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Diversity and conservation status of vascular plants of Dir Kohistan valley, Khyber Pakhtunkhwa Province

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Abstract

In this research effort have made to document the diversity and conservation status of important medicinal plants found in Dir Kohistan valley. This is ever first record of the flora of this area. The area has many climatic and vegetation zones. Locals residing in mountainous areas belonging to various ethnic groups are traditionally utilizing plants over many generations. The rural population of the valley is dependent on the forest wood and medicinal plants to fulfill their fuel, shelter and livestock fodder demands. In the present study 83 plant species belongs to 50 families have been reported. Out of 83 species, 43 threatened plant species has been reported from Dir Kohistan Valley, of which 22 % species were ranked as endangered, 20 % species vulnerable and 10 % species are rare. Many of these medicinal plants are used in local community. *Colchicum luteum*, *Geranium wallichiana, Paeonia emodi*, *Podophylum emodi, Valeriana jatamans* and *Viola biflora* are some of the most threatened species and need special attention. Furthermore, out of the total 83 plant species, 80% were medicinal plant species, 47% were used as fuel wood and 33 % were fodder species. Over exploitation of plant resources combined with improper harvesting and post harvesting techniques have intensified pressure on plants of area. The major factors contributing towards plant diversity loss found were poverty, grazing of pasture, forest encroachment, medicinal plant collection, agro-system threats, fuel collection, forest fire, soil-slope erosion and invasive species intensify the environment. Further extensive field conservation/management research is needed.

Introduction

Over the past three decades, conservationists, natural resources managers and environmental policy makers have recognized that the conservation of biological diversity depends upon protecting and managing intact habitats. Such recognition has given greater importance and urgency to the international efforts to establish and maintain biosphere reserves, wildlife sanctuaries, national parks, forests reserves and other protected areas (Ahmad *et al.*, 2004). Indiscriminate and non-systematic collection of medicinal plants in various parts of the world has led to severe pressure on the availability of medicinal plants, many of which are now rare, threatened or endangered (Ahmad, 2007). What is the conservation status of medicinal plants and how many species of medicinal plants are threatened today? No one knows. "Knowing what species are traded commercially is the foundation for identifying threatened plants" According to recent figures from IUCN Threatened plant database approximately 32,000 species of plants are threatened with extinction (Bhattarai *et al.*, 2006). This figure represents approximately 13 % of the estimated 250,000 species of higher plants and bryophytes on earth, but does not take into account the many species whose status has not yet been assessed. A widely quoted estimated by Britto and Mahesh, 2007 based on record in the NAPRALERT database, is that 28 % of plants have been used in ethnomedicine. Putting theses estimations together (28 percent of 13 percent of 250,000 plant species) allows the conclusion that roughly 9,000 species of medicinal plants are threatened worldwide. This figure excludes, of course, all the species with uses still undocumented or unknown (Bussmann and Sharon, 2006).

In Pakistan, Only a few projects have been launched for documentation of conservation status as well as sustainable use of plant resources. Approximately 37 species have been cited as threatened from Ayubia National Park (Shah and Khan, 2006). Using IUCN criterion 1970, fifty five medicinal plants species from 3 districts of Malakand division have been reported as threatened (Chaudhri *et al.,* 2000). Adopting IUCN criteria 1994, twenty plant species have been identified as target species from Pakistan (Shah and Shinwari, 1995). The impacts of fuel shortage on conservation of biodiversity of Hindu-Kush Himalayas Mountain region have been reviewed. The most serious crisis to the loss of the biodiversity is fuel shortage, which mainly affects firewood species (Khan, 2003). The conservation status of Astir area, Gilgit has been reported. Five species out of 34 species were found to be endangered, 18 to be vulnerable and 19 to be rare. The major threat of endangerment was noted to *Betula utilis, Ferula narthex, Podophylum hexandrum, Saussurea lappa* and *Tamarix gallica* (Shinwari and Gillani, 2003). Similarly using IUCN criteria 17.61% of the total utility plants of Utror and Gabral valleys are threatened, of which 4.54% are Endangered, 5.68% Vulnerable, 4.54% Rare and 2.84% Near Threatened. The studies indicate that these plant species need special attention before they are eroded genetically (Hamayun *et al.,* 2003).

Objectives

The objectives of the present study was

1. To document the ethnobotanically important flora of the area.
2. To study the conservation issues of the area.
3. To study the diversity of vascular plant species of the area.

