

Full Length Research Paper

Medicinal plant diversity in the flora of Leepa Valley, Muzaffarabad (AJK), Pakistan

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Accepted 17 January, 2012

Plants are inevitable and indispensable in the life of mankind. They are a major source of nutrition and medicament in the world. In this regard, the Leepa valley (LV), Muzaffarabad Azad Jammu and Kashmir (AJK) was identified as the case study. The main objectives of this research were to explore and document the medicinal plant diversity (MPD) in the area. In this study, irrespective of gender, age, demography and literacy, 42 informants were approached and information was documented by using rapid rural appraisal (RRA) method comprising of open-ended and closed-ended interviews. Visual appraisal approach (VAA) was also performed as complimentary tool to support the data. In the study, some quantitative analysis tools: informant consensus factor (ICF), fidelity level (FL), priority ranking (PR) and data matrix ranking (DMR) were employed to find reliability and validity of methods used and informations obtained. This exploratory study revealed a profile of 36 medicinal plants (MPs) of 22 families with their botanic name, local name, family, plant part used, mode of medicament preparation, ethnomedicinal recipes and commercial importance. Family Pinaceae (4 spp.) was the first in the family index ranking followed by Lamiaceae (3 spp.). In health problems, snake bite and sting were the most prevailing (ICF: 0.94) and, hyperglycemia and hypertension were least encountered (ICF: 0.06) in the LV. *Ajuga bracteosa* (FL: 100%) and *Berberis lycium* (FL: 93%) were predominantly used in folklore therapies and FL analysis is good indicator for further pharmaceutical research taxa. *Abies pindrow*, *Pinus wallichiana* and *Taxus wallichiana* were found to be multifarious in use. Illicit export, incessant agriculture expansion and wooden house construction were determined as the major threats for MPD in the area. The pharmaceutical potential of MPD in drug discovery and development is discussed, and recommendations for sustainable use of MPs and their *in situ* and *ex situ* conservation is suggested for the socio-economic uplift of local communities.

Key words: Leepa valley, medicinal plant diversity, ethnomedicines, data matrix ranking, informant consensus factor, Azad Kashmir.

INTRODUCTION

Since the origin of man on this planet, plants have been

utilized to cope with different daily needs to sustain life. Plants provide people with food, medicines and fodder for livestock, as well as materials for construction of houses studied under a discipline named ethnobotany (Harshberger, 1896). The plants are used to manufacture crafts, agricultural tools and many other products like fuel, resins, paints and poisons (Shinwari et al., 2000; Ishtiaq et al., 2007a). In some cultures, plants have a ritual character and/ or are used because of their hallucinogenic character. Many plants are being employed in veterinary therapeutics in many parts of world (Ishtiaq et

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Abbreviations: LV, Leepa valley; AJK, Azad Jammu and Kashmir; MPD, medicinal plant diversity; RRA, rapid rural appraisal; VAA, visual appraisal approach; ICF, informant consensus factor; FL, fidelity level; PR, priority ranking; DMR, data matrix ranking; MPs, medicinal plants.

al., 2006b). The term “ethnobotany” was coined by John Harshberger in 1996, encompassing the aboriginal study of local plants by indigenous people. This new emerging field was soon recognized as a discipline and many departments are established in different Universities of the world. In ethnobotanical (EB) research, not only knowledge about plants and their use in life communities but also ethnological features of race or caste is also gathered and documented. There are different protocols and techniques used to perform ethnobotanical (EB) study of a region or about specific plant. An ethnobotanist may use qualitative or quantitative method depending on the purpose of study (Hamilton et al., 2003; Ishtiaq et al., 2006a).

Plants and their botanic products are frequently used in various herbal medicine systems in the globe (Ishtiaq et al., 2010a, b). Traditional Chinese medicines (TCMs) of China, homeopathic medicine system (HMS) of Pakistan, ayurvedic medicine system (AMS) of India and so many other systems are present in other countries of the globe. Recently, in developed nations there is new turn towards the use and trust on alternative therapeutics of herbal medicines because they believe that botanics depict better results in synergistic fashion than western medicines with little or no side effects (Shinwari et al., 2000; Ishtiaq et al., 2007b). Many drugs are being discovered by extracting their chemical biochemical constituents from plant/s for curing fatal diseases to benefit human life (Ishtiaq et al., 2007b, 2010b).

Pakistan is endowed with rich and diversified vegetation by the nature. The exploration and documentation of significance of endemic and exotic flora is very imperative because plants are part and parcel of folklore medical and nutritive therapies with their historical and cultural perspectives from each area of the country. The country has more than 6,000 species of wild plants of which about 600–2000 are used partially or holistically in folklore medicines (Hamayun et al., 2003; Ishtiaq et al., 2007b). A considerable ethnomedicinal and ethnobotanical research has been conducted on different areas of Pakistan (Haq and Rehman, 1990; Ahmed and Siraj, 1996; Qureshi and Khan, 2001; Shinwari and Khan, 1996; Rizwanana et al., 2007; Ihsan, 2008; Ishtiaq et al., 2001, 2006a, b, 2007a). Geographically, the explored area: Leepa valley (AK; 73–75°N, 32–35°E) is situated in the north and northeast of Muzaffarabad Azad Kashmir, Pakistan (Figure 1) (Qamar et al., 1998; Qureshi, 2000). Its altitude varies from 600–800 m. Generally, it is characterized by rugged topography, mountain terrains of lofty glaciated peaks, perennial snowfields, glaciers, falls, pastures, river, streams, nallahs and intact forest. The climate of the area has diversified features. It has moist temperate, dry temperate forests, sub-alpine, high-alpine pastures, high elevated peaks and cold desert constitutes major portion of the area which experience long severe winter. These specific physiographic and climatic features present ecosystem diversity with variety of vegetation and wildlife.

