Ethnobotanical survey of lesser-known economic plants in the Chamba region of the Western Himalaya, Uttarakhand, India

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Research

Abstract

Background: The Chamba region of the Western Himalaya in Uttarakhand, India, is enriched with traditional knowledge and is a treasure house of various significant ethnomedicinal plants. Although few plant species have been explored, yet most of these plants are still unexplored and undocumented, based on lesser-known economic plants and sustainable development perspectives. This scarcity of information about conservation strategies and management plans poses serious hazards to the economic potential of ethnomedicine, a valuable treasure trove of plants. Globally this study is crucial because it addresses broader issues like biodiversity loss, climate change, malnutrition, and the need for sustainable resources. The ambition of this research is to document the lesser-known economic plants through an ethnobotanical survey and investigate the factors contributing to these economic plants being unpopular. The study creates awareness, therefore, encouraging self-employment and revenue production through the cultivation of lesser-known economic plants in the area.

Methods: An ethnobotanical investigation was carried out in 8 representative villages in the Chamba region (namely Arakot, Chopariyal Gaon, Dharsal Gaon, Dobhal, Pursol, Weer, Dargi, and Saundkoti), where traditional practices are most common among all the local inhabitants. The frequent periodical field trips were made up to three times a month during the flowering and fruiting season. Various methods were utilized (questionnaires, personal observation, meetings, group discussions, and distinct interviews) to acquire information about lesser-known economic plants from local inhabitants, including 124 key informants (86 females and 38 males). The data interpretation is done through quantitative analysis indices like use value (UV), informant consensus factor (ICF), and fidelity level (FI). The various questions were used to find out the reason behind the lesser-known economic plants and awareness for self-employment and revenue production through the cultivation of lesser-known economic plants.

Results: This study documented that 40 medicinal plant species represented 37 genera and 24 families. Out of these, 35 plants were categorised as 'lesser-known economic plants,' while 5 were classified as ‘very lesser-known economic plants.' The local inhabitants utilized various plant parts, including roots (19.15%), leaves (38.29%), flowers (19.15%), fruits (7.44%), whole plant (1.07%), seeds (6.38%), barks (4.25%), stem (1.07%), twig (1.07%), and latex (2.13%), for both ethnomedicinal and economic purposes. The modes of preparation included extract (30%), decoction (17.5%), paste (17.5%), infusion (2.5%),

powder (5%), juice (10%) and others (17.5%). The study also found that herbs accounted for 60% (24 species), and shrubs for 35% (14 species), with one tree and one climber each making up 2.5% of the total species documented.

Conclusions: This present study documented traditional knowledge and uncovered various reasons for the lesser-known status of economic plants. This invaluable conventional knowledge can be used to educate local communities, create significant self-employment opportunities, boost revenue production, and improve livelihoods through the cultivation of lesser-known economic plants and the conservation of plant diversity.

Keywords: Lesser-known economic plants, Western Himalaya, Local communities, Traditional knowledge, Self-employment, Income generation, Cultivation, Livelihoods

Background

Globally, nutritional insecurity is affecting the world population, primarily those who depend on cereal- based diets. Approximately 691 to 783 million people suffered from severe food insecurity and malnutrition in 2022, which is 122 million greater than the 2019 pandemic report (FAO 2023; UNICEF 2023). According to the World Health Organization (WHO), close to 80% of the global population receives basic medical treatment from traditional medicine (Azaizeh *et al.* 2003; Alemu *et al.* 2024). There is little information about some economic plant species due to insufficient scientific investigations. However, the rural community is knowledgeable of the importance and benefits of these plants. Various natural plants have improved local communities' livelihoods. Importantly, some of these plants are used differently in foods, flavors, cosmetics, fragrances, pharmaceuticals, and textiles (Tomar & Singh 2021; Garg *et al.* 2024). The growing interest in wild edible plants (WEPs) has catalyzed various regional ethnobotanical studies, even in current communities (Choudhary *et al.* 2008; Goyal & Sharma 2009; Khadka *et al.* 2024).

On this planet, 75-80% of people still utilize herbal medicine as their main source of treatment, especially in underdeveloped countries. Herbal medicine is perceived as cultural, harmoniously interacts with the body, and has fewer occurrences of adversities (Kamboj 2000). Herbal medicines have been used since time immemorial and are considered safe and non-toxic (Kumar *et al.* 2021). However, understanding the influence of herbal medicine remains uncertain, primarily due to the lack of documentation by traditional healers regarding these ancient practices (Chakraborty *et al.* 2016). The indigenous people living in isolated regions depend primarily on traditional medicinal practices to treat their illnesses (Patro 2016). However, the popularity of traditional remedies is slowly reducing as a result of the quick urbanization and availability of allopathic facilities (Das & Misra 1988).

India is renowned as one of Asia's significant mega-biodiversity hotspots. The Himalayan region, which covers 18% of the country's land area, harbors over 40% of unique species and more than 50% of its forests. This area has a rich biodiversity, being home to over 3,000 wild plants, which provide supplementary nutritious diets for various communities, showcasing its economic and ecological significance (Anon 1994). Today, generational experience has deepened the understanding of herbal therapy in every culture around the world (Al-Snaf 2016). The majority of the medicinal chemicals utilized in traditional medicine come from plant products (Khond *et al.* 2009; Bandow *et al.* 2003). Traditional methods, including medicinal plants, are used by millions of people around the world for trade and as a source of income (Malik *et al.* 2011; Rather & Baba 2015).

The Himalaya offers a wide range of ecological significance both in flora and faunal diversity. As of current, it faces several threats including excessive use of resources. This has decreased the vegetation structure and resulted in natural disasters (Bisht *et al.* 2022). Natural plant resources are essential to the food security, health, and economic stability of a region. People in rural Himalayan, depend on a diverse range of natural resources for their livelihoods, animal husbandry, and limited-scale agriculture acting as the key contributions to their economies (Kala 2005; 2007). The local population derives their income from harvesting and selling medicinal plants sourced from forests (Seth 2003; Adnan & Holscher 2011). Traditional knowledge gathered indicates that 229 plants are used for fuel, food, fiber, timber, beverages, tannin, crafts, resin, dye, sacred groves, medicine, fodder, and cosmetics (Jadhav 2006).

The Garhwal Himalaya is renowned for its extensive legacy of wild edible plants. The region has a rich flora and fauna, despite its social and cultural diversity. These God-given forest products contribute towards households' daily necessities as well as other requirements in this region (Shrestha & Dhillon 2006; Das *et al.* 2022). The rural Himalayan people depend on a variety of ecological resources for their everyday survival. Agriculture is the main source of their economy (Kala 2005; 2007; Bijalwan 2011). Currently, the majority of ethnic communities in underdeveloped countries depend on wild flora daily. Approximately

20,000 species of WEPs have been recognised globally. Of these, 1,532 WEP species are found in India, and more than 675 species are specifically in the Himalaya region (Abbasi *et al.* 2013; Pal *et al.* 2014).

Forest dwellers and other tribal people rely on native knowledge, which cascaded from their elders and perpetuated to future generations. They harvest wild edible plants for both commercial and personal usage. This provides a better income for the tribal people (Guha 1983; Berkes 2004; Kala 2005). There are varieties of edible plant parts, which include, roots, stems, fruits, tubers, inflorescences, flowers, seeds, thallus, and fruiting bodies. These can be eaten raw, roasted, fried, cooked, boiled, or stored for an extended duration of time in the form of oil, spices, seasonings, pickles, and jams. Most importantly wild edible plants are unique to places and communities (Negi 1986; Samant *et al.* 2001).

