Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan

Akhtar et al.
Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan

Naveed Akhtar1,2, Abdur Rashid3, Waheed Murad4 and Erwin Bergmeier2*

Abstract

Background: Due to its diverse geographical and habitat conditions, northern Pakistan harbors a wealth of medicinal plants. The plants and their traditional use are part of the natural and cultural heritage of the region. This study was carried out to document which medicinal plant species and which plant parts are used in the region of Swat, which syndrome categories are particularly concerned, and which habitat spectrum is frequented by collectors. Finally, we assessed to which extent medicinal plants are vulnerable due to collection and habitat destruction.

Methods: An ethnobotanical survey was undertaken in the Miandam area of Swat, North Pakistan. Data were collected through field assessment as well as from traditional healers and locals by means of personal interviews and semi-structured questionnaires.

Results: A total of 106 ethno-medicinal plant species belonging to 54 plant families were recorded. The most common growth forms were perennial (43%) and short-lived herbs (23%), shrubs (16%), and trees (15%). Most frequently used plant parts were leaves (24%), fruits (18%) and subterranean parts (15%). A considerable proportion of the ethno-medicinal plant species and remedies concerns gastro-intestinal disorders. The remedies were mostly prepared in the form of decoction or powder and were mainly taken orally. Eighty out of 106 ethno-medicinal plants were indigenous. Almost 50% of the plants occurred in synanthropic vegetation while slightly more than 50% were found in semi-natural, though extensively grazed, woodland and grassland vegetation. Three species (Aconitum violaceum, Colchicum luteum, Jasminum humile) must be considered vulnerable due to excessive collection. Woodlands are the main source for non-synanthropic indigenous medicinal plants. The latter include many range-restricted taxa and plants of which rhizomes and other subterranean parts are dug out for further processing as medicine.

Conclusion: Medicinal plants are still widely used for treatment in the area of Swat. Some species of woodlands seem to be adapted to wood-pasture, but vulnerable to overcollecting, and in particular to deforestation. It is suggested to implement local small-scaled agroforestry systems to cultivate vulnerable and commercially valuable ethno-medicinal woodland plants under local self-government responsibility.

Keywords: Ecosystem services, Ethnobotany, Medicinal plants, Miandam, Phytomedicine, Plant applications, Plant conservation, Vernacular plant names

* Correspondence: erwin.bergmeier@bio.uni-goettingen.de
1Department of Vegetation Analysis and Phytodiversity, Albrecht von Haller Institute of Plant Sciences, Georg August University, Göttingen 37073, Germany
2Full list of author information is available at the end of the article
**Introduction**

Plants are an important source of traditional medicine for the treatment of various diseases [1]. It has been estimated that herbal medicines are used by more than 80% of the world's population in developing countries to meet their primary healthcare needs [2]. In Pakistan, the available modern healthcare services are either insufficient or inaccessible and unaffordable to the majority of people. In addition, due to illiteracy and poverty most of the population is dependent on traditional phytomedicine to cure various ailments. As the country has diverse socio-economic, ethnic, linguistic and cultural areas, as well as unique biodiversity, copious knowledge of indigenous medicinal plants and their use in treating human ailments might reasonably be expected. More than 10% of the national flora of Pakistan (600-700 plant species) are used for medicinal purposes [3]. Phytomedicinal research in Pakistan is a recent activity and the documentation of ethnomedicinal plant knowledge and its applications are ongoing [3-6]. The loss of precious medicinal plant wealth due to overgrazing, agricultural expansion, environmental degradation, acculturation and deforestation, enhanced by population pressure and poverty, has been reported by various researchers [3,7-10] but information on which medicinal plant species in particular are vulnerable, and why, is lacking.

Traditional resources of medicinal plants from Chitral, North Pakistan, have been evaluated [7,11]. Several studies exist on the ethnomedicinal use of plants in different regions of Swat, North Pakistan [8,12-15]. In an ethnomedicinal study from the valley of Miandam, Swat, a total of 179 plant species have been listed [16], with medicinal use reported for 27 plants, but without reference to local names, habitats, and which parts of these plants are used. Recording the indigenous knowledge of medicinal plants is an urgent task. Traditional knowledge is usually passed verbally from generation to generation, and valuable information about medicinal plants is easily lost if not preserved in written form. The main objective of the present study was therefore to survey and to document the scattered indigenous knowledge of medicinal plants of the Miandam valley as basis for future phytochemical and pharmacological studies. Moreover, and for the first time in any region of Pakistan, the medicinal plants of the study area are classified according to their biological and distributional properties as well as ecological preference. It is essential to know where and in which habitats ethno-medicinal plants occur, as such knowledge is a prerequisite to identify vulnerable plant species susceptible to collecting or habitat change.

**Study area**

The valley of Miandam, Swat, is a well-known summer resort in northern Pakistan. Located about 50 km northeast of Saidu Sharif, the valley lies between 35° 4’ N and 72° 29-32’ E in the mountain range of Hindu Raj [17]. The study area ranges between 1400 to 3900 m a.s.l. It is a narrow valley with a number of gorges, bounded on the north, east and south by high mountains. Its western boundary is the river Swat. Gujars (Indian Aryans) and Yousafzai (Pakhtoon) are the two main tribes residing in the area. Their main source of income is agriculture (nearly 41%) [18] and most of the population of the study area is directly or indirectly engaged in it. Miandam is a mountainous region and the cultivated land is insufficient for subsistence. Additional sources of income are daily wages and salaries (20%), foreign and domestic remittances (17%), forest products including medicinal plants (12%) and other professions (10%). Findings from [19] reveal that 59% of the households in north-western Pakistan derive their income from the forests.

Due to its considerable variation in altitude, temperature, topography, soil type and moisture, the vegetation of Miandam Valley can be classified into a series of altitudinal belts, namely dominated by *Olea ferruginea* and *Quercus oblongata* (montane), *Pinus wallichiana*, *Abies pindrow*, *Picea smithiana* and *Quercus seneocarppifolia* (montane), and alpine-subalpine flora, respectively [16]. See also the vegetation maps of the northern Pakistan regions of Chitral and Hunza [20,21].

