Sustainable Management of the Herbal Wealth of the Himalayas:
prioritising biodiversity for conservation and development

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Abstract

The Himalayas region in India houses several species of medicinal & aromatic plants (MAPs), including many rare and endemic species that are highly valued in the pharma and cosmetic industry. These Himalayan herbs are a priority for conservation action, since many of them are critically endangered today, threatened by both anthropogenic impacts and climate change. At the same time, the rapidly growing market demand for the species is also an opportunity for the economic development of farmers in Himalayan villages. A development organisation, Pragya, carried out a comprehensive intervention aimed at studying and resolving these opposing pulls with respect to Himalayan MAPs. The intervention included surveys and consultations for inventorying and threat assessment of medicinal species and mapping Important Plant Areas for medicinal plants in the Indian Himalayan Region; findings have also enhance understanding of the vulnerability and resilience of high altitude habitats and helped focus conservation action for medicinal plants in their natural habitats and outside it. To address the need to seize the opportunity of exploding demand for medicinal plants for rural development, a series of multi-stakeholder consultations followed a thorough supply-cum-demand-side analysis of Himalayan herbs in industry. This strand of the intervention prioritised the Himalayan MAPs with potential for rural livelihoods and also determined the necessary actions for making them levers for developing the Himalayan economy. A holistic grassroots project was also carried out in several Himalayan districts with considerable success; the project demonstrates the effectiveness of applying the recommendations of the studies and consultations.

***Keywords**:* medicinal plants, biodiversity, vulnerability, Important Plant Areas, participatory mapping, species prioritization, ex-situ conservation

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1. Introduction

The Himalayas, stretching over 3,000 kilometers of northern India, Nepal and Bhutan, is a bio-geographically unique region, with a very high species diversity, supported by its ecological, phyto-geographical and evolutionary factors, and the maximum degree of endemism in the Asian region. The Indian Himalayan Region supports about 18,000 species of plants, including a large repository of medicinal & aromatic plant species (MAPs), including many rare and valuable species. The medicinal plants are an integral part of the culture of the local communities of the Himalayas, woven into their lives in innumerable ways and a major input for the healthcare of the rural poor. In recent times, the market for alternative medicine and herbal products has also been growing exponentially, and many of the Himalayan MAPs are highly valued as inputs for these products.

The value of the Himalayan MAPs in local lives as well as far markets constitutes an opportunity as well as a threat, that require a strategic approach and management. Most of the plant material in use is extracted from the wild, and the destruction of their habitats due to development pressures along with the negative impacts of climate change, have also contributed to their shrinking populations. Several Himalayan species of MAPs have suffered depletion rates of upto 80% in the last six to ten years, and many of them, including those endemic to the region, are at various levels of endangerment today. Apart from biodiversity and ecological impacts, the depleting plant resources in the wild also has adverse impacts on the Himalayan poor who are dependent on them for their healthcare and food supplements. At the same time, this exploding demand for medicinal plant material in the national and international markets is an opportunity that should be seized to help improve the economic status of Himalayan farmers in India. If cultivated, they could prove to be high value cash crops and help farmers benefit from the burgeoning herbal trade sector. However non-availability of cultivation packages, marketing problems, quality assurance issues, are some of the bottlenecks.

1.1 Key issues

***Habitat degradation and impacts of climate change*:** The Himalayan region has lost more than 70% of its original habitat, and is one of the 34 biodiversity hotspots of the world (Conservation International). The

steadily increasing human population in the region has led to large-scale conversion of forests, wetlands and grasslands for agriculture, and for settlements. Road construction has contributed to fragmentation of habitats and also facilitates the spread of invasive species, diseases and harmful insects. Unplanned and poorly managed tourism along with transnational instability has led to increased habitat destruction. The remaining wild areas are a source of Minor Forest Products for the rural communities and extraction is increasing with the increasing population, contributing to degradation of forests.
Ecological change as a result of global warming, it is estimated, will also be especially catastrophic for Himalayan MAPs because of their habitat specificity and narrow range of distribution. Analysis of tree-ring samples of *Taxus baccata, Albies pindrow*, *Abies spectabilis* from various forest stands have provided valuable information on the plant growth and climate relationship (Yadav RR, Bera SK, 2002). The impacts of climate change are going to be more pronounced for the highly sensitive sub-alpine and alpine species like *Saussurea* spp. Thus, a greater understanding and vulnerability assessment of various species and habitats are necessary, with a focus on their adaptability range.

High demand levels and unsustainable extraction for herb trade**:** The worldwide market for herbal material is of the order of over US$60 billion, and increasing rapidly; closer home, several herbal industries, pharmacies and TM practitioners use MAPs for serving the healthcare needs of a wide population base in India, while many rural households are supported by incomes from the collection of MAPs for domestic use and exports. The high economic-use value of MAPs leads to over-extraction and consequent endangerment of the species. Himalayan MAPs are much in demand due in part to their rarity and small populations: 18% of the MAP material traded in India and 350 of the 960 most used MAPs in industry, come from the Himalayan region (Export-Import Bank of India, 2003). The price trends of most of the Himalayan species of medicinal plants traded in market, such as *Picrorhiza, Aconitum, Jatamansi,* have been on a continual upward trend, indicative of the surge in demand and value for these species in markets worldwide. The present scale of commercial cultivation & production of medicinal plants is way below the raw material demand of the industry and largescale illegal harvesting from the wild is resorted to in order to meet the demand-supply gap. Close to 90% of the plant material used locally and in the herbal industry is collected from the wild, as much as 70% of it destructively harvested (Planning Commission, Govt. of India, 2000). The open access to medicinal plants combined with the low rates paid to commercial collectors leads to mining of the high value species from their natural habitats in the Himalayas. Community norms that had traditionally ensured sustainable use have been replaced by forest laws by the state, whose implementation and enforcement, especially in the remote terrain of the Himalayas, is extremely weak. A study carried out on Himalayan MAPs indicated that 41% of the primary-level traders source their material only through collection, 45% follow a mixed sourcing, i.e., from both collection and cultivated sources. A large majority of the plants in trade are used for parts that require destructive forms of harvesting- 63% of the material in trade comprises roots and 5% comprise whole plants. Less than 20 of the estimated 800 species that are currently used in industry for large-scale production of herbal products, are under commercial cultivation. A factor that discourages farmers from commercial cultivation of medicinal plants especially in the high altitude zones is the long gestation period of these species.

Endangerment of species: The Himalayan herbal resource base is at great risk with species survival seriously threatened and the associated social and ecological functions performed by these species also jeopardized. Hundreds of species are now threatened because of over-harvesting, destructive collection techniques, and conversion of habitats to crop-based agriculture or other land-use. Species associated with habitats of restricted occurrence, as *Mecanopsis* spp. in the Himalayas, are especially vulnerable. While *Aconitum heterophyllum, Aconitum ferox, Dactylorhiza hatagirea, Picrorhiza kurroa, Nardostachys jatamansi, Arnebia euchroma, Valeriana jatamansi, and Angelica glauca,* have been determined at severe levels of endangerment, others such as *Dioscorea deltoida~~,~~ Jurinea*, *Polygonatum*, *and Berberis* are also under threats. Of about 3500 flowering plants in Himachal Pradesh in the western Indian Himalayas, nearly 130 are in great demand in industry and 68 are threatened. The situation appeals for urgent need of conservation both in their natural habitat as well as outside their natural habitats.

Impacts on host communities**:** The large-scale commercial exploitation of the MAP resources in the wild is leading to increased insecurity and a further impoverishment of the poor in the Himalayas, who are most dependent on them. As the resources in the wild get depleted, there is less available for meeting their consumption and healthcare needs. The depletion of medicinal plant resources is affecting the lives of host communities indirectly through ecosystem services, as well. Agricultural productivity is being affected as a result of desertification, soil erosion and other effects of large-scale removal of these plants. Further MAPs are a biocultural resource of the people of the region, on which various social and cultural practices are based: they are an intrinsic part of religious rituals, festivals and celebrations, cosmetic uses and adornments; their rapid depletion would leave a cultural vacuum among the Himalayan people. Even in the commercial exploitation of the plants, very little of the benefits flow back to the host communities, who are typically paid collector's wages for harvesting the required plant parts.

***Lack of R&D and policy neglect*:** The high altitude belt of the Himalayas suffers from a severe paucity of information on the status of biodiversity, development and its impacts. The Mountain Research Initiative has recorded a large observational data gap in mountainous regions between approximately 40°N and 30°S. There are very few high-elevation measurement and monitoring sites to support any scientific research, the inaccessibility of the region having robbed it of the research attention it deserves. Altitude has been found to be inversely related to resources and development, with the high altitude areas with the rarest of species and most vulnerable of ecosystems receiving almost no attention. It is increasingly evident today however that rapid environmental change in this region would significantly alter the numerous, critical goods & services lowland populations receive from it, for instance, MAPs being one of them. The burgeoning trade and conservation urgency of the MAPs indicates the severity of the need for research to create alternate sources of supply for the material in use in trade. Mainstreaming the high-demand species in cultivation would ensure protection of the resources in the wild. However, most of these species suffer from lack of proven and successful agro-techniques and the inter-relationships between the growing conditions and/or post-harvest processing requirements and their active principle, are also not adequately understood. There is a critical need therefore to promote research and development on many aspects of Himalayan MAPs.

***Lack of protection and conservation*:** Although the importance of the Indian Himalaya ecoregion and its protection has been recognised by the national government in India, as well as the global conservation community, management of forests of the ecoregion has suffered heavily due to overexploitation & habitat degradation as well as inadequacies of conservation action. At a national level, special importance has been given to protection of these forests and 75 PAs have been established in the IHR. In spite of this, there is an accelerated loss of the habitat in the PAs, with majority of the PAs suffering from encroachments; only a few of them are interconnected by natural corridors, whereas extremes of weather in the Himalayas imply that vegetation & animals need contiguous habitats in order to maintain adequate & viable populations. Himalayan PAs are also poorly managed because of their extreme remoteness and inaccessibility; further, the exclusion of communities from the forests has alienated the communities from these resources and contributed in part to the unsustainable use of the resources. Protected areas also tend to focus on the larger and the more charismatic of the species that inhabit this earth. Thus wildlife receives much more attention and protection than do the shrubs and herbs. Implementation of the regulations for conservation and sustainable use of MAPs is also inadequate.

1.2 MAP Research in the HAH (High Altitude Himalayas)

Pragya, a non-governmental development organisation, dedicated to the conservation and sustainable development of the Himalayan region, undertook to study the medicinal plants diversity and distribution of the high altitude belt, in context of climate change and eco-system resilience, through in-depth field research. Analysis helped identify ‘species at risk’ and ‘important plant areas’ for conservation action, and grassroots initiatives in the Himalayan region served to support sustainable MAP-based livelihoods and encourage community stewardship for protecting the plants in the wild. A series of consultations followed at local and national levels, towards prioritising MAP species for research, conservation and cultivation, and crystallising strategies for policy and programming, which formed an input to programming at the National Medicinal Plants Board of the Government of India, as well as for conservation planning for the greater Himalayan region spanning five Himalayan countries.

Aims of Pragya’s MAP research in the high altitude Himalayas:
(1) Inventorying the herbal wealth status in the high altitude Indian Himalayas and creating a scientific database for further action
(2) Identifying the threatened species of Medicinal and Aromatic Plants and the priority habitats that call for urgent conservation
(3) Devising conservation and management strategies for MAPs in the HAH with multi-stakeholder involvement, and including ex-situ and in-situ methods, as well as grassroots to policy action

2. Study of diversity and vulnerability of Himalayan MAPs

A comprehensive inventorying of the MAP-wealth of the high altitude Himalayas was undertaken in 2003-06 and involved extensive ground surveys in the Western, Central and Eastern divisions of the Indian Himalayan region; the exercise focused on the high altitude and very high altitude belt (9000-18500 ft.) in the region. This was followed by a thorough status assessment and vulnerability analysis of species identified through the process. The study had wide participation of a range of stakeholders and contribution of several research institutions.

