illustration for biodiversity policies [5]. India is a land of diverse ethnic groups and abundant biological resources, making it a hotspot for ethnobotany [6]. The Bhotia, Tharu, Jaunsari, and Buxa are just a few of the indigenous communities that call Uttarakhand state home and are distinguished by their unique flora varieties [7]. The Jaunsari tribe, who inhabit the state's northernmost portion JaunsarBawar region, is extremely knowledgeable about the indigenous flora and its traditional usage [8]. Because of this, the area has a high biodiversity and a long history of using plants and other natural resources [9]. The majority of their livelihood comes from wild natural resources, which they are familiar with. The majority of the population works in agriculture and cattle raising. These individuals also make money by selling the wild produce to nearby markets when the weather is favorable. Wild edible plants make up the majority of the resources that the people who live in the district's communities use to generate income [10]. Several workers have conducted ethnobotanical investigations of a central region of the western Himalayas [11,12,1,13,4]. However, not much is known about the utilization of plants other than their ethnomedicinal significance in the

JaunsarBawar region. Hence, the sole objective of this exploration work was to summarise the anthropogenic approach to forest products by investigating the plants used for several purposes by the hill communities in their daily life; recording the plant species of medicinal value, wild edibles, fiber yields, fodder, fuelwood; identified the taxa used in religious ceremonies and psychological practices of the local people; and documented the species used as vegetables, fruits, seeds, grains, condiments, oils, and beverages as wild edibles of the of Uttarakhand'sJaunsarBawar region.

2. METHODOLOGY

2.1 Study Area

The study has been conducted in the hilly area of north Indian state of Uttarakhand's Gharwal division. Jaunsar-bawar tribe is mainly present in the districts of Uttarkashi and Dehradun in several villages [14], out of which 11 villages were chosen from tehsil Kalsi (4 villages) with elevation 780 m above mean sea level, tehsil Chakrata (5 villages) with elevation of 2,118m amsl and tehsil TYUNI (2 villages) with elevation of 947m amsl, as mentioned in Table 1.

The map layout for geographical representation of selected sites of the study area has been developed using ArcMap.

2.2 Selection of Study Sites

During first two months (Jan-Feb, 2023), field trips were done for a reconnaissance survey. Availability of local inhabitants was the basis of site selection [15].

2.3 Data Collection

The initial stages of data collection were secondary in nature. Information regarding access to local people was collected from the panchayat offices and block development offices. Semi-structured interviews with the Kalsi Forest Department officials provided the information for the basis of field visits according to the composition of floral wealth in accordance with the working plan. Primary data was collected based on ethnographic approach and accessibility to the remote villages [4].

Table 1. Study Area

SR	Village	Gram panchayat	No. of household surveyed	Coordinates
Teh. Kalsi				
1	Vyas Nahri	Vyas Nahri	10	30.5225°N, 77.8403° E
2	Tilwari	Tilwari	10	30.4010°N, 77.8982° E
3	Hari pur	Haripur	10	30.5170°N, 77.8363° E
4	Kalsi	Kalsi	10	30.5179°N, 77.8439° E
Teh. Chakrata				
5	Sahiya	Sahiya	10	30.6115° N, 77.8753° E
6	Lakhamandal	Lakhamandal	10	30.7016° N, 77.8696° E
7	Rikhar	Rikhaad	10	30.6461° N, 77.8810° E
8	Birmau	Rikhaad	10	30.6587° N, 77.8953° E
9	Thana	Thana	10	30.6666° N, 77.8739° E
Teh. Tyuni				
10	Bhagawat	Meghatu	10	30.9483°N, 77.8467° E
11	Raygi	Raygi	10	30.6332°N, 77.6753° E

