Indigenous knowledge on ethnic plant resources of a rural community, Khandachakra-11, Kalikot

Shakti Raj Giri, Chhatra Mani Sharma, Purnima Regmi

Correspondence

Shakti Raj Giri, Chhatra Mani Sharma*, Purnima Regmi

Central Department of Environmental Science, Institute of Science and Technology, Tribhuvan University, Kirtipur, Nepal

*Corresponding Email: cmsharma@cdes.edu.np

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Research

Abstract

Background: Ethnobotanical knowledge plays a vital role in healthcare for rural communities, particularly in remote areas of Nepal, where modern medical facilities are limited. Despite its importance, many regions, including Khandachakra-11 in Kalikot district, remain understudied. This study aimed to document medicinal plants used by local communities and evaluate their cultural and therapeutic significance.

Methods: An ethnomedicinal survey was conducted in Khandachakra-11 with 70 respondents using semi-structured questionnaires, focus group discussions, and key informant interviews. Quantitative indices, including use value (UV), relative frequency of citation (RFC), fidelity level (FL), and informant consensus factor (ICF), were calculated to assess the cultural and medicinal importance of each species. A generalized linear model was used to examine the relationship between medicinal plant knowledge and sociodemographic factors.

Results: A total of 66 medicinal plant species belonging to 46 families were documented, including herbs (30 species), trees (20), climbers (7), shrubs (6), and vines (2). Roots, shoots, seeds, rhizomes, barks, fruits, flowers, and leaves were used for medicinal purposes. *Zanthoxylum armatum* (RFC=0.66, UV=1.39), *Tinospora sinensis* (RFC=0.73, UV=0.41), *Acorus calamus* (RFC=0.33, UV=0.93), and *Drymaria diandra* (RFC=0.23, UV=0.70) emerged as the most culturally and medicinally significant species, reflecting their central role in local healthcare practices. FL values (100%) were recorded for *Zanthoxylum armatum, Tinospora sinensis*, *Bauhinia variegata*, and *Ocimum tenuiflorum*, indicating strong agreement among informants on their specific medicinal uses. ICF values were highest for eye, neurological, digestive, and dermatological ailments, demonstrating consistent and well-preserved ethnomedicinal knowledge within the community. Sociodemographic factors significantly influenced ethnobotanical knowledge, e.g., elderly ($p < 0.001$), females ($p = 0.001$), and illiterate or primary-level educated respondents ($p < 0.001$ and $p = 0.006$, respectively) reported significantly more medicinal plants. However, 86% of respondents noted a decline in medicinal plants, attributing it primarily to climate change, grazing, fire, and inadequate regulations. Therefore, local inhabitants were looking for support programs to conserve the medicinal plants.

Conclusions: Rural communities in Kalikot heavily rely on medicinal plants for healthcare, highlighting the importance of preserving traditional knowledge and implementing support programs for sustainable conservation.

Keywords: Diseases; Ethnobotanical knowledge; Medicinal plants; Rural community; Sociodemographic factors

Background

The country's topography is classified into five physiographical zones: Terai lowlands, Siwalik hills, Middle and High Mountains, and High-Himalayan ranges (Kanel *et al.* 2017). This ecological variation has supported a significant biological diversity, which has long been recognized across scientific studies (HMGN/MFSC 2002, Bhuju *et al.* 2007, Shrestha *et al.* 2010). Among the country's flora, an estimated 2,500 species possess medicinal value and play an important role in traditional healing practices and local healthcare systems (Kunwar *et al.* 2013).

Ethnobotany has evolved into a multidisciplinary science, integrating domains such as plant science, anthropology, ecology, and cultural studies (Shengji 1998). Ethnobotany thus provides a holistic framework for understanding the connections between people and plants (Balick & Cox 2020, Mishra & Kumar 2025). The use of plants and plant products for medicinal purposes has persisted since the dawn of human civilization (Kunwar *et al.* 2006a, Jamshidi-Kia *et al.* 2017, Srivastava 2018). Indigenous communities passed down practical knowledge about which plants to use or avoid through self-sustaining practices, ensuring the transmission of valuable botanical knowledge across generations (Rajbhandari 2001, Pushpangadan *et al.* 2018). This enduring utilization of plants as medicine underscores their importance in human history and highlights the role of indigenous knowledge in shaping medicinal practices.

Nepal has a diverse population of over 125 ethnic groups, each with unique cultural practices and traditional knowledge about using plants for medicine (CBS 2021). The Chhetri and Brahmin communities are the largest, making up about 29% of the population, but other groups like the Gurung, Magar, and Raute also have significant knowledge of medicinal plants. The use of medicinal plants is especially important in rural and remote areas of Nepal, where modern healthcare is scarce (Kunwar *et al.* 2013, Kunwar *et al.* 2022). Indigenous communities in these regions have developed a deep understanding of the healing properties of local plants. They rely on this traditional knowledge to treat a wide range of health issues, from common ailments like colds to more serious conditions (Kunwar *et al.* 2022). This indigenous knowledge is vital for healthcare in these communities where access to modern medicine is limited.

Traditional medicine systems are vital for healthcare, especially in developing countries (WHO 2019). Ethnobotanical knowledge, often found in rural ethnic communities of remote regions, is frequently under-documented. The Karnali region of Nepal is one of the most remote and socio-economically marginalized areas of the country, where local people heavily depend on ethnobotanical knowledge for primary healthcare, food, and daily subsistence. Although several ethnobotanical studies have been conducted in parts of the Karnali Zone (Kunwar & Adhikari 2005, Kunwar *et al.* 2006a, Rai 2007, Rokaya *et al.* 2010), there is still a lack of detailed documentation from the rural Khandachakra area of Kalikot district, where a reasonably high number of medicinal plants exist. No previous study has specifically explored the ethnobotanical practices of this locality, where communities rely extensively on wild and cultivated plant resources.

This study fills that gap by identifying locally used plant species, documenting their medicinal and cultural uses, and recording the specific plant parts utilized in traditional remedies. By integrating quantitative ethnobotanical indices such as Use Value (UV), Relative Frequency of Citation (RFC), Fidelity Level (FL%), and Informant Consensus Factor (ICF), the study also assesses the cultural and therapeutic significance of key species. Such information is vital for preserving traditional knowledge, supporting local healthcare practices, guiding sustainable harvesting, and providing scientific evidence for future conservation and management of plant resources in the region.

Materials and Methods

Study area

The study was carried out in four villages of Khandachakra Municipality-11, Kalikot district, Nepal: Baratu, Rengli, Badalkot, and Jimjedi (Fig. 1). The dominant ethnic communities in these villages were Chhetri, Thakuri, Dhasnami, and Dalit. Agriculture is the main occupation in this area. Kalikot District has a total population of 144,917, comprising 72,243 males and 72,674 females, and a literacy rate of 72.7% (CBS 2021). Ethnically, the district comprises various caste and indigenous groups, with a significant proportion belonging to historically marginalized communities. The study villages reflect similar demographic characteristics. This study area is located at the coordinates of 29°09'49.1" N latitude and 81°38'01.9"E longitude with an altitudinal range of 1300 m to 4400 m. The study area lies in a temperate monsoon climatic zone with the mean normal temperature of 12.83 ^{0}C (-5^{0}C to 26^{0}C) and mean annual rainfall of 811.4 mm (DHM 2017). The major species of trees found in the region are *Pinus roxburghii*, *Quercus* sp., *Toona ciliata*, *Rhododendron arborium*, *Woodfordia fruticosa*, *Lyonia ovalifolia*, *Phyllanthus emblica*, *Alnus nepalensis*, and *Myrica esculenta*.