**Methods**

Regular field surveys were carried out in the Miandam valley from September 2010 through July 2011 in order to document the habitats and indigenous uses of ethnomedicinal plants of the valley. The surveys were carried out at different seasons so as to obtain identifiable plants and multiple information and also to cross-check the information provided by the local informants during earlier visits. We interviewed a small group of chiefly elder people of both Gujars and Yousufzai tribes who were highly esteemed in their societies due to their sound knowledge of medicinal plants. Structured questionnaires, formal and informal interviews and participatory observations were used to inquire about vernacular names, used plant parts and the process of remedy preparation. We did not encounter controversial issues among the informants but commonly received complementary information. Moreover, for each plant species growth forms (tree, shrub, woody climber, perennial herb, annual or biennial herb), plant status (indigenous, established alien, cultivated), abundance in the area (common, scattered, rare) and habitat preferences (arable fields, ruderal sites, wetland, woodland, mountain grassland) were recorded. Voucher specimens were identified using relevant standard literature [22-25] and submitted to the Herbarium PUP at the Department of Botany, University of Peshawar. Plant nomenclature was updated using the World Checklist of
| Plant family       | Taxon name                      | Local name       | Parts used       | Medicinal uses, remedies                                                                 | Growth form | Plant status      | Frequency | Habitat         |
|-------------------|---------------------------------|------------------|------------------|-----------------------------------------------------------------------------------------|-------------|-------------------|-----------|-----------------|
| Amaranthaceae     | Amaranthus viridis              | Chalvaray        | Leaves           | Leaf extract is emollient, also used for curing cough and asthma.                       | Annual      | Indigenous        | Common    | Ruderal         |
| Anacardiaceae     | Pistacia chinensis             | Shnai            | Insect galls, leaves and bark | Powdered insect galls, bark and leaves are topical antiseptic, also for curing jaundice and liver diseases. |
| Apiaceae          | Bupleurum longicaule           | Gillo            | Whole plant      | Powdered plant is mixed with milk and used as laxative                                  | Tree        | Established       | Scattered | Woodland        |
| Apiaceae          | Coriandrum sativum             | Dhanyal          | Whole plant      | Stimulant and carminative                                                                | Annual      | Indigenous        | Common    | Arable          |
| Apiaceae          | Foeniculum vulgare             | Kaga vanalay     | Fruit            | Powdered fruit is mixed with sugar, taken with a cup of milk for curing urinary problems (dysuria); dry fruits are carminative and laxative |
| Apiaceae          | Pimpinella diversifolia        | Watani kaga      | Fruit            | Powdered fruits are carminative                                                          | Perennial   | Indigenous        | Scattered | Woodland        |
| Apiaceae          | Heracleum candicans            | Kadu panra       | Root             | Decoction of root against colic and asthma                                             | Perennial   | Indigenous        | Scattered | Wetland         |
| Araceae           | Anisomma japonic               | Marjarai         | Rhizome          | Rhizome bolus is given orally to livestock for respiratory problems                     | Perennial   | Indigenous        | Scattered | Woodland        |
| Araliaceae        | Hedera nepalensis              | Prewata          | Leaves           | Juice from leaves for curing diabetes, also considered as blood purifier                | Woody climber | Indigenous     | Common    | Woodland        |
| Asclepiadaceae    | Periploca aphylla               | Barara           | Stem, fruits     | Milky juice of stern and fruit applied to swellings; stem latex as antimycotic for curing dermatitis in livestock |
| Asteraceae        | Artemisia scoparia              | Jaukay           | Shoot and seeds  | Respiratory stimulant, anthelmintic, purgative and against earache                      | Biennial    | Indigenous        | Common    | Woodland        |
| Asteraceae        | Cichorium intybus              | Han              | Root             | Decoction of fresh root for treatment of fever                                           | Perennial   | Indigenous        | Common    | Ruderal         |
| Asteraceae        | Echinops echinatus             | Ghwand Saray Ghanwala | Root             | Powdered root applied to wounds of cattle for killing maggots; also to kill lice       | Perennial   | Indigenous        | Scattered | Wetland         |
| Asteraceae        | Launaea procumbens             | Shauda pai       | Leaves           | Mixture of powdered leaves with sugar to enhance lactation in livestock                 | Perennial   | Indigenous        | Common    | Ruderal         |
| Asteraceae        | Sonchus asper                   | Shauda pai       | Shoot            | Shoots fed to livestock for enhancing lactation                                          | Annual      | Indigenous        | Common    | Ruderal         |
| Asteraceae        | Taraxacum sp.                   | Ziar gulai       | Leaves and roots | Grinded leaves are tonic, root decoction against kidney and liver disorders           | Perennial   | Indigenous        | Common    | Ruderal         |
| Asteraceae        | Xanthium strumarium             | Ghishkay         | Leaves           | Leaf decoction recommended in malarial fever                                             | Annual      | Indigenous        | Common    | Ruderal         |
Table 1 Medicinal plants of the Miandam area with their medicinal properties, and biological, ecological and chorological characteristics (Continued)

| Family               | Genus                  | Common Name   | Part Used          | Use                                                                 | Life Span | Growth Form | Habitat          |
|----------------------|------------------------|---------------|--------------------|----------------------------------------------------------------------|-----------|--------------|------------------|
| Berberidaceae        | *Berberis lycium*      | Kwaray        | Root bark          | Dried root bark given orally as body tonic                          | Shrub     | Indigenous   | Scattered woodland |
| Berberidaceae        | *Podophyllum hexandrum*| Kakora        | Rhizome            | Powdered rhizome used to cure liver diseases                        | Perennial | Indigenous   | Scattered woodland |
| Boraginaceae         | *Cynoglossum lanceolatum* | Gat Gul      | Whole plant        | Powdered plant taken with a decoction of *Coriandrum sativum* fruits as laxative | Perennial | Indigenous   | Common Woodland   |
| Boraginaceae         | *Onosma hispida*       | Khwaga abai   | Root               | Used to color mustard oil which is applied for smoothing hair       | Perennial | Indigenous   | Common Ruderal   |
| Brassicaceae         | *Brassica campestris*  | Sharshum      | Seeds              | Oil, extracted from seeds, is used as ointment, for massage of body and hair | Annual    | Cultivated   | Common Arable    |
| Brassicaceae         | *Brassica campestris var. rapa* | Tepar       | Leaves, roots      | Against stomachache and ulcer problems                              | Annual    | Cultivated   | Common Arable    |
| Brassicaceae         | *Capsella bursa-pastoris* | Bambesa     | Leaves and seeds   | Paste of fresh leaves with milk for curing diarrhea; seeds are stimulant and diuretic | Annual    | Indigenous   | Common Ruderal   |
| Brassicaceae         | *Nasturtium officinale*| Talmera       | Young shoot        | Young shoot against constipation and stomachache                     | Perennial | Indigenous   | Common Wetland   |
| Buxaceae             | *Sarcococca saligna*   | Ladanr        | Leaves             | Heated in mustard oil and applied to muscular pain; infusion of leaves orally for rheumatism | Perennial | Indigenous   | Common Woodland   |
| Cannabaceae          | *Cannabis sativa*      | Bang          | Leaves             | Leaves in bandage for wound healing; powdered leaves as anodyne, sedative, tonic and narcotic; juice added with milk and nuts as a cold drink ("Tandai") generating a pleasant excitement; "Charah" is also prepared from it | Annual    | Indigenous   | Common Arable    |
| Caprifoliaceae       | *Sambucus wightiana*   | Benakai       | Leaves, fruits and flowers | Poultice from leaves and flowers to treat burns and rheumatism; berries are purgative and used in dropsy | Shrub     | Indigenous   | Rare Woodland    |
| Caprifoliaceae       | *Viburnum grandiflorum*| Ghuze meva    | Fruit              | Fresh fruit is eaten to cure stomach problems                       | Shrub     | Indigenous   | Common Woodland   |
| Caryophyllaceae      | *Arenaria griffithii*  | Kinar         | Shoot              | Dried shoot powder with honey after meal as antispasmodic           | Perennial | Indigenous   | Common Woodland   |
| Caryophyllaceae      | *Silene vulgaris*      | Matorangay    | Shoot              | Shoot against stomachache and as emollient                          | Perennial | Indigenous   | Common Woodland   |
| Caryophyllaceae      | *Stellaria media*      | Oulalai       | Whole plant        | Decoction is considered as purgative                               | Annual    | Indigenous   | Common Arable    |
| Chenopodiaceae       | *Chenopodium album*    | Sarmay        | Whole plant        | Dried powdered plant considered as carminative and diuretic agent   | Annual    | Indigenous   | Common Ruderal   |
| Clusiaceae           | *Hypericum perforatum* | Shin chai     | Shoot              | Used as diuretic and its tea is stimulant and analgesic              | Perennial | Indigenous   | Scattered woodland |