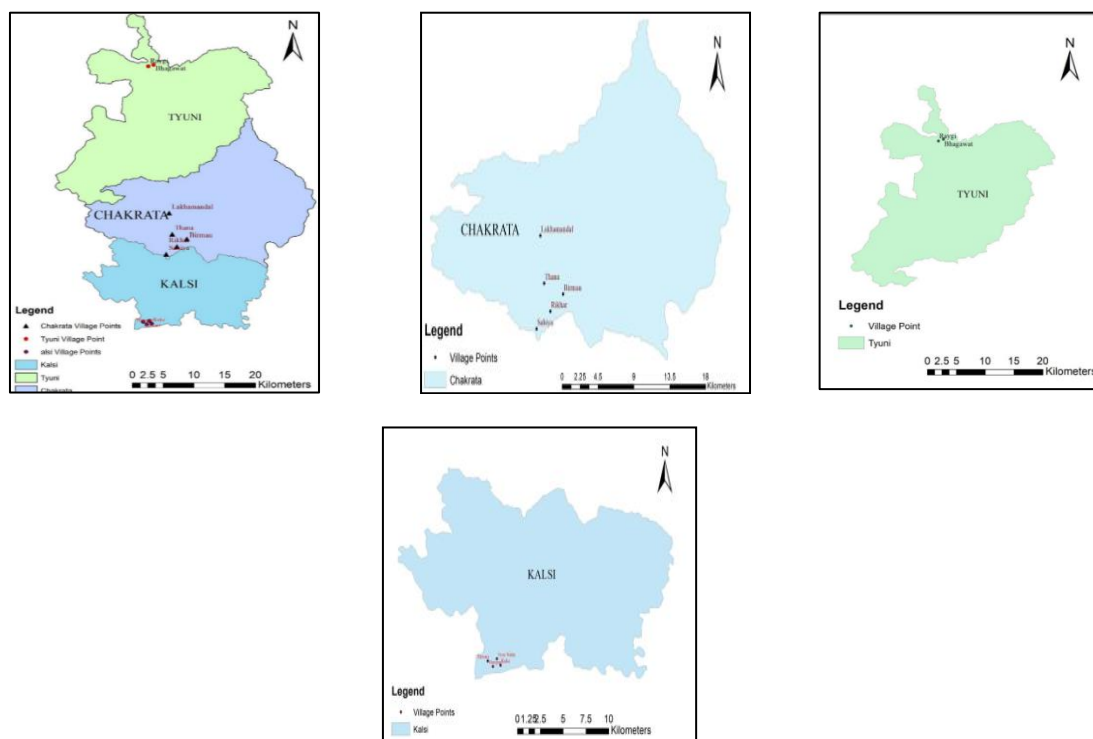


Fig.1. Study sites map

The ethnobotanical surveys were conducted using a standard questionnaire to obtain a huge number of qualitative data on plants used by the tribes by speaking with a significant number of their members of different ages; Vaidyas, known as Jariyaras in Jaunsar-Bawar area [4], Hakeems, and local healers, according to the contact information that was obtained from the locals, were mostly consulted [16]. The questionnaire was prepared to collect information based on local names, ethnobotanical usage, part used, etc. [17]. The identification was confirmed based on local names of plant species

as mentioned in the Forest Flora of Chakrata, Dehra Dun & Saharanpur [18]. The primary data have been categorized and organized according to their botanical names and families. The updated botanical names of all the plants were cross-checked from the World Flora Online Plant list [19]. During the study, attempts were made to collect optimum data from January 2023 to May 2023 from the maximum parts of the study area. This study aimed to document the native plant species and explore the existing traditional wisdom for the ethnobotanical and cultural usage of those plants by the tribe.



Fig. 2. Interaction with the local inhabitants of Jaunsar Bawar region

3. RESULTS AND DISCUSSION

The results of the study are based on responses from 110 respondents with 57.27% male and 42.72% females (Fig. 3) from 11 villages on their traditional usage of various plant species present in the area.

3.1 Ethnobotanical Knowledge

The present study compiles 64 ethnobotanical plant species belonging to 44 families and 59 genera varied in their usage and consumption by the local inhabitants are listed in Table 2. Out of the recorded 44 families, three dominant families are Rosaceae (13.6%), Fabaceae and Lamiaceae (6.8% each). Most common plant species available in three study sites are *Rhododendron arboretum* (Burans), *Pinus roxburghii* (Chir), *Quercus leucotrichophora* (Banj), *Cedrus deodara* (Devdar), *Aesculus indica* (Ban akhrot), *Ficus religiosa* (Peepal), *Pyrus pashia* (Kainth), *Berberis aristata* (Daruhaldi), *Bombax ceiba* (Simal), *Bauhinia variegata* (Kachnar), *Bauhinia vahlii* (Siyali), *Cupressus torulosa* (Surai), *Phyllanthus emblica* (Amla), *Ricinus communis* (Arandi), *Grewia optiva* (Bhimal), *Mentha arvensis* (Pudina), *Betula utilis* (Bhojpatra), *Toona ciliate*

(Toon), *Rubus ellipticus* (Hisalu), *Celtis australis* (Khirak), *Urtica dioica* (Kandali) etc. The plant species fall under various growth habit and form within which trees (40.6%) covers the maximum number and climbers cover the minimum number of species (Fig. 4).

Each plant species tabulated in Table 2 have multiple uses but most preferred plant species used under different categories are discussed below.

3.1.1 Medicine

84.3% of the total plant data was documented to have medicinal properties such as anti-inflammatory, antiviral, antitumor, anti-malarial, analgesic, etc. Some important medicinal plant species present in the three study sites are given below:

Cedrus deodara (Vernacular name: Devdar) belongs to the family Pinaceae. It is a large evergreen coniferous tree that can grow up to 40–50 metres (131–164 feet) tall, or 60 metres (197 feet), with a trunk diameter of up to 3 metres (10 feet). It features a conic crown with both level and drooping branches. At low concentrations (KD50 0.4452% in acetone),

cedarwood oil exhibits insecticidal properties against adult Indian mosquitoes, *Anopheles slephensis*. The plant's essential oils have a longer duration of fungicidal activity [20]. Itching and skin infections of domestic animals like cows are treated with its wood oil. Wood is also being used for furniture crafting.

Picrorhiza kurroa (Vernacular name: Kutki) belongs to the family Scrophulariaceae. Kutkin, the active ingredient of *P. kurroa*, is a combination of picroside and kutkoside. Kutkin has demonstrated pharmacological hepatoprotective qualities [21]. The Jaunsari tribe of Tiyuni and Chakrata uses it as a traditional fever medicine. It also treats liver and upper respiratory tract diseases, lowers fevers, and treats indigestion, scorpion stings, and persistent diarrhoea [17]. To treat diabetes, 5 g of crushed

root is steeped overnight in 250 ml of water in a copper kettle, cleaned, and then consumed.

