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AN ANALYSIS UPON CLASSIFYING AND MANAGING OF IMPORTANT PLANT AREAS FOR DISTRIBUTION OF MEDICINAL ECONOMIC PLANTS

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An Analysis upon Classifying and Managing of Important Plant Areas for Distribution of Medicinal Economic Plants

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Abstract – Medicinal plants are of great importance in the Himalaya, supporting people's healthcare, income and cultures. All the National Reports confirmed that some medicinal plants are under threat, especially through habitat loss (including deforestation) and commercial over-harvesting.

Important Plant Areas (IPAs) are sites of international significance for the conservation of global plant diversity that are recognised at a national level. Their recognition is based on three standard criteria (presence of threatened species, species richness, and presence of threatened habitats).

The popularity of herbal drugs is on the constant rise in many developed countries of the world, while in developing countries like Indian; medicinal plants contribute significantly to the income sources of people living in remote areas. Keeping such importance in view, the World Health Organization (WHO) launched a global vision in the form of " Global Strategy for Plant Conservation" having various targets and mile stones. Target 5 of the strategy required for the global integration of the herbal medicine in health care system with proper identification of medicinal plants and the conservation of sites where such plants are found naturally, as its basic elements.

In order to contribute to the specified target, WHO advised the relevant institutions to develop research plans and conservation programmes that are focused on the Global strategy in general and target 5 in specific. Presence of naturally occurring medicinal herbs with species of global or regional concern, and (3). Threatened habitats that are supporting plant species of medicinal and economic values. Apart from various values of the selected sites such as their scientific and economic importance, the selected sites had a treasure of indigenous knowledge related to the wise uses and conservation of medicinal plants. The study also focused on exploring the complex natural interactions between plants and other organisms; their dependence under various environmental parameters; traditional knowledge of the local inhabitants; and the significance of the landscape to conserve such plants on long-term basis.

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INTRODUCTION

Important Plant Areas (IPAs) are defined as the most important places in the world for wild plant diversity that can be managed as specific sites. Their identification and conservation have been promoted as a contribution to Target 5 of the *Global Strategy for Plant Conservation* (GSPC, part of the Convention on Biological Diversity) – *Protection of 50 per cent of the most important areas for plant diversity assured* (to be met by 2010). All Himalayan countries are signatories to the CBD and hence should be trying to achieve this target. It is recommended that the process of recognizing IPAs be undertaken through a collaborative process involving as many experts as possible of the country concerned. Plant life is recognised internationally as a facilitating organisation for Target 5 of the GSPC.

The greatest experience in identifying IPAs has so far been in Eastern Europe, where the IPA process has proved valuable for uniting botanical communities to jointly assess their national priorities in plant conservation. Plant conservationists in Eastern Europe have generally found the IPA concept intuitively understandable and useful. The present study, based in a different part of the world, has helped to further advance the IPA concept. This is particularly so regarding the 'conservation' (contrasted with the 'identification') element of the IPA process. Particularly because medicinal plants are resources, their choice as a floristic sub-group for

identifying IPAs has drawn attention to the positive side of peoples relationships with plants – how people can be seen as opportunities for conservation, not just as causes of threat.

A site has the potential to be recognised as an IPA if it meets one or more of these criteria: (1) presence of threatened species of global or regional concern; (2) exceptional botanical richness for its biogeographic zone; or (3) presence of threatened habitats. IPAs are internationally important sites that are recognised formally (but not legally) at national-level. The numbers and sizes of sites selected are matters for national decision.

The criteria require some modification when IPAs are recognised with reference only to medicinal plants (as here), namely a site should be marked by the: (1) presence of threatened species of medicinal plants of global or regional concern; (2) exceptional richness in medicinal plants for its biogeographic zone; or (3) presence of threatened habitats for medicinal plants.

Owing to over exploitation, population of medicinal plants has become drastically reduced. Forests and rangelands are the main habitats of medicinal plants in all parts of Himalaya, which are commonly exploited commercially for decades (Sher *et al,* 2005; Ahmad *et al.*, 2008, 2009). Their cultivation *ex-situ* management has been neglected in the past. The evaluation of changes in ecological conditions and their related plant life is often done on the basis of vegetation monitoring. Moreover, shift in densities, frequencies and abundances of targeted plants with a narrow ecological tolerance are frequently used as indicators for assessing change and habitat quality (Palmer, 1987).

