

Indigenous Knowledge and Application of Ethnomedicinal Plants in Western Himalayas

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Abstract

Background: In the modern era, the practice of herbal medicine for health care practices has been declining and may led to the loss of valuable information about plants used in traditional medicine from ancient times. The present study was aimed to document ethnomedicinal knowledge of plants used by the inhabitants of Garhwal Himalaya for health care management in rural areas and can be base line for the contribution of drug discoveries for Pharmaceutical industries.

Methods: A snowball sampling technique was employed to gather information using questionnaires and informal interviews followed by discussions with peer and prominent healer practitioners. Consensus factor (F_{ic}) was used to test the homogeneity in ethnomedicinal knowledge of rural inhabitants. Fidelity level (FL), cultural importance index (CI) were computed for the people depends on plants.

Results: A total of 88 medicinal plants species belonging to 45 families with 80 genera were reported for different ailments. The most frequent plant parts usage was from leaves followed by fruits, seeds, roots, bark, and flowers/buds. Skin problems were healed with the highest number of taxa (15 species) with F_{ic} value 0.85. Maximum number of plant species (15 species.) was used for skin treatment followed by wound, cough and digestive problems.

Conclusion: A significant relation of medicinal plants usage with distance (access time), and family income was observed. In the recommendation, it might have possibilities for the plants with higher FL and CI can contribute in discovery of new drugs after further pharmacological experiments.

1. Background

Worldwide humans have explored various approaches of using plant parts to enhance physical and spiritual well-being [1], medicinal plants have continued to gain prominence even in modern era [2]. Throughout the world about 40,000–50,000 plants species are used in traditional and modern medicine systems [3]. According to the World Health Organization (WHO) 65–80% of the world's population particularly in developing countries depends on plants for healing various diseases, as they have accepted it traditional culture [4], poverty and lack of access to modern medicine [5]. Traditionally used medicinal plants have a long history as they are considered safe, non-toxic to the human beings and this concept and knowledge is considered as a major contributory factor for drug discovery by pharmaceutical industries [6].

Most people residing in rural areas depend on subsistence agriculture for their survival and have a great cultural knowledge of curing several diseases by the utilization of various forest resources from ancient times [7, 8]. The natural resources particularly forest resources used by diverse ethnic communities for different purposes play a significant role in the subsistence economy of the inhabitants [9] through income generation and affordable tool in healthcare [10]. Wild collection practices secure valuable income for many rural household and provide incentives for conservation and sustainable use of forest vegetation which can play an important role in sustaining local economy [11]. Inhabitants of the hilly tracts particularly in rural areas, have major dependency on forests for subsistence where, a great deal of knowledge on the use of flora has been acquired through generations [12].

The ethnobotanical knowledge arises from a complex interaction between human beings and their surrounding environment [13] which depends on various factors such as local classification systems [14] communicated through language [15], human cognition and cultural history [16], beliefs and religion [17], social networks and access to information [18]. Ethnomedicinal research is the study among the rural inhabitants for recording their unique knowledge about plant wealth and search of new resources for preparation of herbal medicines, edible plants for consumption and other aspects of plants [19]. In India, 20% of plant species are used because of their medicinal values [20]. Uttarakhand a Himalayan state, well known for its biotic wealth and variety of cultural heritage covers about 12.18% of the total Indian Himalaya with greater than 40% of diverse forest types comprising the highest cover of natural forest and alpine pastures [21]. The diverse ethnic communities i.e., *Garhwali*, *Jaunsari*, *Bhotia*, *Tharu* etc., living in the state are dependent on forests for primary health care and for their livelihoods [7].

Herbal practice still plays a significant role in managing and curing various health problems particularly in the remote and rural areas of India [22]. The knowledge of medicinal plant conservation and its use has developed a link between promoting environmental conservation and indigenous knowledge [23]. In the present scenario, the practice of herbal medicine has been declining even in the places where it has been once developed and nurtured by oral tradition from generations. This situation may lead to the loss of traditional and valuable information about the plants used in healthcare management in the coming time [24]. The present study was initiated with the objective that; the traditional knowledge of medicinal plants and their uses in healthcare management for rural inhabitants staying in far flung areas of Garhwal Himalaya.

2. Methods

2.1. Study area

The present study was conducted in Pauri Garhwal and Rudraprayag Districts of state Uttarakhand (Fig. 1). The districts extend from 29°30'–30°50'N latitude and 78°10'–79°20'E longitude. The altitudinal range of all the surveyed villages was between 700 m to 1800 m. The rainfall pattern in the region is largely governed by the monsoon rains during the month of July to September, which accounts for about 60–80% of the total annual rainfall [25]. The region has very a rich biodiversity supporting different forest types, varies in species composition with elevation and latitude and the dominant tree species of the region is *Pinus roxburghii* (Chir pine).

Agriculture is the primary profession of about 80% of people in western and central Himalaya [26] and about 70% of them having land holding size less than 1 ha [27]. Inhabitants of the study area are dependent mainly on forests for diverse needs which are critical for the existence of their livelihoods and wellbeing. Livelihoods of the people are directly or indirectly derived from natural resources, traditional terrace based rainfed agriculture and animal husbandry practices as revealed by rural inhabitants. The agricultural terraces lined with numerous trees, wild bushes, grasses and herbs offer inhabitants fodder for livestock [28]. According to the 2011 census, population of both districts is 9, 29,546 with average literacy rate 82.33% (Table 1) [29].

2.2. Sampling techniques

Snowball sampling technique was used for selection of individuals (informants) that had a sound traditional knowledge of medicinal plants used in the area. In the beginning we approached *Gram Pradhan* (the head of village) and older people of the village, who are with sound knowledge of medicinal plants used in treatment of various health ailments. Once a traditional healer/plant collector was identified, snowball sampling was followed to locate and identify the second respondent and so on [30]. Since young generation had less awareness about the traditional knowledge therefore respondents with age group of 50–80 years were taken as sample for data recording. A large number of respondents (75.3%) were literate and were very friendly in disclosing the information about of traditional medicines which was passed on to them from their ancestors.

2.3. Field work

A test questionnaire was framed and was used to test the suitability and flow of questions with 48 households in twin districts of *Pauri* and *Rudraprayag* with 21 and 27 households respectively. After the changes were incorporated and the questionnaire was reframed again, the information was then gathered through semi-structured questionnaires from 161 households in which 64 were fall in *Pauri* and 97 from *Rudraprayag*. The semi-structured interviews were conducted, in *Hindi* or local dialect (*Garhwal*) for documentation of plants species which are used for traditional medicines.

Before starting of an interview, the inhabitants were advised about the purpose of the study and interview. Most of the information about the medicinal plants was recorded from the older people of the villages and mainly for plants medicinally important, plant parts used, name of the disease for which a particular plant they are using, etc. The published literature and consensus of the inhabitants was also used for the plants which were recorded in the study area. The collected plant specimens were identified and confirmed from the traditional healers and the people who are using these plants in their daily routine for medicinal purposes. Flora of Garhwal Himalayas was also used to cross check the species local name and scientific nomenclature [31; 32]. The specimens were then processed in the Laboratory, verified by curator and submitted to Garhwal University Herbarium.