Several studies have shown the cultivation and sustainable harvesting of *Saussurea lappa* and *Picrorhiza kurrooa*, therefore, showing their economic importance both in the market and in the rural economy (Kuniyal *et al.* 2013; Singh *et al.* 2024). A study on the women-centric approach of medicinal plants recorded 34 medicinal plant species belonging to different families (Joshi & Bhardwaj 2017). Seventy-three wild edible plant species have been identified in the Jaunpur region of Uttarakhand, signifying their importance to human well-being (Dangwal & Lal 2024). Recently Lal *et al.* 2024, documented the 30 ethnomedicinal plants used to cure diarrhea and dysentery.

Despite its natural beauty and cultural background, the Chamba region of Tehri Garhwal Uttarakhand state remains unexplored with regard to known economic plant species. This study aims to provide insights into biodiversity preservation and economic prosperity of natural resources. With these in mind, the present study documented the lesser-known economic plants through an ethnobotanical surveys and investigated the factors contributing to these economic plants being unpopular. The study creates awareness, therefore encouraging self-employment and revenue production through the cultivation of lesser-known economic plants in the study area.

Materials and Methods

Study area

The current investigation was conducted in the Chamba block, Tehri Garhwal, Uttarakhand. It is very unique and rich in vegetation, encapsulating a diverse range of habitats from 400-2000m above sea level (Dangwal 2016). Geographically, this area comprises 34,832 hectares, which is equivalent to 6.96% of the overall land area of the district. It is located between 30° 26′ to 30° 40′ N latitude and 78° 36′ to 78° 55′ E longitude (Dangwal *et al.* 2010).

The Chamba block is bounded by Narendranagar to its south, Jaunpur to the west, Pratapnagar to the north, and Jakhanidhar to its east, all within the Tehri district (Sharma 2005). The study area experiences a climate ranging from subtropical to temperate zones (Mishra 1968). The area is hilly in nature, with an average minimum temperature of 9.55° and a maximum temperature of 19.47°C, respectively, and the average annual rainfall is 108.88 mm (Dobhal *et al.* 2023).

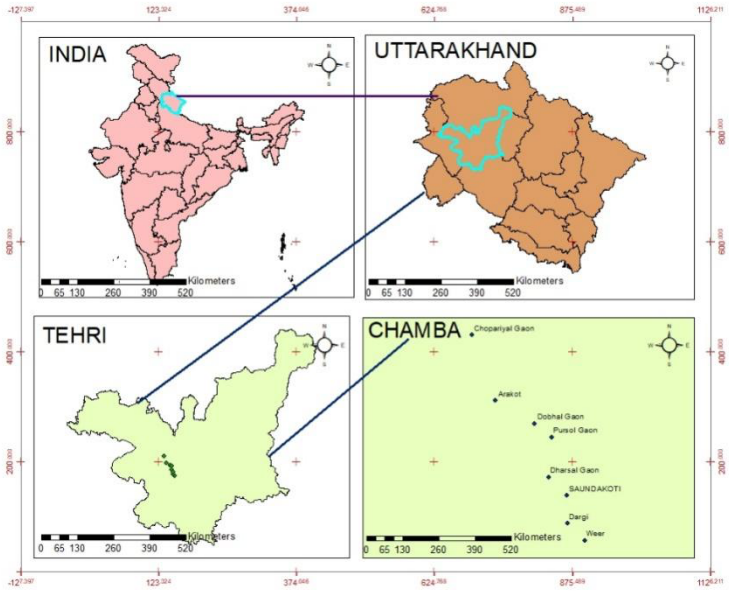


Figure 1. Map of the study area

Data collection

The intensive field survey was carried out during the period of March 2024 to July 2024 in the Chamba region, Tehri district to gather information about the lesser-known economic plants. During this period, an investigation was conducted in 8 villages in the block, i.e. Arakot, Chopariyal Gaon, Dharsal Gaon, Dobhal, Pursol, weer, Dargi, and Saundkoti. The periodic field trips were made up to thrice a month during the flowering and fruiting season. The data were collected from the local inhabitants through various methods like questionnaires, personal observation, meetings, group discussions, and distinct interviews (Figure 2). The main key respondents were 124 in number, including 86 women and 38 men. Most of the local informants were primarily farmers, with others including government employees, educators (teachers, Anganwadi workers, etc.), shepherds, traditional healers (vaidyas), shopkeepers, priests (pujari), students, and retired service members. Various age groups (20-90) were engaged to record their knowledge about these plants to ensure authentic information.

Figure 2. (a-b). Information gathered from local informants of different locality (c). Information gathered from Vaidya in Chamba region (d-f) Information gathered from local informants at various villages

The survey of lesser-known economic plants mostly focused on answering the following questions to find out the reason behind the lesser-known economic plants in the study region.

1. Can you describe some of the plants that grow naturally in this area and how you use them?
2. What local, social, cultural, and economic values are associated with these plants?
3. Are any of these plants sold or traded locally?
4. Do younger generations in your community know about these plants and their uses?
5. Have you noticed any plants becoming less common or harder to find?
6. Are there any local markets or businesses that specialize in products made from these plants?
7. What challenges do you face in cultivating, growing, and harvesting these plants?
8. Are there any barriers or challenges to marketing these plants more widely, such as lack of awareness or access to markets?

The awareness campaign was conducted in these representative villages such as Arakot, Chopariyal Gaon, Dharsal Gaon, Dobhal, Pursol, weer, Dargi, and Saundkoti to educate, motivate (through various cultivation techniques i.e. Propagation, grafting, layering, cutting, growing of seeds) and spread knowledge of valuable lesser-known economic plants for promoting the self-employment opportunities and revenue production among all the local inhabitants residing in the study region.

Identification of collected plants

All the collected plant specimens were accurately characterized by using relevant flora and validated from regional herbaria at the Botanical Survey of India, Northern Circle (BSD), Dehradun. The standard survey methods outlined by Jain & Rao (1977) and Singh & Subramaniyam (2008) were implemented for the collection, maintenance, and preservation of specimens (Figure 3). The collected plant specimens were deposited in the H.N.B. Garhwal University, S.R.T. Campus, Badshahithaul, Department of Botany, SRTGUH Herbarium.

Data Interpretation

The data interpretation is done through quantitative analysis indices like use value (UV), informant consensus factor (ICF), and fidelity level (FI).

It is utilized to determine the importance of different plant species in the region and provide help to estimate the significance of UV, ICF, and FI of plant usage within the community (Phillips *et al.* 2002).

$$= \sum U/\mathrm{n}$$

Use value (UV), is defined as the "number of local informants (n), frequency of use reports for a particular plant species (U). Informant consensus factor is employed to assess the degree of consensus among informants regarding the use of ethnomedicinal plants, particularly when ailments are classified into different classes of disease groups (Heinrich *et al.* 1998). It was calculated by using this formula

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

The Informant Consensus Factor (ICF) as "Nt", is the total number of used taxa "Nur" is the number of use reports utilized for specific diseases.

The Fidelity Index (FI%) was calculated by using this mathematical formula introduced by (Friedman *et al.* 1986).

$$FI = \frac{Np}{N} \times 100$$

The fidelity index value (FI%) is calculated as "N", entire number of use reports for plant species, and “Np”, use reports for several illnesses.