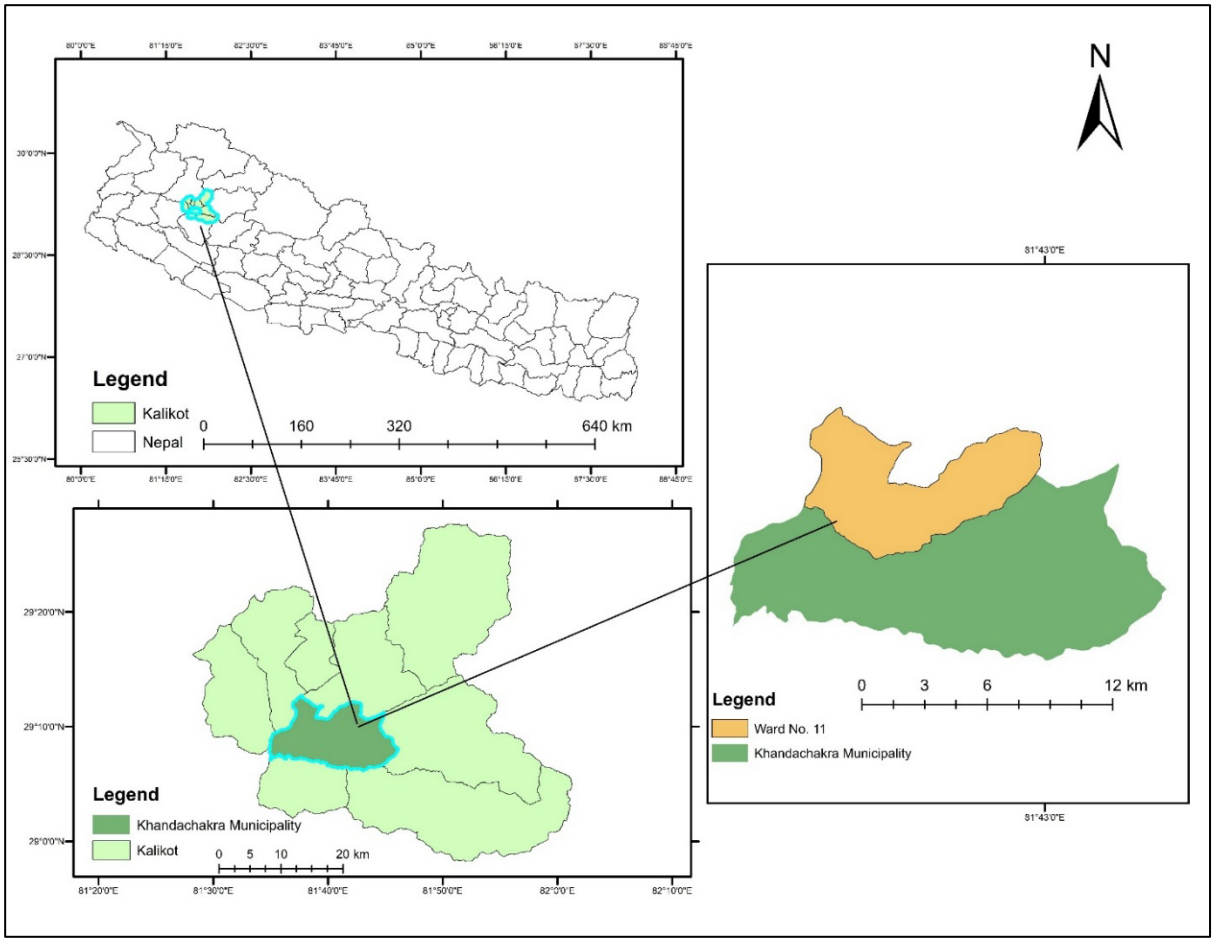

Figure 1. Map of the study area showing (a) Nepal and Kalikot District, (b) Kalikot District and Khandachakra Municipality, and (c) Khandachakra Municipality and Ward No. 11

Data Collection Methods

Data collection was conducted in October 2023. A purposive sampling method was used to select 70 respondents from the total of 223 households in Khandachakra-11, representing approximately 31% of the population. This approach follows established ethnobotanical sampling guidelines (Alexiades 1996, Tongco 2007). Key informants were selected based on their knowledge and experience with medicinal plants, local recognition, and willingness to participate. In addition to individual interviews, focus group discussions were conducted with community members to gather collective knowledge, practices, and perceptions regarding medicinal plants.

All plant species were carefully identified, and their names cross-checked against regional flora and expert knowledge to ensure data validity and taxonomic accuracy.

Data Analysis

Data analysis was performed using Microsoft Excel and R version 4.3.3 (R Core Team 2024). Qualitative and quantitative information about ethnobotany were analyzed by using different techniques, such as Fidelity Level (FL%), Use Value (UV), Informant Consensus Factor (ICF), Frequency of Citation (FC), and Relative Frequency of Citation (RFC), which enhance the indicative value of ethnomedicinal studies. Similar methods were used in hilly communities in India (Ojha *et al.* 2020), whose characteristics resemble those of our study area.

Relative Frequency of Citation (RFC)

RFC was used to determine the most commonly recognized plant species by the local community. It reflects the proportion of informants who cited a particular species for any use. The RFC value ranges from 0 to 1, where 0 indicates that the species was not cited by any informant, and 1 indicates that it was cited by all informants. The RFC was calculated using the following formula (Tardío & Pardo-de-Santayana 2008).

$$RFC = FC/N$$

Where, FC= number of respondents who mentioned the use of species,
N= total number of respondents who took part in the survey

Fidelity Level (FL%)

FL was used to find out the highly preferred plant species for treating certain health problems. It shows the percentage of people who mentioned using a specific plant for a particular illness. The FL% was calculated using the following formula after Friedman *et al.* (1986):

$$FL\ (\%) = \frac{Np}{N} \times 100$$

Where, Np= number of informants reporting the use of the plant for a specific illness,
N= total number of informants reporting the use of the plant for any health condition

Use Value (UV)

UV measures the overall significance of a plant species based on the frequency of its citation by informants. Higher UV values indicate species that are widely recognized and used within the community. The UV was calculated using the formula (Phillips & Gentry 1993).

$$UV = \sum Ui/N$$

Where, Ui= number of use-reports cited by each informant for a given species,
N= total number of informants

Informant Consensus Factor (ICF)

ICF reflects the degree of agreement among informants regarding which plant species are used for a specific disease category. Values range from 0 (no agreement) to 1 (complete agreement). Higher ICF values indicate stronger consensus and suggest culturally important or effective species. The ICF was calculated using the formula (Heinrich *et al.* 1998, Trotter & Logan 2019).

$$ICF = (Nur - Nt)/(Nur - 1)$$

Where, Nur= number of use-reports in a particular ailment category,
Nt= number of species used for that category

The number of medicinal plants reported per respondent was analyzed as count data to examine the effects of socio-demographic variables (age, gender, ethnicity, education, religion, and occupation). A Poisson Generalized Linear Model (GLM) was first fitted, but underdispersion was detected (dispersion = 0.266). Therefore, a Quasi-Poisson GLM was applied to obtain robust standard errors. Multicollinearity among predictors was low (mean VIF = 2.06), indicating reliable model estimates.

Results

Sociodemographic Information of Respondents

The age of respondents ranged from 20 to over 80 years, with the largest proportion (44.3%) aged 40-59 years (Table 1). The majority of respondents were male (72.9%), while females accounted for 27.1%. Regarding education, most had primary-level education (35.7%), followed by illiterate respondents (30.0%), and a small proportion had attended university-level studies (5.7%). Agriculture was the predominant occupation (72.9%), whereas business was the least common (1.4%). Ethnically, Thakuri (34.3%) and Dhasnami (27.1%) were the dominant groups, and all respondents reported Hinduism as their religion (Table 1).

Information on Ethnobotany

In Khandachakra-11, a rural community renowned for its ethnobotanical knowledge, this study revealed an extensive utilization of 66 plant species from 46 families for medicinal purposes, both cultivated and wild plants. However, concerning trends, 86% of respondents noted a decline in species, attributing it primarily to climate change, grazing, fire, and inadequate regulations. Nearly all respondents (98%) inherited their knowledge from their parents, with only a small fraction (2%)

learning from others. They rated their understanding of medicinal plants as moderate and expressed a willingness to pass on their knowledge through practical means to the next generation.

Interestingly, respondents claimed that using medicinal plants rarely causes any side effects. Nevertheless, recent years have witnessed a decline in their application due to reduced availability, leading many to resort to chemical medicines and hospitals. Respondents voiced a strong demand for free training initiatives by governmental and non-governmental entities, alongside calls for stringent conservation regulations and financial aid to preserve medicinal species.

Table 1. Sociodemographic characteristics of respondents from Khandachakra-11 (N = 70)

Demographic variables	**Category**	**Frequency**	**Percentage (%)**
Gender	Male	51	72.86
	Female	19	27.14
Age	20-39	15	21.43
	40-59	31	44.29
	60-79	18	25.71
	Above 80	6	8.57
Education level	Illiterate	21	30.00
	Primary	25	35.71
	Secondary	11	15.71
	Higher Secondary	9	12.86
	University	4	5.71
Occupation	Agriculture	51	72.86
	Job	10	14.29
	Wage	8	11.43
	Business	1	1.43
Ethnicity	Thakuri	24	34.29
	Dalit	16	22.86
	Dhasnami	19	27.14
	Chettri	11	15.71
Religion	Hindu	70	100.00

Locally Declining and High-Risk Medicinal Species

Several documented species are under threat due to overharvesting and habitat loss (Table 2). The table summarizes their conservation status according to CAMP, IUCN, CITES, and GoN regulations, along with notes on local availability and usage.

Table 2. Locally declining and high-risk medicinal plant species documented in Khandachakra-11, Nepal

Species	**CAMP**	**IUCN**	**CITES**	**GoN**	**Local Status**
Dactylorhiza hatagirea (D.Don) Soo.	EN		II	Complete ban	Highly threatened; overharvested
Paris polyphylla Smith	V	V			Declining due to overcollection
Curculigo orchioides Gaertn.	V				Locally rare
Rheum australe D.Don	V	V			Declining, harvested for medicinal use
Juglans regia L.				Complete ban	Declining due to logging
Pistacia chinensis		R			Rare locally
Brachycorythis obcordata			II		Locally harvested, rare
Dioscorea deltoidea Wall. ex Griseb			II		Overharvested for medicine
Asparagus racemosus Willd	V				Locally used medicinally
Delphinium himalayae Munz.	V				Rare or locally declining

Note: CAMP = national conservation status (V = Vulnerable, EN = Endangered, R = Rare); IUCN = global status (International Union for Conservation of Nature Red List); CITES = international trade protection (Appendices I-III); GoN = legal protection in Nepal (Gurung & Pyakurel 2017).

Taxonomic Distribution of Medicinal Plants

Out of 66 species belonging to 46 families, Asteraceae emerged as the most prominent family, comprising four species, followed by Fabaceae, Anacardiaceae, Lamiaceae, and Rosaceae, each with three species. Furthermore, Zingiberaceae, Rutaceae, Polygonaceae, Poaceae, Orchidaceae, Lauraceae, Dioscoreaceae, Compositae, and Cucurbitaceae were represented by two species each, while the remaining 32 families were represented by a single species each (Fig. 2).