2.4. Data analysis

2.4.1. Informant consensus factor

Data collected during fieldwork was entered in a database i.e., information was structured in use-reports (*UR*), where the informant *i*, mentions the use of the species *s* in the use-category *u* [33]. A consensus survey was conducted based on people's agreement on the number of plants used for a particular health ailment. To test homogeneity of traditional medicinal knowledge about the plants, the informant consensus factor (F_{ic}) was used [34]. The F_{ic} for each of the recorded plant species was calculated using the following formula:

Where, N_{ur} is the number of use reports for particular health problem and N_t is the number of species used for a particular health problem by all the informants.

2.4.2. Fidelity value (fl)

The fidelity level [35] is the percentage of informants claiming the use of a certain plant species for the same major purpose, was calculated as:

Where, I_p is the number of informants indicating independent use of a species for the same major ailment and I_u is the total number of informants mentioning the use of plant for any major ailment.

To assess the importance of each species, cultural importance index (CI) was calculated by dividing the number of UR in use-category by the number of informants [33] using the following formula:

Where UR is the number of use reports in various health problems (NC) and N is the total number of informants.

One-way ANOVA and binary logistic regression analysis was used to estimate the relationship between various household factors and use of medicinal plants. Description of various explanatory variables has been provided in Table 2a.

Table 1
Demographic status of the study area.

Parameters	Uttarakhand	District	
		Pauri Garhwal	Rudraprayag
Population			
Male	5,137,773	326,829	114,589
Female	4,948,519	360,442	127,696
Literacy rate (%)			
Male	87.4	92.71	93.90
Female	70.01	72.60	70.35
Number of villages			
Inhabited villages	15,745	3,142	653
Uninhabited villages	1,048	331	35
Source: Census of India, 2011			
Description of variables used.			

Table 2a
Description of variables used.

Variable name	Description
GEN	Gender of respondent (1 if male, 0 for female)
AGE	Age of respondent (in years)
EDU	Education level of respondent (0 for illiterate, 1 for literate, 2 for primary, 3 for high school, 4 for intermediate, 5 for bachelor and above)
PROF	Profession (1 for others, 2 for wage labor, 3 for business, 4 for agriculture, 5 for service)
HEAL	Healer (1 for yes, 0 for no)
DISTFOR	Distance from forest (in km)
DISTHOSP	Distance from hospital (in km)
INCOME	Monthly income (1 for Below, 2 for 3000–6000, 3 for 6000–12000, 4 for 12000–24000)

Table 2b
Statistical test of significance of variables.

Variables	Average	Std Dev	Standard error (S.E)	F value (sig.)
GEN	-	-	-	Ns
AGE	62.211	8.6627	0.6827	Ns
EDU	-	-	-	Ns
PROF	-	-	-	Ns
HEAL	-	-	-	Ns
DISTFOR	1.646	0.9281	0.0731	4.766 (0.001)
DISTHOSP	8.646	6.7446	0.5315	3.600 (0.000)
INC	-	-	-	8.614 (0.000)
Ns = non significant				

3. Results

The existing traditions of managing different diseases by inhabitants of *Pauri* and *Rudraprayag* district have been recorded and which is presented in the Table 3. A total of 88 medicinal plants were recorded under 46 families and 80 genera. The plant parts used included leaves, roots and underground parts. In the present study maximum number of plant species (15 species) were used for skin treatment followed by wound, cough (10 species each); digestive problem (9 species); diabetes (8 species); respiratory problems (7 species); stomach problem (6 species); blood pressure, cattle diseases, dysentery, fever, ulcer (5 species each); cut wounds, diarrhea, eye problems (4 species each); piles, hair treatment, skin burn (3 species each); rheumatic pain, cholesterol problems, liver problems, appetite improvement, ear ache, cold, bone problem, astringent, anemia, urinary issues (2 species each); antioxidant, back ache, cancer and tuberculosis, throat infections, dengue, heel crack, insecticide and nematicide, kidney stones, paralysis, pyorrhea, scorpion bites and snake bites, tooth ache (1 species each) (Fig. 2). Among the different plant parts used leaves contributed the most (30.7%) followed by fruits (27.3%), seeds (17%), roots (12.5%), bark (10.2%), flowers (8%), whole plants (6.8%); tuber/rhizome/bulb, twig, latex (4.5% each); gum and stem (2.3% each) and resin, pollen dust (1.1% each) (Fig. 3). The practice of using medicinal plant resources in health care management by rural households' is a part of their cultural tradition, which is passed to them from generations. This observations during study reveals that local people are dependent on a number of plants for their daily needs especially medicines and nutrition.

3.1. Consensus of medicinal plants

Medicinal plants used for different ailments and these ailments were classified into 40 groups and F_{ic} values for each category are mentioned in Table 4. The results of the F_{ic} showed that the antioxidant; back ache; cancer and tuberculosis; throat infections; dengue, healing heal crack; insecticide and nematicide; kidney stones; paralysis; pyorrhea; scorpion and snake bites; and tooth ache category had the greatest agreement with a F_{ic} of (1.00), followed by cold, appetite improvements and cholesterol level reduction (0.98); hair treatments (0.97); urinary infections and bone problems (0.96); ear ache and eye problems (0.95); astringent and cuts (0.94). The least agreement between the informants was recorded in the piles and ulcer with F_{ic} value of (0.50). Skin problems were cured with the highest number of taxa (15 spp.) with F_{ic} value 0.85 (Table 4). The awareness about the species used in skin related problems was observed high in the study area.

The inhabitants of the study area are engaged in various activities and have to face many issues while collecting fuelwood and fodder; cooking food in traditional stoves; agricultural farming in hilly terrains; carrying of portable water from distant places. These situations lead inhabitants to suffer from many skin related problems, such as ringworm, skin disorders, skin allergy, fungal infection, skin dryness, skin infection etc.

3.2. Cultural importance of medicinal plants

The study results revealed that *Trigonella foenumgraecum* and *Allium sativum* with CI value 0.292 were the most used species in health care mangement with 47 use reports each. The results further reported that the most important species used in treating skin related problems were *Artemesia wallichiana* and *Phyllanthus emblica* with CI value 0.273 and 0.205 respectively indicating more use of these species by the inhabitants due to availability of plant species and knowhow of their use in treating skin problems. The ANOVA analysis

shows that distance of household from hospital ($F = 3.600; p < 0.05$), monthly income of family ($F = 8.614; p < 0.05$) are the main influencing factors favoring the use of medicinal plants for curing health problems followed by distance of household from forest ($F = 4.766; p < 0.05$) (Table 2b).

4. Discussion

The results revealed that local traditional knowledge play an essential role in primary healthcare and the practice of plant-based medicine are still prevalent in rural areas of Garhwal region. The traditional herbal medicine is considered as the lifeline, the first choice, with fewer side effects, better patience tolerance, relatively economic, cultural recognition and long history of use, in comparison to pharmaceutical medicine [36]. Local people show preferences to the use of traditional herbal remedies due to their belief in the effectiveness of folklore herbal remedies [22]. In this study it was found that use of ethnomedicinal plants in herbal care at higher elevation was found to be higher due to lack of alternative options and accessibility to markets. The recognition and escalating faith in herbal medicine of medicinal plants has persistent in remote areas due to low price and fewer side effects as compared to general medicines [37].