References: Akhtar et al. *Journal of Ethnobiology and Ethnomedicine* 2013, 9:25, http://www.ethnobiomed.com/content/9/1/25
| Family            | Genus/Species            | Common Name     | Part Used         | Medicinal Uses                                                                 | Lifeform   | Origin             | Habitats       |
|-------------------|--------------------------|-----------------|-------------------|--------------------------------------------------------------------------------|------------|--------------------|----------------|
| Convolvulaceae    | Convolvulus arvensis     | Prewatai        | Whole plant       | Purgative, also applied in skin disorders                                      | Perennial, climber | Indigenous         | Common Arable |
| Cuscutaceae       | Cuscuta reflexa          | Zelai           | Whole plant       | Decoction for urine control, diabetes and blood purification; plant extract used as anti-lice | Perennial, climber | Established alien  | Scattered Arable |
| Dioscoreaceae     | Dioscorea deltoidea      | Kanis zelai     | Rhizome           | Powdered rhizome mixed with powdered root of Berberis lycium, the mixture is used for treatment of jaundice and ulcers | Perennial, climber | Indigenous         | Scattered Woodland |
| Ebenaceae         | Diospyros kaki           | Sur amlok       | Ripe fruits       | Laxative                                                                        | Tree       | Cultivated         | Common Arable |
| Ebenaceae         | Diospyros lotus          | Tour amlok      | Dried ripe fruits | Carminative, purgative and causing flatulence; boiled in milk and taken against constipation and dysentery | Tree       | Cultivated         | Common Arable |
| Elaeagnaceae      | Elaeagnus umbellata      | Ghanum ranga    | Flowers, leaves   | Decoction of flowers used twice a day to cure heart diseases; decoction of leaves against cough; mature raw seeds eaten as vitamin C source | Shrub      | Indigenous         | Rare Woodland  |
| Euphorbiaceae     | Euphorbia wallichii      | Shangla         | Whole plant       | Dried leaves and seeds given to children in bowel complaints; plant juice against ringworm | Perennial   | Indigenous         | Common Woodland |
| Euphorbiaceae     | Ricinus communis         | Harhandha       | Seeds             | Seed oil demulcent and to evacuate bowels in children                           | Shrub      | Established alien  | Scattered Ruderal |
| Fabaceae          | Indigofera heterantha    | Ghwarija        | Root and leaves   | Dried powdered root taken with glass of water against scabies; leaves against stomach problems | Shrub      | Indigenous         | Common Woodland |
| Fabaceae          | Lathyrus aphaca          | Korkamanai      | Seed              | Decoction of the seed 3 times a day for wound healing                           | Annual     | Indigenous         | Scattered Arable |
| Fabaceae          | Lotus corniculatus       | Fateh khana     | Whole plant       | Decoction of dried powdered plant with ghee or boiled water against sexual debility and backache | Perennial   | Indigenous         | Scattered Woodland |
| Fagaceae          | Quercus oblongata        | Banj            | Fruit             | Powdered fruits in urinary infection                                            | Tree       | Indigenous         | Common Woodland |
| Fagaceae          | Quercus floribunda       | Tour banj       | Fruit             | Powdered fruits for treating gonorrea and urinary disease                        | Tree       | Indigenous         | Common Woodland |
| Fumariaceae       | Corydalis stewartii      | Mamera          | Floral shoot      | Decoction of floral shoot to cure eye diseases                                  | Biennial   | Indigenous         | Scattered Mountain grassland |
| Geraniaceae       | Geranium wallichianum    | Srazela         | Root              | Root decoction with pods of Pistacia chinensis to treat cough and fever and urinary complaints | Perennial   | Indigenous         | Common Woodland |
| Hippocastanaceae  | Aesculus indica          | Jawaz           | Seeds and bark    | Fruits are anthelmintic and given to horses in colic; plant oil externally used against rheumatism; nuts against colic and to cure chest diseases in horses, donkeys and mules | Tree       | Indigenous         | Scattered Woodland |
Table 1 Medicinal plants of the Miandam area with their medicinal properties, and biological, ecological and chorological characteristics (Continued)