In ethnological perspectives, Leepa valley (LV) depicts a rich ethnic, cultural and lingual diversity. In LV, 15 different tribes are dwelling there, including various casts such as: Dravidian, Loan, Mir, Dar, Awan, Gujars, Mughals, Raja, Butt, Syed, Qureshi, Suddhen, Abbasi, Ranas, Raishay and Bhatti. There are different sections on religious basis such as Sunni, Shiya, Wahabi, Aele-Hadees, etc and these people speak different local languages with variable dialects changing from one vale to other or one side to other side of mountain. This does have paramount impacts on their habits and culture and subsequently on plants and fauna too. Hence, the specific geographic, phytogeographic, plant and ethnic biodiversity makes this area very crucial to explore and hunt the phytotherapeutic potential of flora of the area.

The purpose of this research study was multifarious and it was focused on documenting these parameters:

- i) To prepare checklist of medicinally important plants of LV.
- ii) To document the folklore (therapeutic) uses of plants in the valley.
- iii) To prepare botanical inventories and to do assessment of conservation status of plants.
- iv) To determine major diseases and their causes and the suggestions for eradication.
- v) To know, preserve and recover mechanism of means of transfer of indigenous botanical knowledge and wisdom from ancestors to descendants in the area.
- vi) Reinforcement of ethnic and national identity for cultural survival of traditional customs of domestic treatment of different ailments.

METHODOLOGY

In this study, ethnomedicinal data were generated and documented by random and planned visits arranged during 2009. Visual appraisal approach (VAA) and rapid rural appraisal (RRA) methods were employed. In VAA explorers pay keen observations to the field workers, household activities of women and diagnosis and prescription process of local herbalists, and accordingly information was documented in filed notebook. While in RRA, a small group of local people was selected and interviewed qualitatively about a wide range of topics in an open-ended way, allowing a comprehensive view of how the community acts as a whole (Martin, 1995; Ishtiaq et al., 2007b). In closed-ended interview scheme, a questionnaire method was employed for documentation of interviewee in fields, houses or markets. To collect the data from local communities their local languages were used which is very important to know the real knowledge about local flora (Alexiades, 1996; Martin, 1995; Ishtiaq et al., 2006b). The plants were collected and their traditionally uses were asked from five or more individuals and data described by 3 or more persons (>60%) was included in the study, the plants uses which are just mentioned by one or two people are also important but their reliability ratio is lesser and it indicates that traditional knowledge of area about plants is disappearing from the area (Ishtiaq et al., 2006b). This may be due to modernization and advancement of science or lack of interest of the new generations in herbal medicines.

For further authentication and reliability of data, botanical names and families of each plant specimen were reconfirmed with the help of herbaria comparison, taxonomic literature, manuals and Flora of Pakistan (Stewart, 1982; Ali and Nasir 1970-2002). A standardized