In an ethnomedicinal study of Kedarnath Wildlife Sanctuary Malik et al. [22] reported that the most contribution of plant parts used was roots (33%), followed by leaves (27%), bark (20%), etc., which was partially inconsistent to our findings as the inhabitants were less aware about the medicinal use of root parts. Sharma et al [25] also reported uses of different plant parts and the most commonly used plant part in preparation of herbal ointment was leaves followed by seeds, roots, whole plant, stem, flower and fruit. Ayyanar and Ignacimuthu [38] suggested that the most of the studies confirmed the medicinal uses of leaves in treatment of various health illnesses.

Consensus factor analysis was performed to measure the reliability of the informant's claim about the plant use [39]. High F_{ic} value indicates the use of some plants by many inhabitants in curing a particular health illness whereas; low value means use of different plants by many inhabitants in curing a particular health illness [40]. Cultural importance of a plant depends on the versatility of plants with different uses than to those with only one use [33]. Many studies have also claimed the use of *Artemisia spp.* in treating various skin diseases [8, 41].

Medicinal plants and their traditional formulations have always been a part of social life of rural communities, which have proved to be very helpful in tackling various health related issues [42]. The dependency of the villagers on medicinal plants increased due to lack in healthcare facilities. The informants of the study area informed that medicinal plants serve as an important source in healthcare and the associated knowledge, which was traditionally transmitted and thus improving health conditions of human beings [43]. After having discussion with respondents in the study area, it was observed that older people believe more on the ethnomedicinal plants for curing different health issues.

Pharmaceutical medicines cure a range of diseases; however, their higher prices and side effects limit their applications therefore people living in remote areas who are associated with nature and medicinal plants from generations have involved themselves in using herbal medicines as they have fewer side-effects [38]. Due to globalization and its influence on cultural settings, has led to depletion of traditional knowledge in several areas including the Himalaya, due to unorganized way of knowledge transfer to the new generations [44].

This state of affairs can lead to eradication of vast ethnomedicinal understanding of the region if proper documentation is not taken care of. Therefore, to preserve traditional medicinal knowledge, the importance of herbal practitioners and their role in primary health care systems should be recognized at the regional as well as national level. This can be achieved by capacity building of herbal practitioners and education of new generations which will have substantial impact on the long-standing sustainability of herbal knowledge [45]. Furthermore, there is an urgent need to document this information, as it is rapidly declining due to influence of pharmaceutical medicines [46]. Thus, it is important to collect this information and develop a data base of medicinal plants for future research and potential development of new herbal medicines.

The wider application and adaptation of uses of ethno-medicinal plants, and the inclusion of traditional knowledge in decision making processes at highest level is of great importance. Most of the documented species in the present study have also been reported for multiple uses in various regions of the globe (Table 5). Multiple uses of these plants may incite the appropriate authorities to frame better conservation and management strategies for the plants used in medicinal purposes.

Table 3
Medicinal plants used for health care practices by inhabitants.

Scientific Name and Family	Voucher specimen no.	Local name	Use reports	Habit	Part Used	Medicinal Use	Other uses	Occurrence status (Gaur, 1999)	CI
Acanthaceae									
<i>Adhatoda vasica</i> Nees	GUH-21001	Basingu	15	Shrub	Flower	Flower with honey is used for treating bronchitis, asthma, cough and cold.	Leaves as livestock fodder	Fairly common	0.093
Amaranthaceae									
<i>Achyranthes aspera</i> L.	GUH-21002	Latjeera	2	Herb	Whole plant	Paste of whole plant is used for treating scorpion and snake bite.	None	Fairly common	0.012
<i>Amaranthus spinosus</i> L.	GUH-21003	Marsu	31	Herb	Leave, seed	Helpful in improving appetite, constipation.	Nutrient supplement	Common	0.193
Amaryllidaceae									
<i>Allium cepa</i> L.	GUH-21004	Pyaaaj	17	Herb	Bulb	Juice extracted from bulb is used in lice treatment	Whole plant is used as nutrient supplement	Common	0.106
<i>Allium sativum</i> L.	GUH-21005	Lahsun	47	Herb	Bulb	Bulb heated with mustard oil is helpful in treating cold.	Whole plant is used as flavouring agent in Indian dishes	Common	0.292
Anacardiaceae									
<i>Mangifera indica</i> L.	GUH-21006	Aam	29	Tree	Fruit, leave, Twig	Leaves are used for cough treatment and fruit is helpful in digestion.	Nutrient supplement, ritual, fuelwood	Abundant	0.18
<i>Rhus parviflora</i> Roxb.	GUH-21007	Tunglu	20	Shrub	Leave	Leaf paste is applied to wound or cut to stop bleeding.	Leaves are used for livestock fodder and twig for tooth cleaning	Abundant	0.124
<i>Semecarpus anacardium</i> L.	GUH-21008	Bhilow	12	Tree	Fruit	Helpful in treating skin allergy, cough, diarrhea.	None	Fairly common	0.075
Apiaceae									
<i>Coriandrum sativum</i> L.	GUH-21009	Dhaniya	8	Herb	Leave, seed	Leaf paste is applied on skin disease.	Leaf and fruit are used as condiment.	Commonly cultivated	0.050
Apocyanaceae									

<i>Calotropis procera</i> (Aiton) W.T. Aiton	GUH-21010	Aak	5	Shrub	Root, latex	Helpful in treating skin problems.	None	Common	0.031
<i>Carissa carandas</i> L.	GUH-21011	Karonda	8	Shrub	Root, fruit	Crushed root is used to cure wound. Fruit is helpful in fever treatment.	Fruit is edible	Often cultivated	0.05
Asparagaceae									
<i>Asparagus curillus</i> Buch.-Ham. ex Roxb.	GUH-21012	Satavar	2	Herb	Root	Powdered root is used to cure diabetes.	None	Common	0.012
Asteraceae									
<i>Ageratum conyzoides</i> L.	GUH-21013	Jangli pudina	3	Herb	Whole plant	Used as insecticide and nematocide.	None	Common	0.019
<i>Anaphalis adnata</i> Wall. ex DC.	GUH-21014	Bugulu	12	Herb	Leave	For healing cuts and wounds.	None	Common	0.075
<i>Artemisia vulgaris</i> L.	GUH-21015	Kunju	44	Herb	Leave	Leaf paste is useful for skin infection, ringworm and wound. Leaf juice is used for earache.	For ritual purpose	Fairly common	0.273
<i>Eupatorium adenophorum</i> Spreng.	GUH-21016	Basya	37	Shrub	Leave	Paste of leave paste is applied on cuts and wounds. Paste with mustard oil is used for ulcer treatment.	Used as firewood	Common	0.230
<i>Tagetes erecta</i> L.	GUH-21017	Gainda	11	Herb	Flower	Curing skin wound	For ritual purpose	Common	0.068
Berberidaceae									
<i>Berberis asiatica</i> Roxb.	GUH-21018	Kingora	33	Shrub	Root	Root after soaking in water is used for diabetes treatment and root juice is used to cure conjunctivitis	Nutrient supplement	Fairly common	0.205
Brassicaceae									
<i>Brassica campestris</i> Linn.	GUH-21019	Sarso	42	Herb	Leave, seed	For treating poor appetite	Nutrient supplement and flavouring agent in Indian dishes	Often cultivated	0.261
<i>Raphanus sativus</i> Linn.	GUH-21020	Muli	21	Herb	Whole plant	Helpful in curing jaundice, skin disorders and	Nutrient supplement, salad	Commonly cultivated	0.130