2.1 Ground mapping of Himalayan MAPs

Ground surveys were carried out in the high-altitude belt in the six states of Jammu & Kashmir, Himachal Pradesh, Uttaranchal, W. Bengal, Sikkim and Arunachal Pradesh, across four flowering seasons (from June 2003 to August 2006) of Himalayan MAPs. A nested process was followed for sampling (refer fig. 2). Thirty-nine stretches were selected for the field surveys: 17 in the Trans Himalayas, 8 in the western Himalaya, 5 in the central Himalaya and 9 in the eastern Himalaya. Within these stretches, 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 500 pockets were selected for detailed study, and 5000 quadrats of 3x3 m size laid in them for gathering and recording species data. Primary data collected included: enumeration of plant species, recording of morphological characters, photographic documentation, soil sampling, physiographic information documentation, traditional knowledge and ethno-botanic documentation. This was supplemented with collection of collateral information from Forest Survey of India and Botanical Survey of India reports, District Statistical records, and vegetation and topographical maps, particularly on population (human and animal), climate and ecology, development pressures, occurrence of disasters, etc. Previous studies carried out in this belt by other researchers were also consulted.

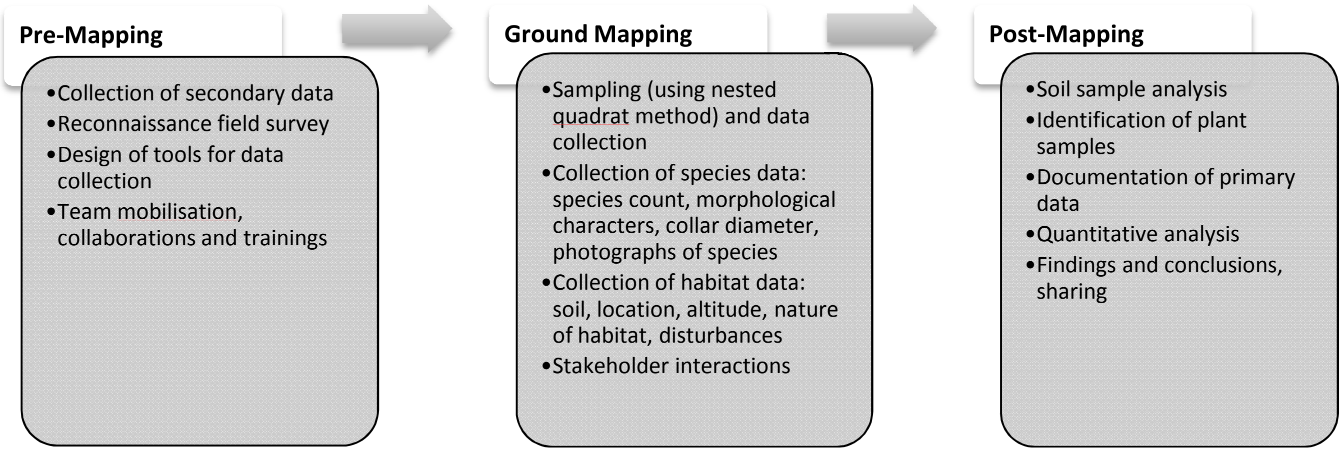
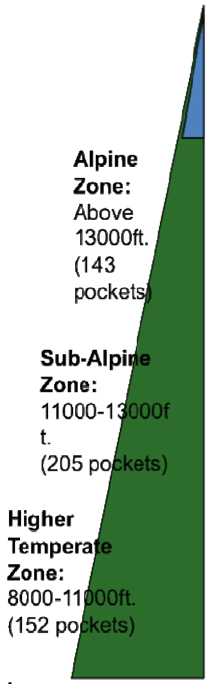


Fig.1 - Process followed for medicinal plants mapping and IPA selection

Biogeographic Zone (4)	State (6)	Sub-Zone (14)	Stretch (39)
Trans Himalayas	*Jammu & Kashmir*	Leh	Central Leh, Kharu, Khaltse
		Changthang	Nyoma, Durbuk
		Nubra	Hunder, Sumur
		Zanskar	Suru, Lugnak
	Himachal Pradesh	Spiti	Lower, Middle, Upper Spiti
		Lahaul	Gar&Tod, Tinan, Pattan & Mayar
Western Himalayas	*Himachal Pradesh*	Pangi	Sach, Chenab, Hudan & Sural
		Kinnaur	Phoo, Hungrung, Ropa, Sangla
Central Himalayas	*Uttarakhand*	Chamoli	Niti, Mana
		Uttarkashi	Gaumukh, Nanadanvan
		Pithoragarh	Milam
Eastern Himalayas	*Arunachal Pradesh*	Tawang & W. Kameng	Zemithang, PTTso, Geshela, Thangapa, Luguthang, Chabrila
	Sikkim	N & W Sikkim	N.Sikkim
			W.Sikkim
	W. Bengal	Darjeeling	Sandakpho



Surveyed Area: 5000 quadrats of 9 sq.m. in 500 pockets across 39 stretches covering 14 sub-zones in 6 states

Fig.2 - Sampling detail for the mapping study in Himalayas

The process for the study was wholly participative, and hence as insightful as were its findings. Local communities, particularly the traditional healers, local youth and tourist guides, women, and pastoralists, participated in the survey and documentation of species as well as identification of species-rich *in-situ* areas; the traditional healers also provided information on traditional knowledge value of species. Premier research and academic institutes of India including the Forest Research Institute (FRI, Dehradun), Botanical Survey of India, G.B. Pant Institute of Himalayan Environment and Development (GBPIHED), Field Labs of Defense Research and Development Organization (DRDO, now DIHAR) collaborated at various stages of study- from imparting inventorying skills to the 40-odd qualified botanists that constituted the mapping team of Pragya (apart from local community surveyors), to identification of plant specimens collected. The community participants also attended post-mapping consultations, along with state functionaries, individual MAP specialists, botanists, foresters and researchers from forest departments, local and regional research institutions, NGOs and CSOs.

Following the ground surveys, 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. A national level CAMP helped validate the findings and draw out conclusions.

Indices for species and vulnerability assessment: The data collected through the ground surveys was put through rigorous quantitative analysis at multiple levels, beginning with simple computation of species populations and richness, followed by extraction of indices, and thereafter, an analysis of vulnerability/resilience of habitats vis a vis MAPs. Variables related to ecology, demographics & behaviour, and climate, were combined through principal component analysis to arrive at composite indices that constituted the predictive variables for vulnerability assessment. Analysis of these predictive variables and the direction of their influence helped to determine the criterion variables of MAP-diversity Index and Habitat Vulnerability Index, and their component indices. MRA (Multiple Regression Analysis) were carried out to establish a cause and effect relationship between the predictive variables (i.e. natural disaster, developmental interference, anthropogenic pressure, change in climate, soil quality, use of MAPs) and the criterion variables.

Species Density: no. of plants per unit of area
Frequency: %age occurrence of a species in a unit of area
Basal Area: basal diameter of a species
Species Richness: no. of species in a unit of area

Importance Value: summation of Relative Density, Relative Frequency, Relative Basal Area
Species Clusters: clusters of species that display an association by occurring together
At-Risk Species: species with lowest populations (relative density + relative frequency) in HAH

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Anthropogenic Pressure: Population & animal pressure; Tourist inflows and developmental interventions
Climate Change: Change in minimum, maximum and average temperature; Change in rainfall and snowfall)
Habitat Conditions: NPK, organic carbon and pH level in soil; Moisture levels; Altitude
Human Value Index: Economic and ethno-botanical value of species
Supportive Habitat Index: Soil & habitat; Altitude; Average precipitation
Pressure/threat Index: Population pressure; Usage of MAPs; Developmental interference; Natural disasters

***MAP Conservation Value Index*: species richness, species density, species at risk**
***Habitat Vulnerability Index*: MAP conservation value; human-use value, supportive characteristics, pressure/threat**

2.2 MAP-diversity and vulnerability of habitats in the high-altitude Himalayas

While the analysis validated through scientific processes some widely held beliefs regarding Himalayan habitats, species richness and vulnerability, it also brought forth some interesting findings, relative richness and threat levels of the western, central and eastern Himalayas, and thereby helped create an evidence-base to direct and guide conservation action. Highlights of the findings with respect to MAP species and related habitat aspects in the high-altitudes are discussed below.

2.2.1 Inventory of species and habitats

The study created an inventory of 2094 MAP species across the 4 zones mapped, along with their ethnobotanic values. This included 622 species in the eastern Himalayas, 300 species in the central Himalayas, 550 species in the western Himalayas, and 622 species in the Trans-Himalaya. The species distribution was analysed (using the Bray-Curtis Cluster Analysis) to draw out 18 gross species clusters across the Himalayas, 5 in the eastern Himalayas, 3 in the central Himalayas, 4 in the western Himalayas and 6 in the Trans-Himalaya. These comprise 11 finer clusters in the eastern Himalayas, 14 in the central Himalayas, 12 in the western Himalayas, and 3 in the Trans-Himalayas.

Species-habitat match: Description of the habitat characteristics also helped derive the species-habitat match. This has particular relevance both for conservation and cultivation objectives: conservation of the species cluster may be met by adopting a habitat protection approach; cultivation research is easier undertaken when the habitats of multiple species and related support conditions are mapped, and farmers may be guided to cultivate species based on the precise match between their field conditions and the specific species habitat.

2.2.2 Species at risk and conservation value of habitats

The variety and density of MAP species in the high-altitude Himalayas were found to vary with longitude and altitude; corroborating studies in other regions, a significant positive relationship was also found between species richness and density. The average number of species per pocket (average species richness) across the high altitude Himalayas was found to be: 12.7, while the average species density across the region was 21.67. It ranges from Ladakh region in the trans-Himalaya at the low end (9.5 species richness; 14.77 species density) to a MAP-diversity that is nearly double in the Central Himalayas (20.2 species richness; 25.7 species density) and the Eastern Himalayas (18.8 species variety; 37.32 species density). Malari (north) in Chamoli, Uttarakhand in the Central Himalayas was found to have the highest richness and density (species richness of 62; species density of 125.75). An in-depth appraisal reveals that the altitude zone of 11000-13000ft is most suited to MAPs with highest species density (20), and richness of medicinal plants (13.3), and above this altitude, MAP richness and density decrease sharply. A total of 327 'At-Risk' MAP species were identified in the high altitude Himalayas during the study; the concentration of these species are higher in Trans and Eastern Himalayas (123 in Trans Himalayas, 43 in Western Himalayas, 57 in Central Himalayas and 127 in the Eastern Himalayas); the occurrence of these species in a single pocket is the highest in the Central Himalayas (15 species), and lowest in the Trans-Himalayan zone. 70% of the pockets surveyed had the occurrence of at least one at-risk MAP species, and 23 pockets were found to be especially rich in at-risk species, each displaying the occurrence of 5-15 species.

***MAP Conservation Value index*:** The MAP Conservation Value (ranging from 4.85 to -1.16) was found to be highest in the Central and Eastern Himalayas, indicating higher species richness, diversity as well as endangerment levels in these regions, and lower in the Ladakh Himalayas. Of the pockets surveyed, Ghumsali in Chamoli, Uttarakhand, and Hot spring Sachu river in Tawang, Arunachal Pradesh, were determined to have highest conservation value.

2.2.3 The people and plants relationship

The significance of various Himalayan MAP species for humans, is dependent on the extent of use of each species for local consumption for medicine or for food, in the alternative medicine and formal pharma or herbal sector, as determined by their demand, and their economic value in trade. Medicinal plants with higher ethnobotanical (local use) values are found concentrated in Uttarakhand in the central Himalayas, and Arunachal Pradesh in the eastern Himalayas follows a close second; the herbal wealth of Himachal Pradesh (eastern corner of western Himalayas) and Sikkim (western corner of eastern Himalayas) are nearly alike in ethnobotanical value, and this is followed by the species found in Ladakh (Jammu & Kashmir) in the western Himalayas. Occurrence of species of high economic value is highest in Arunachal Pradesh, followed by the stretches in Himachal Pradesh.