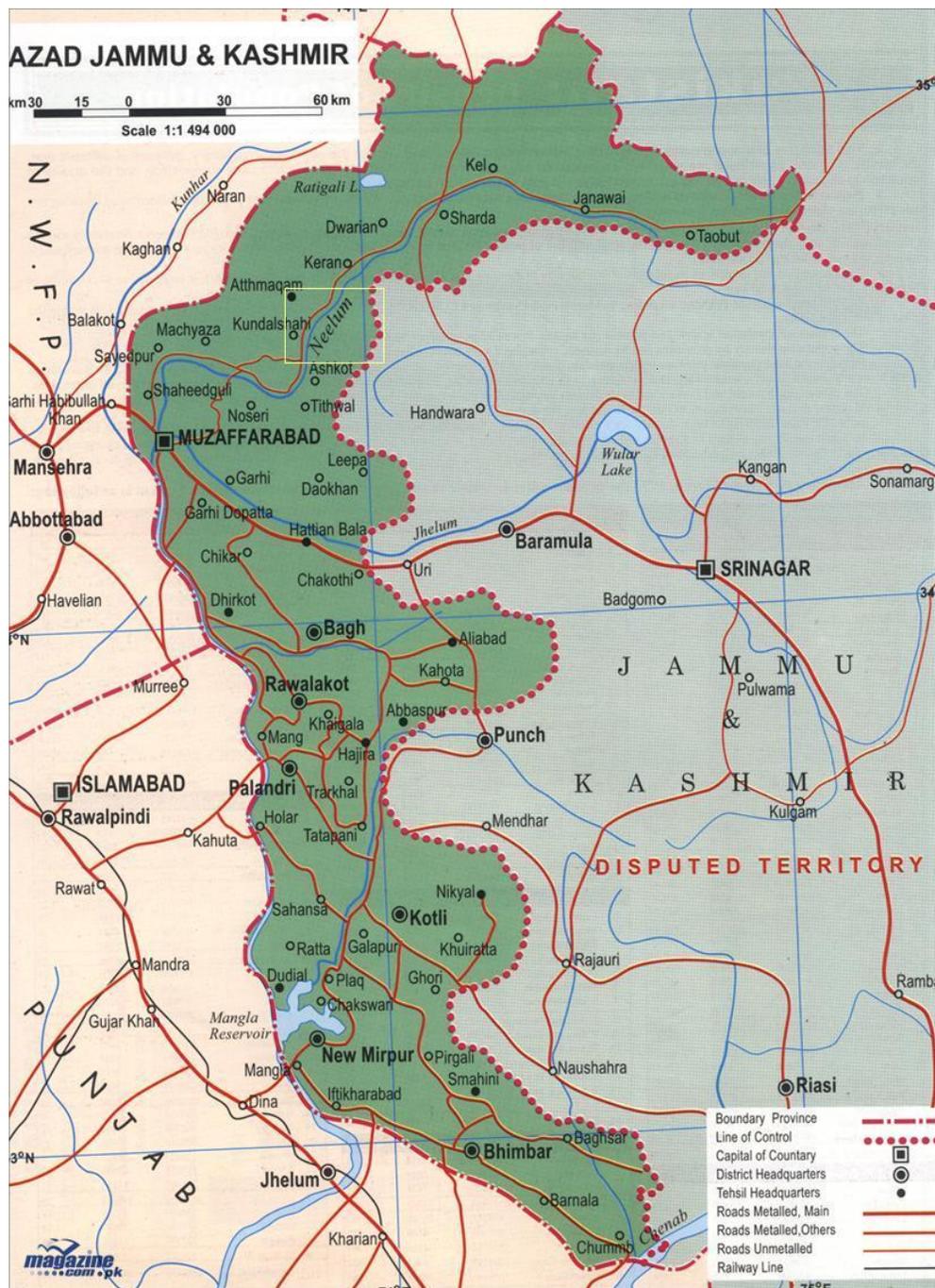


Figure 1. Map of Azad Kashmir and study area (Leepa valley) is encircled in yellow box.

voucher numbering system was used to label all collections and cross reference them with the field notes to validate their authenticity (Alexiades, 1996). The ethnomedicinal data are presented in alphabetical order based on botanical names with family, their vernacular name, plant parts used, disease cured and its reliability factor. The plants surveyed under study process were collected (having flowers, fruit or both) and preserved according to the standard process (Olorode, 1984). The herbaria were prepared (Alexiades, 1996; Ishtiaq et al., 2010a) and placed in the herbarium of Department of Botany, Mirpur University of Science and Technology (MUST) Bhimber Campus, Bhimber (AK) Pakistan for

future reference because they allow taxonomists to identify the family, genus and species of a collection/plants (Martin, 1995; Ishtiaq et al., 2010b).

Data analysis

Data generated comprising of plant species' botanical and local name, family, plant part used, mode of preparation and ethnomedicinal uses were formulated in a matrix (MS excel worksheet) and summarized as proposed by Cook (1995). The

Table 1. Frequency of respondent's to questionnaires.

SN	Respondent	Frequency (%)
1	Demographic status :	
	Indigenous	67.00
	Migrants	33.00
2	Gender :	
	Male	70.00
	Female	30.00
3	Literacy rate :	
	Primary school	15.00
	Middle school	12.00
	High school	10.00
	College	08.00
	University	02.00
4	Illiterate	53.00
	Marital status :	
	Single	18.00
5	Married	82.00
	Age:	
	10~25 years	05.00
	26~40 years	15.00
	41~60 years	48.00
	61~ above years	32.00

generated data was compared with previous research conducted on the same area or on same topic by using books, e-books and net surfing for its verification and reliability. The data after stringent and peer review was screened and only authentic informations were retained for further meta-analysis. The reliability and validity of ethnobotanical work and information was checked and supported by calculating Informant consensus factor (ICF), fidelity level (FL), data matrix ranking (DMR) and priority ranking (PR) techniques with Personal Computer (Ishtiaq et al., 2007b; Fisseha et al., 2009).

Informant consensus factor (ICF) was calculated for each category of ailments to identify the agreements of the informants on the reported medicures for the group of ailments. ICF was calculated as follows: Number of use citations in each category (nur) minus the number of species used (nt), divided by the number of use citations in each category minus one (Heinrich, et al., 1998).

$$ICF = \frac{nur - nt}{nur - 1}$$

The fidelity level (FL), the percentage of informants claiming the use of a certain plant for the same major purpose was calculated for the most frequently reported usages or ailments as:

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

Where, N_p is the number of informants that claim a use of a plant

species used for a particular purpose/disease, and N is the number of informants that use the plants as a botanic/medicine to fill/treat any given demand/disease (Alexiades, 1996). This method is helpful in the selection of plants for further studies in pharmaceutical analysis and other research projects. DMR and PR methods depict population density of tree species and their conservation status in the area.

RESULTS AND DISCUSSION

Since time immemorial, man has been employing plants for curing different diseases and as life subsistence. The present study was conducted in the far and remote area Leepa Valley (LV) located in Azad Jammu and Kashmir, Pakistan (Figure 1). Every species recorded in this survey has been utilized in different life supporting programmes by local inhabitants. The practice to extract and process the medicinal plants for local economic uplift is being used by many rural communities in Pakistan (Khan, 1951; Ahmed et al., 2003; Ishtiaq et al., 2006b). The study area is purely mountainous with diverse climate hence people totally rely on local flora for fulfilling their major necessities of daily life. The study was conducted explicitly without gender, age and literacy biases (Table 1), which culminated into elaborative

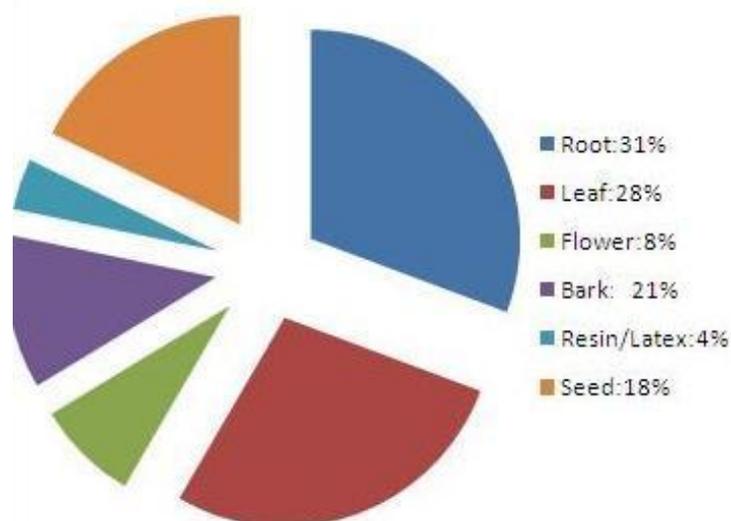


Figure 2. Percentage (%) frequency of plant parts used in ethnomedicines in Leepa valley.

