Important Plant Areas in the Hindukush-Himalayan Region of Pakistan

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Background

Pakistan is divided into 9 ecological regions with about 6000 plant species. Out of this, 410 are endemic to Pakistan while about 200 are believed to be threatened because of various reasons. Amongst all the eco-regions, those that occur within the Hindukush-Himalayas are the richest from floral perspective. About 2500 plant species have so far been recorded from the Hindukush-Himalayas that include 90% of all the endemic plants, reported from Pakistan.

Pakistan is among the top eight exporting countries of MAPs in the world, exporting plants worth US$5.45 million per year. Over 60% of the total export originates from the Hindukush-Himalayas regions of the country. The destinations of such exports include Germany, USA, Middle East, India, Iran, etc. However, Pakistan also imports some of the MAPs, worth US$ 130 million, from the above countries. Such imports have increased over the last ten years.

Studies have revealed that about 70% of the MAPs that are being imported to Pakistan actually grow wild in the Hindukush-Himalayas of Pakistan but these have neither been explored fully nor their commercial and medicinal importance is known to the local communities. The potential to enhance the cover and density of most of such plants does exists, provided promoted under *ex-situ* and *in-situ* conditions and treated as a cash crop in the country. This will not only save the valuable foreign exchange but shall also open up new avenues for the income of the low income groups.

The country on the whole has serious problem with the loss of floral richness and diversity. Deforestation, followed by heavy grazing/browsing by domestic livestock; and unsustainable uses of various forms are the major factors behind the rapid loss of floral resources.

Medicinal plant species that constitutes almost 10% of all the plants found in Pakistan are severely affected by the major factors given above; and several other reasons that are more local and specific in nature. The places that are rich in medicinal plants have different problems in different sites of their occurrence. For instance, if heavy grazing by livestock is taken as reason No.1 in one location, the problem of unsustainable harvest for commercial uses is at top in another location. Similarly, if the faulty land tenure and resource ownership is the major root cause in one area, the lack of appropriate rules, or the poor implementation of the available rules is a major reason behind the issue in other locations.

The Hindukush-Himalayan tract of Pakistan is spread over the Malakand and Hazara administrative divisions of the North West Frontier Province. The region supports a diverse flora and fauna that also include several of the globally important, yet threatened species. The flora in particular consists of a number of progenitors of economically useful crops and a multitude of medicinal and aromatic plants (MAP) with tremendous potential of useful pharmaceutical applications. Presently these regions face serious threat to MAP species and its

habitats spurred by demographic, economic and technological changes. Habitat degradation by domestic livelihood, forest depletion to meet the needs of local communities, and the over-harvest of MAP and other economically useful flora by traders; are some of the issues that require elaborate study and attention. Indigenous people in rural communities rely on plants for food, medicines, fuel, building materials, fiber and other products. The task of documenting the floral wealth and indigenous knowledge about the use of plants resource is vital for effective biodiversity management in general and MAP species in particular.

With the rapidly growing population and associated poverty, indigenous people are under pressure to change their ways of thinking, making decisions and harvesting the bio-resources. This in turn has resulted in rapid deforestation, ecosystem degradation and over harvesting of the MAP species. Moreover, much of the indigenous knowledge about plants is being lost with the transformation of local ecosystem and cultures. All of such factors have severely reduced the population status of MAP species and chances for the overall environmental sustainability of the plant resources of the Hindukush-Himalayan Region.

Although the whole of the Hindukush-Himalayan region is important for the conservation of floral resources, certain locations have strategic importance for the values that are attached to the role of its flora in maintaining water quality and quantity, providing stability to the eco-system on the whole and supporting life in its various forms, including the people that are dependent on such locations for their various needs. Details of such locations/ clusters of locations is included in the report.