***Human-use value*:** The gross Human-use Value for MAPs in the Himalayan region lie between 2.13 and 2.22. The use of the MAPs by local communities, as well as their use & value in trade, indicate the strength of the people-plants relationship in the region, but, unfortunately, also contribute to their extraction from the wild and consequent depletion. Species with higher ethno-botanical and economic value were found to be concentrated in the 11000ft-13000ft altitude, making this zone 'high risk' in terms of extraction pressure. The central and eastern Himalayas were found to have a greater concentration and number of species with higher human-use values; of the areas surveyed, Ghumsali (Chamoli, Uttarakhand, central Himalayas) and Karpkarchang (Tawang, Arunachal Pradesh, eastern Himalayas) were found to have the highest human-use value of MAPs. It is important to note that the areas with higher Conservation Value and those with higher Human-Use Value coincide, a clear indication of the relationship between the significance of specific species for humans and their status in the wild.

2.2.4 Extent and nature of threats to MAPs

MAPs in the Himalayas are at risk due to both anthropogenic pressures as a result of increasing pressure of the local population and their cattle, escalating tourist inflows and other presures of development, and increasing natural threats on the MAP habitats – of disasters and climate change. The study brought out a significant and positive correlation between 'at risk' species and these threat factors, while species richness and density were found to have a negative association with anthropogenic and natural pressures.

The study revealed that the anthropogenic pressure is highest in the central Himalayas. People in the high altitudes are heavily dependent on natural resources, with the majority following agro-patoralism as a livelihood; most households also extract food supplements and material for a host of items of daily use from the forests. The dependent human population is the highest in Uttarakhand (356/pocket) followed by Tawang (297), and it is lowest in Himachal Pradesh (189). Pressure of cattle population (1791/pocket) is mediated by the nature of livelihood and hence the highest in Ladakh in the cold deserts of the Trans Himalayas where nomadic pastoralism is a way of life for many, followed by Uttarakhand (840) and Himachal Pradesh (657); lowest pressure of cattle population is in Tawang (423) in the eastern Himalayas. Uttarakhand in the central Himalayas is also the most severely affected by high tourist inflows, followed by Sikkim in the eastern Himalayas and Leh in the Trans Himalayas; the Pangi sub-region, a lesser-known area in the western Himalayas, displays the lowest tourist pressure. The Himalayan MAPs are also affected by development interference in the natural sites. The study revealed that 43% of the area in the high altitudes is affected by development interference, majority of this located in the western Himalayas (60%), with the trans-Himalayas and the eastern Himalayas being less affected (23.87% and 28.34% respectively), and the central Himalayas lying in between (42.42%).

The high altitudes are also prone to frequent natural disasters and this is another cause for habitat destruction and thereby reducing MAPs. Frequency of natural disaster is highest in Western Himalayas, followed by Eastern and Central Himalayas; Trans-Himalayan region has the lowest occurrence of natural disasters. Pangi block in Himachal Pradesh and Tawang district of Arunachal Pradesh have among the highest frequency of natural disasters (44 in 5 years in Pangi, and 30 in Tawang). The 8000-11000ft altitude belt is the most prone to natural disasters. That disaster in the making, climate change, is higher at higher altitudes, with the degree of change in minimum as well as maximum temperature increasing with altitude; the change in precipitation was found to be the highest in altitude band 8,000-11,000ft.

***Pressure/Threat Index*:** The Gross Anthropogenic Pressure ranges from -0.93 to +1.16 in the high altitude Himalayas. Kalpa in Kinnaur district of Himachal Pradesh (western Himalayas) was found to be under maximum stress, while Tapovan pocket in Chamoli district of Uttarakhand (central Himalayas) displays lowest anthropogenic pressure. The Gross Natural Pressure on the other hand, is highest in Kinnaur (0.51), followed by Central Leh (0.38); Sandakphu (-0.48) and Tawang (-0.33) display greater environmental stability and lowest pressure due to natural disasters and climate change, among the areas surveyed.

2.2.5 Support factors for MAP growth

While the above mentioned threat & pressure factors are contributing to endangerment of MAPs in the Himalayas, the intrinsic supportive quality of Himalayan habitats acts as a positive force, enabling regeneration of species and resilience to extreme pressure and threat levels. Availability of soil nutrients, moisture conditions and precipitation at the sites, constitute these supportive habitat conditions. The study revealed that Central Himalayan soils are the most suited for plant growth (NPK: 0.41%, 15.62 ppm, 2.87%), followed by the Eastern and Western Himalayas where the soil qualities are moderately good; Trans-Himalayan soils are lowest in nutrient content (NPK: 0.16%, 8.96 ppm, 1.98%). Across all the 39 stretches surveyed, the best soils for plant growth are found in the Sandakphu area of Darjeeling, West Bengal (NPK: 0.16%, 8.96ppm, 1.98%). Observations show that the soil quality is good in altitude band 11,000-13,000 ft., the range with the highest species richness and density as well. Soils in the 8,000-11,000ft. range are moderate in quality, while the highest altitude band (>13,000 ft) has the poorest soil quality. Chamoli and Tawang have the highest average annual precipitation among the sites covered and the lowest precipitation is in Ladakh region.

The supportiveness of the various habitats is seen to be reflected by the species richness under the particular habitat category in a particular zone. The average species richness values vary widely across the zones. The highest species richness for Trans Himalayas is 13.57, whereas the lowest value in the central Himalayas is 13 and it goes up as high as 31.66. The supportiveness of a particular habitat type is also seen to vary across the region. The species richness of alpine forest habitats are higher in the central Himalayas (24) compared to the other zones (16 in western Himalayas, 12.5 in the Trans Himalayas and only 11.31 in the eastern Himalayas). Similarly, the glacial stream banks have average species richness of 29 in the eastern Himalayas, and 19.66 in the central Himalayas, 13.09 and 13.57 in the western Himalayas. This habitat category has the highest species richness in both the trans Himalayas and Eastern Himalayas, but the values vary significantly (13.57 and 29). Open semi-arid slopes have the lowest species richness in trans, western and the central Himalayan zone; the values vary considerably though - from 13 in the central Himalayas to only 7.22 in the western Himalayas. The highest species richness in a habitat category is observed for the moist slopes in the central Himalayas (31.66), followed by glacial stream habitats in the eastern Himalayas (29) and the alpine forests in the central Himalayas (24).

***Supportive Habitat Index*:** The gross supportive index ranges from a high of +1.35 (supportive) to a low of -1.53 (unsupportive) across the high altitude Himalayas. Supportive habitats are found predominantly in the eastern, western and central Himalayas, in the 8,000-11,000 ft. and 11,000-13,000 ft. altitude bands (38% and 34% respectively). The Trans-Himalaya has lowest percentage of supportive habitats for MAP growth-only 15% of the surveyed area was deemed supportive; the eastern Himalayas on the other hand had maximum MAP-supportive area, with only 11% assessed to be unsupportive. The central Himalayas showed the maximum area (61%) in the ‘most supportive’ habitat category. The most supportive sub-zones are: Sandakphu (average 0.46); Chamoli (average 0.34); Tawang (average 0.31); Kinnaur (average 0.24). The least supportive of all the sub-zones was found to be the Changthang belt in Ladakh (-0.26). The very high altitude band (>13,000ft.) was found to be the least MAP-supportive habitat across the Himalayas, with more than 50% of the area deemed to be unsupportive for MAP growth.

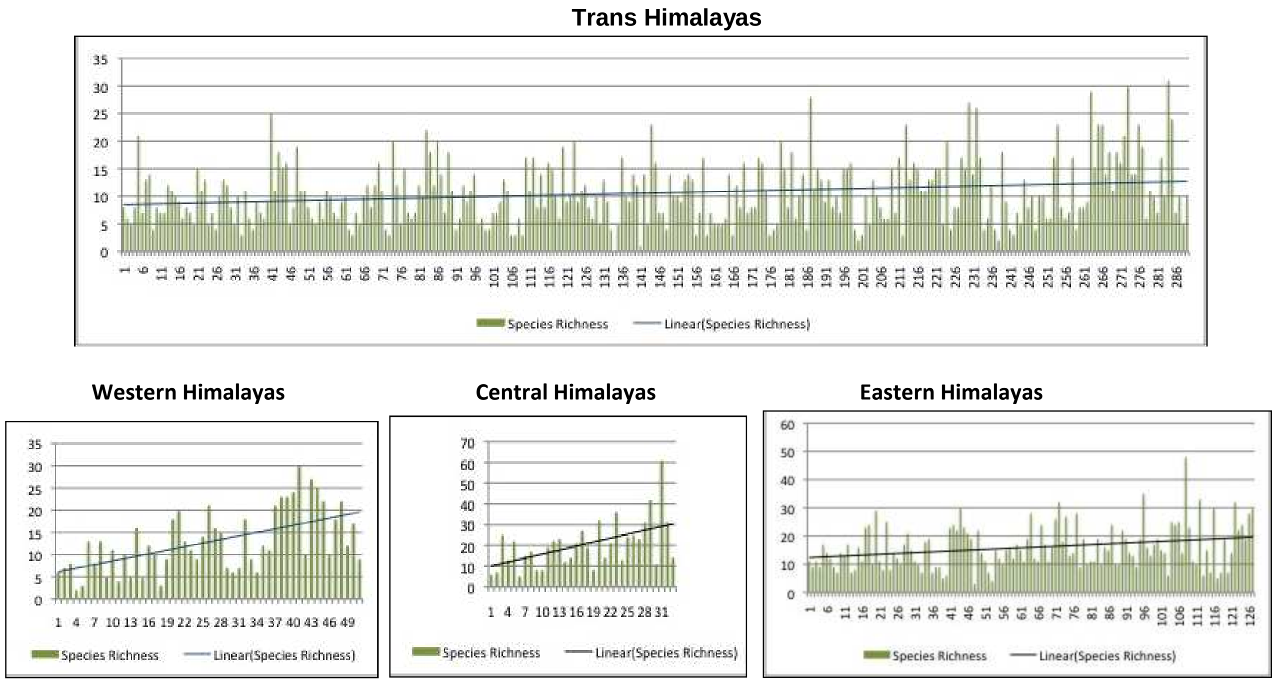

Fig.3 – Species richness across different pockets in the Himalayas used to determine habitat supportiveness

2.2.6 Vulnerability and resilience of sites in the high altitude Himalayas

Habitats of Himalayan MAPs and thereby the MAP species, are made vulnerable to degradation by anthropogenic pressure (population, tourism, development) and natural environmental processes (degradation, disasters, climate change). Their resilience on the other hand is a factor of the supportive charcateristics of soil, nature of habitat, precipitation and altitude. The Trans-Himalaya and Sikkim in the Eastern Himalaya were found to be highly vulnerable, the former as a result of unsupportive habitat, and low MAP populations, along with high anthropogenic pressure, the latter because of severe anthropogenic pressure. 89% of pockets in Ladakh (western Himalayas) were categorised as vulnerable, with Mathoo in Central Leh being most vulnerable across the range, while 74% of pockets in Sikkim are vulnerable. Central and western Himalayan stretches display moderate to low vulnerability, with only 8 out of 33 pockets in Uttarakhand and 16% of the pockets in Himachal Pradesh being vulnerable; the specific MAP-hotspots that were determined to be highly vulnerable (Chamoli in central Himalayas, Poh in western Himalayas) indicate the negative influence of tourism and development interventions on habitat integrity. Habitat resilience (96% of pockets) was found to be highest in the eastern Himalayas, due to its supportive habitat, very high MAP populations and relatively low anthropogenic presure, with Hot spring Sachu river having the highest resilience. Specific parts of the central and western Himalayas emerged as MAP-greenspots due to their high intrinsic biodiversity, along with relative inaccessibility and low anthropogenic pressure. Thus Pangi, a remote and less-developed area in the western Himalayas contributed a chunk of the region’s resilience score, and Ghumsali in Uttarakhand (central Himalayas), another less-accessible and biodiversity-rich area had the highest resilience score.