Studies (Adnan *et al.,* 2006; Sher, 2011) have revealed that about 70% of the MAPs that are being imported to India actually grow wild in the Himalayas of India 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 (Scakali, 2008).

Medicinal plant species constituting about 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 top reason in one location, the problem of unsustainable harvest for commercial uses is at top in another location. Similarly, if the 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 (Larsen & Smith, 2004; Hameed *et al.*, 2011).

In 2005, Plant life International launched a new *Plant Conservation and Livelihoods Programme* with an initial emphasis on medicinal plants (the *Medicinal Plants Conservation Initiative*).With geographical areas of focus in the Himalaya and East Africa, the programme is seeking ways to conserve plant diversity within the context of people's livelihood needs. Six community-based projects to conserve medicinal plants in the Himalaya have so far been supported, thanks to a generous grant to Plant life from the Allachy Trust – one project in each of China, Nepal and Pakistan and three in India. These projects are being used to develop and test approaches and methodologies to the conservation of Himalayan medicinal plants. The intention is to later identify lessons learnt and promulgate more effective methodologies. Descriptions of these projects and some initial analyses can be viewed on Plant life's website.

The project reported here marries Plant life's livelihoods programme with its more established programme on Important Plant Areas (IPAs). It provides a first test of the applicability of the IPA concept in this large and geographically complex region. The selection of medicinal plants as a floristic sub-group for this purpose was considered intuitively reasonable. This is because of the large number of Himalayan species that are regarded as medicinal and the likelihood that, being useful plants, their distribution and conservation status are probably relatively well known.

HIMALAYAN MEDICINAL PLANTS

The Himalaya form the highest mountain range on Earth. Extending for 2500 km along the northern border of the Indian subcontinent, the range forms a barrier to moisture laden winds moving up from the south. The high altitude trans-Himalayan region of the Tibetan (Qinghai-Xizang) Plateau lies in the rain-shadow of this range. Following the common practice in China, the Himalaya are considered here as additionally covering the Hengduan Mountains of China and the Qinghai-Tibetan Plateau.

A large proportion of the Himalayan flora is medicinal resulting in the Himalaya being a globally significant centre for medicinal plants. The two countries globally with the highest numbers of medicinal plants are both partly Himalayan – China with 10,027 species (41% of its angiosperm flora) and India with 7500 species (44% of its vascular flora).

Species of medicinal plants grow at all altitudes in the Himalayas, up to the permanent snowline. However, as reported for India and Nepal, the majority of traded medicinal plants (whether measured in terms of number of species, total volume, or total value) originate from lower altitudes. Eighty-two percent of species of medicinal plants traded from the Indian Himalaya come from the subtropical zone 5. On the other hand, the great diversity of herbs and shrubs found in Alpine meadows is of great importance in Tibetan medicine, though Tibetan doctors insist that all altitudes and all vegetation types provide plants useful to them.

Himalayan medicinal plants are found in diverse habitats according to their ecology. There is considerable variation in types of species along the west-east axis of the range, associated with a major gradient of increasing climatic moistness towards the east. The eastern end, including Arunachal Pradesh and the Hengduan Mountains, is recognized as one of the world's great centres of botanical diversity; there is an exceptional number of medicinal species. The trans-Himalayan region of the Tibetan Plateau is a rain-shadow area with a distinctive flora. Attitudinally, the natural vegetation of the Himalaya varies from tropical or subtropical types at lower altitudes (up to roughly 1000 m), broad-leaved and coniferous forest in a temperate zone (up to roughly 3000-3800 m) and sub-alpine and alpine communities at higher altitudes. Lowland vegetation ranges from xeric thorn scrub forest in the west to moist evergreen forest in the wetter east. Medicinal plants are not confined just to more natural habitats in the Himalayas. There are many species of Himalayan medicinal plants favouring habitats strongly disturbed by man.

The medicinal plants of the Himalaya contribute immensely to the healthcare of its inhabitants, with the great majority of people in the Himalaya relying primarily on herbal medicine (as contrasted with western medicine) for their healthcare. Medicinal plants also provide many with a source of income through their sale. There are hundreds of millions of people living outside the Himalaya who benefit from medicines made from Himalayan plants.