Figure 3. (a). Collection of plant specimens (b). Drying of plant specimens (c). Poisoning of plant specimens (d & e). Stitching and Mounting (f). Labelling of herbarium sheets

Results and Discussion

The present study documented 40 plant species of lesser-known economic plants representing 37 genera and 24 different families. The most dominant families were Asteraceae and Lamiaceae (5 species each), followed by Amaranthaceae and Rosaceae (4 species each) followed by Polygonaceae and Euphorbiaceae (2 species each), followed by Asparagaceae, Berberidaceae, Cannabaceae, Coriariaceae, Anacardiaceae, Solanaceae, Moraceae, Araliaceae, Fabaceae, Acanthaceae, Malvaceae, Nyctaginaceae, Oxalidaceae, Plantaginaceae, Ranunculaceae, Caprifoliaceae, Scrophulariaceae and Lythraceae (1 species each) (Table 1, Figure 4). In which herbs were 24 (60%), shrubs were 14 (35%), and there was 1 tree and 1 climber, each making up 2.5% (Table 1, Figure 5). The local inhabitants utilized specific plant parts such as roots (19.15%), stem (1.07%), twig (1.07%), barks (4.25%), latex (2.13 %), leaves (38.29%), flowers (19.15%), fruits (7.44%), whole plant (1.07%), and seeds (6.38%) for ethnomedicinal and economic uses (Table 1, Figure 6). Among the various economic uses, 35 plants fall under the category of 'Lesser-known economic plants,' while 5 fall under 'Very lesser-known economic plants (Table 1, Figure 7). These are several modes of preparation were utilized in different modes such as infusion (2.5%), decoction (17.5%), extract (30%), paste (17.5%), powder (5%), juice (5%), and others (17.5%) (Table 1, Figure 8). Other significant economic uses include fodder for livestock, furniture, fuel, ornamental purposes, rituals and ceremonies, crafts, pesticides, skincare products, natural dyes, sacred groves, juice, vegetables, salads, tea, desserts, soups, spinach, dishes, beverages, perfumes, jams, jellies, shampoo, toothbrushes, aromatic oils, musical instruments, curries, chutney, candies, and agricultural implements for indoor house plant growth.

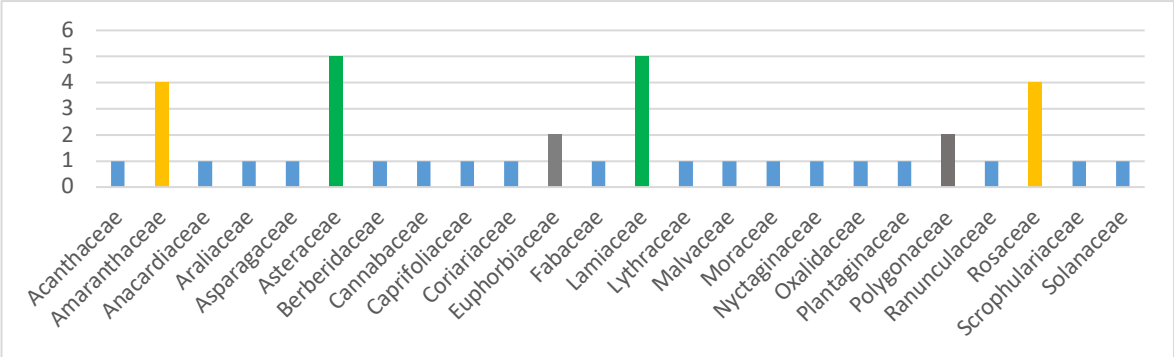


Figure 4. Graph chart showing the number of species in different families

Use value of medicinal plants

Based on their use value, the most valuable and important ethnomedicinal plants are categorized into three groups in the present study site. In group i category, UV= >0.80 use value were: *Ajuga parviflora* (UV=0.99), *Asparagus racemosus* (UV=0.87), *Ficus palmata* (UV=0.84), *Rumex hastatus* (UV=0.97), *Rumex nepalensis* (UV=0.83). In group ii category, UV= 0.60 to 0.80 were: *Amaranthus spinosus* (UV=0.66), *Berberis aristata* (UV=0.72), *Bidens pilosa* (UV=0.65), *Cotinus coggygria* (UV=0.75), *Erigeron emodi* (UV=0.60), *Eupatorium adenophorum* (UV=0.76), *Euphorbia helioscopia* (UV=0.75), *Gerbera gossypina* (UV=0.62), *Oxalis corniculata* (UV=0.78), *Plantago major* (UV=0.64), *Potentilla indica* (UV=0.60), *Ricinus communis* (UV=0.79), *Valeriana wallichii* (UV=0.69). In group iii category, UV= <0.60 were: *Achyranthes aspera* (UV=0.59), *Ajuga bracteosa* (UV=0.33), *Amaranthus caudatus* (UV=0.40), *Cannabis sativa* (UV=0.52), *Chenopodium album* (UV=0.37), *Coriaria napalensis* (UV=0.46), *Datura stramonium* (UV=0.44), *Hedera nepalensis* (UV=0.43), *Indigofera heterantha* (UV=0.45), *Justicia adhatoda* (UV=0.21), *Leucas lanata* (UV=0.46), *Malva parviflora* (UV=0.54), *Mirabilis jalapa* (UV=0.41), *Prinsepia utilis* (UV=0.28), *Rosa brunonii* (UV=0.53), *Rubus ellipticus* (UV=0.53), *Salvia lanata* (UV=0.50), *Sonchus asper* (UV=0.21), *Thalictrum foliolosum* (UV=0.59), *Verbascum thapsus* (UV=0.45), *Vitex negundo* (UV=0.25), *Woodfordia fruticosa* (UV=0.25) (Table 1, Figure 9).

Informant consensus factor

(a). Respiratory disease: Cold (ICF=0.96), Cough (ICF=0.96), Asthma (ICF=0.96), Bronchitis (ICF=0.95), (b). Gastrointestinal disease: Diarrhea (ICF=0.96), dysentery (ICF=0.94), stomach pain (ICF=0.96), indigestion (ICF=0.97), stomach ulcer (ICF=1), tuberculosis (ICF=1), constipation (ICF=1), (c). Cardiovascular disease: Blood Pressure (ICF=1), (d). Neuro-related diseases: Headache (ICF=1), insomnia (ICF=1), (e). Musculoskeletal and pain: Muscle pain (ICF=1), arthritis (ICF=1), (f). Reproductive health: Menstrual cycle (ICF=1), infertility (ICF=1), (g). Kidney function (ICF=0.97), (h). Infection and wound care: Urinary tract infection (ICF=0.96), bacterial and fungal infections (ICF=0.91), wounds (ICF=0.98), cuts (ICF=1), (i). Skin disease: Skin infection (ICF=0.98), eczema (ICF=1), dermatitis (ICF=1), rashes (ICF=1), (j). Others: Fever (ICF=0.96), diabetes (ICF=1), inflammation (ICF=0.96), eye disease (ICF=1), malaria (ICF=1), insect bite (ICF=0.95), HIV/AIDS (ICF=1), snake bite (ICF=1), and cancer (ICF=1), (Table 2, Figure 8).