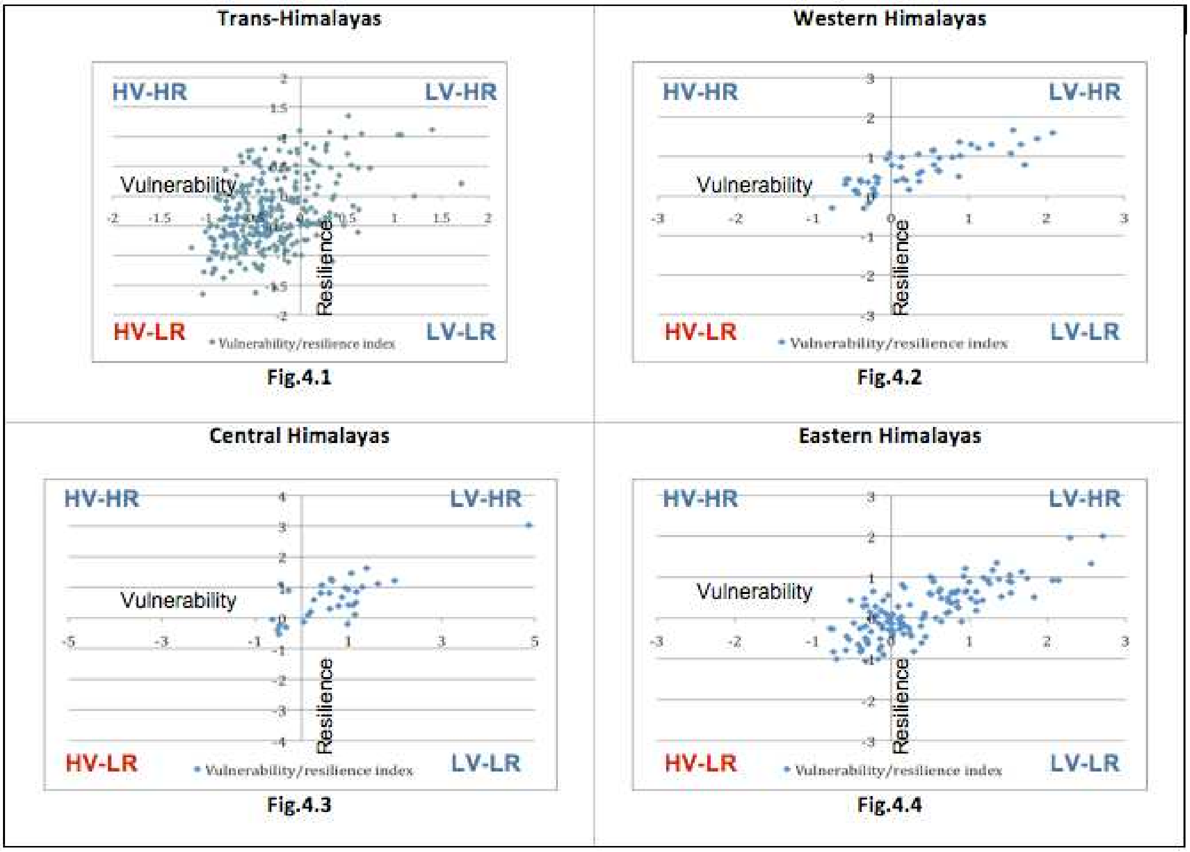

Fig.4 – Vulnerability/Resilience pattern - across the 4 Bio-geographic Zones
HV-LR = high vulnerability-low resilience; HV-HR = high vulnerability-high resilience;
LV-HR = low vulnerability-high resilience; LV- LR = low vulnerability-low resilience

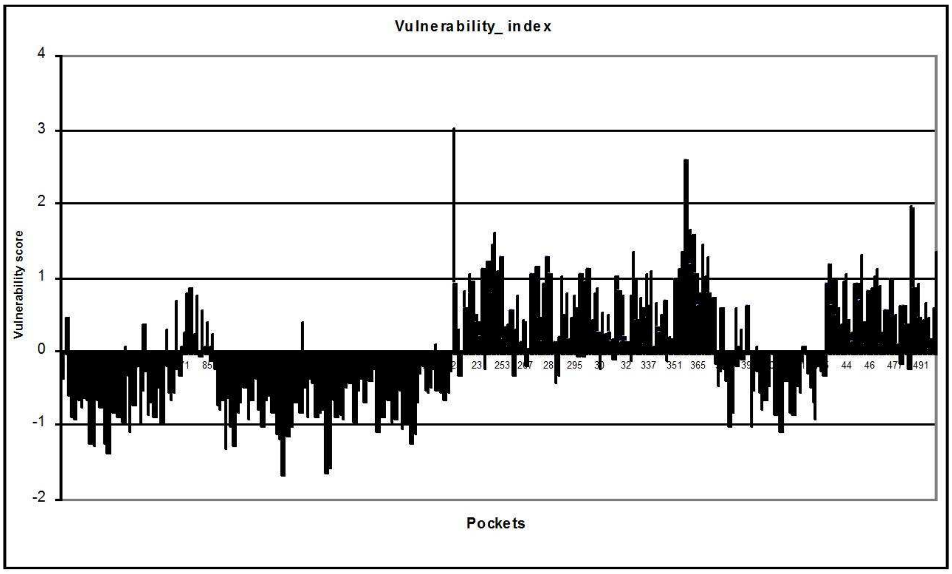

Fig.5 – Vulnerability/Resilience across different pockets in the Himalayas

2.2.7 Priorities for conservation in the high altitude Himalayas

***High 'Net Vulnerability' sites*: ** The priorities for conservation may be determined first at the level of the specific geographic sites that have a high Net Vulnerability. A specific site could be highly vulnerable and yet resilient at the same time, and determining Net Vulnerability of a site would help identify the sites for which vulnerability is higher than resilience. The vulnerability and resilience levels of the pockets surveyed have been cast in the scatter diagrams above (fig. 4.1, 4.2, 4.3, 4.4), each diagram clustering the pockets into 4 quadrats: (i) high vulnerability-low resilience, (ii) high vulnerability-high resilience, (iii) low vulnerability-low resilience and (iv) low vulnerability-high resilience. Net Vulnerability is the highest for the first group (high vulnerability-low resilience) and the pockets that lie in this quadrat need the highest level of attention in all the region, followed by those that are assessed to be in the high vulnerability-high resilience category. The Trans Himalayas have the highest Net Vulnerability in that 175 pockets (62.7% of the sample) are highly vulnerable and low on resilience; another 229 pockets are vulnerable and only 11.11% pockets are ecologically stable. The Eastern Himalayas similarly has a high concentration of vulnerable pockets (73 of 127 pockets) of which, 80.82% have low resilience. The western and central Himalayas show better resilience and most of the pockets surveyed are also low on vulnerability. 5 of only 8 vulnerable pockets in Uttarakhand (central Himalayas) are in the high vulnerability-low resilience category and need urgent conservation focus.

The study also brings out that anthropogenic pressure, natural disasters, developmental interventions, ethno-botanical and economic uses of medicinal plants, are jointly responsible for 63.8% of the vulnerability of high altitude Himalayan habitats for MAPs. On the other hand, soil quality, nature of habitat, average precipitation and altitude collectively contribute to 57.7% of resilience of pockets in high altitude Himalayas. It is estimated that a 1% reduction of developmental interventions in MAP-rich sites could reduce their vulnerability by 0.46%; reducing anthropogenic pressure and wild harvesting of medicinal plants by 1%, would imply a concomitant reduction of 0.25% and 0.23% respectively in the vulnerability of the concerned habitats. These can be used to guide action options for conservation in the degraded and vulnerable stretches in the Himalayas. While the Vulnerability/Resilience index helps in determining the priority sites for interventions, understanding of the contribution of the sub-indices (e.g. human-use, natural disaster, developmental interference, anthropogenic pressure, change in climate, soil quality, use of MAPs etc) help in determining the action options for each pocket.

Critical 'species-habitat composites': Within the vulnerable sites, the most critically at-risk species and habitats would be the focus for conservation. The At-Risk Species in the high altitude Himalayas identified through the survey were assessed by a multi-stakeholder group, and classified into 3 conservation categories based on their status in the wild and conservation value:

- C1: Most threatened and conservation action is critical and imperative- the 'highest risk' species
- C2: Threatened and conservation action is important and urgent
- C3: Serious (moderately threatened) and conservation action is beneficial

An average of 10 species were selected for each category in each high-altitude zone under the survey, for focussing conservation actions. The associated habitats for the species were identified with the aim of an ecosystem-based conservation approach. The highest risk species across the high altitude Himalayas were thus identified to be: *Aconitum heterophyllum, Podophyllum hexandrum, Swertia chiraiyta, Arnebia benthamii, Arnebia euchroma, Bunium persicum, Ephedra gerardiana, Angelica glauca, Dactylorhiza hatagirea*. The related habitats are: alpine deserts; dry, stony and rocky slopes; open slopes; moist, shady slopes, particularly at high passes; moist alpine slopes and meadows and grazing lands; along glacial streams and wetlands.

3. Important Plant Areas in the Himalayas

As mentioned earlier, protected areas in the Himalayan ecoregion have not succeeded in saving it from the escalated degradation and the herbal wealth of the region is especially at risk as a result. The strategic weaknesses of PA systems may be remedied through informal approaches to site conservation through local and civil society actions. The first step towards this would be the identification of the in-situ sites for MAPs that are most deserving of conservation focus. *Important Plant Areas* - selected based on the three standard criteria of presence of threatened species, species richness, and presence of threatened habitats - are the most important places in the world for wild plant diversity that can be protected and managed as specific sites (Plantlife International). Identification of such Important Plant Areas for MAPs in the Himalayas can help focus conservation efforts for MAPs, and provide a framework for protection, research and policy implementation for conservation of medicinal plants, inside and outside protected areas.

IPAs for MAPs in the Himalayas would be areas of concentration of medicinal plants within the larger hotspot of the Himalayan region. These 'high resource wealth' sites could include government-managed forests, sacred groves, community lands, individual landholdings, etc., and would function as micro-ecological niches of particular threatened species. Since in the higher altitudes, medicinal plants frequently act as keystone species for the particular habitats, nurturing other vegetal species through biodynamics and being food for several faunal species as well, determination and conservation of medplants focused IPAs would have significant ecosystem preservation value beyond the particular species themselves. It is desirable therefore to prioritise such medplants IPAs and establish a 'conservation grid' of small-scale community protected areas dispersed through various ecological zones in the region.

3.1 Identification of Important Herb Areas in the Himalayas

Identification of IPAs, specifically for MAPs in the Himalayas, was taken up by Pragya, with the aim of directing local conservation action. IPAs in the high-altitude belt (2500-5500m) of the Indian Himalaya were identified based on the ground mapping and subsequent CAMP workshops and consultations described in (2) above, while those in the lower altitude belts were based on an extensive review of the literature and consultation with well-informed research institutes. Site prioritisation and IPA identification involved:

1. Compilation of site-specific data on presence of threatened species, species abundance and richness
2. Clustering of sites based on habitat homogeneity, biophysical boundaries and physical proximity
3. Prioritization of clusters ensuring representation of all ecotypes, proportionate to species abundance & diversity

3.1.1 IPA selection inputs for the high altitudes in the Himalayas

The data collected through the mapping process was analysed to reveal tracts of habitat that met the first two IPA criteria ('presence of threatened species' and 'exceptional species richness').

- *Presence of Threatened Species*: Site-specific occurrence of threatened MAP species (IUCN Red listed, Indian Red Data Book listed) was gathered for each pocket. The threatened species identified through the regional CAMP workshops were also taken into consideration.
- *Species Concentration and Richness:* Further short-listing of sites was carried out based on species concentration as revealed by mapping data and inputs from regional CAMPs. The data from the ground mapping provided the number of individual plants of each MAP species occurring at the pocket level, determined through the Species-Area Curve.
  The concentration of each threatened species in a pocket were classified thus: < 4 individual plants per 9 sq.m. = low; < 4-7 individual plants per 9 sq.m. = medium; 7 individual plants per 9 sq.m. = high.
  Species Richness was determined by the species count of each site, with special focus on the RET (rare, endangered, threatened) MAP species. This analysis helped arrive at the distribution pattern of such MAP species, and CAMP inputs on the original habitat and degradation levels were also considered.

3.1.2 IPA selection inputs for the low and medium altitudes in the Himalayas

For extracting information on middle and low altitude Himalayas, not covered through the ground mapping exercise, to enable IPA selection in these region, Pragya carried out an extensive literature study and sourcing of secondary data. This involved review of both historical and current information from published literature, field biologists, local administrators in the regions and available literature on Himalayan flora, comprising scientific papers, reports and books, primarily relying on the premier institutes for plant research in the country, reputed NGOs, prominent university departments and govt. bodies for data collection.

