

## Review

# Medicinal plants research in Pakistan

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Accepted 2 December, 2009

Out of about 258,650 species of higher plants reported from the world; more than 10% are used to cure ailing communities. Beside many known drugs (e.g. tubocurarine, reserpine, aspirin and morphine etc) are discovered based on traditional knowledge. Majority of the people in Pakistan rely on medicinal plants to find treatment for their minor, even in some cases major diseases. Some wild plants are now being commonly used e.g. *Ephedra*, *Artimisia*, St. John's wort, *Hippophae* beside some that have been domesticated e.g. Garlic, *Ginseng* and Cumin etc. There is a local market system (Pansara) specifically dealing with medicinal plants business in Pakistan and several plants are exported. Plants having active constituents are used to treat various ailments in both human and animal. In most instances, certain plant species are considered specific for a particular illness but occasionally they have mixed usage. Women, followed by children, are identified as the principal collectors of medicinal plants. Due to over-collection, several species have gone extinct in the Hindukush-Himalayan regions. Local collectors, vendors, herbal drug dealers and others are the ones who threaten the flora of Pakistan contribute (though unknowingly) to the extinction of some and bringing others to the brink of extinction. Though medicinal plants from wild are important source of income for local communities, but if not properly managed, this may lead to the destruction of habitat and in return extinction of species. There is therefore, a need to find ways to harvest medicinal plants sustainably from the wild, train local collectors (in proper collection techniques, train the people in growing medicinal plants, and remove some of the middlemen from the trading chain. In the present article, an effort was made to review the status of medicinal plants research in Pakistan.

**Key words:** Medicinal plants of Pakistan, research and development, conservational issues, marketing, problems and prospects.

## INTRODUCTION

Pakistan has an area of 80,943 km<sup>2</sup>, lies between 60° 55' to 75° 30' E longitude and 23° 45' to 36° 50' N latitude. Pakistan has an altitude ranging from 0 to 8611 m, therefore, has a variety of climatic zones and a unique biodiversity. It has about 6,000 species of higher plants. It has been reported that 600 to 700 species are used for medicinal purposes. It has also been estimated that 70% of the total species are uni-regional and about 30% are bi-or pluri-regional. The country has four phytogeographical regions: (i) Irano-Turanian (45% of species); (ii) Sino-Himalayan (10%); (iii) Saharo-Sindian (9.5%); (iv) Indian element (6%) (Figure 1). Despite the Saharo-Sindian Region being the biggest area, the diversity of species confined to this area is lowest for any phytogeographical region (Ali and Qaiser, 1986).

Major research activities on medicinal plant research in Pakistan are on the documenting level. The research is being conducted mainly in universities and that too as

ethnobotanical listing of resources. The local communities of different regions of Pakistan have centuries old knowledge about traditional uses of the plants occurring in their areas. This indigenous knowledge of plants has been transferred from generation to generation. These plants are used to treat almost any kind of disease from headache to Stomachic to cut and wound (Bhardwaj and Gakhar, 2005). Some of the important plants are commercially harvested for extraction of various types of active ingredients. Though different systems of *Unani*, *Ayurvedic* [Eastern medicines] are largely based on the medicinal properties of plants, yet the precious wealth of indigenous knowledge is in danger of being lost. The use of traditional knowledge also reflects the values embedded in the traditions upheld by elders, especially with regard to medicine.

Medicinal plants practitioners know that respecting

plants is often essential to the efficacy of medicines, which should not be seen as 'miracle' cures based on chemical compounds, but due to curative energy that draws its medicinal qualities founded on a relationship between the plants and the people (Juden, 2003). There are few educational institutes where they are studying practical implications of medicinal plants. Major reason of use of plants as medicines is that medicinal plants contain synergistic and/or side-effects neutralizing combinations (Gilani and Atta-ur-Rahman, 2005). There is also a concern about the harmful effects of synthetic chemicals; hence, trends are changing towards natural products. Besides the research based activities, the medicinal plants from the wild resources are also exploited for commercial purposes which lead to the endangerment of species in their respective habitats. Though these medicinal plants are also important sources of income for poor people as well as for herbal dealers, and exporters but still no cultivation practices for these medicinal plants are observed in Pakistan. The current review paper will focus on issues of current status of medicinal plants in Pakistan, cultivation practices, conservation and their sustainable utilization as an income generation activities. These issues will provide a baseline to researchers, students, relevant institutes and conservation organization to plan or initiate research or activities related to income generation for poor farmers/collectors and for conservation of medicinal plants in Pakistan.

#### **MAJOR ISSUES PERTAINING TO MEDICINAL PLANTS CULTIVATION, CONSERVATION AND INCOME- GENERATION IN PAKISTAN**

Following are the major issues that the medicinal plants face in Pakistan, besides the prospects of cultivation, conservation and income generation:

- a. Potentials of medicinal plants in Pakistan.
- b. Increasing global demands of herbal medicines and current status in Pakistan.
- c. Extent and causes of threats to existence of medicinal plants in Pakistan.
- d. Policy issues in relation to promoting large scale cultivation and conservation.
- e. Case Study (Ayubia National Park).

These issues are discussed, summarized and explained below.

#### **Potentials of medicinal plants in Pakistan**

This topic summarizes the research activities regarding medicinal plants in Pakistan carried out till date and also the regions of the country identified as hotspots.