| Family      | Genus          | Common Name | Part Used     | Medicinal Properties                                                                 | Habitat          |
|-------------|----------------|-------------|---------------|--------------------------------------------------------------------------------------|-------------------|
| Juglandaceae| Juglans regia  | Ghwaz       | Fruit, bark, leaves | Dried fruit mixed with coconut and honey used as tonic; bark (locally called Dandasa) for cleaning and sparkling of teeth; decoction of leaves against eczema and intestinal worms | Tree              |
| Lamiaceae   | Ajuga bracteosa| Booti       | Whole plant   | Locally, decoction of the plant or its powder swallowed with water before breakfast for the treatment of throat sore, internal colic, purifying blood and epilepsy; decoction for curing jaundice and hypertension | Perennial Indigenous Common Common Ruderal |
| Lamiaceae   | Mentha spicata | Podina      | Leaves and stem| Carminative                                                                          | Perennial Cultivated Common Common Arable |
| Lamiaceae   | Mentha royleana| Valenay     | Whole plant   | Decoction of leaves for treatment of diarrhea in children; powdered plant mixed with sugar for prevention of vomiting and dyspepsia | Perennial Indigenous Common Common Ruderal |
| Lamiaceae   | Nepeta cataria | Pisho botai | Flowers and leaves | Dried leaves and flowering tops carminative                                           | Perennial Indigenous Scattered Mountain grassland |
| Lamiaceae   | Otostegia limbata | Spin azghai | Whole plant | Juice of leaves applied to gums for treatment of gum problems in children; dried powder of plant is used in jaundice | Perennial Indigenous Common Woodland |
| Lamiaceae   | Isodon rugosus | Spearkai    | Leaves        | Dried leaves put in mouth as remedy for toothache                                      | Shrub             |
| Lamiaceae   | Oreganum vulgare | Shamakay  | Whole plant   | Diuretic and against toothache and earache                                            | Perennial Indigenous Common Woodland |
| Lamiaceae   | Salvia lanata  | Spera botai | Leaves        | Paste of leaves applied to toes laceration in hot and moist season                     | Perennial Indigenous Scattered Woodland |
| Lamiaceae   | Salvia moorcroftiana | Kherghwag | Leaves        | Brassica campestris oil applied to fresh leaves tied round for healing of wounds       | Perennial Indigenous Common Ruderal |
| Lamiaceae   | Thymus linearis| Chi botai   | Shoots        | Tea of shoots advised for treating pain and fever                                       | Perennial Indigenous Common Mountain grassland |
| Liliaceae   | Allium sativum | Ouga        | Bulb and leaves | Boiled and the cooled extract administered against diarrhea, dysentery and for lowering blood pressure; bulbs stimulant; leaves diuretic, aphrodisiac and expectorant; antiseptic; juice applied to soothe irritation caused by scorpion and hornet stings | Perennial Cultivated Common Arable |
| Family      | Genus                  | Species          | Part(s)          | Uses                                                                 | Habit          | Origin           | Type         | Type          |
|-------------|------------------------|-------------------|------------------|----------------------------------------------------------------------|----------------|------------------|--------------|---------------|
| Liliaceae   | Allium cepa            | Piaz              | Bulb and leaves  | Bulbs stimulant; leaves diuretic; aphrodisiac and expectorant; also antiseptic and juice applied to soothe irritation caused by scorpion and hornet sting; Mountaineers have it with them while crossing high altitude passes as it enhances the intake of oxygen | Perennial      | Cultivated      | Common       | Arable        |
| Liliaceae   | Colchicum luteum       | Qaimat guallay    | Whole plant      | Blood purifier, laxative and aphrodisiac; fried corms are used for joints pain | Perennial      | Indigenous      | Rare         | Mountain grassland |
| Liliaceae   | Polygonatum multiflorum| Noorealam         | Rhizome          | Rhizome infusion against dysentery; referred aphrodisiac              | Perennial      | Indigenous      | Scattered    | Woodland      |
| Liliaceae   | Polygonatum verticillatum| Noorealam        | Rhizome          | Against rheumatism and as aphrodisiac                                | Perennial      | Indigenous      | Scattered    | Woodland      |
| Malvaceae   | Abelmoschus esculentus | Bhindi            | Fruits           | Emollient, demulcent and diuretic                                    | Annual         | Cultivated      | Scattered    | Arable        |
| Malvaceae   | Melia azedarach        | Tora bakyana, shandai | Fruits, shoots, bark, leaves                                      | Dried, crushed fruits against gastric trouble, fever and cough; dry leaves mixed with wheat flour used as anthelmintic in livestock; decoction of the bark considered anti-allergic; extraction of leaves used by women against head lice; leaves, young branches or fermented fruits are given as carminative to cattle, when belly is swollen through gas accumulation due to overeating | Tree           | Established     | Scattered    | Woodland      |
| Moraceae    | Ficus palmata          | Inzer             | Flowers and fruits | Fresh floral parts as demulcent; juice extracted from fruit as expectorant | Tree           | Cultivated      | Common       | Arable        |
| Moraceae    | Morus alba             | Toot              | Fruit            | Fruit to treat constipation and cough | Tree           | Indigenous      | Common       | Arable        |
| Oleaceae    | Jasminum humile        | Rambil chambil    | Roots and flowers | Powdered roots as anthelmintic and diuretic; juice extracted from flowers against skin diseases, headache and mouth rash | Shrub          | Indigenous      | Rare         | Woodland      |
| Oleaceae    | Olea europaea          | Khona             | Leaves           | Decoction of leaves as gargle considered as remedy for toothache, mouth and gum diseases | Tree           | Cultivated      | Scattered    | Arable        |
| Oxalidaceae | Oxalis corniculata     | Tarukey           | Whole plant      | Decoction of plant to enhance digestion                               | Annual         | Indigenous      | Common       | Ruderal       |
| Paeoniaceae | Paeonia emodi          | Mamekh            | Rhizome          | Powdered rhizome with milk to cure backache and general weakness      | Perennial      | Indigenous      | Scattered    | Woodland      |
| Papaveraceae| Papaver somniferum     | Qashqash          | Capsule, seeds   | Capsules and seeds as narcotic; dried capsule to make tea for cough and fever | Annual         | Indigenous      | Scattered    | Arable        |
| Plantainaceae | Plantago lanceolata | Jabai | Leaves | Leaves applied to treat bedsores, inflamed surfaces and candidiasis | Perennial | Indigenous | Scattered | Ruderal |
|--------------|---------------------|-------|--------|---------------------------------------------------------------|-----------|------------|-----------|---------|
| Plantainaceae | Plantago major | Ghwa jabai | Seeds, leaves | Leaves applied to treat bedsores and candidiasis | Perennial | Indigenous | Scattered | Ruderal |
| Platanaceae | Platanus orientalis | Chinar | Bark | Powdered bark taken orally to control diarrhea | Tree | Indigenous | Scattered | Woodland |
| Poaceae | Avena sativa | Jamdaray | Fruit | Fried in ghee and milk, the paste is considered as general body tonic and aphrodisiac | Annual | Cultivated | Common | Arable |
| Poaceae | Cynodon dactylon | Kabal | Whole plant | Decoction as blood purifier and to control nose bleed; chewed and placed on wound to stop bleeding and as topical anti-septic | Perennial | Indigenous | Common | Ruderal |
| Polygonaceae | Rumex dentatus | Shalkhay | Rhizome, leaves | Rhizome and leaves as poultice for wound healing | Annual | Indigenous | Common | Ruderal |
| Portulacaceae | Portulaca oleracea s.l. | Warkharae | Shoot | Shoot decoction against liver and kidney diseases | Annual | Cultivated | Common | Arable |
| Primulaceae | Primula denticulata | Mamera | Stem base | Infusion of young stem base ophthalmic | Perennial | Indigenous | Common | Woodland |
| Punicaceae | Punica granatum | Nangoray, Anar | Fruit | Dried fruit in bolus form for removal of intestinal helminths | Shrub | Cultivated | Scattered | Arable |
| Ranunculaceae | Aconitum violaceum | Zaharmora, Da Ghra Zahar | Rhizome | Rhizomes, wrapped in sheep or goat intestine and thoroughly boiled in milk; milk discarded and rhizomes crushed into powder, taken against rheumatism and arthritis; administering as such may cause death or mental problems if overdozed | Perennial | Indigenous | Rare | Woodland |
| Ranunculaceae | Caltha alba | Makan path | Leaves | Leaves laxative in nature | Perennial | Indigenous | Scattered | Wetland |
| Ranunculaceae | Delphinium denudatum | Jadwar | Rhizome | Rhizome powder with water to cure cough and fever | Perennial | Indigenous | Scattered | Woodland |
| Rosaceae | Fragaria bucharica | Da zmaki toot | Root, fruit | Powdered root useful in disease of urinary tract; fruits carminative and laxative | Perennial | Indigenous | Common | Woodland |
| Rosaceae | Prunus armeniaca | Khubanai | Stem | Gum obtained from stem famed as anticancer | Tree | Cultivated | Common | Arable |
| Rosaceae | Prunus domestica | Alucha | Fruits | Fruit laxative | Tree | Cultivated | Common | Arable |
| Rosaceae | Rosa moschata | Gulab | Flowers | Decoction of flowers for curing stomach disorders | Shrub | Indigenous | Scattered | Woodland |
| Rosaceae | Spiraea spec. | Krachae | Flowers | Tea from its flowers to ease natal pain | Shrub | Indigenous | Common | Woodland |
| Family       | Genus and Species           | Common Name | Part(s) Used | Medicinal Properties                                                                 | Growth Form | Indigenous Distribution |
|--------------|----------------------------|-------------|--------------|---------------------------------------------------------------------------------------|-------------|-------------------------|
| Rutaceae     | Skimmia laureola           | Nazar pana  | Leaves       | Burnt incense to expel evils and evil eyes; tea for indigestion, smoke considered as antiseptic | Shrub       | Indigenous, Common, Woodland |
| Rutaceae     | Zanthoxylum armatum        | Dambbara    | Fruit        | Fruits as antipyretic and for treating stomachache                                     | Shrub       | Indigenous, Scattered, Woodland |
| Saxifragaceae| Bergenia stracheyi         | The Spinsar Gat Pana | Rhizome  | Powdered rhizome with milk in the mornings as tonic                                    | Perennial   | Indigenous, Common, Woodland |
| Simaroubaceae| Ailanthus altissima        | Backyanra   | Bark         | Bark juice mixed with milk to cure dysentery and diarrhea                              | Tree        | Established, Common, Arable |
| Solanaceae   | Atropa acuminata           | Bargak      | Leaves       | Poulstice of leaves against pain and rheumatism                                        | Perennial   | Indigenous, Scattered, Woodland |
| Solanaceae   | Capsicum annuum            | Marchakay   | Fruits       | Carminative                                                                           | Annual      | Cultivated, Common, Arable |
| Solanaceae   | Datura stramonium          | Batora      | Leaves, seeds and flowers | Poulstice of flowers applied to wounds to reduce pain; seeds narcotic in nature      | Annual      | Indigenous, Common, Ruderal |
| Solanaceae   | Solanum nigrum             | Kachmacho   | Leaves and fruit | Leave paste applied to treat skin inflammation, fruits against fever                      | Annual      | Indigenous, Common, Ruderal |
| Solanaceae   | Solanum virginianum        | Marraghonay | Fruit        | Decoction of fruit diuretic and anthelmintic                                            | Perennial   | Indigenous, Scattered, Ruderal |
| Solanaceae   | Withania somnifera         | Kotilal     | Whole plant  | Aphrodisiac                                                                           | Shrub       | Indigenous, Scattered, Ruderal |
| Thymelaeaceae| Daphne mucronata           | Laighonai   | Fruits, leaves| Poulstice from fruits and leaves against rheumatism                                      | Shrub       | Indigenous, Common, Woodland |
| Ulmaceae     | Celtis australis           | Tagha       | Fruits, bark | Fruits against colic and amenorrhea; bark decoction as anti-allergic                    | Tree        | Indigenous, Scattered, Woodland |
| Urticaceae   | Debregeasia saeneb         | Ajlai       | Leaves       | Fresh ground leaves in paste form for blistered feet                                   | Shrub       | Indigenous, Common, Woodland |
| Verbinaceae  | Verbena officinalis        | Sharnakai   | Whole plant  | Decoction is anti-malarial                                                            | Perennial   | Indigenous, Common, Ruderal |
Selected Plant Families (http://apps.kew.org/wcsp/home.do) and The Plant List (www.theplantlist.org/). Family assignment in this paper follows the Flora of Pakistan [25].