Institutions (and their works) consulted have included:
Centre for Himalayan Bioresources, Palampur; National Research Centre for Orchids, Gangtok; RRL, Jammu; Herbal Research Development Institute, Chamoli; BSI, Kolkata/Dehradun; FRI, Dehradun; University of Almora, Uttaranchal; GB Pant High Altitude Plant Physiology Centre, SKUAST, J&K; Agricultural University, Solan; DRDO, Ladakh; Forest Departments of various states, Ministry of Environment and Forests, state govt. bodies on Ayurveda and other Traditional Health care systems; NGOs like TERI, Delhi; WWF-India, FRLHT, Bangalore; TRAFFIC-India; Fauna & Flora International, UK; Nature Conservancy, UK; CITES; IUCN; ICIMOD, BGCI, Plantlife International, Conservational International.

The important and medicinally rich sites mentioned in the secondary literature was crossed checked in the field, wherever possible. Forest officers, traditional healers, local resource persons, scientists and researchers working with medicinal plants were interviewed for garnering more information on the selected sites and also for validation.

3.1.3 Structuring and selection of MAP-IPAs

The tracts identified through the processes in 3.1.1 and 3.1.2 above, were grouped into clusters, in order to build sufficient scale, thereby allowing effective conservation of the species. 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 were:

- *Habitat Homogeneity*: In most cases, sites that demonstrate a relative homogeneity of habitat, in terms of

the ecological conditions of the sites, viz, the soil, humidity and other physical characteristics and the associated vegetation type, were clustered together. This has typically meant that a cluster adheres to a particular altitudinal band; in certain cases however, such as for the eastern Himalayas, river valley systems were used as cluster defining criteria, which has meant that multiple altitudinal bands have been included in the same cluster.
- *Biophysical Delineations & Physical Proximity*: Physical proximity of sites was also used as a factor for clustering. Typically in the mountains, physical proximity and related conditions of access are associated with the biophysical features of mountain ranges and river valleys. To a great extent therefore, this system was used to delineate the boundaries of a cluster, although in certain cases, a few sites that could lie just outside a particular valley or beyond a particular range, but display habitat homogeneity and adhere to the proximity principle, have been included in the cluster.

A total of 32 such clusters were identified and the final prioritization of the clusters was carried out ensuring a representation of all administrative and biophysical divisions within the Indian Himalayas. 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. 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);
(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.

3.1.4 IPAs identified in the Himalayas

The above processes resulted in the recognition of 15 IPAs for medicinal plants in the Indian Himalaya, each typically with a small number of tracts. The list of identified IPAs for medicinal plants in the Indian Himalaya is given in Table 1 below.

Constraints: The availability of information was a key factor in the identification of IPAs in the middle and lower Himalayas. Many other areas that are probably botanically rich but less documented, had to be excluded in the process of selection of IPA sites. The plant rich sites are difficult to locate in maps since for co-ordinate information is often not available. Demarcation of the IPA boundaries also poses problems in these areas. It is difficult to locate contiguous stretches of rich virgin floral areas because of the characteristic undulating topography; areas in the higher reaches, especially in the cold deserts, display sparse and fragmented vegetation because of low succession rate, harsh climatic condition, and scanty moisture. Many of the plant-rich sites in the Himalayas are in strategic locations with considerable military presence and related activities like road construction. These sites are not open to study nor conservation interventions.

3.1.5 Observations and implications for Conservation

There are several noteworthy features of these IPAs for Himalayan MAPs. One is that, despite the unprejudiced procedures, most IPAs are concentrated at high altitudes. In the Himalayan context, plant endemism was used as an important tool for determining priority conservation sites and species in the timberline zone of western Himalaya, and the higher proportion of IPAs in the high-altitudes reflects the higher number of endemic species found in these altitudes[30-32] (alpine and sub-alpine zones), especially in the case of the western Himalaya (including the trans-Himalayan region)[30,36,37], where even quite small sites can be exceptionally rich in endemics[33,34]. A study revealed that some of the relatively small, non-protected areas (Pindari: 76.7km^2 area; 39.85 endemics) with high endemic diversity ranked highest on priority. This shows that even a relatively small area can serve as a rich repository of endemic diversity.

The IPAs vary widely: in area, species concentration, ownership, etc. Each IPA typically has a cluster of plant rich tracts and the area of an IPA, although the number of tracts within an IPA varies as per the density of such tracts within a relatively homogenous area, and the total spread and boundaries of the IPA, are determined by a composite of the habitat characteristics and delineating biophysical features. While some IPAs, such as those in the western Himalayas are spread over a large area within the same agro-ecological zone, in the eastern Himalayas one the other hand, an IPA spread is lesser but it spans multiple altitudinal belts and hence diverse vegetation characteristics. The number of IPAs identified in a particular region, viz, western, central and eastern Himalayas, has been to an extent determined by the area required to save or conserve the designated medicinal plant species, the floral diversity present in the region, and also on the economic value of the species. A few of the identified sites are under the government's Protected Area system and Forest Reserves while a few sites are a mix of state owned forests and community owned land.

Table 1: IPAs of the Himalayas

Himalayan Division	State	Important Plant Areas for Medicinal Plants	No. of Tracts	Names of Tracts	Conservation issues
Trans and Western Indian Himalayas	Jammu & Kashmir	1/ Khardung-la	1	Khardung-la	overgrazing, overharvesting and illegal trade of MAPs, heavy vehicular traffic (army), impacts of climate change
		2/ Sapi-Penzi-la	3	Sapi, Panikher-Parkachik, Penzi-la-Rangdum	overgrazing, overharvesting and illegal trade of MAPs, impacts of climate change
		3/ Argi-Sarchu	2	Argi, Sarchu	overgrazing, road construction, climate change
	Himachal Pradesh	4/ Chika-Peukar-Khangsar	3	Chika-Rarik-Patseo, Peukar-Charji, Khangsar	conversion to agricultural land, overgrazing, overharvesting and illegal trade of MAPs, heavy vehicular traffic, road construction
		5/ Rohtang and Solang	2	Rohtang pass, Solang valley	unsustainable tourism, heavy vehicular traffic, very heavy wild-harvesting of MAPs
		6/ Malana-Parbati-Sainj	3	Malana valley, Sainj-Tirthan, Manikaran-Mantalai	tourism, wildharvesting
		7/ Rakcham-Chitkul and Rupi-Bhaba	2	Rakcham-Chitkul, Rupi-Bhaba	overgrazing, wildharvesting of MAPs and MFPs, conversion to agricultural land, hydel projects, frequent landslides
Central Indian Himalayas	Uttarakhand	8/ Kedar-Gangtori	3	Kedarnath, Khatling-Sahastratal, Kedartal-Gangotri, Harsil-Bhaironghati	overgrazing, wildharvesting of MAPs and MFPs, effects of mass tourism, frequent landslides and earthquakes
		9/ Valley of Flowers and Niti	4	Mana-Valley of Flowers, Niti valley, Dronagiri, Kuari pass	effects of mass tourism, overgrazing and MFP collection, conversion of land to agricultural purposes, construction activities, hydel project, frequent landslides
		10/ Gauri and Pindar	2	Gauri valley, Pindar valley	effects of tourism, overgrazing, excess collection of fuelwood and fodder
Eastern Indian Himalayas	West Bengal & Sikkim	11/ Dzongri-Phedang and Sandakphu	2	Yuksam-Goeshela, Sandakphu	effects of tourism, overgrazing, firewood extraction and fodder collection, extraction/use of forest products, use of herbicides and other agri-chemicals in tea gardens
		12/ Lachen and Lachung	2	Lachen-Chopta,Lachung-Goeshela	tourism, overuse of forest wealth, overgrazing, road building and clearing of vegetation by the army
	Arunachal Pradesh	13/ Dirang-Tawang	4	Thingbu-Luguthang, Goeshela-PTTso, Sela-Bangajang, Senge-Nyukmadung	overgrazing, logging, collection of MFPs
		14/ Upper Siang and Dibang	2	Pemako, Anini-Bruini-Andra	shifting cultivation, exploitation of timber, medicinal plants, and MFPs
		15/ Western Lohit-Changlang	2	Deomali, Demwee-Tiding	logging, conversion to agricultural and urban land, mining, collection of MFPs

Conservation of IPAs: The IPAs identified follow the cluster approach. This essentially implies that several core areas for medicinal plants conservation have been identified within a larger area of the same/similar habitat with a degree of physical proximity and delineated by a set of biophysical features. Effective conservation could focus on protection of the identified core areas, using them for in-situ gene pool creation of the herbal species, and developing corridors between multiple core areas within an IPA. it is essential to instill a strong sense of stewardship in the communities that live in and around the IPAs, and help them with processes such as ecosystem monitoring for sustainable management of habitats. The host communities should be facilitated to develop the IPAs into 'community heritage parks'; efforts should also be made to extend these sites, and to network with other neighbouring sites, thereby spreading the impacts of conservation wider in the ecosystem. It is noteworthy that the core areas of many of the IPAs lie within protected areas, although there are many plant-rich sites that lie outside the PA system. The locations of most of the plant-rich areas pose significant problems in conservation and management however**.** Those sited in the high altitudes are less-accessible and disturbed by humans, but the rugged topography and hostile climate, take their toll and make constructive intervention difficult. The high altitude areas lie snow-bound for more than half of the year. In the lower altitudes and Eastern Himalayas the sites are more accessable, but as a consequence, most of the identified IPA sites have a lot of human interference in the form of grazing, conversion of forest areas to agricultural land, logging and hunting, destructive harvesting.

4. Prioritisation of species and action options

In order to bring the results of the studies conducted into appropriate action and policy, multi-stakeholder consultations were conducted under the aegis of the National Medicinal Plants Board, supply and demand side issues were analysed to arrive at broad strategies for management of Himalayan MAPs, and species-specific options devised for conservation, research and market promotion. A framework was created for analysis of Himalayan MAPs, and their prioritisation for development policies and interventions. The consultations involved: foresters and policymakers from the state sector; academicians, scientists and researchers in medicinal plants; representatives of civil society groups working on medicinal plants; traders and industry representatives of the herbal sector; large-scale practitioners/producers of traditional medicine, and individual traditional healers; farmers and growers of medicinal plants.

4.1 Supply and Demand side analysis

4.1.1 Supply side gaps and needs

The supply side of the herbal sector chain as it applies to Himalayan MAPs stretches from the first stage of access of plant material, either by collection or through cultivation, and through post harvest processing, to the first buyer in the trade channel. The key issues on the supply side are to do with conservation of the Himalayan MAP species and their habitats, and the lacunae vis a vis cultivation of the species for supply of quality material for its use in healthcare and industry. Conservation issues have been dealth with in detail in previous section. The cultivation of medicinal herbs is also faced with several problems. There are few high value medicinal species with reliable and mainstreamed agro-techniques. MAPs need observation starting from their habitat, distribution, and adaptability to different micro-climatic conditions and morphological variability, before cultivation, and information on these aspects is still incomplete. Non-availability of planting materials, lack of appropriate cultivation practices, uncertainty in trade and lack of sufficient land under cultivation are major concerns. Furthermore, several species have long gestation periods pre-harvest. The legal requirements also confuse the growers, and lack of established grading norms, leads to non-uniform quality of plant material to intermediate processors.

Conservation-related Issues:
Lack of information on species populations and harvesting limits
Absence of appropriate regulatory mechanisms
Cultivation-related Issues:
Lack of market information on MAPs
Lack of agro-technologies
Shortage of quality planting material
Quality issues with respect to plant material
Lack of control of toxicities
Lack of post harvest treatment and high wastage
Fluctuations in the MAP market
Unfair transactions and lack of financial support

Different action types could be adopted to address the range of supply side issues for Himalayan MAPs. Research and technology development is needed for addressing conservation aims and for improving the quality of plant material available for processing; use of participatory methods in such work would also enable pro-poor technologies and benefits. Educational and promotional activities are required for sustainable management of biodiversity as well as for responsible trade; these need to be targeted at various stakeholders and at all levels in the supply-demand chain. Extension and grassroots work would help increase the numbers of growers and thereby widen the stakeholder and benefits base from the herbal sector. These actions would need to be supported through adequate financial and infrastructural inputs to enable optimal development of the supply side of the herbal sector, while suitable regulatory actions would ensure sustainable use of biodiversity, as well as fair trade.