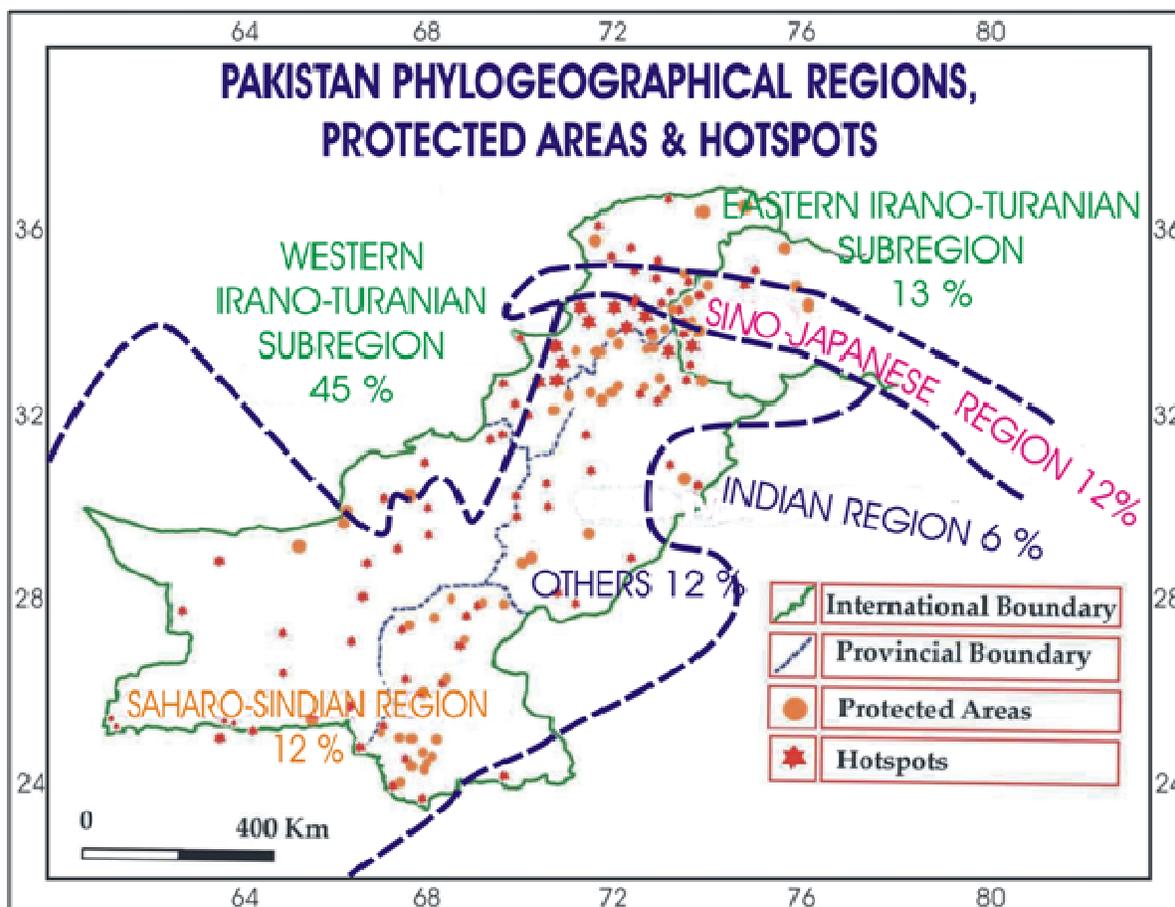
There are various reports on use of plants as medicine in Pakistan (Hocking, 1958). At national level, Shinwari et

al. (2006) published a "pictorial guide of medicinal plants of Pakistan" enlisting more than 500 species of flowering plants, being used a medicine. Athar and Siddiqui (2004) reported 95 species as medicinal Plants from Pakistan. While geographic-wise several reports on ethnobotanical studies have been published. However, some important studies are mentioned here. Shinwari and Gilani (2003) and Hamayun et al. (2006) listed from medicinal Plants from Northern Pakistan. Haq and Hussein (1993) reported 70 species of medicinal plants from Mansehra, NWFP province. Ethnobotanical studies on Ayubia National Park, Nathiagali, and Swat have been conducted in detail by Shinwari et al. (2002, 2003). Ali and Qaisar (2009) reported 83 taxa that were used locally in Chitral district of Hindukush range. Goodman and Ghafoor (1992) reported 114 species with local ethnobotanical usage from Baluchistan province. Shah (1996) reported 171 species used as medicinal Plants by communities in Kharan district, Baluchistan.

Besides listing plants used as medicines, other aspects (Chemical and Pharmacological etc.) of these plants were also looked at (Gilani et al., 2007; Kirbag et al., 2009). Gilani and Cobbin (1986) were successful in reporting plant-derived drug himabicine, as a prototype of a cardioselective antimuscarinic drug. Gilani et al. (2004, 2005) and Shinwari et al. (2009) had some success in reporting the presence of ACE inhibitory substances in medicinal plants and thus provided scientific explanation for some of the traditional uses of the respective medicinal plants. Similarly, juliflorine from *Prosopis juliflora* and Withanolides from *Withania somnifera* were found to possess this unique combination of activities (Choudhary et al., 2005). Tariq et al. (1995) tested medicinal plants for their antimicrobial activities against 25 different pathogens and non pathogens from Karachi, Sindh Province.

According to Chaudheri and Qureshi (1991), nearly 37% (266 species) of the total of 709 endangered species are endemic to Pakistan. A recent study has revealed that the endemic species of Indo-Pakistan are over 600 (Shinwari et al., 2002) (Table 9). The centre of evolutionary radiation is Kashmir, northern Balochistan and Chitral (northern Pakistan). Endemic species may also be explored for ethnobotanical, pharmacological and pharmaceutical activities.

The plant hotspots of Pakistan are spread over 13 Natural Regions from alpine pastures to mangrove forest. More than 10% of the flora is endangered (Shinwari et al., 2000, 2002). Reasons of endangerment includes population pressure (Table 5), poverty and poor quality of the natural resource-base, breakdown of social institutions, lack of land use plans and lack of enforcement of existing rules in whatever form these are. In addition rapid infrastructural development (roads, building construction), spread of irrigation system, pollution and to top it all, the destructive activities of the colossal influx of the Afghan refugees also contribute in threatening the



**Figure 1.** Floristic regions represented in Pakistan.

resources.

### **Increasing global demands of herbal medicines and current status in Pakistan**

Use of plants as medicine ranges from 4 to 20% in different countries and about 2500 species are traded internationally (Schippmann et al., 2002). Global efforts to conserve and protect the natural environment are a recent phenomenon, though efforts to conserve economically important natural resources have a long history. Although we may think of environmental degradation as a product of recent times and certainly the scale of recent losses is enormous, significant environmental degradation has always accompanied humankind; and may therefore, have been responsible for the extinction of a number of species of animals and plants.