Global significance

The global importance of medicinal and aromatic plants is evident from the fact that in 2001, world wide trade of MAPs touched upon 60 billions of US dollars. With the increase in demand for MAPs , such trade is expected to further grow to 5 trillion by the year 2050 (FRLH, 1996). Beside health benefits, MAPs provide crucial livelihood options for millions of rural people in South Asia, particularly women and low income groups. As per our calculations, the collection and processing of MAPs is an important occupation for approximately 5,000 low income families with in the Hindukush-Himalayan region of Pakistan. It contributes to at least 3 millions workdays of employment per annum. The use of medicinal herbs is getting more popular day by day with gradual increase in the percentage of the people using herbal medicines. It is also woth mentioning that the use of wild edible herbs/culinary plants is increasing in the global food market for diverse items ranging from salads to desserts.

The pressure arising from the implementation of WTO is opening new avenues for the diverse use of wild herbs such as their uses as herbal dyes, herbal fertilizers and pesticides and other biocides. Pakistan has immense wealth of wild flora that contains important bioactive agents and has the potential of promoting the use of herbs and their useful biochemical compounds in various industries. However, like many other developing countries, it is yet in the developing stage and needs concerted efforts in different areas such as the documentation of available flora and their traditional uses; discovering potential

uses through phyto-chemical analysis through industrial application, tests, intellectual property rights, certification of products, expanding cultivation trials, *in-situ* conservation for threatened species, commercial production; and international marketing along with conservation and development as well as transfer of technology to the grass root level.

Selected IPAs

Based on various criteria that were provided in he guidelines, such as the presence of threatened species, exceptional botanical richness and the threatened habitats, four valleys in the Hindukush while 3 in the Himalayas were selected as potential IPAs. Various clusters have also been identified for use later.

Details of selected valleys are presented below:

1. Utrorr valley

Utrorr, the inner valley of Hindu Raj mountains in the Hindukush Range is situated between 85^{o}-20′ to 35^{o}-48′ N latitudes and 72^{o}-12′ to 72^{o}-32′ E longitudes in the northern part of Pakistan. The total area of the valley is about 47400 ha. Which has about 16 hamlets, big and small, with a population of about 12000 people? The elevation of the valley ranges from 2300m at a site called “Konai” to over 4000m at “Loi Pandghal”.

There are no accurate records of snow and rainfall, though both forms of precipitation occur to various extents in different seasons. The area is out of the influence of monsoon. Most of the precipitation is received during winters and springs. Snow fall ranges from 2ft in the valley to 10ft on highest altitudes.

This site harbors a variety of wildlife species. Block Bear, Musk Deer, Fox, Wolf, and snow Leopard; and Monal and Koklass Pheasants, are some of the examples. Main vegetation/forest type is the dry temperate conifer forest, sub-alpine and alpine meadows and Oak-scrub.

Vegetation and Flora

Utrorr valley occupies the floristically rich southern extension of Hindu Raj of the Hindu Kush series. Vegetation of the valley is diverse, representing the dry temperate, sub-alpine, alpine and cold desert vegetation zones. Phyto-geographically, the valley is representative of the Sino-Japanese, Irano -Turanian and Euro-Sirberian floristic elements. Principal species of these regions are *Taxus wallichiana, Juglans regia, Ephedra gerardiana.* Studies have revealed that the valley has about 200 species of flowering plants, with high ethno-botanical values. Out of 200 species, 90 plant species have medicinal properties. 31 species of important medicinal plants are threatened. Such species occur mostly in the high altitudinal habitats. Most of these species are perennial, yet slow growing, which require a few years, at least, of growth for reproduction.

Our preliminary search for information reveals that the forests of the valley have been subjected to major structural changes during the last few decades that has reduced the potential habitat for MAPs by about 20%. Some of the MAPs are of commercial importance such as *Valeriana jatamansi, Aconitum violaceum, A. laeve, Podophyllum hexandrum, Colchicum luteum, Dioscorea deltoidea,*

Ephedra gerardiana and *Bunium persicum.*Over and above this, species like Taxus occur in the valley but greatly reduced in number due to local uses.

Overgrazing, unsustainable harvesting of MAPs and over cutting of the forests, are some of the reasons for the plants to get threatened, endangered, or vulnerable. Following are some of the proposed measure that could be undertaken to mitigate the negative impacts of un-sustainable resource use practices with regards to MAP.

