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## Abstract

**Background:** The documentation and phytochemical screening of medicinal plants has been an important way over the years for the discovery of new drugs and pharmaceutical products. Bandipora, one of the northern districts of Kashmir, India, is rich in ethnic and biological diversity. Owing to increasing demand and subsequent pressure on medicinal plants, it is highly imperative to document their traditional uses, understand their distribution and diversity, and highlight their availability in their natural habitats. To this end, the present study was carried out to elicit a firsthand wealth of information on the traditional medicinal uses of plants practiced by the local populace of this remote district.

**Material and Methods:** Frequent field trips and plant collections were made between March 2011 to October 2012 and the methods used to gather ethnomedicinal data included semi-structured interviews, focus group discussions and walk-in-the-woods with local knowledgeable elders, traditional practitioners (*Bhoeris*) and tribals (*Gujjars* and *Bakkerwals*). The collected data was analyzed with three quantitative tools viz. the informant consensus factor ( $F_{ic}$ ), fidelity level (FL) and use value (UV).

**Results:** A total of 131 plant species belonging to 120 genera and 59 different families were found to be used as remedies for curing various human and livestock ailments. Out of 131 species, angiosperms comprised the highest number (124 species) followed by pteridophytes (4 species) and gymnosperms (3 species). Two dominant families were Asteraceae (16 species) and Lamiaceae (9 species). The highest informant's consensus factor ( $F_{ic}$ ) value was 0.95 for insect stings, followed by dermatological, hair ailments, anticancer/tumor (0.90 each), which indicated best agreement among informant knowledge on medicinal plant used to treat ailments in these categories while the lowest  $F_{ic}$  value of liver disorders and fever (0.63 each) indicated less agreement among informant knowledge on medicinal plant used to treat ailments in these categories. The 100% FL was expressed by 6 plant species for dermatological disorders followed by 3, 1, 1, 1 and 1 for mouth ailments, cardiovascular, joint ailments, gastrointestinal and insect stings category respectively. Use value was high for *Artemisia absinthium* (0.70), *Cannabis sativa* and *Saussurea costus* (0.47 each), *Calendula officinalis* (0.45) and *Taraxacum officinale* (0.39). The lowest use value was calculated for *Ranunculus arvensis* (0.01), with only three people reported the utility.

**Conclusion:** Since drug discovery from medicinal plants continues to provide new and important leads against various pharmacological targets, an effort to collect medicinal plants and their associated traditional knowledge could serve an important tool for the discovery new potent compounds because if the documented plants are subjected to thorough phytochemical and pharmacological investigations, new potent leads against various pharmacological targets could definitely be discovered as there is no doubt that botanic gems are still found in the world.

**Keywords:** Indigenous/traditional knowledge, Drug discovery, Informant's consensus factor, Fidelity level, Use value, Traditional practitioners.

## Introduction

Recently, documentation of the biological resources and the associated indigenous knowledge existing within a country has assumed the highest priority. Plants have played a vital role in the treatment of diseases since prehistoric times and are one of the most important areas of research in the world today. From the very earliest days of civilization, mankind has turned to plants for healing, a tradition that has survived the arrival of modern medicine and found new strength at the end of 20<sup>th</sup> century (Sullivan and Sheally, 1997).

Traditional medicine is the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures used in the maintenance of health, prevention of diseases and improvement of physical and mental illness (WHO, 2000). In practice, traditional medicine refers to the following components: Acupuncture (China), Ayurveda (India), Unani (Arabic countries), traditional birth attendant's medicine, mental healer's medicine, herbal medicine, and various forms of indigenous medicine (Ramawat et al. 2009).

Traditional medicine has maintained its popularity in all regions of the developing world, and its use is rapidly spreading in industrialized countries (Ramawat and Goyal, 2008). Knowledge of plants and their healing properties have been closely linked from the time of human beings' earliest social and cultural groupings. The medicine man was usually an accomplished botanist. Even in historical times, botany and medicine continued to be virtually one and the same discipline until about 1500 CE, when they began to separate from their close association, to the advantage of both sciences.

India and China are two of the largest countries in Asia with the richest arrays of registered and relatively well known medicinal plants (Ravan, 1998). India, endowed with such a rich wealth of medicinal plants is unique in the use of plants/plant parts by all sections of people either directly as folk remedies in different indigenous systems of medicine or indirectly in the pharmaceutical preparations of modern medicine (Lone et al. 2013a). The knowledge of medicinal plants has been accumulated in the course of many centuries based on different Indian systems of medicines such as Ayurveda, Unani and Siddha (Alagesaboopathi, 2011). *Rigveda* and *Atharveda* which dates back to 2000-1000 BC and several post Vedic treatises, viz. *Charakasamhita* (100 AD), *Sushruthasamhita* (100-800 AD), *Dhanwanthari Nighantu* (1200 AD), are the important ancient sources of information on medicinal plants (Rajith et al. 2010).

Some 80% of the world's population still relies upon plants for primary health care; even today in Western medicine, and despite progress in synthetic chemistry, some 25% of prescription medicines are still derived either directly or indirectly from plants (Fowler, 2006). Knowledge of the medicinal plants used in the drugs of traditional systems of medicine has been of great significance, especially as a lead for the discovery of new single-molecule medicines for modern system of medicine (Ramawat et al. 2009). It is interesting to note that the ethnomedicinal uses of plants is one of the most successful criteria used by the pharmaceutical industry in finding new therapeutic agents for the various fields of biomedicine (Williams, 2006). For example some outstanding medicinal drugs which have been developed from the

ethnomedicinal uses of plants include: Vinblastine and Vincristine from *Catharanthus roseus* G.Don (Periwinkle) used for treating acute lymphoma, acute leukaemias etc., Reserpine from the roots of *Rauwolfia serpentina* Benth. ex Kurz (Indian Sarpagandha) used for treating hypertension, Aspirin from *Salix purpurea* L. (Willow) used for treating inflammation, pain and thrombosis and Quinine from *Cinchona pubescens* Vahl (Cinchona) used for treating malaria (Lone et al. 2013b). Thus, medicinal plants are used in crude or purified form in the preparation of drugs in different systems.

Traditional medicinal plant knowledge nowadays serves an important tool in the search for new sources of drugs and pharmaceuticals. Medicinal plants are living resources, exhaustible if overused, but sustainable if used with care and wisdom. It is noticed that the people living in urban areas have almost no knowledge about medicinal properties of plants (Alcorn, 1984; Altieri and Merick, 1987). In rural areas however, the people especially elders and females have sufficient knowledge about this prosperous natural treasure, which is gifted to mankind by God (Mahmood et al. 2011). Thus, rural communities have useful knowledge on various herbal remedies which they have received after generations of experimentation. This knowledge is descended to them from their forefathers in the form of folklores and is often kept as a heavily guarded secret. The ways they diagnose various ailments are very interesting because they live in the interior areas and lack the use of modern scientific equipments for diagnosis and treatment. They however treat diseases using locally available medicinal plants (Santhya et al. 2006).

In countries like India, China and others with well-founded traditional systems of medicine, plant-based formulations occupy an important place in health management. However, the recent broadening of the horizons of drug discovery, due to advances in instrumentation and bioinformatics (computational methods), has opened up new avenues for use of this knowledge in drug development research (Ramawat, 2007). Hence, the purpose of present study was to document the medicinal plants and their associated traditional medicinal knowledge in floristically rich Bandipora district of Jammu and Kashmir. Such plants can be subjected to phyto-chemical studies leading to the isolation of active principles followed by pharmacological and chemical trails to validate their ethnomedicinal claims.

## Material and Methods

### Description of study area

The State of Jammu and Kashmir has been regarded as a heaven on earth, and is also called the “Biomass State” of India. The ethnobotanical explorations conducted so far have depicted that vast storehouses of herbal charms still exist with the hilly tribes living peacefully in the far flung mountain ranges surrounded by everlasting snow. Kashmir Himalaya, often referred to as *Terrestrial paradise* on Earth, is located at the northwestern tip of the Indian Himalayan Region (Mittermeier et al. 2005) that supports a rich and spectacular biodiversity of great scientific, curiosity and promising economic benefits, chiefly owing to its topographic variations spreading from valley floor through terraced lands and dense forests, up to to snow-capped alpine peaks (Husain, 2001). The study area selected for the present investigation was one of the northern Himalayan districts of Kashmir valley namely Bandipora. The hilly and mountainous areas of Bandipora form an important northern part of Kashmir Himalaya. Bandipora is a backward district with Bandipore town as its administrative headquarters. It has population of 385099 (Census 2011) and a geographical area of 398 Sq Km's. The district lays 34° 64' N latitude and 74° 96' E longitudes and is situated at an average height of 1701 meters (AMSL). The district is located on the northern bank of the Wular Lake- the largest fresh water lake in Asia. The district is mainly hilly and mountainous with stretches of plains and is full of natural beauty with thick forests. The area under forests in the district is about 199396 Hectares of land. The district has deciduous vegetation and due to its varied altitude and topography, it is the site of diverse flora. Plants like *Platanus orientalis* (locally called 'Boin'- State tree), *Crataegus songarica*, *Populus caspica*, *Salix acmophylla*, *Ailanthus altissima*, *Cedrus deodra*, *Ulmus wallichiana*, *Celtis australis*, *Robinia pseudoacacia*, *Abies pindrow*, *Pinus wallichiana*, *Morus nigra*, *Juglans regia*, *Zizyphus jujuba* and other fruit trees (temperate Rosaceae fruit trees- apple, pear, cherry, almond, peach, plum and apricot) grow throughout the district. Forests of the district provide timber and firewood while the meadows provide fodder for cattle. The medicinal herbs including *Aconitum*, *Podophyllum*, *Berberis*, *Dioscorea*, *Sassauria*, *Adiantum*, *Artemisia*, *Dryopteris*, *Geranium*, *Jurinea*, *Mentha*, *Inula*, *Bunium*, *Rheum*, *Sambucus*, *Senecio*, *Taxus* grow in these forests. It is bordered in the west by district Kupwara, in the south-east by district Ganderbal and in the east by district Kargil, Baramulla in the south and on north side it is bounded by Line of Control (LOC).

The climate of the district is moderate which has its own peculiarities and can be divided into six seasons of two months each. These include, Spring (16 March to 15 May), Summer (16 May to 15 July), Rainy Season (16 July to 15 September), Autumn (16 September to 15 November), Winter (16 November to 15 January) and Ice Cold (16 January to 15 March). All these seasons are locally called 'Sont', 'Retkol', 'Waharat', 'Harud', 'Wandh' and 'Shishur' respectively. The hottest months are July and August when the maximum temperature generally rises well about 32°C. The coldest months are January and February, when minimum temperature falls a few degrees below freezing point. On account of heavy snowfall and low temperatures the winters are usually harsh. Each part of the district experiences snowfall during winter. The hilly and mountainous areas of Bandipora district remain cut off from the rest of the district at least for 2 months every year due to harsh climatic conditions such as heavy snowfall and low temperature (sometimes below minus 10°C) during winter. Thus, the people have to depend upon wild resources for their daily needs. In Kashmir there is a famous phrase about Bandipora or in other words Bandipora is famous for three A's - A'lim (knowledge), Adab (good habits or literature) and Aab (water). There are three tehsils (smallest administrative units) namely Bandipore, Gureiz and Sonawari in the said district (Fig. 1).

A little amount of documented information about traditional uses of medicinal plants of this floristically rich area of Himalayan region (Kapahi et al. 1993; Dad and Khan, 2011; Ara and Naqshi, 1992) is available. Since a major portion of this district is still unexplored ethnobotanically and ethnomedicinally, there is no information available in published form it deserves a great attention for ethnomedicinal research.

**Table 1:** List of traditional medicinal plants documented in this study with their use value (UV)

Plant's Scientific/Local Name/Family	AN	FP	Plant Part(s) Used	Ailment (s) against which plant part is used	Use value (UV)	TS	
<i>Achillea millefolium</i> Linn. "Bariguer"/ Asteraceae	3889	5	JL-S	Leaves and flowers	Gum inflammation and toothache.	0.22	C
<i>Aconitum heterophyllum</i> Wall. "Pivak"/ Ranunculaceae	3780	4	AU-S	Roots	Arthritis, abdominal pain, dyspepsia, fever, headache, vomiting and gaseous bloat.	0.14	CR

<i>Aconitum violaceum</i> Jacquem. ex Stapf "Mohand"/ Ranunculaceae	37799 0	AU- O	Roots and flowers	Cough, cold, fever, stomach problems, liver disorders, toothache, boils and joint pains.	0.1	VU
<i>Acorus calamus</i> Linn. "Vai"/ Araceae	3891 0	MY- JL	Rhizome	Dyspepsia, acidity, chronic diarrhoea, lung disorders, rheumatism and food poisoning.	0.22	LC
<i>Actaea spicata</i> Linn. "Banparthi"/ Ranunculaceae	3927 8	MY- JN	Roots and fruits.	Sprains, wounds and paralysis.	0.04	C
<i>Adiantum capillus-veneris</i> Linn. "Guetheer"/ Pteridaceae	38882	NFL	Fronds	Jaundice, nasal catarrh, chest infection, urinary problems, blood loss, bone weakness, hair loss, dandruff, headache, fever and body muscular pains and chilblain.	0.24	C
<i>Adiantum venustum</i> D.Don "Kakbai"/ Pteridaceae	3928 3	NFL	Whole plant	Cough, jaundice, stomach ailments, headache, fever, body muscular pains and hair loss.	0.07	C
<i>Aesculus indica</i> Colebr. ex Wall. "Haandoon"/ Hippocastanaceae	3886 5	MY- JN	Fruits	Chilblain, joint pains, boils, skin rashes, eruptions, headache, burns, wounds and rat killer.	0.2	C
<i>Ajuga parviflora</i> Benth. "Jan-i-adam"/ Lamiaceae	3884 9	AP- JN	Leaves	Cough, stomach problems, intestinal infection, general body weakness, indigestion and fever.	0.09	R*
<i>Allium cepa</i> Linn. "Gundh"/ Liliaceae	38877 0	JN- AU	Bulb	Loss of appetite, acidity, impotency, cold, anorexia, frothy bloats and flow of tears.	0.14	C
<i>Allium proliferum</i> Schrad. ex Willd. "Praan"/ Liliaceae	3884 0	MY- JL	Bulb	Corns, frothy bloat, joint loosening and cold.	0.17	C
<i>Allium sativum</i> Linn. "Rhoon"/ Liliaceae	38867 3	JN- AU	Bulb/cloves	Stomach problems, hypertension, asthma, respiratory disorders, greenish diarrhea, rodent repellent and eye vision.	0.26	C
<i>Althea rosea</i> Linn. "Suzposh"/ Malvaceae	3781 3	JL-S	Whole plant	Throat pain and its swelling, jaundice, kidney pain, urinary irritation and dandruff.	0.17	C
<i>Amaranthus caudatus</i> Linn. "Lessa"/ Amaranthaceae	3779 2	JL-S	Leaves	Kidney disorders and boils.	0.02	C
<i>Amaranthus retroflexus</i> Linn. "Ganhaar/ Amaranthaceae"	3890 4	JN- AU	Whole plant	Measles and dandruff.	0.12	C
<i>Anagallis arvensis</i> Linn. "Charisaban"/ Primulaceae	3890 6	AP-S	Whole plant.	Skin itches	0.15	C
<i>Angelica glauca</i> Edgew. "Chora"/ Apiaceae	39281 1	JN- AU	Roots	Tooth ache, stomach disorders, cold, diarrhea and alopecia.	0.17	EN
<i>Anthemis cotula</i> Linn. "Fuck Ghasa"/ Asteraceae	3781 1	JN-S	Whole plant	Body muscular pains, insect stings and insect repellent.	0.11	C
<i>Arnebia benthamii</i> (Wall. ex G.Don) I.M.Johnst. "Gaozaban"/"Kahzaban"/ Boraginaceae	38900 3	JL- AU	Leaves, flowers and roots	Jaundice, palpitation of heart, cough, cold, chronic constipation, fever, urinary problems, bone weakness and wounds.	0.21	CR
<i>Artemisia absinthium</i> Linn. "Tithwan"/ Asteraceae	37789 8	JL- AU	Leaves and inflorescence	Worms, abdominal pain, fever, diabetes, sprains.	0.7	R*
<i>Berberis lycium</i> Royle. "Kaodauch"/"Dandlider"/ Berberidaceae	3888 0	AP- JL	Roots	Urinary problems, dropsy, internal injuries, body weakness, diabetes, wounds and eczema.	0.22	C
<i>Bergenia ciliata</i> (Haw.) Sternb. "Zakhmihyat"/"Palpati"/ Saxifragaceae	3780 0	AP- JN	Roots and leaves	Wounds, diarrhea, weakness, headache and fever.	0.19	C
<i>Brassica campestris</i> Linn. "Telgogul"/ Brassicaceae	38848 2	AP- JN	Seeds	hair loss, dandruff, rheumatic pains, thorns pricks and skin eruptions.	0.37	C
<i>Brassica oleracea</i> var. <i>haka</i> Linn. "Hakh" / Brassicaceae	3885 2	JN- JL	Leaves	Corns and constipation.	0.15	C
<i>Bunium persicum</i> B. Fedtsch. "Kala Zeera"/ Apiaceae	3887 2	MY- JN	Fruits	Digestive disorders, foul breath, joint pain, lumbago and weak memory.	0.12	EN
<i>Calendula officinalis</i> Linn. "Hamesh Bahar" / Asteraceae	38884 1	AP- D	Leaves and flowers	Boils, burns, eyelid abscesses and pneumonia.	0.45	C
<i>Cannabis sativa</i> Linn. "Bunga"/ Cannabinaceae	3779 1	JN-S	Leaves and flowers	Narcotic, loss of appetite, diuretic and rheumatoid arthritis.	0.47	C
<i>Capsella bursa-pastoris</i> (Linn.) Medik. "Kralmond"/ Brassicaceae	37781 0	AP- O	Leaves	Abdominal pain, nose bleeding, intestinal problems and obesity.	0.03	C
<i>Cedrus deodara</i> (Roxb. ex D.Don) G. Don "Devdoor"/ Pinaceae	38851 0	AU- O	Stem	Skin rashes, eruptions, itching, arthritic pains, alopecia and vomiting.	0.35	C
<i>Centaurea iberica</i> Trevir. ex Spreng. "Krech"/ Asteraceae	3883 0	JL- AU	Leaves and thorns	Burns, skin rashes, eye vision and defective lactation.	0.17	C
<i>Cichorium intybus</i> Linn. "Kasni Hundh"/"Wari Hundh"/ Asteraceae	38913 0	JL-O	Leaves	Body weakness, loosening of joints, body muscular pains, frequent bleeding, loss of appetite and liver problems.	0.1	C

