



Assessment of medicinal and aromatic plant species on their collection, usage, demand, markets, price trends and life cycle in Lahaul and Pangi landscape, Himachal Pradesh



An outcome of the SECURE Himalaya Project

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Front cover: 1st row (top): *Fritillaria cirrhosa*, *Picrorhiza kurroa*, *Sinopodophyllum hexandrum*, *Aconitum heterophyllum* and *Bunium persicum*; 2nd row (below): *Fritillaria cirrhosa*, *Dactylorhiza hatagirea*, *Picrorhiza kurroa*, *Rheum australe* and *Aconitum heterophyllum*

Back cover: Seichu Tuan Nala Wildlife Sanctuary, Chamba

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Foreword

The Indian Himalayan Region accounts for nearly 50% of the total flowering plant species of India, of which nearly 30% species are endemic. The region is also home to several medicinal and aromatic plant species that are predominantly found in the wild at high elevations. Owing to immense natural, ecological and cultural values, collection and harvesting of these high value medicinal plants have been practiced in this region since time immemorial.

The state of Himachal Pradesh is a repository of Medicinal and Aromatic Plants (MAPs) and the immense traditional knowledge associated with the conventional utilization of these MAPs. A total of ca. 548 species have been recorded in the state and the consumption of these plants resources in day-to-day lives has been an old age practice for the local communities. However, the increased commercial demand, unorganized and over harvesting practices has caused decline in wild population of several medicinal plant species. Unfortunately, unsustainable harvesting practices, illegitimate trade, over-exploitation and overgrazing are the major threats to the survival of high value medicinal plants in the present scenario, that eventually leads to decline in its natural population, regeneration and survival.

The project report on 'Assessment of medicinal and aromatic plant species on their collection, usage, demand, markets, price trends and life cycle in Lahaul and Pangi landscape of Himachal Pradesh' aimed to study threatened medicinal and aromatic plant (MAP) species viz. *Aconitum heterophyllum*, *Aconitum heterophylloides*, *Bunium persicum*, *Dactylorhiza hatagirea*, *Fritillaria cirrhosa*, *Picrorhiza kurroa*, *Polygonatum verticillatum*, *Rheum australe*, *Rheum webbianum* and *Sinopodophyllum hexandrum* with a focus to ensure sustainable harvesting and cultivation by (i) identifying usage patterns of MAPs, and (ii) studying existing value chains. The study revealed that the major issues adversely impacting the MAP species in the Lahaul and Pangi landscape include illegal/ over/ premature/ unorganized harvesting of MAPs, high demand and non-transparent operations in the markets of MAPs. Besides these issues, few gaps such as knowledge on available stock of MAPs, lack of information on cultivation and harvesting methods of key MAP species specific to Lahaul and Pangi landscape, lack of information on end users and middlemen and inadequate information on quantity of raw material traded have been reported by the authors.

As an outcome of the SECURE Himalaya project, it's a wonderful and timely effort made by the authors to bring this report on threatened MAPs of the Himachal Pradesh, Western Himalaya. I wish them success in their future endeavours.

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Contents

Sr. no.	Chapters	Page no.
1.	Introduction	1-4
2.	Study area	5-8
3.	Materials and methods	9-10
3.1	Key Tasks 1 and 2	9
3.2	Key Tasks 3 and 4	9
3.3	Key Tasks 5 and 6	10
3.4	Key Tasks 7 and 8	10
3.5	Key Tasks 9 and 10	10
3.6	Key Tasks 11 and 12	10
4.	Results and discussion	11-104
4.1	Key Task 1: Ethno-botanical documentation of MAP species	11
4.1.1	<i>Medicinal and aromatic plant wealth of Himachal Pradesh</i>	11
4.1.2	<i>Ethno-botanical studies in Lahaul and Pangi landscape</i>	12
4.1.3	<i>Government scheme and other initiative on MAPs</i>	13
4.1.4	<i>Subsidies or Incentives</i>	13
4.1.5	<i>Cultivation, value addition and processing of medicinal and aromatic plants</i>	14
4.1.6	<i>Schemes under Himachal Pradesh Forest Department</i>	14
4.2	Key Task 2: Identify and list MAPs with significant economic end usage in the focal landscape	16
4.3	Key Task 3: Select five MAPs each in two categories	18
4.4	Key Task 4: Assessment of distribution, abundance and conservation of the listed 10 species identified as per the criteria above in the focal landscape	21
4.4.1	<i>Strategies of addressing the gaps in conservation, management and livelihood enhancement of primary collectors</i>	24
4.5	Key Task 5: Study of value chains for the ten listed species	26
4.5.1	<i>Export data of selected MAPs</i>	29
4.5.2	<i>Trade route and market chain</i>	30
4.5.3	<i>MAPs collectors in the focal landscape</i>	34
4.5.4	<i>Price of selected MAPs based on current study</i>	34
4.5.5	<i>Average fortnightly market price of selected species</i>	35