4.1.2 Demand side gaps and needs

> ***Demand-side Issues**:*
> - *Lack of market and channel information*
> - *Inadequate post harvest facilities*
> - *Adulteration*
> - *Lacunae in packaging & labeling*
> - *Absence of quality standards and facilities*
> - *Lack of administrative support*

On the demand side are those issues that characterise the part of the herbal sector chain that stretches from the primary trader to the final customer, i.e., the user of herbal products and medicines. Demand side issues are many, but may be broadly classified into the following four areas: Post-Harvest & QA Processes, Information & Regulation, Channel Development, and Marketing & Promotion. Much of the plant material that processing points, goes through very basic quality checks, if any, and standards either do not exist, or are not in use. Post harvesting, the plant material is stored poorly and 40% of the material is wasted due to spoilage during storage and transportation. Adulteration is a growing problem and is threatening to cloud the image of the traditional medicine sector, while also potentially affecting the future and the international market prospects.

Research and technology development for demand side issues has to focus on improving quality at all stages of the value-addition, as well as on the processing – methods, technologies and equipment. Since lack of availability and wastage of plant material are critical issues, process efficiency in terms of use of plant material, should be examined. There is a need to disseminate these technologies to existing producers, backing it up with adequate regulatory rigour to ensure adherence to quality requirements. Towards ensuring benefits to the poor, technology and other services must be deployed to grower communities at the grassroots to address storage, quality and post-harvest processing requirements, and facilitation of linkages between channel partners and stakeholders can ensure optimal and shared benefits. Suitable programmes and state support would help promote particular species, while financial and infrastructural support for particular aspects such as quality enhancement, testing labs, process efficiency improvement, etc., could enhance sectoral effectiveness. Regulations are called for particularly with respect to quality of plant material, transportation and fair trade.

4.2 Species Prioritisation and Development Options

4.2.1 Potential of Himalayan MAPs for livelihoods

Apart from their enormous value to human health globally, and to Himalayan communities in particular in innumerable ways in their daily lives, Himalayan MAPs have the power to act as an engine of growth for the rural economies of the Himalayan region and catalyse livelihoods for the poor. Despite the rich heritage of the Himalayas, the people of the region face a 'vertical gradient of poverty'[1] that puts 30-40% of them below the poverty line, with an average of 47% of underemployment as well. Although stewards of the medicinal plants wealth of the Himalayas, they benefit only marginally from the trade of medicinal plants harvested from the region, in the form of collector's wages. If high-value herbs were to be cultivated by small & marginal farmers in the Himalayas, they would as cash crops serve to lift many of the Himalayan poor out of the clutch of poverty. Most Himalayan MAP species are high-value species and fetch a premium price in the market. A study by CECI- India (Regmi & Bista, 2002), indicated that from a single district of Pitthoragarh in Uttaranchal state of India, more than 1300 tons of MAPs are collected and traded annually. In the Great Himalayan National Park, local people earn around $100/HH/year through collection & sales of MAPs. A preliminary cost benefit analysis (Karki, et al, 2003) of the production of *Aconitum heterophyllum* **-** a high-value MAP species in Uttarkashi district of the Central Himalayas revealed that as compared to the traditional crop of potato which yields a net profit $ 200/ha, *Aconitum heterophyllum* yields $ 6000/ha.

Cultivation of Himalayan MAPs by farmers in the region would also deliver multiple other benefits. These species are agro-climatically adapted and hence need lesser inputs of water & manure; being hardy, native species, they are less vulnerable to pests and diseases and even droughts to an extent; they do not degrade the land as other non-native species and in fact also perform certain other functions, such as soil binding; the income per unit of land with the cultivation of medicinal plants is much higher than with other cash crops such as peas or potatoes. Most important of all, the high-value Himalayan species are endemic to the region, giving the Himalayan farmer a definite competitive advantage in these species, vis a vis other cash crops.

Prioritisation of the Himalayan MAPs becomes important in this context. Analysis of the specific supply and

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[1] *Payne, Katrina, Warrington, Siobhan and Bennett, Olivia; 2002; High Stakes - The future for mountain societies; The Panos Institute*

demand side issues that beleaguer each Himalayan species, would help to determine the potential of the species for use in Himalayan livelihoods. It would also indicate the specific actions required to develop, support and promote each prioritised species to deliver to its potential. The key factors are:
On the supply side: The status of a species in the wild and the extent of need for conservation is a factor that has a strong bearing on the supply of the species in trade. The extent to which a species is suitable to the agro-ecological conditions of the given area and the degree to which it has been domesticated, in the form of existing agro-techniques, would also influence the feasibility of its inclusion in Himalayan livelihoods.
On the demand side: The incidence of local use and the diversity of use at the local level of a particular species, is a major determinant of the quantities required of the plant material of the species, as well as the strength of the local/regional market and demand for the species. The demand of a species in far markets and in overseas markets, as well as its use in well-known formulations of alternative medicine or in allopathic medicine, would imply higher levels of market prospects.

4.2.2 The Framework for Prioritization

While designing the framework for prioritization of species, several development considerations were kept in mind, and 5 principles were evolved in order to address these considerations. A comprehensive and appropriate evaluation of species would require examination of the medicinal plant wealth of various eco-regions in the Himalayas. Each medicinal species is besides, circumstanced differently, and the particular species circumstances determine the prospects and problems with respect to that species. This 'species circumstance' cannot be understood through a skewed look at only the commercial considerations or at the ecological status. Although prioritisation calls for examination of species, one against another, a purely relative assessment of species is likely to lose validity over time. An assessment framework that enables change of ratings with a change of 'species circumstance' would retain validity over a longer term. Further, a species assessment procedure that enables an identification as well as measurement of the severity of the issues with respect to each species, would greatly facilitate the determination of interventions.

Hence, the following principles were evolved:
1: Species prioritisation should be for each eco-region of the Himalayas, to be subsequently compiled, ensuring an equitable representation of all Himalayan eco-regions.
2: Species prioritisation process has to involve assessment on each species on supply side considerations as well as demand side considerations.
3: Species prioritisation process has to involve an assessment of each species against key issues that beset the sector at both supply and demand ends, ensuring attention to conservation and commercial concerns.
4: The species assessment framework should enable independent evaluation of species as well as a comparative evaluation between species.
5: The species assessment scoring should be a composite that allows tracing to key issues and thus determination of action requirements for each species.

Whole Chain Assessment: The prioritization framework takes into consideration both supply side and demand side issues for a comprehensive assessment of the factors that drive the herbal sector.
Supply side aspects: The key supply side issues and associated values that were determined for each species under consideration, were: *Conservation value*, indicating the status of a species in the wild and the criticality of its need for conservation; high conservation values indicate lesser availability of wild resources; *Cultivation prospect value*, indicating degree to which a species has been domesticated, and the availability of agro-techniques, to enable uptake of cultivation.
Demand side aspects: The key demand side issues and associated values that were determined for each species under consideration, were: *Local use value*, indicating strength of the local/regional market and demand for the species, with higher values indicate higher estimated volumes of

*A 20-point disaggregated **Species Prioritisation Scale**, with equal weightage for each of two supply side issues as well as two demand side issues (5 points per issue), was used. Scores were allotted to each species against its Conservation Value & Cultivation Prospects under Supply Side considerations, and its Value in Local Use and Far/Larger Market Status under Demand Side considerations. Species with higher ratings were accorded a higher priority.*
- *Species were scored on their Conservation Values depending on the size & distribution of their wild resource base (horizontal & vertical), erosion of the resource base, nature & scale of impacts by trade, status on the red list, phylogenetic distinctiveness, available legal protection (e.g. CITES, etc), regeneration period.*
- *Scores on Cultivation Prospects were based on suitability to the area's agro-ecology and farming systems, availability of cultivation/propagation techniques, harvestable in short rotation period, social acceptance for promotion in the specific zone.*
- *Local Use Values were by the use of the species in primary health care, in treating common ailments as well as a range of ailments, importance in local ethnobotany and traditional medicine, use for multiple purposes- sociocultural, fodder, food.*
- *Scores for Far/Larger Market Status were assigned on the basis of demand in local, regional, national and global markets, market price, potential for domestic value addition, annual industrial demand and export potential.*

local demand; *Far/larger market value*, indicating demand of a species in markets beyond the local area, including in overseas markets; higher values indicate a higher market demand in such markets.

4.2.2 Prioritized Medicinal Plant Species of the Indian Himalayas

Following the framework described above, the Himalayan medicinal plant species identified during the mapping exercise, were prioritized in 2 sub-groups: Priority I (with aggregate ratings of 15-20 on the 20-point Species Rating Scale- see box above) and Priority II (with ratings of 10-15), based on scores assigned to them by the working groups at the national consultations. The list of prioritized species is given in Table 2.

4.2.3 Action options for optimising on species potential

The framework used for prioritisation also point out the exact nature of support required for each prioritised species, towards optimising on the potential of the species in the herbal sector, while addressing its conservation needs. Three well-delineated Action Options may be crystallised, comprising a mix of supply and demand side interventions.

Action A: R&D First! The Priority Species that were assessed to have a 'Low Cultivation Prospect', whether rated high or low against the other three parameters of conservation value, local use value and far/larger market demand, are placed in this group and prioritized for R&D interventions. The rationale is that the required research needs to precede any other developmental activity for these particular species, in order to remove/reduce the existing bottlenecks that affect optimising on the potential of the species. Species with low scores on cultivation prospects especially, lack developed propagation methods through natural means and/or standardised cultivation packages, and adequate nursery production of saplings for use in cultivation. They also might have specific agro-climatic niche requirements that are not available at a larger scale. Besides, several of these species are not adequately understood in terms of the inter-relationships between the growing conditions and/or post-harvest processing requirements and the active principle content in the plant material. These are bottlenecks that will not allow a sustainable use of these species by the herbal sector, in spite of the high market demand for them. The R&D intervention should therefore include:
- Developing propagation & cultivation protocols for strengthening the supply base, including micro-propagation protocols for recalcitrant species
- Nursery propagation and production support
- Developing techniques for post-harvest processes, establishing quality standards and testing methods

Action B: Conserve, Cultivate, Channelise: The Priority Species that were assessed to have a 'High Conservation Value' as well as a 'High Cultivation Prospect', and an established market with a high value in local use and/or far/larger markets, are placed in this group. Such species call for a composite intervention that comprises conservation of the species along with promotion of cultivation and marketing. Prioritised species with high scores on Conservation Value indicate a restricted resource base for the species. Harvesting and usage of the species without adequate conservation action would lead to serious biodiversity impacts. Several such species are also rated to possess high cultivation prospects, indicating an availability of cultivation techniques and hence good chances of lucrative returns to farmers. However, this potential will not be realised unless farmers are made aware of available technologies and galvanised for production. Several of the species have existing demand in local markets, which calls for local level sources of supply. A high rating on the status in far/larger markets, indicates assured returns to the farmers and with it, the need to work on developing the marketing channel. Depending on the species status, Action B could include:
- Targeted conservation measures for MAP-rich areas, and a ex-situ conservation for species
- Promoting cultivation for local consumption, and for supplying to far/larger markets
- Regulating supplies for sustainability, optimal quality and fair benefits
- Improving post-harvest processes and adherence to quality standards

Action C: A Market Boost!: The Priority Species that were assessed to have a 'Low Value in Markets', whether in Local and/or Far/Larger Markets, and whether rated high or low against the other two parameters of conservation value, cultivation prospects, are placed in this group and prioritized for Market Development interventions. Such species do not have a well-established market demand, although they might have established pharmaceutical actions and/or potential for use in wellness or cosmetic products. Research may have indicated that these species have high potential in the market and in certain cases, local use value may be high but far/larger markets do not recognise these values. Unless the markets are made aware of the potential of these species, this potential is unlikely to be realised. Action C is therefore aimed at creating an adequate market in order to ensure the realisation of the potential of such species, and would include:
- Focussed attention on product development
- Analyzing potential markets and product positioning
- Promotion and demand creation