Globally, there is a rising trend to shift resources from allopathic to traditional healthcare systems. The global market (2002) for medicinal and aromatic plants was US\$ 62 billion and estimates suggest that it will reach US\$ 5 trillion by 2050. For example in Japan, a Society of Oriental Medicine Studies was established by 98 members

interested in Kampo [traditional Japanese medicine]. Today, it has about 10,000 members of whom 80% are allopathic doctors. Back in 1967, only four Kampo prescriptions were approved by health insurance companies. Today, there are more than 200 approved prescriptions while the Kampo medicine is worth more than 1 billion \$ per year. These medicines are effective for diseases like constipation, chronic hepatitis, allergies, etc.

There is a global need to cultivate medicinal plants (MP). In Russia 50,000 tons of medicinal plants are used annually of which, 50% are cultivated. Alone in Lucknow (India) medicinal plants worth Rs.90 million are grown annually. As such, cultivation becomes necessary when there is a demand. For example, European Union (EU) uses 3,000 kg of *Glycyrrhiza* each year for which 400 tonne plant roots are needed. Take the example of our neighboring country China where in the year 2000, the total output value of the pharmaceutical industry was 233 billion yuan (28 billion US\$). By the year 2010, the share of traditional Chinese medicine in the international market of herbal medicine is projected to improve to 15% from the existing 3%. But unfortunately in Pakistan not enough emphasis has been given to cultivation of medicinal



**Figure 2.** Have we saved plants to bear fruits, sustainably? Or have we uprooted them; and made them perish, for ever.

Plants, though we are blessed with a country which has an altitudinal range from 0 - 8611 m, hence having variety of climatic conditions at a given time.

#### **Extent and causes of threats to existence of medicinal plants in Pakistan**

Over-harvesting of medicinal plants for commercial purposes and chemical analysis has threatened their abundance, and even occurrence (Figure 2). Human pressure has also caused fragmentation of populations (Gilani et al., 2009). *Withania coagulans* has shown the similar kinds of results when molecular studies of fragmented populations of *W. coagulans* from Kohat Plateau, Pakistan were carried out (Gilani et al., 2009). There are a number of institutes involved in research on medicinal plants from survey to various kinds of analytical studies. List of some known organizations is given as Table 1. Detailed surveys of all the stakeholders were conducted to document species of priority for commercial harvesting. Priority species opted by the Ministry of Food, Agriculture and Livestock (MINFAL), and two major herbal facilities in Pakistan (Hamdard and Qarshi) as listed in Tables 2 - 4. The use of medicinal plants in the last decade by two leading industries of Pakistan (Qarshi and Hamdard) showed strange pattern (Table 3 and 4). Majority of the plant use decreased and the reasons given were that there is less wastage, less consumption and efficient production etc. However, use of certain

some species of high price (saffron) increased and price of the product was also increased. But conservationists are worried that majority of the revenue generated went to few hands and the collectors felled below poverty line despite use of such huge quantity of medicinal plants from the wild.

#### **Causes of threats to survival of medicinal plants**

##### **Deforestation**

Deforestation in the Himalayas (Figure 3) is generally attributed to demographic pressure and other related effects: increase in demand for land for cultivation; livestock population; use of the remaining forest to meet growing needs for fodder, fuelwood, and timber. On the other hand, social issues, such as social relationships, perceptions and values about natural resources as seen by different social groups, issues of access to and control over resources, and issues of power in relation to deforestation, have rarely been discussed in current literature as possible driving forces to deforestation (Saxena et al., 2001).

##### **Dependence of local people and Afghan refugees on medicinal plants**

Thousands of Afghan refugees have taken shelter in

**Table 1.** Ten major organizations involved in medicinal plant research.

Name of department	Organization name	Area of interest	Involved since
Dept. of Botany; Pharmacy; Chemistry and Pak. Forest Inst	Peshawar University	Documentation; analytical work	1950's
ICCS, HEJ Inst.; Botany Dept.	Karachi University	Chemical analysis	1960's
Hamdard Laboratories	Hamdard, Karachi	Herbal Medicine	1960's
Dept. of Botany and Biochemistry	Baluchistan Univ., Quetta	Documentation and Analysis	1970's
Qarshi Research Int.	Qarshi Industries (Pvt) Ltd.	Herbal Medicine; Bot. Garden	1980's
Dept. Plant Sciences and Chemistry	Quaid-i-Azam University	Ethnobotanical studies and Chemical analysis	1980's
Department of Biological and Biomedical Sciences	Agha Khan University, Karachi	Pharmacognocny	1990's
National Agric. Res. Center	Pak. Agric. Res. Council, Islamabad	Cultivation and Documentation	1990's
Dept. of Botany and Chemistry	Kohat University of Sci. and Tech.	Documentation; analytical work	2004

**Table 2.** Priority species recommended by MINFAL.

Scientific name	Local name
<i>Apium graveolens</i>	Ajmood
<i>Carum copticum</i>	Ajwain
<i>Cassia angustifolia</i>	Sana-maki
<i>Cassia senna</i>	Sana-Makki
<i>Curcuma zeodaria</i>	Aania Haldi
<i>Foeniculum vulgare</i>	Sonf
<i>Hyocymus niger</i>	Ajwain Khurasani
<i>Lawsonia inermis/alba</i>	Barg-e-Hina
<i>Matricaria chamomilla</i>	Gul-e-Baboona
<i>Nigella sativa</i>	Kalonji
<i>Rosa damasena</i>	Gul-e-Surkh

Pakistan. They are passing an unenviable life due to abject poverty. They are totally dependent on the plants for their daily domestic needs. The way they store herbs for future use is also unhygienic (Figure 4). Sometimes the plant is hosting pest residues. The Ghamkol Area, Peshawar Road in Kohat, for example, was rich in *Berberis lycium* and *Delphinium kohatense* (a local endemic species). The Ghamkol Refugees Camp was established in early 1980s. Today, *Berberis lycium* and *Delphinium kohatense* are totally lost from the area (Shinwari et al., 2002). And because of such declining trends, most of the species, especially having medicinally values, are alarmingly joining the 'Threatened Species Club' (Table 8).