4.6	Key Task 6: Understand the role of 10 MAPs in livelihoods of respective communities and assess how businesses pertaining to these MAPs operate under the existing economic and legal framework	37
4.6.1	<i>Analysis national/state level frameworks</i>	41
4.7	Key Tasks 7 and 11: Create one pilot project to demonstrate Access and Benefit Sharing (ABS) model in the focal landscape	43
4.7.1	<i>Background and rationale</i>	43
4.7.2	<i>The context</i>	44
4.7.3	<i>The ABS Model Process</i>	44
4.7.4	<i>The Basic Information</i>	45
4.7.5	<i>Processes for ABS Model</i>	46
4.7.6	<i>Scopes for strategic collaboration between HPSBB and other existing institutions/departments/schemes</i>	50
4.8	Key Task 8 and 10: Design sustainable harvesting and collection protocols, and cultivation tools and techniques of MAPs in the focal landscape	54
4.8.1	<i>Aconitum heterophyllum</i>	56-62
4.8.2	<i>Dactylorhiza hatagirea</i>	63-67
4.8.3	<i>Bunium persicum</i>	68-73
4.8.4	<i>Sinopodophyllum hexandrum</i>	74-77
4.8.5	<i>Rheum spp.</i>	78-81
4.8.6	<i>Fritillaria cirrhosa</i>	82-87
4.8.7	<i>Polygonatum verticillatum</i>	88-92
4.8.8	<i>Picrorhiza kurroa</i>	93-97
4.9	Key Task 9: Areas of High Conservation Value	97
4.9.1	<i>Concept of Medicinal Plants Conservation and Development Area (MPCDA)</i>	97
4.9.2	<i>State of the existing Medicinal Plants Conservation Area (MPCA), legal status of the areas identified as MPCDAs</i>	97-98
4.9.3	<i>Community led initiatives</i>	104
4.9.4	<i>Development of a conservation/management strategy</i>	104
4.9.5	<i>Strategies/recommendations</i>	104-105
4.10	Key Task 11: Access and Benefit Sharing	105
4.11	Key Task 12: Hold consultative workshops with stakeholders in the focal landscape	105-106
5.	Conclusion	107-108
6.	Key recommendations	109-111
7.	References	112-124
8.	Annexures	125-159
9.	Poster (English)	160
10.	Poster (Hindi)	161