						digestive problems			
Cannabaceae									
<i>Cannabis sativa</i> L.	GUH-21021	Bhang	11		Leave, seed	Leave or seed with pepper, cumin seeds is used for treating fever.	Seed as nutrient supplement.	Common	0.068
Caricaceae									
<i>Carica papaya</i> L.	GUH-21022	Papita	33	Tree	Seed, fruit, leave	In treating blood pressure, constipation and dengue.	Nutrient supplement	Widely cultivated	0.205
Cleomaceae									
<i>Cleome viscosa</i> L.	GUH-21023	Jakhiya	17	Herb	Seed	Useful in treating high blood pressure.	Used as condiment in dishes	Common	0.106
Combretaceae									
<i>Terminalia belerica</i> Roxb.	GUH-21024	Bahera	8	Tree	Fruit	Fruit rind is used for treating cough and dysentery. Used in triphala.	Nutrient supplement	Common	0.05
<i>Terminalia chebula</i> Retz.	GUH-21025	Harad	23	Tree	Fruit	Fresh or boiled fruit pulp with honey in treating of asthma, cough and bronchitis. Also used in curing piles.	For livestock fodder	Common	0.143
Cucurbitaceae									
<i>Cucumis sativas</i> L.	GUH-21026	Kakdi	16	Climber	Seed	Seed paste mixed with water is useful in urinary problem.	Fruit as nutrient supplement	Commonly cultivated	0.099
<i>Lagenaria siceraria</i> (Molina) Standl.	GUH-21027	Lauki	29	Climber	Fruit	Helps in curing urinary disorders, indigestion and stomach acidity	Nutrient supplement	Cultivated	0.18
<i>Luffa cylindrica</i> (L.) M. Roem.	GUH-21028	Tori	13	Climber	Fruit	Helps in curing anemia and liver disorders	Nutrient supplement	Cultivated	0.081
<i>Momordica charantia</i> L.	GUH-21029	Karela	3	Climber	Fruit	Helpful in curing diabetes	Nutrient supplement	Commonly cultivated	0.019
Dipterocarpaceae									
<i>Shorea robusta</i> Gaertn.	GUH-21030	Sal	6	Tree	Bark	Bark paste is used in treating skin diseases.	None	Common	0.037

Discoreaceae									
<i>Dioscorea bulbifera</i> L.	GUH-21031	Genthi	3	Climber	Tuber	Cooked tubers are used in curing ulcers and piles.	Tuber used as vegetable	Common	0.019
Ericaceae									
<i>Rhododendron arboreum</i> Sm.	GUH-21032	Burans	5	Tree	Flower	Flower juice is used for curing blood pressure.	Leaves used for livestock fodder	Common	0.031
Euphorbiaceae									
<i>Phyllanthus emblica</i> L.	GUH-21033	Amla	33	Tree	Fruit	Hair wash, skin smoothening.	Nutrient supplement	Common	0.205
<i>Sapium insigne</i> (Royle) Benth. & Hook. f.	GUH-21034	Khinnu	9	Tree	Leave	Leaf paste is used on burns.	Used for ritual purposes.	Common	0.056
Fagaceae									
<i>Quercus leucotrichophora</i> A. Camus	GUH-21041	Banj	5	Tree	Gum	Gum of plant obtained is boiled with small amount of cow urine and then applied on the areas around broken horn.	For livestock fodder, doors, windows and fuelwood	Abundant	0.031
Juglandaceae									
<i>Juglans regia</i> L.	GUH-21042	Akhrot	12	Tree	Fruit, root, twig	Root bark and twig are used for khur pakka treatment. Fruit peel is useful for the treatment of ringworm.	Tooth cleaning	Common	0.075
Lamiaceae									
<i>Mentha arvensis</i> L.	GUH-21043	Pudina	7	Herb	Whole plant	Stomach ache treatment.	As condiment	Uncommon	0.043
<i>Ocimum sanctum</i> L.	GUH-21044	Ban tulsi	14	Herb	Whole plant	Diabetes, cough treatment.	For ritual purpose	Commonly cultivated	0.087
<i>Perilla frutescens</i> (L.) Britton	GUH-21045	Bhangzeera	7	Herb	Leave	Juice extracted after crushing leaf is used in earache.	Nutrient supplement	Common	0.043
Lauraceae									
<i>Cinnamon tamala</i> Nees & Eberm.	GUH-21047	Tejpatta	26	Tree	Stem, bark, leave	Stem and bark is used in curing cough. Leave is used in curing throat, asthma problems.	As flavouring agent in dishes.	Common	0.161
Leguminosae									

<i>Bauhinia vahlii</i> Wight. & Arn.	GUH-21048	Malu	11	Climber	Root	Pyorrhea treatment	For livestock fodder	Abundant	0.086
<i>Bauhinia variegata</i> L.	GUH-21049	Kweral	11	Tree	Leave, bark	Leaf paste in skin disease, bark powder in treating blood pressure	Nutrient supplement, livestock fodder, firewood	Common	0.068
<i>Abrus precatorius</i> L.	GUH-21035	Ratti	3	Climber	Root	Root is used to cure ulcer and rheumatic pain	None	Common	0.019
<i>Butea monosperma</i> (Lam.) Taub.	GUH-21036	Dhak	3	Tree	Seed, flower	Seed and flower are used in the treatment of dysentery and ringworm.	None	Common	0.019
<i>Glycine max</i> (L.) Merr.	GUH-21037	Kala bhatt	11	Herb	Seed	Seed paste is used for eye sores.	Nutrient supplement	Cultivated	0.068
<i>Macrotyloma uniflorum</i> (Lam.) Verdc.	GUH-21038	Ghaith	26	Herb	Seed	Seed soaked in water are helpful in treating kidney stones	Nutrient supplement	Commonly cultivated	0.161
<i>Ougeinia oojeiensis</i> Hochr.	GUH-21039	Sandhan	2	Tree	Gum	Gum is used for treating digestive trouble.	Wood for timber and firewood purpose	Common	0.012
<i>Trigonella foenum-graecum</i> L.	GUH-21040	Methi	47	Herb	Leave, seed	Helps in lowering cholesterol	Used as flavouring agent in Indian dishes	Often cultivated	0.292
Linaceae									
<i>Reinwardtia indica</i> Dumort.	GUH-21050	Phionly	6	Herb	Whole plant	Used for treating cattle diseases and wounds.	Used as livestock fodder	Common	0.037
Lythraceae									
<i>Punica granatum</i> L.	GUH-21051	Anar	13	Tree	Root	Roots are grinded to powder and then mixed with half liter of water and fed to animal to remove internal parasite.	Nutrient supplement	Cultivated	0.081
<i>Woodfordia fruticosa</i> L.	GUH-21052	Dhaura	2	Shrub	Flower	Dried flowers are used in dysentery.	Used for livestock fodder	Common	0.012
Malvaceae									
<i>Bombax ceiba</i> L.	GUH-21053	Semal	5	Tree	Bark	Curing joint break	Nutrient supplement	Common	0.031
Meliaceae									
<i>Melia azedarach</i> L.	GUH-21054	Dainkan	7	Tree	Leave, seed,	Treating skin disease	For livestock	Common	0.043