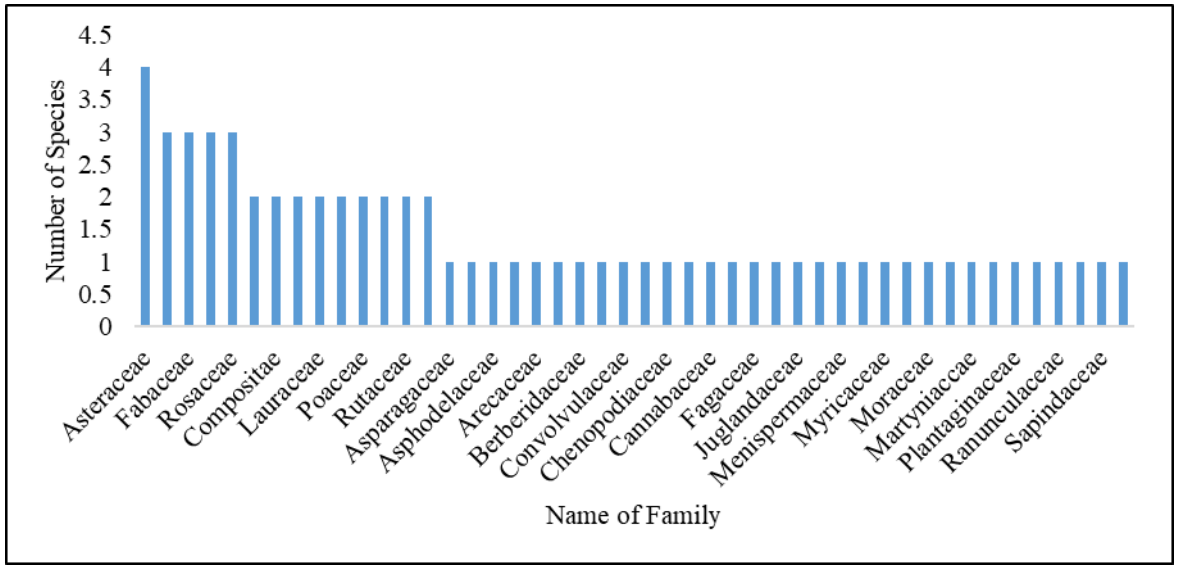

Figure 2. Taxonomic distribution of medicinal plants recorded in the study area, showing the number of species within each plant family

Life Form of Medicinal Plants

The documented medicinal plants were distributed across five life forms (Fig. 3). Herbs were the most frequently used, with 30 species reported, followed by trees (20 species). Climbers were also commonly utilized (7 species), while shrubs (6 species) and vines (2 species) were reported less frequently.

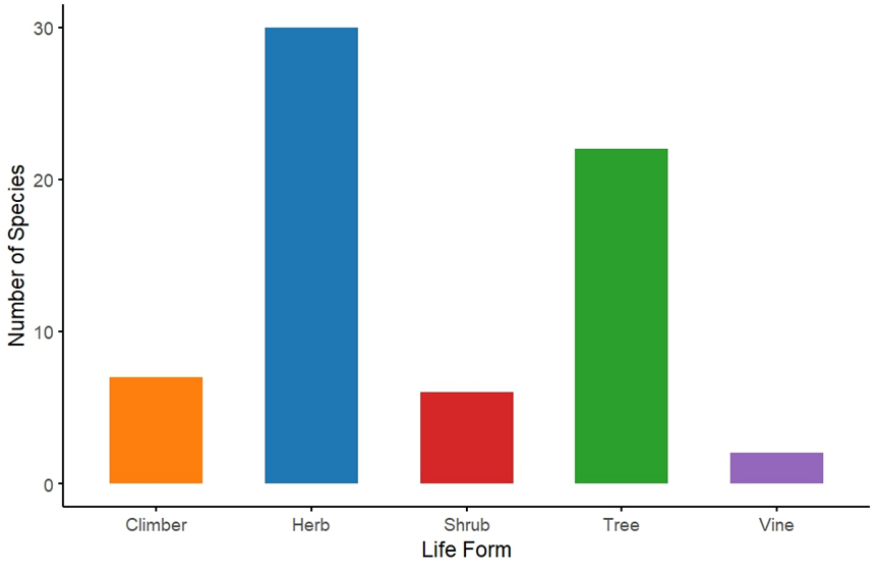

Figure 3. Distribution of medicinal plants according to their life forms recorded in the study area

Plant Parts Used for Medicinal Purposes

Various plant parts, including leaves, entire plants, roots, bark, fruits, flowers, rhizomes, seeds, and latex, were used to treat different ailments (Fig. 4). Leaves and roots were the most commonly utilized parts, followed by fruits, bark, and rhizomes. These findings highlight the diverse use of plant parts for medicinal purposes by the local community (Fig. 4).

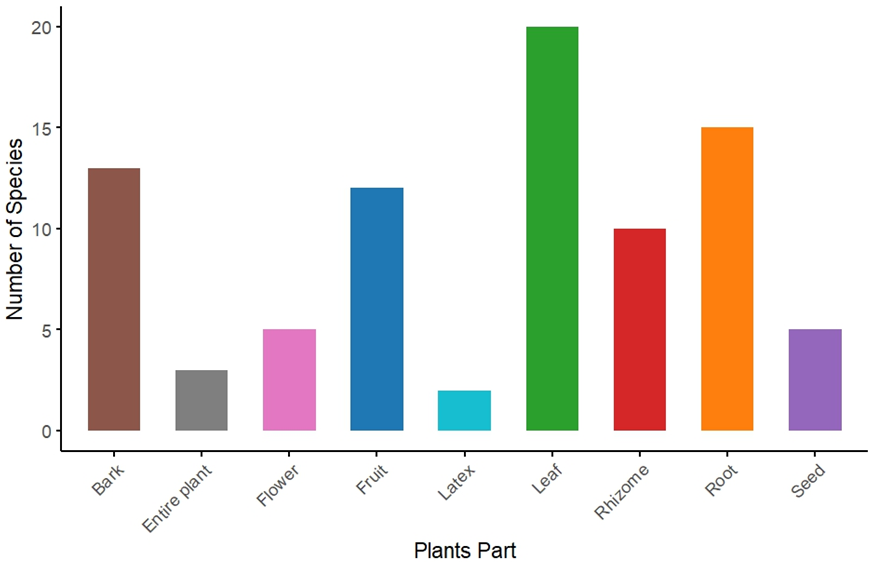

Figure 4. Number of medicinal plants categorized by the plant parts used for medicinal purposes

Mode of Use of Medicinal Plants in Disease Treatment

The application methods for utilizing these medicinal plants for treating diseases vary, contingent upon the specific plant and the ailment being targeted. Common modes of administration included powder, paste, juice, oil, resin, etc. Among the 66 identified plant species, the majority were employed in paste form, followed by juice and powder (Fig. 5).

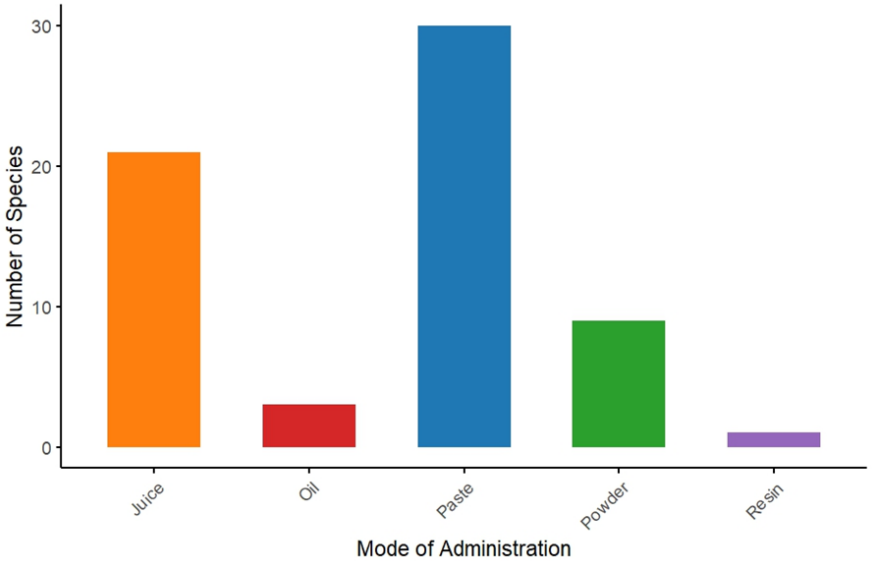

Figure 5. Number of medicinal plants used according to their modes of application in disease treatment

Plant Species Used for Disease Treatment

We observed a rich tradition of using local plant resources for medicinal purposes, reflecting deep-rooted indigenous knowledge and healthcare practices. The highest number of species (61) was used to treat digestive ailments, including diarrhea, dysentery, gastritis, stomachaches, and indigestion (Fig. 6). Dermatological and respiratory ailments were each addressed by 30 plant species. These plants were commonly applied to treat conditions such as skin infections, wounds, burns, cracked heels, as well as respiratory issues like colds, coughs, sore throats, bronchitis, and tonsillitis. Musculoskeletal problems, including joint pain and body aches, were treated using 15 plant species. Meanwhile, general and unspecified ailments such as fever, body pain, and general weakness accounted for 17 species. Smaller numbers of plant species were reported for other categories: circulatory (5), endocrine (4), neurological (3), urinary (3), and eye ailments (2).