Rhododendron arboretum (Vernacular name: Burans) belongs to the family Ericaceae. Significant reductions in magnesium sulphate-induced diarrhoea were observed with the ethyl acetate fraction of *R. arboreum* flowers; this effect may be attributed to enhanced water and electrolyte absorption [22]. The majority of the population uses flower juice as a coolant and treatment for dysentery. Vaidyas suggests grinding the leaves of the plant and inhaling the fine powder to relieve coughing. The paste of young leaves is applied to the forehead to relieve headaches and is also claimed to be therapeutic and deadly (high doses can cause intoxication) [23]. 40% of the flowers are to be retained on the tree during collection.

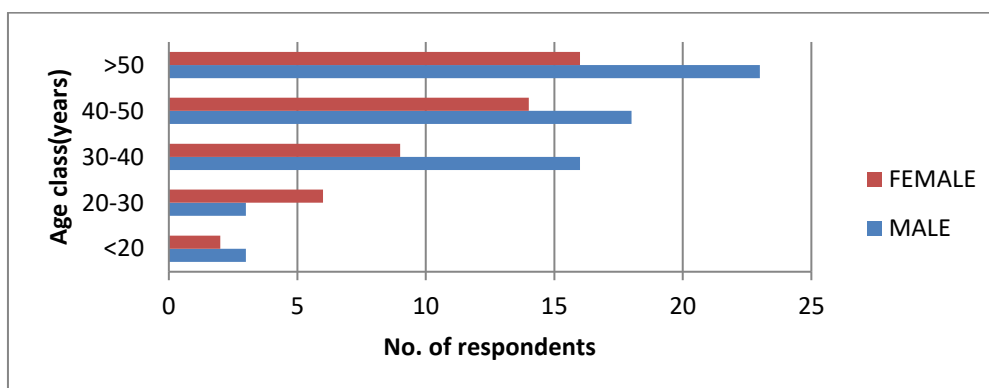


Fig. 3. Number of respondents based on gender

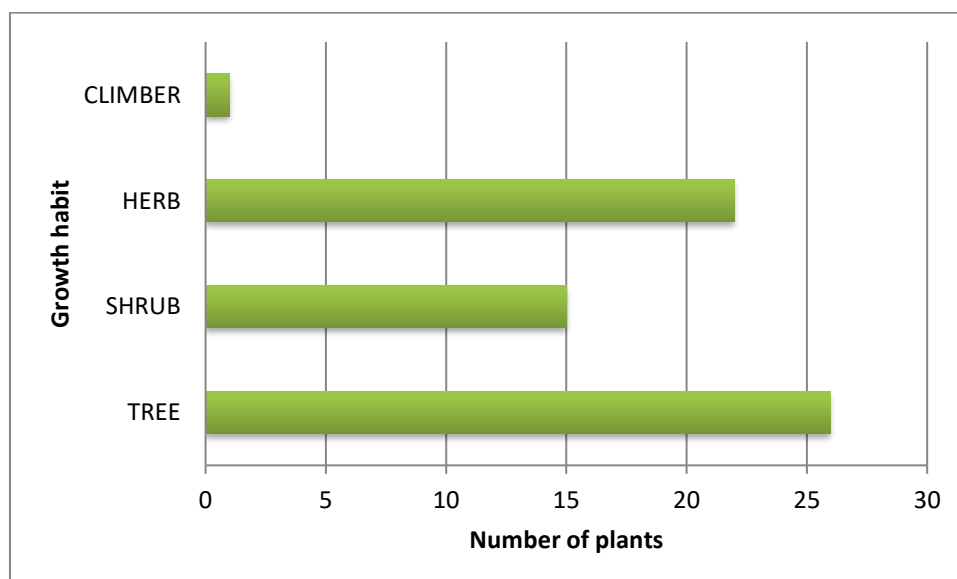


Fig. 4. Growth habit of species

Siegesbeckia orientalis (Vernacular name: Dudhla) belongs to the family Asteraceae. *Siegesbeckia orientalis* is an annual herb or subshrub that grows to be approximately 0.4–1.5 m (1 feet 4 inches–4 ft 11 in) tall. It is typically multi-branched and has hollow, reddish stems. Traditional medicine has utilised the sections of *Siegesbeckia* to treat rheumatoid arthritis, hypertension, malaria, neurasthenia, and snakebite [24]. The roots are crushed and applied directly to the snakebite.

Terminalia bellirica (vernacular name Baheda) belongs to the family Combretaceae. The enzymatic and non-enzymatic antioxidants found in the fruits of the large deciduous tree, *Terminalia belerica*, have antioxidant qualities and can be highly efficient against microorganisms that cause a variety of ailments [25]. The fruit is roasted and ground, and the powder so formed is consumed with honey to treat coughs.