Results and discussion
Plant diversity, use and applications
A total of 106 ethno-medicinal plant species belonging to 96 genera and 54 plant families were recorded. The plants have been used to treat a wide range of diseases from simple headache to complex disorders of kidney and liver. The results are presented in Table 1 with family names in alphabetical order, taxon name, local name, parts used, medicinal use, growth form, plant status, frequency and habitat preference. Perennial herbs were the most common growth form among medicinal plants (43%), followed by annuals and biennials (23%), shrubs (16%) and trees (15%) As far as documented the use of herbs for remedy preparation in the study area is in consistence with other studies [11,26-40].

Ninety-nine of the species (93%) are used for human ailments, three species (3%) for livestock cure and four (4%) to treat both human and livestock ailments. No less than 44 plant species were used to treat gastro-intestinal disorders such as dyspepsia, dysentery and stomach-ache followed by the treatment of dermatological diseases with more than 25 herbal remedies. Ten species were used against skeletal-muscular complaints like rheumatism, backache and muscular pain. Sixteen species were used to cure respiratory problems such as cough and asthma, fourteen for urinary complaints, twelve for cardio-vascular complaints and circulatory diseases, twelve to treat fever and headache, eleven for genital and sexual diseases, six for dental problems, six for ear, nose, throat (ENT) and eyes diseases, two for nerve disorders, one species (Spiraea spec.) was used to ease childbirth, and eighteen species for other purposes (wounds, cuts, narcotic, tonic, anticancer and tumor) (Table 2). The leaves of Skimmia laureola are used for spiritual purposes.

A single plant species may be used to cure several human ailments (Table 2). Some of the remedies were prepared by combining different plants such as the powdered rhizome of Dioscorea deltoidea mixed with powdered root of Berberis lycium for the treatment of jaundice and ulcers. Similarly, root decoction of Geranium wallichianum with pods of Pistacia chinensis was used for curing urinary complaints, cough and fever. According to traditional healers, complex medicines of two or more plant species are more potent than those prepared with single species. This has been attributed to interactive effects of the plants [41]. The most common medicinal recipe preparation was in powder form followed by decoction, infusion, juices, poultice and paste.

The traditional healers and local herbalists of the region usually utilize every part of the plant. However, the use of a particular plant part depends on the plant habit and user’s needs. The most frequently used plant parts in the preparation of herbal remedies were leaves (29%), followed by fruit (18%), roots and rhizomes (17%), and whole plants (7%). Seeds (9%), flowers (8%), bark (7%), bulbs (2%), capsules, floral shoots and insect gall (1% each) have also been used. The use of specific plant parts suggests that these parts have strongest medicinal properties but it needs biochemical analysis and pharmaceutical screening to cross-check the local information. Our findings of the frequent use of green leaves in the preparation of remedies corroborate the results of [42-46].