### Traditional health care system and extinction scenario

Twelve percent of Pakistani flora are used in medicines and more than 300 medicinal plants are traded (Table 6). Ten leading Dawakhana [Herbal manufacturers] of Pakistan annually consume more than 2 million kg of 200

medicinal plants in 1990s while its consumption increased multifold in the last two decades (Table 7). Some of the uses of medicinal plants in the Unani system for some ailments seem to have origin in the medicine of ancient Greece (Figure 5).

According to an estimate, 22 species of medicinal plants worth Rs.14.733 million were traded in 1990 while in 2002, this value rose to more than Rs.122 million, an eight-and-a-half times increase. In 1990, 95 species were consumed worth Rs.36 million while in 2002, medicinal plants worth Rs. 218 million were consumed: a six-fold increase (Shinwari et al., 2002).

### Collection chain of medicinal plants in Pakistan

Almost all the medicinal plants in Pakistan are collected from the wild. Local collectors are unaware of the best collection procedures. Medicinal plants from the sites of collection to the national and international markets pass through various middlemen. Consequently, the prices of the crude drugs increase more than 100% along the trade chain.

### Policy issues in relation to promoting large scale cultivation and conservation

The rapid loss of floristic and cultural diversity, and the state of absolute material poverty of 30% of people in Pakistan, makes it urgent that we should find solutions to their problems and to take active roles in making decisions about the management of natural resources and about the legal status of their traditions and knowledge. The practical example of policy issues and large scale cultivation of medicinal plants and cultivation may be quoted below which was implemented and managed by the author in Ayubia National Park, NWFP, Pakistan and Applied Ethnobotany project as coordinator for project of ethnobotany. The project was the collaborative effort of WWF (World Wide Fund for Nature),

**Table 3.** Species, prices, quantities, and values of medicinal plants (Hamdard laboratories (Waqf) Pakistan.

Scientific name	Common name	Avg. price (2002) (Rs./kg)	Avg. price (July'2008 to Jun '2009) (Rs./kg)	Qty. used (July'2008 to Jun '2009) (kg)	Qty. used (2002) (kg)
<i>Lavandula officinalis</i>	Ustukhuddus	320	408	3,625	3,000
<i>Achillea millefolium</i>	Baranjasif	285	180	13,200	6,000
<i>Viola odorata</i>	Gul-e-Banafsha	550	635	5,750	2,000
<i>Carum carvi</i>	Zeera siya	495	330	3,100	2,500
<i>Onosma bracteatum</i>	Gul-e-Gaozaban	290	2,140	2,100	1,500
<i>Berberis aristata</i>	Zarishk	238	350	2,500	2,000
<i>Polypodium vulgare</i>	Bisfaj	250	210	5,000	4,000

**Table 4.** Data shows the consumption and selling price of Qarshi Industries (PVT) Limited, Pakistan in 2002 and 2009.

Scientific name	Common name	Average price (2002) (Rs./kg)	Average price (2009) (Rs./kg)	Quantity used (2002) (kg)	Quantity used (2009) (kg)
<i>Plantago ovata</i>	Ispaghool (HUSK)	225	455	2,300	1555
<i>Achillea millefolium</i>	Saffron	30,000	3,10000	20	35
<i>Viola odorata</i>	Gul-e-Banafsha	550	1,000	2,000	2760
<i>Carum carvi</i>	Zeera siyah	400	185 (white)	2,500	16400
<i>Lavandula officinalis</i>	Ustukhuddus	320	329	3,000	419
<i>Onosma bracteatum</i>	Gul-e-Gaozaban	290	1,435	1,500	250
<i>Berberis aristata</i>	Zarishk	238	250	2,000	550
<i>Polypodium vulgare</i>	Bisfaj	250	210	4,000	436

People and Plants joint programme of UNESCO, WWF and the Royal Botanical Gardens KEW, with the main aim of developing an applied ethnobotany project to investigate the status of fodder and fuel wood management at Ayubia National Park and in its periphery.

#### **Collaborative project of WWF for conservation and livelihood improvement (A case study)**

##### ***Ayubia national park***

Ayubia national park (ANP) was chosen for the

project in applied ethnobotany because it is representative of many situations encountered in other forested areas in NWFP. High pressure on resources due to high energy needs (because of prolonged winters and non-availability/scarcity of alternate sources) (Figure 6), mismanagement



**Figure 3.** Happy co-existence: Trees provide protection (to MPs) and medicinal plants provide nutrients (to trees).



**Figure 4.** Could the medicinal plants be viable (clinically); even when attacked by insects?

**Table 5.** Population estimates for Pakistan (millions).

Year	Basis	Population
1951	Census	34
1961	Census	43
1972	Census	65
1981	Census	84
1991	Census	114
1998	Census	130
2002	Estimated	144
2010	Projections	168
2020	Projections	195

**Table 6.** Medicinal plants of Pakistan.

Utilization and extent of wastage of Medicinal plants	Quantity
Total species of higher plants (medicinal and non medicinal)	About 6,000
Species used as medicine	(10%) > 600
Species available in the market	> 300
Wastage from collector to consumer	> 50 %
Price difference from collector to consumer	> 100 %
Availability of quality material	Questionable
Trained collectors	None

**Table 7.** Annual consumption of important medicinal plants used by 10 leading Dawakhanas (Data from 1990, published by NIH-Pakistan).

