



Status, utilization and trade of Hazara areas healing plants of Pakistan

A. Rauf^{1*}, Musa K. Baloch², Fida M. Abbasi³, M. Riaz Chattha⁴ and T. Z. Mahmood⁴

¹ IPMP, IPEP, National Agricultural Research Centre (NARC), Park Road, Islamabad, Pakistan. ² Department of Chemistry, Gomal University, Dera Ismail Khan, Pakistan. ³ Rice Programme, ⁴ Weeds Management Programme, National Agricultural Research Centre (NARC), Park Road, Islamabad, Pakistan. *e-mail: rauf_eco@yahoo.com

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Abstract

The healing plants entail the search for economically valuable phytochemical resources from the floral wealth of a country. Such initiatives hold the promise of new medicines and pesticides of plant origin that can be a source of income for agricultural based developing country like Pakistan, thus providing incentives to conserve indigenous floral diversity. The Hazara areas in the Himalayas, as one of the major ecological zone of Pakistan need thorough exploration of its invisible natural resources. The collection of existing folk information comprising of local name, general distribution, flowering period, part used, healing importance and other uses, market value and taxonomic diversity of healing plants has been carried out to prospect the importance of the residual plants in the local and abroad markets. The folk/traditional information about 117 (108 wild and 9 cultivated) healing plants was collected. Out of total 117 noted species, about 48 found were market-oriented comprising of about 20% endangered species followed by about 44% vulnerable and about 20% rare species. Status of commercially important six indigenous species were found as dominant. The endangered species consisted of one tree (*Taxus wallichiana*), one shrub (*Berberis lycium*) and eight herbaceous (*Asparagus adscendens*, *Atropa acuminata*, *Colchicum luteum*, *Dioscorea deltoidea*, *Paeonia emodi*, *Podophyllum hexandrum*, *Saussurea costus* and *Valeriana jatamansi*) plants. Further of the total 117 species about 6% have pesticidal potential. Of the plants used for healing purposes 63% were herbs followed by 17% shrubs, 13% trees and 7% climbers. Similarly the diversity of these plant's parts used was 17% root, 22% leaves, 8% stem, 6% bark, 3% flower, 11% fruit, 12% seed and 21% whole plant.

Key words: Healing plants, status, utilization, trade.

Introduction

For our study healing plants are used to restore health and can be exploited for their pesticidal potential as well. In Pakistan reliance on herbal medicine might be due to the high cost of conventional allopathic medicine and inaccessibility of modern health care facilities. Further, traditional medicine is often deemed a more appropriate method of treatment especially in remote villages. In spite of the many potent and specific drugs available for the treatment of different diseases, there is a public swing towards herbal remedies in a number of countries, especially Pakistan.

In the perspectives of Agreements on Agriculture of World Trade Organization, the emphasis on documentation of knowledge about plants has increased since last few decades. The present and past status of natural thorn forest of Punjab province has been described and *Salvadora oleoides* has been given special attention because of its great ecological and ethno-botanical importance. Similarly, folk utilization of medicinal plants of Nara desert and Cholistan areas¹⁻³ and wild medicinal plants of Sind province⁴ has been explored. Parallel studies have been carried out in the documentation of the information on the healing plants of Baluchistan province also. One hundred and fourteen medicinal plants species from a heterogenous culture of southwestern Baluchistan⁵, traditional medicinal uses of 27 plants of Makran⁶, preliminary ethno-botanical information from six districts of Baluchistan province⁷, plant utilization studies of northeastern Baluchistan⁸ and ethno-botanical information about Kharan district⁹ have been documented. The similar work is also underway in the Himalayas and Koh Hindukush ranges. Traditional

knowledge of about 69 medicinal plants found in Machyara National Park¹⁰, indigenous knowledge of about 85 medicinal plants from Northern Chitral¹¹, uses of about 77 species recorded from Shogran valley¹², indigenous knowledge about 25 medicinal herbs from Kahuta-Rawalpindi district¹³, 58 medicinal species listing from Ayubial National Park¹⁴, utilization of 160 plants and their conservation from Margalla Hills National Park^{15, 15a, 15b} and ethno-botanical importance of about 48 species from Khagan valley¹⁶ have been explored. Out of 6000 wild plants, about 2000 medicinal plants are known in Pakistan¹⁷ and only a small proportion of these have been so far commercially exploited (Ibrar, M., unpublished).

According to the National Institute of Health, approximately 400 plant species are used extensively in traditional medicines. The Tibbi Pharmacopeia of Pakistan (a pharmacopeia of traditional drugs compiled by the Tibbi Board) has listed around 900 single drugs and about 500 compound preparations made of medicinal plants. Further, according to the estimates of last decades, there are one hundred herbal product manufacturers (including 27 large companies) in Pakistan, producing Unani's medicines on commercial scale, while number of herbal remedies/medicines manufacturers in non-organized sector runs into hundreds. Traditional healers (around 74,000; Inam-Ul-Haq, pers. comm.) serve about 60% of the population, particularly those living in the rural areas. Moreover, of the total 622 endangered plants listed in the Red Data Books, 137 occur in the Himalayan region and the different systems of Eastern medicines, i.e., Unani, Ayurvedic

and Homeopathy etc., exploit the healing properties of these species. The unsustainable utilization of these plants by locals and their overexploitation on commercial basis by the industrialists as well, have threatened their abundance and occurrence. Therefore, these plants themselves are not only susceptible to the endangerment or vulnerability but indigenous knowledge about healing plants is also in danger of being lost if it is not documented. Thus a study was carried out to highlight the prospects in this regard.