The number of plant species used in folk medicine at particular localities in the Himalaya is said to be often about 45 to 60, with more species recorded at some localities, for instance 110 species at Humla (Nepal) 21, 100 species at Darjeeling Himalaya 22 and an extraordinary 450 species at Dolpa (Nepal) (according to a presentation of Suresh Ghimire at the Regional Workshop). However, not all communities use medicinal plants extensively. The Shuhi people of the Hengduan Mountains know of only 27 species of medicinal plants, with no evidence that their knowledge has ever been greater.

The Himalaya are home to four of the world's great medical traditions – Ayurveda, Chinese, Tibetan and Unani. All of these, except perhaps Tibetan medicine, are very extensively used also outside the Himalayas, which is one reason why so much collection pressure is placed on some types of Himalayan plants. About 100 of the 750 native species in all-India trade are sourced from the Himalaya . The numbers of medicinal plant species (not all Himalayan) used by these major medical traditions are reported to be: Ayurveda 1250-1400, Chinese 1200-1600 (commonly),Tibetan 1100-3600 and Unani 342. Apart from the major medical traditions, the Himalaya are home to several other notable medical traditions more limited in their extent, such as those associated with the Bai, Dai, Lahu, Naxi, Qiang and Yi minorities in China 26.Yunnan and Sichuan are recognised as places of outstanding botanical and cultural diversity.

Millions of Himalayan residents depend on the harvesting of wild medicinal plants for an income. There is generally very little cultivation. An estimated 323,000-470,000 households (2.6 million people) are engaged in the collection of wild medicinal plants for sale in Nepal. Medicinal plants are economically so important in Uttarachal that this Indian state now calls itself the *Herbal State*. Estimates of the percentage of income received from the sale of non-timber forest products (NTFPs) in the Tibetan Autonomous Prefecture of northwest Yunnan (China) range between 25-80%, the most lucrative commodity being *mastutake* (*Tricholoma*), a medicinal/culinary mushroom.

Medicinal plant collection for the market is especially significant as an economic activity for the very poor, particularly those living at high altitude 29. Much of the income of such people can come from the sale of wild medicinal plants.

CURRENT CONSERVATION INITIATIVES ON HIMALAYAN MEDICINAL PLANTS

Experts in five Himalayan countries were invited to prepare National Reports, containing background information on medicinal plants, their conservation status and current conservation initiatives. The National Reports contain sections on current conservation initiatives on Himalayan medicinal plants, augmented at the Regional Workshop by extra contributions from Nepal. Medicinal plant conservation is a complex task and the authors of the National Reports concentrated on various different aspects.

This section summarizes presentations made at the Regional Workshop, based on the five National Reports with additional presentations for Nepal (see Annex 3 for workshop participant list and contacts). This is not a complete review of all conservation

initiatives on medicinal plants that are being or have been undertaken in the Himalaya. That would be a huge undertaking. Interested readers should consult a recent publication by MAPPA and WWF, which carefully reviews many recent experiences.

Bhutan. The National Report for Bhutan describes how the Royal Government of Bhutan has made a national commitment to uphold its obligation to future generations by charting a Middle Path, which views both environmental and cultural preservation as integral to the process of development. The government is committed to maintaining over 60% of the land under forest cover. Traditional medicine (Gso-ba-Rig-pa or Tibetan medicine) has an equal status to that of modern medicine. A central pharmaceutical unit has been constructed for the production of high quality traditional medicines, while cultivation of medicinal plants is being encouraged to ensure adequate supplies are available. Government projects (supported by the EU) have helped to assure systematic progress in the medicinal plants sector. An Institute for Traditional Medicine Services has been founded and there is an interest in developing exports based on sustainable production. The Ministry of Agriculture, through its Agriculture Marketing Services, is developing policies on export for different categories of medicinal plants, e.g. no export allowed for Convention on International Trade in Endangered Species (CITES) Category I species (easily threatened by over-harvesting) and commercial trade from wild sources allowed for Category III species, provided a management plan has been prepared by the Department of Forests.

India. The National Report for India describes the community-based approaches of Pragya. Active in all 5 Himalayan states, Pragya is an NGO that strives to sensitize and empower villagers to preserve their cultural and natural heritage, and to assist them in their searches for sustainable development. The formation of Natural Heritage Conservation Councils (NHCCs) has been promoted, which are encouraged to seek out and conserve sites of special importance for medicinal plants – Community Reserves. In some cases, these Community Reserves are protected through social or physical fencing, or the engagement of caretakers. Three of the NHCCs have created Ethno botanic Centres to conserve local knowledge about medicinal plants. Aspects include ethno botanic museums and gardens, and traditional health clinics.