List of Figures

Sr. no.	Title	Page no.
1.	Map showing Lahaul and Pangi landscape in Himachal Pradesh	6
2.	Map showing forest cover and villages in the focal landscape	6
3.	Value chain analysis of Kadu and Kalazeera	26
4.	Trade route of <i>Fritillaria cirrhosa</i> in the Lahaul landscape	31
5.	Trade route of <i>Sinopodophyllum hexandrum</i> in the Lahaul landscape	31
6.	Trade route of <i>Picrorhiza kurroa</i> in the Lahaul landscape	31
7.	Trade route of <i>Picrorhiza kurroa</i> in Pangi (2017-2020)	32
8.	Trade route of <i>Fritillaria cirrhosa</i> in Pangi (2017-2018)	32
9.	Trade route of <i>Fritillaria cirrhosa</i> in Pangi (2018-2019)	33
10.	Trade route of <i>Fritillaria cirrhosa</i> in Pangi (2019-2020)	33
11.	Trade route of <i>Fritillaria cirrhosa</i> in Pangi (2020-2021)	34
12.	Average fortnightly market price of <i>Picrorhiza kurroa</i> in the major markets of India	35
13.	Average fortnightly market price of <i>Sinopodophyllum hexandrum</i> in the major markets of India	36
14.	Average fortnightly market price of <i>Rheum australe</i> in the major markets of India	36
15.	Average fortnightly market price of <i>Aconitum heterophyllum</i> in the major markets of India	37
16.	Sustainable harvesting and collection framework	54
17.	Map showing Chasak bhatori as a potential MPCDA	99
18.	Map showing Hudan bhatori as a potential MPCDA	99
19.	Map showing Sural bhatori as a potential MPCDA	100
20.	Map showing Hadsar as a potential MPCDA	100
21.	Map showing Kadu nalah as a potential MPCDA	101
22.	Map showing Thanpattan as a potential MPCDA	101

List of Tables

Sr.No.	Title	Page no.
1.	Proposed key tasks of the study	4
2.	Major projects on MAPs in Himachal Pradesh	15
3.	List of MAPs with significant economic end usage in Lahaul and Pangi	17
4.	Selected MAPs in the Lahaul and Pangi landscape	18
5.	Details on the potential source areas, distribution, collection pressure and impact on survival of selected MAP species	21
6.	Habitats, nativity and threat status of selected MAP species	22
7.	Density of selected species in Himachal Pradesh and Uttarakhand	23
8.	Abundance of selected MAPs based on populations (including Lahaul and Pangi) studied in Himachal Pradesh	24
9.	Value addition in the final product from raw medicinal plant	27
10.	Export data of selected MAPs in Pangi	29
11.	Average market price (Rs. /kg \pm SE) of MAPs	35
12.	Ethno-botanical information of the selected species	40
13.	Existing harvesting and collection protocols of selected MAPs	55
14.	Price of <i>Aconitum heterophyllum</i> in different markets	59
15.	Price of <i>Aconitum heterophyllum</i> in various raw drug markets	60
16.	Price of <i>Bunium persicum</i> in various raw drug markets	71
17.	Price of <i>Fritillaria cirrhosa</i> in various raw drug markets	86
18.	Proposed Medicinal Plants Conservation and Development Areas in Lahaul	99
19.	Location of Medicinal Plants Conservation and Development Areas in Lahaul	99
20.	Proposed Medicinal Plants Conservation and Development Areas in Pangi	100
21.	Location of Medicinal Plants Conservation and Development Areas in Pangi	100

List of Plates

Sr. no.	Title	Page no.
1.	Pangi valley: (a) A spectacular view of an alpine meadow in Chasak Bhatori (Seichu valley), (b): <i>Betula</i> forest in Hudan Bhatori and (c): Majestic view of Sural valley	7
2.	Lahaul valley: (a) Enchanted view of Chandrabhaga river, (b) Hamlet at Miyar valley, (c) An adhwari amidst coniferous forest enroute Hadsar	8
3.	Selection of species based on 'High Threat Perception'	19
4.	Selection of species based on 'High Quantum of Collection'	20
5.	Field team exploring MAPs in the focal landscape	25
6.	<i>Sausurrea costus</i> (Kuth) cultivation in Miyar valley, Lahaul	42
7.	A village setup along with the Chandrabhaga river, Lahaul valley	43
8.	Selected species (wild) for ABS mechanism	52
9.	Selected species (cultivated) for ABS mechanism	53
10.	<i>Aconitum heterophyllum</i> plant and its parts	56
11.	Market samples of <i>Aconitum heterophyllum</i>	59
12.	<i>Dactylorhiza hatagirea</i> plant and its parts	63
13.	<i>Bunium persicum</i> plant and its parts	68
14.	Market samples of <i>Bunium persicum</i>	71
15.	<i>Sinopodophyllum hexandrum</i> plant and its parts	74
16.	<i>Rheum</i> species, plant and its parts	78
17.	<i>Fritillaria cirrhosa</i> plant and its parts	82
18.	<i>Fritillaria cirrhosa</i> bulbs carried by a local collector	85
19.	<i>Polygonatum verticillatum</i> plant and its parts	88
20.	<i>Picrorhiza kurroa</i> plant and its parts	92
21.	Stakeholder consultative workshops held in Lahaul and Pangi landscape	104