Methodology

The study sites selected were Ayubia National Park (ANP), Bhurban, Margalla Hills, Kaghan Valley and Hilkot Valley. These areas were supposed to be promising location of healing plants of the region with the ANP as focal point. To get the participatory and quantitative approach about status and utilization knowledge of healing information, the stakeholders viz., local people, farmers, Hakims (herbalists), local authorities and societies, were interviewed randomly. The economic and commercial information was found through market survey of the study area accordingly the predefined questionnaires (Annexure 1). The status of commercially important species in terms of threatened condition was determined following IUCN criteria¹⁸.

Results

We found that healing plants after harvesting are dried to prevent fungal attack before their subsequent use or sale. Then dried crude material is used in different remedies accordingly the various traditional knowledge or methodology. The noted 117 healing species comprising of 108 wild and 9 cultivated are listed as follows: *Abies pindrow*, *Achillea millefolium*, *Aconitum heterophyllum*, *Acorus calamus*, *Adiantum capillus-venesis*, *Aesculus indica*, *Ajuga parviflora*, *Amaranthus viridis*, *Angelica glauca*, *Arisaema flavum*, *Artemisia roxburghiana*, *Artemisia indica*, *Artemisia scoparia*, *Asparagus adscendens*, *Atropa (A) acuminata*, *Barleria cristata*, *Berberis lycium*, *Bergenia ciliata*, *Bergenia himalaica*, *Bistorta amplexicaulis*, *Boerhavia (B) procumbens*, *Cannabis sativa*, *Carisea opaca*, *Cedrus deodara*, *Cichorium intybus*, *Cirsium arvense*, *Cissampelos pariera*, *Colchicum luteum*, *Convolvulus arvensis*, *Corydalis stewartii*, *Cuscuta reflexa*, *Cynodon dactylon*, *Cynoglossum(C) lanceolatum*, *Daphne mucronata*, *Diospyrose lotus*, *Datura stramonium*, *Dioscorea deltoidea*, *Dodena viscosa*, *Dryopteris (D) ramosa*, *Ephedra gerardiana*, *Euphorbia helioscopia*, *Euphorbia (E) wallichii*, *Ficus virgata*, *Flacoertia indica*, *Fragaria nubicola*, *Fumaria(F) indica*, *Galium aparine*, *Gentianos kurroo*, *Geranium (G) wallichianum*, *Hedra nepalensis*, *Hyoscyamus niger*, *Hypericum(H) perforatum*, *Ipomaea hederacea*, *Isodon (I) rogosus*, *Jasminum humile*, *Jasminum officinale*, *Justicia (J) adhatoda*, *Lavartera (L) kasmeriana*, *Mallotus philipensis*, *Mentha longifolia*, *Morus alba*, *Myrsine (M) africana*, *Nasturtium officinale*, *Narium (N) oleander*, *Paeonia emodi*, *Pinus roxburghii*, *Plantago lanceolata*, *Plantago major*, *Plantago ovata*, *Podophyllum hexandrum*, *Polygonum plebeic*, *Potentilla nepalensis*, *Punica granatum*, *Pyrus (P) pashia*, *Quercus (Q) leucotrichophora*, *Rheum australe*, *Rosa macrophylla*, *Rubia cordifolia*, *Rubus fruticosus*, *Rumex (R) nepale*, *Saussurea costus*, *Saussurea heteromalla*, *Sida cordifolia*, *Silene conoidea*, *Silybum marianum*, *Sisymbrium irio*, *Skimmia laureola*, *Smilax*

aspera, *Solanum nigrum*, *Solanum amplexicaulis*, *Sonchus asper*, *Swetria(S) angustifolia*, *Taxus wallacihanum*, *Thymus serpyllum*, *Tribuluns (T) terrestris*, *Urtica (U) dioica*, *Valeriana jatamansi*, *Verbascum thapsus*, *Verbena officinalis*, *Veronica melissifolia*, *Viburnum grandiflorum*, *Viola canescens*, *Viola pilosa*, *Vitex (V) negundo*, *Withiana (W) somnifera*, *Xanthium (X) strumariam*, *Zanthoxylum (Z) armatum*, *Althea (A) rosea*, *Coriandrum (C) sativa*, *Ficus carica*, *Foeniculum (F) vulgare*, *Grewia (G) asiatica*, *Juglans(J) regia*, *Murraya (M) koenigii*, *Ocimum(O)basilicum* and *Trigonella (T) foenum-graecum*. The letters in parenthesis A, B, C, D, E, F, G, H, I, J, L, M, N, P, Q, R, S, T, U, V, W, X and Z stand for each and every individual generic name beginning with the corresponding alphabet appeared in the rest of the manuscript text. Use of these species in treatment of different kinds of diseases and disorders is shown in Fig. 1. Their utilization magnitude for other than the remedial purpose is shown in Fig. 2. The phenological variation of the noted species is shown in Fig. 3. The representative diversity of life form proportion of 117 noted species is shown in Fig. 4. Diversity of their parts used in different remedies is indicated in Fig. 5. The reported pesticidal significance and their applications in other than medicinal sectors are indicated in Tables 1-6 while results of our market survey of the studied areas are presented in Tables 7-9.