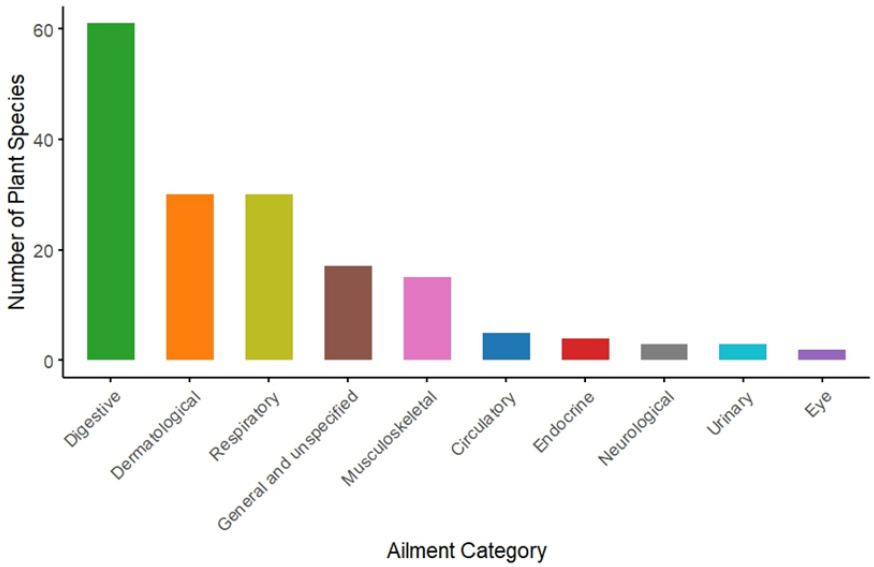

Figure 6. Number of plant species used for disease treatment

Target diseases

Among the documented plant species, 24 were used for three different medicinal purposes, while 18 were used for two purposes (Fig. 7). The rural communities employed either single plants or mixtures of plants to treat various ailments. In addition, individual plant species were often used to address multiple diseases.

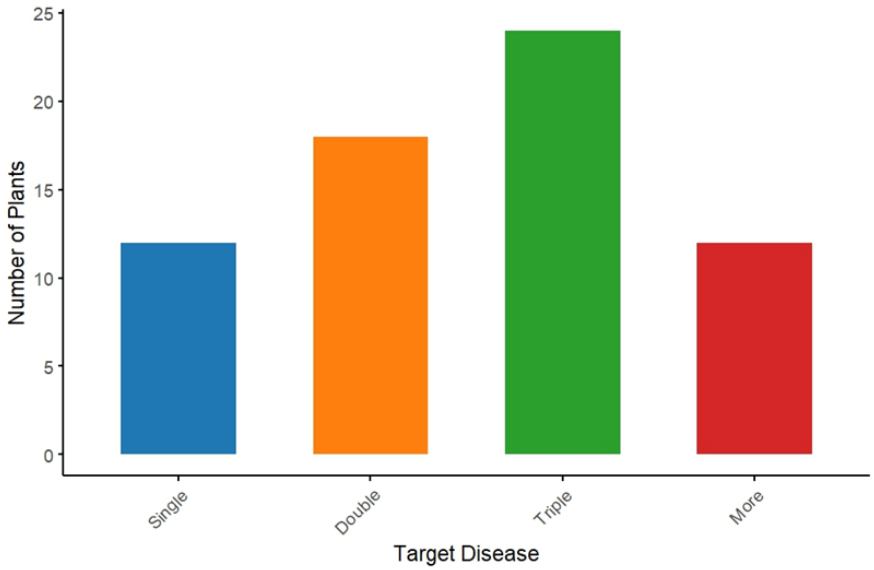

Figure 7. Number of medicinal plants used for different target diseases

Fidelity Level (FL%)

The study identifies several medicinal plant species with notably high FL, reflecting strong agreement among local informants regarding their specific uses. *Zanthoxylum armatum*, *Bauhinia variegata*, *Ocimum tenuiflorum*, *Tinospora sinensis*, *Parnassia nubicola*, *Prunus cerasoides*, and *Machilus odoratissima* each achieved an FL of 100%, indicating exclusive use for treating gastritis, scabies, cough and cold, eye infections, fractures, and other ailments (Table 3). Similarly, *Delphinium himalayae* Munz. showed high FL values for multiple conditions, including headache (84.21%) and snake bite (89.47%). Notably, *Momordica charantia* and *Helianthus annuus* recorded FL values above 90% for managing blood pressure, while *Urtica dioica* and *Acorus calamus* L. demonstrated strong fidelity in treating diabetes and fever, respectively (Table 3).

Table 3. Fidelity Level (FL%) value of medicinal plants showing their use consistency for specific ailments

Aliments Category	Specific Disease	Species	Np	N	FL%
Digestive	Gastritis	*Rubus ellipticus* Sm	9	11	81.82
		Thymus linearis Benth.	15	18	83.33
		Cinnamomum zeylanicum Breyn	26	32	81.25
		Dioscorea deltoidea	11	12	91.67
		Terminalia chebula Retz.	6	10	60.00
		Bauhinia variegate L	4	4	100.00
		Zanthoxylum armatum DC	59	59	100.00
Endocrine	Diabetes	*Urtica dioica*	37	41	90.24
		Momordica charantia	14	39	35.90
		Allium sativum	9	16	56.25
Circulatory	Blood pressure	*Allium sativum*	6	16	37.50
		Momordica charantia	36	39	92.31
		Helianthus annus	13	14	92.86
		Picrorhiza scrophulariiflora	14	19	73.68
Dermatological	Scabies	*Artemisia indica* Willd.	54	54	100.00
	Cracked heels	*Diploknema butyracea*	49	53	92.45
Respiratory	Cough and Cold	*Acorus calamus* L.	34	34	100.00
		Thymus linearis Benth.	13	18	72.22
		Ocimum tenuiflorum	9	9	100.00
		Tinospora sinensis	29	29	100.00
		Phyllanthus emblica L.	10	14	71.43
		Rheum australe D. Don	8	16	50.00
		Delphinium himalayae Munz.	16	19	84.21
		Zanthoxylum armatum DC	38	59	64.41
		Zingiber officinale Rosc	32	34	94.12
		Curcuma angustifolia Rpxb	11	15	73.33
Urinary	Urinary problem	*Chenopodium album* L	17	23	73.91
Eye	Eye infection	*Berberis aristata* DC	14	18	77.78
		Parnassia nubicola Wall.	19	19	100.00
Musculoskeletal	Fracture	*Prunus cerasoides*	21	21	100.00
		Rheum australe D. Don	11	16	68.75
		Machilus odoratissima	18	18	100.00
		Asparagus racemosus Willd.	9	16	56.25
	Joint pain	*Drymaria diandra* Blume	28	29	96.55
		Diploknema butyracea	8	53	15.09
Neurological	Headache	*Artemisia indica* Willd.	6	54	11.11
		Ocimum tenuiflorum	9	9	100.00
		Delphinium himalayae Munz.	16	19	84.21
General and unspecified	Fever	*Acorus calamus* L.	31	34	91.18
		Phoenix acaulis Roxb.	19	21	90.48
		Coccinia grandis	11	16	68.75
		Drymaria diandra Blume	21	29	72.41
		Dactylorhiza hatagirea (D. Don) So	23	28	82.14
		Picrorhiza scrophulariiflora	18	19	94.74
	Snake Bite	*Delphinium himalayae* Munz.	17	19	89.47

Relative Frequency of Citation (RFC)

The RFC for medicinal plants documented in the study ranged from 0.20 to 0.73, indicating varying degrees of local recognition and use (Fig. 8). *Tinospora sinensis* exhibited the highest RFC value (0.73), reflecting its prominent role in traditional healthcare practices. This was followed by *Zanthoxylum armatum* (0.66), *Zingiber officinale* (0.47), *Picrorhiza scrophulariiflora* (0.36), and *Acorus calamus* (0.33), all of which were frequently cited by informants. Other commonly

mentioned species included *Asparagus racemosus*, *Dactylorhiza hatagirea*, and *Drymaria diandra*, with RFC values ranging from 0.23 to 0.27.

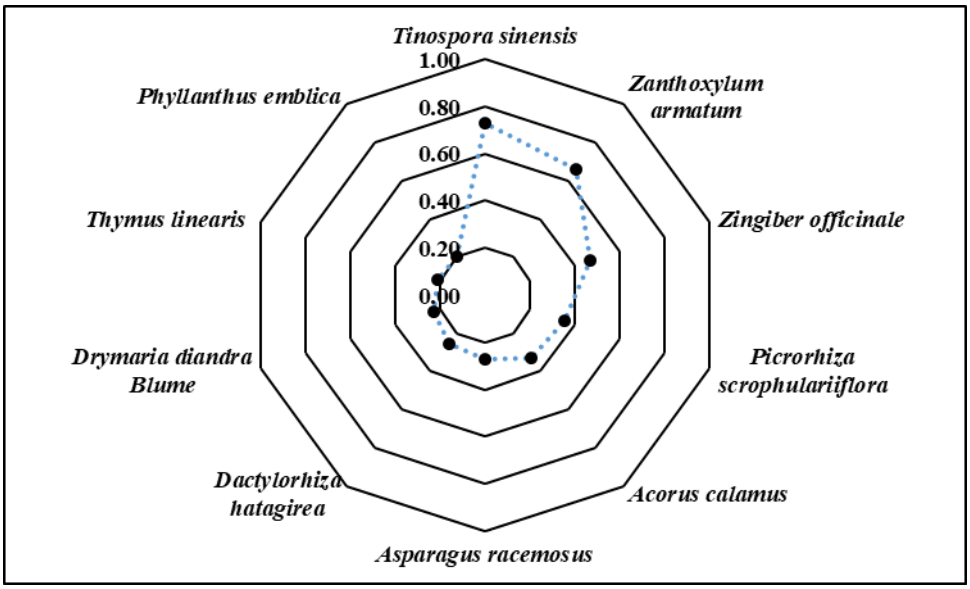

Figure 8. Radar diagram showing the Relative Frequency of Citation (RFC) of the top ten medicinal plants reported by respondents

Use Value (UV)

The UV analysis revealed the most culturally significant medicinal plants in the study area (Table 6). *Zanthoxylum armatum* exhibited the highest UV (1.39), indicating widespread recognition and use among respondents. Other species with high UV included *Diploknema butyracea* (0.81), *Acorus calamus* (0.93), *Artemisia indica* (0.86), *Momordica charantia* (0.71), *Drymaria diandra* (0.70), and *Delphinium himalayae* (0.70). Plants such as *Paris polyphylla* (0.49), *Tinospora sinensis* (0.41), and *Curculigo orchioides* (0.41) also showed notable importance. Species with lower UV (≤0.10) were less frequently cited, suggesting limited use within the community.