- Management of common property resources.
- Introduction of rotational grazing system.
- Introduction of rotational harvesting programmes.
- Promotion of cultivation on private land.
- Sustainable use and value addition
- Development of small scale enterprises from medicinal and aromatic plants material

Details of these measures are provided in the management strategy section of this document.

Gurnai valley

Gurnai valley is located in the north-eastern part of the Hindu Kush mountain ranges. It lies between 34° 27′ to 34° 52′ N latitudes and 71° 26′ to 72° 48′ E longitudes and spread over approximately 42000 ha. The elevation ranges from 4600 ft to over 14000 ft. the valley consist of four big villages and nine small hamlets with a population of about 14000 people.

The valley has little monsoon influence. The precipitation is mostly received in the form of snow during winter. The snow depth varies from area to area, with variation in altitude.

Vegetation and Flora

The valley has various MAPs and wildlife species associated with semi-dry temperate, sub-alpine and alpine meadows. Lower parts of the valley represent coniferous and oak forest while its upper reaches has sub-alpine and alpine meadows. Coniferous forest mainly comprises of *Cedrus deodara*, *Pinus wallichiana*, *Abies pindrows, Picea smithiana* and *Taxus wallichiana* with associated broad leaved species such as *Quercus dilitata, Juglans regia* and *Acer* species.

Phyto-geographically, Irano-Turanian and Sino-Japanese elements with several endemic species are dominant in the flora of the valley. About 250 species of flowering plants have been identified so far in the valley out of which, about 130 plants have ethno-botanical importance. The valley hosts a number of MAPs, some of which have big commercial value in the national and international markets. Out of 250 species, about 31 are classified as threatened in the valley due to various inimical factors. Details of the threatened species are provided in table 3.

Conversion of forest habitats to other land uses through illicit encroachment, overgrazing by nomads, forest logging and unsustainable harvest of medicinal plants are some of the major conservation issues.

The authors suggests that in order to have an effective medicinal and aromatic plants management and its sustainable utilization, it is extremely important to ensure that the benefits of the resources are fairly shared with the owner communities. The sense of ownership can only be inculcated if the communities at large see the benefits coming from the resource. Non equitable distribution of benefit often lead to unsustainable practices.

Daral valley

Daral valley is located in the north-western part of Hindukush mountain ranges. The valley ranges in elevation from 4600 ft at the valley bottom to over 15000 ft at the top. The communities of the valley, 15000 in number, live in ten big villages and 12 small hamlets. It lies between 33° - 19′ to 36° - 46′ N latitudes and 70° - 10′ to 72° - 30′ E longitudes, and is spread over about 39000 ha. The valley has a low monsoon influence and is surrounded by high peaks all around. This feature has profound effects on its environment. Precipitation is mostly received in the form of snow during winter and spring. Snow that ranges from 3-5m in depth normally stays up to a couple of weeks.

Vegetation and Flora

The valley's vegetation is of dry temperate, sub-alpine and alpine in nature with groves of Oak (*Quercus dilitata*) and Poplar (Populus ciliate). Phyto-geographically the valley represents the flora of Euro-Siberian, and Sino-Japanese regions. The valley has about 150 species of flowering plants, out of which, about 90 plants have ethno-botanical importance. These forests have rich diversity of endemic MAPs, having high commercial value. Most of these species are included in the threatened and protected list of IUCN. Out of 150 species, 4 species are critically endangered, 7 are endangered, 6 are commercially threatened, 6 are rare, and one species *Saussurea lappa* is extinct from the valley (see table 3). The vegetation of the valley is under heavy biotic pressure with deforestation, overgrazing and terrace cultivation, as prominent features. Following are the major issues in the conservation and management of MAPs.

- Indiscriminate exploitation of MAPs for sale.
- Conversion of natural forest lands for other purposes, thereby destroying the habitats of MAPs.
- Poor harvest and plant treatment of MAPs.