Urtica dioica (Vernacular name: Bicchughas) belongs to the family Urticaceae. Stinging nettles have been used to treat arthritis and stomach-aches. The leaves are high in calcium, iron, magnesium, potassium, sodium, phosphorus, vitamins B, C, and other minerals and have also been used to treat diarrhoea, vaginal discharge, internal bleeding, and external bleeding. The high nutritional content of the leaves makes them useful for human use as a tonic to strengthen the body and for making soups, etc. [26]. Flowers and leaves of plants are cooked as vegetables for pregnant women. Dry and brownish seed heads of the plant are collected, and seeds are extracted by rubbing. Seeds are then cleaned and dried, away from sunlight, and stored.

Withania somnifera (vernacular name Ashwagandha) belongs to the family Solanaceae. Ashwagandha helps with insomnia but does not act as a sedative. Its rejuvenating and nervine effects boost energy levels, promoting restful sleep [27]. The light brown roots, which are free from mould or decay, are cleaned and washed thoroughly using a brush. Then they are dried and roasted for 15 minutes. Once cooled, roots are ground into a fine powder using a mortar and pestle. Powder is served in hot drinks.

The traditional medicinal knowledge of Uttarakhand has been partially highlighted by several works of literature. However, there are various undocumented regions and plant species

that are utilised for purposes other than medicine.

3.1.2 Timber

10.9% of the total data accounts for plant species used for furniture and construction. Some species in the timber category are discussed below:

Celtis australis (Vernacular name: Kharik) belongs to the family Cannabaceae. The timber quality of this multipurpose tree species is excellent. It is used to create tools, whip handles, mugs, spoons, churners, sports equipment, canoes, sticks, and agricultural implements. It can be carved, used to manufacture carriages, and used as a general building material. Its wood is also used for fuel purposes [28]. The handles of agricultural implements used by the local farmers of the region are made from the wood of the tree. Thin, flexible shoots are used as walking sticks for elders.

Himalayacalamus falconeri (Vernacular name: Himalayan bans) belongs to the family Poaceae. Researchers have explored many approaches to using bamboo as a wood substitute. Bamboo is a renewable resource with numerous applications, including chipboard, medium-density fiberboard, and flake board for engineering and construction. Bamboo plywood is used for floor tiles and wall panels. Bamboo is used to make fuel briquettes, handicrafts, pulp and paper, furniture, and composite thermoplastic reinforcement for roofing. Bamboo is also used to make drinks and beverages, pharmaceuticals, pesticides, and household items like toothpaste and detergent [29]. The olive green hollow and dense clumps are smooth and are harvested for making furniture. The outer parts of culms are weaved into baskets and mats by the tribal people. The young edible shoots, about 8 cm, are harvested in March–May for making pickles.

Juglans regia (Vernacular name: Akhrot) belongs to the family Juglandaceae. Walnut wood is recognised as the most valuable of temperate zone woods and is appropriate for a wide range of products and uses, including veneers, furniture and interior woodwork constructions, music instruments, carving, sporting goods, gun stocks and fore-ends, etc. [30]. In spite of the edible fruit obtained from the tree, walnut wood is dark, very hard, moderately dense, and tight-grained, but in short lengths, thus being used by locals mainly for furniture.

Populus ciliata (Vernacular name: Neeru) belongs to the family Salicaceae. *P. ciliata* is a versatile wood that can be used to make packing cases, crates, doors, matches, and artificial limbs. It also produces high-quality veneers that peel easily [31]. Local people readily use Neeru wood logs for furniture. The logs are stacked and air-dried to 20%, then recut and used accordingly.

3.1.3 Food

Some of the plant species preferred for food purposes, such as jams, pickles, spices, etc., are:

Mentha arvensis (vernacular name Pudeena) belongs to the Lamiaceae family. Unani scholars refer to this aromatic plant as Misni [32]. Its antioxidant, cytotoxic, antibacterial, and antidiabetic properties make it a valuable ingredient in the food sector [33]. Most tribal women grow pudeena in their kitchen gardens and use the fresh leaves in dal and drinks. The leaves are collected, sun-dried for 2 hours, and then shade-dried. The powder obtained after grinding is used in various food recipes.

Murraya koenigii (Vernacular name: Gandheli) belongs to the family Rutaceae. *Murrayakoenigii* is noted for its therapeutic properties, including phenolics, flavonoids, and carboxylic alkaloids. Plant has previously claimed to have anti-diabetic, anticarcinogenic, antidiysenteric, antioxidant, hypoglycemic, and antibacterial properties [34]. The green leaves are rich in iron; thus, women readily use the leaves in curries. Also, the leaves are boiled with coconut oil and applied to dry hair.

Myrica esculenta (vernacular name Kaphal) belongs to the family Myricaceae. These wild fruits grown in isolated regions provide an important source of food and revenue for local communities. *Myrica esculenta* fruit contains ascorbic acids, phenols, flavonoids, saponins, and alkaloid compounds. The fruit contains several chemicals, including hydroxybenzoic acid, gallic acid, p-coumaric acid, caffeic acid, catechin, ellagic acid, trans-cinnamic acid, chlorogenic acid, and myricetin. This is also a pleasant source of protein, carbs, and vitamin C [35]. Fruit ripening from April to May is being collected and sold by the local people. Pickles are made after drying fruit for 3–4 days, and jams are made immediately by adding jaggery and salt.