<i>Citrullus colocynthis</i> (Linn.) Schrad. "Hoon Haendwind"/ Cucurbitaceae	38909	JN-AU	Roots	Toothache	0.04	C
<i>Colchicum luteum</i> Baker. "Vir Kim Posh"/ Liliaceae	38894	F-MR	Corms and seeds	Body pains, back pain, weakness of bones, fever, cough, stomach gases, constipation and insomnia.	0.17	VU
<i>Conyza canadensis</i> (Linn.) Cronquist "Shallut"/ Asteraceae	38834	JL-O	Arial portion	Indigestion, dysentery, stomach gases, internal injuries, fever and cough.	0.04	C
<i>Coriandrum sativum</i> Linn. "Daniwaal"/ Apiaceae	38833	JN-JL	Seeds	Palpitation of heart, fever, jaundice, drying of mouth and headache.	0.11	C
<i>Cotula anthemoides</i> Linn. "Thulibabuel"/ Asteraceae	37780	JN-AU	Whole plant	Headache, fever, body muscular pains, hair loss, chilblain, fever, joint pain and sprains.	0.2	C
<i>Crataegus songarica</i> K. Koch "Reng Kul"/ Rosaceae	38853	MY	Fruits	Palpitation of heart and hypertension.	0.21	R*
<i>Cucumis sativus</i> Linn. "Laer"/ Cucurbitaceae	38903	JN-AU	Fruits and seeds	Headache, fever, stomach heat up, kidney stones and burning sensation of urine.	0.08	C
<i>Cuscuta reflexa</i> Roxb. "Kuklioth"/ Cuscutaceae	37782	JL-S	Whole plant	Skin diseases, hair loss, dandruff, migraine, fatigue, body weakness and swelling of testicles.	0.18	C
<i>Cydonia oblonga</i> Mill. "Bumchoont"/ Rosaceae	38886	MY	Seeds, fruits and flowers	Constipation, birth problems, jaundice, cough, cold, chronic constipation, fever, dysentery, blood purifier, asthma, chest problems, general body weakness and body muscular pains.	0.22	LC
<i>Cynodon dactylon</i> (Linn.) Pers. "Dramun"/ Poaceae	38829	AP-N	Whole plant	Body muscular pains, thirst, C cold, fever, kidney and gall stones, dysentery, general body weakness, burning sensation of feet, eye disorders and weak vision.	0.21	C
<i>Cypripedium cordigerum</i> D. Don "Pholaan"/ Orchidaceae	38842	JN-JL	Rhizome	Joint pains, heart palpitations and weakness.	0.05	R
<i>Datura stramonium</i> Linn. "Datur"/ Solanaceae	37783	JN-S	Leaves, seeds and fruits	Chilblain, toothache, leech entry into nostrils, insect stings, paralysis, cold, headache and rheumatism.	0.37	C
<i>Daucus carota</i> Linn. "Moharmunj Ghasa"/ Apiaceae	39277	JN-S	Roots	Dysuria, digestive disorders and fatigue.	0.06	C
<i>Dioscorea deltoidea</i> Wall. ex Kunth "Kreth"/ "Krees"/ Dioscoreaceae	38847	MY-JL	Tubers	Anti-lice	0.14	EN
<i>Dipsacus inermis</i> Wall. "Wopal Hakh"/ Dipsacaceae	38902	JL-AU	Leaves	Cough, general body weakness, tightening of blood vessels, pain and swelling of body parts and defective milk production.	0.1	C
<i>Dryopteris barbigera</i> (Moore) Kuntze "Dade"/ "Kunji"/ Pteridaceae	39276	NFL	Leaves and rhizome	Constipation, worms and dysentery.	0.24	C
<i>Equisetum arvense</i> Linn. "Gandumgund"/ Equisetaceae	37796	NFL	Whole plant	Teeth infection, acidity, gases and urinary problems.	0.08	C
<i>Euphorbia helioscopia</i> Linn. "Gur-Sochal"/ Euphorbiaceae	38868	MY-S	Aerial portion	Skin eruptions, warts, arthritic pain, indigestion, worms and constipation.	0.11	C
<i>Euphorbia wallichii</i> Hook.f. "Gur-Dud"/ Euphorbiaceae	37807	MY-AU	Latex of whole plant	Warts and skin infections	0.13	C
<i>Euryale ferox</i> Salisb. "Jumar"/ "Kena Bub"/ Nymphaeaceae	38854	JL-AU	Seeds	Whooping cough, semen deficiency and weak libido.	0.04	LC
<i>Ficus carica</i> Linn. "Anjeer"/ Moraceae	38869	MY-JL	Fruits and latex	Abdominal pain, cold, asthma, constipation, jaundice, kidney and gallbladder stones, indigestion, liver enlargement, defective lactation, high blood pressure and eczema.	0.27	C
<i>Foeniculum vulgare</i> Mill. "Bodiyaan"/ Apiaceae	38863	JN-JL	Whole plant	Dyspepsia, acidity, abdominal pain, jaundice, cough, cold, chronic constipation, fever, blood purifier and joint pains.	0.15	C
<i>Fragaria nubicola</i> Lindl. "Rengressh"/ "Ishtabur"/ Rosaceae	38883	AP-MY	Rhizome	Rheumatic pains, headache, fever, profuse menstruation, general body weakness and defective lactation.	0.13	C
<i>Fumaria indica</i> (Hausskn.) Pugsley "Shahtar"/ Fumariaceae	38845	AP-JL	Whole plant	Defective eye vision, palpitation of heart, breathing problems, skin diseases, blood purifier, asthma, defective urination with pus, skin rashes, dropsy, menstrual irregularities, male impotency and general body weakness.	0.15	C
<i>Galinsoga parviflora</i> Cav. "Marchawagan Ghasa"/ Asteraceae	38890	MY-O	Whole plant	Joint pains	0.03	C

<i>Galium aparine</i> Linn. "Zoa Ghasa"/"Khurti"/ Rubiaceae	38880	JN- JL	Whole plant	Wound infection	0.02	C
<i>Geranium wallichianum</i> D. Don "Ratanjog"/ Geraniaceae	38928	JL-S	Roots	Fever, joint and muscular pains, weakness and defective milk production.	0.17	C
<i>Helianthus annuus</i> Linn. "Gulaftab"/ Asteraceae	38905	JL-S	Seeds	Whooping cough and joint pains.	0.04	C
<i>Hyoscyamus niger</i> Linn. "Bazarbunga"/ Solanaceae	38878	JN- JL	Seeds and leaves	Toothache, mental disturbance, arthritis and eyelid abscesses.	0.14	VU
<i>Inula racemosa</i> Hook.f. "Poshkar"/ Asteraceae	37805	JL- AU	Roots	Fever, cough, chest pain and wounds.	0.05	VU
<i>Iris kashmiriana</i> Baker "Mazarmund"/ Iridaceae	37786	MY- JL	Rhizome	Rodent repellent, joint pain, eczema, wounds, and general body weakness.	0.08	C
<i>Juglans regia</i> Linn. "Duon"/ Juglandaceae	38866	MY- JN	Root bark, fruits and leaves	Tooth infection and toothache, mouth ulcers, dry cough, hypertension, joint pains, hair loss, defective milk production in cows, chilblain, insect repellent.	0.33	C
<i>Jurinea dolomiaea</i> Boiss. "Dupha"/"Thandi Jadi"/"Guggal Dooph"/ Asteraceae	37808	AU- S	Roots and leaves	Cough, cold, headache, thirst, whitening of tongue, wounds, boils, body muscular pains and fever.	0.14	EN
<i>Lagenaria siceraria</i> (Molina) Standl. "Kashir Aull"/ Cucurbitaceae	38908	JN-S	Fruits	Cough, cold, fever, chest pain, stomach ulcers and heat up, kidney stones, urine problems and yoke gall.	0.18	C
<i>Linum usitatissimum</i> Linn. "Alish"/ Linaceae	38907	JN- JL	Seeds	Boils, rheumatism and defective milk production in cows.	0.06	C
<i>Lychnis coronaria</i> (Linn.) Desr. "Shosh Ghasa"/"Angaarda"/ Caryophyllaceae	38876	JN- JL	Roots	Constipation and chronic cough.	0.02	LC
<i>Malus domestica</i> Borkh. "Maharaji Treil"/ Rosaceae	38873	AP- MY	Fruits	Dyspepsia, diabetes, jaundice, urinary problems, loss of appetite, phlegm, thirst, obesity, cough and chest ailments.	0.18	C
<i>Malva neglecta</i> Wallr "Sochal"/ Malvaceae	37793	JN- JL	Leaves and seeds	Constipation, wounds, post delivery problems in cows, jaundice, cough, cold, blood purifier and defective lactation.	0.11	C
<i>Marrubium vulgare</i> Linn. "Troper"/ Lamiaceae	38889	JL- AU	Whole plant	Arthritic pains, swelling of eyelids, abdominal pain, dysentery, chilblain and muscular pains.	0.04	C
<i>Mentha arvensis</i> Linn. "Pudnah"/ Lamiaceae	37788	JN- AU	Leaves	Dyspepsia, loss of appetite, abdominal pain, dysentery, constipation, flatulence, intestinal infection and menstrual disorders.	0.08	C
<i>Mentha longifolia</i> Linn. "Veina"/"Jungli Pudnah"/ Lamiaceae	38871	AU- S	Leaves	Fever, headache, flatulence and digestive disorders.	0.05	C
<i>Morus nigra</i> Linn. "Tul Kul"/ Moraceae	3883	MY- JN	Fruits and leaves	Stomach problems, constipation, boils, burns and wounds.	0.08	C
<i>Nelumbo nucifera</i> Gaertn. "Nadroo"/ Nelumbonaceae	38858	JL-S	Rhizome and seeds	Stomach problems, dysentery, constipation, vomiting, urinary problems and semen deficiency.	0.09	C
<i>Nepeta cataria</i> Linn. "Gund Soi"/ Lamiaceae	38911	JL-O	Leaves	Fever, worms, diarrhea and sprains.	0.07	C
<i>Notholirion thomsonianum</i> (Royle) Stapf "Salamisri"/ Liliaceae	38845	AP- MY	Bulb	Body muscular pains and menstrual irregularities.	0.03	R*
<i>Nymphaea maxicana</i> Zucc. "Bumiposh"/"Gul-e-Nelofar"/ Nymphaeaceae	38859	JL-S	Rhizome, stolons and flowers	hair loss, boils, diabetes, rheumatism, fever, heart palpitation, urinary problems and liver disorders.	0.11	C
<i>Ocimum basilicum</i> Linn. "Babber"/ Lamiaceae	37794	JL-S	Seeds and leaves	Fatigue, kidney stones, urinary problems, chronic constipation, headache, fever, body muscular pains and hair loss.	0.12	C
<i>Oryza sativa</i> Linn. "Daani"/ Poaceae	38914	JN- JL	Fruits	Infectious diseases, post delivery problems in cows, mumps, constipation and wound infection.	0.1	C
<i>Oxalis corniculata</i> Linn. "Khatti Golda"/ Oxalidaceae	38928	JN-S	Leaves	Gum bleeding, jaundice and stomach disorders.	0.04	C
<i>Papaver dubium</i> Linn. "Rut Gulala"/ Papaveraceae	38831	MY- JL	Flowers	Skin problems and weak memory.	0.02	C
<i>Papaver somniferum</i> Linn. "Khas-Khash"/ Papaveraceae	38879	MY- JL	Fruit (Capsule)	Mental tension, stomach problems, male impotency and knee pain.	0.19	C
<i>Phytolacca acinosa</i> Roxb. "Brand Hakh"/ Phytolaccaceae	38841	JL- AU	Leaves and roots	Stomach disorders, swelling of nipples and arthritic pains.	0.03	C