Materials and methods

Study areas

Dir Kohistan Valley covers 1 40,351 acres of the coniferous forests situated between latitude 35°- 9' to 35°-47' and longitude 71°-52' to 72°-22' in the northern position of the watershed of Panjkora river. The Hindu Raj range bound the area generally known as Dir Kohistan on the north and northwest, by the Torwal and Gabral range on the east, by Dodbah Sarghar on the south, and by Btarai ghar on the Southwest. The total area of Dir Kohistan is 4, 12,570 acres i.e., 645 squares miles, of this, an area of 1, 40,351 acres covered with forests (Table 1). Research

work was carried out from May 2012 to August 2013 in Bar Kali, Biar, Kot Kali, Jaz Banda, Patrak, Shandoor, Sheringal and Thal villages of Dir Kohistan valley Gul *et al*., 2011 (Fig 1).

Fig. 1. Dir Kohistan Valley Map showing the areas from where plants species were collected.

Present effort was made during 2008 to 2010. Conservation status of ethnobotanically valued flora of Northern areas of Pakistan was studied by developing a new conservation assessment scale. The (World Conservation Union**)** IUCN criteria for threatened categories were also used (Version 3.1) with some modification in order to get a clear picture without any complication. (World Conservation Union) IUCN (2001) included nine different categories which were modified to seven categories in the present study and criteria for rare and secure category were also included (IUCN, 2001).

Criteria Developed for Conservation Status Assessment

A plant is assigned global rank (G-rank), which applies across its entire range; a national rank (N-rank) for each nation in its range, and a sub-national rank (S-rank) for any other small unit (a specific locality) jurisdiction in its range (e.g. Dir Kohistan valley). The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a specific number from 0 to 6, preceded by a G (Global) (Hamayun *et al.,* 2003).

N (National) and S (Sub-national or local). The numbers have the following meaning:
0= Extinct 1=Critically Endangered
2=Endangered
3=Vulnerable to extirpation or extinction
4=Rare
5=Near Threatened
6=Secure.

Total conservation score of a species at different localities

Conservation Status Scale (CSS) = ----------

Total no. of localities visited

For different threatened categories, the CSS value should fall in the following given ranges:

Extinct = 0 Critically Endangered = 0<CE≤1
Endangered = 1<R≤2 Vulnerable = 2, V≤3
Secure = 5 <S≤6 Near Threatened = 4<NT≤5.

Data collection

In order to study the diversity of the flora, transect walks were made during different seasons throughout the area, which covered all slopes, aspects and altitudes. Local were consulted getting valuable information about localities of their maximum availability, distribution and abundance. Information was confirmed through field visits. Personal observations were made in the field keeping several parameters in consideration. Different parameters were taken into account like range extent and area of occupancy, exploitation level, plants availability, habitat, alternation, conservation efforts, plant collection techniques. The plant species were then categorized into endangered, vulnerable, rare and threatened species (Hussain *et al*., 2008).

Results

The results revealed that there are 83 plant species belongs to 50 families. Gymnosperms are represented by four families (Cupressaceae**,** Ephedraceae Pinaceae and Taxaceae); Pinaceae is represented by five species (*Abies pindrow, Cedrus deodara, Pinus roxburghii, Pinus wallichiana* and *Picea smithianna*). 45 families represent angiosperms. The well-represented families is Asteraceae (9 species), Ranunculaceae (6species), Rosaceae (4 species), Lamiaceae (4 species). While Berberidaceae,

Ebinaceae, Ephedraceae, Moraceae, Salicaceae, Fagaceae, Caryophylaceae, Violaceae, Vitaceae and Rhamnaceae with 2 species each. The remaining families are represented by a single species (Table 2). Based on the utility, there are 66 medicinal plants, 27 species of fodder and forage, 39 fuel wood species, 7 plants were used for ornamental purposes, and 19 species are utilized to make agricultural tools (Table 2, Fig. 2). The present study revealed that there are 43 threatened species in Dir Kohistan Valley, of which 22 % are endangered, 20 % vulnerable and 10 % are rare. (Table 2; Fig. 3). Results also indicated that those multipurpose medicinal plant species are currently exploited more for construction, firewood and fodder purposes than for their medicinal role.

Table 1. Total area covered (in acres) by forests in Dir Kohistan.