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Miandam Valley

Miandam is located in the north east of Swat district and lies between 34° 34′ to 35° - 07′ N latitudes and 72° - 36′ to 73° - 35′ E longitudes in the Hindu Kush mountain range. The elevation of the valley ranges from 3900 ft to 12000 ft. The total area of the valley is about 36768 acres. The valley comprises of 11 big villages and 15 small hamlets with a population of about 10,000. The valley has

some influence of monsoon while the precipitation is mainly received during winter and spring in the form of snow. Snow varies from 2 ft to 10 ft, depending on elevation.

Vegetation and Flora

The valley has moist temperate environment, and varies climatically in different parts because of variation in altitude and exposure to sun. As a result thereof, the valley represents three main vegetation types: broad leaved deciduous forest; coniferous forest; sub-alpine and alpine meadows. Phyto-geographically, the valley is represented by the Sino-Japanese, and Irano-Turanian elements. The valley is home to more than 150 species of flowering plants with 120 having high ethno-botanical uses. Over and above this, 50 species have high medicinal value and are being collected from the area for commercial purposes.

Several species of MAPs are endemic to the valley and many of them i.e. 27 species are included in the various threatened categories of IUCN (see table 3).

In regards to maintain adequate cover and density of MAP species the study proposes a joint medicinal plant management approach involving the collectors, users, traders, and herbal pharmaceutical companies and resources management institutions. Furthermore, it should be integrated with the current natural resources management practices.

Nathiagali

Nathiagali is part of Galis Reserved Forests and lies between 34^{o}: 01' to 34^{o}: 3.8' N latitude and 73^{o}: 22.8' to 73^{o}: 27.1' E longitude. The area is spread over 3,312ha, which has 12 villages in its periphery with a population of about 50,000 people. The altitude varies between 1,800 and 2,980m, "Miranjani" being the highest peak with an altitude of 2,980m. The valley lies within the effective reach of monsoon and receive precipitation in the form of snowfall in winter and rain fall in summer.

The valley host a variety of wildlife species. Rhesus Monkey, Common leopard, Yellow-throated martin, flying squirrel, Koklas and chukar are some of the wildlife species, associated with the Himalayan Moist Temperate Forest, sub-alpine and alpine meadows.

Vegetation and Flora

Ecologically, the valley is a representative of the Himalayan Moist Temperate and sub-alpine conifer forests. Phyto geographically the valley is dominated by Irano-Turanian and Saharo-Sindian floristic element. The forests of the valley hosts 264 species, many of them are of medicinal and economic importance. Investigations have revealed that about 25 species are included in the threatened and protected list of IU CN. Heavy deforestation, free grazing, and large quantities of fuel and fodder collection are some of the factors affecting the regeneration capacity of MAPs.

Siran and Shogran valleys

The two valleys i.e. Siran and Shogran are located in the northern Himalayan mountain range. Although these valleys are geographically isolated a

and located far from each other thus independent from each other but since both have common flora; and similar problems and issues, these are being described as one unit. About 20,000 people, live in both the valley in 10 big villages and 12 small hamlets. The total area of the valleys is about 35000 ha. Elevation of the sites varies from 4000 ft to 16000 ft.

Climate of both the sites is moist temperate with sufficient monsoon rains in summers and snow in winters.

The entire eco-system is exposed to extreme biotic pressures; however, some of the forests, being in the protected category, is still safe from heavy degradation and is a major seed source for areas that are now devoid of major vegetation

Vegetation and Flora

The vegetation of the valleys is a combination of the moist and dry temperate coniferous types of vegetations. Oaks, open scrub, sub-alpine and alpine forests are the main vegetation types.

Phyto geographically the valleys have the representation of Saharo-Sindian, Sino-Japanese, Irano-Turanian and Indian elements, which are dominant in the flora of the valleys. Studies have shown that Siran has about 123 species , while Shogran hosts 117 species having high ethno botanical and medicinal importance. Several of them are endemic to each valley. Out of the reported species a total of 24 MAPs are classified as threatened in the *IUCN Red List (See table.3).*

Lack of alternative sources of fuel, fodder and energy, inappropriate and over collection of MAPs, and lack of awareness are some of the worth mentioning factors resulting in rapid degradation of these resources. Keeping in view the magnitude of the current conservation issues, the study suggests capacity building of the collectors with regards to pre and post harvest treatment of MAPs, provision of alternative sources of fuel and energy and target specific public environmental education and awareness campaign to undo the negative impacts of unsustainable practices.