Farmers have been encouraged to grow medicinal plants and Medicinal Plant Growers Cooperatives have been formed to help with marketing. Women have been encouraged to start kitchen gardens of medicinal and aromatic plants (MAP) to provide them with household produce and sources of income. Village processing units are now being considered as a further step to enhance women's income. For *ex situ* conservation, nurseries have been developed and herb orphanages founded, the later conceived as places where experiments and trials can be undertaken to back up the conservation of high altitude species under threat. All these field activities of Pragya are supported by a Central Services Division, which includes a Natural Resource Management unit (which undertook the extensive surveys of medicinal plants described later in this report), a tissue culture laboratory and a High Altitude Medicinal Plant Research Centre, charged specifically to find solutions to the cultivation concerns of farmers.

China. The Chinese Government began to give attention to the conservation of medicinal plants in the 1980s, with the passage of various laws. Among these was *Regulations on Protection and Management of Wild Medicinal Materials* (1987), establishing principles for the protection, regulation of wild collection and cultivation of medicinal plants. Species of medicinal plants have been prioritized in China into 3 categories: (1) species nearing extinction, rare or very precious – no collection allowed; (2) species suffering from reductions in their distributions and abundance – collection and trade allowed only under license; and (3) commonly used major medicinal species showing declines – these too may only to be collected or traded under license. There are various lists of the threatened medicinal plants of China, for example in the *Red Book of China* (which lists 168 endangered medicinal plant species) and in *China National Action Plan for Biodiversity Conservation* (which lists 19 medicinal plants requiring urgent protection).

Protected areas play an important role in conservation of medicinal plants in China. By 2004, China had established 2194 protected areas, constituting 14.8% of its land area and containing more than 50% of China's species of medicinal plants. Ten of the 220 botanical gardens in China have special gardens for medicinal plants. In 2004, a Southwest China Wild Plants Germplasm Bank was established by the Chinese Academy of Sciences at Kunming (Yunnan), with conservation of medicinal plants high on its agenda.

IMPORTANT PLANT AREAS FOR HIMALAYAN MEDICINAL PLANTS

The project reported here represents the first attempt to apply the concept of Important Plant Areas in the Himalaya. Medicinal plants were selected as an initial group for this analysis, on the basis of the large number of medicinal species in the Himalaya, and the likelihood that their distributions and conservation status would be relatively well known. It also provided an opportunity for joint work between the IPA and Livelihoods programmes of Plant life. As the project progressed, it became apparent that a further advantage of selecting this particular group is that it has helped to advance the 'conservation' element of IPA (contrasted with the hitherto more extensively addressed element of 'identification'). It has revealed how the use of plants, as resources, can provide be a powerful motivating force for conservation.

Major components in each of the five National Reports were accounts of original preliminary research undertaken for the identification of the IPAs. Funding for this research was made available from a grant to Plant life International from the Rufford Maurice Laing Foundation. A broad overview of approaches to conservation of medicinal plants at IPAs drawing on all this work is presented here. The analysis is organised in sections, according to conservation processes and instruments associated with various geographical scales – the national level, the community level, cultural and commercial systems, and regional collaboration. They are all relevant to the conservation of medicinal plants at IPAs in the Himalaya.

IPA identification - IPAs for medicinal plants in the Indian Himalaya were identified based on an extensive review of the literature, consultation with well-informed research institutes and original field surveys. Training for the field surveys (which were undertaken in 2003-2005) was provided to Pragya staff by the research institutes. Thirty-two localities were selected for the field surveys, 21 in the western Himalaya, 4 in the central Himalaya and 7 in the eastern Himalaya. Within these localities, likely areas for field recording were identified through ground reconnaissance and consultation with knowledgeable local residents, such as traditional healers, forest officers and scientists. A total of 115 stretches were selected in this way for detailed follow-up sampling, which was through recording the presence of plant species in quadrats 3 x 3 m in size. Altogether, 2700 quadrats were recorded and 2100 plant species encountered. The field surveys were restricted to higher altitudes (2500-5500 m), with only secondary sources of data used to identify IPAs at lower altitudes.