Table 1. The list of important medicinal plants found in the Chamba block along with their Botanical name, Family, Local name, Habit, Part used, Ethnomedicinal uses, Use value, Other uses, and Economic value

Botanical name (Voucher No.)	Family	Local name	Habit	Part used	Ethnomedicinal uses	Use value	Other uses	Economic value
Achyranthes aspera L. **BB-SRTGUH-1539**	Amaranthaceae	**Latjiri/ Chaff-flower**	H	Lf, Tw, Rt	Decoction of twigs and leaves was added with honey and given orally to a person for curing the diarrhea (62) and dysentery (12).	0.59	Extract of roots are used as a natural dye. Leaves are used as fodder for livestock.	LKEP
Ajuga bracteosa Wall. ex Benth. **TL-SRTGUH-1661**	Lamiaceae	**Ratpatia**	H	Lf, Rt	Paste of leaves is applied to relieve from headache (23), and decoction of roots are used to treat fever (18).	0.33	Infusion of leaves and roots was utilized to make herbal tea.	LKEP
Ajuga parviflora Benth. **TL-SRTGUH-1706**	Lamiaceae	**Neelkanthi**	H	Lf, Fl, Rt	Extract of leaves was used to treat diabetes (45) and reduce fever (17). Flowers were used to treat diarrhea (26) and dysentery (10). Roots extract alleviate digestive problems (6), stomach pain (13), and indigestion (12).	0.99	The plant serves as fodder for livestock, with its young leaves eaten as a green vegetable or added to salads.	LKEP
Amaranthus caudatus L. **BB-SRTGUH-1533**	Amaranthaceae	**Marshu**	H	Lf, Sd, Fl	Leaves juice is used to treat diarrhea (23), and inflammation of the mouth and throat (27). Seeds are edible and rich in protein, nutrients and antioxidants.	0.40	Flowers are used for ornamental purposes in gardens.	LKEP
Amaranthus spinosus L. **BB-SRTGUH-1511**	Amaranthaceae	**Sagoti**	H	Lf, Sd	A warm paste of leaves, peach seeds, and salt is used to treat unhealthy stomach ulcers (5). Also promotes urine production (31), supports kidney function (12), and helps regulate excessive menstrual bleeding (35).	0.66	The young leaves are edible, consumed as a vegetable, and added to salads. It is also used as animal feed.	LKEP

Asparagus racemosus Willd. **TL-SRTGUH-1749**	Asparagaceae	**Shatavar**	S	Rt, Lf	Roots were used to improve female reproductive health, including treating infertility (52) and regulating the menstrual cycle (28). Leaves and flowers help to treat urinary tract infection (16) and diarrhea (12).	0.87	Young shoots are edible and cooked as vegetables.	VLKEP
Berberis aristata DC. **BB-SRTGUH-1541**	Berberidaceae	**Kingoda**	S	Rt, Lf, Br, Fr	Root extract is used as eye drops for eye disease (15). Leaves juice is used for jaundice (62). Bark is used to cure a variety of bacterial (6) and fungal infections (7).	0.72	The juicy, sugar-rich bright, red berries are commonly eaten as a dessert.	VLKEP
Bidens pilosa L. **TL-SRTGUH-1826**	Asteraceae	**Saryala**	H	Lf, Fl	Leaves are antidiabetic (5), helping to regulate blood sugar levels and are also used to reduce inflammation (25) and treat wounds (37). Flower extract is used to treat malaria (14).	0.65	Leaves and flowers are used in salads, soups, and herbal tea. Entire plant extract is used for natural skincare products.	LKEP
Cannabis sativa L. **BB-SRTGUH-1535**	Cannabaceae	**Bhang**	H	Rt, Lf, Fl, Sd	Leaves paste is used for insect bites (16) and wounds (23). Flowers (buds) help to stimulate appetite in conditions like HIV/AIDS (15) and cancer (6). Roots treat inflammation (3) and pain (2).	0.52	Dry leaves are commonly used in smoke. Seed oil helps with cooking and skin care products like lotion, soap, etc.	LKEP
Chenopodium album L. **BB-SRTGUH-1537**	Amaranthaceae	**Bethoo**	H	Sd, Lf	Leaves used for intestinal disorder (26), anti-inflammatory (13), and treating scurvy. Rich in Vitamin C. Green vegetable used in bladder stone (8).	0.37	Seeds are used in gruel-type dishes.	LKEP

Coriaria napalensis Wall. **BB-SRTGUH-1542**	Coriariaceae	**Masuri**	S	Lf, Br, Fr	Extract of bark and leaves used traditionally as insecticides and in pest control. Fruits treating rheumatism (37) and skin disorder (21).	0.46	The plant is used for ornamental purposes, cultivated for its attractive foliage and flowers, which enhance landscaping and garden aesthetics.	LKEP
Cotinus coggygria Scop. **TL-SRTGUH-1658**	Anacardiaceae	**Dhakda**	S	Lf, Br, Fl	Leaves are frequently used to treat mucosal lesion (15). Bark treats fever (24), urinary disease (33), and liver disease (21).	0.75	The plant is cultivated for ornamental purposes in gardens and landscaping due to its pinkish blooms. It is also used as fuel.	LKEP
Datura stramonium L. **MP-SRTGUH-1563**	Solanaceae	**Dhatura**	H	Lf, Fl, Sd	Leaves, flowers, and seeds mixtures were used to treat asthma (17), cough (22), and cold (16).	0.44	Plants help to control insect pests in agriculture.	LKEP
Erigeron emodi I.M.Turner **BB-SRTGUH-1538**	Asteraceae	**Himalayan Daisy**	H	Lf, Fl	Leaves and flowers are utilized for treating cold (23), cough (25), bronchitis (27).	0.60	Due to its attractive flowers, it is grown as an ornamental plant in gardens and landscapes.	LKEP
Eupatorium adenophorum Spreng. **BB-SRTGUH-1536**	Asteraceae	**Kala Bansa**	S	Lf	Extract of leaves applied externally to treat wounds (53), and skin infections (42).	0.76	Plants used for fuel and ornamental purposes.	LKEP
Euphorbia helioscopia L. **MP-SRTGUH-1570**	Euphorbiaceae	**Dudhi**	S	Lf, Lt	Leaves were used to treat cold (27), asthma (16), bronchitis (12), and snakebite (7). small amounts of the latex were ingested to treat intestinal parasite (31).	0.75	Plant are used for ornamental purposes for their unique appearance.	LKEP
Ficus palmata Forssk. **BB-SRTGUH-1503**	Moraceae	**Bedu**	T	Lf, Lt, Fr	Decoction of leaves are used to treat respiratory issues such as cough (37). The latex from the tree is used to control bleeding (68) and remove spine.	0.84	The fruits are edible, eaten fresh, and also used to make jam and jellies.	LKEP