Category	Avg. consumption (million kg) 1990	Total value (million Rs.) 1990	Estimated Avg. consumption (million kg) 2009	Estimated Total value (million Rs.) 2009
20 species used > 10,000 kg/year	0.33	5.6	0.5	10
80 species used > 1,000 kg	0.26	8.2	0.5	18
100 species used < 1,000 kg	0.05	1.4	0.1	2
Total 200 species	0.64	15.2	1.1	30
Estimated production 4 - 2 million kg	1.27	30.4	>4	>100

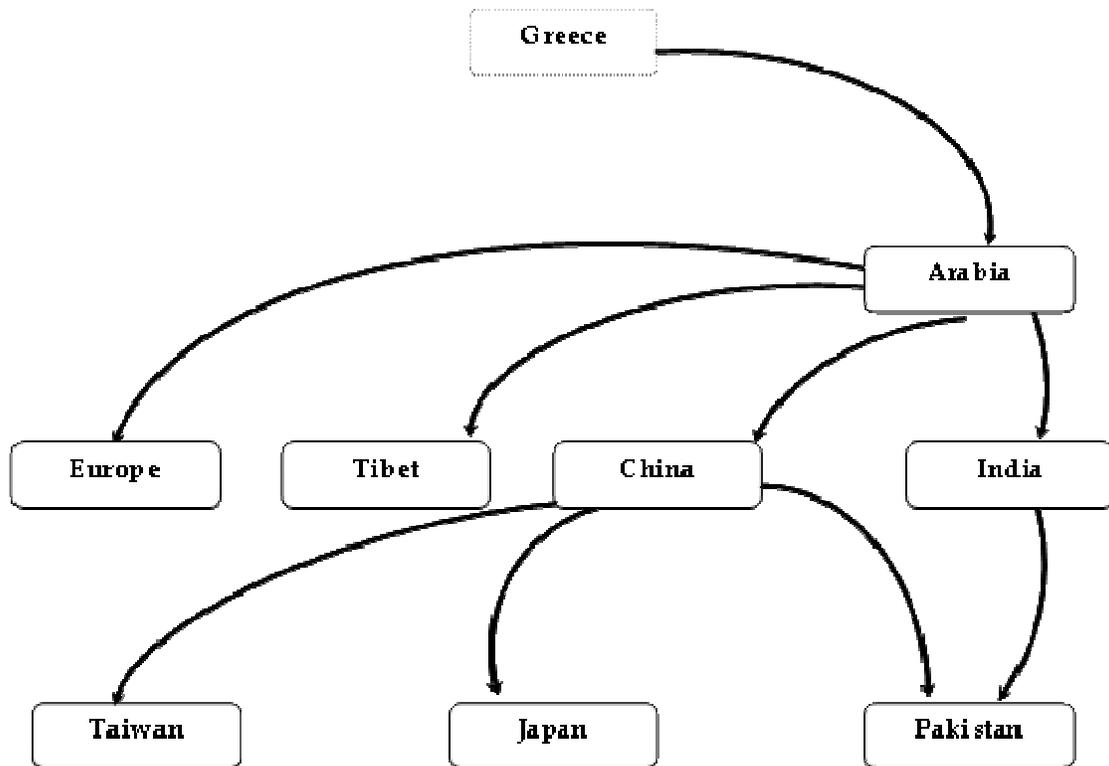
due to unclear access and tenure regimes, and a high level of conflict between local communities and the Wildlife and the Forest departments. ANP was declared a National Park in 1984, with the main objective of preserving its captivating landscape, unique ecosystems and biodiversity for scientific research, education, and recreation.

Altitudes of the Park vary from approximately 3,000 m at the Muskpuri top to an average of 2,300 m. Its area initially of 1,684 ha was extended towards north in 1998 and now totals 3,312 ha. The vegetation is said to be one of the best examples of moist temperate forest in Pakistan.

Most of the vegetation in and around the Park is heavily influenced by people. The vegetation of ANP, which

seems fairly well preserved in places, is dominated by coniferous species principally Bluepine (*Pinus wallichiana*) and Spruce (*Abies pindrow*) mixed with scattered broad-leaved tree species such as Oak (*Quercus dilatata*), *Aesculus indica*, Elm (*Ulmus wallichiana*), *Prunus padus*, etc. However, due to human impact in the park, populations of broad-leaved trees have declined. On the other hand, Blue pine and Fir, being very resilient; have colonized large areas, leaving seemingly little space for broad-leaved species to grow and relatively poor vegetation in the understorey. Outside the Park, forested areas are almost entirely composed of Fir in the northern aspects, and Blue pine elsewhere.

The project was initiated in 1997 as a collaborative effort between WWF Pakistan and the People and Plants



**Figure 5.** Trade chain of medicinal plants showing its possible origin from Greece.



**Figure 6.** (Project area) Save trees; to save medicinal plants: If trees are on the move out, medicinal plants will follow suit.

**Table 8.** Total Flora and medicinal plants of the hotspots of Pakistan and their current status.

Region	Size of flora (No of species)	Total no. of medicinally important species	Threatened flora (No. of species)
Chitral	± 1,600	800	150
Kashmir	1,500	900	200
S. Waziristan	425	323	??
Sindh	1,185	700	100
Hazara	1,759	>1000	??
Swat	1,550	500	87
Balochistan	1,330	700	>150
Kurram Agency	1,200	>600	>100

**Table 9.** Endemic plants of Pakistan (Modified from Qaisar and Ali, 1986).

Area	No. (%)
Endemic in Kashmir (both the sides of the divide)	Over 600 (37)
Endemic in Alpine-Hindukush	76 (20)
Endemic Species in Pakistan	Over 400
Bi or Tri-regional	Over 100
Uni-regional	Over 300
Irano-Turanian	125
Sino-Himalayan	115
Saharo-Sindian	60
Mountainous areas	78
Other regions	22

joint programme of UNESCO, WWF and the Royal Botanical Gardens KEW, with the main aim of developing an applied ethnobotany project to investigate the status of fodder and fuelwood management at Ayubia National Park and in its periphery. The project, currently known as Ayubia Ethnobotany Project, also aimed at providing recommendations for improvement of fodder and fuelwood management systems, as well as implementing some activities to contribute towards greater sustainability of plant resources at Ayubia National Park and in the surrounding forests. Ayubia Ethnobotany Project has been conducted in two phases: a first four-year period (1997 - 2000) with a large component of research as well as initiation of some implementation, and a second phase (2001 - 2004) that has mostly focused on implementation.