After field sampling, 9 *Conservation Assessment and Management Planning* (CAMP) workshops were held at regional and sub-regional levels to validate the threat status of the species (following IUCN guidelines) and to learn more about the population dynamics of the species according to local stakeholders. The data from the quadrats and secondary sources were then analysed to reveal tracts of habitat that met the first two IPA criteria ('presence of threatened species' and 'exceptional species richness').The third IPA criterion ('presence of threatened habitats') proved difficult to apply in the absence of standard sources of information or methods of threat assessment for habitats.

The tracts, as identified above, were next grouped into clusters, of which 32 were initially recognised. The reasons for undertaking this clustering were to provide sufficient scale, to allow effective conservation of the species and also to generate and absorb focused attention. A typical cluster consists of several core areas for medicinal plants and the ground between them, the latter being poorer in medicinal plants but regarded as having the potential to be restored as ecological corridors. The parameters used for clustering included physical proximity, habitat homogeneity and delimitation by natural features, such as ranges and valleys. The physical geography of the Himalaya dictated some features of the clustering. For instance, the tracts in the eastern Himalaya tend to be smaller, based on valleys and span multiple altitudinal belts. In contrast, tracts in the western Himalaya are often geographically more extensive but confined to particular altitudinal zones. The clustering process often proved to be hard, the boundaries of the clusters being difficult to establish precisely in this region of broken topography and fragmented habitats.

Finally, the clusters were reviewed to ensure good representation according to several major geographical features of the Indian Himalaya: (1) adequate coverage of all major Himalayan regions (western, central, eastern); (2) adequate coverage of all major administrative units (states and districts); and (3) adequate coverage of all altitudinal eco-regions (sub-tropical, temperate, alpine etc.). The review also considered representation in relation to the relative areas covered by these various geographical features. The end result was recognition of 15 IPAs for medicinal plants in the Indian Himalaya, each typically with a small number of tracts.

There are several noteworthy features of these provisionally recognised IPAs. One is that, despite the procedures described above aimed at representation; most IPAs are concentrated at high altitudes. This reflects the high proportion of endemic species found at higher altitudes (alpine and sub-alpine zones), especially in the case of the western Himalaya (including the trans-Himalayan region), where even quite small sites can be exceptionally rich in endemics. It is also noteworthy that the core areas of many of the IPAs lie within protected areas, although there are places elsewhere (often of small size) rich in medicinal plants.

Himalayan division	State	Important Plant Areas for medicinal plants (designated IPA numbers and names)	No. of tracts	Names of tracts
Western Indian Himalaya	Jammu and Kashmir	1. Khardung-la	1	Khardung-la
		2. Sapi-Penzi-la	3	Sapi, Panikher-Parkachik, Penzi-la-Rangdum
		3. Argi-Sarchu	2	Argi, Sarchu
	Himachal Pradesh	4. Chika-Peukar-Khangsar	3	Chika-Rarik-Patseo, Peukar-Charji, Khangsar
		5. Rohtang and Solang	2	Rohtang pass, Solang valley
		6. Malana-Parbati-Sainj	3	Malana valley, Sainj-Tirthan, Manikaran-Mantalai
		7. Rakcham-Chitkul and Rupi-Bhaba	2	Rakcham-Chitkul, Rupi-Bhaba
Central Himalaya	Uttaranchal	8. Kedar-Gangotri	3	Kedarnath, Khatling-Sahastratal, Kedartal-Gangotri, Harsil-Bhaironghati
		9. Valley of Flowers and Niti	4	Mana-Valley of Flowers, Niti valley, Dronagiri, Kuari pass
		10. Gauri and Pindar	2	Gauri valley, Pindar valley
Eastern Indian Himalaya	West Bengal and Sikkim	11. Dzongri-Phedang and Sandakphu	2	Yuksam-Geochela, Sandakphu
		12. Lachen and Lachung	2	Lachen-Chopta, Lachung-Goechela
	Arunachal Pradesh	13. Dirang-Tawang	4	Thingbu-Luguthang, Geshela-PTTso, Sela-Bangajang, Senge-Nyukmadung
		14. Upper Siang and Dibang	2	Pemako, Anini-Bruini-Andra
		15. Western Lohit-Changlang	2	Deomali, Demwee-Tiding

Table 1. Provisional IPAs for medicinal plants in the Indian Himalaya.

Analysis of IPA identification - Information basis. The evidential basis used in the National Reports for recognition of the IPAs varies greatly between the countries, in part reflecting variations in the amounts of available published information. The National Report for India is exceptional for its extensive use of primary data from the field (surveys undertaken by Pragya in 2003-2005).