<i>Picrorhiza kurroa</i> Royle “Koud”/“Kutki”/ Scrophulariaceae	37802	JN- AU	Rhizome	Wormicide, intestinal infection, stomach disorders, pneumonia, weakness, whooping cough and joint pains.	0.08	EN
<i>Pinus wallichiana</i> A.B. Jacks. “Kayur”/ Pinaceae	3884 4	MY- JN	Resin	Boils, wounds, insect repellent, wormicide and intestinal infections.	0.05	C
<i>Plantago lanceolata</i> Linn. “Kashur Gulla”/“Chamchipeti”/ Plantaginaceae	38827	MY- S	Whole plant	Stomach acidity, vision and hearing problems, body pains, urinary irritation, dysentery, constipation, fever and yoke gall.	0.06	C
<i>Plantago major</i> Linn. “Bud Gulla”/ Plantaginaceae	3778 7	MY- S	Seeds	Body pains, urinary irritation, dysentery, constipation and fever.	0.04	C
<i>Podophyllum hexandrum</i> Royle “Banwagan”/“Bankakri”/ Podophyllaceae	37806	MY- JL	Roots and fruits	Stomach ulcers, dyspepsia, tumours growth, skin diseases.	0.14	EN
<i>Polygonum amplexicaule</i> D. Don “Maachran Chai”/“Masloon Chai”/ Polygonaceae	3928 2	JN-S	Roots	Laziness, sleepiness, drying of mouth, wounds and burns.	0.15	LC
<i>Polygonum hydropiper</i> Linn. “Chock Chine”/ Polygonaceae	38898	JL-S	Leaves	Abdominal pain, dysuria, high blood pressure, stomach heat up and jaundice.	0.05	C
<i>Portulaca oleracea</i> Linn. “Nunner”/ Portulacaceae	37784	JN- AU	Whole plant	Constipation, body pains, weakness, defective eye vision and blood purifier.	0.03	C
<i>Potentilla reptans</i> Linn. “Ringa Chai”/ Rosaceae	3885 7	JN- AU	Roots	Body muscular pains, headache and whitening of tongue.	0.06	C
<i>Prunella vulgaris</i> Linn. “Kalaveuth”/ Lamiaceae	3779 5	JN- JL	Leaves and flowers	Headache, fever, body muscular pain, hair loss, migraine, chest infections and wounds.	0.19	LC
<i>Prunus persica</i> (Linn.) Batsch “Chenun”/ Rosaceae	3888 5	AP	Fruits and leaves	Indigestion, cough, worms, joints pain, wounds, chilblain, burns.	0.1	C
<i>Punica granatum</i> Linn. “Daen”/ Punicaceae	38860	MY- AU	Fruits	Fever, jaundice, urinary problems, loss of appetite, general body weakness, diarrhoea and tooth and gums infection.	0.11	C
<i>Pyrus communis</i> Linn. “Faraish Tung”/ Rosaceae	38839	MY	Fruits	Chronic constipation, kidney stones, heart palpitation and urinary problems.	0.06	C
<i>Ranunculus arvensis</i> Linn. “Chermi Ghasa”/ Ranunculaceae	3883 7	MY- AU	Whole plant	Eczema	0.01	C
<i>Raphanus sativus</i> Linn. “Mujh”/ Brassicaceae	3885 5	JN- JL	Roots	Indigestion, loss of appetite, jaundice, urinary problems and chronic constipation.	0.08	C
<i>Rheum emodi</i> Wall. “Pumbchalan”/ Polygonaceae	3889 9	JN- JL	Rhizome	Ulcers, burns and wounds.	0.16	EN
<i>Robinia pseudoacacia</i> Linn. “Keekur”/ Fabaceae	38864	MY- JN	Roots, leaves and flowers	Toothache, hernia, chilblain, fever, sprains, swelling of joints and other body parts.	0.06	C
<i>Rorippa islandica</i> (Oeder) Borbas “Thru”/ Brassicaceae	38897	MY- JL	Whole plant	Loss of appetite and asthma.	0.02	C
<i>Rosa damascena</i> Mill. “Kashur Gulab”/ Rosaceae	38887	MY- JN	Flowers	Cough, cold, throat infection and swelling, diarrhoea, asthma, body muscular pains, headache, bronchitis, chicken pox, fever and measles.	0.3	C
<i>Rubia cordifolia</i> Linn. “Majaith”/ Rubiaceae	3883 8	JL-O	Whole plant	Stomach ailments, teeth infection, fever and diabetic ulcers.	0.06	C
<i>Rumex dentatus</i> Linn. “Obej”/ Polygonaceae	37779	MY- JN	Leaves and roots	Constipation, general body weakness, back pain, boils, cough, gaseous bloat and sprains.	0.05	C
<i>Salix acmophylla</i> Boiss. “Kril Veer”/ Salicaceae	38891	F-AP	Leaves and twigs	Boils, stomach problems, teeth infection, hernia, chilblain, fever and swelling of joints.	0.2	C
<i>Salvia moorcroftiana</i> Wall.ex Benth. “Shollari”/ Lamiaceae	3889 3	MY- JL	Whole plant	Cough, constipation, acidity, joint pain, back pain, stomach problems and boils.	0.05	C
<i>Sambucus wightiana</i> Wall. “Gandhoola”/ Caprifoliaceae	3928 6	JN- JL	Roots	Foot and mouth disease.	0.09	C
<i>Saussurea costus</i> (Falc.) Lipsch. “Kouth”/ Asteraceae	37803	MY- JL	Roots	Skin diseases, arthritis, paralysis, body weakness, stomach problems and kidney stones.	0.47	CR
<i>Senecio chrysanthemoides</i> DC. “Bagghu”/ Asteraceae	37798	JN-S	Leaves, flowers and roots	Skin rashes, eruptions, eczema, minor cuts, stomach problems, dysentery, urinary disorders and defective eyesight.	0.12	C
<i>Sisymbrium irio</i> Linn. “Cheri Laschij”/ Brassicaceae	3889 6	MY- JL	Seeds	Fever, body muscular pains, headache, cough, cold, measles.	0.13	C

<i>Skimmia anquetilia</i> N.P.Taylor & Airy Shaw "Naera"/ Rutaceae	38846	AP- JN	Leaves	Abdominal pain, whooping cough, body muscular pains, sore throat, dysentery, urinary infections, cough, cold, indigestion, nasal catarrh.	0.21	LC
<i>Solanum nigrum</i> Linn. "Kambai"/ Solanaceae	38912	JN-O	Fruits	Stomach problems, jaundice, constipation, palpitation of heart and defective eye vision.	0.12	C
<i>Solanum tuberosum</i> Linn. "Alua"/ Solanaceae	38861	AP- JN	Tuber	Burns	0.09	C
<i>Sonchus arvensis</i> Linn. "Dudh Kandij"/ Asteraceae	3885 <sub>6</sub>	JN-S	Latex	Boils, wounds and defective milk production.	0.05	C
<i>Taraxacum officinale</i> F.H.Wigg. "Madan Hundh"/ Asteraceae	37810	MY- S	Leaves and roots	Blood loss, jaundice, general body weakness, bone fractures, cold, abdominal pain, thirst and urinary problems.	0.39	C
<i>Taxus wallichiana</i> Zucc. "Postul"/"Brammi"/ Taxaceae	3885039285	AP- JL	Bark	Asthma, headache, giddiness, arthritis and tumourous growths.	0.16	EN
<i>Thymus linearis</i> Benth. "Jangli Javind"/ Lamiaceae	3885039285	MY- JL	Whole plant	Cough, cold, fever, dropsy, pneumonia, indigestion, loss of appetite, asthma, chest infections and wounds.	0.08	C
<i>Trapa natans</i> Linn. "Gaer Kul"/ Trapaceae	3885 <sub>5</sub>	JN- JL	Fruits	Chronic constipation, diabetes, leucorrhoea and cancer.	0.09	C
<i>Tribulus terrestris</i> Linn. "Meitcher Kund"/ Zygophyllaceae	39274	AU- S	Whole plant	Kidney stones, uterine disorders, jaundice and burns.	0.1	LC
<i>Trigonella foenum-graecum</i> Linn. "Meth"/ Fabaceae	38828	MY- JL	Seeds	Diabetes, body pains, cold, itching of eyes, constipation, heart and liver problems, menstrual irregularities, stomach problems (ulcers, pain, acidity), intestinal infection and lumbago.	0.09	C
<i>Trillium govanianum</i> Wall "Surmganda"/"Reech Ki Jadi"/ Liliaceae	3779	JN- AU	Rhizome	Worms and boils.	0.03	C
<i>Triticum aestivum</i> Linn. "Kanik"/ Poaceae	3887	MR- AP	Fruits (Grains)	Toothache, fever, backache and worms.	0.04	C
<i>Urtica dioica</i> Linn. "Soi"/ Urticaceae	3778	JN-S	Roots and leaves	Wounds, blisters, high blood pressure and paralysis.	0.1	C
<i>Valeriana jatamansi</i> Jones. "Mushkibala"/Valerianaceae	37801	MY- JL	Roots	Abdominal pain, wormicide, diarrhoea, fever, urinary disorders and wounds.	0.06	VU
<i>Verbascum thapsus</i> Linn. "Wantamook"/ Scrophulariaceae	39284	JN-S	Leaves and seeds	Mental fatigue, asthma and burns.	0.06	C
<i>Verbena officinalis</i> Linn. "Huthmool"/ Verbenaceae	3779	AU- S	Whole plant	Indigestion, food poisoning, wounds and boils.	0.05	C
<i>Viburnum grandiflorum</i> Wall. ex DC. "Kilmunch"/ Caprifoliaceae	3889	MR- AP	Fruits and Stem	Cough, defective eye vision and eczema.	0.03	C
<i>Viola odorata</i> Linn. "Nunposh"/"Bunfsha"/ Violaceae	38870	MY- JL	Flowers	Cough, cold, throat infection and swelling, chest congestion, hoarseness of voice, body muscular pains, headache and bronchitis.	0.28	C
<i>Vitis vinifera</i> Linn. "Dauch"/ Vitaceae	38862	JN- JL	Leaves, fruits and sap	Skin rashes and itching, boils, corns, heart problems, hair loss, defective memory and fever.	0.15	C
<i>Wulfenia amherstiana</i> Benth. "Badikakbai"/ Scrophulariaceae	3927 <sub>5</sub>	JL- AU	Leaves	Body muscular pains and high fever.	0.02	C
<i>Ziziphus jujuba</i> Mill. "Brai"/ Rhamnaceae	38881	AP- MY	Fruits and leaves	Jaundice, cough, cold, chronic constipation, fever, blood purifier, defective lactation, scabies, hair loss and diabetes.	0.22	LC

Abbreviations Used: AN- Accession Number; AP- April; AU- August; CR- Critically Endangered; D- December; EN- Endangered; F- February; FP- Flowering Period; JL- July; JN- June; MR- March; MY- May; N- November; O- October; R- Rare; R\*- Rare categories defined based on field observations of authors; S- September; LC- Less Common; C- Common; TS- Threat Status; VU- Vulnerable; UV- Use Value; NFL- Non Flowering.

**Table 2:** Category of ailments and their informant consensus factor ( $F_{ic}$ )

Category of ailments	Number of taxa	% of all taxa	Number of use - reports	% all use-reports	Informants' consensus factor ( $F_{ic}$ )
Gastrointestinal	74	14.50	607	18.18	0.88
Dermatological	63	12.35	587	17.59	0.90
Respiratory	44	8.62	280	8.39	0.85
Gynaecological/andrological	24	4.70	145	4.34	0.84

Body pains	41	8.03	256	7.67	0.85
Fever	40	7.84	105	3.14	0.63
Diabetes	07	1.37	53	1.58	0.89
Ophthalmological	12	2.35	45	1.34	0.75
Urological problems	28	5.49	128	3.83	0.79
Ailments of mouth	23	4.50	199	5.96	0.89
Insect stings	03	0.58	35	1.04	0.95
Cardiovascular	24	4.70	153	5.58	0.85
Ailments of hair	15	2.94	136	4.07	0.90
General body weakness	25	4.90	90	2.69	0.73
Liver disorders	21	4.11	54	1.61	0.63
Ailments of joints	39	7.64	316	9.46	0.88
Anticancer/tumor	03	0.58	20	0.59	0.90
Other/unclassified	24	4.70	128	3.83	0.82

**Table 3:** Fidelity level (FL) of ethnomedicinal plants of the study area.

Ailment categories	Plants with fidelity level (FL)
<b>Fever</b>	<i>Aconitum heterophyllum</i> (7.14%), <i>Aconitum violaceum</i> (5%), <i>Adiantum capillus-veneris</i> (6.52%), <i>Adiantum venustum</i> (14.28%), <i>Ajuga parviflora</i> (11.11%), <i>Arnebia benthamii</i> (5%), <i>Artemisia absinthium</i> (3.05%), <i>Bergenia ciliata</i> (29.72%), <i>Colchicum luteum</i> (3.12%), <i>Conyza Canadensis</i> (11.11%), <i>Coriandrum sativum</i> (40.90%), <i>Cotula anthemoides</i> (5.26%), <i>Cucumis sativus</i> (12.5%), <i>Cydonia oblonga</i> (2.32%), <i>Cynodon dactylon</i> (21.95%), <i>Foeniculum vulgare</i> (3.44%), <i>Fragaria nubicola</i> (7.69%), <i>Geranium wallichianum</i> (6.06%), <i>Inula racemosa</i> (20%), <i>Jurinea dolomiaea</i> (7.14%), <i>Lagenaria siceraria</i> (5.71%), <i>Mentha longifolia</i> (9.09%), <i>Nepeta cataria</i> (28.57%), <i>Nymphaea maxicana</i> (4.76%), <i>Ocimum basilicum</i> (8.33%), <i>Plantago lanceolata</i> (7.69%), <i>Plantago major</i> (11.11%), <i>Prunella vulgaris</i> (11.11%), <i>Punica granatum</i> (13.63%), <i>Robinia pseudoacacia</i> (8.33%), <i>Rosa damascena</i> (1.75%), <i>Rubia cordifolia</i> (33.33%), <i>Salix acmophylla</i> (15.38%), <i>Sisymbrium irio</i> (11.53%), <i>Thymus linearis</i> (6.66%), <i>Triticum aestivum</i> (12.5%), <i>Valeriana jatamansi</i> (15.38%), <i>Vitis vinifera</i> (6.89%), <i>Wulfenia amherstiana</i> (40%), <i>Ziziphus jujuba</i> (4.65%).
<b>Respiratory</b>	<i>Aconitum violaceum</i> (10%), <i>Acorus calamus</i> (2.38%), <i>Adiantum capillus-veneris</i> (6.52%), <i>Adiantum venustum</i> (7.14%), <i>Ajuga parviflora</i> (16.66%), <i>Allium cepa</i> (3.57%), <i>Allium proliferum</i> (33.33%), <i>Allium sativum</i> (18.36%), <i>Angelica glauca</i> (6.06%), <i>Arnebia benthamii</i> (20%), <i>Calendula officinalis</i> (2.35%), <i>Colchicum luteum</i> (3.12%), <i>Conyza canadensis</i> (11.11%), <i>Cydonia oblonga</i> (60.43%), <i>Cynodon dactylon</i> (4.87%), <i>Datura stramonium</i> (2.85%), <i>Dipsacus inermis</i> (35%), <i>Euryale ferox</i> (22.22%), <i>Ficus carica</i> (39.21%), <i>Foeniculum vulgare</i> (6.89%), <i>Helianthus annuus</i> (44.44%), <i>Inula racemosa</i> (20%), <i>Juglans regia</i> (12.69%), <i>Jurinea dolomiaea</i> (28.57%), <i>Lagenaria siceraria</i> (20%), <i>Lychnis coronaria</i> (40%), <i>Malus domestica</i> (8.57%), <i>Picrorhiza kurrooa</i> (26.66%), <i>Prunella vulgaris</i> (5.55%), <i>Prunus persica</i> (5.26%), <i>Rorippa islandica</i> (40%), <i>Rosa damascena</i> (71.92%), <i>Rumex dentatus</i> (9.09%), <i>Salvia moorcroftiana</i> (18.18%), <i>Sisymbrium irio</i> (15.38%), <i>Skimmia anquetilia</i> (17.07%), <i>Taraxacum officinale</i> (1.35%), <i>Taxus wallichiana</i> (20%), <i>Thymus linearis</i> (66.66%), <i>Trigonella foenum-graecum</i> (5.88%), <i>Verbascum thapsus</i> (69.23%), <i>Viburnum grandiflorum</i> (16.66%), <i>Viola odorata</i> (67.92%), <i>Ziziphus jujuba</i> (27.90%).
<b>Urological problems</b>	<i>Adiantum capillus-veneris</i> (2.17%), <i>Althea rosea</i> (33.33%), <i>Amaranthus caudatus</i> (50%), <i>Arnebia benthamii</i> (22.5%), <i>Berberis lyceum</i> (11.62%), <i>Cannabis sativa</i> (4.49%), <i>Cucumis sativus</i> (43.75%), <i>Cynodon dactylon</i> (14.63%), <i>Daucus carota</i> (50%), <i>Equisetum arvense</i> (20%), <i>Ficus carica</i> (&.84%), <i>Lagenaria siceraria</i> (31.42%), <i>Malus domestica</i> (11.42%), <i>Nelumbo nucifera</i> (11.76%), <i>Nymphaea maxicana</i> (9.52%), <i>Ocimum basilicum</i> (41.66%), <i>Plantago lanceolata</i> (7.69%), <i>Plantago major</i> (33.33%), <i>Polygonum hydropiper</i> (20%), <i>Punica granatum</i> (9.09%), <i>Pyrus communis</i> (25%), <i>Raphanus sativus</i> (25%), <i>Saussurea costus</i> (5.61%), <i>Senecio chrysanthemoides</i> (4.16%), <i>Skimmia anquetilia</i> (14.63%), <i>Taraxacum officinale</i> (1.35%), <i>Tribulus terrestris</i> (63.15%), <i>Valeriana jatamansi</i> (7.69%).