Rubus ellipticus (Vernacular name: Ishav) belongs to the family Rosaceae. The shrub grows to a height of 1–3 metres and has glandular hair and a needle-like hook on the stem. The plant is well-known for its golden-yellow subglobose fruit, which is high in nutrients. As the fruit matures, its colour changes from green to golden or yellow, enhancing its aesthetic and therapeutic benefits [36]. Fruits are directly consumed by children and locals. Jams are also being prepared by women.

3.1.4 Recreation, cultural, and sacred

18.7% of the data accounts fall under this category. Some of them are:

Cannabis sativa (vernacular name Bhang) belongs to the family Cannabaceae. Cannabis has long been produced and used in India for medical, nutritional, spiritual-religious, and socio-cultural purposes, as recounted in ancient Indian literature. Furthermore, other ancient therapeutic methods unique to India, such as Ayurveda, Siddha, and Unani, demonstrate the widespread usage of cannabis in treating a variety of illnesses. Cannabis cultivation and application of various components of the plant such as the flowers, leaves (and the resinous materials obtained from them), fruit, young twigs, and stalk or stem, have a long and continuous history in India, dating back centuries [37]. The five-finger leaves are worshipped and offered to Lord Shiva in various temples every day in the region, along with fruit.

Emblica officinalis (vernacular name Amla) belongs to the family Euphorbiaceae. Native to tropical Southeast Asia, *Emblica* is a small to medium-sized deciduous tree. Its leaves are small, closely spaced, feather-like, and simple along the branchlets. The smooth and hard round greenish-yellow fruits have a smooth look, while the flowers are yellow-green in colour. Indian cuisine often includes hand-harvested fruits, which ripen in autumn [38]. It is an antioxidant-rich, fleshy edible fruit used in Ayurvedic medicine and hair color. Endocarps with distinctive marks on their surfaces are prevalent in Hindu temple buildings [39]. Lord Vishnu is worshipped in the form of the Amla tree. On Thursdays, eating alma fruits is restricted, as has been worshipped.

Ocimum sanctum (Vernacular name: Tulsi) belongs to the Lamiaceae family. Planting tulsi in the home serves both religious and spiritual

reasons, connecting the devotee with nature's creativity. Connecting with nature has several physiological, emotional, social, and cognitive benefits [40]. Almost every household in the region has planted Tulsi and offers water every day except Sundays for spiritual reasons.

Pyrus pashia (Vernacular name: Kainth) belongs to the family Rosaceae. The bark and roots of *P. pashia* fruits have been used in Ayurvedic medicine to cure sore throats, fevers, and ulcers. The fruits are edible and hold religious and cultural significance. The locals believe that maintaining *P. pashia* twigs in their agricultural fields may ward off evil spirits [41]. Local people believe in keeping the twigs of the plant in their verandas to protect their families from evil eyes.

Tribulu sterrestis (Vernacular name Gorkhu) belongs to the family Zygophyllaceae. It is a widespread weed that grows in numerous countries across the world. It is well-known for its ability to treat sexual problems, impotence, and hormonal imbalances in humans and animals alike. It is also used as a sexual stimulant. However, in the last 30 years, there has been a surge of interest in this plant following the identification of active compounds that can be used to treat sexual and other diseases [42]. This annual herb is collected by Vaidayas and Hakeems, converted into small balls of thick paste, and then dried. This medicine is given to people suffering from uterine and sexual problems.