In general, there is a massive deficiency in current information on the distribution and conservation status of medicinal plants in the Himalaya. The results reported here on the identification of IPAs should be regarded as provisional, being based on what is currently known by the authors of the National Reports through the research possible with the (very limited) resources made available for the preparation of these reports. Therefore, some IPAs will undoubtedly have been missed. In principle, this is regarded as not a problem for the IPA process, because the identification of IPAs is seen as a dynamic (ongoing) matter with adjustments in IPA lists possible as more information accumulates.

Use of the standard IPA criteria. All authors placed most emphasis on the two IPA 'species' criteria ('presence of threatened species' and 'species richness').There was general agreement that two types of threatened species can be recognised – narrow range endemics and more widespread medicinal species threatened by commercial trade. Many narrow-range endemics are regarded as potentially under threat because of their susceptibility to casual disturbance of their habitats and climatic change. Some species believed to be under widespread threat from commercial trade are listed in Annex 1.The habitat criterion ('threatened habitats') proved more problematic to apply, which may be why comparatively few IPAs have been recognised for lower altitudes.

Use of additional criteria. Extra criteria were widely used to support the three standard IPA criteria. They include the importance of places regarding: (1) knowledge or use of medicinal plants (seen as resources); (2) provision of other types of plant resources; (3) provision of ecosystem services (such as water supplies); and (4) the presence of local people believed to be willing to actually engage in conservation. A resource approach to the identification of the IPAs is a particularly noticeable feature of the National Report for China.

In some cases, it is possible that the criteria were widened through fear that places not classified as IPAs may be neglected in conservation initiatives. For example, the National Report for Pakistan states that:"*It is important to conserve plant diversity throughout the whole … region, not just at selected sites (our emphasis)*" (see Section 8 for further remarks about the importance of landscape-level conservation in the Himalaya).

It is stressed here that the selection of places for field initiatives in plant conservation will (and should) be determined by several factors, not just concentrating on sites recognised as IPAs. These factors will include the particular interests and capabilities of the people or organisations undertaking the initiatives – which will vary enormously. Also to be taken into account should be the values that particular places have for different aspects of plant conservation, apart from their contributions to global plant species conservation (the focus for IPA programmes).These other aspects include conservation of plant species on other scales, conservation of genetic diversity within species, conservation of plant resources and conservation of species or vegetation types because of their contributions towards the provision of ecosystem services. IPAs are just one aspect of geographical prioritization in plant conservation.

METHODS

Development of IPA Identification Criteria -

The aims of the IPA project are to identify and protect a network of the best sites for plants by using consistent criteria. Methodologies and criteria for the identification of IPAs have been developed by Plant life International (PLI) (Anderson 2002). According to PLI, a site has the potential to be recognized as an IPA if it meets one or more of the following three criteria:

1. Criterion A (Presence of Threatened Species): The site holds significant populations of one or more species that are of global or regional conservation concern.

2. Criterion B (Exceptional Botanical Richness): The site has an exceptionally rich flora in national context in relation to its biogeographic zone.

3. Criterion C (Presence of Threatened Habitats): The site is an outstanding example of a habitat type of global or regional plant conservation and botanical importance.

Data Collection-

There are several stages in the identification of IPAs. At first. Criterion 'A' species were identified primarily based on secondary information. Thereafter, data about the locations of threatened species and habitats, and of data about areas of botanical richness were collected. Three field visits were made to collect primary information on the status of plant diversity and to verify, to some extent, the information gathered from secondary sources. For species data, the main data collection units were grid reference/spot location; and orographical unit (e.g., a large geographical unit such as an area of a mountain range or valleys, or a particular elevation of a mountain range) (Alfarhan & Al-Abbasi 2005). Habitat

locations available maps, field studies and expert knowledge about the locations and range of habitats.