					bark, root		fodder.		
Menispermaceae									
<i>Tinospora cordifolia</i> (Willd.) Miers ex Hook. f. & Thomson	GUH-21055	Gilloi	31	Climber	Twig	Fever, respiratory problems, indigestion treatment.	None	Not uncommon	0.193
Moraceae									
<i>Ficus subincisa</i> Buch.-Ham. ex Sm.	GUH-21056	Umaru	6	Tree	Latex	Latex with boiled water is used for treating diarrhea, piles and diabetes.	For livestock fodder	Common	0.037
<i>Ficus roxburghii</i> Wall.	GUH-21057	Timla	35	Tree	Latex, fruit	Latex is used to cure cuts and wound. Roasted fruit is used to cure diarrhea and dysentery.	Nutrient supplement, fuelwood, fodder	Common	0.217
<i>Ficus palmata</i> Browicz	GUH-21058	Bedu	10	Tree	Latex	Skin wound	Nutrient supplement	Common	0.062
<i>Morus serrata</i> L.	GUH-21059	Shahtoot	9	Tree	Fruit	Curing anemia	Fodder, basket making, fuelwood, nutrient supplement	Not uncommon	0.056
Musaceae									
<i>Musa paradisiaca</i> L.	GUH-21060	Banana	19	Herb	Fruit	In curing high blood pressure, asthma, diabetes.	Nutrient supplement	Cultivated	0.118
Myricaceae									
<i>Myrica esculenta</i> Buch.-Ham. ex D. Don	GUH-21061	Kaphal	12	Tree	Fruit, bark	Fruit eaten when mixed with mustard oil and salt is helpful in digestion. Stem bark powder is used for cough.	Fruit is used as nutrient supplement	Abundant	0.075
Myrtaceae									
<i>Psidium guajava</i> L.	GUH-21062	Guava	11	Tree	Leave	Curing cough.	Nutrient supplement	Cultivated	0.068
<i>Syzizium cumini</i> (L.) Skeels	GUH-21063	Jamun	4	Tree	Fruit	Helps in treating diabetes	Nutrient supplement	Common	0.025
Oxalidaceae									
<i>Oxalis corniculata</i> L.	GUH-21064	Khatibuti/ Tipati	10	Herb	Leave	Leaf paste is applied on skin ulcer and wound.	Nutrient supplement	Common	0.062
Pedaliaceae									
<i>Sesamum</i>	GUH-	Til	23	Herb	Seed	Curing joint	For ritual	Common	0.143

<i>orientale</i> L.	21065					pain	purpose		
Pinaceae									
<i>Pinus roxburghii</i> Sarg.	GUH-21066	Kulah	39	Tree	Resin, pollen dust	Resin is used as crack cream. Pollen dust and resin with water is used for cancer and tuberculosis treatment.	Wood for timber and firewood, needles are used for livestock bedding and for ritual purpose	Abundant	0.242
Poaceae									
<i>Cynodon dactylon</i> (L.) Pers.	GUH-21067	Doob	18	Herb	Whole plant	Plant juice is used for fever and burning sensation.	Used in rituals	Common	0.112
<i>Echinochloa crus-galli</i> L.	GUH-21068	Jhangora	14	Herb	Seed	Curing loose motion.	Nutrient supplement	Commonly cultivated	0.087
<i>Hordeum vulgare</i> L.	GUH-21069	Jau	12	Herb	Leave	Leaf juice is used for cataract.	Nutrient supplement and livestock fodder	Commonly cultivated	0.075
<i>Oryza sativa</i> L.	GUH-21070	Satti	13	Herb	Seed	Helpful in curing constipation.	Nutrient supplement and livestock fodder	Commonly cultivated	0.081
<i>Zea mays</i> L.	GUH-21071	Mungri	5	Herb	Seed	Flour of dry seed is used for digestion.	For livestock fodder	Commonly cultivated	0.031
Polygonaceae									
<i>Rumex hastatus</i> D. Don	GUH-21072	Almoda	5	Herb	Leave	Leave paste is applied on fungal infection.	Nutrient supplement	Fairly common	0.031
Rhamnaceae									
<i>Ziziphus mauritiana</i> Lam.	GUH-21073	Ber	3	Shrub	Root	Roots are used in treating human indigestion.	Nutrient supplement	Fairly common	0.019
<i>Ziziphus nummularia</i> (Burm. f.) Wight & Arn.	GUH-21074	Jhar ber	9	Shrub	Fruit, leave	Fruit as astringent, leaves for treating skin diseases.	Nutrient supplement	Common	0.056
Rosaceae									
<i>Prunus cerasifera</i> Ehrh.	GUH-21075	Poolam	28	Tree	Fruit	Fruit act as antioxidant, helps in lowering cholesterol.	Nutrient supplement, leaves for livestock	Commonly cultivated	0.174
<i>Prunus cerasoides</i> Buch.-Ham. ex D. Don	GUH-21076	Panya	39	Tree	Fruit, bark	Fruit is astringent and digestive. Juice of bark is applied externally to treat backaches.	Ritual, fuelwood, nutrient supplement	Common	0.242