**Gastrointestinal**

*Aconitum heterophyllum* (53.57%), *Aconitum violaceum* (15%), *Acorus calamus* (92.85%), *Adiantum venustum* (7.14%), *Ajuga parviflora* (50%), *Allium cepa* (60.71%), *Allium proliferum* (33.33%), *Allium sativum* (16.32%), *Angelica glauca* (42.42%), *Arnebia benthamii* (5%), *Artemisia absinthium* (67.93%), *Bergenia ciliata* (16.21%), *Brassica oleracea* var. *Haka* (17.24%), *Bunium persicum* (30.43%), *Cannabis sativa* (10.11%), *Capsella bursa-pastoris* (66.66%), *Cedrus deodara* (3.22%), *Cichorium intybus* (10%), *Colchicum luteum* (9.37%), *Conyza canadensis* (66.66%), *Cucumis sativus* (31.25%), *Cydonia oblonga* (16.27%), *Cynodon dactylon* (4.87%), *Daucus carota* (16.66%), *Dryopteris barbigera* (100%), *Equisetum arvense* (26.64%), *Euphorbia helioscopia* (27.27%), *Ficus carica* (9.80%), *Foeniculum vulgare* (58.62%), *Lagenaria siceraria* (17.14%), *Lychnis coronaria* (60%), *Malus domestica* (17.14%), *Malva neglecta* (50%), *Marrubium vulgare* (22.22%), *Mentha arvensis* (86.66%), *Mentha longifolia* (81.81%), *Morus nigra* (31.25%), *Nelumbo nucifera* (70.58%), *Nepeta cataria* (57.14%), *Ocimum basilicum* (12.5%), *Oryza sativa* (5%), *Oxalis corniculata* (25%), *Papaver somniferum* (5.55%), *Phytolacca acinosa* (28.57%), *Picrorhiza kurrooa* (53.33%), *Pinus wallichiana* (20%), *Plantago lanceolata* (23.07%), *Plantago major* (22.22%), *Podophyllum hexandrum* (36%), *Polygonum hydropiper* (40%), *Portulaca oleracea* (28.57%), *Prunus persica* (31.57%), *Punica granatum* (27.27%), *Pyrus communis* (58.33%), *Raphanus sativus* (37.5%), *Rorippa islandica* (60%), *Rosa damascena* (3.5%), *Rubia cordifolia* (16.66%), *Rumex dentatus* (36.36%), *Salix acmophylla* (2.56%), *Salvia moorcroftiana* (45.45%), *Saussurea costus* (4.49%), *Senecio chrysanthemoides* (12.5%), *Skimmia anquetilia* (21.95%), *Solanum nigrum* (21.73%), *Taraxacum officinale* (2.70%), *Thymus linearis* (13.33%), *Trapa natans* (41.17%), *Trigonella foenum-graecum* (23.52%), *Trillium govanianum* (66.66%), *Triticum aestivum* (25%), *Valeriana jatamansi* (61.53%), *Verbena officinalis* (20%), *Ziziphus jujuba* (4.65%).

**Ailments of joints**

*Aconitum heterophyllum* (10.71%), *Aconitum violaceum* (10%), *Acorus calamus* (4.76%), *Actaea spicata* (62.5%), *Aesculus indica* (13.15%), *Allium proliferum* (6.06%), *Artemisia absinthium* (20.61%), *Brassica compestris* (15.49%), *Bunium persicum* (34.78%), *Cannabis sativa* (5.61%), *Cedrus deodara* (58.06%), *Cichorium intybus* (15%), *Cotula anthemoides* (21.05%), *Cypripedium cordigerum* (30%), *Datura stramonium* (28.57%), *Euphorbia helioscopia* (31.81%), *Foeniculum vulgare* (10.34%), *Fragaria nubicola* (38.46%), *Galinsoga parviflora* (100%), *Helianthus annuus* (55.55%), *Iris kashmiriana* (12.5%), *Juglans regia* (6.34%), *Linum usitatissimum* (23.07%), *Marrubium vulgare* (22.22%), *Nepeta cataria* (14.28%), *Nymphaea maxicana* (9.52%), *Papaver somniferum* (8.33%), *Phytolacca acinosa* (9.09%), *Picrorhiza kurrooa* (13.33%), *Prunus persica* (10.52%), *Robinia pseudoacacia* (16.66%), *Rumex dentatus* (2.09%), *Salix acmophylla* (2.56%), *Salvia moorcroftiana* (9.09%), *Saussurea costus* (78.65%), *Taraxacum officinale* (36.48%), *Taxus wallichiana* (43.33%), *Trigonella foenum-graecum* (17.64%), *Urtica dioica* (15.78%).

**Body pains**

*Aconitum heterophyllum* (28.57%), *Adiantum capillus-veneris* (26.08%), *Adiantum venustum* (35.71%), *Aesculus indica* (7.89%), *Anthemis cotula* (71.42%), *Artemisia absinthium* (18.32%), *Berberis lyceum* (2.32%), *Bergenia ciliata* (29.72%), *Brassica compestris* (4.22%), *Capsella bursa-pastoris* (33.33%), *Cichorium intybus* (20%), *Colchicum luteum* (31.25%), *Conyza canadensis* (11.11%), *Coriandrum sativum* (13.63%), *Cotula anthemoides* (21.05%), *Cucumis sativus* (12.5%), *Cuscuta reflexa* (8.82%), *Cydonia oblonga* (6.97%), *Cynodon dactylon* (9.75%), *Datura stramonium* (1.42%), *Dipsacus inermis* (20%), *Fragaria nubicola* (15.38%), *Geranium wallichianum* (36.36%), *Jurinea dolomiaea* (21.42%), *Marrubium vulgare* (22.22%), *Mentha longifolia* (9.09%), *Notholirion thomsonianum* (50%), *Ocimum basilicum* (20%), *Plantago lanceolata* (7.69%), *Plantago major* (33.33%), *Portulaca oleracea* (14.28%), *Potentilla reptans* (84.61%), *Prunella vulgaris* (61.11%), *Rosa damascena* (3.50%), *Sisymbrium irio* (65.38%), *Skimmia anquetilia* (51.21%), *Taxus wallichiana* (10%), *Trigonella foenum-graecum* (5.88%), *Triticum aestivum* (37.5%), *Viola odorata* (15.09%), *Wulfenia amherstiana* (60%).

**Dermatological**

*Aconitum violaceum* (15%), *Actaea spicata* (37.5%), *Adiantum capillus-veneris* (4.34%), *Aesculus indica* (68.42%), *Allium proliferum* (27.27%), *Amaranthus caudatus* (50%), *Amaranthus retroflexus* (26.08%), *Anagallis arvensis* (100%), *Arnebia benthamii* (5%), *Berberis lyceum* (53.48%), *Bergenia ciliata* (10.81%), *Brassica compestris* (9.85%), *Brassica oleracea* var. *Haka* (82.75%), *Calendula officinalis* (94.11%), *Cedrus deodara* (28.78%), *Centaurea iberica* (24.24%), *Cotula anthemoides* (39.47%), *Cuscuta reflexa* (5.88%), *Datura stramonium* (37.14%), *Euphorbia helioscopia* (40.90%), *Euphorbia wallichii* (100%), *Ficus carica* (11.76%), *Galium aparine* (100%), *Inula racemosa* (30%), *Iris kashmiriana* (31.25%), *Juglans regia* (33.33%), *Jurinea dolomiaea* (25%), *Linum usitatissimum* (30.76%), *Malva neglecta* (9.09%), *Marrubium vulgare* (11.11%), *Morus nigra* (68.75%), *Nymphaea maxicana* (19.04%), *Oryza sativa* (65%), *Papaver dubium* (50%), *Phytolacca acinosa* (42.85%), *Pinus wallichiana* (60%), *Podophyllum hexandrum* (8%), *Polygonum amplexicaule* (13.79%), *Prunella vulgaris* (5.55%), *Prunus persica* (52.63%), *Ranunculus arvensis* (100%), *Rheum emodi* (100%), *Robinia pseudoacacia* (33.33%), *Rosa damascena* (1.75%), *Rubia cordifolia* (16.66%), *Rumex dentatus* (27.27%), *Salix acmophylla* (41.02%), *Salvia moorcroftiana* (18.18%), *Saussurea costus* (3.37%), *Senecio chrysanthemoides* (79.16%), *Sisymbrium irio* (7.69%), *Solanum tuberosum* (100%), *Sonchus arvensis* (40%), *Thymus linearis* (6.66%), *Tribulus terrestris* (26.31%), *Trillium govanianum* (33.33%), *Urtica dioica* (52.63%), *Valeriana jatamansi* (15.38%), *Verbascum thapsus* (7.69%), *Verbena officinalis* (80%), *Viburnum grandiflorum* (33.33%), *Vitis vinifera* (48.27%), *Ziziphus jujuba* (2.32%).

**Ophthalmological**

*Allium cepa* (14.28%), *Allium sativum* (6.12%), *Centaurea iberica* (48.48%), *Cynodon dactylon* (14.63%), *Hyoscyamus niger* (7.40%), *Marrubium vulgare* (33.33%), *Plantago lanceolata* (7.69%), *Portulaca oleracea* (28.57%), *Senecio chrysanthemoides* (4.16%), *Solanum nigrum* (13.04%), *Trigonella foenum-graecum* (5.88%), *Viburnum grandiflorum* (50%).

**Diabetes**

*Artemisia absinthium* (8.39%), *Berberis lyceum* (20.93%), *Malus domestica* (45.71%), *Nymphaea maxicana* (19.04%), *Trapa natans* (41.17%), *Trigonella foenum-graecum* (17.64%), *Ziziphus jujuba* (6.97%).

<b>Gynaecological/andrological</b>	<i>Adiantum capillus-veneris</i> (19.56%), <i>Allium cepa</i> (21.42%), <i>Centaurea iberica</i> (27.27%), <i>Cichorium intybus</i> (35%), <i>Cuscuta reflexa</i> (47.05%), <i>Cydonia oblonga</i> (4.65%), <i>Dipsacus inermis</i> (30%), <i>Euryale ferox</i> (77.77%), <i>Ficus carica</i> (7.84%), <i>Fragaria nubicola</i> (38.46%), <i>Geranium wallichianum</i> (6.06%), <i>Juglans regia</i> (3.17%), <i>Linum usitatissimum</i> (46.15%), <i>Malva neglecta</i> (22.72%), <i>Mentha arvensis</i> (13.33%), <i>Nelumbo nucifera</i> (17.64%), <i>Notholirion thomsonianum</i> (50%), <i>Oryza sativa</i> (25%), <i>Papaver somniferum</i> (8.33%), <i>Sonchus arvensis</i> (60%), <i>Taraxacum officinale</i> (36.48%), <i>Trapa natans</i> (11.76%), <i>Trigonella foenum-graecum</i> (5.88%), <i>Ziziphus jujube</i> (4.65%).
<b>Cardiovascular</b>	<i>Allium sativum</i> (55.10%), <i>Arnebia benthamii</i> (15%), <i>Berberis lyceum</i> (4.65%), <i>Capsella bursa-pastoris</i> (16.66%), <i>Coriandrum sativum</i> (31.81%), <i>Crataegus songarica</i> (100%), <i>Cydonia oblonga</i> (4.65%), <i>Cypripedium cordigerum</i> (50%), <i>Dipsacus inermis</i> (5%), <i>Ficus carica</i> (17.64%), <i>Foeniculum vulgare</i> (13.79%), <i>Fumaria indica</i> (44.82%), <i>Juglans regia</i> (20.63%), <i>Malva neglecta</i> (4.54%), <i>Nymphaea maxicana</i> (14.28%), <i>Polygonum hydropiper</i> (20%), <i>Portulaca oleracea</i> (14.28%), <i>Pyrus communis</i> (16.66%), <i>Solanum nigrum</i> (17.39%), <i>Thymus linearis</i> (6.66%), <i>Trigonella foenum-graecum</i> (11.76%), <i>Urtica dioica</i> (31.57%), <i>Vitis vinifera</i> (6.89%), <i>Ziziphus jujuba</i> (16.27%).
<b>Insect stings</b>	<i>Anthemis cotula</i> (14.28%), <i>Datura stramonium</i> (7.14%), <i>Dioscorea deltoidea</i> (100%).
<b>Liver disorders</b>	<i>Aconitum violaceum</i> (5%), <i>Adiantum capillus-veneris</i> (4.34%), <i>Adiantum venustum</i> (7.14%), <i>Althea rosea</i> (12.12%), <i>Arnebia benthamii</i> (7.5%), <i>Cichorium intybus</i> (5%), <i>Coriandrum sativum</i> (9.09%), <i>Cydonia oblonga</i> (2.32%), <i>Ficus carica</i> (1.96%), <i>Foeniculum vulgare</i> (6.89%), <i>Malus domestica</i> (11.42%), <i>Malva neglecta</i> (4.54%), <i>Oxalis corniculata</i> (25%), <i>Polygonum hydropiper</i> (20%), <i>Punica granatum</i> (9.09%), <i>Raphanus sativus</i> (37.5%), <i>Solanum nigrum</i> (47.82%), <i>Taraxacum officinale</i> (2.70%), <i>Tribulus terrestris</i> (10.52%), <i>Trigonella foenum-graecum</i> (5.88%), <i>Ziziphus jujuba</i> (6.97%).
<b>Ailments of hair</b>	<i>Adiantum capillus-veneris</i> (23.91%), <i>Adiantum venustum</i> (28.57%), <i>Althea rosea</i> (6.06%), <i>Amaranthus retroflexus</i> (73.91%), <i>Angelica glauca</i> (27.27%), <i>Brassica campestris</i> (70.42%), <i>Cedrus deodara</i> (13.63%), <i>Cotula anthemoides</i> (5.26%), <i>Cuscuta reflexa</i> (29.41%), <i>Juglans regia</i> (4.76%), <i>Nymphaea maxicana</i> (19.04%), <i>Ocimum basilicum</i> (4.16%), <i>Prunella vulgaris</i> (16.66%), <i>Vitis vinifera</i> (20.68%), <i>Ziziphus jujuba</i> (4.65%).
<b>General body weakness</b>	<i>Adiantum capillus-veneris</i> (4.34%), <i>Ajuga parviflora</i> (22.22%), <i>Arnebia benthamii</i> (20%), <i>Berberis lyceum</i> (6.97%), <i>Bergenia ciliata</i> (13.51%), <i>Bunium persicum</i> (13.04%), <i>Cichorium intybus</i> (20%), <i>Colchicum luteum</i> (6.25%), <i>Cuscuta reflexa</i> (2.94%), <i>Cydonia oblonga</i> (2.32%), <i>Cynodon dactylon</i> (7.31%), <i>Cypripedium cordigerum</i> (10%), <i>Daucus carota</i> (33.33%), <i>Dipsacus inermis</i> (10%), <i>Fragaria nubicola</i> (10.34%), <i>Geranium wallichianum</i> (6.06%), <i>Iris kashmiriana</i> (12.5%), <i>Ocimum basilicum</i> (12.5%), <i>Papaver dubium</i> (50%), <i>Picrorhiza kurrooa</i> (6.66%), <i>Punica granatum</i> (31.81%), <i>Rumex dentatus</i> (9.09%), <i>Saussurea costus</i> (10.11%), <i>Taraxacum officinale</i> (17.56%), <i>Vitis vinifera</i> (17.24%).
<b>Ailments of mouth</b>	<i>Achillea millefolium</i> (100%), <i>Aconitum violaceum</i> (40%), <i>Althea rosea</i> (48.48%), <i>Angelica glauca</i> (24.24%), <i>Bunium persicum</i> (21.73%), <i>Citrullus colocynthis</i> (100%), <i>Coriandrum sativum</i> (4.54%), <i>Datura stramonium</i> (17.14%), <i>Equisetum arvense</i> (60%), <i>Hyoscyamus niger</i> (59.25%), <i>Juglans regia</i> (12.69%), <i>Jurinea dolomiaea</i> (7.14%), <i>Oxalis corniculata</i> (50%), <i>Polygonum amplexicaule</i> (10.34%), <i>Potentilla reptans</i> (15.38%), <i>Punica granatum</i> (9.09%), <i>Robinia pseudoacacia</i> (25%), <i>Rubia cordifolia</i> (33.33%), <i>Salix acmophylla</i> (35.89%), <i>Sambucus wightiana</i> (100%), <i>Skimmia anquetilia</i> (4.87%), <i>Triticum aestivum</i> (25%), <i>Viola odorata</i> (16.98%).
<b>Anticancer/tumor Other/unclassified</b>	<i>Podophyllum hexandrum</i> (59.25%), <i>Taxus wallichiana</i> (10%), <i>Trapa natans</i> (5.88%). <i>Adiantum capillus-veneris</i> (2.17%), <i>Aesculus indica</i> (10.52%), <i>Allium sativum</i> (4.08%), <i>Capsella bursa-pastoris</i> (16.66%), <i>Colchicum luteum</i> (46.87%), <i>Datura stramonium</i> (5.71%), <i>Ficus carica</i> (7.84%), <i>Hyoscyamus niger</i> (14.81%), <i>Iris kashmiriana</i> (43.75%), <i>Juglans regia</i> (6.34%), <i>Jurinea dolomiaea</i> (10.71%), <i>Lagenaria siceraria</i> (25.71%), <i>Malus domestica</i> (5.71%), <i>Papaver somniferum</i> (77.77%), <i>Pinus wallichiana</i> (20%), <i>Plantago lanceolata</i> (53.84%), <i>Polygonum amplexicaule</i> (75.86%), <i>Robinia pseudoacacia</i> (16.66%), <i>Rosa damascena</i> (1.75%), <i>Salix acmophylla</i> (2.56%), <i>Skimmia anquetilia</i> (7.31%), <i>Taraxacum officinale</i> (1.35%), <i>Taxus wallichiana</i> (16.66%), <i>Verbascum thapsus</i> (23.07%).