Following are the major threats to MAPs in these IPAs:

- Deforestation
- Overgrazing
- Over harvesting of MAPs
- Non sustainable practices

Some of the specific root causes are as under:

- Lack of education and awareness
- The need to establish MAPs gardens.
- Lack of incentives for *in-situ* and *ex-situ* conservation of MAPs,
- Lack of MAPs as a subject in schools.

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Exceptional ethno botanical richness of the selected IPAs

Ethno botanical database generated by WWF and others revealed that the targeted valleys have rich diversity of floral elements, many of which have high

medicinal, economic and other ethno botanical values. Investigations have revealed that certain plants are used to cure various ailments of both human and livestock since centuries. They are also used as timber, firewood, fodder, food, fruit and row materials to make handicrafts and tools in the targeted valleys. Hundreds of plants in the targeted valleys have been identified and documented. However, the local indigenous knowledge of various uses of plants has still to be documented in many areas of Hindu Kush and Himalayas, including the targeted valleys to avoid its loss.

Studies conducted on the ethnobotany of the targeted valleys have shown that almost 560 plants species, have one or the other uses, thus have ethno botanical importance. Out of these, about 300 Spp have medicinal uses, 50 are multipurpose Spp), 20 have timber values, 35 are used as fire wood, 10 are wild vegetable, 15 are wild fruits, 15 are used in making handicraft & tools, 10 are used to enhance viscosity of mud, 5 are used for cleaning floors, 10 are used to make fences/hedges of agricultural land, 10 to deter evils and bad spirits 5 are repellents , and 5 are used by honey bees species. In addition, 10 plants are being considered poisonous while the uses of 70 are still unknown.

It is generally concluded that the targeted valleys are traditionally rich in traditional usage of plants, and in the forest products and that, exept a few species, men are more aware of plants of ethno botanical value than women. There are still some species not known for their uses.

Presence of threatened MAP species in the selected IPAs

The available information reveals that about 30 plant species, found in the selected sites, are classified as threatened and put in appendix 1 and 2 of CITES.

Most of the threatened MAP species are of commercial value in the targeted valleys and collected in big. This has reduced the availability of such species by about 1/3^{rd,} as compared to 20 years ago. This information is based on the fact that the collectors now have to travel 5 hrs to collect the same quantity of MAPs, Valeriana for example, as they used to collect in 2 hours about 20 years ago.

The authors have analyzed that there are four major forest types with in the selected sites, where MAPs are abundantly found. Each species in such forest types has a minimum optimum and maximum ecological range where it flourishes. The plants generally grow to their maximum in their optimum ranges. Within this range the plants produce the maximum percentage of active chemical ingredients. The minimum and maximum growth ranges could be affected by the population distribution as well as chemical constituents in plants.

Valeriana jatamansi, Podophyllum hexandrum, Colchicum luteum, Bistorta amplexicaule, Dioscorea deltoidea and many others are either fully extinct or rare in the foot hills and alpine pasture. However, because of their absence from two major habitats, pressures from the community is increasing on the left over habitat.

There are three types of collectors in the selected valleys: the nomads: permanent residents of the foothills: and the outsiders who come to these valleys to gather MAPs.

Distribution of MAPs in different sites of each selected IPAs

The MAP species are found in almost all habitats throughout the selected valleys, i.e. from temperate forests to sub-alpine and alpine pastures and meadows. Most of the important MAPs are found in the coniferous zone, however, the distribution is influenced by altitude, aspect and the slope. The pattern of distribution and availability of targeted plants were found to be quite variable according to differences in harvesting intensity, grazing, habitat loss and coniferous vegetation. These factors have adversely affected the natural regeneration and seriously reduced the availability of MAP species in particular sites of the selected valleys. As a result the indigenous plant species are becoming rare and sparse in the selected valleys. Secondly the number of endangered species is increasing steadily due to environmental degradation, and indiscriminate collection of MAP species.