Results were presented in a working paper that covered mainly the first phase, with some elements of follow-up during the second phase until 2002, especially regarding social forestry (Aumeerudy et al., 2003). The overall objectives of the People and Plants programme in Pakistan were to: (1) strengthen the capacity for work in applied ethnobotany in Pakistan through a programme of training of young professionals and students and (2) achieve better integration between conservation and

development at selected field sites.

Importance of forests for local livelihoods and the realization throughout the region that local communities should be formally involved in the management of forests have lead many countries to shift their forest management approaches to Joint Forest Management or Community Forestry (Aumeeruddy et al., 1998) which implies the sharing of decision making and management practices of forests between local communities and the Forest Department. In Pakistan, this approach has not yet been established although structural changes are underway in the Forest Department to allow a greater role for local communities in the management of forests (Shinwari and Khan, 2001). The work conducted at Ayubia National Park and in the surrounding forests was thus developed in order to provide a model, where the aim is to improve the management of forests including fuelwood and fodder resources outside the National Park. The aim was also to encourage reaching of the agreements between the communities from local villages and the Forest Department for joint management of forests in which communities have certain rights of use, and thus reduce pressure on plant resources in the National Park. The intention was actually to develop a

model that could be adopted by the Forest Department.

### Conservation and developmental issues at ANP

Forests are important in the Himalayan foothills for catchment's protection. At the local scale, conservation of plant resources in and around the ANP is crucial to the lives of people. At present, poorly regulated collection is leading to degradation of the resource base, both within and outside the Park. Tree populations are decimated and regeneration is highly affected. Women have to walk very long distances to collect fuelwood and fodder, and a situation of conflict persists between the women and the Park guards. The National Park does not have sufficient manpower to enforce the rules culminating in a situation of uncontrolled use of resources. Guzara forests (outside the Park) do not have a clear tenure regime and wild plant resources have greatly declined due to mismanagement, and the absence of clear rules of control and access to resource. A critical social issue at Ayubia is that women are the main harvesters and users of natural resources but are also the least represented in decision-making processes. It is men who control the influential networks taking decisions regarding access to resources, tree planting, or timber harvesting.

Unlike in many other traditional societies, there is no well-developed classification or folk taxonomy; although local ethnobotanical and ethnobiological knowledge is very rich. Moreover, knowledge and practices especially relating to fodder and fuel wood are not linked to cosmology or larger cultural beliefs. Beyond ethnobotanical knowledge, they also have some ethnoecological expertise, such as knowledge of bird-nesting or overflying the area, and habits and habitats.

### Wild vegetable and mushroom collection in ANP

Domesticated chilies may have seasoned cuisine more than 6,000 years ago (Ledford, 2007). People residing in vicinity of ANP used various kind of wild vegetables. We have initiated projects on studying nutritional importance of our natural resources in areas where their habitats are threatened (Hussain et al., 2009). Types of mushroom collected were mainly different species of morels, locally known as 'Kali' [black] and 'Surkh [red] Guchi' (*Morchella esculenta*), Narela, Begar Guchi (*Morchella* sp.). 'Kali' and 'Surkh' are apparently phenotypic variations of *Morchella esculenta*, the only mushroom collected for sale. The sale of *Morchella esculenta* at the doorstep varies from 1,500 to 5,000 rupees per kg, mostly on the basis of quality. For women, collection is associated with fodder or fuelwood collection trips.

Main vegetables collected are 'Kunji' (*Dryopteris stewartii*), 'Mushkana' (*Nepeta laevigata*), 'Kandhor' (*Dryopteris blanfordii*), 'Mirchi' (*Solanum nigra*), and 'Tandi' (*Dipsacus inermis*). Parts collected are young leaves for all

species. The most collected vegetables are the two *Dryopteris* species, followed by *Nepeta laevigata* with amounts averaging 7 kg of *Dryopteris stewartii*, 4 kg of *Dryopteris blanfordii* and 3 kg of *Nepeta laevigata* per person per season. It should be noted that two of these three species are ferns. Collection season for wild vegetables is between April and the end of June (Aumeerudy et al., 1998).

### DISCUSSION

Looking at the activities done in Pakistan regarding medicinal plants research. Some projects have played a key role in conservation and sustainable utilization of Natural Resources. For example:

WWF Pakistan is playing a leading role towards conservation and sustainable management of plant resources. Keeping in view the floristic richness, local uses, danger of loss of knowledge, conservation status and endemism, the Ethnobotany Project (then headed by the author), introduced Ethnobotany as a subject at M. Sc., M. Phil. and Ph. D. level in various universities. The project also dealt with other aspects of ethnobotany (e.g., Joint Forest Management; Land Tenure and Resource Ownership, etc.) besides working on the concept of integrated medicinal plants conservation.

There is a lot of potential of getting benefit from cultivation. One of the most expensive medicinal plants, *Crocus sativus* (Saffron) is used by the leading herbal industry in the country. Saffron is an aromatic and flavouring agent in spices. It is also considered as a sacred plant, the stamens of which are used as ink to write holy verses of the Holy Quran. The quantity and price of saffron was increased many fold in recent years. Its annual yield was increased from 70,000 to 200,000 flowers yield 1 kg dried saffron threads. Qarshi Industries consumed 20 kg in 2002 (Pak Rs. 30,000 per kg – US \$500 per kg) in herb-based preparations while they consumed 35 kg (Pak Rs. 310,000 per kg – US \$4,000) in 2009. Growing 50 corms/m<sup>2</sup> may yield 80 to 400 flowers in two years. One acre land may yield profit of >Rs.100,000. Generally, saffron is grown in cooler climates. Information regarding commercial value and importance of saffron may be disseminated to the local farmers in cooler regions, especially northern part of the country where the climate is cool. As a pilot project, saffron cultivation may be initiated among local farmers and herbal industries may be linked to the communities for assuring to buy saffron from these farmers.