**Table 4:** Threatened medicinal plants of Bandipora district (Jammu and Kashmir) based on *Red Data Book of Indian Plants* (Nayar and Sastry, 1987, 1988, 1990), CAMP (Conservation Assessment and Management Plan, 2003) workshop, other existing literature (Pant and Pant, 2011; Kumar et al. 2011) and personal observation of authors.

Botanical name	Local name	Habit	Threat Status
<i>Aconitum heterophyllum</i>	“Patris”/ “Pivak”	Perennial herb	Critically Endangered
<i>Aconitum violaceum</i>	“Mohand”	Perennial herb	Vulnerable
<i>Ajuga parviflora</i>	“Jan-i-adam”	Perennial herb	Rare*
<i>Angelica glauca</i>	“Chora”	Perennial herb	Endangered
<i>Arnebia benthamii</i>	“Gaozaban”/ “Kahzaban”	Perennial herb	Critically Endangered
<i>Artemisia absinthium</i>	“Tithwan”	Perennial herb	Rare*
<i>Bunium persicum</i>	“Kala Zeera”	Perennial herb	Endangered
<i>Colchicum luteum</i>	“Vir Kim Posh”	Perennial herb	Vulnerable
<i>Crataegus songarica</i>	“Reng Kul”	Perennial tree	Rare*
<i>Cypripedium cordigerum</i>	“Pholaan”	Perennial herb	Rare
<i>Dioscorea deltoidea</i>	“Kreth / Krees”	Perennial climbing herb.	Endangered
<i>Hyoscyamus niger</i>	“Bazarbunga”	Biennial herb	Vulnerable

<i>Inula racemosa</i>	“Poshkar”	Perennial herb	Vulnerable
<i>Jurinea dolomiaea</i>	“Dupha”/ “Thandi Jadi”/ “Guggal Dooph”	Perennial herb	Endangered
<i>Notholirion thomsonianum</i>	“Salamisri”	Perennial herb	Rare*
<i>Picrorhiza kurroa</i>	“Koud”/ “Kutki”	Perennial herb	Endangered
<i>Podophyllum hexandrum</i>	“Banwagan”/ “Bankakri”	Perennial herb	Endangered
<i>Rheum emodi</i>	“Pumbchalan”	Perennial herb	Endangered
<i>Saussurea costus</i>	“Kouth”	Perennial herb	Critically Endangered
<i>Taxus wallichiana</i>	“Postul”/ “Brammi”	Perennial tree	Endangered
<i>Valeriana jatamansi</i>	“Mushkibala”	Perennial herb	Vulnerable

\*Categories defined based on personal observation of authors.

### Selection of informants and ethnomedicinal data collection

During investigation, all the three tehsils were selected for the present study. However, tehsil Gurez being already explored ethnobotanically by some workers (Kapahi et al. 1993; Dad and Khan, 2011; Ara and Naqshi, 1992), main emphasis was laid upon Bandipore and Sonawari tehsils as there is no information available in published form with respect to these two tehsils and hence deserve a great attention for ethnomedicinal research. Many far flung and remote regions were surveyed from March 2011 to October 2012. Representative informants including local knowledgeable persons (who themselves had used these plant-based therapies for health treatments) and tribals (*Gujjars* and *Bakkerwals*) were sampled during random visits made to houses in the study area. Besides, efforts were made to approach as many as traditional medical practitioners (*Bhoeris*). Particularly the places that were floristically rich as well as had sizeable population of tribals (*Gujjars* and also *Bakkerwals* during summer months) were given preference for surveys. It was ensured that all the places that lie at different elevations would represent all characteristics of the whole district. Methods used to collect ethnomedicinal data included semi-structured interviews, focus group discussions and walk-in-the-woods with local knowledgeable persons, *Bhoeris*, *Gujjars* and *Bakkerwals*. Informants were stimulated to talk freely about their ethnomedicinal knowledge, and were asked to mention all the medicinal plants known or used, asking them the following questions (Qureshi et al. 2009):

1. Do you know the medicinal plants in your local area?; If yes, please name them;
2. What is the use of these medicinal plants? How do you use them and for which ailment?
3. Which part of the plant is used for medicinal purposes?
4. When do you collect these plants? and
5. Do you collect them for your personal use or sell them to pharmaceutical companies.

Thus informed consent was obtained from each informant who participated in this study after explaining the purpose of the study and assuring them of the most responsible judicial use of the resulting information before the start of interviews. The total number of informants consulted during the ethnomedicinal survey was 187 (77% men and 23% women). Informants' age ranged between 37–98 years. Interviews and discussions with informants were held in Kashmiri language that was understandable in most of the cases. However, Urdu language (official language of Jammu and Kashmir) was also used in tribal areas. In order to provide independent information, informants were separately asked to share their traditional knowledge on the utilization of medicinal plants. With a view to bring an element of accuracy, the information was cross-checked with others. To ensure further accuracy and to get some more valuable tips regarding ethnobotanical surveys some important works (Jain, 1967, 1995; Khan, 1993) were also consulted.

Moreover, information regarding the plant abundance, distribution, localities of their maximum availability, exploitation level and various threats was collected personally from local people especially from plant collectors of the area and this information was confirmed with regular field trips.

### Collection and deposition of ethnomedicinal plants

Efforts were made to collect the medicinal plants from the natural habitats in their flowering and fruiting stages. In case there was no flowering and fruiting conditions, the plant twig with few leaves was collected for proper identification with the help of local *Bhoeris* and knowledgeable persons so as to ascertain the correct identification of plants and also to obtain information on their habitat. Furthermore, field photographs of the plants were taken with the help of a digital camera for easy identification and habitat recognition. Collected plants/plant parts were dried, pressed, preserved (poisoned) and finally mounted on herbarium sheets with the help of gum, thread and cellophane tape following standard herbarium technique (Miller and Nyberg, 1995). Every herbarium sheet was provided with a herbarium label containing information pertaining to botanical name, local name, family, habit, habitat, collection number, accession number, date of collection, place of collection and collector's name. Plant specimens were then identified and accessioned by matching them with already identified herbarium specimens housed at the departmental herbarium (KASH Herbarium) of Kashmir University, Srinagar (Jammu and Kashmir). Apart from that, available floristic literature (Kirtikar and Basu, 1933-1935; Wali and Tiker, 1964; Javeid, 1968; Nasir and Ali, 1970-1987; Stewart, 1972; Kachroo et al. 1977; Kachroo, 1978; Nawchoo and Kachroo, 1995) and various publications dealing with the flora of temperate regions were also consulted for identification purposes. Finally, collected herbarium specimens were deposited at KASH herbarium and herbarium section of the Department of Botany, Government Narmada Post Graduate College, Hoshangabad (M.P.), for authenticity and future use. The International Plant Names Index (<http://www.ipni.org>) was followed for the botanical nomenclature of each plant species.

### Data analysis

Collected ethnomedicinal data about plants was entered in excel spreadsheet (Microsoft corporation, 2007) and organised for statistical analysis. Descriptive statistics was applied to compute the number and percentage of species, genera and families of ethnomedicinal medicinal plants, proportions of plant parts harvested, plant percentage from various sources, plant distribution among different families, their flowering phenology, life forms, nature of habitat, plant percentage in curing various ailments. Besides efforts were made to identify the most-preferred medicinal plant species used for curing the most frequently reported disease types in the area. The collected data was analyzed with three quantitative tools viz. the informant consensus factor ( $F_{ic}$ ), fidelity level (FL) and use value (UV).

**Informant Consensus Factor ( $F_{ic}$ )**

All ailments occurring in the district were categorized into eighteen disease categories following a standard chart (Heinrich et al. 1998). To test the level of homogeneity of information provided by different informants, Informants' Consensus Factor,  $F_{ic}$  (Trotter and Logan, 1986) was calculated simply by computing number of use reports in each disease category (Nur) minus the number of times species used (Nt), divided by the number of use reports in each category minus one;  $F_{ic} = \text{Nur} - \text{Nt} / (\text{Nur} - 1)$

$F_{ic}$  values range between 0 and 1, where a high  $F_{ic}$  value (close to 1) indicates the highest level of informant consensus which means that there exists well-defined selection criteria for the species regarding a specific illness category on behalf of the informants and/or that they are in agreement in using that species for a specific use, whilst a low  $F_{ic}$  value (close to 0) indicates the choice of the species is random and that there is no consensus amongst the informants on the medicinal use of the species.

**Fidelity level (FL)**

Fidelity level (FL) index (Friedman et al. 1986) was used to determine the relative healing potential of each reported medicinal plant used against various ailments i.e., to determine the most preferred species used in the treatment of a particular ailment as in majority of cases more than one plant species are used in treatment of the same category. Thus, Fidelity level (FL%) =  $(N_p / N \times 100)$ , where  $N_p$  is the number of informants who independently indicated the use of a species for treating a particular disease, and N the total number of informants who reported the plant for any given disease.

**Use value (UV)**

The use value (UV) (Phillips et al. 1994) that demonstrates the relative importance of species known locally was also calculated using the formula:  $UV = (\Sigma U/n)$ , where UV is the use value of species, 'U' is the total number of use reports per species and 'n' represents the total number of informants interviewed for a given plant. Values will be high (near 1) if there are many use reports for a plant, implying that the plant is important, and near 0 if there are few reports related to its use. The use value does not distinguish whether a plant is used for single or multiple purposes.

**Results and Discussion****Ethnography of key informants**

In the present study, people of different ethnic groups such as tribals (*Gujjars* and *Bakkerwals*), knowledgeable persons of the plains and traditional practitioners (*Bhoeris*) were consulted and interviewed about the curative features of plants. Tribals such as *Gujjars* are generally permanent settlers at the foot hills of Himalayas. They constitute a good segment of the population of the study area and live in environment characterized by defined area with specific food habits, language, cultural homogeneity, a unified social organization and a unique way of nomadic life style. Besides breeding their own livestock, they also take care of animals of the other communities, fulfilling the role of village cowherd. The rich biological diversity of the area is managed and utilized by them in a variety of ways. *Bakkerwals* on the other hand are nomadic tribe and high altitude goatherds/shepherds. *Bakkerwals* lead a lonely and tough life in the high altitude meadows of the Himalayas and Pir Panjal ranges (Bhat et al. 2012). While interacting with the *Bakkerwals* it was found that they actually belonged to far-flung Rajauri and Poonch districts of Jammu and Kashmir and visited the study area every year in the months of April and May. They take their livestock animals high into the mountains, above the tree line to graze in the lush meadows. They travel by foot and it takes them more than thirty days to reach these meadows. They are accompanied by their dogs to guard the sheep/goats and their pack animals. During summer, they move from one meadow to other and ultimately leave the district in the months of August and September. However, some of them have settled permanently in the foothills of Himalayas of the district. For example, a few could be easily found near Saderkoot Bala area, living there for years. Both these ethnic groups (*Gujjars* and *Bakkerwals*) have their own knowledge of traditional herbal medicine inherited from their fore-fathers. These medicines are well accepted by the local people since generations have experienced their efficacy in alleviating a variety of diseases (Tantray et al. 2009). Besides, these ethnic groups have to rely on the traditional system as they do not have the modern medicinal facilities available in the vicinity.

Traditionally, *Bhoeris* are the herbal medicine practitioners of this indigenous medicine system, who would buy important medicinal plants from needy people living both in plains as well as in tribal areas. They either visited the areas by themselves or the same people came to them for selling these plants. The people especially tribals, who sold herbal medicine in return got a little money to sustain their basic needs of livelihood. Bought medicinal plants were then prescribed and sold simply by establishing small shops not only in small villages but also in semi-urban and urban areas.

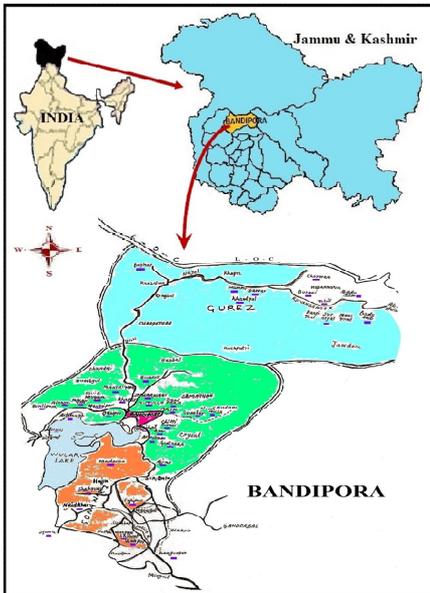
It would be appropriate to mention here that, earlier, in the study area, *Bhoeris* were mainly the Kashmiri Pandits who had vast deep rooted knowledge of traditional herbal medicine. This knowledge was descended to them from their forefathers in the form of oral folklores, and is not yet documented. They enjoyed high respect and social status among the communities. But due to uprising turmoil that started in 1989 in Kashmir valley, they left the district in order to defend themselves and migrated along with this precious knowledge to other parts of the country. This is the reason that a few abandoned shops that belonged to them were reported during the course of survey in the main market of Bandipora (Lone and Bhardwaj, 2013a). Until they stayed in the district they shared their precious medicinal knowledge with some Kashmiri Muslims among whom a few at present are carrying forward and practicing this profession.

**Traditional beliefs, modes of treatment and dosage**

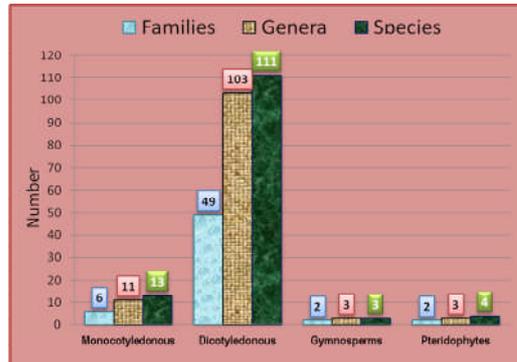
It was found during interviews that, formerly, prescribing herbal medicine to patients by *Bhoeris* was free of cost, because taking fees for any kind of treatment was highly discouraged as they believed that health care was an essential need and if a fee was charged that the poor might be deprived of the treatment. In return, local people would provide them some donation in the form of cereals, pulses and vegetables. But now they prescribe and sell the herbal medicines to earn money. However, the low cost of herbal medicine and its unlikely income is one of the reasons that the youth of *Bhoeris* are discouraged from carrying forward this ethnomedicine prescribing profession and that is why only few

*Bhoeris*, practicing in this field, were found in the study area. On the other hand, the cost of modern medicine is very high than the cost of indigenous medicine so there is a public demand for services (Samal et al. 2004).