Species information with respect to its management

The harvest level of plants has to be based upon the biological response of the plant. Harvest of rhizomes and corms (underground stems) can result in the death of plants as in case of *Corms of Colchicum luteum and rhizomes of Dioscorea deltoidea, Valeriana jatamansi, Bistorta amplexicaule, Podophyllum hexandrum* and many other rhizomatous plants in the sites. Harvest of the vegetative part of the plant above the level of ground shall not cause the mortality of the plant itself, such as the leaves and flowers of *Viola serpens,* fruits of *Bunium persicum,* seeds of *Plantago ovata* and *Hyoscyamus niger*e. With proper harvesting technique at proper time, the plants may recover from damage due to harvesting of leaves and flowers to replenish compensatory growth. This can result in a net higher biomass production as compared to an undisturbed plant.

In order to regulate collection of medicinal plants and livestock grazing in the target sites, the phenological studies are useful to conduct which envisages a relationship between climate and growing periods of the plants of an area.

Strategy for MAPs management in each IPAs

Following is the management strategy proposed for each o f the selected IPA.

The problems of medicinal and aromatic plants are rooted deep in the socio-cultural and economic facets of an area. Such problems and their intensity is further aggravated by natural hazards such as harsh climatic conditions and difficult terrain with steep and precipitous slopes. Although very little can be done to over come natural problems, there are opportunities to manipulate the existing medicinal and aromatic plant resources to the benefit of local community

The main features of the proposed strategy includes:

- Management of plants on communal land/ property .
- Introduction of rotational grazing system.
- Introduction of rotational harvesting programmes.
- Promotion of cultivation on private land.
- Sustainable use and value addition
- Development of small scale enterprises from medicinal and aromatic plants material

Management of plants on communal land/ property

Most of the Non Wood forest Produces in general, and medicinal and aromatic plants in particular, are harvested from communal land where access appears to be neither restricted nor regulated. Sustainable harvesting and management of these resources would not be possible without promoting social institutions that could over see, monitor and enforce regulations and ensure sustainable management and equitable benefits sharing of these resources. Examples of such institutions are to be explored.

Rotational grazing and harvesting Management

Rotational grazing and harvesting program are designed to provide periodic rests, and intensive stocking rates. However, for grazing programme, the interval between two consecutive grazing should be two months of growing season, while for harvesting of Medicinal and Aromatic Plants), the interval could be only one year.

To implement such a strategy, each selected valley shall be divided into a number of blocks and they are put to intensive grazing and harvesting for some pre-determined period on rational basis. When one block is used, the others are kept at rest with different periods. Indigenous knowledge, however, could be further helpful if explored and used.

Promotion of cultivation on Private land

There are a number of medicinal and aromatic plants that could be conveniently cultivated on farmlands. This could be a useful tool to recover some of the threatened species back in the area.

Sustainable use and value addition

For an effective resource base management, community participation is of utmost importance as the resource in question might have certain social or economic benefit to. The relevant communities must also be made aware of the problems and ultimate disappearance of the resources. It is important that the benefits of the resources are equitably shared with the communities so that a sense of ownership is inculcated among them. Te identification and management of certain monetary values of the species could more conveniently create the desired awareness and interest for the promotion of conservation.

In order to add value to the medicinal plant resources, the following need to be considered:

- Harvesting at proper time.
- Proper identification of plants before harvesting to know the plant that is being traded. Correct identification is relatively easy when all plant parts are present.
- Harvesting only of the required and healthy parts of the plants and their storage in separate and properly labeled bags.
- Initial cleaning of material by removing dust, husk, bird excrements, insects, and unwanted plants and their parts after harvesting.

- Shade drying of the materials that is kept suspended on clean nylon nets for 2-3 days (depending upon the species and their parts) until required moisture levels is achieved.
- Before packing, repeated re-examination of the dried plant materials to remove any rotten parts, strange pests and any other foreign particles.
- Grading and packing of materials in sealed, labeled bags for transportation.
- Providing all necessary information including site of collection, scientific and trade names of the species.