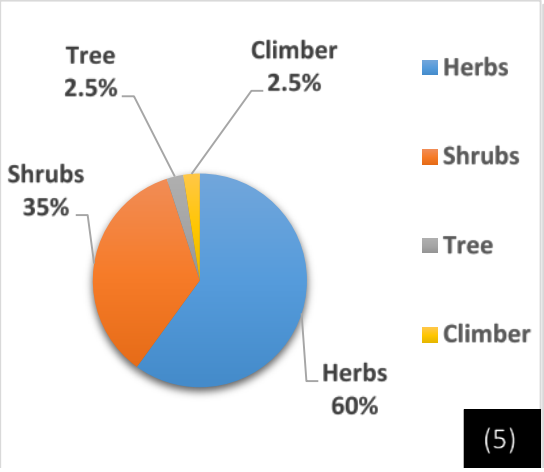
Gerbera gossypina (Royle) Beauverd **BB-SRTGUH-1526**	Asteraceae	**Jhulu**	H	Rt, Fl	The paste of roots is traditionally used for skin infection such as ringworm and other fungal infection (32). The flowers are utilized to alleviate cough (16), cold (15), and bronchitis (14).	0.62	The plant is widely cultivated for its vibrant flowers and is popular in gardens and floral arrangements.	LKEP
Hedera nepalensis K.Koch **TL-SRTGUH-1611**	Araliaceae	**Banaksha**	C	Lf	The extract of leaves is applied to inflamed areas to reduce swelling (37) and pain (17).	0.43	Plant growth indoors helps improve air quality by absorbing pollutants and increasing oxygen levels in the environment.	LKEP
Indigofera heterantha Wall. ex Brandis **BB-SRTGUH-1517**	Fabaceae	**Kainth**	S	Rt, Lf	Root extract is used to treat digestive disorder including stomachache (23) and indigestion (16). Leaves help to treat gastrointestinal and abdominal disorder (17).	0.45	Plant is used as fodder for livestock.	LKEP
Justicia adhatoda L. **TL-SRTGUH-1732**	Acanthaceae	**Baisingu**	S	Lf, Rt, Fl	Leaves extract helps to clear mucus from the respiratory tract, making it easier to breathe and also treat tuberculosis (5). Decoction of roots are used to improve digestion (22) and treat gastrointestinal ailment.	0.21	Flowers used in ritual, and ceremonies, or as offerings.	LKEP
Leucas lanata Benth. **BB-SRTGUH-1506**	Lamiaceae	**Pipswas**	H	Lf, Fl	Paste of leaves are used to treat septic wounds (58).	0.46	Flowers are used in religious or spiritual ceremonies.	LKEP
Malva parviflora L. **TL-SRTGUH-1777**	Malvaceae	**Soncheli**	H	Lf, Fl	Crushed leaves are applied to wounds (17), cuts (16), and insect bites (12). Flowers extract was used to treat sore throats (23) and respiratory issues.	0.54	Flowers extract is used in skin care, helping to moisturize and soothe the skin.	LKEP

Mirabilis jalapa L. **BB-SRTGUH-1532**	Nyctaginaceae	**Dophriya**	H	Rt, Lf, Fl	Roots are utilized to treat urinary tract infection (13), while leaves are applied to heal wound (23) and manage skin condition (16).	0.41	Plants are widely cultivated as ornamental plants in gardens and parks for their colorful and fragrant flower. It also helps with coloring the food item.	LKEP
Oxalis corniculata L. **TL-SRTGUH-1649**	Oxalidaceae	**Khati-Buti**	H	Lf	Leaves paste is applied to skin disease (97).	0.78	The leaves are eaten raw in salads and cooked as vegetables.	LKEP
Plantago major L. **BB-SRTGUH-1534**	Plantaginaceae	**Badi Ghass**	H	Sd, Lf	Seeds powder is utilized to treat dysentery (35). While a decoction of the leaves combined with carrier oil is applied to the skin to alleviate eczema (17), dermatitis (15), and rashes (13).	0.64	Leaves are used for eye wash to relieve irritation and redness.	LKEP
Potentilla indica (Andrews) Th.Wolf **BB-SRTGUH-1510**	Rosaceae	**Jangli strawberries**	H	Lf, Fr	Leaves and fruits used to treat digestive disorder such as diarrhea (37), dysentery (16), and stomachache (22).	0.60	The fruits are made into jam, jelly, or eaten raw in salads, and an infusion of leaves is used as herbal tea.	LKEP
Prinsepia utilis Royle **BB-SRTGUH-1523**	Rosaceae	**Bhainkal**	S	St, Lf, Rt, Fr	Stem, leaves, and fibrous roots help to treat oral cavity issues and support blood circulation (35).	0.28	Fruits are used as vegetable.	LKEP
Ricinus communis L. **BB-SRTGUH-1520**	Euphorbiaceae	**Arandi**	S	Lf	The leaves are applied to the breast of nursing mothers to boost milk production (63) and are also used to relieve joint and muscle pain (35).	0.79	The plant is used to make biopesticide effective against various pests and insects.	LKEP

Rosa brunonii Lindl. **BB-SRTGUH-1505**	Rosaceae	**Kunja**	S	Lf, Fl	Juice of leaves and flowers is used to treat skin care and wounds (41). Dried flowers powder was used to treat diarrhea (25).	0.53	Plants cultivated as ornamental in distinct gardens and landscapes. Flowers are used in the production of natural perfumes and aromatic oils.	VLKEP
Rubus ellipticus Sm. **BB-SRTGUH-1518**	Rosaceae	**Hinsar**	S	Rt, Fr	Root paste is applied to ulcers and skin sores (25). Decoction of roots and leaves are used to treat diarrhea (13), dysentery (12), and stomachache (16).	0.53	The fruits are edible and are consumed fresh or used to make jams, jellies, and desserts.	VLKEP
Rumex hastatus D.Don **BB-SRTGUH-1504**	Polygonaceae	**Ameldu**	H	Lf, Rt, Fl	Leaves was treating minor wounds (12), insect bites (15), and skin irritation (21). Roots extract is used to treat like arthritis (31) and other inflammatory disorders (42).	0.97	Infusion of plant (stems, leaves, and flowers) used to make herbal tea. Leaves are used to prepare chutney.	VLKEP
Rumex nepalensis Spreng. **BB-SRTGUH-1530**	Polygonaceae	**Jangli Palak**	H	Lf, Rt	Leaves extract is used to treat digestive issues such as constipation (35) and stomach pain (17). While roots treat urinary problems (51).	0.83	Young leaves are used as a vegetable. They can be cooked and consumed as spinach soups, stews, and curries.	LKEP
Salvia lanata Roxb. **TL-SRTGUH-1614**	Lamiaceae	**Bhatkatiya**	H	Rt, Lf	Decoction of roots used to relieve indigestion (63), and other gastrointestinal discomfort.	0.50	Infusion of leaves are commonly used to prepare herbal tea.	LKEP
Sonchus asper (L.) Hill **BB-SRTGUH-1515**	Asteraceae	**Bichhu Ghas**	H	Wp	The entire plant is used to increase urine production and promote kidney function (27).	0.21	Leaves are consumed as a leafy vegetable and as an edible source of salads.	LKEP

Thalictrum foliolosum DC. **TL-SRTGUH-1827**	Ranunculaceae	**Kirmuli**	H	Rt, Lf	Root extract support liver function and are used to treat liver disorders, including jaundice (35). The leaves are used topically to treat wound (16), cuts (23).	0.59	The plant is used in various craft projects and decorations.	LKEP
Valeriana wallichii DC. **TL-SRTGUH-1635**	Caprifoliaceae	**Jatamansi**	H	Rt, Lf, Fl	Roots are used to promote relaxation, treat insomnia (52), and reduce blood pressure (13). Leaves and flowers improve digestion (21) and relieve gastrointestinal discomfort.	0.69	Plant extract is used in skincare products and perfume production.	LKEP
Verbascum thapsus L. **BB-SRTGUH-1512**	Scrophulariaceae	**Jakhmvir**	H	Lf, Fl	Infusion of leaves are used to make herbal tea and treat respiratory conditions such as cough (18), bronchitis (11), and asthma (27).	0.45	Flowers are used in cosmetic preparation.	LKEP
Vitex negundo L. **TL-SRTGUH-1641**	Lamiaceae	**Shiwali/ Nirgundi**	S	Lf, Fl, Fr	Juice of fresh leaves was used to treat ear disease (7). The consumption of fresh fruit treats the diarrhea (24).	0.25	Flowers are used for ornamental purposes.	LKEP
Woodfordia fruticosa (L.) Kurz **TL-SRTGUH-1666**	Lythraceae	**Dhaula**	S	Fl, Br	Flowers are used to treat dysentery (15) and diarrhea (17). The bark contains tannins and is used in the tanning industry.	0.25	Flowers are used as a refreshing drink.	LKEP