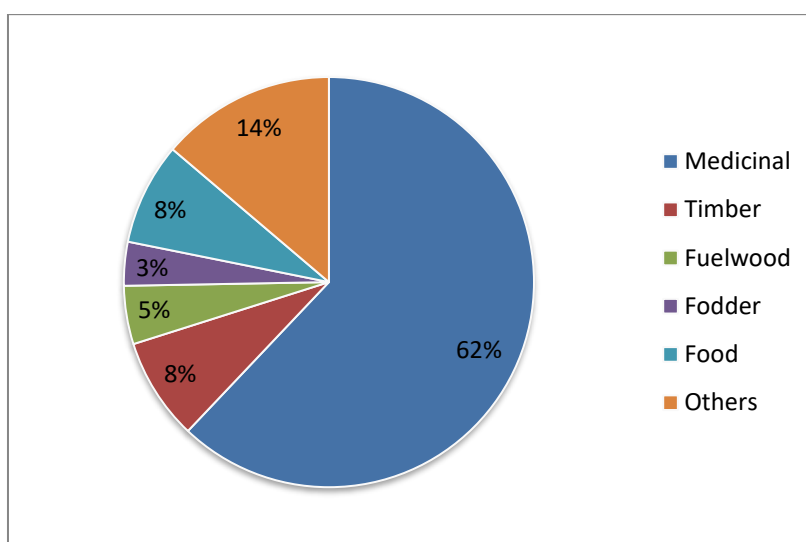


Fig. 5. Category of usage

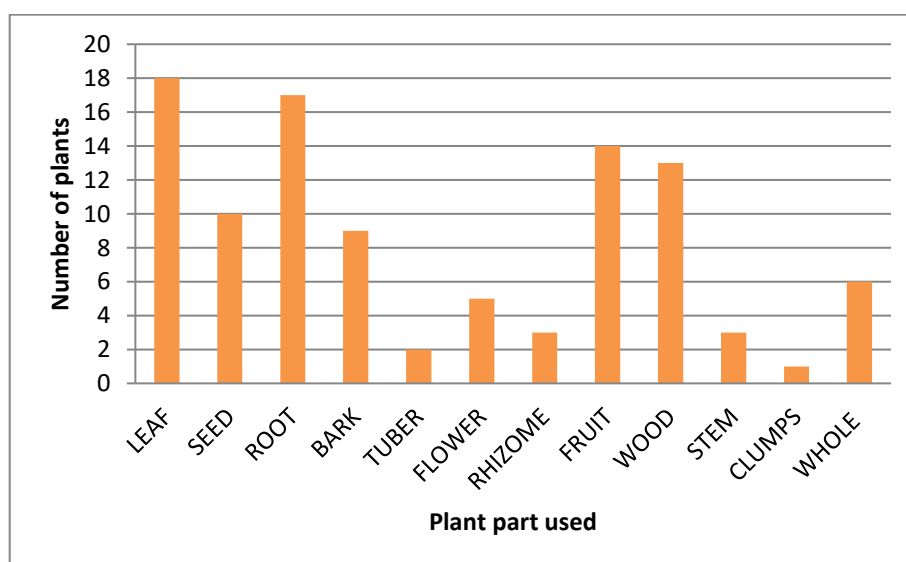


Fig. 6. Number of plants used for its various parts

Table 2. List of plant species and their utility in Jaunsar Bawar

Sr	Botanical Name	Family	Habit	Vernacular Name	Uses	Plant Part (S)
1	<i>Abrus precatorious</i>	Fabaceae	Climber	Gunja	Headache, intestinal ulcer	Leaf, Seed, Root
3	<i>Acorus calamus</i>	Araceae	Herb	Bach	Stomach worms	Root
4	<i>Ageratum conyzoides</i>	Asteraceae	Herb	Ghaghra	Healing in cuts	Leaf
5	<i>Aloe vera</i>	Liliaceae	Herb	Gwarpatha	Treat burns, wounds, and skin diseases	Leaf
6	<i>Amomum subulatum</i>	Zingiberaceae	Herb	Siru	Digestive problems, spice	Seed
7	<i>Asparagus curillus</i>	Asperagaceae	Shrub	Sharanoi	Acne	Tuber
8	<i>Bauhinia variegata</i>	Fabaceae	Tree	Kachnar	Acne, lowers blood sugar level	Leaf
10	<i>Berberis spp.</i>	Berberidaceae	Shrub	Kashmoi	Eye tonic	Root
11	<i>Bergenia ciliata</i>	Saxifragaceae	Herb	Pattharchoor	Urinary troubles	Tuber
9	<i>Bistorta nplexicaulis</i>	Polygonaceae	Herb	Ninai	Ear ache, acne	Root
12	<i>Bombax ceiba</i>	Malvaceae	Tree	Semal	Combat fever and acne problems	Bark
13	<i>Cannabis sativa</i>	Cannabaceae	Herb	Bhang	Medicinal, recreational	Whole plant
14	<i>Cassia tora</i>	Fabaceae	Shrub	Panwar	Vermicide, malaria	Seed, Root, Leaf, Whole plant
15	<i>Cedrus deodara</i>	Pinaceae	Tree	Deodar	Itching in animals, furniture	Wood
16	<i>Celtis australis</i>	Cannabaceae	Tree	Kharik	Fever, cough, and diarrhea, furniture, agricultural tools, religious ceremonies	Bark, Leaf, Fruit, Wood
17	<i>Cinnamomum tamala</i>	Lauraceae	Tree	Tejpatta	Cold	Leaf
18	<i>Clerodendrum serratum</i>	Lamiaceae	Shrub	Bharangi	Cold, allergy, sinusitis	Flower
19	<i>Curcuma zeboaria</i>	Zingiberaceae	Herb	Kachoor	Infant stomach ache	Rhizome
20	<i>Cynodon dactylon</i>	Poaceae	Herb	Doob	Dysentery, sacred purpose	Whole plant
21	<i>Diploknema butyrcea</i>	Sapotaceae	Tree	Cheura	Diarrhea, dysentery, and skin disease, furniture and oil preparation	Seed, Wood
22	<i>Embllica officinalis</i>	Euphorbiaceae	Tree	Amla	Hair tonic, cultural use	Fruit
23	<i>Ephedra gerardiana</i>	Ephedraceae	Small shrub	Somlata	Eye trouble	Leaf, Fruit, Root, Stem
26	<i>Ficus palmata</i>	Moraceae	Tree	Bairu	Fuelwood and fodder for domestic animals	Leaf, Wood
24	<i>Ficus racemosa</i>	Moraceae	Tree	Fig	Digestion, edible fruits, sacred purposes	Flower, Wood
25	<i>Ficus religiosa</i>	Moraceae	Tree	Peepal	Burn	Bark
27	<i>Grewia optiva</i>	Malvaceae	Tree	Bhimal	Rope making, fodder, edible fruits, firewood, religious purpose	Leaf, Bark, Wood, Fruit