List of Annexures

Sr. no.	Title	Page no.
1.	Details of stakeholder consultative workshops and internal review meetings held under the SECURE Himalaya Project	123
2.	List of number of permits/collectors/traders of the MAPs in Pangi landscape	124
3.	Number of permits/collectors/traders of the MAPs in Lahaul	126
4.	Potential BMCs in Lahaul and Pangi landscape	127
5.	Potential natural bio-resources under trade in Lahaul and Pangi landscape	129
6.	Bio-resource based industrial units in Himachal Pradesh	130
7.	List of traders and exporters in Himachal Pradesh	135
8.	High trade medicinal plant species with sizeable wild populations in Himachal Pradesh	137
9.	List of manufacturers in Himachal Pradesh	139
10.	Export of tradable commodities from Himachal Pradesh	144
11.	List of traders/collectors for four MAP species for ABS in Lahaul and Pangi landscape	145
12.	List of participants in the consultative workshops in Lahaul	155
13.	List of participants in the stakeholder consultative workshop in Killar, Pangi	156
14.	List of participants in the stakeholder consultative workshop in Keylong, Lahaul	158

Abbreviations

ABS:	Access and Benefit Sharing
AVM:	Aushadhi Vanaspati Mitra Program
AYUSH:	The Ministry of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy
BDA:	Biological Diversity Act
BMCs:	Biodiversity Management Committee
CBD:	Convention on Biological Diversity
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CUG:	Community User Group
FD:	Forest Division
FDA:	Forest Development Agencies
FRLHT:	Foundation for Revitalization of Local Health Traditions
GHNP:	Great Himalayan National Park
HPFD:	Himachal Pradesh Forest Department
IEC:	Information Education and Communication
IHR:	Indian Himalayan Region
ITH:	Indian Trans-Himalaya
JFMCs:	Joint Forest Management Committee
MAPs:	Medicinal and Aromatic Plant species
MAT:	Mutually Agreed Terms
MOEFCC:	Ministry of Environment, Forest and Climate Change
MP:	Medicinal Plants
MPCDA:	Medicinal Plants Conservation and Development Area
NMPB:	National Medicinal Plants Board
NP:	National Park
NTFP:	Non-timber Forest Produce
PBR:	People's Biodiversity Register
PIC:	Prior Informed Consent
RCFC:	Research-Cum-Facilitation Centre
SGSY:	Swarnajayanti Gram Swarozgar Yojana
SHGs:	Self Help Groups
SMPB:	State Medicinal Plant Board
WLS:	Wildlife Sanctuary

Executive Summary

Nested in the Western Himalaya, the state of Himachal Pradesh (30° to 33°N and 75° to 79° E) is known for its rich biological diversity. It covers an area of 55,673 km² with >3,300 distinct plants species. Interestingly, the alpine areas of Lahaul and Spiti are one of the major hot spots of wild MAPs in the Western Himalaya. Unfortunately, the remote valleys such as Lahaul, Pangi, Spiti, Kinnaur including micro-watersheds lying in the cold-arid regions of Himachal Pradesh are relatively less studied in terms of available growing stock and population status of MAPs. Notably, there is a general lack of literature on medicinal plants at the catchment, watershed and valley levels. Further, the information on recent levels of trade of MAPs are available only from a few localities of the Western Himalaya. Like other areas, these areas have also been facing additional stress due to over-exploitation of forest resources, including the unscientific and premature harvesting of MAPs from the wild, which functions parallel to the illegal and hidden markets thus, putting tremendous pressure on the wild resource base resulting in the dwindling populations and precarious livelihoods of local communities. The rising demand of herbal products has caused excessive harvesting of many of the important MAPs from these regions, putting their wild population at the risk of extinction. Keeping aforementioned aspects in view, the current study was proposed which aims to study selected Medicinal and Aromatic Plant (MAP) species in Lahaul and Pangi landscape of Himachal Pradesh with focus to ensure sustainable harvesting and cultivation by (i) identifying usage patterns of MAPs, and (ii) studying existing value chains. In order to address the project objectives, the present study has been categorized into 12 key tasks.