Where, H= "Herbs", **S=** "Shrubs", **C=** "Climber", **T=** "Tree", **Rt =** "Roots", **Lf =** "Leaves", **Tw=** "Twig", **St =** 'Stem", **Fr =** "Fruits", **Wp =** "Whole plant", **Fl =** "Flowers", **Br=** "Barks", **Sd =** "Seeds", **Lt=** "latex", **VLKEP=** "Very Lesser-Known Economic Plant'', **LKEP=** "Lesser-Known Economic Plant'', **UV=** "use value", **U=** "total citation", **n =** "total number of informants



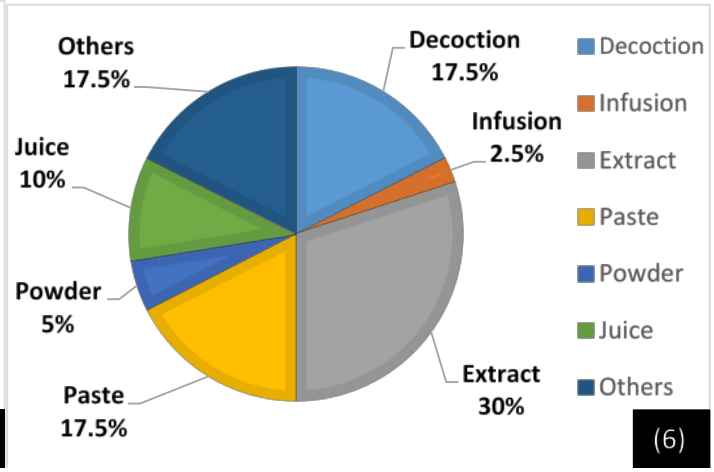
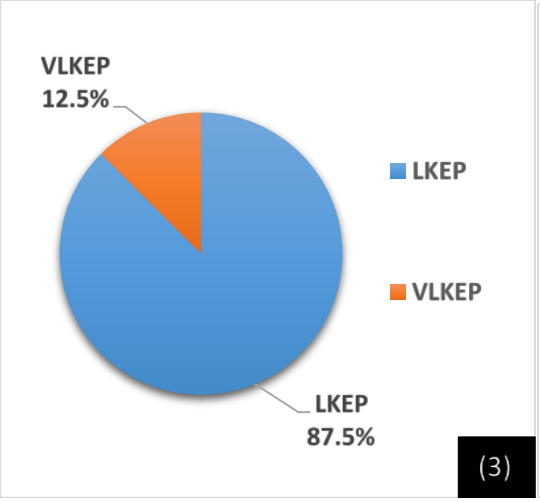


Figure 5 and 6. Pie chart showing the percentage of various habits and several modes of herbal preparation



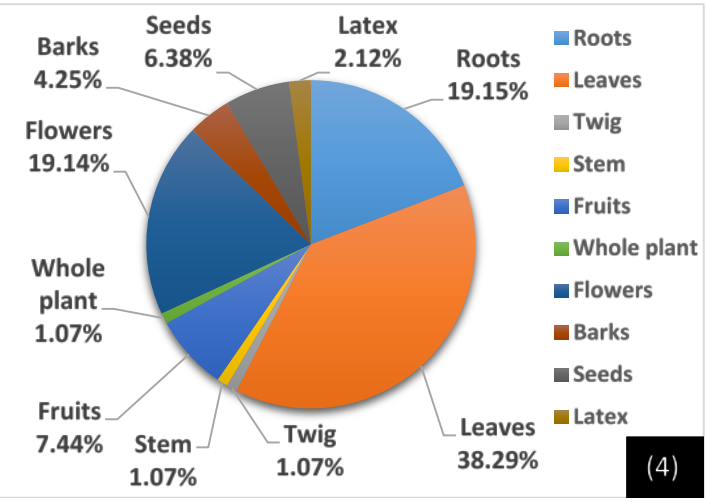


Figure 7 and 8. Pie chart showing the percentage of the economic value of various plants and the percentage of different parts of the plant used

Fidelity index

In this investigation, the fidelity level value was between 5.02% to 100%. To increase the accuracy of cited species, fewer than five respondents were not included in the final study. The fidelity index values for (a). Respiratory disease: Cold viz., *Datura stramonium* (FI=19.75%), *Erigeron emodi* (FI=28.39%), *Euphorbia helioscopia* (FI=33.33%), *Gerbera gossypina* (FI=18.51%), Cough viz., *Datura stramonium* (FI=18.64%), *Erigeron emodi* (FI=21.18%), *Ficus palmata* (FI=31.35%), *Gerbera gossypina* (FI=13.55%), *Verbascum thapsus* (FI=15.25%), Asthma viz., *Datura stramonium* (FI=28.33%), *Euphorbia helioscopia* (FI=26.66%), *Verbascum thapsus* (FI=45%), Bronchitis viz., *Erigeron emodi* (FI=42.18%), *Euphorbia helioscopia* (FI=18.75%), *Gerbera gossypina* (FI=21.87%), *Verbascum thapsus* (FI=17.18%), (b). Gastrointenstinal disease: Diarrhea viz., *Achyranthes aspera* (FI=25.94%), *Ajuga parviflora* (FI=10.87%), *Amaranthus caudatus* (FI=9.62%), *Asparagus racemosus* (FI=5.02%), *Potentilla indica* (FI=15.48%), *Rosa brunonii* (FI=10.46%), *Rubus ellipticus* (FI=5.43%), *Vitex negundo* (FI=10.04%), *Woodfordia fruticosa* (FI=7.11%), Dysentery viz., *Achyranthes aspera* (FI=12%), *Ajuga parviflora* (FI=10%), *Plantago major* (FI=35%), *Potentilla indica* (FI=16%), *Rubus ellipticus* (FI=12%), *Woodfordia fruticosa* (FI=15%), Stomach Pain viz., *Ajuga parviflora* (FI=43.33%), *Rumex nepalensis* (FI=56.66%), Indigestion viz., *Ajuga parviflora* (FI=13.81%), *Indigofera heterantha* (FI=17.58%), *Salvia lanata* (FI=69.23%), Stomach ulcer; *Amaranthus spinosus* (FI=%100), Tuberculosis; *Justicia adhatoda* (FI=100%), Constipation; *Rumex nepalensis* (FI=100%), (c). Cardiovascular disease: Blood Pressure; *Valeriana wallichii* (FI=100%), (d). Neuro-related disease: Headache; *Ajuga bracteosa* (FI=100%), Insomnia; *Valeriana wallichii* (FI=100%), (e). Musculoskeletal and pain: Muscle pain; *Ricinus communis* (FI=100%), Arthritis; *Rumex hastatus* (FI=100%), (f). Reproductive health: Menstrual cycle; *Asparagus racemosus* (FI=100%), Infertility; *Asparagus racemosus* (FI=100%), (g). Kidney function viz., *Amaranthus spinosus* (FI=30.76%), *Sonchus asper* (FI=69.23%), (h). Infection and wound care: Urinary tract infection viz.,