Informant Consensus Factor (ICF)

The highest ICF was recorded for eye and neurological ailments, indicating complete agreement among respondents regarding the plant species used in these categories. Digestive and dermatological disorders also showed strong consensus (ICF = 0.83), followed by general and unspecified ailments (0.81) and respiratory problems (0.79). Moderate agreement was observed for circulatory (0.75), musculoskeletal (0.71), and endocrine disorders (0.67). The lowest consensus was found for urinary ailments (0.50), suggesting greater variability in plant selection (Table 4).

Table 4. Informant Consensus Factor (ICF) values for different ailment categories

Ailment Category	N_{ur}	N_t	ICF
Digestive	61	11	0.83
Endocrine	4	2	0.67
Circulatory	5	2	0.75
Dermatological	30	6	0.83
Respiratory	30	7	0.79
Urinary	3	2	0.50
Eye	2	1	1.00
Musculoskeletal	15	5	0.71
Neurological	3	1	1.00
General and unspecified	17	4	0.81

Analysis of Socio-demographic Factors Influencing Medicinal Plant Knowledge

Age, gender, ethnicity, education, and occupation significantly influenced the number of medicinal plants reported (Table 5). Older individuals reported more medicinal plants ($p < 0.001$) than younger ones. Females mentioned more plants than males ($p = 0.001$). Among ethnic groups, Dalit participants reported the highest number of medicinal plants ($p = 0.007$), followed by Dhasnami ($p = 0.037$), while Thakuri did not differ significantly. Education level was positively associated with reported knowledge: illiterate individuals reported more plants ($p < 0.001$), as did those with primary ($p = 0.006$), secondary ($p = 0.049$), and university education ($p < 0.001$). In terms of occupation, business workers reported significantly fewer plants ($p = 0.001$), and wage laborers also reported fewer plants ($p = 0.014$) compared to the reference group, while job holders showed no significant difference ($p = 0.065$).

Table 5. Summary of Quasi-Poisson Generalized Linear Model (GLM) analyzing the effect of socio-demographic variables on the number of medicinal plants reported

Predictor	Estimate	Std. Error	t-value	p-value	Significance
(Intercept)	1.508	0.121	12.513	<0.001	***
Age	0.0132	0.0017	7.977	<0.001	***
Gender (Male)	-0.1384	0.0402	-3.443	0.0011	**
Ethnicity (Dalit)	0.2093	0.0743	2.817	0.0067	**
Ethnicity (Dhasnami)	0.1361	0.0638	2.134	0.0372	*
Ethnicity (Thakuri)	0.0884	0.0638	1.386	0.1711	
Education (Illiterate)	0.3438	0.0856	4.018	<0.001	***
Education (Primary)	0.2298	0.0808	2.845	0.0062	**
Education (Secondary)	0.1825	0.0905	2.017	0.0485	*
Education (University)	0.3783	0.1037	3.648	<0.001	***
Occupation (Business)	-0.8176	0.2346	-3.485	0.001	***
Occupation (Job)	-0.1682	0.0895	-1.879	0.0653	.
Occupation (Wage)	-0.2143	0.0842	-2.546	0.0136	*

Significance codes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, . $p < 0.1$

The detailed list of medicinal plants, including scientific and local names, life forms, parts used, mode of administration, target diseases, and Use Value (UV) for each species, is presented in Table 6.

Discussion

In this study, females and older respondents reported significantly more medicinal plants. Dalit and Dhasnami ethnic groups showed higher plant knowledge, while illiterate individuals had the greatest knowledge. Agriculturalists also knew more plants compared to business workers and wage laborers. These results align with Kutal *et al.* (2021), who identified gender, ethnicity, and livelihood as key factors influencing plant knowledge in Nepal. The greater knowledge among elderly respondents is supported by Karki *et al.* (2023) and Kidane *et al.* (2014), who noted that traditional knowledge accumulates with age. Although the present study observed that female respondents reported a higher number of medicinal plant species than males, findings from other regions are inconsistent. Torres-Avilez *et al.* (2016) conducted a global meta-analysis and concluded that there is no universal pattern favoring one gender, as knowledge distribution often varies with local ecological, cultural, and socioeconomic contexts.

The findings of this study highlight the rich ethnomedicinal knowledge preserved within the rural communities of Khandachakra, where 66 medicinal plant species from 46 families are traditionally utilized for primary healthcare. Among these, Asteraceae emerged as the most dominant family, a pattern that is consistent with ethnobotanical studies in Nepal and elsewhere. Similar dominance of Asteraceae has been reported from Ramkot Village, Kathmandu (Gautam 2020), the middle mountains of Nepal (Kutal *et al.* 2021), and in broader regional and global assessments (Singh *et al.* 2019, Monika *et al.* 2020, Khajuria *et al.* 2021). The widespread use of this family in herbal medicine is often attributed to its spontaneous availability in diverse habitats (Maulidiani *et al.* 2015) and its high concentrations of bioactive compounds such as phenols and flavonoids (Maulidiani *et al.* 2015, Miara *et al.* 2018), which enhance its therapeutic relevance. Together, these findings reinforce the ecological importance and cultural value of Asteraceae in traditional medicinal systems.

Table 6. Detailed list of medicinal plants, including life forms, parts used, mode of administration, target diseases, and Use Value (UV)

Botanical Name	Local Name/Common Name	Family	Life form	Part used	Mode of administration	Target disease	User Value (UV)
Pistacia chinensis	Kaakar silo/Kaakar singhi	Anacardiaceae	Tree	Fruit	Powder	Dysentery, ulcer, cough, diarrhoea, and asthma	0.26
Asparagus racemosus Willd.	Kurilo/Satawari	Asparagaceae	Climber	Root	Juice	Cuts, wounds, fractures, and stomach problems	0.13
Artemisia indica Willd.	Titepaati	Asteraceae	Herb	Leaf	Juice	Headache, cuts, wounds, scabies, and fever	0.86
Anaphalis triplinervis	Buki fool	Asteraceae	Herb	Leaf	Juice	Cuts and wounds	0.40
Acorus calamus L.	Bojho	Araceae	Herb	Root	Paste	Cough, fever, sore throat, and tonsillitis	0.93
Aloe barbadensis Miller.	Ghukumari	Asphodelaceae	Herb	Leaf	Paste	Burn and skin disease	0.10
Allium sativum L	Lasun	Amaryllidaceae	Herb	Rhizome	Paste	control high blood pressure, reduce sugar in blood, and wounds in ear	0.21
Mangifera indica L	Aap/Mango	Anacardiaceae	Tree	Fruit and seed	Paste	Stomach problem, diarrhoea, and toothache	0.06
Phoenix acaulis Roxb.	Thakal	Arecaceae	Shrub	Root	Paste	Fever	0.27
Colocasia antiqorum Schott. var.esculenta	Karkalo	Araceae	Herb	Entire plant	Paste (Cooking)	Dysentery	0.16
Rhus javanica L.	Bhak amilo	Anacardiaceae	Tree	Fruit	Powder	Diarrhoea and dysentery	0.14
Ageratina adenophora	Banmara	Asteraceae	Herb	Leaf	Juice	Wounds, cuts, and skin infection	0.04
Ageratum conyzoides L	Gandhe jhar	Asteraceae	Herb	Leaf	Juice	Cuts and wounds	0.11
Berberis aristata DC	Chutro	Berberidaceae	Shrub	Root and bark	Juice	Eye infection, diarrhoea, stomach problem, jaundice	0.20
Parnassia nubicola Wall.	Nirbisi	Celastraceae	Herb	Root and Leaf	Juice	Cuts, wounds, and eye infection	0.27
Coccinia grandis	Golkankri	Cucurbitaceae	Vine	Fruit	Paste	Jundice, fever, and asthma	0.16
Momordica charantia L	Tite karela	Cucurbitaceae	Vine	Fruit and leaf	Paste	Diabetes, piles, and control high blood pressure	0.71
Anaphalis busua DC.	Jhulo	Asteraceae	Herb	Root	Juice	Wounds	0.27
Helianthus annuus	Suryamukhi	Compositae	Herb	Seed	Oil	Blood pressure and lung infection	0.19
Ipomoea batatas	Ganjir/Sakharkhand/sweet potato	Convolvulaceae	Climber	Rhizome	Paste	Sexual stimulant and tonic	0.06