Sr	Botanical Name	Family	Habit	Vernacular Name	Uses	Plant Part (S)
28	<i>Hellenia speciose</i>	Costaceae	Herb	Keol, Belori	Gonorrhea	Rhizome
29	<i>Heracleum candicans</i>	Apiaceae	Herb	Padra	Eczema, skin diseases	Root, Fruit, Seed
30	<i>Himalayacalamus falconeri</i>	Poaceae	Herb	Bans, Himalayan bamboo	Baskets, mats, furniture & other construction, young shoots edible.	Culms
31	<i>Jasminum humile</i>	Oleaceae	Shrub	Sungli, Shanjol	Ring worms, STDs, Skin diseases	Bark, Root, Flower, Leaf
32	<i>Juglans regia</i>	Juglandaceae	Tree	Akhrot	Fruit, furniture, oil for skincare	Fruit, Wood
33	<i>Mallotus philippensis</i>	Euphorbeaceae	Tree	Kamil, Kamlu	Itching, Stomach ache	Seed, Leaf
34	<i>Mentha arvensis</i>	Lamiaceae	Herb	Pudeena	Dysentery, Culinary purposes	Leaf
35	<i>Murraya koenigii</i>	Rutaceae	Tree	Gandheli	Stomach worms in infants, Culinary purposes	Leaf
36	<i>Musa spp.</i>	Musaceae	Herb	Banana	Used in festivals and ceremonies, fruit is consumed directly, mats, baskets etc.	Leaf, Flower, Fruit
37	<i>Myrica esculenta</i>	Myricaceae	Tree	Kaphal	Fruit for pickle, jam and chutneys, timber, fuelwood	Fruit, Wood
38	<i>Ocimum sanctum</i>	Lamiaceae	Shrub	Tulsi	Fever, Cough, Cold	Whole plant
40	<i>Picrorhiza kurroa</i>	Scrophulariaceae	Herb	Kutki	Fever, digestion, cultural, flavoring agent	Root, Rhizome, Whole plant
41	<i>Pinus roxburghii</i>	Pinaceae	Tree	Chir	Bark used as cast for cattle fracture, fuel	Bark
42	<i>Podophyllum hexandrum</i>	Podophyllaceae	Herb	Bankakri	Hoof diseases	Root
43	<i>Populus ciliata</i>	Salicaceae	Tree	Neeru	Timber, fuelwood, bark and leaves for fever and pain	Bark, Leaf, Wood
39	<i>Prinsepia utilis</i>	Rosaceae	Shrub	Bhekkoi	Boils	Root
45	<i>Prunus armeniaca</i>	Rosaceae	Tree	Chula	Headache	Seed
46	<i>Prunus persica</i>	Rosaceae	Tree	Aadu	Seed coat for acne	Seed
44	<i>Punica granatum</i>	Lythraceae	Shrub	Damoi, Anar	Gastric	Fruit
47	<i>Pyrus pashia</i>	Rosaceae	Tree	Kainth	Cough, fever, fuelwood, timber, jams and pickles	Fruit, Wood
48	<i>Quercus leucotrichophora</i>	Fagaceae	Tree	Banj oak	Scorpion bite, fodder	Leaf
49	<i>Rauvolfia serpentina</i>	Apocynaceae	Shrub	Sarpgandha	Powder of roots used for hypertension	Root
50	<i>Rhododendron arboretum</i>	Ericaceae	Tree	Burans	Dysentery, blood coolant	Flower
51	<i>Rubus ellipticus</i>	Rosaceae	Shrub	Aakhe, Ishav	Edible fruit	Fruit
52	<i>Rubus niveus</i>	Rosaceae	Shrub	Kali achoi, Heesar	Wounds	Root
53	<i>Sapindus mukorossi</i>	Sapindaceae	Tree	Reethachilka	Hair tonic	Seed

Sr	Botanical Name	Family	Habit	Vernacular Name	Uses	Plant Part (S)
54	<i>Senegalia catechu</i>	Fabaceae	Tree	Khair	Diarrhea, cough, fever	Leaf, Bark
55	<i>Siegesbeckia orientalis</i>	Asteraceae	Herb	Dudhla	Snake bite	Root
56	<i>Terminalia bellirica</i>	Combretaceae	Tree	Baheda	Piles, urinary disorders, liver problems	Bark, Fruit, Seed
57	<i>Terminalia chebula</i>	Combretaceae	Tree	Harad	Constipation, diarrhea, and indigestion	Fruit
58	<i>Tinospora cordifolia</i>	Menispermaceae	Shrub	Giloy, guduchi	Jaundice, diabetes	Stem
59	<i>Toona ciliata</i>	Meliaceae	Tree	Tun, Toon, Tooni	Hair oil to cure baldness, fodder	Bark
60	<i>Trianthema portulacastrum</i>	Aizoaceae	Herb	Panchphuli	Fever, skin diseases, leafy vegetable	Leaf
61	<i>Tribulus terrestris</i>	Zygophyllaceae	Herb	Gokhru	Uterine tonic, vegetable	Fruit, Root, Whole plant
62	<i>Urtica ardens</i>	Urticaceae	Herb	Kushka	Skin diseases	Root
63	<i>Viola pilosa</i>	Violaceae	Herb	Vanafsa	Fever, Cold	Flower
64	<i>Withania somnifera</i>	Solanaceae	Shrub	Ashwagandha	Stress, anxiety, inflammation, flavoring agent and cultural use	Root, whole plant
65	<i>Zanthoxylum armatum</i>	Rutaceae	Shrub	Timru, Timbur	Stem used as toothbrush, toothache	Stem, seed