Conservation of plants involves more than plant protection and controlling access to plant resources. Conservation also demands collection of baseline data on social, economic, and ecological parameters, to be incorporated into a comprehensive management strategy. Effective conservation also requires extension activities and education about the importance of plants as well as strategic cultivation initiatives. Moreover, conser-

vation requires the involvement and support of the communities that ultimately depend on these plant resources. To reduce pressure on plant resources, complementary activities such as encouragement of fodder crops (e.g. multipurpose fast-growing fodder trees) fuel-efficient stoves, improved crops and livestock management, must be initiated.

*In-situ* conservation may be achieved by the selection and demarcation of adequately sized plant conservation areas (PCA), where there is active collection from the wild in case of medicinal plants or other use in practice. These areas, to be termed as Core Zones, will provide a setting where local communities can manage forest parcels and associated habitats on a long-term basis for the purpose of conservation and sustainable uses of medicinal plants and other non-timber resources. Such conservation areas will also serve as a base for cultivation and marketing initiatives, and for education and extension programmes to outlying communities.

The foundation for *in-situ* conservation-based activities will include the identification and establishment of PCAs in areas where there is active consumption of plants from the wild and contain significant population of plants. The PCAs are associated with core conservation zones where the primary focus should be the elimination (or at least, gradual reduction) of human activities that have negative impacts on the conservation of plants. Surrounding the Core Zone shall be the Sustainable Use Zones and areas where the cultivation of medicinal plants is possible. The outer boundary of a PCA is established on a number of considerations, including access to selected communities, agreement of villagers, availability of land for PCA facilities, plants cultivation, and village development activities. Implementation of ethnobotanical activities will be in accordance with the existing local system/legislation governing each conservation area.

Experiments would be established to investigate ways of growing plants and to provide a better understanding of the propagation and agronomic requirements, especially of selected species of medicinal plants, concurrent with the reduction in harvest of wild species that will occur once sustainable *management* practices are developed and put into place.

A notable lack of available information on propagation and management of important species limits the increased cultivation of plants. This lack of information is exacerbated by a paucity of quality planting materials. By increasing both the amount of available information and the quantity of local nursery-based stocks, the project hopes to leverage a substantial reduction in the pressure on wild populations of plants. Whatever information that exists on the cultivation of plants, is not readily available to the farmers who actually could use it. This needs to be ensured that it reaches where it is needed most.

In the next phase, focus should be on the expansion of *ex-situ* cultivation and conservation comprising the establishment of nurseries. Within different regions

selected, it is required to identify, acquire, and demarcate sites for nurseries development.

Selection of species for study must be based on several criteria: degree of endangerment in the wild, actual or potential market value, and the availability of existing information. To harvest medicinal plants sustainably, training of collectors, training in nursery techniques, and removal of some of the middlemen from the trading chain is essential.

### Major developmental issues in Pakistan

Pakistan is the 10th most populated country in the world with 170 million people inhabiting about 796,000 km<sup>2</sup> space on earth. Major national developmental issues are to alleviate poverty through increasing agricultural productivity and through improvement of other sectors such as industrial development, trade and tourism (UNEP/WTO, 1998). In the forestry sector, programmes of afforestation have been implemented to try and meet the country's timber and fuelwood needs. The government also seeks to improve education levels, healthcare systems, and communications. Timber harvesting through (unsustainable) logging is threatening environmental quality including supplies of some resources required by local communities. Local cultural and social systems are progressively fading - as a result of changing lifestyles and effects of centralized administration - and with them, the local knowledge of resource management (Shinwari et al., 1996). National healthcare support at the village level is poor due to lack of facilities and qualified staff. The use of medicinal plants is therefore a necessity in many rural areas.

Women are usually responsible for fuelwood, fodder collection and water carriage besides a host of agricultural activities. Access to fuelwood and fodder and other non-timber forest products (NTFPs) is also decreasing due to decreases in forest cover and also mismanagement of existing forests. Besides being overwhelmed by fuelwood and fodder collection tasks, education of young girls is also affected by lack of schools for girls. As is generally recognized in South Asia (Gururani, 2002) and based on our own assessment of the situation at Ayubia National Park, the link between women and resource management requires particular attention (Aumeeruddy, 1996).

Applied ethnobotany, a discipline which is at the interface of social and biological sciences, is particularly useful in this context to analyzed conflicts of use, practices and perceptions, as well as proposing new avenues of management (Figure 7, Aumeeruddy and Pei, 2003; Hamilton et al., 2003).

### Conservation priorities

On one side, forest cover represents only 5.2% (4.58



**Figure 7.** It's not just the medicinal value: it's the aesthetic value as well, contributed by medicinal plants.

million ha) of the country's area, but to the other, the country is highly dependant on trees as well as on non-timber forest products (Shinwari et al., 2001). Scarcities of biological resources are a major concern for the country because they represent the livelihood basis for a large portion of the population. Biodiversity is therefore, endangered through increase in population, timber harvesting beyond the productive potential, overgrazing in forest undergrowth as well as in pastures, unsustainable collection of NTFPs such as medicinal plants, for trade; and unsustainable collection of fuelwood. Fuelwood is still the main source of energy in Pakistan with 90% of the rural population and 50% of the urban population mainly relying on it.

#### **Pakistan forest institute (PFI)**

The Pakistan Forest Institute (PFI) located in Peshawar (NWFP) is the main training institute for foresters in Pakistan and includes research sectors such as wildlife, silviculture, forest products, social forestry/agroforestry, sericulture, and medicinal plants. General ethnobotanical surveys have been conducted by the PFI including some quantitative surveys especially on medicinal plants. PFI also focuses on the cultivation of medicinal plants but little analysis of its conservation status at source areas has been conducted (Khan, 1985, 1991). Little importance is given to NTFPs at the PFI in general as opposed to timber management, which is the priority of the Forestry Sector in Pakistan.