Forest Type	Area Covered/ Acres	Percentage
Pure deodar forests	517	0.13
Mixed fir and spruce forests	1325	0.35
Mixed deodar, kail, fir and spruce forests	136277	35.98
Shrub oak forests	11917	3.15
Alpine pasture	226387	59.78
Total		100.00

(Hamayun *et al.*, 2003).

Table 2. Conservation Status and uses of plant species of Dir Kohistan, Khyber Pakhtunkhwa province Pakistan.

S. No	Botanical Name	Family	Conservation Status	Fodder and forage	Fuel wood	Ornamental species	Honeybee attracting	Agricultural tools	Thatching and sheltering	Timber trees	Medicinal uses
1.	*Abies pindrow* Royle.	Pinaceae	E	-	+	-	-	+	+	+	+
2.	*Acer cappadocicum* Gled.	Aceraceae	V	-	-	-	-	+	-	-	-
3.	*Ailanthus altissima* (Mill). Swingle.	Simarubaceae	-	+	+	-	-	+	-	+	+
4.	*Achillea millefolium* L.	Asteraceae	V	-	-	-	-	-	-	-	+
5.	*Aesculus indica* (Wall ex. Camble).	Hipocastinaceae	E	+	+	-	-	+	-	+	-
6.	*Aconitum violaceum* Jacq. ex Staph.	Ranunculaceae	V	-	-	-	-	-	-	-	+
7.	*Aconitum hetrophyllum*	Ranunculaceae	V	-	-	-	-	-	-	-	+
8.	*Acorus calamus* L.	Araceae	E	-	-	-	-	-	-	-	+
9.	*Aquilegia pubiflora* Wall. ex Royl	Ranunculaceae	V	-	-	-	-	-	-	-	+
10.	*Artemisia vulgaris* Waldst and Ket.	Asteraceae	R	-	+	-	-	-	+	-	-
11.	*Artemisia trichophylla* Wall.ex DC.	Asteraceae	R	-	+	-	-	-	+	-	-
12.	*Berberis lycium* Royle.	Berberidaceae	V	-	+	-	-	-	-	-	-
13.	*Berberis vulgaris* Royle	Berberidaceae	E	-	-	-	-	-	+	-	+
14.	*Bergenia ciliate* (Haw) Sternb	Saxifragaceae	E	-	-	-	-	-	-	-	+
15.	*Buxus wallichiana* Bill.	Buxaceae	E	-	+	-	-	+	+	-	+
16.	*Caltha alba* Camb.	Ranunculaceae	V	-	-	-	+	-	-	-	+
17.	*Cedrus deodara* (Roxb.ex Lambert) G.Don	Pinaceae	E	-	+	-	-	+	-	+	-
18.	*Cichorium intybus* L.	Asteraceae	R	+	-	-	-	-	-	-	+
19.	*Clematis orientalis* Wall.	Ranunculaceae	E	+	-	-	-	-	-	-	+
20.	*Clematis grata* Wall.	Ranunculaceae	-	+	-	-	-	-	-	-	+
21.	*Colchicum luteum* Baker.	Colchicaceae	V	-	-	-	-	-	-	-	+
22.	*Cotoneaster microphylla* Wall.e	Rosacea	-	-	+	-	-		+	-	-
23.	*Daphne oleoides* Schreb.	Thymelaeaceae	V	-	+	-	-	-	-	-	+
24.	*Debregeasia salicifolia* (Forssk) Hepper& Wood.	Urticaceae	-	-	+	-	-	+	+	-	+
25.	*Diospyrus lotus* L.	Ebinaceae	-	+	+	-	-	+	-	+	+