Discussion

To developing countries like Pakistan, healing plants are of great value in the treatment of various kinds of diseases and disorders. They are also more accessible and affordable than allopathic medicines. The systematic documentation of indigenous information about the use of these plant resources by the local people and their chemical and biological examination would be useful for the discovery of new therapeutic agents. Our survey indicates that people used healing plants largely in remedies against the digestive complaints or skin problem (Fig. 1). They include about 7% climbers, 13% trees, 17% shrubs and 63% herbs, and 38% of these plants as depicted by Fig. 5 were used in the form of root or rhizome or as a whole plant. Fig. 2 indicates that about 29% are utilized as fodder, which is the biggest stress on the healing plants of the surveyed areas, reflecting the dire need for conservation of such species. Fig. 3 shows that maximum healing plants (58) bloom during April to July while least (12 plants) from November to January, so field visits would be beneficial during such months.

In Table 8 the superscripts of small alphabets, “e, v and r”, indicate commercially important species found to be endangered (about 20%), vulnerable (about 44%) followed by about 20% rare species. The endangered species consisted of one tree (*T. wallichiana*), one shrub (*B. lycium*) and eight herbaceous plants (*A. adscendens*, *A. acuminata*, *C. luteum*, *D. deltoidea*, *P. emoldi*, *P. hexandrum*, *S. costus* and *V. jatamansi*) while 44% vulnerable species consisted of *A. millefolium*, *A. heterophyllum*, *A. calamus*, *A. capillus-veneris*, *B. amplexicaulis*, *C. intybus*, *F. indica*, *G. wallichianum*, *L. kashmeriana*, *M. philipensis*, *P. major*, *P. granatum*, *Q. leucotrichophora*, *R. cordifolia*, *R. australe*, *S. cordifolia*, *S. aspera*, *T. terrestris*, *V. canescens*, *V. negundo*, *W. somnifera* and *Z. armatum*.

The main cause of depletion of healing plants from this wild resource and as a matter of prime concern is exploitation of these plants on commercial scale as shown in Table 7.

Table 1. Healing plants used against different animal bites (15 plants).

Name of species (Family)	Local name	Type
<i>A. calamus</i> (Araceae)	Bach	Insect & snake
<i>A. viridis</i> (Amaranthaceae)	Chaleri	Scorpion & snake
<i>A. flavum</i> (Araceae)	Obais	Snake
<i>B. cristata</i> (Acanthaceae)	Tadrelu	Snake
<i>B. procumbens</i> (Nyctaginaceae)	Itsit	Scorpion
<i>C. pariera</i> (Menispermaceae)	Bili/Pilligar	Snake
<i>D. stramonium</i> (Solanaceae)	Dhatura	Fish
<i>F. carica</i> (Moraceae)	Anjir	Bee
<i>J. officinalis</i> (Oleaceae)	Chambeli	Scorpion
<i>M. koenigii</i> (Rutaceae)	Kammi	Insect
<i>P. roxburghii</i> (Pinaceae)	Chir	Scorpion & snake
<i>R. cordifolia</i> (Rubiaceae)	Manjit	Scorpion & snake
<i>S. venosum</i> (Araceae)	Sap ki booti	Snake
<i>S. heteromalla</i> (Asteraceae)	Butt peva	Horse
<i>V. officinalis</i> (Verbenaceae)	Karanta/Pamukh	Scorpion & snake

Table 2. Healing plants used in veterinary medicines (12 plants).

Name of species (Family)	Local name	Remarks
<i>A. indica</i> (Hippocastanaceae)	Bankhor	Fever & Cough
<i>A. flavum</i> (Araceae)	Obais	Rani Khait (FIADS)
<i>C. sativa</i> (Cannabaceae)	Bhang	Appetizer
<i>C. opaca</i> (Apocynaceae)	Garanda	Sore
<i>C. dactylon</i> (Poaceae)	Talla	Milk & butter
<i>F. indica</i> (Fumariaceae)	Pitpara	Diarrhea
<i>H. nepalensis</i> (Araliaceae)	Kurie/Albumber	Milk supply
<i>M. alba</i> (Moraceae)	Toot	Milk supply
<i>P. major</i> (Plantaginaceae)	Batti	Mavakhar
<i>S. heteromalla</i> (Asteraceae)	Butt peva	Dyspepsia
<i>V. thapsus</i> (Scrophulariaceae)	Geedar tamaku	Diarrhea
<i>Z. armatum</i> (Rutaceae)	Timber	Give warmth

Table 3. Healing plants used as kitchen fuel (13 plants).

Name of species (Family)	Local Name	Remarks
<i>A. pindrow</i> (Pinaceae)	Partal/Plundar	Tree
<i>C. deodara</i> (Pinaceae)	Deodar/Diar	Tree
<i>D. lotus</i> (Ebenaceae)	Kala Amlok	Tree
<i>D. viscosa</i> (Sapindaceae)	Sanatha	Shrub
<i>E. gerardiana</i> (Ephedraceae)	Asmani	Shrub
<i>F. carica</i> (Moraceae)	Anjir	Tree
<i>J. regia</i> (Juglandaceae)	Akhrot	Tree
<i>M. alba</i> (Moraceae)	Toot	Tree
<i>P. roxburghii</i> (Pinaceae)	Chir	Tree
<i>P. granatum</i> (Pinaceae)	Anar/Darunna	Shrub
<i>P. pashia</i> (Rosaceae)	Butangi	Tree
<i>Q. leucotrichophora</i> (Fagaceae)	Ban/Reen	Tree
<i>T. wallichiana</i> (Taxaceae)	Burmi	Tree

On the other hand there is no serious attempt to augment the cultivation aspect. Naturally, imbalance in the population of certain species is arising. Secondly, both the oral and codified folk information about such plants is eroding because of the global domination of the monoculture society and only of those knowledge systems that are components of this culture¹⁹. Thirdly, our collectors are not familiar with the optimal time of harvesting, the correct identification of the plant or its part used neither they have any training or knowledge about the propagation of these plants which results in their depletion. Last but not least reason may be the immigration of villages in the past and post earthquake currently as well that produced weak links between people and their surroundings resulting in the reduced incentives of conservation.