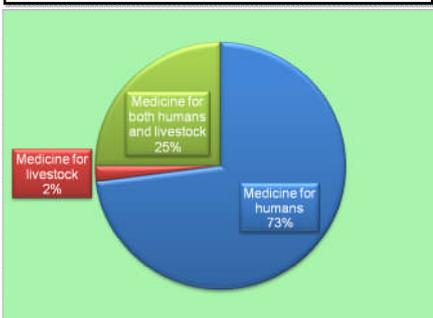
Various diagnosis and treatment methods depending on the type of ailment were used by *Bhoeris*. These practitioners commonly diagnosed each health problem by an interview and physical/visual inspection of the patient. Patients or their attendants were commonly interviewed for symptoms observed and the duration of the health problem. Changes in eye and skin colour, tongue and throat regions, body temperature and status of sores were all visually inspected by the practitioner and the remedy was prescribed. Most of the medicinal plant preparations given had no standardized doses. In most of cases dosages were determined according to the age, sex and physical condition of the patient. Medicinal plant doses were usually measured in pinches, fists, spoons, small cups or glasses.



**Figure 1:** Location map of the study area. Geometric co-ordinates are not shown because the area is highly restricted.



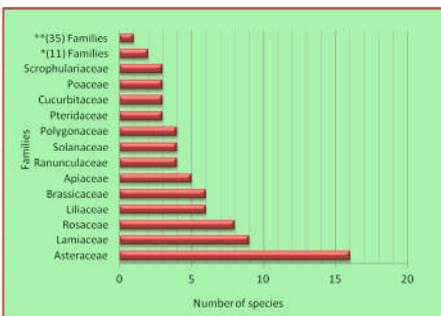
**Figure 2:** Number of taxa of different classes of tracheophytes.



**Figure 3:** Proportion (%) of medicinal plants species for curing various types of ailments.



**Figure 4:** Availability of medicinal plants from various sources.

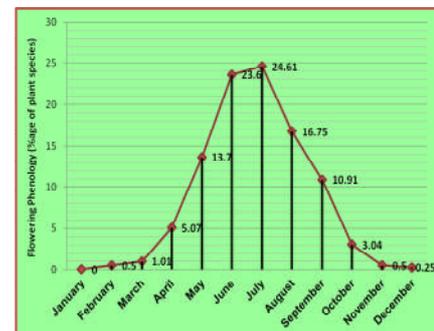


**Figure 5:** Distribution of plant species among different families. \*Figures in parentheses indicate the number of families with two plant species each such as Malvaceae, Amaranthaceae, Pinaceae, Fabaceae, Plantaginaceae, Papaveraceae, Rubiaceae,

Moraceae, Nymphaeaceae, Euphorbiaceae and Caprifoliaceae.

\*\*Figures in parentheses indicate the number of families with one plant species each such as Hippocastanaceae, Primulaceae, Boraginaceae, Berberidaceae, Saxifragaceae, Cannabinaceae, Cuscutaceae, Orchidaceae, Dioscoreaceae, Dipsacaceae, Equisetaceae, Euphorbiaceae, Fumariaceae, Geraniaceae, Iridaceae, Juglandaceae, Linaceae, Caryophyllaceae, Nelumbonaceae, Oxalidaceae, Phytolaccaceae, Podophyllaceae, Portulacaceae, Punicaceae, Salicaceae, Rutaceae, Taxaceae, Trapaceae, Zygophyllaceae, Urticaceae, Valerianaceae, Verbenaceae, Violaceae, Vitaceae and Rhamnaceae.

**Figure 6:**



Flowering phenology of collected medicinal plants of Bandipora district.



Figure 7: Variation in life forms of collected medicinal plants.

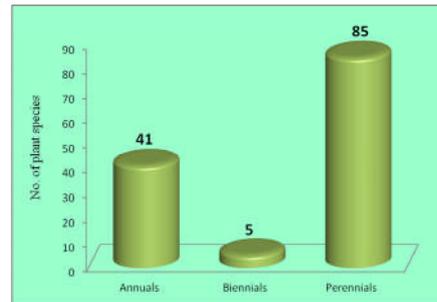


Figure 8: Variation in life span of medicinal plants.

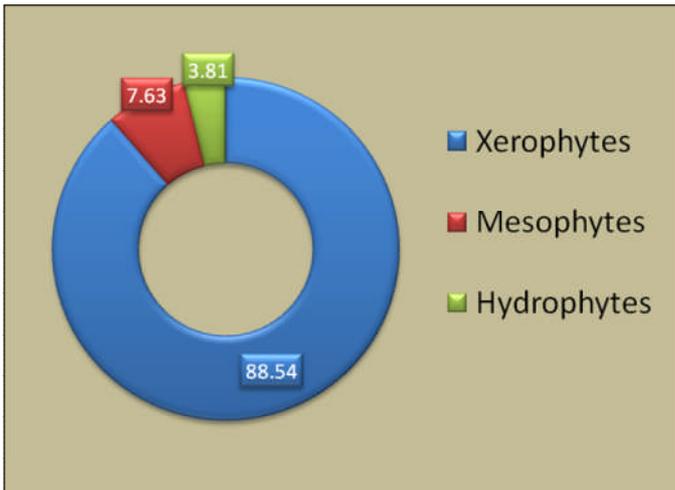


Figure 9: Nature of habitat of various medicinal plants.

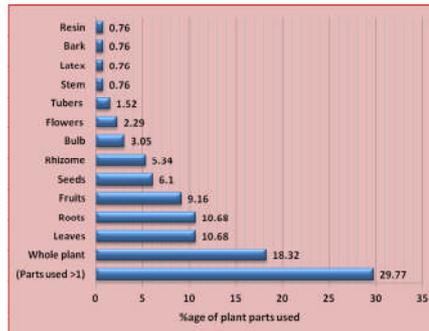


Figure 10: Percentage of plant parts used to cure various ailments.

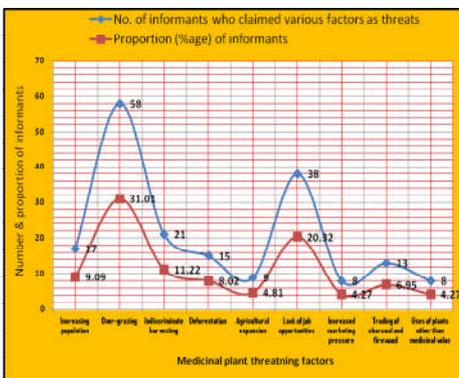


Figure 11: Proportion of informants who claimed various factors as threats to plant species in Bandipora district.

**Ethnomedicinal plant diversity and uses reported by the informants**

In Table 1 each medicinal plant is provided with its scientific name and author citation; followed by local name, family, accession number, flowering period, plant part(s) used, ailment (s) against which plant part used and threat status.

In this study, a total of 131 plant species belonging to 120 genera and 59 different families were found to be used as remedies by the local people in their day to day life to cure various human and livestock ailments. Out of 131 species, angiosperms comprised the highest number being represented by 124 species (95%) followed by pteridophytes (4 species, 3%) and gymnosperms (3 species, 2%). Dicotyledonous and monocotyledonous are represented by 111 species in 103 genera and 49 families, and by 13 species in 11 genera, 6 families, respectively, gymnosperms share 3 species in 3 genera and 2 families, whereas 4 species of pteridophytes belonging to 3 genera, distributed over 2 families were also recorded (Figure 2).

Though gymnosperms were represented by less number of taxa, they formed the dominant component in the forests of the study area on account of congenial physiographic conditions and altitudinal and latitudinal locations of the area. Of these 131 species, 96 species (73%) were alone used as human medicine, 2 species (2%) as livestock medicine and the remaining 33 species (25%) were used for treating both human and livestock ailments (Figure 3). The presence of such a large number of medicinal plant species and associated ethnomedicinal knowledge in the district compared to number of species reported from other regions in Kashmir indicates that the area has a very high diversity of medicinal plant species and is a site of precious indigenous knowledge.

Amongst the species, 89 (68%) species were collected from the wild, 27 (21%) species from cultivation and 15 (11%) species from both sources (Figure 4). This indicates that the residents mainly depended on wild sources or the natural environment rather than on

home/vegetable gardens to obtain the medicinal plants, and the activity of medicinal plant cultivation was very poor in the study area. It also indicated that the natural forests of Bandipora are being over-exploited by the people especially by *Gujjars*, *Bakkerwals* and also by traditional practitioners (*Bhoeris*) for their medicinal plant composition.

At some places in Bandipore and Gureiz tehsils, it was also found that the richness of medicinal herbs decreased with increasing altitude but the percentage of plants used as medicine steadily increased with increasing altitude. The reason for this was due to preferences given to herbal medicines at high altitude areas as well as having no alternative choices, poverty and trust in the effectiveness of traditional herbal medicines. Similar findings were also reported by many other workers (Kunwar and Bussmann, 2008; Shaheen et al. 2012) in their ethnobotanical investigations.

The highest number of medicinal plants were recorded in two families viz. Asteraceae (16 species, 12%) and Lamiaceae (9 species, 12%) followed by families Rosaceae (8 species, 10%), Liliaceae and Brassicaceae (6 species, 8% each), Apiaceae (5 species, 6%), Ranunculaceae, Solanaceae and Polygonaceae (4 species, 5% each), Pteridaceae, Cucurbitaceae, Poaceae and Scrophulariaceae (3 species, 4% each), Malvaceae, Amaranthaceae, Pinaceae, Fabaceae, Plantaginaceae, Papaveraceae, Rubiaceae, Moraceae, Nymphaeaceae, Euphorbiaceae and Caprifoliaceae (2 species, 3% each). Rest families were monotypic and included only one species, 1% only (Figure 5). Many workers (Kumar et al. (2009); Gangwar et al. (2010); Murugan et al. 2010) also reported family Asteraceae as the dominant family during their ethnobotanical investigations. This also indicates that the area consisted of high diversity of plant species.

### Flowering phenology of medicinal plants

The general flowering calendar of collected medicinal plants of the study area depicted that maximum number of plants species were in flowering stages in the month of July (25%) followed by June (24%) and August (17%), whereas only one plant species flowers during the month of December and no plant species in the month of January (Figure 6). The species in flowering over 11 months of the year first showed an increasing trend reaching maximum in the month of July and then falling again. This trend of flowering during summer is perhaps attributable to the physiography of the study area, since a considerable portion of the study area remains covered with snow till the end of June, which prevents seedlings and other vegetative parts from coming out of the soil. One more reason for frequent occurrence of the majority of medicinal plants species in summer season (May-July) in comparison to other seasons of the year, could be attributed to the suitable temperature, enough moisture and availability of macronutrients (Ahmad et al. 2009). The extended flowering period of certain herbaceous annuals is because of their extended distribution along altitudinal gradient. Since there is gradual decrease of temperature as the altitude increases, the growth of certain plants triggers earlier at lower levels as compared to the species growing at higher elevations (Singh and Kachroo, 1994).

The finding on existence of majority of the collected plants in flowering stages in the month of July gets further support from other works (Malik et al. 2011a) where majority of the plants in flowering stage during this month were also reported. Besides, two interesting plants with respect to their flowering namely *Colchicum luteum* and *Prunus persica* were reported in which leaves emerged from their plant bodies following flowering.

### Habit and habitat of medicinal plants

The reported medicinal plants were found to grow in a diverse range of habitats along with an altitudinal range of 1510-3600 meters (AMSL), spreading from plains, mountain forests, sub-alpine and alpine pastures. As far as the life form (habit) of medicinal plants is concerned, the herbs constituted the highest proportion being represented with 103 species (79%), followed by trees (14 species, 11%), shrubs (6 species, 4%), climbers (6 species, 4%), sub-shrubs (1 species, 1%) and parasites (1 species, 1%) in descending order (Figure 7). This finding is in conformity with many earlier findings (Srivastava, 1988; Kapahi et al. 1993; Khan et al. 2004; Khuroo et al. 2007; Rashid et al. 2008; Tantray et al. 2009; Gangwar et al. 2010; Pant and Pant, 2011; Malik et al. 2011b; Punjaji, 2012 and Ahmad et al. 2012), where herbaceous medicinal plants were also reported to dominate. This could be associated to the abundance and year round availability of herbaceous species in the study area. Regarding the life span of medicinal plants, perennials made up the highest proportion, being represented with 85 species (65%), followed by annuals (41 species, 31%) and biennials (5 species, 4%) (Figure 8). On the basis of nature of habitat of collected medicinal plants, the highest number were represented by xerophytes (116 species, 88%) followed by mesophytes (10 species, 8%) and hydrophytes (5 species, 4%) (Figure 9). The maximum number of xerophytes was probably due to physiologically non-availability of usable form of water.

### Plant parts used for various crude drug preparations

On the basis of the plant parts used, it was observed that in maximum plant species (39 species, 30%) various plant parts such as leaves, roots, rhizomes, flowers, seeds and fruits etc were used, followed by single plant when used as a whole (24 species, 18%), roots (14 species, 11%), leaves (14 species, 11%), fruits (12 species, 9%), seeds (8 species, 6%), rhizomes (7 species, 5%), bulbs (4 species, 3%), flowers (3 species, 2%), tubers (2 species, 1%), bark, latex, stems and resin (1 species, 1% each) to cure various ailments (Figure 10). To prepare herbal formulation, plant parts were mostly used in dried form rather than in fresh form. Dried plant parts were also stored at homes in order to be used in later season especially in winter when life in the entire district becomes tough and medicinal plants become scarce. People would not only store the dried wild herbs, but also dried vegetables (locally called 'Hokhseun'), smoked fish (locally called 'Farrigad') and dried fish (locally called 'Hokhegad') to survive during the extreme winter. Some medicinal plant parts were used without washing or only after washing and some other implied a more or less complex preparation process. Underground parts such as roots and rhizomes were most commonly used plant parts for herbal preparations in the area. Such practice of harvesting underground parts from widely distributed area which are important for survival of plants has a negative influence on the survival and continuity of useful medicinal plants and hence affects sustainable utilization of the plants. Large proportion of herbal prescriptions from root sources was also reported by many workers (Lulekal et al. 2008; Dangwal et al. 2010) in their ethnobotanical investigations.

### Method of drug preparation

In most cases, drugs were prepared from a single plant species. However some applications were prepared from mixtures of different plants/plant parts with the understanding that synergistic effect of different species of plants improved the cure rates. This argument is further strengthened by some previous investigations (Bonet and Valles, 2007; Dilshad et al. 2009; Gertsch, 2011). The medicinal plants had various methods of preparation and application for different types of ailments and they had various preparation forms including powder, paste, poultice,

decoction, latex, juice, infusion, lotion and raw. In this study paste constituted the highest type of preparation form, followed by decoction, powder, raw, poultice, infusion, juice, latex, smoke and lotion. The preparation and application methods varied based on the type of disease treated and the actual site of the ailment. Furthermore, most of the formulations were recorded to be prepared and administered at household level, which is in agreement with other findings (Deribe et al. 2006; Giday et al. 2009).

#### Routes of administration

The medicinal plant preparations were applied through different routes of administration like oral, topical or dermal, and nasal routes. However, oral application was the highest and most commonly used route of application followed by topical or dermal application. These results are consistent with the findings of various other ethnobotanical researches (Yineger and Yewhalaw, 2007; Panghal et al. 2010). So far as the treatment of various ailments is concerned, internal ailments were commonly treated by making the patient drink herbal preparations; skin infections were treated by massaging preparations on the infected skin; painful areas such as boils and wounds were treated by spitting chewed remedial plant part on the affected part; fever and body muscular pain were treated by hot water and steam bath and vapour inhalation. Similar results were reported elsewhere in India (Hiremath et al. 2010; Malik et al. 2011a).