Asparagus racemosus (FI=55.17%), *Mirabilis jalapa* (FI=44.82%), Bacterial and Fungal Infections; *Berberis aristata* (FI=100%), Wounds viz., *Bidens pilosa* (FI=61.66%), *Cannabis sativa* (FI=38.33%), Cuts; *Thalictrum foliolosum* (FI=100%), (i). Skin disease: Skin infection viz., *Eupatorium adenophorum* (FI=43.24%), *Gerbera gossypina* (FI=56.75%), Eczema; *Plantago major* (FI=100%), Dermatitis; *Plantago major* (FI=100%), Rashes; *Plantago major* (FI=100%), (j). Others: Fever viz., *Ajuga bracteosa* (FI=30.50%), *Ajuga parviflora* (FI=28.81%), *Cotinus coggygria* (FI=40.67%), Diabetes; *Ajuga parviflora* (FI=100%), Inflammation viz., *Amaranthus caudatus* (FI=49.09%), *Bidens pilosa* (FI=45.45%), *Cannabis sativa* (FI=5.45%), Eye disease; *Berberis aristata* (FI=100%), Malaria; *Bidens pilosa* (FI=100%), Insect Bite viz., *Cannabis sativa* (FI=37.20%), *Malva parviflora* (FI=27.90%), *Rumex hastatus* (FI=34.88%), HIV/AIDS; *Cannabis sativa* (FI=100%), Snake Bite; *Euphorbia helioscopia* (FI=100%), Cancer; *Cannabis sativa* (FI=100%), (Table 3, Figure 8).

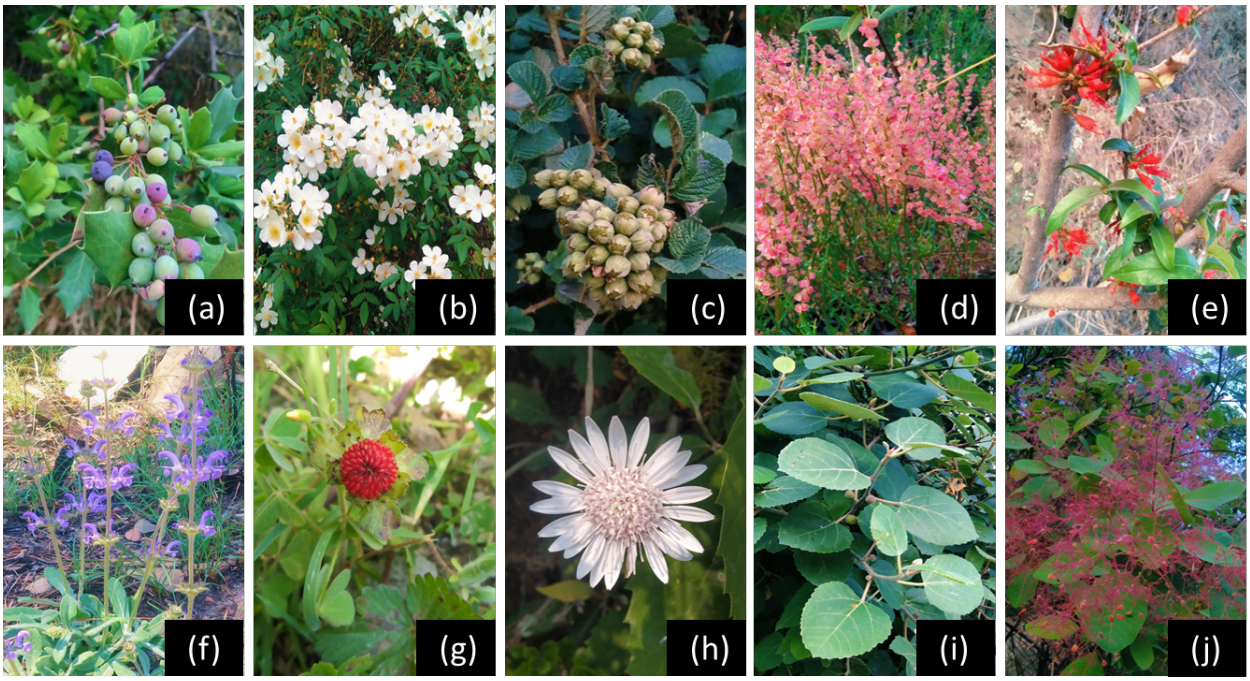


Figure 9. (a). *Berberis aristata* (b). *Rosa brunonii* (c). *Rubus ellipticus* (d). *Rumex hastatus* (e). *Woodfordia fruticosa* (f). *Salvia lanata* (g). *Potentilla indica* (h). *Gerbera gossypina* (i). *Ficus palmata (j). Cotinus coggygria*

Table 2. Ailment category and informant consensus factor (ICF)

Ailment Category	**Number of species (Nt)**	**Use citations (Nur)**	**Informant consensus factor (ICF) in percentage**
(a). Respiratory disease:			
Cold	4	81	0.96
Cough	5	118	0.96
Asthma	3	60	0.96
Bronchitis	4	64	0.95
(b). Gastrointestinal disease:			
Diarrhea	9	239	0.96
Dysentery	6	100	0.94
Stomach pain	2	30	0.96
Indigestion	3	91	0.97
Stomach ulcer	1	5	1
Tuberculosis	1	5	1
Constipation	1	35	1
(c). Cardiovascular disease:			
Blood pressure	1	13	1
(d). Neuro related disease:			
Headache	1	23	1

Insomnia	1	52	1
(e). Musculoskeletal and pain:			
Muscle pain	1	35	1
Arthritis	1	31	1
(f). Reproductive health:			
Menstrual cycle	1	28	1
Infertility	1	52	1
(g). Kidney function	2	39	0.97
(h). Infection and wound care:			
Urinary tract infection	2	29	0.96
Bacterial and fungal infections	2	13	0.91
Wounds	2	60	0.98
Cuts	1	23	1
(i). Skin disease:			
Skin infection	2	74	0.98
Eczema	1	17	1
Dermatitis	1	15	1
Rashes	1	13	1
(j). Others:			
Fever	3	59	0.96
Diabetes	1	45	1
Inflammation	3	55	0.96
Eye disease	1	15	1
Malaria	1	14	1
Insect bite	3	43	0.95
HIV/AIDS	1	15	1
Snake bite	1	7	1
Cancer	1	6	1

Where, **Nt =** "Number of species", **Nur =** "Use citation", and **ICF=** "Informant consensus factor"

Table 3. Fidelity index (FI%) of significant plant species to cure various disease groups

Disease groups	Important species	Fidelity index
(a). Respiratory disease:		
Cold	*Datura stramonium* L.	19.75%
	Erigeron emodi I.M.Turner	28.39%
	Euphorbia helioscopia L.	33.33%
	Gerbera gossypina (Royle) Beauverd	18.51%
Cough	*Datura stramonium* L.	18.64%
	Erigeron emodi I.M.Turner	21.18%
	Ficus palmata Forssk.	31.35%
	Gerbera gossypina (Royle) Beauverd	13.55%
	Verbascum thapsus L.	15.25%
Asthma	*Datura stramonium* L.	28.33%
	Euphorbia helioscopia L.	26.66%
	Verbascum thapsus L.	45%
Bronchitis	*Erigeron emodi* I.M.Turner	42.18%
	Euphorbia helioscopia L.	18.75%
	Gerbera gossypina (Royle) Beauverd	21.87%
	Verbascum thapsus L.	17.18%
(b). Gastrointestinal disease:		
Diarrhea	*Achyranthes aspera* L.	25.94%
	Ajuga parviflora Benth.	10.87%
	Amaranthus caudatus L.	9.62%