Table 4. Healing plants used for grazing/ fodder (34 plants).

Name of species (Family)	Local name	Remarks
<i>A. pindrow</i> (Pinaceae)	Partal/Plundar	Tree
<i>A. indica</i> (Hippocastanaceae)	Bankhor	Tree
<i>A. flavum</i> (Araceae)	Obais	Herb
<i>B. lycium</i> (Berberidaceae)	Kashmal	Shrub
<i>B. amplexicaule</i> (Polygonaceae)	Maslun	Herb
<i>C. intybus</i> (Asteraceae)	Kasni	Herb
<i>C. arvensis</i> (Convolvulaceae)	Lehli/Hiran padi	Herb
<i>C. dactylon</i> (Poaceae)	Talla	Herb
<i>D. lotus</i> (Ebenaceae)	Kala Amlok	Tree
<i>E. gerardiana</i> (Ephedraceae)	Asmani	Shrub
<i>E. helioscopia</i> (Euphorbiaceae)	Dhodol	Herb
<i>E. wallichii</i> (Euphorbiaceae)	Harvi	Herb
<i>F. virgata</i> (Moraceae)	Phagwara	Shrub
<i>F. indica</i> (Fumariaceae)	Pitpara	Herb
<i>F. nubicola</i> (Rosaceae)	Panjakha	Herb
<i>G. aparine</i> (Rubiaceae)	Kochan	Herb
<i>G. wallichianum</i> (Geraniaceae)	Rattanjot	Herb
<i>H. nepalensis</i> (Araliaceae)	Albumber	Climber
<i>J. humile</i> (Oleaceae)	Peeli Chambeli	Shrub
<i>J. officinalis</i> (Oleaceae)	Chambeli	Shrub
<i>J. regia</i> (Juglandaceae)	Akhrot	Tree
<i>M. alba</i> (Moraceae)	Toot	Tree
<i>P. major</i> (Plantaginaceae)	Chamchipatra	Herb
<i>P. hexandrum</i> (Podophyllaceae)	Bankaki	Herb
<i>P. granatum</i> (Punicaceae)	Darunna	Shrub
<i>P. pashia</i> (Rosaceae)	Batangi	Tree
<i>R. fruticosus</i> (Rosaceae)	Gharacha	Shrub
<i>R. nepalensis</i> (Polygonaceae)	Hulla	Herb
<i>Q. leucotrichophora</i> (Fagaceae)	Ban/Reen	Tree
<i>S. angustifolia</i> (Gentianaceae)	Chriayita	Herb
<i>T. wallichiana</i> (Taxaceae)	Burmi	Tree
<i>V. jatamansi</i> (Valerianaceae)	Mushkbala	Herb
<i>V. melissifolia</i> (Scrophulariaceae)	Mushkanna	Herb
<i>V. canescens</i> (Violaceae)	Banafsha	Herb

Table 5. Healing plants used as food (24 plants).

Name of species (Family)	Local name	Use
<i>A. viridis</i> (Amaranthaceae)	Chaleri	Vegetable
<i>D. mucronata</i> (Thymeliaceae)	Kuttillal	Fruit
<i>D. lotus</i> (Ebenaceae)	Kala Amlok	Fruit
<i>D. ramosus</i> (Pteridaceae)	Pakha	Vegetable
<i>F. carica</i> (Moraceae)	Anjir	Fruit
<i>F. virgata</i> (Moraceae)	Phagwara	Fruit
<i>F. indica</i> (Flacourtiaceae)	Kokoh	Fruit
<i>F. vulgare</i> (Umbelliferae)	Sonf	Condiment
<i>F. nubicola</i> (Rosaceae)	Panjakha	Fruit
<i>G. asiatica</i> (Tiliaceae)	Falsa	Fruit
<i>H. perforatum</i> (Hypericaceae)	Balsana	Vegetable
<i>J. regia</i> (Juglandaceae)	Akhrot	Fruit
<i>M. alba</i> (Moraceae)	Toot	Fruit
<i>M. koenigii</i> (Rutaceae)	Kamni	Condiment
<i>P. roxburghii</i> (Pinaceae)	Chir	Fruit
<i>P. hexandrum</i> (Podophyllaceae)	Bankaki	Fruit
<i>P. granatum</i> (Punicaceae)	Darunna	Condiment
<i>P. pashia</i> (Rosaceae)	Batangi	Fruit
<i>R. fruticosus</i> (Rosaceae)	Gharacha	Fruit
<i>S. minutum</i> (Solanaceae)	Mako	Vegetable
<i>S. asper</i> (Asteraceae)	Hind	Vegetable
<i>T. wallichiana</i> (Taxaceae)	Burmi	Fruit
<i>V. grandiflorum</i> (Sambucaeeae)	Guch	Fruit
<i>Z. armatum</i> (Rutaceae)	Timber	Condiment

Table 6. Reported pesticidal compound(s) of healing plants of the visited areas ²³.