#### Transfer of traditional plant knowledge

Sometimes, when necessary, people would seek the help of knowledgeable persons in their respective locales with meagre or no charges. Majority of the informants reported that they kept their medicinal plant knowledge secret. They further revealed that free transfer of knowledge could only take place along the family line, usually from parents to sons and that's why in present study males were found to have a rich traditional knowledge of medicinal plants than females. It has been already found throughout world that the secrecy of traditional medical practice is a common phenomenon (Sharma et al. 1992; Upadhyay et al. 2007; Giday et al. 2009; Balemie et al. 2004; Ayyanar and Ignacimuthu, 2005). But because of this secrecy the knowledge of medicinal plants is now disappearing, as most of the people with medicinal plant knowledge die without properly passing their knowledge to next generations (Singh and Singh, 2009).

#### Dilutant's used for remedy preparation

In the preparation of various herbal remedies, most frequently used solvent/dilutant was water but occasionally formulations were prepared with milk, oil or *ghee* - clarified butter made from cow's milk (Panghal et al. 2010; Jain et al. 2010). Besides, human saliva was sometimes also used as dilutant for the preparation of remedies. The use of water as solvent/dilutant in majority of cases was perhaps because of its easy availability and more effectiveness in isolating the substance/compound of therapeutic value from the medicinal plant/plant part(s). However, availability could be one of the criteria used in the selection of solvents/dilutants (Giday et al. 2009).

#### Preference for medicinal plant harvesting by local populace

While gathering the medicinal plants from their habitats, it was reported that the people of the study area avoided collecting those plants that were infected by insects, pests and other diseases. Besides, plants affected by toxicity, sunstroke, hailstorms, high wind velocity and fire were also ignored. Only those plants that were fresh and best in all respects were preferred.

#### Medicinal plants and the common diseases

Results showed that the people of the district used these plants through different modes of preparation for curing various ailments, ranging from simple to highly complicated, such as rheumatism, asthma, diarrhoea, dysentery, sprains, wounds, boils, throat infection, chilblains, toothache, urinary disorders, jaundice, indigestion, flatulence, cough, general body weakness, gaseous bloat, fever, diarrhoea, warts, anorexia, wounds, cold, headache, hair loss, warts, skin diseases, gynecological disorders etc. In total about 110 types of ailments were recorded to be treated by using remedies made from different plant species. This shows the existence of rich knowledge about medicinal uses of plants possessed by the local people in the area. The occurrence of some ailments in the study area, besides many other ailments, was reported most frequent with proportionally higher number of plant species used for their treatment. The major occurrences of these ailments could be attributed to their high prevalence in the study area. According to local people ailments such as cough, cold, fever, headache and those related to joints pains occur most frequently during winter months when entire district remains under intense grip of cold. Some plant species were used as tonic for body and hair, narcotic, rodent and insect repellents etc.

Of the collected medicinal plant species, only 7 species (5%) were used for the treatment of single ailment, 14 species (11%) for two ailments while majority of 110 species (84%) were used to treat more than two ailments. Since, a majority of the documented plant species were used for the treatment of more than one disease; it is very difficult to assess which plant is actually effective in curing a particular disease. Thus only clinical trials on these plants can give some indications. Information related to the medicinal uses of plants such as *Actaea spicata*, *Allium proliferum*, *Amaranthus retroflexus*, *Anthemis cotula*, *Brassica oleracea* var. *haka*, *Conyza canadensis*, *Cotula anthemoides*, *Cypripedium cordigerum*, *Dryopteris barbigera*, *Euphorbia helioscopia*, *Euryale ferox*, *Galinsoga parviflora*, *Lychnis coronaria*, *Malus domestica*, *Notholirion thomsonianum*, *Papaver dubium*, *Rorippa islandica*, *Sonchus arvensis*, *Trapa natans*, *Trillium govanianum*, *Verbena officinalis*, *Wulfenia amherstiana* etc were found to be either not known or little known. However, most of the medicinal plant species collected and identified in this study were also medicinally used in other parts of India and also in other Asian countries. For example, of the 131 medicinal plants found and used in Bandipora district: Kunwar and Adhikari (2005) documented 16 species from Nepal; Hamayun et al. (2006) documented 16 species from Pakistan; Kumar et al. (2009a) documented 31 species from Jammu and Kashmir; Sardar and Khan (2009) documented 29 species from Pakistan; Rana et al. (2010) documented 13 species from India; Cakilcioglu et al. (2010) documented 11 species from Turkey; Razaq et al. (2010) documented 22 species from Pakistan; Malik et al. (2011b) documented 33 species from north Kashmir Himalayas, and Khan et al. (2013) documented 37 species from Pakistan as medicinally important to cure human and livestock diseases. Such widespread use of these plants by different groups of societies in different countries could be attributed for their efficacy against various ailments in their respective areas. In other words, the ethnomedicinal reports of those species from wider geographical regions and different cultural groups could validate the medicinal properties of the species.

Among the medicinal plants used for herbal preparations to treat human ailments, *Adiantum capillus-veneris* was found commonly used by most of the traditional practitioners (*Bhoeris*) followed by *Zizyphus jujube*, *Arnebia benthamii*, *Nymphaea maxicana*, *Saussurea costus* and *Rheum emodi*. Herbs such as *Cotula anthemoides*, *Adiantum capillus-veneris* and *Datura stramonium* were used to cure Chilblains (locally called 'SHUH'); a painful itching swelling caused by exposure to severe cold during winter. Children whose age ranged between 2-10 years were reported the worst victims of this disease.

According to local people, this disease is not cured by allopathic medicine and they always preferred herbal medicine for its treatment. Boils was another acute disease and for its treatment, many plants were used in different modes of administration but the most potent reported plants were *Calendula officinalis*, *Morus nigra*, *Nymphaea maxicana* and *Aconitum violaceum*. Although many herbs in different modes of administration were used for the treatment of arthritis, *Saussurea costus* scored the highest mark and ranked first indicating that it was the most effective in treating arthritis followed by *Cedrus deodara*, *Taxus wallichiana* etc (Lone and Bhardwaj, 2013b). Ethnobotanical investigations done elsewhere in India in general and Kashmir in particular also reported that *Saussurea costus* was used for treatment of arthritis (Kumar and Hamal, 2011; Tantray et al. 2009; Malik et al. 2011a). Besides, interesting claims of throat infection and, swelling and respiratory disorders were reported in which the flowers of *Viola odorata* or *Rosa damascena* and sugar were mixed and kept in a closed jar for about 10-15 days for fermentation. This fermented mixture is locally called "KHAMBIRI BANAFSHA" or "GULKAND" respectively. 1-2 teaspoons of "KHAMBIRI BANAFSHA" or "GULKAND" was given early in the morning. It is hoped that pharmacological testing of all these species against various ailments might reveal promising results.

### Choice of use for medicinal plants

The choice of use for herbs was noticed to be influenced by many factors such as season of the year, accessibility and knowledge of other species. People who lived at lower altitudes of the district had difficult access to herbs found at higher altitudes such as *Actaea spicata*, *Ajuga parviflora*, *Aconitum heterophyllum*, *Aconitum violaceum*, *Angelica glauca*, *Arnebia benthamii*, *Bergenia ciliata*, *Euphorbia wallichii*, *Inula racemosa*, *Jurinea dolomiaea*, *Picrorhiza kurroa*, *Podophyllum hexandrum*, *Rheum emodi*, *Saussurea costus*, *Valeriana jatamansi*, *Wulfenia amherstiana*. Hence their first choice remained for the species available in and around their homes. However, people especially tribals who lived at higher altitudes and had knowledge of these important medicinal plant species used to collect and store them and eventually made them available to others residing at lower altitudes. Of the 131 plant species, 93 species were reported growing at low to medium altitudes and were easily available to most of the inhabitants.

### Proportion of informants for folk medicinal knowledge

Results also revealed that a major proportion (75%) of folk medicinal knowledge came from people who were above the age of 55 years, while a small proportion (25%) of it came from people who were between the ages of 37 and 50. This finding is up to some extent in accordance with earlier findings (Hamayun et al. 2006; Khan et al. 2012). Gender wise, men especially old ones had more traditional knowledge about medicinal plants and their uses than females (Lulekal et al. 2013). Furthermore, this may be attributed to two reasons. Firstly, because of the involvement of males in collection and trade related activities. The same was also reported by Qureshi *et al.* (2006b). Secondly, higher reaches are under the intense seizure of security forces for many decades in response to terrorist threats thus posing biggest hindrances in the movement of women. Informants below the age of 50 years were reported less aware of the potential of medicinal plants than their older counterparts who had also gathered knowledge from the point of view of their traditional healthcare and their day to day practices. This difference in the perception of the two age classes will likely result the knowledge loss over time. Discussions with local people especially *Bhoeris* indicated that the attitude of the younger generation was not towards continuing this traditional practice because they realized less opportunity in this tradition for getting immediate benefits mainly in terms of cash in the form of money.

### Overdoses of crude drugs and antidotes

Though special care was taken, some herbal preparations had side effects and resulted in diarrhoea and vomiting. When such conditions happened, antidotes like milk, honey, hot salt tea locally called "Noon Chai", *Chuchwoor* - a kind of bread locally made by Kashmiri bakers and rice decoction were used to reverse the condition. Thus, the patients who suffered from overdose were therefore believed to recover by the application of antidotes.

### Uses of plants other than medicinal

In the study area, majority of the inhabitants relied on wild plants for various purposes such as forage, medicine, firewood, charcoal making, construction and food. It was found that some species of medicinal plants had values other than their medicinal role. Uses of plants besides medicinal were also reported by other authors (Das et al. 2009) For example, *Taxus wallichiana*, *Cedrus deodara*, *Pinus wallichiana*, *Robinia pseudoacacia*, *Salix acmophylla* are used as firewood, for charcoal making, construction besides their medicinal value. The uses other than medicinal of *Taxus wallichiana*, *Cedrus deodara*, *Pinus wallichiana*, have been also reported earlier (Hussain et al. 2006). Leaves (at juvenile stages) of some plants such as *Allium proliferum*, *Cypripedium cordigerum*, *Dioscorea deltoidea*, *Dipsacus inermis*, *Dryopteris barbigera*, *Jurinea dolomiaea*, *Malva neglecta*, *Phytolacca acinosa*, *Plantago lanceolata*, *Polygonum hydropiper*, *Rheum emodi*, *Rumex dentatus* and *Taraxacum officinale* were used as vegetables. Black stalks of *Adiantum venustum* were used as toothpicks to clean teeth. Raw spongy torus of *Nelumbo nucifera* was sold to tourists for their seeds having sweet taste. Stem of *Salvia moorcroftiana* after removing the bark/rind was eaten in raw form due to its sweet taste. It was found that the people of the study area were Muslims who practiced Islam. They used miswaak (local toothbrush) for cleaning their teeth. The miswaak was made from the fresh twigs of finger size of *Salix acmophylla*, bark of *Juglans regia*, stem cuttings of *Rubia cordifolia* and *Equisetum arvense*. Women of the study area fondly used the bark of root of *Juglans regia* for decoration of their lips. The use of "Miswaaks" for teeth cleaning in various parts of Pakistan has been reported earlier (Dastagir, 2001). Thus, it indicated that the plants were known for their values other than their medicinal role and this could be associated directly with the cause of their depletion in the study area. Hence special focus should be given to conservation of these plants since they are being widely exploited also for purposes other than their medicinal value.

### Prescriptions in tradition for healthy life

*Bhoeris*, in addition to local knowledgeable elders, always recommended the selection of proper diet and drug for maintaining healthy life. They believed that the type of food which is taken by an individual and the process of taking it are also important for good health. The environment in which food is to be taken and combination of different types of ingredients with meals also play an important role. If a person taking food is not peaceful and takes food in hurry, then even good food may not give him good health. According to *Bhoeris*, mental disturbances due to unhappiness have adverse impact on the functioning of the gastrointestinal tract that results in chronic health hazards. They would discourage their patients and even healthy persons from eating a combination of fish and milk as well as a combination of pulses and milk. It is believed that fish, milk and pulses are individually good for health, but when fish and milk or pulses and milk are taken together they produce serious health hazards. It is believed that the people in ancient times were healthier than that of today because of their simple life style and harmony with the nature.

#### Informant's consensus factor ( $F_{ic}$ ), fidelity level (FL) and use value (UV) for therapeutic purposes

The ethnomedicinal plants were reported to be used for treating 110 different ailments which are grouped into eighteen categories including: fever; respiratory; urological problems; gastrointestinal; ailments of joints; body pains; dermatological; ophthalmological; diabetes; gynaecological/andrological; cardiovascular; insect stings; liver disorders; ailments of hair; general body weakness; ailments of mouth; anticancer/tumor; other/unclassified. The highest informant's consensus factor ( $F_{ic}$ ) value was 0.95 for insect stings, followed by dermatological, hair ailments, anticancer/tumor (0.90 each), diabetes, mouth ailments (0.89 each), gastrointestinal, joint ailments (0.88 each), respiratory, body pains, cardiovascular (0.85 each), gynaecological/andrological (0.84) disease categories indicated best agreement among informant knowledge on medicinal plant used to treat ailments in these categories while the lowest  $F_{ic}$  value of liver disorders and fever (0.63 each) indicated less agreement among informant knowledge on medicinal plant used to treat ailments in these categories (Table 2). In addition, highest plant use citation (18.18%) was recorded for gastrointestinal followed by dermatological (17.59%) and joint ailments (9.46%).

The most important plant in each category of illness was analyzed using fidelity level. The fidelity value (FL) of a plant species for a specific disease in the study area varied from 1.35% to 100%. The 100% FL is expressed by 6 plant species for dermatological disorders followed by 3, 1, 1, 1 and 1 for mouth ailments, cardiovascular, joint ailments, gastrointestinal and insect stings category respectively (Table 3). Use value representing the relative importance of plants, were high for *Artemisia absinthium* (0.70), *Cannabis sativa* and *Saussurea costus* (0.47 each), *Calendula officinalis* (0.45) and *Taraxacum officinale* (0.39). The lowest use value was calculated for *Ranunculus arvensis* (0.01), with only three people reporting utility (Table 1). High use-value plants were the most frequently used plant species used for each ailment category: *Artemisia absinthium* for worms, abdominal pain, diabetes and sprains, *Cannabis sativa* for loss of appetite and narcotic, *Saussurea costus* for arthritis and body weakness, *Calendula officinalis* for boils and burns, *Taraxacum officinale* for blood loss, general body weakness and bone fractures. The high UV of these species could be attributed to their efficacy against various ailments prevalent in the area and hence the high UV of these plants will lead them to have scarce availability in future in the study area. The low UV of 0.01 was reported for *Ranunculus arvensis*, followed by UV of 0.02 each for *Amaranthus caudatus*, *Galium aparine*, *Lynchnis coronaria*, *Papaver dubium*, *Rorippa islandica* and *Wulfenia amherstiana*. These plants with low UV were commonly found in the study area and hence their less utilization for medicinal purposes will not affect their survival in the study area.