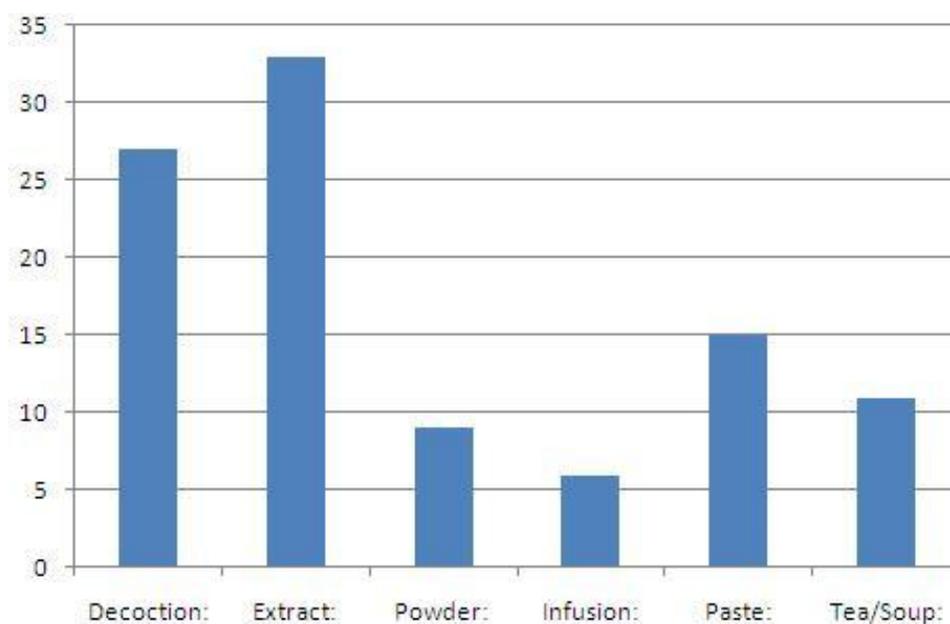


Figure 3. Mode of application of ethnomedicines in Leepa valley (in percentage (%) frequency).

collection of EB data presented in enumeration section.

The study reveals that total 36 plants (belonging to 22 families) are being used in different medicures by the local people. The most frequently used plants in ethnomedicines (EMs) belong to families Pinaceae and Lamiaceae, which might be due to their medicinal diversity (biochemicals) or frequent availability and easy accessibility (Table 4) (Ishtiaq et al., 2006b, 2007a). Many common diseases such as fever, flu, headache, eyesight, earache, toothache, bronchitis, cough, sour throat and skin infection, as well as fatal ailments in-

cluding brain paralysis, heart disorders, kidney failure, splenic disorders, rheumatism, labor and after birth complications of mother and child are being cured by using EMs in LV. The most common used parts of these medicinal plants (MPs) were root (31%), leaf (28%) and bark (21%) (Figure 2). Their prevalent usage is due to their easy availability and having rich source of active bio-constituents (Ishtiaq et al., 2006b, 2007a, b). The popular mode application in EMs was extract form (33%), decoction (27) and paste (15%) (Figure 3). This may be due to the fact that during the process of extraction, all or

maximum number of ingredients are extracted out and this cure the disease promptly (Ishtiaq et al., 2008, 2010b).

Ethnomedicinal enumerations

1) Botanical name: *Viola odorata* L.

Local name: Banafsha
 Family: Violaceae
 Herbaria no: MUH-1091
 Part used: Whole Plant
 EB Uses: The root decoction is used expectorant and diuretic. The oil is sedative and used as hypotonic to the brain. Flower is mixed with hot tea to cure flu and cold.

2) Botanical name: *Rubus fruticosus* Lindley

Local name: Akhray
 Family: Rosaceae
 Herbaria no: MUH- 1092
 Parts used: Leaf, root and fruit
 EB Uses: Its fruit is boiled in water and used to cure sore throat. Decoction of root is remedy for bowl and dysentery.

3) Botanical name: *Pyrus malus* Linn.

Local name: Seb
 Family: Rosaceae
 Herbaria no: 1093
 Part used: Fruits
 EB Uses: The fruit or its extract in milk is used for uric acid, blood pressure and rheumatism problems in the community. Dwellers use it as tonic to vigorate their body and strengthen bones.

4) Botanical name: *Mentha longifolia* (Linn.) Huds

Local name: Podina
 Family: Lamiaceae
 Herbaria no: MUH-1094
 Parts used: Leaf and root
 EB Uses: A decoction is largely used with lemon grass as febrifuge in fever. Menthol is extracted from this plant is useful in reliving the symptoms of bronchitis. The extract of plant is used as antibacterial therapy to cure sours and pimples. It is frequently employed in treating common diseases such as cold, cough, sore throat, vomiting and diarrhea at home.

5) Botanical name: *Salvia officinale* St.

Local name: Puntar
 Family: Lamiaceae
 Herbaria no: MUH-1095

Part used: Leaf
 EB Uses: The extract of leaf is used to cure skin infections prevailing in monsoons season.

6) Botanical name: *Berberis lyceum* Royle

Local name: Sumbli
 Family: Berberidaceae
 Herbaria no: MUH-1096
 Part used: Root
 EB Uses: The root powder is taken with goat milk to cure splenic and intestinal disorders. Its extract is used in cough and chest infection.

7) Botanical name: *Nigella sativa* L.

Local name: Kalonjee
 Family: Nigellaceae
 Herbaria no: MUH-1097
 Parts used: Seed and oil.
 EB Uses: Its seeds are eaten in empty stomach at morning to cure hypertension and hyperlipidemia. Heart patients are given its extract/tea with *Allium sativum* juice as domestic therapy. The seeds are considered effective for anti-tumor cure too.