#	Plant name (trade/local name)	Common name (pesticidal activity) of the compound
1	<i>A. pindrow</i> (Partial/Plunder)	Juvabione (insect juvenile hormone activity; interfering with the metamorphosis and preventing maturation, with fatal consequences)
2	<i>A. calamus</i> (Bach)	β -Asarone (antifungal activity; insect chemosterilant; insect attractant)
3	<i>A. flavum</i> (Obais)	Plumbagin (active molluscicidal agent; insect antifeedent)
4	<i>C. sativum</i> (Bhang)	Dronabinol (toxic to Lepidopteran larvae)
5	<i>C. intybus</i> (Bekh-e-kasni; Tukhum-e-kasni)	Cichoralexin (antifungal agent: Phytoalexin) Cichoriin (antifeedent activity against the locust) 8-Deoxylactucin (antifeedent against locust) Lactucopicrin (antifeedent activity against the locust)
6	<i>C. arvensis</i> (Lehli/Hiran padi)	Pseudoatropine (toxic effects to mice, toad)
7	<i>D. lotus</i> (Kala amlak)	Isodiospyrin (molluscicide) Plumbagin (active molluscicidal agent; insect antifeedent)
8	<i>D. deltoidea</i> (Angoor-e-shifa)	Deltonin (potential rodenticide)
9	<i>E. heliscopa</i> (Dhodai)	Milliamine L (molluscicidal at 4 nM conc. The most powerful molluscicide against <i>Biomphalaria glabrata</i> known to date)
10	<i>F. nepalensis</i> (Albumber)	Imperatorin (toxic to toads and also has piscicidal properties)
11	<i>F. nubicola</i> (Panjakha)	Imperatorin (as in above)
12	<i>F. indica</i> (Pitpara)	Sanguinarine (potential rodenticide)
13	<i>G. wallichianum</i> (Rattanjot)	Germacrone (antifeedent to the snowshoe hare, protecting the Labrador tea plant from grazing)
14	<i>H. nepalensis</i> (Albumber)	Hederagenin 3-O- arabinoside (molluscicidal properties, the LD 100 after 24 hours for snail <i>Biomphalaria glabrata</i> is 3 mg/L)
15	<i>J. regia</i> (Akhrot)	Juglone (as molluscicide; feeding deterrent to the barkbeetles, <i>Scolghus mullistriatus</i>)
16	<i>J. adhatoda</i> (Bheker)	Carpacin (toxic to insects)
17	<i>O. basilicum</i> (Tukhum-e-rehan)	Juvocimene 1 (insecticide: a juvenile hormone mimic, it upsets normal metamorphosis in insects larvae)
18	<i>P. roxburghii</i> (Chir)	Piceatannol (fungitoxin) Pinisylvin methylether (antifeedent to the snowshoe hare, <i>Lepus americanus</i>)
19	<i>S. cordifolia</i> (Beejband siah)	Vasicinol (antifeedent to the insects) Vasicinone (antifeedent to the insects)
20	<i>S. asper</i> (Hind)	Cichoriin (antifeedent activity against the locusts)
21	<i>V. jatamansi</i> (Mushkbala)	N-(p-hydroxyphenyl) actinidine (highly active inhibitor of cholinesterase activity)
22	<i>V. thapsus</i> (Geeder tamaku)	Rotenone (widely used as insecticide and rodenticide)

Table 7. Extracted quantity of healing plants (23) from different locations in year 2002.

Scientific name	Local name	Quantity in kg			
		Hil Kot	*Kaghan	Ayubia	Murree
<i>A. heterophyllum</i>	Atis		80	64	
<i>A. calamus</i>	Bach	1,200			
<i>A. capillus-venesis</i>	Persioshan		24		
<i>B. lycium</i>	Kashmal	1,000	25		
<i>B. ciliata</i>	Zakham-e-hayat			10	40
<i>B. amplexicaule</i>	Maslun		780		
<i>D. deltoidea</i>	Angoor-e-shifa		4,480		
<i>G. wallichinum</i>	Rattanjot	1,200		16	
<i>J. regia</i>	Akhrot			80	
<i>J. adhatoda</i>	Bhekar		50	56	
<i>L. kashmeriana</i>	Raisha khatmi		2,760		
<i>M. longifolia</i>	Pudina			240	45
<i>P. emodi</i>	Mamekh	4,000	520	75	
<i>P. hexandrum</i>	Bankakri		13,960		
<i>P. granatum</i>	Darunna		10	140	160
<i>R. australe</i>	Chuttial	2,000			
<i>S. costus</i>	Kuth		8,000	80	
<i>S. laureola</i>	Ner	160			164
<i>S. angustifolia</i>	Chirayita			32	
<i>T. wallichiana</i>	Burmi		5,920		
<i>V. jatmansi</i>	Mushkbala	500	18,920	40	
<i>V. canescens</i>	Thandi-booti	2,000	48		40
<i>Z. armatum</i>	Timmer	200	10		56

Source: Survey of Local Crude Drug Dealers & Community Collectors,* Kaghan Forest Division/ Forest Department government of NWFP Province.

Table 8. Market value of indigenous healing plants (48 species).