#### **International organization**

International NGOs such as IUCN (International Union for Conservation) and WWF (World Wide Fund for Nature) are involved in Pakistan working on natural resource management with a strong emphasis on the role of local communities. Notable achievements include biodiversity and threat assessments at Zarghoon Juniper Forests of Balochistan (WWF Pakistan, 1998), developing management plans for protected areas, as for example, WWF's involvement in developing Khunjerab National Park Management Plan including activities for trophy hunting inside the Park (WWF Pakistan, 1996) or through site-specific projects on particular issues such as management of Chilgoza pine in Balochistan based on a process of conflict resolution (WWF Pakistan, 2000b). IUCN has been involved in recording traditional management of medicinal plants in Bomberet Valley in Chitral (Ali and Khuwaja, 2003). Among local NGOs, the Agha Khan Rural Support Programme is regionally recognised for its experience related to natural resource management involving local populations in afforestation programmes, cultivation of medicinal plants, and social forestry. International agencies such as the European Union, and a German aid agency (GTZ) are also involved in major projects in close collaboration with the Forest Department: the European Union (EU) project "Environmental Rehabilitation in NWFP and Punjab" and GTZ Joint Forest Management project in Mansehra (NWFP). Some policy issues were addressed through thematic workshops by WWF-Pakistan such as those which addressed joint/

participatory forest management, land tenure and resource ownership, and curriculum development in applied ethnobotany (Shinwari and Khan, 2001; Hamilton et al., 2003).

### Priorities for capacity building in ethnobotany

Ethnobotany is a multi-disciplinary science encompassing botany, anthropology, economics, and linguistics that studies the way in which a society relates to its environment and particularly to the plant world. These relationships can be social, economic, symbolic, religious, ritualistic, commercial, or artistic. In the early 1980s, there had been an increased focus on local management practices by ethnobotanists as a result of greater global concerns about the environmental crisis. A great number of ethnobotanists were then engaged in studies to understand the rationale for such practices, the functioning of local institutions relating to management practices as well as their impact on the conservation of biodiversity (Aumeeruddy-Thomas and Shengji, 2003).

An introductory workshop was organized in September 1996, jointly by WWF Pakistan, the National Agricultural Research Centre (NARC) and the National Herbarium (NH) in the context of the People and Plants UNESCO/ICIMOD Ethnobotany Project for the Hindukush Himalayas (Shinwari et al., 1996). The status of applied ethnobotany was an important output of this workshop that showed that ethnobotany in Pakistan had mainly focused on people's use of medicinal plants with relatively little concern for other plant resources. It was also recognized that large-scale trade was endangering the resource-base. However, the practicalities related to resource management, aspects related to tenure, ownership, rights of access, methods of harvesting had not yet been investigated. Consultation during the workshop with conservation managers, academics, NGO representatives, and practitioners such as '*hakeems*' [traditional doctors] have shown that there is much interest in using ethnobotany as a tool to learn more about people's needs and perceptions, in order to design better conservation approaches.

The high level of interest that developed in Pakistan for applied Ethnobotany, actually led to focusing the second phase of the Project (2001 - 2004) on a programme of curriculum development at the national level in applied ethnobotany for universities and educational centres in forestry.

### RECOMMENDATIONS AND CONCLUSION

(i) To initiate conservation-based activities, strengths and weaknesses should be identified. For example, major problems in one of the study areas (Kurram Valley) were poverty, lack of awareness of alternatives, lack of skills, lack of marketing opportunity, heavy human and animal pressure, absence of any working institution, etc.

Strengths were recognized as organized communities, common and equal rights [egalitarian society], functional social institutions, uniform social and economic status, high diversity in climate and topography, Rich natural resources, community willingness.

(ii) Future line of action may have the following components:

- a. Awareness-raising
- b. Institutionalization of community organizations: The poorer households usually depend on forests for a larger share of their overall livelihood needs. Forest products-based activities can be particularly important to women because many of such activities can be combined with their household tasks. Ease of access to the resource and low skill and capital thresholds to commercial forest product activities mean that these can be very important in coping with the needs of the poor.
- c. Joint collaboration of future projects of different NGOs, government agencies etc.
- d. Linkages development among different stakeholder
- e. Capacity building
- f. Holistic NRM Programme, for example identify key mutualisms for management as

(i) Pollinators, including insects, birds, bats, certain arboreal mammals such as opossums, even a few lizards;

(ii) Seed dispersers, including mammals, birds, ants, and fish that transport, drop or ingest fruits and their seeds, thereby facilitating the establishment of new populations;

(iii) Over-storey plants, such as nurse trees that are critical for providing suitable microhabitats for seed germination, seedlings growth and protection from trampling or consumption by herbivores;

(iv) Microbial symbionts, such as mycorrhizae and nitrogen-fixing bacteria that enhance plant growth through nutrient uptake;

(v) Organism that provide defense for a plant, such as ants that protect a plant's foliage and fruit from herbivores and seed predators

g. Ethnobotany Programme

Opportunities to participate in decentralized resource management, a willingness to try to understand better the complex environment of communities, to respect and incorporate traditional knowledge into resource management plans, ensuring communities' access to technological innovations and/or opportunities for them to develop forest management practices and technologies based on their own felt needs, are some of the important factors that will contribute to communities' sustainable livelihoods.

While reviewing the whole programme of medicinal plants research, we may conclude:

i) Main dependence of the users of herbs are on the wild plants. There is unsustainable harvest of the natural

resources. The government should encourage cultivation of the resources.

ii) Lessons learnt from success stories are implemented at wider scale to train the collectors, reduce post harvest losses and honour intellectual property rights (extending monetary benefits to the local communities).

iii) Value addition is done on the wild herbs (use of extracts) and clinical studies are encouraged to reduce trust deficits among stake holders.

## ACKNOWLEDGEMENTS

I am grateful to my former colleagues Abdullah Gilani and Abdul Latif for their critical review of the article and valuable suggestions. I am also indebted to Iqbal A. Qarshi, Dr. Altaf of Qarshi Industries for their input and Dr. Afzal Rizwi and Dr. Saleem of Hamdard Industries for valuable information about their industries.

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