8) Botanical name: *Calotropis procera* R.Br.

Local name: Aak
 Family: Asclepiadaceae
 Herbaria no: MUH-1098
 Parts used: Leaf, latex and root
 EB Uses: The milky latex is poured on snake bite spot to lessen the poison. Its dried leaves are smoked as "hooka" therapy as inhaler for bronchitis infection, cough and asthma. Roots are powdered, mixed with "desi ghee" and pasted on points of leprosy and rheumatism.

9) Botanical name: *Sisymbrium irio* Linn.

Local name: Jangli sarsoo
 Family: Brassicaceae
 Herbaria no: MUH-1099
 Parts used: Seeds and leaves.
 EB Uses: The seeds are spread on bed of small pox patient and it aids in prompt treatment. During this process, currant is boiled in cow milk and taken twice a day. Its seed macerated amla juice is effective against stomach heat. The leaves are used in killing of stomach worms given with sour yogurt.

10) Botanical name: *Solanum xanthocarpum* Schard & Wendl.

Local name: Mokari
 Family: Solanaceae
 Herbaria no: MUH-1100
 Parts used: Root and fruit

EB Uses: The root extract is used in healing of wounds as antiseptic. The fruit is cooked and used to cure diabetics. It is also effective in treating kidney problems with *Amarnathus* leaf extract.

11) Botanical Name: *Abies pindrow* Royle
Local Name: Abie (Fir)
Family: Pinaceae
Herbaria No: MUH-1101
Parts Used: Leaves, seeds and cones
EB Uses: The leaves are used in tea form to cure flu and cold. The cones are burnt and a medicine is made by mixing with ghee for rheumatism cure. Its seeds are used as tonic for body vigour.

12) Botanical name: *Achyranthus aspera* Linn.
Local name: Puthkanda
Family: Amaranthaceae
Herbaria no: MUH-1102
Parts Used: Root and whole plant
EB Uses: Root infusion is used for removing stones from kidneys. The whole plant decoction is applied as diuretic, laxative and stomachic treatment.

13) Botanical name: *Adiantum venustum* D. Don.
Local name: Sumbal
Family: Adiantaceae
Herbaria no: MUH-1103
Parts used: Rhizome and whole plant
EB Uses: Rhizome juice is used to cure scorpion and wasp sting. The extraction of whole plant is used in cough and it is also used as expectorant, emetic and diuretic by local communities.

14) Botanical name: *Ajuga bracteosa* Wall. ex. Benth.
Local name: Hari bootei
Family: Lamiaceae
Herbaria no: MUH-1104
Parts used: Roots and whole plant
EB Uses: The root decoction is used to cure constipation and wormicide. Its whole plant extraction is used to cure diabetes. The decoction is employed in curing jaundice, hypertension and sore throat. Its macerate with yogurt is applied to cure barnacles and pimples.

15) Botanical name: *Allium sativum* Linn.
Local name: Thome, Lehsan
Family: Liliaceae
Herbaria no: MUH-1105
Parts used: Bulbulus and leaves
EB Uses: The bubulus and leaves are used extensively in cooking of dishes. A recipe named "Char Gist" is prepared by mixing juice of lehsan (*A. sativum*), lemon, (*Citrus medica*), apple (*Pyrus malus*) and honey (natural, of hilly area) equally and taken on empty stomach in morning to cure heart disorders and hyper-

tension. It lessens the blood cholesterol. The decoction prepared in water is used in hysteria, flatulence and seasonal cough. Its leaf/bulbulus extract is also used in snake bite and scorpion sting.

16) Botanical name: *Artemisia scoporia* Waldst and Ket.
Local name: Kali booti
Family: Asteraceae
Herbaria no: MUH-1106
Parts used: Leaves, shoots and seeds
EB Uses: The seeds are crushed and taken with milk as respiratory stimulant and purgative. The leaf juice is effective in earache. Its shoots/leaf extract with *Eruca sativa* oil emulsion is employed as lactagogue.

18) Botanical name: *Brassica campestris* Linn.
Local name: Sarsoon
Family: Brassicaceae
Herbaria no: MUH-1107
Parts used: Leaf and seeds
EB Uses: Tender leaves and flowering tops are used laxative for stomach pain and wormicide. Seed oil is used in cooking dishes, pickles as food. The oil is applied for body massage and shining of hair. The oil mixed with curd is applied as lice-cide and anti-dandruff agent as local medicures.

19) Botanical name: *Calendula arvensis* Linn.
Local name: Kaya
Family: Asteraceae
Herbaria no: MUH-1108
Parts used: Leaf and flowers
EB Uses: The leaf decocte is used in curing scrofula and head pain. Its flowers are used as tonic, diaphoretic and antihelmithic. The leaf juice is inhaled to cure uneasiness of flu for its prompt release and relief.

20) Botanical name: *Canabis sativa* Linn.
Local name: Bhang
Family: Canabaceae
Herbaria no: MUH-1109
Parts used: Leaves and flowering tops
EB Uses: The juice of leaf is used as hallucinating agent for relaxation. It is also used as sedative, narcotic and anodyne refrigerant. A narcotic agent "Charas" is also prepared from it.

21) Botanical name: *Conyza canadensis* Cronquist
Local name: Neeli booti
Family: Asteraceae
Herbaria no: MUH-1110
Part used: Leaf
EB Uses: Leaf decoction is used in diarrhea and dysentery. The leaf crushed paste form is applied as homeostatic and stimulant. The juice is diuretic and astringent.

22) Botanical name: *Clematis grata* Wall.

Local name: Bailari
 Family: Ranunculaceae
 Herbaria no: MUH-1111
 Parts used: Leaf and root
 EB Uses: The root aqueous extract is applied in treating bile disorders. The leaf tea with black tea is employed in the cure of scanty lactogenesis.