Different liquids such as water, juices, sugar, tea, honey, mustard oil, desi ghee (butter) and milk are mixed with plants or plant parts during the preparation of the remedies. The prepared remedies are mostly administered orally (77%), less frequently dermally (10%) or both orally and dermally (12%). Only 1% is administered through ears or eyes.

Habitats and conservation of ethno-medicinal plants
Eighty-two out of 106 medicinal plants are indigenous to the area while the others are cultivated (19) or established alien plants (5). The latter groups are of no conservation concern as they are common (17) or scattered (7) in the study area. Also among the indigenous medicinal plants the majority of species is common (59%) or scattered (35%) in the area, thus neither of immediate conservation concern. Only five medicinal plant species (6%) are rare in the study area: Aconitum violaceum, Colchicum luteum, Elaeagnus umbellata, Jasminum humile and Sambucus wightiana. Sambucus and Elaeagnus are woodland shrubs of which leaves and fruits or leaves and flowers, respectively, are collected for medicinal purposes. Since this kind of harvesting is non-destructive, the rarity of the shrub species is apparently not caused by overcollection. In contrast, populations of Aconitum violaceum, Colchicum luteum and Jasminum humile may be harmed since rhizomes, corms or whole plants are collected, respectively. In these cases, plant populations should be monitored to avoid overcollection.

The synanthropic flora (i.e., occurring in arable fields or ruderal sites) contains a high proportion of the ethno-medicinal plants. Slightly under 50% (51) out of the 106 ethno-medicinal plant species occur in man-made habitats (in arable fields 27 species, most of which being cultivated; another 24 in ruderal sites). Since they can be expected to grow abundantly in or near settlements, or are even cultivated and harvested, they may be collected without much effort, and in suitable quantities. Slightly more than 50% (55) of the ethno-medicinal plant species encountered in the study area occur in semi-natural habitats (though extensively grazed or otherwise used). Most species of the latter group (47) occurred in
different kinds of woodland, while only few occur in wetlands (4) and mountain grasslands (4). Mountain grassland medicinal plants known in the Miandam valley comprise Colchicum luteum, Corydalis stewartii, Nepeta cataria and Thymus linearis. Since Himalayan mountain floras are rich [45-47] and the local almost certainly contains more species of pharmaceutical value, we assume that the habitat is too remote and too difficult to access to be of much interest as a “medicinal plant hunting area” for the people in the Miandam valley.

Woodlands are the main source for non-synanthropic indigenous medicinal plants. They comprise 21 woody plants (apart from the climber Hedera nepalensis, seven trees and thirteen shrubs), two short-lived and 24 perennial herbs. Almost half of the perennial herbs are dug to collect the stem base (Primula denticulata) or chiefly the rhizomes (Aconitum violaceum, Arisaema jacquemontii, Bergenia griffithii, Artemisia scoparia, Delphinium denudatum, Elaeagnus umbellata, Ficus palmata, Geranium wallichianum, Henacyleum candidans, Melia azedarach, Morus alba, Papaver somniferum, Ricinus communis)

| Syndrome category | Plants |
|-------------------|--------|
| Gastrointestinal disorders | Aesculus indica, Alanthus altissima, Ajuga bracteosa, Allium sativum, Artemisia scoparia, Brassica campestris var. rapa, Bupleurum longicaule, Capsella bursa-pastoris, Caltha palustris, Celsis australis, Capsicum annuum, Chenopodium album, Colchicum luteum, Convallaria arvensis, Coriandrum sativum, Cynoglosus lanceolatum, Dioscorea deltoidea, Diospyros kaki, Diospyros lotus, Euphorbia wallichii, Foeniculum vulgare, Fragaria chusanica, Heracleum candicans, Hypericum perforatum, Indigofera heterantha, Jasminum humile, Melia azedarach, Mentha spicata, Mentha royleana, Nasturtium officinale, Nepeta cataria, Oxalis comiculata, Pimpinella diversifolia, Plantago major, Platani orientalis, Polygonatum verticillatum, Prunus domestica, Pumica granatum, Ricinus communis, Rosa moschata, Sambucus wightiana, Skimmia laurenula, Solanum nigrum, zincodorum, Zanthoxylum armatum |
| Dermatological and topical diseases | Abelmoschus esculentus, Allium cepa, Allium sativum, Amaranthus viridis, Brassica campestris, Celsis australis, Convallaria arvensis, Cuscuta reflexa, Cynodnon dactylon, Datura stramonium, Debregesia saeneb, Echinops echninatus, Euphorbia walllichii, Indigofera heterantha, Jasminum officinale, Juglans regia, Melia azedarach, Onosma hisipda, Periploca aphylla, Pistacia chinensis, Plantago lanceolata, Plantago major, Salvia lanata, Sambucus wightiana, Silene vulgaris, Skimmia laurenula, Solanum nigrum |
| Respiratory illness | Abelmoschus esculentus, Allium cepa, Allium sativum, Amaranthus viridis, Arisaema jacquemontii, Arenaria griffithii, Artemisia scoparia, Delphinium denudatum, Elaeagnus umbellata, Ficus palmata, Geranium wallichianum, Henacyleum candicans, Melia azedarach, Morus alba, Papaver somniferum, Ricinus communis |
| Skeleto-muscular problems | Aesculus indica, Aconitum violaceum, Atropa acuminata, Colchicum luteum, Daphne mucronata, Lotus corniculatus, Parma emodi, Polygonatum verticillatum, Sambucus wightiana, Sarcococca saligna |
| Cardio-vascular complaints and circulatory diseases | Ajuga bracteosa, Allium sativum, Colchicum luteum, Cuscuta reflexa, Dioscorea deltoidea, Elaeagnus umbellata, Hedera nepalensis, Ototegia limbat, Pistacia chinensis, Podophyllum hexandrum, Portulaca oleracea, Taraxacum spec. |
| Fever, headache, analgesic | Cichorium intybus, Delphinium denudatum, Geranium wallichianum, Hypericum perforatum, Jasminum humile, Melia azedarach, Papaver somniferum, Solanum nigrum, Thymus lineani, Verbena officinalis, Xanthium strumarium, Zanthoxylum armatum |
| Urinary complaints | Abelmoschus esculentus, Allium cepa, Allium sativum, Capsella bursa-pastoris, Chenopodium album, Cuscuta reflexa, Foeniculum vulgare, Fragaria vesca, Hypericum perforatum, Portulaca oleracea, Quercus oblangeata, Quercus fimbunda, Solanum virginianum, Taraxacum spec. |
| Dental problems | Isodon rugosus, Juglans regia, Olea europaea, Origanum vulgare, Ototegia limbat, Rumex dentatus |
| ENT complaints | Ajuga bracteosa, Artemisia scoparia, Corydalis stewartii, Origanum vulgare, Primula denticulata |
| Nerve disorders (anodyne, epilepsy, sedative) | Ajuga bracteosa, Cannabis sativa |
| Genital and sexual diseases | Allium cepa, Allium sativum, Avena sativa, Celsis australis, Colchicum luteum, Geranium wallichianum, Lotus corniculatus, Polygonatum multiflorum, Polygonatum verticillatum, Quercus dilatata, Withania somnifera |
| Others (wounds, cuts, narcotic, tonic, tumor, anticancer and stimulant) | Allium cepa, Allium sativum, Avena sativa, Berberis lycium, Bergenia stracheyi, Cannabis sativa, Capsella bursa-pastoris, Coriandrum sativum, Cynodnon dactylon, Datura stramonium, Juglans regia, Lathyrus aphaca, Paeonia emodi, Papaver somniferum, Periploca aphylla, Prunus armeniaca, Salvia macrosphila, Taraxacum spec. |
| Delivery | Spiraea spec. |
two, these species are range-restricted taxa of Himalayan or narrower distribution. Due to their biochemical components they are largely unpalatable for livestock, hence fairly resistant under the widespread practice of wood-pasture, but may be vulnerable to overcollecting for medicinal purposes, although so far only Aconitum violaceum is considered rare in the study area. A currently more serious threat to the ethno-medicinal plant wealth of the woodlands as well as to the social and economic basis of the rural population in northern Pakistan is excessive timber exploitation leading to deforestation and habitat destruction.