Terminalia chebula Retz.	Harro	Combretaceae	Tree	Bark, seed, and fruit	Powder	Diarrhoea, digestion, cough, fever, and gastritis	0.09
Chenopodium album L	Bathe	Chenopodiaceae	Herb	Leaf	Juice and paste	Intestinal worms, urinary problems, and kidney stones	0.24
Drymaria diandra Blume	Abijalo	Caryophyllaceae	Herb	Entire plant	Paste	Fever, Joint pain, and Indigestion	0.70
Cannabis sativa L	Bhang	Cannabaceae	Herb	Seed	Paste	Diarrhoea and dysentery	0.10
Dioscorea bulbifera	Gittha tarul	Dioscoreaceae	Climber	Rhizome	Paste	Cure piles	0.09
Dioscorea deltoidea	Ban tarul	Dioscoreaceae	Climber	Rhizome	Juice	Dysentery, gastritis, wounds, and intestinal worms	0.16
Rhododendron arboreum Wall. ex G. Don	Laligurans	Ericaceae	Tree	Flower	Juice	Sore throat	0.19
Senegalia catechu	Khayar	Fabaceae	Tree	Bark	Juice	Stomach problem, skin burn, and ulcer	0.33
Bauhinia vahlii	Bhorla	Fabaceae	Climber	Bark and seed	Juice	Stomachache and diarrhea	0.09
Bauhinia variegate L	Koiralo	Fabaceae	Tree	Stem, bark, and flower	Juice	Gastritis, stomach problem, diarrhea	0.06
Castanopsis indica	Dhale katus	Fagaceae	Tree	Bark	Paste	Chest pain	0.07
Curculigo orchioides	Kalo musali	Hypoxidaceae	Herb	Root	Juice	Vomiting, diarrhoea, and asthma	0.41
Juglans regia L.	Okhar	Juglandaceae	Tree	Bark, fruit, and stem	Paste	Skin disease and toothache	0.16
Machilus odoratissima	Kaulo	Lauraceae	Tree	Bark	Paste	Fracture	0.26
Cinnamomum zeylanicum Breyn	Dalachini	Lauraceae	Tree	Bark and leaf	Powder and Juice	Diarrhoea, stomach problems, gastritis	0.37
Woodfordia fruticose	Dhairo	Lythraceae	Shrub	Leaf, bark, and flower	Juice	Diarrhoea, stomach problems, dysentery	0.19
Thymus linearis Benth.	Ghodamarcha	Lamiaceae	Herb	Leaf and flower	Juice	Cough, stomach problems, gastritis, and indigestion	0.40
Ocimum tenuiflorum	Tulsi	Lamiaceae	Shrub	Leaf and stem	Paste	Cough, headache, and kidney stone	0.26
Mentha spicata L.	Pudina	Lamiaceae	Herb	Entire plant	Paste	Fever, stomach problems, and toothache	0.27
Tinospora sinensis (Lour.) Merr	Gurjo	Menispermaceae	Climber	Stem, root, leaf	Juice	Stomach problem, fever, diarrhoea, cold	0.41
Paris polyphylla Sm	Satuwa	Melanthiaceae	Herb	Rhizome	Paste	Stomachache and diarrhea	0.49
Myrica esculenta Buch.-Ham. ex D. Don	Kaphal	Myricaceae	Tree	Bark	Paste	Cough, bronchitis, diarrhoea, asthma, and toothache	0.13
Bombax ceiba L	Simal	Malvaceae	Tree	Root and leaf	Paste	Cuts, wounds, bronchitis, and cough	0.10

Ficus religiosa L	Pipal	Moraceae	Tree	Bark and leaf	Juice	Stomachache and constipation	0.21
Psidium guajava	Amba	Myrtaceae	Tree	Latex and Fruit	Paste	Diarrhoea, dysentery, and stomach problems	0.17
Martynia annua	Bagh nakhi/tiger's claw	Martyniaceae	Herb	Leaf	Juice	Sore throat	0.09
Dactylorhiza hatagirea (D. Don) So	Hatejadi/panchaule	Orchidaceae	Herb	Rhizome	Powder	Wounds, cuts, and fever	0.33
Brachycorythis obcordata	Kaladana/sunakhari	Orchidaceae	Herb	Rhizome	Paste	Body pain	0.29
Phyllanthus emblica L.	Amala	Phyllanthaceae	Tree	Fruit	Paste and Powder	Cold, diarrhoea, and jaundice	0.14
Picrorhiza scrophulariiflora	Katuko	Plantaginaceae	Herb	Root	Powder and Juice	Cold, fever, and blood pressure	0.46
Pinus roxburghii Sarg	Khote sallo	Pinaceae	Tree	Latex	Resin	Cuts and boils	0.26
Saccharum officinarum L	Ukhu	Poaceae	Shrub	Stem	Juice (Chewing)	Anemia and tonic	0.13
Rheum australe D. Don	Padamchal	Polygonaceae	Herb	Rhizome, leaf, and stem	Paste	Cuts, fractures, and cough	0.27
Rumex hastatus	Kapo	Polygonaceae	Herb	Root	Juice	Diarrhoea, and dysentery	0.07
Cynodon dactylon (L.) Pers	Dubo	Poaceae	Herb	Entire plant	Juice	Stomachache	0.06
Delphinium himalayae Munz.	Nirmasi	Ranunculaceae	Climber	Root	Powder and Juice	Snake bite, common cold, toothache, and headache	0.70
Zanthoxylum armatum DC	Timur	Rutaceae	Tree	Fruit	Juice	Toothache, cough, cold, and gastritis	1.39
Rubus ellipticus Sm	Ainselu	Rosaceae	Shrub	Root	Juice	Gastritis, fever, and throat problems	0.13
Fragaria nubicola	Bhui ainselu	Rosaceae	Herb	Root	Juice	Throat problem	0.07
Prunus cerasoides	Painyu	Rosaceae	Tree	Leaf	Paste	Curing fracture	0.30
*Citrus aurantifokia (*Christ). Swingle	Kagati	Rutaceae	Tree	Fruit	Juice	Vomiting, sore throats, and fever	0.26
Diploknema butyracea	Chiuri	Sapotaceae	Tree	Fruit	Juice	Joint pain and cracked heels	0.81
Sapindus mukorossi	Rittha	Sapindaceae	Tree	Fruit, bark	Juice	Wounds and cuts	0.06
Urtica dioica	Sisnu	Urticaceae	Herb	Root and Leaf	Paste and powder	Fever and diabetes	0.53
Zingiber officinale Rosc	Aduwa	Zingiberaceae	Herb	Rhizome	Paste	Cold, fever, and cough	0.46
Curcuma angustifolia Rpxb	Haldi/besara	Zingiberaceae	Herb	Rhizome	Paste	Cough, cold, wounds, cuts	0.16

The present study documented a higher number of ethnomedicinal plant species compared to previous studies conducted in eastern Nepal (Bhattarai 2020). Bhattarai (2013) conducted indigenous community-centered research focusing on the Lepcha community of Illam district, recording 35 species, while another study centered on the Rai community in the Bhojpur district documented the same number of species (Paudyal *et al.* 2021). A study conducted in Suryabinayak Municipality documented 107 medicinal plant species across 60 families (Bhaila *et al.* 2022). Similarly, a study in Kavrepalanchok district recorded 116 species (Ambu *et al.* 2020), while another study in the Machhapuchchhre rural municipality of Kaski district recorded a total of 105 medicinal plant species belonging to 58 families and 99 genera (Adhikari *et al.* 2019). These results highlight the abundant knowledge of medicinal plants in the region, similar to other parts of Nepal. This wealth of information is likely due to the unique geography and the presence of indigenous communities living in remote areas with limited access to modern healthcare resources.

The herbs and trees, as the primary life forms used for medicinal purposes, are similar to findings from other ethnobotanical studies in Nepal (Bhattarai *et al.* 2010, Gautam 2020, Karki *et al.* 2023). Similar patterns have also been reported in earlier studies across South Asia and the Himalayan region (Gaur 1999, Rawat *et al.* 2016, Singh *et al.* 2017, Singh *et al.* 2019, Monika *et al.* 2020, Khajuria *et al.* 2021, Ahirwar & Bhoi, 2025). Herbs are typically abundant and accessible, making them popular choices for traditional remedies. This consistency in life form preferences suggests a deep-rooted reliance on locally available flora for healthcare needs. The prevalence of herbs and trees as dominant life forms in medicinal plant usage can be attributed to their natural abundance in the wild, with herbs being low in height and trees providing a wide variety of medicinal plants due to their towering stature (Shrestha & Dhillion 2003, Uprety *et al.* 2010).

Leaves and roots were the most frequently used plant parts in this study, a trend consistently documented in ethnobotanical research across Nepal. Studies conducted in Rasuwa and eastern Nepal (Shrestha *et al.* 2014, Shrestha *et al.* 2016), as well as recent works from Okhaldhunga (Karki *et al.* 2023), Kavrepalanchok (Ambu *et al.* 2020), Khotang (Mahara & Ojha 2024), Parbat (Malla *et al.* 2015), and national-level assessments (Kunwar *et al.* 2022), all reported leaves and roots as the dominant plant parts used in herbal medicine. Similar patterns have been observed regionally and globally, including India (Singh *et al.* 2017, Khajuria *et al.* 2021, Ahirwar *et al.* 2025), Pakistan (Khan *et al.* 2015, Amjad *et al.* 2017), China (Li *et al.* 2020), and Bangladesh (Faruque *et al.* 2018). Leaves are favored for their ease of collection, wide availability, and simple preparation, while roots are valued for their concentrated therapeutic compounds.