	Asparagus racemosus Willd.	5.02%
	Potentilla indica (Andrews) Th.Wolf	15.48%
	Rosa brunonii Lindl.	10.46%
	Rubus ellipticus Sm.	5.43%
	Vitex negundo L.	10.04%
	Woodfordia fruticosa (L.) Kurz	7.11%
Dysentery	*Achyranthes aspera* L.	12%
	Ajuga parviflora Benth.	10%
	Plantago major L.	35%
	Potentilla indica (Andrews) Th.Wolf	16%
	Rubus ellipticus Sm.	12%
	Woodfordia fruticosa (L.) Kurz	15%
Stomach pain	*Ajuga parviflora* Benth.	43.33%
	Rumex nepalensis Spreng.	56.66%
Indigestion	*Ajuga parviflora* Benth.	13.81%
	Indigofera heterantha Wall. ex Brandis	17.58%
	Salvia lanata Roxb.	69.23%
Stomach ulcer	*Amaranthus spinosus* L.	100%
Tuberculosis	*Justicia adhatoda* L.	100%
Constipation	*Rumex nepalensis* Spreng.	100%
(c). Cardiovascular disease:		
Blood Pressure	*Valeriana wallichii* DC.	100%
(d). Neuro-related disease:		
Headache	*Ajuga bracteosa* Wall. ex Benth.	100%
Insomnia	*Valeriana wallichii* DC.	100%
(e). Musculoskeletal and pain:		
Muscle pain	*Ricinus communis* L.	100%
Arthritis	*Rumex hastatus* D.Don	100%
(f). Reproductive health:		
Menstrual cycle	*Asparagus racemosus* Willd.	100%
Infertility	*Asparagus racemosus* Willd.	100%
(g). Kidney function	*Amaranthus spinosus* L.	30.76%
	Sonchus asper (L.) Hill	69.23%
(h). Infection and wound care:		
Urinary tract infection	*Asparagus racemosus* Willd.	55.17%
	Mirabilis jalapa L.	44.82%
Bacterial and fungal infections	*Berberis aristata* DC.	100%
Wounds	*Bidens pilosa* L.	61.66%
	Cannabis sativa L.	38.33%
Cuts	*Thalictrum foliolosum* DC.	100%
(i). Skin disease:		
Skin infection	*Eupatorium adenophorum* Spreng.	43.24%
	Gerbera gossypina (Royle) Beauverd	56.75%
Eczema	*Plantago major* L.	100%
Dermatitis	*Plantago major* L.	100%
Rashes	*Plantago major* L.	100%
(j). Others:		
Fever	*Ajuga bracteosa* Wall. ex Benth.	30.50%
	Ajuga parviflora Benth.	28.81%
	Cotinus coggygria Scop.	40.67%
Diabetes	*Ajuga parviflora* Benth.	100%

Inflammation	*Amaranthus caudatus* L.	49.09%
	Bidens pilosa L.	45.45%
	Cannabis sativa L.	5.45%
Eye disease	*Berberis aristata* DC.	100%
Malaria	*Bidens pilosa* L.	100%
Insect bite	*Cannabis sativa* L.	37.20%
	Malva parviflora L.	27.90%
	Rumex hastatus D.Don	34.88%
HIV/AIDS	*Cannabis sativa* L.	100%
Snake bite	*Euphorbia helioscopia* L.	100%
Cancer	*Cannabis sativa* L.	100%

Where, **FI%**= Fidelity Index percentage

Conclusion

The present study of lesser-known economic plants concluded that the research area is rich in plant diversity, cultural legacy, and untapped potential for local economic growth. It also documented the priceless traditional knowledge and various reasons behind the lesser-known economic plants.

The ethnobotanical survey helps to identify and document several lesser-known economic plants with significant potential for various uses, including medicinal, nutritional, cultural, industrial and other applications. The local inhabitants use these plants in various forms including fuelwood, medicine, furniture, fodder, fiber, edible, vegetables, oil, juice, etc. They use some higher economic plants species such as *Cedrus deodara, Rhododendron arboreum, Pinus roxburghii, Quercus leucotrichophora, Morus alba* and more for their livelihood, but similarly there are various plants such as *Rumex hastatus, Rosa brunonii, Woodfordia fruticosa, Ficus palmata, Valeriana wallichii* and more plants species of this reason have higher medicinal, cultural and other important economic value, but they don't use them as an income purpose, due to lack of knowledge and awareness and their commercial value.

However, the reasons behind the lesser-known status of economic plants are multifaceted. These include a decline in traditional knowledge among younger generations, limited local trade and market access, and a lack of modern techniques. Additionally, environmental changes and overexploitation have made some plants harder to find, and cultivation challenges persist. Lastly, there is a lack of awareness to protect, sustain, and management plan of the lesser-known economic plant. More awareness campaigns will be required to aware and educate the local people to create golden self-employment opportunities, revenue production, and improved livelihoods through the cultivation, and conservation of plant biodiversity of lesser-known economic plants. The economic importance of lesser-known medicinal plants, highlighting their uses, benefits, and sustainable cultivation practices.

Promoting the cultivation and commercialization of lesser-known economic plants can provide new avenues for self-employment and revenue generation in the region and conservation strategies must be implemented to protect the biodiversity. While promoting sustainable use of these plant resources because there are various anthropogenic activities like forest fire, road construction, over exploitation, deforestation, urbanization, pollution, and natural factors such as heavy rainfall, landslides, cloud burst, climate change, etc. are influencing the diversity of this area.

Community engagement and education are essential for the effectiveness of conservation initiatives and the long-term development of plant resources. Further research is needed to explore the full potential of these plants, including phytochemical analysis, agronomic practices, and market value. Collaborative efforts between scientific researchers, local communities, governmental and non-governmental support, and policymakers can drive innovation and support the sustainable utilization of lesser-known economic plants and fulfill the livelihoods of local inhabitants, generate self-employment, value added products, revenue production and preserving cultural heritage through the cultivation of these plant species.

Declarations

List of abbreviations: H= Herbs, S= Shrubs, C= Climber, T= Tree, Rt = Roots, Lf = Leaves, Tw= Twig, St = Stem, Fr = Fruits, Wp = Whole plant, Fl = Flowers, Br= Barks, Sd = Seeds, Lt= latex, VLKEP= Very Lesser-Known Economic Plant, LKEP= Lesser-Known Economic Plant

Ethics approval and consent to participate: This study did not involve the export of any animal or plant material. Information was obtained from the participants. All informants were orally consented.

Consent for publication: All participants shown inj images gave their consent to have the images published.

Availability of data and materials: The manuscript contains all the data.

Competing interests: We declare that there is no conflict of interest.

Funding: No funding

Authors' contributions: LRD Supervision, conceptualization and review, BB Conceptualization, investigation, data collection, data analysis and writing, TL data Interpretation and review, MR Interpretation and review, UKS: data collection, AP data collection. All the authors corrected and approved the manuscript for the publication.

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