**Conclusion**

The Miandam valley in northern Pakistan is very rich in commercially and pharmaceutically important ethno-medicinal plant species. The locals, in particular traditional healers, have centuries-old knowledge regarding the uses of the plants, and the locals use these species in a traditional way for curing a wide spectrum of diseases. Few species were found to be vulnerable probably due to overcollection. Especially perennial woodland herbs with rhizomes are of conservation concern. The local inhabitants depend on plants for the treatment of diseases but not all are familiar with the proper collection, parts to be used, preservation and storage. In contrast, local traditional healers are familiar with proper collection and use of medicinal plants, and they should be involved in efforts of conservation and sustainable use of ethno-medicinal plant resources. In view of the outstanding importance and ecosystem services of woodlands and forests in northern Pakistan the currently widespread and uncontrolled deforestation is a serious threat both to ecological and social sustainability as well as to the long-term economic basis of the local population [19]. It is also a threat to the ethno-medicinal plant wealth. For purposes of plant conservation and to increase the locals’ income we suggest to cultivate vulnerable woodland medicinal plants of commercial value in newly designed and locally administered self-government agroforestry systems. Due to the specific habitat demands of many woodland plant species better results may be obtained through well managed agroforestry systems than in ex-situ sites [48].

**Competing interests**

The authors declare that they have no competing interests.

**Authors’ contributions**

NA carried out the field work, analyzed the data and drafted the manuscript. EB revised the whole manuscript and contributed to the editing and interpreting of the data. AR conceptualized and designed the study while WM helped in the initial drafting of the manuscript. All authors read and approved the final manuscript.

**Acknowledgements**

This research was funded by HEC (Higher Education Commission of Pakistan) under the Faculty Development Program of the Islamia College University Peshawar, Pakistan. We are indebted to all villagers, guides and informants who shared their knowledge with us.

**Author details**

1. Department of Botany, Islamia College University, Peshawar 25000, Pakistan.
2. Department of Vegetation Analysis and Phytodiversity, Albrecht von Haller Institute of Plant Sciences, Georg August University, Göttingen 37073, Germany.
3. Centre of Plant Diversity, University of Peshawar, Peshawar 25000, Pakistan.
4. Department of Botany, Kohat University of Science and Technology, Kohat 26000, Pakistan.

**Received: 26 November 2012 Accepted: 8 April 2013**

**Published: 15 April 2013**

**References**

1. Bakó SP, Bakfur MJ, John J, Bala EI: Ethnomedicinal and phytochemical profile of some savanna plant species in Nigeria. Int J J Bot 2005, 11:147–150.
2. WHO: Traditional medicine, growing needs and potential. WHO Policy Perspectives on Medicines 2002, 2:1–6.
3. Shinwari ZK: Medicinal plants research in Pakistan. J Med Plants Res 2010, 4:161–176.
4. Abbasi AM, Khan MA, Ahmad M, Zafar M: Medicinal plant biodiversity of Lesser Himalayas, Pakistan. New York, Dordrecht, Heidelberg, London: Springer; 2012.
5. Sher Z, Khan Z, Hussain F: Ethnobotanical studies of some plants of Chagharzai Valley, District Buner, Pakistan. Pakistan J Bot 2011, 43:1445–1452.
6. Shinwari ZK, Rehman M, Watanabe T, Yoshikawa Y: Medicinal and aromatic plants of Pakistan: A pictorial guide. Kohat, PK: Kohat University of Science and Technology; 2006.
7. Hussain F, Shah SM, Sher H: Traditional resource evaluation of some plants of Mastuj, District Chitral, Pakistan. Pakistan J Bot 2007, 39:339–354.
8. Ibrar M, Hussain F, Amir S: Ethnobotanical studies on plant resources of Ranyal hills, District Shangla, Pakistan. Pakistan J Bot 2007, 39:329–337.
9. Khan SW, Khatoon S: Ethnobotanical studies of some useful herbs of Haramosh and Bugrote valleys in Gilgit, Northern areas of Pakistan. Pakistan J Bot 2008, 40:43–58.
10. Sher H, Hussain SK: Ecological survey and rapid vulnerability assessment of medicinal and aromatic plants of Mandam, Pakistan. Peshawar, PK: WWF PK; 2007.
11. Ali H, Qaiser M: The ethno-botany of Chitral Valley, Pakistan, with particular reference to medicinal plants. Pakistan J Bot 2009, 41:2009–2041.
12. Hamayun M, Khan SA, Sohni EY, Lee UJ: Folk medicinal knowledge and conservation status of some economically valued medicinal plants of District Swat, Pakistan. J Ethnopharmacol 2006, 11:101–113.
13. Hussain F, Sher H, Ibrar M, Durani MJ: Ethnomedicinal uses of plants of District Swat, Pakistan. Pakistan J Plant Sci 2011, 11:137–158.
14. Sher H, Hussain F: Ethnobotanical evaluation of some plant resources in Northern part of Pakistan. J Biotechnol 2006, 84:4066–4076.
15. Shinwari ZK, Gilani SS: Sustainable harvest of medicinal plants at Bulasba Nullah, Astore (Northern Pakistan). J Ethnopharmacol 2003, 84:289–298.
16. Adnan SM, Khan A, Latif A, ShinwariZA: Threats to the sustainability of ethno-medicinal uses in Northern Pakistan. A case study of Miandam valley, District Swat, NWFP, Pakistan. J Ethnopharmacol 2002, 84:4066–4076.
17. Porter SC: Quaternary glacial record in Swat Kohistan, West Pakistan. Geol Soc Am Bull 1970, 81:1421–1446.
18. Rechid M: Resource management plan for Swat Forest Range of Swat Forest Division. Forest Management Center NWFP, Forest Department & Intercooperation SDC: Government of Switzerland; 1999.
19. Rabbif, Bauer S, Ildaliya J: Contribution of forests to rural inequality reduction: present scope and future options for rural development and sustainable use of forests. Int J J Dev World 2010, 17:4–14.
20. Nüsser M, Dickoré WB: A tangle in the triangle: vegetation map of the eastern Hindukush (Chitral, northern Pakistan). Erdkunde 2002, 56:37–59.
21. Eberhardt E, Dickoré WB, Miehe G: Vegetation map of the Batura Valley (Hunza Karakorum, North Pakistan). Erdkunde 2007, 61:95–112.
22. Nasir E, Ali SI: Flora of Pakistan. No. 1-131. Karachi, PK: University of Karachi; 1970–1979.
23. Nasir E, Ali SI: Flora of Pakistan. No. 132–192. Karachi, PK: University of Karachi; 1980–2005.
24. Nasir E, Ali SI: Flora of West Pakistan and Kashmir. Islamabad: Pakistan Agriculture Research Council; 1970–1995.
25. Ali SI, Qaiser M: Flora of Pakistan. Karachi, PK: University Press; 1993–2012.
26. Abbasi AM, Khan MA, Ahmad M, Zafar M, Khan H, Muhammad N, Sultan S: Medicinal plants used for the treatment of jaundice and hepatitis based on socio-economic documentation. *African J Biotechnol* 2009, 8:1643–1650.