The focus on treating digestive, respiratory, and dermatological ailments reflects the primary health concerns of rural communities and the practical orientation of local ethnomedicinal knowledge. The highest number of plants was used for digestive disorders, followed by respiratory and skin-related ailments. These findings are consistent with previous ethnobotanical studies conducted across Nepal, which similarly report the dominance of treatments for diarrhea, dysentery, gastritis, colds, coughs, and skin infections (Rokaya *et al.* 2010, Kunwar *et al.* 2015, Bhandari *et al.* 2023, Karki *et al.* 2023). Similarly, Joshi *et al.* (2011), Ambu *et al.* (2020), Gautam (2020), and Bhaila *et al.* (2022) have recorded the use of medicinal plants to address ailments like fever, wounds, toothache, body aches, fractures, blood pressure, and gastrointestinal problems. These parallels across geographically and culturally diverse regions suggest a shared understanding of plant-based remedies for treating common health conditions.

High Fidelity Level (FL%) values indicate strong agreement among informants on specific medicinal uses, while Informant Consensus Factor (ICF) highlights agreement across disease categories. Species such as *Zanthoxylum armatum*, *Bauhinia variegata*, *Ocimum tenuiflorum*, and *Tinospora sinensis* showed 100% FL, reflecting exclusive and culturally important applications (Friedman *et al.* 1986, Tardío & Pardo-de-Santayana 2008). These species also contribute to high ICF values in categories such as digestive, dermatological, and respiratory ailments, suggesting both specificity of use and widespread cultural recognition (Kunwar & Bussmann 2008, Kunwar *et al.* 2010). *Delphinium himalayae* exhibited high FL for snake bite and headache, consistent with its multipurpose traditional use in Himalayan ethnomedicine, though care is needed due to toxic alkaloids (Kunwar *et al.* 2006b, Adhikari & Bhandari 2020). Similarly, *Momordica charantia* and *Helianthus annuus* had FLs above 90% for blood pressure, supporting their recognized pharmacological roles (Grover *et al.* 2002). High FL values for *Urtica dioica* and *Acorus calamus* in diabetes and fever treatment align with reported antidiabetic and antipyretic effects (Chehri *et al.* 2022, Dewangan *et al.* 2025). Overall, the combined FL and ICF patterns indicate a well-preserved ethnomedicinal knowledge system in which culturally important species are widely recognized, specifically applied, and trusted across the community.

The ethnobotanical analysis revealed that certain species are highly significant both in terms of Use Value (UV) and Relative Frequency of Citation (RFC), reflecting their cultural importance and widespread use. *Zanthoxylum armatum* exhibited the

highest UV (1.39) and a high RFC, indicating strong local recognition and frequent application in treating various ailments (Tardío & Pardo-de-Santayana 2008). Similarly, *Tinospora sinensis* and *Acorus calamus* were among the most cited and valued species, highlighting their central role in the community's healthcare practices. Other culturally important species, including *Diploknema butyracea*, *Artemisia indica*, and *Momordica charantia*, also showed high UV and RFC values, consistent with their reported ethnomedicinal significance in Nepal (Kunwar *et al.* 2006b, Bhattarai *et al.* 2010, Rokaya *et al.* 2010). Plants with high UV and RFC are typically accessible, culturally embedded, and perceived as effective, whereas species with lower values are less known or less utilized (Phillips & Gentry 1993, Tardío & Pardo-de-Santayana 2008). The combined analysis of UV and RFC underscores which species are priorities for conservation, sustainable use, and potential pharmacological research.

Conclusion

The present study documented 66 medicinal plant species utilized by the rural community of Khandachakra-11, highlighting their importance for healthcare and daily life. Leaves and roots were the most frequently used plant parts, and herbs were the dominant life form, reflecting preferences shaped by availability and traditional practices. Significant associations were observed between sociodemographic factors (age, gender, ethnicity, occupation, and education) and medicinal plant knowledge, indicating that traditional practices are influenced by community structure. Quantitative indices further emphasized the cultural and therapeutic significance of key species. Use Value (UV) and Relative Frequency of Citation (RFC) identified *Zanthoxylum armatum*, *Tinospora sinensis*, *Acorus calamus*, and *Diploknema butyracea* as highly valued species central to local primary healthcare. High Fidelity Level (FL%) values for *Tinospora sinensis*, *Bauhinia variegata*, *Ocimum tenuiflorum*, and *Zanthoxylum armatum* reflect strong agreement among informants regarding specific medicinal uses. Likewise, high Informant Consensus Factor (ICF) values across major ailment categories, particularly digestive, respiratory, and dermatological disorders, indicate that community knowledge is consistent, well-preserved, and based on shared cultural practices. These findings underscore the importance of documenting and preserving ethnobotanical knowledge, especially as many medicinal plant species are reportedly declining and local inhabitants seek support programs for sustainable use.

Declarations

List of abbreviations: FC - Frequency of Citation; FL - Fidelity Level; GLM - Generalized Linear Model; ICF - Informant Consensus Factor; RFC - Relative Frequency of Citation; UV - Use Value

Ethics approval and consent to participate: Ethical approval for this study was obtained from Khandachakra Municipality, Ward-11. Verbal informed consent was obtained from all participants before data collection. Permissions were also secured from the community and local authorities to ensure compliance with local guidelines and ethical standards.

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Literature cited

Adhikari M, Thapa R, Kunwar RM, Devkota HP, Poudel P. 2019. Ethnomedicinal uses of plant resources in the Machhapuchchhre rural municipality of Kaski District, Nepal. Medicines 6(2):69.

Adhikari S, Bhandari A. 2020. Human poisoning due to *Delphinium* species in the Himalayan region of Nepal: a case report. Journal of Nepal Medical Association 58(232).

Ahirwar RK, Bhoi DK, Jangde R. 2025. Ethnobotanical insights: Medicinal plants used by the Baiga community in Amarkantak region, Madhya Pradesh. Pharmacological Research-Natural Products 7:100227.

Ahirwar RK, Bhoi DK. 2025. Ethnobotanical secrets of the Baiga tribe in Chhattisgarh Central India. Scientific Reports 15:38130.

Alexiades MN. 1996. Collecting ethnobotanical data: an introduction to basic concepts and techniques. Advances in Economic Botany 10:53-94.

Ambu G, Chaudhary RP, Mariotti M, Cornara L. 2020. Traditional uses of medicinal plants by ethnic people in the Kavrepalanchok district, Central Nepal. Plants 9(6):759.

Amjad MS, Qaeem MF, Ahmad I, Khan SU, Chaudhari SK, Zahid MN, Khan AM. 2017. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PloS One 12(2).

Balick MJ, Cox PA. 2020. Plants, people, and culture: The science of ethnobotany. Garland Science, New York, U.S.A.

Bhaila A, Shakya S, Kunwar B, Baral B, Chaudhary S, Munankarmi NN. 2022. Ethnomedicinal exploration of plants utilized by the people of Suryabinayak Municipality in Bhaktapur District, Nepal. Vegetos 35(3):763-774.

Bhandari R, Pandeya B, Ghimire B. 2023. Ethnobotanical study of plant resources in Dhurkot rural municipality, Gulmi district, Nepal. Ethnobotany Research and Applications 25:1-19.

Bhattarai KP. 2013. Ethnomedicinal plants of Lepcha community in Ilam district, eastern Nepal. Nepal Journal of Biosciences 3(1):64-68.

Bhattarai KR. 2020. Ethnobotanical survey on plants used in Mai Municipality of Ilam district, eastern Nepal. Banko Janakari 30(2):11-35.

Bhattarai S, Chaudhary RP, Quave CL, Taylor RS. 2010. The use of medicinal plants in the trans-Himalayan arid zone of Mustang district, Nepal. Journal of Ethnobiology and Ethnomedicine 6(1):14.

Bhuju UR, Shakya PR, Basnet TB, Shrestha S. 2007. Nepal biodiversity resource book: Protected areas, Ramsar sites, and World Heritage sites.

CBS. 2021. National Population and Housing Census 2021, Caste/Ethnicity & Language. Government of Nepal, Kathmandu, Nepal.

Chehri A, Yarani R, Yousefi Z, Novin Bahador T, Shakouri SK, Ostadrahimi A, et al. 2022. Anti-diabetic potential of Urtica dioica: current knowledge and future direction. Journal of Diabetes and Metabolic Disorders 21(1):931-940.

Dewangan C, Kashyap R, Patel S, Sahu G. 2025. *Acorus calamus*: an ancient remedy with modern medicinal applications. International Journal of Science Research and Technology.

DHM. 2017. Observed climate trend analysis of Nepal (1971-2014). Department of Hydrology and Meteorology, Ministry of Population and Environment, Kathmandu, Nepal.

Faruque MO, Uddin SB, Barlow JW, Hu S, Dong S, Qian C, Xiaohua L, Li Xuebo H, Hu X. 2018. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. Frontiers in Pharmacology 9:40.

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. Journal of Ethnopharmacology 16(2-3):275-287.

Gaur RD. 1999. Flora of the District Garhwal: Northwest Himalaya (with Ethnobotanical Notes). Transmedia, Srinagar (Garhwal), India.

Gautam D. 2020. Medicinal plants and their traditional uses in Ramkot Village, Kathmandu, Nepal. Patan Pragya.

Grover JK, Yadav S, Vats V. 2002. Medicinal plants of India with anti-diabetic potential. Journal of Ethnopharmacology 81(1):81-100.

Gurung K, Pyakurel D. 2017. Identification manual of commercial medicinal and aromatic plants of Nepal. Nepal Herbs and Herbal Products Association (NEHHPA), Kathmandu, Nepal.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: Healers' consensus and cultural importance. Social Science & Medicine 47(11):1859-1871.