Botanical name (Trade name)	Part used	Rawalpindi Market	
		Price US\$ kg ⁻¹	Consumption (tons/year)
^v <i>A. millefolium</i> (Baranjasif)	Whole	0.8	1.56
^v <i>A. heterophyllum</i> (Atis)	Root	13.33*	5.00
^v <i>A. calamus</i> (Bach)	Rhizome	6.25*	25.00
^v <i>A. capillus-veneris</i> (Perioshan)	Whole	0.60	4.32
^e <i>A. adscendens</i> (Musli sufaid)	Root	4.22**	1.135
^e <i>A. acuminata</i> (Angoor-e-shifa)	Root	0.2	10.00
^e <i>B. lysium</i> (Rasout)	Sap	6.0**	1.02
^v <i>B. amplexicaulis</i> (Bekh-e-anjbar)	Root	0.45	0.44
^v <i>B. diffusa</i> (Tukhm-e-aspat)	Seed	2.0	0.10
^v <i>C. intybus</i> (Bekh-e-kasni; Tukhum-e-kasni)	Root; seed	0.63; 1.0	2.64; 6.54
^e <i>C. luteum</i> (Suranjan-e-talkh)	Rhizome	7.00*	2.76
<i>C. sativum</i> (Dhaniya)	Fruit	0.63	10.08
<i>C. reflexa</i> (Afsitamone; Tukhum-e-kasoos)	Shoot; seed	2.0; 1.63	0.61; 0.84
<i>D. deltoidea</i> (Kanis sabz)	Root	0.45	0.12
<i>F. caria</i> (Anjir zard)	Fruit	2.30	3.80
<i>F. vulgare</i> (Badyan; Bekh-e-badyan)	Fruit; Root	0.8; 0.6	7.00; 2.34
^v <i>F. indica</i> (Burg-e-shahtra)	Leaves	0.45	2.94
^v <i>G. wallicianum</i> (Rattan jot)	Root	0.80	28.00
^v <i>H. niger</i> (Ajwain khurasani)	Fruit	1.0	0.40
<i>J. regia</i> (Maghz-e-akhrot)	Seed	3.0	20.00
^v <i>J. adhatoda</i> (Berg-e-bansa)	Leaves	2.1	0.88
^v <i>L. kashmeriana</i> (Tukhum-e-khatmi)	Seed	0.8	54.40****
^v <i>M. philipensis</i> (Kamila)	Fruit	2.0	0.27
^v <i>M. longifolia</i> (Podina desi)	Whole	0.3	17.20
<i>O. basilicum</i> (Tukhum-e-rehan)	Seed	2.0	2.540
^e <i>P. emodi</i> (Ud-e-salep)	Root	0.8	50.42****
^v <i>P. major</i> (Tukhum-panwar)	Seed	0.63	0.82
^v <i>P. ovata</i> (Ispaghol musullum; Bhozi ispaghol)	Seed; Seed	1.0; 2.60	53.50****
^v <i>P. hexandrum</i> (Bankakri)	Rhizome	1.5	19.58
^v <i>P. granatum</i> (Anardana)	Seed	0.8	30.00
^v <i>Q. leucotrichophora</i> (Juft-e-baloot)	Seed	0.45	120.04***
^v <i>R. cordifolia</i> (Majheet)	Root	1.21	0.41
^v <i>R. australe</i> (Asarat-e-revand; Revandchini)	Root sap; root	1.6; 7.0*	0.21; 0.12
^e <i>S. costus</i> (Qast-e-talkh)	Root	2.33	0.76
^v <i>S. cordifolia</i> (Beejband siah)	Seed	1.222	0.40
^v <i>S. irio</i> (Khaksi)	Seed	1.111	0.44
^v <i>S. laureola</i> (Berg-e-ner)	Leaves	0.15	24.00
^v <i>S. aspera</i> (Chobchini)	Root	6.0	0.61
^v <i>S. nigrum</i> (Mako khushk)	Fruit	0.66	0.20
<i>S. angustifolia</i> (Charaita shirin)	Shoot	0.50	0.30
^e <i>T. wallichiana</i> (Zarnabad)	Leaves	0.50	2.04
^v <i>T. terrestris</i> (Gokhrokhurd)	Fruit	0.50	2.04
<i>T. foenum-graecum</i> (Tukhum-e-methi)	Seed	0.51	1.35
^v <i>V. jatamansi</i> (Mushkabla)	Root	0.80	100****
^v <i>V. canescens</i> (Burg-e-banafsha; Gul-e-banafsha)	Leaves; flowers	0.45; 3.22	3.14; 2.94
^v <i>V. negundo</i> (Tukhum-e-sumbhaloo)	Seed	0.50	0.70
^v <i>W. somnifera</i> (Asgand nagori)	Root	2.50	11.18
^v <i>Z. armatum</i> (Timmer/Timber)	Seed	0.10	31.00

Price Maximum followed by 2nd Maximum* and ***Consumption Maximum followed by 2nd higher ****Consumption; The superscripts e = endangered species (20%), v = vulnerable species (44%) and r = rare species (20%).

Table 9. Price per kg of commercially exploited species at different market levels.