#### Trends of medicinal plant trade

Surveys' conducted during present study showed that the market sector of medicinal plants in Bandipora was not well established and was generally unregulated. Traditional botanical drugs that were collected from wild sources during different months of the year and then sold included *Adiantum capillus-veneris*, *Ajuga parviflora*, *Althea rosea*, *Angelica glauca*, *Arnebia benthamii*, *Artemisia absinthium*, *Berberis lyceum*, *Bunium persicum*, *Colchicum luteum*, *Cotula anthemoides*, *Cuscuta reflexa*, *Cydonia oblonga*, *Datura stramonium*, *Dioscorea deltoidea*, *Inula racemosa*, *Jurinea dolomiaea*, *Nymphaea maxicana*, *Picrorhiza kurroa*, *Podophyllum hexandrum*, *Prunella vulgaris*, *Rheum emodi*, *Saussurea costus*, *Sisybrium irio*, *Taxus wallichiana*, *Tribulus terrestris*, *Viola odorata*, *Ziziphus jujuba*. Thus, out of 131 species, a total of 27 medicinal plant species were been found to be collected and traded most commonly. This was because the collectors including 80% men, 10% women and 10% children always carried digging tools and dug the medicinal plants wherever found. Men usually collected the plants while grazing their livestock at higher altitudes. Since, higher reaches were under the siege of security forces for decades in response to terrorist threats and infiltration, the movement of people was highly restricted. Therefore, the local populace doesn't allow the women to graze livestock at higher reaches and the task was mainly carried out by men especially old ones. Thus women and children collected plants while on their way to work in the fields and surrounding area of their work place. People usually preferred medicinal plants from wild sources because they believed that wild plants are pure and grow in untouched forests free from disturbances of man himself. Actually local people of remote hilly areas including *Gujjars* and *Bakkerwals* were involved in collection and trade of medicinal plants to sustain their basic needs of livelihood as they were poor and needy. Besides some local people of plains who were also poor and needy collected medicinal plants in large quantities from different areas of the district. The collectors are often unaware of the real market prices of medicinal plants. Men are selective in their collection as they collected only those plants from the forests that were profitable and could be sold easily. These collectors had expertise in finding the required medicinal plants as they knew the exact locations from where they could get their required plants. These collection trips were usually for 3-8 days in the forest. Once the plants were collected, they were then sold to some middle man crude drug dealers besides local traders and *Bhoeris*. However, some medicinal plants were stored in homes for own consumption. Crude drug dealers came from cities and often visited these collectors. Mostly collected plant species were cleaned, dried, stored for some time and then sold. However, some species were sold in fresh form, since gatherers were poor and needy. During storage considerable amounts of medicinal plants were wasted due to humidity, insect attacks, inappropriate storage facilities and lack of awareness on the part of collectors. The *Bakkerwals* were found carry large amounts of indiscriminately collected medicinal plants such as *Aconitum violaceum*, *Aconitum heterophyllum*, *Angelica glauca*, *Berberis lyceum*, *Jurinea dolomiaea*, *Saussurea costus*, *Arnebia benthamii*, *Rheum emodi*, *Podophyllum hexandrum*, *Picrorhiza kurroa* on the back of their pack animals. Since, they move from one forest area to other while grazing their livestock, they get easy access to a majority of precious herbs and harvest them ruthlessly. After leaving the study area, once they reached their respective destinations, they besides bringing them into use for themselves, sold these plants at high costs to some drug dealers of neighboring states who in turn sold them to pharmaceutical companies. Such an activity was causing a rapid depletion of medicinal plant resources in the area. Local traders bought medicinal plants from local people particularly from *Gujjars* and then sold them to *Bhoeris*.

Formerly medicinal plant species were gathered especially for own consumption or by local herbalists, but due to increasing demand of raw materials at local, national and international markets, they are being indiscriminately harvested for the commercial purposes. The trade of this kind will continue, till the existence of a seller and a buyer. Thus such malpractices have posed these plants at the brink of extinction (Ved et al. 1998; Dhar et al. 2000; Kala, 2000). According to local collectors and traders, the demand of some species like *Aconitum heterophyllum*, *Arnebia benthamii*, *Picrorhiza kurroa*, *Aconitum violaceum*, *Jurinea dolomiaea*, *Saussurea costus*, *Podophyllum hexandrum* and *Angelica glauca* is very high but supply is low which is due to rare populations and absence of cultivation of these precious medicinal plants. It is already known that collectors, traders and pharmaceutical industries are generally involved in medicinal plant trade and major beneficiaries are only traders and pharmaceutical companies. Medicinal plant collectors in the study area are generally poor villagers and plant collection is their part time activity besides farming and livestock rearing. Mostly underground parts such as roots, rhizomes and tubers were collected. The ideal time for the collection of these plants was believed to be autumn or early spring during which plants remain dormant. In autumn or early spring, plants convert their nutritional chemical constituents of aerial parts into alkaloid contents and store them in the underground parts. Collectors were not aware of the end products of these medicinal plants and huge profit is basically earned by the traders and associated pharmaceutical industries.

### Conservation status of medicinal plants

The famous and great adage by the patron saint of Kashmir, **Sheikh Nur-ud-din Wali [RA]**, '*An poshi teli yeli wan poshi*' (Food will suffice till forests survive) has best described the worth and importance of forests.

The realization of the significance of biodiversity in human welfare and in environmental and developmental context during the earth summit (1992) has necessitated mandatory assessment of plant, animal and microbial resources of any region of the world. Biodiversity is depleting at an alarming rate and the restoration of the lost biodiversity is a big task at present, hence efforts need to be made for the conservation of biological diversity. The initial efforts to conserve the world biodiversity has been through establishment and maintenance of a network of Protected Area (PA) systems by making policy changes, involving local people in the Protected Area management and mobilizing financial resources for their conservation and protection. Article 8 of Convention on Biological Diversity (CBD) advocates the importance of promoting *in-situ* conservation. As a result, international commitment to establish and strengthen Protected Area systems has received considerable attention from all the nations who are signatories to the convention (Rawal and Dhar, 2001).

In recent years the demand of Indian medicinal plants has increased considerably both at national and global markets. India is second largest volume exporter of raw herbal drugs to the global market (Lange, 1997). Keeping this in view, in earlier days India had planned to increase the trade of medicinal plant extracts to 3,000 Crores by the year 2005 and 10,000 Crores by the year 2010 (Bhattacharya and Mitra, 2002). In order to meet this goal within a stipulated time, a huge volume of raw material of medicinal plants was required for which wild populations of medicinal plants, which are the main source of raw materials, were targeted. Besides, for the same goal only a minor fraction of requirements were met from cultivation (Dhar et al. 2000). Of the total medicinal plants known worldwide, so far the agrotechnology of about one percent and propagation protocol of < 10% plant species is available (Lozoya, 1994; Khan and Khanum, 2000). The overharvesting or unsustainable manner of harvesting coupled with other biotic and abiotic factors have brought a sizeable number of medicinal plant species to the brink of extinction (Nayar and Sastry, 1987, 1988, 1990) or under various categories of threats (CAMP, 2003). The situation seems to be more alarming with respect to the species endemic to Himalayan ecosystem and if such practices continue, these plants will ultimately deplete from the biological world. It is estimated that 4,000 to 10,000 medicinal plant species might now be endangered at global level (Edwards, 2004). About 70-80% of the world population use traditional medicine for curing their illness and ailments (Pei, 2001). But this was estimated about a decade ago. A recent work (Titz, 2004) has shown that the percentage of people using traditional medicine decreased in developed countries: 40-50% in Germany, 42% in the USA, 48% in Australia and 49% in France. This might be due to the unavailability of medicinal plants in the wild habitat. In the period 1991-2003, an average of 467,000 tons (valued at US \$ 1.2 billion) of pharmaceutical plants were traded annually on the global scale, with the dominance of few countries (Lange, 2006).

It was noticed in the present investigation that majority of the species (89 species, 68%) used for medicines were collected from the wild sources, only 27 species (21%) from cultivation and 15 species (11%) from both the sources (Figure 4). It is well known fact that the wild populations of medicinal plants are the main sources of raw materials to the pharmaceutical industries (Ved et al. 1998). The local inhabitants, who lived at high altitudes, were found to impose a great deal of pressure on medicinal plant populations because at higher altitudes health care facilities were almost nonexistent and people met their medicinal requirements with forest products. At lower altitudes people also used medicinal plants, but owing to better infrastructure, they also used nearby health centres for the treatment of various diseases. In Bandipora district, various factors that are considered as main threats to species diversity were recorded by interviewing the informants. The major factors claimed were increasing population, over-grazing, indiscriminate harvesting, deforestation, agricultural expansion, lack of job opportunities, increased marketing pressure, trading of charcoal and firewood, and uses of medicinal plants for purposes other than medicinal value (Figure 11). Similar threatening factors were also reported during ethnobotanical exploration of Rajouri district of Jammu and Kashmir (Rashid et al. 2008). During summer season, tribals (*Gujjars* and *Bakkerwals*) let their livestock graze upper lands. In this way the lush green pastures are subjected to intensive overgrazing and are ultimately converted to barren lands at the end of the season. Similar observations were reported by Rawat and Uniyal (1993) for the alpine meadows of Jammu and Kashmir, where overgrazing resulted in great loss to vegetation cover and wide occurrence of unpalatable weedy species. In the lap of dense forests of Bandipore, work on 330 MW Kishenganga Hydro Electric Power Project by Hindustan Construction Company (HCC) was found going on during the course of study. The company is violating the environment conservation norms and not only destroying the scenic topography but also causing destruction of valuable plant resources including beautiful coniferous trees and other crucial medicinal plants (Lone and Bhardwaj, 2013a). Moreover, there is no doubt that the continued environmental degradation of medicinal plant habitats will bring the depletion of medicinal plants and the associated knowledge.

It would be appropriate to mention here that besides all above cited threats, there is one more important threat, namely unregulated research work that has also an adverse impact on medicinal plant populations. The unregulated research work in different institutes of the state has also rendered some of these medicinal plants threatened. The researchers need a lot of plant material particularly for phytochemical studies. Hence this threat has also brought some of the medicinal plants on the verge of extinction.

The efforts to conserve medicinal plants in the district were observed very poor. About 17% of the collected plants such as *Aesculus indica*, *Allium proliferum*, *Althea rosea*, *Amaranthus retroflexus*, *Cichorium intybus*, *Cydonia oblonga*, *Malus domestica*, *Mentha arvensis*, *Ocimum basilicum*, *Papaver somniferum*, *Prunus persica*, *Rosa damascea* were found to be cultivated in home gardens. Traditional beliefs in the area also had their own unintentional role in conservation and sustainable utilization of medicinal plants. It has been already reported in India

that, most of the traditional ethnobotanical knowledge is eroding at faster rate day after day due to losses of the ancient traditions and cultures as they are mostly oral (Mehrotra and Mehrotra, 2005).

During surveys, most of the informants suggested that medicinal plants are an important source for daily healthcare. They also suggested that medicinal plant species help in maintaining the ecological balance of the area by decreasing soil erosion and increasing moisture of the soil, thus improving conditions of human and livestock needs. The people knew that all above cited factors are responsible for the extinction of the valuable medicinal flora of a particular region. However, most of the informants said that they never made any effort to conserve this precious God gifted resource because of the lack of knowledge. Therefore, there was no immediate conservation programme for this valuable source of medicinal flora in the study area till date.

### Rare and Endangered medicinal plants

It is evident from the present investigation that out of 131 collected and identified medicinal plants, many plant species already belong to different threat categories (Nayar and Sastry, 1987-88, 1990; CAMP, 2003; Kumar et al. 2011; Pant and Pant, 2011) (Table 4). As mentioned earlier valuable information regarding the plant abundance, distribution, localities of their maximum availability, exploitation level and various threats, was collected personally from local people especially from plant collectors of the area. Based on that collected information, plants were further categorized into common, less common and rare. With a view to prevent their extinction, these natural resources (medicinal plants) must be looked after and managed. In order to conserve these God gifted resources, a harmonious relationship between humans and nature must be developed and all the stakeholders especially local people should be actively involved in implementation, planning, evaluation and monitoring processes of plans and projects, as they are the major beneficiaries of the area. In addition to this, good governance based on fairness, transparency and empowerment of stakeholders is essential for sustainable medicinal plant use.

### Species endemic to the region

Taxa that are restricted to a specified geographical area or ecological unit comprise the endemic taxa. Bandipora district being an important northern part of Kashmir Himalaya, shows a rich variety in its topography and climate. It is also rich in ethnic and biological diversity. Out of the 131 collected and identified medicinal plants in this study, some plant species are categorized as endemic (Dar et al. 2012). These include: *Saussurea costus*, *Aconitum heterophyllum* and *Iris kashmiriana*. All the three afore-mentioned plants are indiscriminately harvested in the study area on account of having a very high demand for medicinal purposes. And this is the reason why the first two plants are critically endangered. Hence if necessary conservative measures are not taken at the earliest, the day will not be far away when such plants will completely deplete from their natural habitats.

### Conclusions

Present study provides a comprehensive report on vast wealth of traditional medical plant knowledge possessed by the local populace of biodiversity rich Himalayan Bandipora district of Kashmir, India. It is well known fact that indigenous/traditional uses of plants is one of the most successful criteria used by the pharmaceutical industries in finding new therapeutic agents for the various fields of biomedicine. The same holds true when we talk about some outstanding drugs such as Vinblastine, Vincristine, Reserpine Aspirin and Quinine that have been discovered from various plants keeping in the view their traditional uses. Likewise, present study could also serve an important tool for the discovery new compounds against severe diseases because if the documented plants are subjected to thorough phytochemical and pharmacological investigations, new potent leads against various pharmacological targets could definitely be discovered as there is no doubt that botanic gems are still found in the world. The study also represents useful and long lasting information about the medicinal plants and this information can contribute to preserve the indigenous plant use knowledge of the region and also attract the future generations towards the traditional healing practices. Besides, efforts may be taken with a view to conserve the fast-eroding medicinal plant knowledge and resources of the area.

### Recommendations

The following efforts need to be made to conserve the various threatened plant species and to reap the greatest benefits from the available resources:

- ❖ The first and foremost task must be geared towards changing the thinking of people about current indiscriminate harvesting practices which can be done by skill development, training and attitudinal change.
- ❖ Government should impose blanket ban on indiscriminate and uncontrolled grazing at medicinal plant rich higher altitudes. Besides, hawk-eye vigil should be maintained by the concerned authorities on the activities of *Bakkerwals* since they uproot crucial medicinal plants clandestinely for commercial purposes while moving from one lush meadow to other.
- ❖ The cultivation of medicinal plants should be encouraged and efforts should be made to promote their vegetative propagation through grafting, layering, cuttings and also by employing various propagules such as roots, rhizomes, bulbs, corms and buds.
- ❖ Local people must be involved as leaders of activities geared towards environmental conservation awareness and this can be done by local organizations. It would be better, if local school teachers and religious leaders are involved in such awareness programmes.
- ❖ More attention should be paid by the concerned authorities to facilitate the sustainable use of medicinal plant resources.
- ❖ The medicinal plants of the study area should be harvested on priority for one's own consumption and not for commercial purposes.
- ❖ For proper conservation and sustainable utilization, rules and regulations at community level should be implemented, with the help of dignitaries of the community, so that the goal of economic development could be achieved in parallel with the goal of ecosystem conservation.
- ❖ Short training courses should be organized for the collectors, farmers and traders on designed module covering the areas of proper identification, collection and cultivation of medicinal plants and to improve processing and post harvest treatment of crude drugs.
- ❖ Lessons learnt from success stories should also be implemented at wider scale to train local people for the cultivation of medicinal plants.

- ❖ Important medicinal plants should be subjected to thorough phytochemical and pharmacological investigations so that new potent compounds could be discovered as there is no doubt that botanic gems are still found in the world.
- ❖ Small domestic industries such as beekeeping, gardening, handicrafts must be encouraged through social organizations within the local communities so that the pressure on medicinal plants for trade can be reduced to a great extent.
- ❖ Reforestation activities must be encouraged to reduce pressure on fuel wood and fodder species and alternate sources like gas cylinders and energy-efficient cook stoves should be made available to local people especially to those who are poor and needy which may lead to a 25–40% fuel saving.
- ❖ Both *in-situ* and *ex-situ* conservation of medicinal plants in the study area should be promoted and efforts should be made to form Traditional Healers Association (THA) in the district which should be supported by providing suitable land for cultivating medicinal plants, funds and assistance in their activities with professional guidance which will definitely help in conservation of the fast eroding precious medicinal plants of study area.
- ❖ A regulatory mechanism is needed at the institutional level, particularly at the time of assigning research problem to the scholar, and it is also the duty of Departmental Research Committees (DRCs) to evaluate the synopsis and also carefully see the pros and cons of the assigned research problem.

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