<i>Prunus persica</i> (L.) Batsch.	GUH-21077	Aadu	11	Tree	Leave	Treating khur pakka	Nutrient supplement	Commonly cultivated	0.068
<i>Pyrus pashia</i> Buch.-Ham. ex D. Don	GUH-21078	Melu	17	Tree	Fruit	Juice of ripped fruit is used to cure conjunctivitis.	Nutrient supplement, fodder, fuelwood	Fairly common	0.106
<i>Rosa macrophylla</i> Lindl.	GUH-21079	Gulaab	2	Shrub	Flower	Skin moisturizer	For ritual purpose	Uncommon	0.012
<i>Rubus ellipticus</i> Sm.	GUH-21080	Hisoola	5	Shrub	Root	Root paste is applied on ulcer and skin infection.	Nutrient supplement	Common	0.031
Rutaceae									
<i>Aegle marmelos</i> (L.) Correa	GUH-21081	Bel	5	Tree	Fruit	Fruit is used for diabetes treatment.	Leave is used for ritual purpose	Common	0.031
<i>Citrus aurantifolia</i> Swingle	GUH-21082	Nimbu	5	Tree	Fruit	Diarrhea treatment	Nutrient supplement	Uncommon	0.031
<i>Murraya koenigii</i> (L.) Spreng.	GUH-21083	Kadi patta	3	Shrub	Leave	Respiratory problem	As flavoring agent in dishes	Common	0.019
<i>Zanthoxylum armatum</i> DC.	GUH-21084	Timru	23	Shrub	Bark, fruit, twig	Toothache treatment	Tooth cleaning	Common	0.143
Solanaceae									
<i>Datura stramonium</i> L.	GUH-21085	Dhatura	15	Herb	Leave, flower	Leave and flower is used to cure bronchitis, asthma and cough.	Fruit is used in ritual purpose	Common	0.168
Tiliaceae									
<i>Grewia optiva</i> Drumm. ex Burret	GUH-21086	Bhimal	27	Tree	Bark, twig, leave	Hair wash	Rope making, fuelwood, fodder	Common	0.037
Urticaceae									
<i>Urtica dioica</i> L.	GUH-21087	Kandali	6	Herb	Leave	Stomach ache	Rope making, nutrient supplement	Common	0.106
Verbenaceae									
<i>Vitex negundo</i> L.	GUH-21046	Siwali	21	Shrub	Leave, stem	Paste of leaf is used for treating wounds, paralysis and rheumatic pain. Stem paste is used to control fever.	Used for ritual purposes	Common	0.13
Zingiberaceae									
<i>Cautleya spicata</i> (Sm.) Baker	GUH-21088	Jad haldu	17	Herb	Rhizome	Rhizome paste useful in treatment of skin burns.	None	Common	0.093

Table 4
Informant consensus of ethnomedicinal plants

Health problems (F_{ic})	Number of taxa used (N_t)	Number of use reports (N_{ur})	Species Fidelity level ($FL\%$)
Anemia (0.93)	2	15	<i>Morus serrata</i> (100%), <i>Luffa cylindrical</i> (46.2%)
Antioxidant (1.00)	1	12	<i>Prunus armeniaca</i> (42.9%)
Astringent (0.94)	2	18	<i>Prunus cerasoides</i> (28.2%), <i>Ziziphus nummularia</i> (77.8%)
Backache (1.00)	1	21	<i>Prunus cerasoides</i> (53.8%)
Blood pressure (0.92)	5	54	<i>Musa paradisiaca</i> (73.7%), <i>Bauhinia variegata</i> (54.5%), <i>Carica papaya</i> (42.9%), <i>Cleome viscosa</i> (100%), <i>Rhododendron arboreum</i> (100%)
Bone Problem (0.96)	2	28	<i>Sesamum orientale</i> (100%), <i>Bombax ceiba</i> (100%)
Cancer and tuberculosis (1.00)	1	2	<i>Pinus roxburghii</i> (5.1%)
Cattle disease (0.90)	5	43	<i>Prunus persica</i> (100%), <i>Quercus leucotrichophora</i> (100%), <i>Juglans regia</i> (66.7%), <i>Reinwardita indica</i> (100%), <i>Punica granatum</i> (100%)
Cold (0.98)	2	56	<i>Adhathoda vasica</i> (60%), <i>Allium sativum</i> (100%)
Cough (0.89)	10	85	<i>Datura stramonium</i> (60%), <i>Myrica esculenta</i> (33.3%), <i>Psidium guajava</i> (100%), <i>Ocimum sanctum</i> (85.7%), <i>Cinnamom tamala</i> (23.1%), <i>Terminalia chebula</i> (65.2%), <i>Terminalia belerica</i> (87.5%), <i>Adhathoda vasica</i> (20%), <i>Mangifera indica</i> (48.3%), <i>Semecarpus anacardium</i> (33.3%)
Curing throat (1.00)	1	15	<i>Cinnamomum tamala</i> (57.7%)
Cut (0.94)	4	52	<i>Ficus roxburghii</i> (37.1%), <i>Rhus parviflora</i> (35.0%), <i>Anaphalis adnata</i> (66.7%), <i>Eupatorium adenophorum</i> (64.9%)
Dengue (1.00)	1	5	<i>Carica papaya</i> (15.2%)
Diabetes (0.78)	8	33	<i>Aegle marmelos</i> (100%), <i>Ficus subincisa</i> (33.3%), <i>Syzizium cumini</i> (100%), <i>Musa paradisiaca</i> (15.8%), <i>Ocimum sanctum</i> (14.3%), <i>Berberis asiatica</i> (36.4%), <i>Momordica charantia</i> (100%), <i>Asparagus curillus</i> (100%)
Diarrhea (0.73)	4	12	<i>Citrus limon</i> (100%), <i>Ficus subincisa</i> (33.3%), <i>Ficus roxburghii</i> (11.4%), <i>Semecarpus anacardium</i> (8.3%)
Digestive problem (0.87)	9	64	<i>Prunus cerasoides</i> (17.9%), <i>Myrica esculenta</i> (66.7%), <i>Zea mays</i> (100%), <i>Ziziphus mauritiana</i> (100%), <i>Oogenia oojenensis</i> (100%), <i>Tinospora cordifolia</i> (12.9%), <i>Raphanus sativus</i> (52.4%), <i>Lagenaria siceraria</i> (31%), <i>Mangifera indica</i> (51.7%)
Dysentery (0.85)	5	27	<i>Ficus roxburghii</i> (25.7%), <i>Echinochloa crus-galli</i> (100%), <i>Butea monosperma</i> (33.3%), <i>Woodfordia fruticosa</i> (100%), <i>Terminalia belerica</i> (12.5%)
Earache (0.95)	2	23	<i>Perilla frutescens</i> (100%), <i>Artemisia wallichiana</i> (36.4%)
Eye problem (0.95)	4	61	<i>Hordeum vulgare</i> (100%), <i>Pyrus pashia</i> (100%), <i>Glycine max</i> (100%), <i>Berberis asiatica</i> (63.6%)
Fever (0.91)	5	47	<i>Cynodon dactylon</i> (38.9%), <i>Vitex negundo</i> (19%), <i>Tinospora cordifolia</i> (71%), <i>Cannabis sativa</i> (100%), <i>Carissa carandus</i> (37.5%)
Hair treatment	3	67	<i>Grewia optiva</i> (100%), <i>Phyllanthus emblica</i> (69.7%), <i>Allium cepa</i> (100%)