Name of species	Demand	Harvest months	Collector rate in US\$ kg ⁻¹	Market rate US\$ kg ⁻¹			
				Study area	Whole sale	Rawalpindi	Inter
<i>A. adscendens</i>	Increase	Aug-Sep	0.900	1.33	2.50	3.80	43.3
<i>A. acuminata</i>	Normal	Sep-Nov	0.005	0.11	0.17	0.23	----
<i>C. luteum</i>	Increase	Mar-May	1.000	2.50	4.01	6.00	10.0
<i>D. deltoidea</i>	Decrease	Jul-Sep	0.500	1.00	1.60	2.50	0.45
<i>P. hexandrum</i>	Normal	Jul-Sep	0.500	0.60	0.90	1.50	7.00
<i>P. emodi</i>	Decrease	Jul-Sep	0.333	0.41	0.61	0.90	3.33
<i>S. costus</i>	Decrease	Jul-Sep	0.666	0.72	0.90	1.25	5.00
<i>V. jatamansi</i>	Normal	Jul-Sep	1.000	1.10	2.33	3.33	8.85
<i>C. copticum</i>	Increase	May-Jun	0.170	0.33	0.50	0.90	7.00
<i>N. sativa</i>	Increase	May-Jun	0.333	0.50	0.90	1.10	5.07

Trade of medicinal plants: Currently it is estimated that global trade value of medicinal plant material is over US\$ 60.0 billions and it will grow to 5.0 trillions by the year 2050²⁰. In America, the market is huge and worth over \$ 500 millions while France and Germany are the substantial markets. The market in UK is small in comparison to France and Germany. It is estimated that Europe annually imports herbal plant material about an average market value of 1 billion from Africa and Asia and it has highest turn over in herbal medicines in the world over in the year 1995 with an annual retail sales volume of US\$ 6.0 billion. Germany earned nearly 25% of its national pharmaceutical market from its herbal products in the same year. In Asia in the same year 1995, China exported herbal medicines of US\$ 2.3 billion followed by Japan of US\$ 2.1 billion. The former produced 213% more than that of 1990 volume of its herbal products while Japan per capita consumption of herbal products was highest in the world over and around 147 herbal drugs were given reimbursable status by the National Health Insurance of Japan in the same year 1995. In India, 70% of the population is reported to be using the herbal traditional medicines for primary health care and its present manufactured herbals by large companies are estimated to be approximately US\$ 300 million annually²¹.

In Pakistan, national and multinational pharmaceutical companies import raw material of medicinal plants from China, India and Eastern European countries. During 1999, bill on the import of medicinal plant material was worth of value US\$ 31.0 millions whereas it exported medicinal plant material of only US\$ 6.0 millions²². Our studied area market survey (Tables 7-9) shows that out of 48 commercial species 23 indigenous healing plants are extracted from Ayubia, Kaghan, Murree and Hill Kot villages which are the gateway to the national trading market and also abroad. Table 8 reveals that four species (*A. heterophyllum* roots, *C. luteum* rhizome, *R. australe* root and *A. calamus* rhizome) have maximum price, i.e., US\$ 6.2-13.33 kg⁻¹, followed by *A. adscendens* root, *B. lycium* sap and *S. aspera* root (US\$ 4.2-6.0 kg⁻¹).

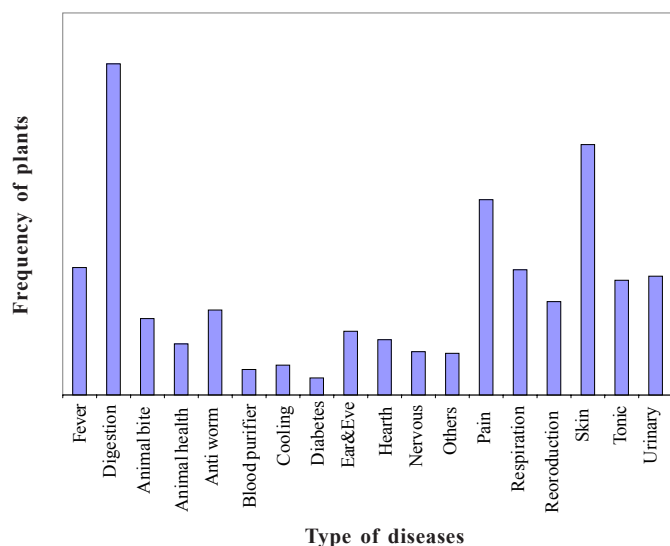


Figure 1. Treatment of different diseases.

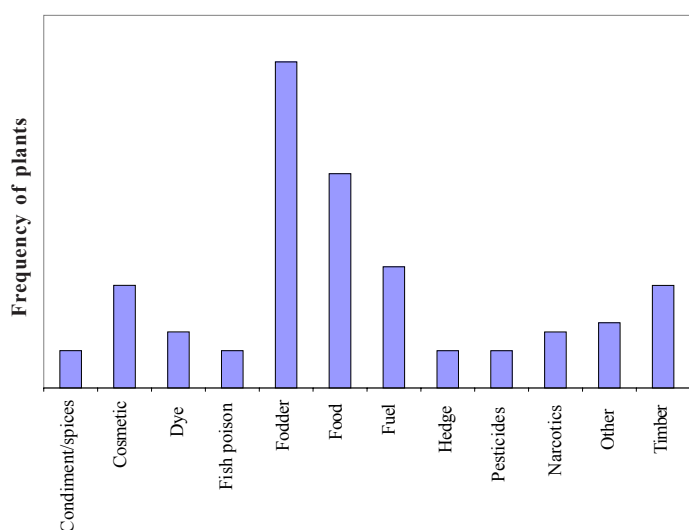


Figure 2. Utilization of healing plants of the area.