26.	*Diospyrus kaki* L.	Ebinaceae	-	+	+	-	-	+	-	+	+
27.	*Ephedra intermedia* Wall. ex Staph.	Ephedraceae	V	-	+	-	-	-	-	-	+
28.	*Ephedra geradiana* L.	Ephedraceae	V	-	+	-	-	-	-	-	+
29.	*Ficus carica* Forssk.	Moraceae	-	+	+	-	-	+	-	-	+
30.	*Ficus palmata* Forsak.	Moraceae	-	+	+	-	-	+	-	-	+
31.	*Foeniculum vulgare* Mill.	Apiaceae	-	-	-	-	-	-	-	-	+
32.	*Fraxinus xantholoides* Wall.ex DC.	Oleaceae	-	-	+	-	-	+	-	-	-
33.	*Gentiana kurroo* Royle.	Gentianaceae	V	-	-	+	-	-	-	-	+
34.	*Hyoscyamus niger* L	Solanaceae	E	-	-	-	-	-	-	-	+
35.	*Hypericum perforatum* L.	Hypericaceae	E	-	-	-	-	-	-	-	+
36.	*Indigofera gerardiana*Wall.	Papillionaceae	R	+	+	-	+	-	-	-	+
37.	*Juniperus communis* L.	Cupressaceae	E	-	+	-	-	-	-	-	+
38.	*Mallotus philippensis* Muell.	Euphorbiaceae	-	-	-	-	-	+	-	-	-
39.	*Myrsine africana* L.	Myrsinaceae	-	+	+	-	-	-	-	-	+
40.	*Ocymum bacilium* L.	Lamiaceae	-	-	-	-	+	-	-	-	-
41.	*Olea ferruginea* Royle.	Oleaceae	-	+	+	-	-	+	+	-	+
42.	*Origanum vulgare* L.	Lamiaceae	-	-	-	-	-	-	-	-	+
43.	*Paoeonia emodi* Wall ex Royal.	Paeoniaceae	E	-	-	-	-	-	-	-	+
44.	*Podophyllum hexandrum* Wall. ex. Royal	Podophylaceae	E	-	-	-	-	-	-	-	+
45.	*Pinus roxburghii* Sargent.	Pinaceae	R	-	+	-	-	+	+	+	+
46.	*Pinus wallichiana* A.B.Jackson	Pinaceae	V	-	+	+	-	+	+	+	-
47.	*Pistacia integerrima* J. L. Stewart ex Brand.	Anacardiaceae	V	+	+	-	-	-	-	-	+
48.	*Platanus orientalis* L.	Plantanaceae	-	-	+	-	-	+	-	+	+
49.	*Plectranthus rugosus* Wall.Ex Bath.	Lamiaceae	-	+	-	-	+	-	+	-	+
50.	*Picea smithianna* (Wall.) Boiss.	Pinaceae	E	-	+	-	-	-	-	+	+
51.	*Populus nigra* L.	Salicaceae	-	+	+	+	-	+	+	+	-
52.	*Poplus alba* L.	Salicaceae	-	+	+	-	-	+	+	+	-
53.	*Portulaca oleracea* L.	Portulacaceae	-	+	-	-	+	-	-	-	+
54.	*Punica granatum* L.	Punicaceae	-	+	+	-	+	-	-	-	+
55.	*Pyrus pashia* Ham ex. D.Don.	Rosaceae	-	+	+	-	+	-	-	-	+
56.	*Quercus dialata* Lindle ex Royal.	Fagaceae	E	-	+	-	-	-	-	+	+
57.	*Quercus incana* Roxb.	Fagaceae	E	-	+	-	-	-	-	+	+
58.	*Quercus ilex* L.	Fagaceae	V	-	+	-	-	-	-	+	-
59.	*Rheum australe* D.Don	Polygonaceae	R	-	-	-	-	-	-	-	+
60.	*Rosa moschata* J.Hern.	Rosaceae	-	-	-	+	+	-	-	-	+
61.	*Rubus fruticosus* Hk.f.	Rosaceae	-	+	-	-	+	-	-	-	+
62.	*Saussurea heteromala* (D.Don) Hand.	Asteraceae	-	-	-	-	-	-	-	-	+
63.	*Senecio chrysenthemoides* DC.	Asteraceae	-	-	-	+	-	-	-	-	+
64.	*Setaria viridis* (L.) P. Beauv	Poaceae	-	+	-	-	-	-	-	-	-
65.	*Silene vulgaris* Grack.	Caryophylaceae	-	-	-	-	-	-	-	-	+
66.	*Silene conoidea* L.	Cortuphyllaceae	-	+	-	-	-	-	-	-	-
67.	*Skimmia laureola* (DC.)Sieb. &Zucc.ExWalp.	Rutaceae	R	-	-	-	-	-	-	-	+
68.	*Solanum surratense* Burm. f.	Solanaceae	-	-	-	-	-	-	-	-	+
69.	*Sonchus asper* L.	Asteraceae	-	+	-	-	-	-	-	-	+
70.	*Stellaria media* (L.) Vill	Caryophyllaceae	-	+	-	-	-	-	-	-	+
71.	*Taraxacum officinale* Weber.	Asteraceae	-	+	-	-	-	-	-	-	+
72.	*Taxus wallichiana* (Zucc). P	Taxaceae	E	-	+	+	-	-	+	+	+
73.	*Thymus linearis* Benth.	Lamiaceae	R	-	-	-	-	-	-	-	+
74.	*Valeriana jatamansi*DC.	Valerianaceae	E	-	-	-	-	-	-	-	+
75.	*Viola canescens* Wall ex Roxb.	Violaceae	V	-	-	-	-	-	-	-	-
76.	*Viola biflora* L.	Violaceae	V	-	-	-	-	-	-	-	+
77.	*Vitex negundo* L.	Verbinaceae	-	-	-	-	-	-	+	-	+
78.	*Vitis vinifera* L.	Vitaceae	-	+	+	+	-	-	-	-	+
79.	*Vitis jacquemonti* R. Parker.	Vitaceae	-	+	-	-	-	-	+	-	+
80.	*Woodforbia fruticosa* (L.) Kuz.	Lytheraceae	-	-	+	-	-	-	-	+	+
81.	*Zanthoxylum armatum* D C.	Asteraceae	-	-	-	-	-	-	-	-	+
82.	*Zizypus nummularia* (Burm. f) Wight. & Arm.	Rhamnaceae	-	-	+	-	+	-	-	-	+
83.	*Ziziphus mauritiana* L.	Rhamnaceae	-	-	+	-	+	-	-	-	+