Harvesting Techniques

There is an optimal time for the collection of plants depending upon their Phenology. Optimal timings have a direct link with the part of plant used. There exists a clear relationship between the time of harvesting and impact on plant regeneration and the amount and nature of active chemical constituents present in the plants, which are not constant throughout the year and through out their life cycle. Each part of a plant contains different chemical component, therefore the collection of the incorrect part for a specific purpose will result in a wrong outcome.

Marketing

Awareness about the market potential for each species is very critical. At present, there are uncoordinated and improper marketing channel of the medicinal plants that are causing problems in the proper management of medicinal plant resources.

Awareness and educational material should be developed in locally understandable languages to inform the communities and collectors in the valleys about the occurrence of medicinal plants, their market values, medicinal importance, threats to specific medicinal plant species, and the legal status of their collection and uses.

In case of species that are threatened, clear guidelines should be developed, and annual quotas of plant parts which may be collected should be clearly established and made known to all concerned parties and stakeholders. A proper mechanism of the implementation of collection quotas should be designed to enforce the conservation efforts. A short identification manual containing colored pictures of threatened plants could be prepared for collectors so that they can easily identify them and therefore refrain from the collection of these plant species.

Demonstration

Some MAP species can make potential demonstration projects for proposed study in the selected valleys.

In order to establish a sustainable level for the harvesting of MAPs in the selected valleys, basic research is needed that could demonstrate the technique to the local community. Accordingly, research plots have to be established to

assess various levels of harvest and determine the best one. Monitoring of population may be required for certain period of time, depending on species.

Table-3: List of Threatened MAP species in the selected valleys of both Hindu Kush and Himalayas mountains

Species	**Hindu Kush Ranges (valleys)**				**Himalyan Range (Valleys)**		
	Utrorr	**Gurnai**	**Daral**	**Miandam**	**Siran**	**Shogran**	**Nathiagali**
Acorus calamus	E	E	E	E	I	I	I
Aconitum leave	R	R	R	VR	V	V	V
A. violaceum	R	R	R	R	I	I	I
Berberis lyceum	CR	K	K	K	K	K	K
Ephedra gerardiana	CE	CE	CE	-	-	-	-
Hyoscyamus niger	CE	CE	CE	CE	-	-	-
Morchella esculenta	R	R	R	R	R	R	R
Corydalis govaniana	R	R	R	R	-	-	-
Dioscorea deltoidea	CT	V	V	V	CT	CT	CT
Podophyllum hexandrum	E	E	E	E	E	E	E
Valeriana jatamansi	CT	CT	CT	CT	CT	CT	CT
Colchicum luteum	V	V	V	V	-	-	-
Paeonia emodi	V	CT	CT	V	C	C	C
Rheum webbianum	E	E	E	-	E	E	E
Taxus wallichiana	E	CE	CE	E	E	E	E
Saussurea lappa	Ex	Ex	Ex	Ex	Ex	Ex	Ex
Atropa belladonna	E	E	E	E	V	V	V
Onosoma bracteatum	E	E	E	E	E	E	E
Bergenia ciliate	C	C	V	C	C	C	C
Viola serpens	CT	CT	CT	CT	CT	CT	CT
Geranium wallichianum	V	V	E	V	V	V	V
Primula denticulata	R	R	R	R	R	R	R

Delphinium roylei	V	V	V	V	V	V	V
Bunium persicum	CT	V	V	V	-	-	-
Arnebia spp	E	E	E	-	-	-	-
Bistorta amplexicaule	CT	CT	CT	CT	V	V	V
Thymus serphyllum	K	K	K	K	K	K	K
Hypericum perforatum	R	R	R	V	V	V	V
Polygonotum multiflorum	CT	CT	CT	CT	V	V	V
Asparagus adscendens	CT	CT	CT	CT	V	V	V
Pinus gerordiana	CE	CE	CE	-	-	-	-

Key: V = Vulnerable
E = Endangered
CE = Critically Endangered
CT = Commercially Threatened
C = Common
R = Rare
VR = Very Rare
I = Indeterminate
K = Insufficiently known

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