Table 2 – Prioritised Himalayan MAP species for intervention

Species name	Rating: Supply-side considerations		Rating: Demand side considerations		Gross rating	Development actions					
	Conservation value CV	Cultivation prospects CP	Value in local use VLU	Value in far/ larger markets VFM	region-scale	Option A	Option B				Option C
						R&D for cultivation	Thrust on conservation	Support for cultivation	Cultivation only for local consumption	Market linkages and post-harvest facilities	Promotion and market develop-ment
Priority I											
Swertia chirayita	5	5	3	5	18		✓	✓		✓	
Aconitum heterophyllum	5	3	5	5	18	✓	✓		✓	✓	
Taxus baccata subsp. *wallichiana*	5	1	5	5	16	✓	✓		✓	✓	
Podophyllum hexandrum	5	2	5	5	17	✓	✓		✓	✓	
Paris polyphylla	5	2	5	5	17	✓	✓		✓	✓	
Gloriosa superba	5	2	4	4	15	✓	✓		✓	✓	
Angelica glauca	5	1	5	5	16	✓	✓		✓	✓	
Dactylorhiza hatagirea	5	1	5	5	16	✓	✓		✓	✓	
Myrica esculenta	4	2	5	5	16	✓	✓		✓	✓	
Nardostachys grandiflora	5	1	5	5	16	✓	✓		✓	✓	
Picrorhiza kurrooa	5	1	1	5	12	✓	✓		✓	✓	
Sapindus mukorossi	1	5	5	5	16	✓	✓	✓	✓	✓	
Saussurea costus	5	1	5	5	16	✓	✓		✓	✓	
Arnebia benthamii	5	1	5	4	15	✓	✓		✓	✓	
Arnebia euchroma	5	1	5	4	15	✓	✓		✓	✓	
Rheum australe	5	1	4	5	15	✓	✓		✓	✓	
Rheum moorcroftianum	5	1	4	5	15	✓	✓		✓	✓	
Coptis teeta	5	5	5	5	20		✓	✓	✓	✓	
Panax pseudo ginseng	5	5	5	5	20		✓	✓	✓	✓	
Aquillaria agallocha	5	4	5	5	19		✓	✓	✓	✓	
Terminalia bellirica	3	2	5	5	15	✓			✓	✓	
Zanthoxylum armatum	5	2	5	5	17	✓	✓		✓	✓	
Ammomum subulatum	3	3	5	5	16	✓			✓	✓	
Hardwickia javanica	4	4	4	4	16		✓	✓	✓	✓	
Rheum nobile	5	4	5	2	16		✓	✓	✓		✓
Costus speciosus	4	5	5	4	18		✓	✓	✓	✓	

Priority II											
Aconitum ferox	5	3	2	4	14	✓	✓			✓	
Allium stracheyi	3	4	5	2	14	✓		✓	✓		✓
Bunium persicum	3	3	5	3	14	✓			✓		✓
Delphinium denudatum	5	1	3	5	14	✓	✓			✓	
Hippophae rhamnoides	5	1	5	3	14	✓	✓		✓		✓
Pistacia khinjuk	2	5	2	5	14			✓		✓	
Rheum webbianum	3	1	5	5	14	✓			✓	✓	
Valeriana jatamansi	5	1	3	5	14	✓	✓			✓	
Carum carvi	2	3	5	3	13	✓			✓		✓
Oroxylum indicum	3	1	5	3	12	✓			✓		✓
Polygonatum cirrhifolium	5	1	2	5	13	✓	✓			✓	
Polygonatum multiflorum	5	1	2	5	13	✓	✓			✓	
Polygonatum verticillatum	5	1	2	5	13	✓	✓			✓	
Acorus calamus	4	1	3	5	13	✓	✓			✓	
Dioscorea deltoidea	5	1	3	3	12	✓	✓				✓
Gentiana kurroo	4	2	1	5	12	✓	✓			✓	
Thalictrum foliolosum	2	1	3	5	11	✓				✓	
Saussurea obvallata	5	1	5	1	12	✓	✓		✓		✓
Gymnocardia odorata	3	3	5	2	13	✓			✓		✓
Gymnocladus assamicus	5	2	5	1	13	✓	✓		✓		✓
Gaultheria fragrantissima	4	1	3	4	12	✓	✓			✓	
Potentilla fulgens	4	2	3	2	11	✓	✓				✓
Meconopsis nepaulensis	5	1	1	0	7	✓	✓				✓

5. Pilot interventions for community based biodiversity conservation

Pragya has been working for conservation and sustainable utilisation of the medicinal and aromatic plants of the Indian Himalayas. A pilot project initiated in Lahaul and Spiti district of Himachal Pradesh was replicated across the high altitude Indian Himalayas. The project promotes the cultivation of high-value herbal species as alternative cash crops by local communities, thus enhancing farmer incomes. Alongside cultivation of medicinal plants, the Pragya intervention also encourages community stewardship for protecting the plants in the wild and preservation of the ethnobotanic traditions. Findings of the MAP mapping & threat assessment study and the various multi-stakeholder consultations over the years, formed key inputs to this work. The project is currently being supported in 12 high altitude districts across 5 Himalayan states including Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh.

This project has also been awarded the 2000 Whitley Gold Award, an international recognition for nature conservation projects, by the Whitley Foundation and the Royal Geographical Society.

The project has multiple components:

Pragya Project ethos:
Pragmatic Conservation. It recognises the fact that the bioresources of a region are as much a cultural as an ecological phenomenon, because of their place in the lives of local communities. The community-centric, development-inclusive conservation approach that Pragya follows begins with rekindling the sense of stewardship in Himalayan communities, and building in them the skills and the responsibility for managing their bio-resources in a sustainable manner, tying in the development of the Himalayan communities with the conservation of their ecosystems. This approach also does not reject the market forces that play, but accepts and manages them for the benefit of the people while also ensuring the sustainable use of biological resources, by instituting appropriate alternatives, such as cultivating medicinal plants as against collection from the wild.
Heritage-based Enterprises and collaborative economic endeavour. Pragya believes that livelihoods shaped around niche produce of the Himalayas, arising from the unique Himalayan heritage, such as Himalayan MAPs, are most suitable as an economic lever for the Himalayan region. Micro/small heritage-based enterprises (based on local cultural and natural heritage), would enable significant economic benefit to be wrested by mountain communities from their specific advantages, and related niche products & markets. Apart from providing alternate income avenues, productive use of local resources could also dynamise these very resources, stem their degradation & erosion, and ensure that a greater part of the benefits is retained by local communities. The sparse population of the Himalayas however pose problems to achieving economies of scale, and inhibits access to markets. Pragya seeks to develop collaborative community enterprises, such as cooperatives of medicinal plants growers, to counter this.

***Community Conservation of Medicinal & Aromatic Plant resources*:** The strong people and plants relationship necessitates that community engagement in conservation is at the core of the initiative. Children, women, youth and traditional healers, are educated on the need for conservation and enlisted for active stewardship of the herbal resources in the wild. Special curricular modules have been designed on 'Ecology & Conservation' and rolled out through the schools in the area. Community-based 'Natural Heritage Conservation Councils' (NHCC) have been formed in all Himalayan valleys with responsibility for the conservation of natural resources and local level activities directed towards it. The NHCCs are also responsible for carrying out conservation campaigns and afforestation drives in the Himalayas and maintaining and updating Community Biodiversity Registers (CBRs) for their own valleys.
The NHCCs are encouraged to adopt areas of MAP concentration (in the identified IPAs) as 'Community Protected Areas', protect them through social or physical fencing, and implement community-controlled usage of the sites. 12 such sites have been set up and are also serving as genetic reserves for the 'at risk' species. This intervention is a step towards creating a grid of community-managed hotspots across the high altitude belt of the Himalayas for in-situ conservation of the region's herbal wealth. Rangeland management interventions and training of pastoralists have also been undertaken in order to reduce grazing-induced stress at MAP-rich stretches. A community-based Biodiversity & Habitat Monitoring System has been launched in the high altitude districts for scientific data collection and management of threatened/degraded habitats. A simple toolkit has been devised and the stakeholders trained in its operation.

Fig.5 – (a) Community Protected Areas in the Himalayas (b) Ethno-botanic Centre in Lahaul, HP

Ex-situ conservation and cultivation of Medicinal & Aromatic Plants: Farmers and traditional healers have been trained and assisted in setting up micro-plantations of medicinal plants at altitudes ranging from 8,000 ft. to 16,000 ft. Recognising women as the key repositories of knowledge on aromatic, spice & dye plants, the project has helped set up several Self-Help-Groups of women kitchen-gardeners and supports them in undertaking cultivation of these species. The Pragya team provides continual support to the medplants growers and works to enhance uptake. It has developed simple, easy-to-use cultivation protocols for 18 MAP species, and seed-dormancy treatment and propagation protocols have been worked out for 10 species. In order to bridge the lab-to-land gap, regular training and field demonstrations are conducted and technical assistance provided on propagation, cultivation, plantation-planning and pest management. Several nurseries and greenhouses have also been set up for the propagation of the high-value medicinal species and distribution of saplings to farmers. Farmer Expert Groups are being created in each valley for local level research into medicinal plants cultivation and mentoring of new med-plants farmers.

In order to promote sustainable bio-enterprises and fair trade, Pragya has established medicinal plants growers' cooperatives in several Himalayan districts. This has involved intensive training on cooperative management, followed by assistance in registration with the authorities and handholding for formalization in terms of accounting systems and participation processes.

Medicinal plants harvesting and processing call for stringent quality norms. The market channel uses the rudimentary measure of physical observation of plant parts for checking quality. This makes incorporation of processing at a local level difficult and value-addition has to be limited to post-harvest processes. Pragya has therefore equipped the medicinal plants growers' cooperatives with produce drying equipment that helps reduce wastage and transportation costs of the produce. Women's SHGs have also been facilitated to set up spices drying and packaging enterprises.

Fair trade mechanisms are being instituted as well. Farmers are provided regular updates on regional and national markets and buyer requirements. The cooperatives have been aided in linking up with channel partners for marketing and sale of the produce. Buyer-seller meets are conducted periodically at which national level manufacturers of herbal products as well as large traders are brought face to face with Himalayan farmers. These interventions have the potential of increasing medicinal plants revenues for the Himalayan farmer by several times.

Fig.6 – (a) Kitchen garden of Medicinal Plants; (b) Cultivation research at Pragya Applied Research Centre

Documentation & Preservation of Ethnobotanical Knowledge: Pragya has carried out a documentation of the ethnobotany in various zones and cultures across the Himalayas. Three Ethnobotanic Centres anchored with the NHCCs and an on-line repository host the information and help conserve local knowledge about medicinal plants. Pragya has also helped create and support traditional healers associations and networks. Traditional Healing Centres/groups have been formed in several districts and been trained in using modern tools & systems for diagnosis, documentation, medicine preparation and treatment. Periodic health camps and awareness sessions on promotive & preventive health involving the traditional healers have helped in keeping the system alive, while also enhancing access to health care services for the remote Himalayan villages.

Regional Networking & Wider Dissemination: Initiatives have also focused on knowledge-sharing and advocacy for the herbal wealth of the high altitude Himalayas. The research on threatened habitats and 'at-risk' species have been able to draw policy focus on the species under threat at the high altitudes. Publication of an inventory and threat status of MAPs and national level consultations & networking have aided in shaping some positive policy decisions in this sector. Documentation of the Himalayan MAPs in the form of species chart/posters, bio-profiles, e-herbarium, etc., have helped in reaching out to the wider public, while the Ethnobotanic Centres and various awareness initiatives have helped spreading awareness among Himalayan people as well as visitors to the region. Pragya continues its endeavours to reach out to the wider public, policy makers and research communities at national & international levels regarding the threats to the Himalayan ecosystem, its rich biodiversity and traditional knowledge, and its community-based, sustainable MAP-enterprises.