The current study revealed that the major issues adversely impacting the MAP species in the Lahaul and Pangi landscape include illegal/ over/ premature/ unorganized harvesting of Medicinal and Aromatic Plants (MAPs), high demand and non-transparent operations in the markets of MAPs. Besides these issues, few gaps such as knowledge on available stock of MAPs, lack of information on cultivation and harvesting methods of key MAP species specific to Lahaul and Pangi landscape, lack of information on end users and middlemen and inadequate information on quantity of raw material traded have been reported.

In order to optimize the benefits to the local communities and adopt the concepts of sustainable harvesting and benefit sharing, it is important to assess the availability, market trends and methods for collection of MAPs including gathering information on population of selected MAPs. This will help in identifying High Conservation Value Areas (HCVAs) and delineating MPCAs for *in-situ* conservation in the landscape.

Additionally, identification of large traders and industries that acquire their raw materials from Lahaul and Pangi will strengthen the implementation of Access and Benefit Sharing model on pilot basis. Furthermore, identification of hidden markets viz., local, regional and national, price trends, value addition and strengthening BMCs will help in sustainable management of MAPs in the landscape. The first step towards conservation is identifying the existing population base, and information on the species distribution and abundance. Identification of the best cultivation practices, R&D to reduce long-gestation periods, cost effective technology, organic-farming, buy-back mechanisms, policy-revision in the interest of stakeholders, protocols for post-cultivation management, quality-control and awareness training are some measures in this direction. It can be concluded that in order to optimize the benefits to the local communities, and to adopt the concepts of sustainable harvesting and benefit-sharing, it is important to assess the availability, market trends and methods for collection of MAPs, including gathering information on population of selected MAPs. A major step towards species conservation can be spreading awareness on the dwindling populations amongst the stakeholders. It is also important to identify alternative sources of income for the locals to create in them confidence that wild harvest of MAPs was not the only source of cash income and, thus to dissuade them from ruthless wild harvest and to make them participate in conservation programs. Identifying and building the capacities of stakeholders including the forest officials, locals, school children, traditional healers and plant traders can help in community based natural resource management. These issues need to be addressed to ensure long-term conservation of the MAP resources of the landscape in a way that livelihood needs of the local communities depending on this resource are not compromised. The following key recommendations have emerged after this study:

- ❖ Documentation of the Conservation Status of Key MAPs
- ❖ Setting aside Conservation Areas around Viable Populations of Priority MAPs
- ❖ Strengthening of Biodiversity Management Committees (BMCs)
- ❖ Value addition by adopting best Post-Harvest Management Techniques
- ❖ Developing Farm-scale Agro-Techniques for Priority MAP Species
- ❖ Developing Germplasm Banks of the Priority MAP Species
- ❖ Study and Monitor Impacts of Climate Change