Criterion	Description	Threshold	Notes
A(i) (threatened species)	Site contains **globally** threatened species or infraspecific taxa	All sites known, though or inferred to contain 5% or more of the natural population, or the 5 'best' sites, whichever is the most appropriate.	Taxa listed as 'threatened' on IUCN global red lists and/or taxa included in CITES Appendices
A(ii) (threatened species)	Site contains **regionally** (Himalayan) threatened species or infraspecific taxa	(If there are less than 10 sites or there are between 5-10 large populations of a species, up to 10 sites can be selected)	Taxa listed as 'threatened' in regional or national red list.
A(iii) (threatened species)	Site contains **national endemic** species or infraspecific taxa with demonstrable threat not covered by A(i) or A(ii)	(If long-term viability of the total population is compromised then more than 10 sites can be selected)	Taxa listed as national endemic (on any recognized list or publication), and 'threatened' on national red lists or taxa protected by national law
A(iv) (threatened species)	Site contains **near endemic/ limited range** species or infraspecific taxa with demonstrable threat not covered by A(i) or A(ii)		Taxa listed as near endemic/ limited range (on any recognized list or publication) and 'threatened' on national red lists or taxa protected by national law
A(v) (threatened species)	Site contains rest of the **nationally** threatened species or infraspecific taxa not covered by A(i) to A(iv)		Taxa listed as 'threatened' on national red lists or taxa protected by national law
B (species richness)	Site contains **high number of species** and/or species of special interest within a range of habitat or vegetation types	Exceptionally rich sites (containing >10% of the total indicator taxa per site) for each habitat or vegetation type	Number of overall species and species of special interest (indicator species) including narrow endemics, national endemics, locally rare species and species of utilization importance (useful species)
C Threatened habitats	Site contains regionally or nationally threatened habitats or vegetation type	All sites known, thought or inferred to contain 5% or more of the national resource (area) can be selected, or the 5 'best' sites, whichever is the most appropriate. (If there are only between 5-10 sites of a particular habitat or there are between 5-10 exceptional sites, up to 10 sites can be selected)	Threatened habitats or vegetation types taken from a regionally recognized list

Table 2 IPA selection criteria, threshold and data source.

Selection of IPA Sites-

Table 2 of IPA criteria describes the acceptable sources of data for each criterion. Potentially, an IPA could be very small and designed to protect a single species or small area of a specific habitat, or it could incorporate a large area with many different IPA species, or habitats, or areas of richness and diversity. General principles for selecting IPAs.

In the present work, the data from the field study and secondary sources were analyzed to reveal the sites that meet one or more of the criteria for the identification of IPA. However, the availability of quality information limited the use of all the three criteria for the identification IPA. The third IPA criterion (criterion 'C\ 'presence of threatened habitats') was particularly difficult to apply due to the lack of precise information. Therefore, the first two IPA criteria (A and B) were mainly used. For each IPA criterion 'A' categories each site was ranked 0 to 5 based on the percentage of natural
population of respective group of plants it contains: 0 (<5%), 1 (>5-10), 2 (>10-15), 3 (>15-20), 4 (>20-25), 5 (>25). The scores of ranking among the criterion 'A' categories were added for each site separately to give the overall measure of importance of that particular site. The identified sites were later grouped into IPA sectors. The different IPA sites in each sector were further evaluated by the consultation with concerned stakeholders. Each IPA site, which may consist one to several localities, is described separately. The main types of data for each IPA site include individual site descriptions, the IPA species and habitats present, the land use and threats to each site, and the degree of existing protection. Finally, based on field and literature-based information recommendation for conservation and sustainable management of most potential IPA species was made.

CONCLUSION

Himalayas mountainous ranges host many endemic and endangered species of MAPs, many of them have high pharmaceutical and economic value. Indigenous knowledge behind the uses, collection and management of MAP species is fast eroding. One reason for this is the lack of awareness among the local community regarding the economic and medicinal importance of MAPs. Another factor contributing in the declination of MAPs cover and eroding of indigenous knowledge is the inadequacy of the MAPs market and lack of government support. The approach to improve or restore the ill effects of resources misuse and economic degradation should be in multiple directions, from improving the economic standard to changing the attitudes of the local people should be adopted in future.

The population sizes and potential density of MAPs are fast decreasing; adequate size of *in-situ* conservation plots is urgently required for the better management of MAP species. One important lesson learned from the current study is to establish community-based companies that depend on local biodiversity and can be adopted as a strategy to provide more equitable returns to community groups and hence incentives for conserving the resource base. This type of efforts may help in better understanding of local plant resources and potential MAPs. Lack of knowledge regarding the local potential at the national level would eventually lead to the genetic erosion of MAP species and the related indigenous knowledge system. In order to ensure the management and conservation of MAP diversity, documenting of indigenous knowledge system and its constant and consisting support is essential.

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