Discussion

Plant and plant resources are always indispensable for any region as they show immense impact on the ecosystem and socio-economic conditions of the people inhabiting that region. Dir Kohistan valley is one of the most exploited areas. The local people collect plant not only for their own requirement for curing disease and also sell some of them in the local market for earning their livehoods. The collectors are unaware of the repercussions of such indiscriminate collection of valuable plant resources. As a result, most economic plants are threatened in the area and may become story of the past if existing conditions prevailed for a long period.

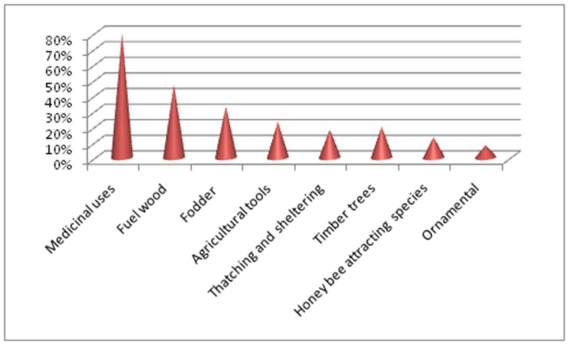

Fig . 2. Ethnobotanical uses of plants of Dir Kohistan Valley.

Documentation of ethnobotanically important plants in different areas of district Gilgit northern areas has been carried out by various researches. The investigation of ethnomedicinal uses of 126 plants belong to 48 families from Khan Abad village and its Allied Areas of district Gilgit have been reported (Gorsi and Miraj, 2002). A list of the 41 species, belonging to 29 families of wild herbs, shrubs and trees reported from Chapursan valley, Gojal ii, Gilgit-Pakistan. The investigated area has a rich diversity of medicinal plants and ideal climatic conditions for their growth (Wazir *et al.,* 2004). Similarly 98 herbaceous medicinal plant species has been reported from Haramosh and Bugrote valleys in Gilgit, northern areas of Pakistan. Out of 98 plants 21 are cultivated and 77 are wild (Khanum and Gilani, 2005).

Many medicinal plant species are threatened with local, commercial and in some cases biological extinction. The cause includes increasing damaged, a vastly increasing human population and intensive conservation of habitats. Concern over the fate of 14 internationally traded medicinal plants has lead to their inclusion in the Appendices of the Conservation on International Trade in Endangered Species of Wild Flora and Fauna (CITES), and a further 233 plant species currently included in the Appendices have medicinal uses (Schippmann, 2001). Conservation of plant diversity assumes greater importance when the world is facing unprecedented loss of biological diversity. As per an estimate about 60,000 out of 2, 87, 655 species of plants known in the world are facing the threat of extinction. 11,824 species were evaluated for their threat status as per the revised 1994 IUCN Red List Categories; of these 8321 species are now on the IUCN Red List 2004 (Martain, 1995, IUCN 2001). Khasbagan **and** Soyolt **(**2008**)** documented over 7300 tree species as globally threatened. Interestingly, about 1665 of these threatened tree species are in cultivation in botanic gardens in different parts of the world (Wyse Jackson 2002). There are over 1800 botanic gardens and arboreta located in about 148 countries and they together maintain over 4 million living plants belonging to more than 80,000 species of vascular plants (Shinwari and Gillani, 2003).