23) Botanical name: *Clematis gouriana* Roxb.
 Local name: Bailari moor
 Family: Ranunculaceae
 Herbaria no: MUH-1112
 Parts used: Leaf and root
 EB Uses: The root infusion is used to cure nephritis, amenorrhoea and edema. The leaf is used to cure eyesight problems with other herbs as synergistic combinatorial therapy.

24) Botanical name: *Clematis orientalis* Linn.
 Local name: Bailari cheiti
 Family: Ranunculaceae
 Herbaria no: MUH-1113
 Parts used: Leaf, root, stem bark and flower
 EB Uses: The leaf paste used with resin of Pine on wounds to cure promptly. The root extract is used as vasodilator and reduces hypertension. Stem gist is used in syphilis and pimple treatment. The flower is dried and taken with honey and Desi ghee to cure rheumatism.

25) Botanical name: *Cupressus sempervirens* Linn.
 Local name: Saro
 Family: Cupressaceae
 Herbaria no: MUH-1114
 Parts used: Fruit and seed
 EB Uses: Fruit is boiled and used in curing of seasonal flu and cold. The seed extract is anthelmintic and astringent.

26) Botanical name: *Citrulus colocynthis* Shard.
 Local name: Tuma
 Family: Cucurbitaceae
 Herbaria no: MUH-1115
 Part used: Fruit
 EB Uses: Fruit juice is used in dropsy but over dose lead to fatal consequences such as being senseless or even death. The fruit dried, powdered and mixed with "Gor" (dried extract of *Saccharum officinale*) is given to cattle in intestinal disorders. Its powder is used by diabetic patients as household therapy.

27) Botanical name: *Datura innoxia* Mill.
 Local name: Datura
 Family: Solanaceae
 Herbaria no: MUH-1116
 Parts used: Leaf and seed
 EB Uses: The paste of leaf is applied externally on swelling of limbs for soothing. Its leaf

powder with piper is employed in toothache, headache and epilepsy. The leaf extract is used to activate nervous system but overdose may induce vomiting, coma and even death. Seeds are used as antipyretic and narcotic.

28) Botanical name: *Ephedra Gerardiana* Wall.
 Local name: Asmani Booti
 Family: Ephederaceae
 Herbaria no: MUH-1117
 Parts used: Rhizome, fruit and root
 EB Uses: The fruit is used as blood purifier and cleaning of teeth as tooth paste. Decoction of root is considered a remedy for rheumatism and syphilis. Its decoction has a compound "Ephedrine" which exerts a sympathomimetic action similar to that of adrenaline. The plant is collected and sold to local traders for pharmaceutical industries. The root stimulates the heart and vasodilates blood vessels. It is also used in anesthesia.

29) Botanical name: *Cedrus deodara* (Roxb.ex. Lamb) G. Don.
 Local name: Diar
 Family: Pinaceae
 Herbaria no: MUH-1118
 Parts used: Root, bark and seed oil
 EB Uses: The decoction of root is used as diaphoretic, anti-rheumatism, anti-renal and antidote to snake bite. Bark juice is used as astringent and to cure fever, diarrhoea and dysentery. Seed oil is employed in ulcers and skin diseases.

30) Botanical name: *Pinus wallichiana* A. B. Jack.
 Local name: Biar
 Family: Pinaceae
 Herbaria no: MUH-1119
 Parts used: Leaf and resin
 EB Uses: Its resin admixture with honey is used to lessen enervation caused by aging and it is common therapy for gonorrhoea. The resin is applied entirely on broken bones as plaster for suppuration and support, and it is thought an elixir to buboes and abscesses. Leaf decoction is employed to quench burning sensation of the body and it is used with burnt fruit scale of *Punica granatum* to cure cough and hooping.

31) Botanical name: *Taxus wallichiana* Zucc.
 Local name: Birmi
 Family: Taxaceae
 Herbaria no: MUH-1120
 Parts used: Bark and leaf
 EB Uses: The leaf and bark extract is used as antitumor herbal medicine. The decoction of leaf with honey is useful in fever, flatulation, epilepsy and asthma. The leaf and root extract is used to kill and catch fish from rivers and dams.

32) Botanical name: *Otostegia limbata* (Bth.) Boiss
 Local name: Chiti

Table 2. Informant Consensus Factor (ICF) by categories of diseases in the study area (Leepa valley).

S/N	Category	Species	All species (%)	Use citation	All citations (%)	ICF
1	Snake bite and Sting	04	1.78	19	5.57	0.94
2	Fever, flu and headache	10	18.75	72	21.11	0.71
3	Eyesight, earache and toothache	05	04.46	19	05.57	0.77
4	Bronchitis, cough and Throat infection	12	15.17	58	17.00	0.71
5	Stomachic, parasites, constipation	09	09.82	85	24.92	0.88
6	Brain, Heart and tonic	09	12.50	16	04.69	0.13
7	Kidney stone, Spleen	07	08.03	12	03.51	0.27
8	Diabetics, BP and blood purifier	11	14.28	17	04.98	0.06
9	Rheumatism and skin disorders	10	08.92	23	06.74	0.59
10	Mother and fetus health	02	06.25	20	05.86	0.68

Family: Labiatae
 Herbaria no: MUH-1121
 Parts used: Leaf and root
 EB Uses: The root burnt ash is used to cure wounds and bruises. The root decoction is taken to cure skin diseases with *Eruca sativa* oil.

33) Botanical name: *Papaver somniferum* Linn.
 Local name: Khash khaash
 Family: Papaveraceae
 Herbaria no: MUH-1122
 Parts used: Leaf, latex and seed
 EB Uses: Leaf juice is used as laxative top cure constipation. The latex is used as in minute quantity as ethnomedicine to give soothing and relax for hypersensitivity. However, its massive production, use and sale is prohibited by law enforcing agencies of the government. Its seeds with almonds are crushed in milk and dieted to pregnant women for vigour and healthy fetal development.