The Lahaul Medicinal Plant Growers' Cooperative: A Pragya initiative

THE JOURNEY IN MILESTONES: *A very successful Medicinal Plants Growers' Cooperative has been formed in Lahaul and is being assisted in forging linkages with bulk buyers at the national level.*

1998: *research into medicinal plants and cultivation prospects and protocols; launch of training for farmers in medplants cultivation*
2000: *6 experimental plots for medplants set up by farmers in the district with technical inputs & assistance from Pragya*
2001: *the first tentative protocols for 3 medicinal species of the district; exposure visit for farmers to industry*
2002: *2 nurseries set up in the district; distribution of seeds & saplings to farmers for medplants cultivation; several new farmers begin cultivation of medicinal plants*
2003: *first national seminar-cum-workshop with farmers and researchers; launch of cultivation protocols for 4 species; launch of the Lahaul cooperative (MPGC) with training and registration*
2004: *first harvest from a Pragya-supported medicinal plants plantation and sale to traders in Kullu; distribution of seeds by MPGC to new members*
2005: *provision of solar dryer to MPGC; members in MPGC increased to 165; second national seminar cum workshop on medicinal plants; first buyer-seller meet with representation of 13 pharma/herbal companies*
2006: *third national seminar; second buyer-seller meet; exposure to national markets, processing centres; training on quality requirements by traders and Hamdard Univ.*
2007: *increase of farmers in MPGC to 205; training of farmers by Unilever Research Lab on post-harvest technologies and quality requirements; participation of MPGC members in a stakeholder consultation commissioned by NMPB towards determining policy inputs for the 11th Plan; cultivation protocols firmed up total 18*
2008: *business deal finalized with Dabur**
2009: *a long-term agreement with industry for supply of medicinal plant material at a mutually negotiated rate.*
2010: *increase in offtake by Dabur; increase of members to 409; new industrial houses contact MPGC for purchasing plant material*

**** The Dabur-MPGC Deal:***

In order to ensure the sustainability of the medplants cultivation endeavour, Pragya worked towards creating market linkages between cultivators and buyers. Towards this end, an extensive market survey was conducted and potential buyers (both at the national and local level) were identified. Buyer-seller meets were organized at several stages to establish fair trade channels between the cultivators/producers of medicinal plants and the traders.

In 2008, we established a dialogue between MPGC and Dabur India Ltd., India's leading pharmaceutical company with approximately 90% of the medicinal plant market share. After several rounds of talks, quality checks on the produce and discussions with the MPGC, Lahaul, Dabur finalized the deal. The deal earned the cooperative Rs. 2 million and several species like Inula, Saussurea and Aconitum were purchased over two phases.

Apart from the monetary benefit of this linkage for farmers in Lahaul valley, the deal served to act as a demonstration of the benefits flowing from a synergy of conservation efforts with market tie-ups. The success of this can be gauged by the steep increase in the membership of the cooperative, following the deal. This has also resulted in an increase in requests for seed and other planting material for growing of medicinal plants commercially.

6. Way ahead/Conclusion

A 9-point MAP Management Strategy for the Himalayan Region

The studies conducted, the consultations and the grassroots initiatives, have brought out the need for a certain strategic agenda going forward, to ensure effective management of the herbal wealth of the Himalayas, including the conservation of the species in the wild, and the delivery of economic benefits of biodiversity to the Himalayan poor.

Given below are the key elements of a 10-point strategic agenda:

i. Strengthen the biodiversity management institutions and enforcement of legislations and good practices. Although the structures for management of biodiversity (Biodiversity Authorities & Committees) and the legislations (Biodiversity Act, etc.) to control threat to bio-resources in India do exist, much illegal wild-harvesting continues. This needs to be addressed by institutional strengthening such that the mechanisms and legislations for biodiversity protection are strictly enforced. Civil society extension activities may be used to create local management structures of Biodiversity Management Committees and build capacity in them for biodiversity & habitat monitoring, and controlling illegal extraction of MAPs. Civil society may also be harnessed to catalyse stricter enforcement of biodiversity legislations. Development, extension and capacity building for sustainable and non-destructive collection practices, even when for consumption by host communities, are necessary. Developing guidelines for conservation & use of MAPs in the wild, along with clear definition of stakeholder roles, and the strict enforcement of necessary certification/governance procedures, could be a key to solving the problem of unsustainable levels of harvesting. Towards this end, a rapid documentation of species populations is critical; since much work has been done in this field by various agencies, collation of existing data with state and non-state agencies and targeted efforts at gap-filling will be most suitable. The status-assessment process would however need to be periodically carried out, and conservation/development strategies adapted to current conditions.

ii. Promote community conservation of species and habitats and facilitate community-state collaboration for conservation. Himalayan communities in India, as all nature-based peoples in the world, have deep-rooted conservation ethics. Hence, extension work with communities must be focused on reviving traditional conservation practices and community stewardship. There should be a thrust on raising conservation awareness among the communities, and engaging the children and youth in the process. A genuinely collaborative approach between the State and the Himalayan communities would contribute to effective management of forests & habitats. Recognising the inefficiency of the conventional conservation paradigm and the escalating man-nature conflicts, the India government has legitimised the customary rights of tribal communities over the forests with the Forest Right Act. At this juncture, it is essential to instill a strong sense of stewardship in the communities along with processes such as ecosystem monitoring, that would help them in sustainable management of the habitats. The halting implementation of the Act also speaks of the need to facilitate the rights & participation approach in State functionaries.
A greater concentration of resource flows to the identified IPAs in the Himalayas would help conserve these MAP-rich sites, and create the suggested ‘Conservation Grid for Himalayan MAPs’. Grassroots capacity building would be necessary to educate on conservation techniques, and facilitate them to access available schemes (such as from the National Medicinal Plants Board) for conservation and efficient management of these areas. Site-specific strategies should be worked out for protection of core MAP-rich areas in IPAs; identification of newer IPAs and core areas, and associated conservation/protection efforts also need to be undertaken.

iii. Participatory agro-technology development and germplasm management. Work on development of agro-techniques for endangered, undomesticated species with high market value, needs to continue at a brisk pace, and dissemination of agro-techniques that exist has to be a major thrust area. R&D institutions with relevant capacity need to share the work of agro-technique development for the priority Himalayan MAPs. It is important to recognise the fact that farmers in the Himalayas can play a significant role in this research, and participatory forms of research involving researchers and farmers in collaborative research efforts, are likely to be more successful by far for the land-based protocols. This would enable quicker absorption of the developed protocols and least lab-land gaps. Particularly for those species that inhabit a wide ecological range, such collaborations will also facilitate a species-area-agrotechnique match. Farmer groups could be encouraged to establish experimental plots for agrotechnique development, that could flow seamlessly into becoming nurseries for bringing the species into production. State and non-state actors as well as the rural media may be harnessed for extension of the technical know-how and promotion of Good Agricultural Practices. Germplasm management should likewise be a dispersed and participative effort. Germplasm banks with R&D institutions may have field counterparts in the form of MAP seed banks with farmer groups in each agro-climatic region. Apart from maintaining the germplasm, this would help enhance supplies of responsibly sourced plant material. Industry linkages will be effective for post-harvest processing and testing, and participation of traditional healers in setting quality and grading norms, could enable dissemination and absorption of quality norms.

iv. Promote area-specific cultivation of prioritised MAPs. Large-scale cultivation of Himalayan medicinal plants is the strategy that would help meet the industry demand while offering an alternative to wild collection and thus conservation of the species in the wild. The endemic nature of several Himalayan medicinal species implies a competitive advantage for Himalayan farmers and indicates the potential for economic development of the region. There is therefore a strong need for a concerted effort by governmental and non-governmental agencies to catalyse cultivation of the particularly at-risk Himalayan MAPs by farmers in the region. Facilitation Centres for MAPs need to be set up, and would do much to escalate the uptake of cultivation of priority species among farmers; these could serve as certification agencies for the plant material as well. Since distances are large in the Himalayas and travel and transportation difficult, to adequately address the remote Himalayan villages, facilitation centres and services would need to be dispersed and made available at a district/sub-district level. A micro-level localised approach is required for the Himalayas, for agro-climatic variation in the region is very high, and most Himalayan species are niche species that do not have a large ecological range. Species that are most ecologically-suited and high-value in each micro agro-climatic zone within the Himalayan region, must therefore be identified and serve to guide farmers on what crops to take up for cultivation. Species-wise targets may be aligned with the market demand for the species.

Although the interest in cultivating medicinal plants is definitely growing in the Himalayan region, planting materials are severely limited and available quantities are not able to meet the demand. Nurseries are required in every cluster of villages in the Himalayan region and these should be supported to produce and distribute saplings to farmers who wish to cultivate medicinal plants. A special thrust should be given to utilising MAP cultivation for poverty reduction and livelihood generation in marginalised regions, and the small & marginal farmers should be supported through subsidies and agri-inputs as well as crop insurance.

v. Develop a network of growers' cooperatives, collection centres and commodity markets for the Himalayan region. The Himalayan farmer is usually a small farmer trading in small volumes, and distant from the market about which he/she has little information. This makes it difficult for an individual Himalayan farmer to reach the buyer or even attract the buyer. It also makes the farmer vulnerable to unfair trade practices. The problem of marketing is magnified due to the region's remoteness and the logistical difficulties and costs involved. The produce to market distance is 200-600 kilometres (not considering local markets) and several days away. Dependence on middle men is high and returns to producers are lower with higher leakage to middlemen; wastage and spoilage of produce and related losses are also higher. Cooperatives for medicinal plants growers in each Himalayan district could enable a collective effort by farmers for handling the marketing and logistics barriers. They would facilitate produce aggregation and collective transportation, and thereby reduce costs, wastage and leakage to middlement, and also provide strength in negotiation. If federated into an apex structure - at the regional or national level – they could also facilitate information flow and fair trade.

There is a strong need for back-end assistance by the State to growers' collectives to make them competitive and ensure quality of produce. Collection, storage and transportation support should be instituted; basic post-harvest processes (drying, cutting and packaging) should be integrated at the local level. Specialised Herbal Markets at the regional level, regulated by state-designated organisations and/or cooperatives, may further facilitate fair trade practices, with transparent grading & pricing, and even global sales, and GAP, GDP, GHP, and all necessary certification. As with commodity markets, both spot trading and forward contracts should be encouraged. Negotiated and transparent buy-back arrangements may be incentivised.

vi. Information & documentation services for farmers. Although some information services do exist today for the herbal trade sector, the actual growers are still unreached by information, and hence vulnerable to exploitation and unfair practices. The Himalayan farmers are especially distant from real time information on medicinal plants markets. Electronic herbal networks could enable real time information of prices of different species and their extracts, regional demand and supply levels, industry events, etc., and direct buyer-seller contacts. The stringent procedural and documentation formalities for trade of medicinal plant material, tend to dissuade the average Himalayan farmer from undertaking medplants cultivation. The suggested facilitation centres and regional MAP markets should assist the Himalayan farmers undertaking medicinal plants cultivation with the various procedural as well as the documentation requirements for international trade in medicinal plant material.

vii. Authentication, Testing & Certification of Produce. Authentication and quality testing of medicinal plants material is necessary for effective negotiations with buyers. But the cost of testing at both the government managed institutions and those run privately, is prohibitive; very few testing centres are besides available and none in the Himalayan region. Testing fees of medicinal plants should be subsidized for early stage growers of medicinal plants. Testing facilities also need to be established nearer to production hubs. Investing into the development of an easy field-testing method and self-certification/authentication system for use by farmers' cooperatives, is likely to yield significant benefits.

viii. Responsible Trade Networks. The creation of a Responsible Trade Network can support conformity to restrictions on wild-harvesting. Manufacturers and buyers should be encouraged to be a part of the Responsible Trade Network and exhibit their corporate social responsibility (CSR) credentials. The peer group support provided by membership in this group and the clean image promoted in the market, would become incentives for fair trade practices. Certain financial incentives are also recommended by the government for the members of this RTN in the initial period.

ix. Undertake promotion for market development and international status of Himalayan MAPs. Awareness of the efficacy of prioritised Himalayan herbs has to be built in international markets, and this would also entail work to remove the barriers to trade in developed nations. Various State and industry association need to play a role in making a strong representation and promote a global integration of traditional medicine systems with the existing mainstream healthcare system, and recognition of national systems and institutions and their certification processes. Considering post-2011 regulatory scenario, State agencies will need to undertake an aggressive drive to register high sales and priority TCAM products, and facilitate industry, especially the smaller units and growers' cooperatives, with respect to handling the international regulatory framework for exports.

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