(0.97)			
Healing heel crack (1.00)	1	37	<i>Pinus roxburghii</i> (94.9%)
Improve appetite (0.98)	2	65	<i>Brassica campestris</i> (100%), <i>Amaranthus spinosus</i> (74.2%)
Insecticide and nematicide (1.00)	1	3	<i>Ageratum coyzooides</i> (100%)
Kidney stones (1.00)	1	26	<i>Macrotyloma uniflorum</i> (100%)
Liver problem (0.90)	2	11	<i>Raphnus sativus</i> (19%), <i>Luffa cylindrical</i> (53.8%)
Lowering cholesterol (0.98)	2	63	<i>Prunus armeniaca</i> (57.1%), <i>Trigonella foenumgraecum</i> (100%)
Paralysis (1.00)	1	7	<i>Vitex negundo</i> (33.3%)
Piles (0.50)	3	5	<i>Ficus subincisa</i> (33.3%), <i>Terminalia chebula</i> (4.3%), <i>Dioscorea bulbifera</i> (66.7%)
Pyorrhea (1.00)	1	11	<i>Bauhinia vahlii</i> (100%)
Respiratory problem (0.80)	7	31	<i>Murraya koenigii</i> (100%), <i>Datura stramonium</i> (26.7%) (13.3%), <i>Musa paradisiaca</i> (10.5%), <i>Cinnamom tamala</i> (19.2%), <i>Tinospora cordifolia</i> (16.1%), <i>Terminalia chebula</i> (26.1%) (4.3%), <i>Adhathoda vasica</i> (13.3%) (6.7%)
Rheumatic pain (0.80)	2	6	<i>Abrus precatorius</i> (66.7%), <i>Vitex negundo</i> (19%)
Scorpion and snake bite (1.00)	1	2	<i>Achyranthes aspera</i> (100%)
Skin burn (0.94)	3	37	<i>Curcuma angustifolia</i> (100%), <i>Cynodon dactylon</i> (61.1%), <i>Sapium insigne</i> (100%)
Skin treatment (0.85)	15	93	<i>Rosa rubiginosa</i> (100%), <i>Rubus ellipticus</i> (60%), <i>Rumex hastatus</i> (100%), <i>Ziziphus nummularia</i> (22.2%), <i>Butea monosperma</i> (66.7%), <i>Juglans regia</i> (33.3%), <i>Melia azederach</i> (100%), <i>Raphanus sativus</i> (28.6%), <i>Bauhinia variegata</i> (45.5%), <i>Shorea robusta</i> (100%), <i>Phyllanthus emblica</i> (30.3%), <i>Semecarpus anacardium</i> (58.3%), <i>Coriandrum sativum</i> (100%), <i>Calotropis procera</i> (100%), <i>Artemisia wallichiana</i> (27.3%) (20.5%)
Stomach problem (0.91)	6	59	<i>Urtica dioica</i> (100%), <i>Oryza sativa</i> (100%), <i>Mentha arvensis</i> (100%), <i>Carica papaya</i> (57.1%), <i>Lagenaria siceraria</i> (31%), <i>Amaranthus spinosus</i> (25.8%)
Tooth ache (1.00)	1	23	<i>Zanthoxylum armatum</i> (100%)
Ulcer (0.50)	5	9	<i>Rubus ellipticus</i> (40%), <i>Oxalis corniculata</i> (30%), <i>Abrus precatorius</i> (33.3%), <i>Dioscorea bulbifera</i> (33.3%), <i>Eupatorium adenophorum</i> (5.4%)
Urinary problem (0.96)	2	27	<i>Lagenaria siceraria</i> (37.9%), <i>Cucumis sativus</i> (100%)
Wound (0.88)	10	76	<i>Ficus roxburghii</i> (25.7%), <i>Ficus palmata</i> (100%), <i>Oxalis corniculata</i> (70%), <i>Vitex negundo</i> (28.6%), <i>Rhus parviflora</i> (65%), <i>Carissa carandus</i> (62.5%), <i>Anaphalis adnata</i> (33.3%), <i>Tagetus minuta</i> (100%), <i>Eupatorium adenophorum</i> (29.7%), <i>Artemesia wallichiana</i> (15.9%)

Table 5
Existing literature of plant species used in different ailments.

Plant Species Ailments	
<i>Justicia adhatoda</i>	Chronic cold and cough, piles, leprosy and diabetes [47]; cough and cold, chronic bronchitis [48]
<i>Achyranthes aspera</i>	Anti-amoebic and Anti-fertility activity [49]; treatment of cancer, leprosy, asthma, fistula, piles, arthritis, wound, insect and snake bite, dandruff, hepatitis [50]
<i>Allium cepa</i>	Edible condiments, vegetable [51] (Geng <i>et al.</i> ,2016)
<i>Allium sativum</i>	Cardiovascular disease, diabetes, blood pressure [52]
<i>Mangifera indica</i>	Cough and cold, dysentery, worm, furniture, leaf religious [53]
<i>Rhus parviflora</i>	Antimicrobial [54]
<i>Semecarpus anacardium</i>	Anti-atherogenic, anti-inflammatory, antioxidant, antimicrobial, anti-reproductive [55]
<i>Coriandrum sativum</i>	Antioxidant [56]
<i>Calotropis procera</i>	Antitumor, antihelmintic, antioxidant [57]
<i>Carissa carandas</i>	Anti-inflammatory and anti-pyretic activity [58]
<i>Asparagus curillus</i>	Piles, fever, wound, anti-toxic, weakness, cough [53]; epilepsy [59]
<i>Ageratum conyzoides</i>	Muscular pain, piles, ring worm, snake bite [60]; control bleeding [61]
<i>Anaphalis adnata</i>	Juice applied on fresh cuts and wounds [62]
<i>Artemisia vulgaris</i>	Nervous and spasmodic affections, asthma [63]
<i>Eupatorium adenophorum</i>	Juice applied on fresh cut [64]
<i>Berberis asiatica</i>	Conjunctivitis and eye inflammation [65]
<i>Brassica campestris</i>	Fever, indigestion and irritation [66]
<i>Cannabis sativa</i>	Diarrhoea and body pain [64]
<i>Carica papaya</i>	Heart problem, skin problem, piles [53]; bone fracture [67]
<i>Terminalia belerica</i>	Fruit for piles, dropsy, diarrhoea, leprosy, headache [68]; cold, constipation, piles [60]
<i>Terminalia chebula</i>	digestion, skin problem [53]; cold, cough, fever, stomach ache [69]; diabetes [70]
<i>Lagenaria siceraria</i>	Jaundice, diarrhoea and dysentery [71, 72]
<i>Shorea robusta</i>	Dysentery, antidote [53]; burning sensation, chest pain, small pox [60]
<i>Dioscorea bulbifera</i>	Edible [67]
<i>Rhododendron arboreum</i>	Diarrhea and headache [66]
<i>Phyllanthus emblica</i>	Constipation, fever, itching, digestive [53]
<i>Mentha arvensis</i>	Rheumatism, fever, weakness, ulcer, wounds, jaundice, cough, asthma and cuts [66]
<i>Ocimum sanctum</i>	bronchitis, asthma and genito urinary disorders [73]; cold and cough [48]
<i>Perilla frutescens</i>	Cough and nausea [74]
<i>Cinnamon tamala</i>	Antigonorrhoeic, hypoglycemic, stimulant, anti-rheumatic and antidote for scorpion sting [75]