34) Botanical name: *Paeonia emodi* Wall ex. Hk. f.
 Local name: Mamaikh
 Family: Paeonaceae
 Herbaria no: MUH-27
 Parts used: Root and rhizome
 EB Uses: The root paste with egg is applied on imbrogio backbone ache. The rhizome extract is used as tonic and cathartic. The root decoction is used to clean air and purify the blood. The root maceration is used with papaver seeds in the treatment of epilepsy.

35) Botanical name: *Picea smithiana* (Wall) Boiss
 Local name: Maghzaey
 Family: Pinaceae
 Herbaria no: MUH-27
 Parts used: Leaf and fruit
 EB Uses: The admixture of *Picea smithiana* and *Ajuga bracteosa* leaf is crushed and employed to cure seasonal piles and pus. The fruit is as sedative and taken with pepper and alovera to treat stomach disorders.

36) Botanical name: *Platanus orientalis* Linn.
 Local name: Chinar
 Family: Platinaceae
 Herbaria no: MUH-27
 Parts used: Leaf, bark and root
 EB Uses: The leaf decoction admixed with *Mentha* sp. extract is used to cure flu and bronchitis. Powdered bark is used to cure toothache and diarrhea. The root infusion is useful in skin disorders. The leaf of Chinar (Maple) is national emblem of Kashmir.

It was observed that due to mountainous area, inhabitants face seasonal and demographic problems such as breaking of bones, injury by falling from high peaks or trees during working hours, and local physiotherapists and hakeems treat these cases by their experienced skills at their homes or clinics. The VAA generated the facts that snake bite and scorpion sting are most common in LV because of its moutnaineous geographic shape, thick and dense forest. This data is also supported and proved by ICF analysis with ICF: 0.94. Its highest values might be that rural people mostly work in fields or forests to collect food, fodder, fuel or medicinal plants for their livelihood and become victim easily (Table 2). The second common health problem faced by the local communities of the area was stomach and intestinal disorders, prevailing with ICF: 0.88 (Table 2). This might be due to the reason that village people use open springs or streams water in or out side of their huts in their daily life without taking any hygienic-precautionary measures (Ishtiaq et al., 2006a, 2007a, 2010b). The third area of predominant disease was bronchitis, cough and throat infection (ICF: 0.77), which might be due to cold and dynamic climate and rural dwellers have to work in forest or field that is inevitable for them to sustain their life (Ishtiaq et al., 2004). Furthermore, due to cold temperature and high wind velocity in the high and lofty mountain area flu, fever, cough and headache are also predominant as common health problems (ICF: 0.71). The dogma of life "food, exercise and proper rest are insignia of healthy and

Table 3. Fidelity Level (FL) values of medicinal plants of the study area (Leepa valley)

Species and Family	Local name	Therapeutic use	Fidelity level (FL) (%)
<i>Ajuga bracteosa</i> Wall. ex Benth, Lamiaceae	Hari booti	Diabetics	100
<i>Berberis lyceum</i> Royle Berberidaceae	Sumblu	Spleenic pain	93
<i>Salvia officinale</i> St. Labiatae	Sage	Skin disorder	90
<i>Nigella sativa</i> L. Nigellaceae	Kalonji	Hypertension, Hyperlipidemia	85
<i>Calotropis procera</i> R.Br. Asclepiadaceae	Desi aak	Leprosy, Rheumatism	82
<i>Solanum xanthocarpum</i> Schard & Wendl. Solanaceae	Mokari	Jaundice, dysentery, cough, gout	74
<i>Achyranthus aspera</i> L. Amaranthaceae	Puht kanda	Kidney, stomach	68
<i>Rubus fruticosus</i> Lindley. Rosaceae	Akharay	Sore throat, cough, dysentery, stomachache	54
<i>Clematis orientalis</i> Linn. Ranunculaceae	Bailari	Syphilis, amenorrhoea, edema.	51
<i>Citrulus colocynthis</i> Shard. Cucurbitaceae	Tuma	Ascariasis, anti-diabetic, blood purifier, antiseptic	43
<i>Taxus wallichiana</i> Zucc. Taxaceae	Birmi	Antitumor fever, flatulation, epilepsy, asthma.	39
<i>Allium sativum</i> Linn Liliaceae	Lehsan	Heart disorders, hypertension, hysteria, flatulence, seasonal cough, snake bite, scorpion sting	21

Table 4. Family Index (with highest number of species used) in the study area (Leepa valley).

S/N	Family	Number of genera	Number of species	Ranking
1	Pinaceae	4	4	1 st
2	Lamiaceae	3	3	2 nd
3	Ranunculaceae	1	3	3 rd
4	Rosaceae	2	2	4 th
5	Solanaceae	2	2	5 th
6	Berberidaceae	1	1	6 th

sound body” was proved true by observing life style of LV people. The ICF analysis was performed for the gathered informations which inferred that the most dangerous and frequently occurring diseases of city and sedentary life such as diabetics (Erasto et al., 2005) (spreading at 6% per year in the world), hypertension and blood related disorders are least (0.06) encountered in the study (Table 2).