HMGN/MFSC. 2002. Nepal biodiversity strategy. Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Jamshidi-Kia F, Lorigooini Z, Amini-Khoei H. 2017. Medicinal plants: Past history and future perspective. Journal of Herbmed Pharmacology 7(1):1-7.

Joshi K, Joshi R, Joshi AR. 2011. Indigenous knowledge and uses of medicinal plants in Macchegaun, Nepal. Indian Journal of Traditional Knowledge 10(2):281-286.

Kanel KR, Kunwar RM, Bhattarai R, Baral SR. 2017. Status study/mapping of important medicinal and aromatic plants (MAPs) of Nepal and preparation of document for Jadibuti Program. Department of Forests and Soil Conservation, Kathmandu, Nepal.

Karki D, Khadka D, Kunwar RM, Aryal PC, Paudel HR, Bhatta S, Shi S. 2023. Ethnomedicinal plants in Champadevi rural municipality, Okhaldhunga district, Nepal. Journal of Ethnobiology and Ethnomedicine 19(1):58.

Khajuria AK, Manhas RK, Kumar H, Bisht NS. 2021. Ethnobotanical study of traditionally used medicinal plants of Pauri district of Uttarakhand, India. Journal of Ethnopharmacology 276.

Khan SM, Din NU, Sohail IU, Rahman FI, Iqbal Z, Ali Z. 2015. Ethnobotanical study of some medicinal plants of Tehsil Kabal, District Swat, KP, Pakistan. Medicinal and Aromatic Plants 4(189):2167.

Kidane B, Van Andel T, Van Der Maesen LJG, Asfaw Z. 2014. Use and management of traditional medicinal plants by Maale and Ari ethnic communities in southern Ethiopia. Journal of Ethnobiology and Ethnomedicine 10(1):46.

Kunwar RM, Acharya RP, Chowdhary CL, Bussmann RW. 2015. Medicinal plant dynamics in indigenous medicines in far-west Nepal. Journal of Ethnopharmacology 163:210-219.

Kunwar RM, Adhikari N. 2005. Ethnomedicine of Dolpa district, Nepal: the plants, their vernacular names and uses. Lyonia 8(1):43-49.

Kunwar RM, Baral B, Luintel S, Uprety Y, Poudel RC, Adhikari B, et al. 2022. Ethnomedicinal landscape: Distribution of used medicinal plant species in Nepal. Journal of Ethnobiology and Ethnomedicine 18(1):34.

Kunwar RM, Bussmann RW. 2008. Ethnobotany in the Nepal Himalaya. Journal of Ethnobiology and Ethnomedicine 4(1):24.

Kunwar RM, Mahat L, Acharya RP, Bussmann RW. 2013. Medicinal plants, traditional medicine, markets, and management in far-west Nepal. Journal of Ethnobiology and Ethnomedicine 9:1-10.

Kunwar RM, Nepal BK, Kshhetri HB, Rai SK, Bussmann RW. 2006a. Ethnomedicine in Himalaya: a case study from Dolpa, Humla, Jumla and Mustang districts of Nepal. Journal of Ethnobiology and Ethnomedicine 2(1):27.

Kunwar RM, Nepal BK, Sigdel KP, Balami N. 2006b. Contribution to the ethnobotany of Dhading District, central Nepal. Nepal Journal of Science and Technology 7:65-69.

Kunwar RM, Shrestha KP, Bussmann RW. 2010. Traditional herbal medicine in Far-west Nepal: a pharmacological appraisal. Journal of Ethnobiology and Ethnomedicine 6(1):35.

Kutal D, Kunwar RM, Baral K, Sapkota P, Sharma HP, Rimal B. 2021. Factors that influence the plant use knowledge in the middle mountains of Nepal. PLoS ONE 16(2):e0246390.

Li S, Zhang Y, Guo Y, Yang L, Wang Y. 2020. Monpa, memory, and change: an ethnobotanical study of plant use in Mêdog County, South-east Tibet, China. Journal of Ethnobiology and Ethnomedicine 16(1):1-26.

Mahara A, Ojha N. 2024. Ethnobotanical study of medicinal plants in Kepilasgadhi Rural Municipality of Khotang District, Nepal. European Journal of Medicinal Plants 35(6):105-131.

Malla B, Gauchan DP, Chhetri RB. 2015. An ethnobotanical study of medicinal plants used by ethnic people in Parbat district of western Nepal. Journal of Ethnopharmacology 165:103-117.

Maulidiani M, Sheikh BY, Mediani A, Wei LS, Ismail IA, Abas F, Lajis NH. 2015. Differentiation of Nigella sativa seeds from four different origins and their bioactivity correlations based on NMR-metabolomics approach. Phytochemistry Letters 13:308-318.

Miara MD, Bendif H, Hammou MA, Teixidor-Toneu I. 2018. Ethnobotanical survey of medicinal plants used by nomadic peoples in the Algerian steppe. Journal of Ethnopharmacology 219:248-256.

Mishra P, Kumar J. 2025. Exploring Ethnobotany: Understanding the Dynamic Relationship Between Humans and Plants. Diverse aspects of Ethnobotany, 196.

Monika DM, Bisht PS, Chaturvedi P. 2020. Medicinal uses of traditionally used plants in Bhatwari block, district Uttarkashi, Uttarakhand, India. Journal of Scientific Research 64(1):119-126.

Ojha SN, Tiwari D, Anand A, Sundriyal RC. 2020. Ethnomedicinal knowledge of a marginal hill community of Central Himalaya: diversity, usage pattern, and conservation concerns. Journal of Ethnobiology and Ethnomedicine 16:1-21.

Paudyal SP, Rai A, Das BD, Paudel N. 2021. Ethnomedicinal knowledge on Rai community of Ramprasadrai rural municipality, Bhojpur district, eastern Nepal. European Journal of Biological Research 11(3):367-380.

Phillips O, Gentry AH. 1993. The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. Economic Botany 47(1):15-32.

Pushpangadan P, George V, Ijinu TP, Chithra MA. 2018. Biodiversity, bioprospecting, traditional knowledge. Sustainable development and value added products: a review. Journal of Traditional Medicine & Clinical Naturopathy 7(01):1-7.

R Core Team. 2024. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available from: https://www.R-project.org/

Rai SK. 2007. Aromatic plants of Karnali zone, Midwestern Nepal. Bulletin of Department of Plant Resources No. 29:55.

Rajbhandari KR. 2001. Ethnobotany of Nepal. ESON, Kathmandu, Nepal.

Rawat DS, Tiwari JK, Tiwari P, Singh H. 2016. Floristic diversity of montane zone of western Ramganga Valley, Uttarakhand, India. Journal of Economic and Taxonomic Botany 40(3-4):104-125.

Rokaya MB, Münzbergová Z, Timsina B. 2010. Ethnobotanical study of medicinal plants from the Humla district of western Nepal. Journal of Ethnopharmacology 130(3):485-504.

Shengji P. 1998. Application of ethnobotany for sustainable management of plant resources. In: Shrestha KK, Jha PK, Shengji P, Rastogi A, Rajbhandari S, Joshi M, editors. Ethnobotany for conservation and community development: Proceedings of National Training Workshop in Nepal, 6-13 January 1997. Kathmandu, Nepal, p. 67-72.

Shrestha N, Prasai D, Shrestha KK, Shrestha S, Zhang XC. 2014. Ethnomedicinal practices in the highlands of central Nepal: A case study of Syaphru and Langtang village in Rasuwa district. Journal of Ethnopharmacology 155(2):1204-1213.

Shrestha N, Shrestha S, Koju L, Shrestha KK, Wang Z. 2016. Medicinal plant diversity and traditional healing practices in eastern Nepal. Journal of Ethnopharmacology 192:292-301.

Shrestha PM, Dhillion SS. 2003. Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. Journal of Ethnopharmacology 86(1):81-96.

Shrestha UB, Shrestha BB, Shrestha S. 2010. Biodiversity conservation in community forests of Nepal: Rhetoric and reality. International Journal of Biodiversity and Conservation 2(5):98-104.

Singh A, Hart R, Chandra S, Nautiyal MC, Sayok AK. 2019. Traditional herbal knowledge among the inhabitants: a case study in Urgam Valley of Chamoli Garhwal, Uttarakhand, India. Evidence-Based Complementary and Alternative Medicine.

Singh A, Nautiyal MC, Kunwar RM, Bussmann RW. 2017. Ethnomedicinal plants used by local inhabitants of Jakholi block, Rudraprayag district, western Himalaya, India. Journal of Ethnobiology and Ethnomedicine 13(1):1-29.

Srivastava AK. 2018. Significance of medicinal plants in human life. In: Synthesis of medicinal agents from plants. Elsevier, U.K., Pp. 1-24.

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Economic Botany 62:24-39.

Tongco MDC. 2007. Purposive sampling as a tool for informant selection. Ethnobotany Research and Applications, 5, 147-158.

Torres-Avilez W, Medeiros PMD, Albuquerque UP. 2016. Effect of gender on the knowledge of medicinal plants: systematic review and meta-analysis. Evidence-Based Complementary and Alternative Medicine 2016(1):6592363.

Trotter RT, Logan MH. 2019. Informant consensus: a new approach for identifying potentially effective medicinal plants. In: Plants and Indigenous Medicine and Diet. Routledge, U.K., Pp. 91-112.

Uprety Y, Asselin H, Boon EK, Yadav S, Shrestha KK. 2010. Indigenous use and bio-efficacy of medicinal plants in the Rasuwa District, Central Nepal. Journal of Ethnobiology and Ethnomedicine 6(1):3.

WHO. 2019. Global report on traditional and complementary medicine 2019. World Health Organization, Geneva, Switzerland.