Table 3. Most common plants used by local women in JaunsarBawar

Plant common name	Method of usage
Aadu	The shell or seed coat of the seeds is grinded as fine paste to be used as scrub and face mask as pimple and acne cure.
Brahmi	The boiled leaves are applied on forehead to cure headache.
Chulu	The oil extracted from the seeds is believed to be hot in nature thus massaged on pregnant women body.
Gandheli	The extract of the leaves are given to young children to kill stomach worms.
Golda	The roots are crushed and applied on the snake bite.
Kashmoi	The roots are dried and consumed empty stomach to control blood sugar level. Extracted juice also cures red eyes and other eye infections.
Shilpada	Kidney and gall bladder stones are cured by the juice of boiled roots.
Timru	Leaves are dried and kept for years and used to cure toothache.

3.1.5 Fuelwood

Most preferred plant species used for making charcoal, heating chullahs, water heating and cooking are-

Pinus roxburghii (Vernacular name Chir) belongs to family Pinaceae. *Pinus roxburghii*, known as Himalayan Long Leaf Pine, is a significant gregarious forest type found in the Himalayan range's middle altitudes of 1000m to 2000m. It is commonly found on dry, sun-facing hillsides where other tree species cannot thrive. Because of its high resin content, the tree wood is a good

fuelwood resource. However, the same property makes its needle litter extremely inflammable [43]. The resinous wood is called chilla in the region and is collected by locals for fuelwood since ages.

Quercus leucotrichophora (Vernacular name: Banj oak) belongs to the family Fagaceae. Oak is an economically important firewood tree species found in warm broadleaf forests, evergreen oak forests, and cool mixed broadleaf forests at various altitudes. Oak firewood is extensively used for heating and cooking in both urban and rural homes due to its high calorific content and

accessibility [44]. Oak logs split easily and are easier to light. These trees are readily available in the region and are lopped in the winter season by the local people because they are dormant in that season.

3.1.6 Fodder

Most preferred plant species used to feed domestic animals are:

Grewia optiva (vernacular name: Bhimal) belongs to the family Malvaceae. *G. optiva* is a small to medium-sized tree of 9–12 m in height, with a clear bole of 3–4 m and a spreading crown. A mature tree has a spreading crown, reaching a height of up to 12 m, a clear bole of 3–4 m, and a girth of approximately 80 cm. The Bhimal tree is a valued asset to the local community due to its numerous benefits. The tree's leaves provide excellent fodder for cattle [45].

Quercus leucotrichophora (vernacular name: Banj oak) belongs to the family Fagaceae. *Q. leucotrichophora* is usually found between 1400 and 2200 m.a.s.l. in the Himalayas. The tree is moderate in size to big evergreen with a slightly rounded crown that attains a height of 20 m and a diameter of 60 cm, seldom reaching 30 m in height and 100 cm in diameter. The tree has been extensively lopped for fodder and is considered to be of good quality [46]. It is the most common species whose leaves are collected for fodder at all three study sites. Branches are lopped throughout the annual seasons except March–April between 3:00 and 8:00 p.m. Tips and branches above 15 cm are to be retained.

Within the documented data, different plant parts used for the various categories mentioned above are leaves (28.1%), wood (20.3%), seeds (15.6%), bark (14.06%), flowers (7.8%), stems (4.6%), and rhizomes (3.1%). 9.3% of the total species is used as a whole plant (Fig. 6).

Some of the traditional plant use methods being observed and explored through interaction with the older women of upper age class in the region are listed in Table 3.

Future research avenues provide researchers with several opportunities to study local plant and animal species. Socioeconomic factors can be calculated for services. Ecotourism can boost the

economic incentives for conservation operations while also benefiting local communities in the area. Policies that encourage local empowerment in natural resource management while simultaneously protecting traditional knowledge systems must be created. Additionally, because the study area is isolated and its narrow, curving roadways are prone to calamities like landslides, researchers can develop tactics to deal with issues like language barriers, as two-fourths of the respondents speak only Jaunsari natively. To prevent any detrimental effects on the local population, cultural awareness must be ensured [47].

4. CONCLUSION

Changes in plant usage may not influence knowledge immediately but can lead to long-term changes. Due to a lack of modern facilities, the JaunsarBawar region retains access to traditional knowledge, which is mostly used for everyday activities. Notable findings from this study show that residents in the more isolated hamlet know and consume more plants than people in more accessible settlements. Knowledge of incorporating cultural norms and customs into conservation strategies is required to achieve more inclusive and successful conservation outcomes. Threats can be detected and conservation strategies can be developed with the help of continuous research and monitoring of the region's plant diversity.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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