Plant Species Ailments	
<i>Bauhinia vahlii</i>	Dysentery [64]
<i>Bauhinia variegata</i>	Dysentery [76]
<i>Abrus precatorius</i>	Antidote, dental caries, baldness, dandruff, erysipelas [77]
<i>Butea monosperma</i>	Tuberculosis [78]
<i>Glycine max</i>	Cholesterol lowering and Anticancer [79]
<i>Macrotylom auniflorum</i>	Kidney stone [74]
<i>Trigonellafoenum-graecum</i>	Diabetes, stomach complaints [80]; easier delivery [81]
<i>Punica granatum</i>	Diarrhoea, fever, indigestion [82]; heart problem, eye and ear disorder, jaundice [53]
<i>Woodfordia fruticosa</i>	Leprosy, toothache, leucorrhea, fever, dysentery, bowel disease [83]
<i>Melia azedarach</i>	Stomatitis, internal worm, stone in urinary bladder [53]; Fever [72]
<i>Tinospora cordifolia</i>	Piles, eye problem, fever, jaundice [53]; jaundice [72]
<i>Ficus subincisa</i>	Boils [84]
<i>Myrica esculenta</i>	Sinusitis [85]
<i>Syzizium cumini</i>	Dysentery [78]
<i>Oxalis corniculata</i>	Diarrhoea, piles, anemia, and eye problems[62, 66]
<i>Sesamum orientale</i>	Skin for sunburns and ringworm [86]
<i>Cynodon dactylon</i>	Antiseptic, snake bite, stop bleeding, wounds, Miscarriage [87, 59]
<i>Hordeum vulgare</i>	Beriberi, cough, influenza, measles, syphilis, nephritis, jaundice, dysentery, abortion, common cold, for kidney diseases, skin diseases [88]
<i>Ziziphus mauritiana</i>	Dried fruits use for anodyne, anticancer, refrigerant, sedative, stomachache [89]
<i>Aegle marmelos</i>	Stomach ache, cures cough, good for asthma, tumors [90]; Dysentery [80]
<i>Murraya koenigii</i>	Anaemia,vomiting, wound [53]; Vomiting, dysentery [72]
<i>Datura stramonium</i>	Against rabies, nervousness, nausea and hysteria [84]
<i>Grewia optiva</i>	Antibacterial, antifungal, antioxidant [91]
<i>Vitex negundo</i>	Headache, stomach problem, diarrhoea, rheumatism, bone fracture, body swelling, swelling of joints, cancer, liver complaints, jaundice, fuel wood branches for making baskets [61, 69, 92]

5. Conclusion

This study provides widespread information about the traditional knowledge of medicinal plants used by rural inhabitants of Garhwal Himalaya, which is under threat of being lost in near future. Medicinal plants and their traditional formulations have always been a part of livelihood of rural inhabitants, which have proved to be a very useful in dealing with various health issues. The results of study showed significant relation of medicinal plants use with distance of hospital from household, monthly income of family and distance of forest from household. Thus it can be concluded that rural inhabitants of Garhwal Himalaya have sound ethnomedicinal knowledge of curing various health related issues by the use of local medicinal plants accessible to them from their vicinity.

This study provides base line information for more scientific studies that may lead to the discovery of new plant-based drugs which will help in the development of effective herbal medicines in coming decades. In present scenario more dependency of young peoples on allopathic medicine system has led to degradation of traditional knowledge system. Therefore, it is the necessity in the present circumstances to document the traditional knowledge related to medicinal uses of plants and its conservation for future generations. The findings of the study encourage a need for the development of methods or policies which can help in conserving the traditional knowledge of plants used by rural inhabitants in health care and thus in sustaining rural health problems needs.

Abbreviations

F_{ic} - Informant Consensus Factor

FL - Fidelity level

CI - Cultural Importance Index

WHO - World Health Organization

UR - Use-Reports

Declarations

Abbreviations

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Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Author's contribution

SR carried out the field study and analyzed data with the help of BN and completed first draft of the manuscript. MK and RK, NP, JAB and RWB read and revised the manuscript. RMP indentified plant species and revision of MS. The final draft of the manuscript was read and approved by the all authors.

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Figures

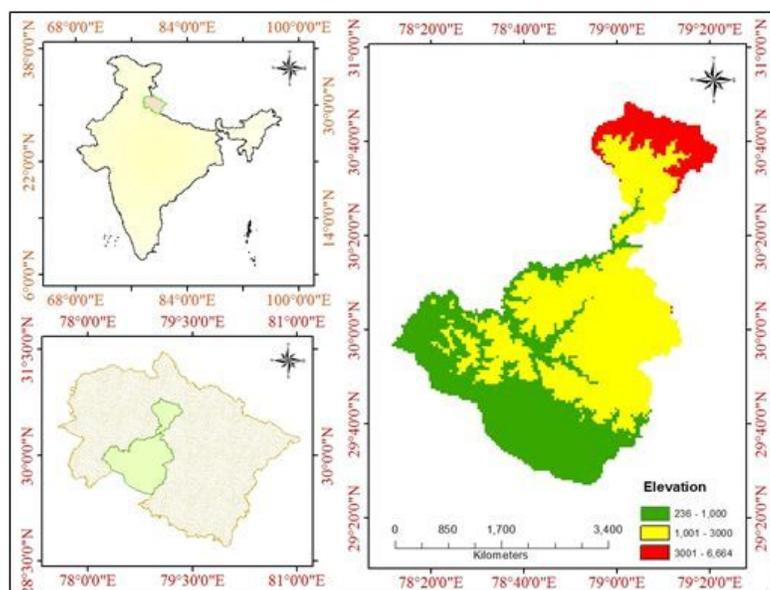


Figure 1

Location map of study area.

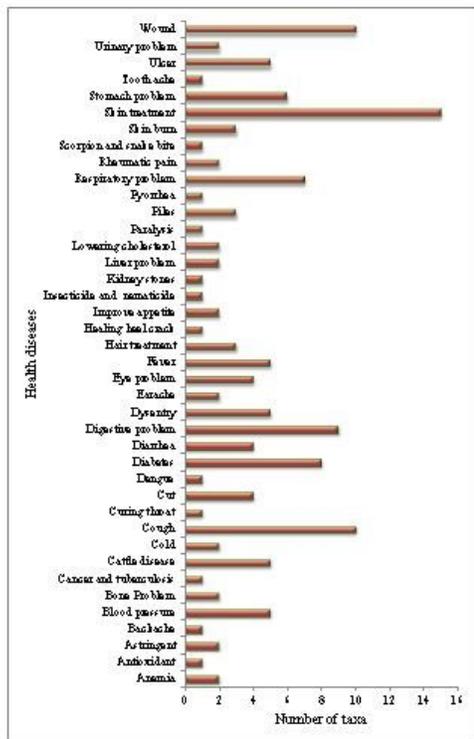


Figure 2

Number of plant species (taxa) used in different health issues.

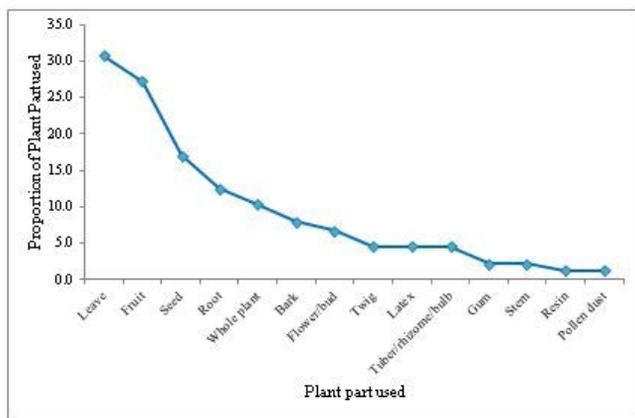


Figure 3

Proportion of different plant parts used in curing health problems.