Many plants are used singly or in admixtures for curing different diseases (Ishtiaq et al., 2007b). In this study, it was demonstrated that *Ajuga bracteosa* has the highest fidelity level (FL: 100%) (Table 3) being used to cure diabetic patients who work in kith city or abroad the country and become hyperglycemic and at their arrival to home town they consult local herbalists or old experienced people for folklore recipes or botanic tonics for treatment. It is the belief of many rural dwellers of the country that plants origin drugs are pure and have least or no side effects (Ishtiaq et al., 2006b, 2007a) and so the inhabitants of LV also follow this doctrine. *Berberis lyceum* and *Salvia officinale* species are also highly rated by FL analysis (93 and 90%, respectively) during this EM research for this particular area (Table 3). The tree species explored in the study are not only used in EMs

but also they are part and parcel of domestic life of local people in construction and decoration. The use of these taxa in ethnobotanical purposes exerts biotic pressure to the species and consequently leading to the endangered zone or may be extinct by the time. In this study, quantitative ethnobotanical protocol DMR was employed in the analysis and it was concluded that the most severely under biotic pressure species are *Abies pindrow* and *Pinus wallichiana*; being used in different life sustaining processes by local people such as construction, fuel and export/smuggling (commercial purpose by illegal manners) (Table 5). The very important medicinal plant species *Taxus wallichiana* (Ishtiaq et al., 2006b, 2007b) is at third in biotic threats that is due to anthropogenic activities - that is illicit smuggling to pharmaceutical industry and unsustainable exploitation for domestic purpose too (Table 5).

This study depicts that illiteracy and less opportunities of livelihood in this far and remote area are causes of inordinate loss to the flora and fauna of the region. The priority ranking (PR) statistics depicted that timber mafia activity for illicit trafficking of commercial logs (wooden) and MPs is at first rank in biotic disturbances and generating threats to the plant diversity (Table 6). The

Table 5. Direct Matrix Ranking (DMR) of plant species with different uses other than medicinal value (total score of 10 informants) in the study area (Leepa valley).

S/N	Uses	<i>Pinus wallichiana</i>	<i>Platinus orientalis</i>	<i>Taxus wallichiana</i>	<i>Clematis orientalis</i>	<i>Abies pindrow</i>	<i>Rubus fruticosus</i>
1	Construction	55	23	12	19	60	04
2	Hedge, Fencing	25	09	08	20	22	21
3	Fire wood	48	26	16	38	30	32
4	Cash income	59	42	76	27	86	22
5	Fodder	01	12	13	22	07	12
6	Fruit, Food	08	05	07	01	35	5
Total		196	117	132	127	205	96
Rank		2 nd	5 th	3 rd	4 th	1 st	6 th

Table 6. Priority Ranking (PR) of factors perceived as threats to plant biodiversity based on their level of destructive effects in the study area, Leepa valley (destructive threat order is: 6<5<4<3<2<1; 6 is the most destructive value).

Threat factor	Respondent (R1-R6)						Total	Percentage (%)	Rank
	R1	R2	R3	R4	R5	R6			
Construction	5	4	4	5	4	3	25	16.02	3 rd
Fuel & Fodder	4	3	5	3	5	4	24	15.38	4 th
Urbanization	3	5	3	4	2	5	22	14.10	6 th
Agriculture expansion	4	3	6	5	4	5	27	17.30	2 nd
Timber mafia/export	6	5	6	5	6	6	35	24.43	1 st
Fire	4	2	5	4	5	3	23	14.74	5 th

Table 7. Frequency (%) of threatened species in Leepa valley.

Species name	Frequency (%)
<i>Taxus wallichiana</i>	33.50
<i>Paeonia emodi</i>	20.00
<i>Pinus wallichiana</i>	13.50
<i>Cedrus deodara</i>	12.00
<i>Clematis orientalis</i>	10.50
<i>Ajuga bracteosa</i>	10.00
<i>Berberis lyceum</i>	08.50
<i>Rubus fruticosus</i>	03.00

smuggling of *Taxus* sp. is becoming rare and in near future may become off of soil thoroughly. The second threat was agricultural expansion that might be due to exponential growth of population but not increase in income or earnings resources at par (Ishtiaq et al., 2007b). So people solely have to rely on local means of cultivation or catering of livestock by grazing in forest land (Table 6). The DMR and PR analysis demonstrated that different species are under biotic stress culminating into thrilling them into threatened or endangered zone. The most effected plants were *Taxus wallichiana* (33.5%), *Paeonia emodi* (20%) and *Pinus wallichiana* (13.5%), respectively (Table 7). These high

medicinal value MPs are exploited ruthlessly and unsustainably by local people for domestic and commercial purposes which debilitate the plant density and occurrence in the area leading to threatened zone (Ahmed and Siraj, 1996).

These facts depict that we should not be ignorant of the scenario and, a planned and comprehensibly biodiversity conservation and preservation program with collaboration of national of international nature conservation agencies should be launched immediately. There should be initiation of public awareness campaign in the area by using demonstration and participatory methods. Furthermore, alternative ways of earnings should also be introduced in the area by government or NGOs to reduce the biotic pressure on the flora. The plinth of this problem is timber mafia activity which may be tackled by incessant efforts by public and private cooperation. It is incumbent to each person of the area to have an eye on environment and if someone violates the rules and regulations he must be put behind the bars or sentenced by imposing heavy levy. Moreover, if this practice remains incessant for years, it may lead towards complete loss of these taxa form this area and ultimately they will become extinct.

Conclusion

This study demonstrates the significance of plant

biodiversity in Leepa valley, Muzaffarabad (AJK), Pakistan. The region is very rich and dynamic in flora and fauna. Many plants have potential in drug discovery (pharmaceutical industry), and phytochemical analysis of these taxa should be conducted comprehensively to combat and cure of ailments in country as well as to generate financial revenue by exportation. Moreover, practices and methods employed for plant collections are not scientific based and will culminate in loss to many MPs and hence botanical collection (sustainable) techniques should be introduced by EMs traders and government agencies. It will aid in protection and conservation of flora and fauna of the area too. The need and uses of sustainable collection and propagation of important medicinal plants is inevitable. There should be laws formulated and enforced in the area for protection of plant biodiversity, and culprits should be brought to the sentence without any prejudice. Overall, participation and co-operation of local communities is very important, without which all practices and efforts will be fruitless.

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