27. Adnan M, Hölscher D: Medicinal plant abundance in degraded and reforested sites in Northwest Pakistan. *Mit Res Dev* 2010, 30:25–32.

28. Ali H, Sannai J, Sher H, Rashid A: Ethnobotanical profile of some plant resources in Malam Jabba valley of Swat, Pakistan. *J Med Plants Res* 2011, 5:4676–4687.

29. Awan MR, Iqbal Z, Shah SM, Jamal Z, Jan G, Afzal M, Majid A, Gul A: Studies on traditional knowledge of economically important plants of Kaghan Valley, Mansehra District, Pakistan. *J Med Plants Res* 2011, 5:3958–3967.

30. Badshah L, Hussain F: People preferences and use of local medicinal flora in District Tank, Pakistan. *J Med Plants Res* 2011, 5:22–29.

31. Hazrat A, Shah J, Ahmad S, Nisar M, Jan AK, Sikanand: Medicinal plants of Usherai Valley, Dir, NWFP, Pakistan. *Pakistan J Bot* 2010, 42:31–34.

32. Iqbal H, Sher Z, Khan Z: Medicinal plants from salt range, Pind Dadan Khan, District Jhelum, Punjab, Pakistan. *J Med Plants Res* 2011, 5:2157–2168.

33. Jabeen A, Khan MA, Ahmad M, Zafar M, Ahmad F: Indigenious uses of economically important flora of Margallah Hills National Park, Islamabad, Pakistan. *Afr J Biotechnol* 2009, 8:763–784.

34. Jan G, Khan MA, Farhatullah, Jan FG, Ahmad M, Jan M, Zafar M: Ethnobotanical studies on some useful plants of Dir Kohistan valleys, KPK, Pakistan. *Pakistan J Bot* 2011, 43:1849–1852.

35. Khan M, Musharraf S, Shrivastva ZK: Ethnobotanical importance of halophytes of Noshipho salts mine, District Karak, Pakistan. *Res Pharmacuet Biotechnol* 2011, 3:46–52.

36. Mahmood A, Qureshi RA, Mahmood A, Sangi Y, Shaheen H, Ahmad I, Nawaz Z: Ethnobotanical survey of common medicinal plants used by people of District Mirpur, AJK, Pakistan. *J Med Plants Res* 2011, 5:4493–4498.

37. Razaq A, Rashid A, Ali H, Ahmad H, Islam M: Ethnomedicinal potential of plants of Changa Valley District, Shangla, Pakistan. *Pakistan J Bot* 2010, 4:3463–3475.

38. Pieroni A, Sheikh QZ, Ali W, Tony B: Traditional medicines used by Pakistani migrants from Mirpur living in Bradford, northern England. *Complement Ther Med* 2008, 16(2):81–86.

39. Teklehaimanot T, Giday M: Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. *J Ethnobiol Ethnomed* 2007, 3:1–21.

40. Yineger H, Kelbessa E, Bekele T, Lulekai E: Plants used in traditional management of human ailments at Bale Mountains National Park, South eastern Ethiopia. *J Med Plants Res* 2008, 2:132–153.

41. Okello J, Siegawa P: Medicinal plants used by communities of Ngai Subcounty, Apac District, northern Uganda. *Afr J Ecol* 2007, 45:76–83.

42. Kala CP: Ethnomedicinal botany of the Apatani in the eastern Himalayan region of India. *J Ethnobiol Ethnomed* 2005, 1:11–18.

43. Muthu C, Ayyanar M, Raja N, Ignacimuthu S: Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. *J Ethnobiol Ethnomed* 2006, 2:483–53.

44. Mundal W, Ahmad A, Gilani SA, Khan MA: Indigenous knowledge and folk use of medicinal plants by the tribal communities of Hazar Nao Forest. *J Med Plants Res* 2011, 5:1072–1086.

45. Adnan M, Begum S, Khan AL, Tareen AM, Lee I-J: Medicinal plants and their uses in selected temperate zones of Pakistani Hindukush-Himalaya. *J Med Plants Res* 2012, 6:4113–4127.

46. Bhat JA, Kumar M, Bussmann RW: Ecological status and traditional knowledge of medicinal plants in Kedarnath Wildlife Sanctuary of Garhwal Himalaya India. *J Ethnobiol Ethnomed* 2013, 9:1.

47. Khan SM, Page S, Ahmad H, Shaheen H, Ullah Z, Ahmad M, Harper DM: Medicinal flora and ethnoecological knowledge in the Naran Valley, Western Himalaya, Pakistan. *J Ethnobiol Ethnomed* 2013, 9:4.

48. Sher H, Hussain F, Sher H: Ex-situ management study of some high value medicinal plant species in Swat, Pakistan. *Ethnobot Res Appl* 2010, 8:17–24.

doi:10.1186/1746-4269-9-25

Cite this article as: Akhtar et al.: Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. *Journal of Ethnobiology and Ethnomedicine* 2013 9:25.