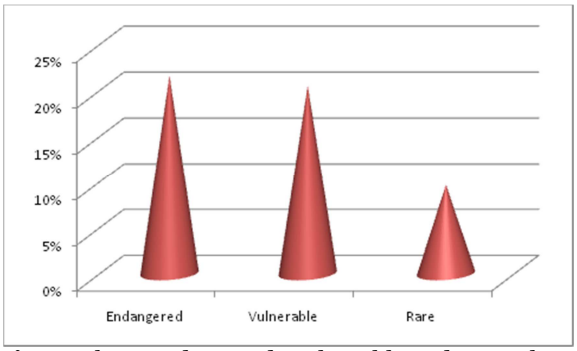

Fig. 3. Show Endangered, Vulnerable and Rare plant species of Dir Kohistan Valley.

The availability of medicinal plants decreased during the past 10 years. According to aged villagers, medicinal plants were abundant in the vicinities of human settlements some 10 years back. However, the

population of medicinal plants drastically decreased due to increased marketing pressure on medicinal plants, lack of job opportunities in the area, non sustainable harvesting methods like digging of whole plant and increased population of the area. The medicinal plants are now collected in large volumes from remote areas like Bar Kali, Biar, Kot Kali, Jaz Banda, Patrak, Shandoor and Thal etc.

Some of the plants are utilized individually, while other are used in mixture with other plants. The same plant drug is generally used for curing several ailments; among such plants are *Acacia modesta, Acorus calamus, Ajuga bracteosa, Berberis lyceum, Buxus wallichiana, Mentha longifolia, Punica granatum, Prunus domestica, Podophyllum hexandrum, Paeonia emodi, Valeriana jatamansi, Viola canescens* and *Viola betonicifolia*.

Collection of medicinal plants had threatened certain species. *Podophyllum hexandrum*, *Valeriana jatamansi* are rare plants, while *Taxus wallichiana* is threatened species. There is a need of careful conservation of the plants resources of the region otherwise many plants may be lost forever and become extinct. Among the medicinal plants, *Paeonia emodi* was once very wide spread in the valley is now restricted in a small localized area. It is due to the over exploitation of this plants for its high quality medicinal properties, especially for backache, dropsy, epilepsy, convulsion, hysteria and uterine diseases. Local people are well aware of its uses. However this plant is vulnerable and will soon be threatened in near future if the measures are not taken for its conservation.

In the valley, huge quantities of precious medicinal plants are wasted during collection and post collection processing. The local people are failing to maximize the return they could get on medicinal plant sale.

Recommendation and suggestion

Due to the indiscriminate cutting, not only the forest area is declining but valuable indigenous species are in danger and if this trend continues, the ultimate result would be the extinction of these species from the area. For relieving pressure on fuel wood species, following recommendations are suggested.

Natural gas should introduce in the area as an alternate fuel source. If presently not feasible for Government, liquid petroleum gas (L.P.G.) cylinders can serve the purpose. However, the prices should be kept in reach of locals.

Introduction of fuel efficient stoves will also helpful in reducing pressure on forests for fuel wood requirements.

The people of the area are ignorant about the importance of biodiversity and conservation status of the area. They also show poor selection of fuel wood species. As a result valuable indigenous flora is used as fuel wood species. Awareness programs at grass root level should be introduces in the area to solve the problem.

The program like sustainable use medicinal plants and accessibility of the community towards markets would help to uplift socio-economic conditions of these backward areas, which would further help the people to get basic facilities and thus lead better lives.

Cultivation of the medicinal plants like *Colchicum luteum, Bergenia ciliata, Caltha alba, Valeriana jatamansii, Berberis lycium, Acorus calamus, Aconitum heterophyllum, Podophyllum emodi, Paeonia emodi* and *Geranium wallichiana* can be introduced as crops on secondary fields.

Conservation education including advance collection techniques, post collection processing techniques may be extended to the local communities especially to the plants collectors.

Community mobilization and involvement may be

ensured in conservation efforts. Community based organization should be encouraged to play their due role.

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