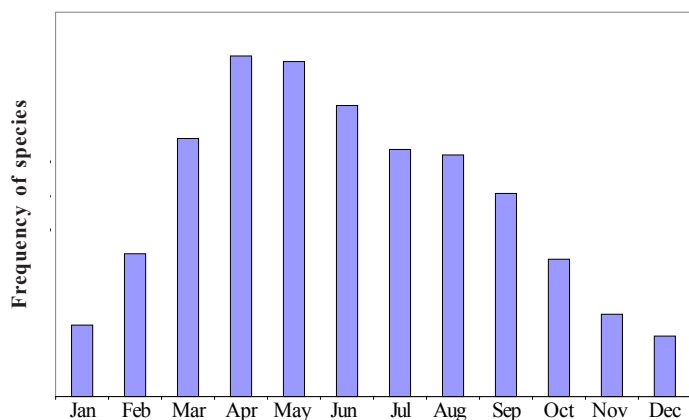


Figure 3. Phenological variations of healing plants of area.

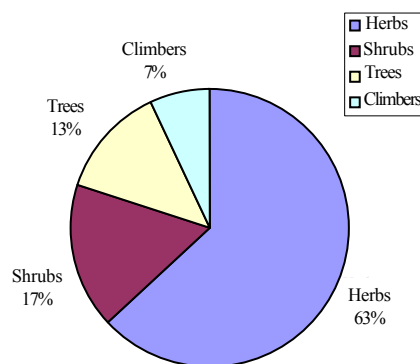


Figure 4. Life form representation of healing plants of the studied areas.

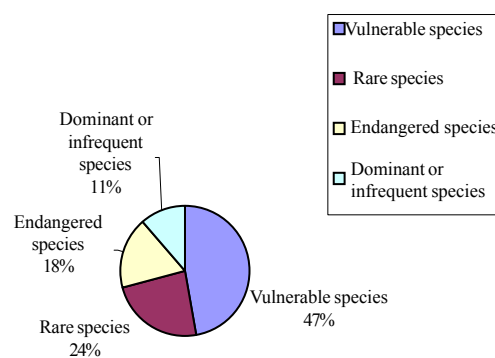


Figure 5. Status of commercially important indigenous healing plants of the studied areas.

Table 8 also shows that only 2 species (*Q. leucotrichophora* and *V. jatamansi*) have maximum annual consumption, i.e., more than 100 tons per annum followed by *L. kasmeriana*, *P. ovata* and *P. emodi*, i.e., 50-100 tons per annum and the rest are consumed below 50 tons per annum. Actually, the postharvest processing of the material is important stage in the herbal marketing. Good herbal material cleaned and properly packed according to the scientific procedure of value addition catches smart prices from the conscious buyers. For instance in Table 9, the price of Pakistani *P. hexandrum* noted in the Rawalpindi city market was 1.5 US\$ against the same Indian entity for 3.0 US\$, and the price for *A. adscendens* was 4.0 US\$ against the same Indian species price of 50.50 US\$. Moreover, in the international market, particularly in the European market, there is increasing demand for originally grown medicinal plants. All the selected species collected from wild, fulfill the requirements of organic produce, if presented in acceptable form. Since the amount and nature of bioactive material of the medicinal plant is not constant throughout the year and throughout their life cycle. Therefore, collectors should be well familiar with the phenology of healing plants and certification procedure also. Otherwise the herbal contents quality vis-e-vis the percentage of the active ingredients reflecting on their efficacy will be uncertain.

Conclusions

It is concluded that appropriate investments and coordinated efforts are needed for the developments of conservation, cultivation and harvesting strategies, as well as on the documentation and application of local indigenous knowledge available on the use of these resources.

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Annexure 1

Questionnaire 1: Documentation of Information of Hazara Areas Healing Plants

Locality of plant collection site; date; name of collector; collector's educational status; local name and habitat of the species collected; use of the plant species; quantity harvested per year/month/day; who collected (child/man/woman); why?; Is it sold? ; Quantity sold per year/month/day; to whom is it sold?; market value; Is the plant perceived by the information to be abundant/common/rare?; changes in the abundance of the plant for the last ten years (more abundant/same/rare); Kinds of tools for harvesting; Are method used to regenerate or otherwise actively manages the plant?; What?; kinds of traditional methods for post harvesting process.

Questionnaire 2: Herbals Market Survey

Name of person doing business; age; name of business; locality; date; type of business (temporary/ permanent/ ambulatory); %age of people of the area involved in this business; trend (increasing/decreasing/normal); local/trade name of the source (village); vegetation and plant part used; who collects (yourself/people/traders); plant condition (fresh/dried/preserved); amount obtained (annually); name of other ingredients; market price; brought to the market weekly/occasionally/daily); estimated quantity to a businessman.....wholesale market.....; availability (January to December); trend of the past and current market (same/less/more); why?; less available to harvest/less depend by buyers/any other reason; what are problems faced by you in this business.

IUCN Criteria for determining the current status of threatened species.

Availability (uncommon/rare = 0; less common/rare = 1; occasional = 2; abundant = 3), collection (more than 1000 kg year⁻¹ = 0; consumed in range 500-1000 kg year⁻¹ = 1; 300 – 400 kg year⁻¹ = 2; 100-200 kg year⁻¹ = 3), growth (re-growth in more than three years = 0; re-growth within three years = 1; re-growth in one year = 3; re-growth in a season = 4), part used (root, rhizome, whole plant = 0; bark = 1; seeds/fruits = 2; flowers = 3; gum/latex/leaves = 4), total score (endangered = 0 – 4; vulnerable = 5 – 8; rare = 9 – 12 and infrequent/dominant = 12-16).