1. Introduction

The high range Himalayan ecosystem is of critical importance for the biodiversity and ecosystems of global significance. It forms an important life-support system for a large number of remote and agro-pastoral communities. This region represents a mosaic of pluralistic diversity - a composite of myriad human cultures and linguistic diversity including a number of tribal communities whose relative seclusion and remoteness has made them the last bastions of globally significant indigenous knowledge and cultural heterogeneity. The Indian Himalayan Region (IHR) constitutes a complex geo-botanical landscape as a result of long-term climatic oscillations. IHR is one of the globally important biodiversity hotspots from the standpoint of its exceptional biodiversity, habitat heterogeneity and sharp environmental gradients (Myers et al. 2000). It is represented by five states, viz., Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh. Considering the unique floristic diversity, fauna and geology, the IHR has been classified into two bio-geographical zones viz., The Trans-Himalaya (zone 1) and The Himalaya (zone 2) and, eight biotic provinces viz., 1A, 1B, 1C, 1D, 2A, 2B, 2C and 2D covering Ladakh, Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh (Rodgers et al. 2000; Kumar et al. 2017). Subsequently, owing to immense natural, ecological and cultural values, this region accommodates 28 National Parks, 99 Wildlife Sanctuaries and five Biosphere Reserves (National Wildlife Database, Wildlife Institute of India). It also includes four UNESCO World Heritage Sites such as, Great Himalayan National Park Conservation Area and Nanda Devi and Valley of Flowers National Parks in the Western Himalaya and Manas Wildlife Sanctuary, and Kanchenjunga Nnal Park in the Eastern Himalaya (www.whc.unesco.org). Additionally, presence of 21 vegetation types, 10 forest types and 11 forest formations in the region is a manifestation of the rich floral diversity (Dhar, 2002).

IHR accounts for nearly 50% of the total flowering plant species of India, of which, nearly 30% species are endemic. The region is also home to many medicinal and aromatic plants species (MAPs) that are predominantly found in the wild at high elevations. It harbours about 1748 species of medicinal plants that includes 1685 angiosperms, 12 gymnosperms and 51 pteridophytes (Samant, 1998); 675 species of wild edible plants (Samant and Dhar, 1997); 279 species of fodder plants (Samant et al. 1998a); 118 species of essential oil yielding medicinal plants (Samant and Palni, 2001) and 155 species of sacred plants (Samant and Pant, 2003). The locals conventionally depend on the traditional medicinal system such as Amchi system (Sowa-Rigpa) of medicine (Namgyal and Phunstong, 1990). Of the total medicinal plants recorded in IHR, about 707 species have been recorded in Sikkim and Darjeeling followed by 701 species in Uttarakhand and about 548 species were identified in Himachal Pradesh, though estimates

range in between 1000 to 1200 species (Badola and Aitken, 2003). Interestingly, species richness of medicinal plants per km² of forestland coverage has also been recorded highest for Sikkim and Darjeeling and fourth in Himachal Pradesh (Badola and Aitken, 2003). Recently, Tali et al. (2019) developed a comprehensive database of 1123 medicinal plant species with practised ethno-medicinal uses in Jammu & Kashmir, North-West Himalaya.

The Indian Trans-Himalaya (ITH) falling in the rain shadow zone of the IHR, has comparatively less albeit unique floral diversity. Kala (2001) estimates that there are over 600 flowering plants and different species of graminoids in this region, many with significant ethno-botanical value as medicinal plants, fuel and forage for livestock. Murti (2001) has enlisted 347 species (102 endemic species) of monocots from the Western Himalaya. Srivastava & Shukla (2015) enlisted 1195 species of dicots, gymnosperms and pteridophytes from the Trans-Himalaya of the Western Himalaya. ITH region is characterized by severe winters lasting over six months and a short plant growth season of merely two to three months when productivity is usually low. These harsh climatic and topographic conditions have given rise to hardy, highly adapted flora, fauna and people (Bhatnagar et al. 2001). The landscape consists of sparsely vegetated steppes, small patches of moist sedge meadows near water bodies and vast areas that are barren and under glaciers. These areas are the headwaters of many major rivers of northern India. This region is also a significant centre of distribution for the globally endangered snow leopard (*Uncia uncia*) listed under Appendix I (i.e., species threatened with extinction) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In spite of the overall low species of plants and animals in the ITH, the region is home to an array of highly specialized assemblage of flora and fauna. As per Samant et al. (1998), the region has about 350 species of medicinal plants that are used by the Indian herbal drug industry. Most of these species are collected from the wild, and thus, their conservation is the key to the survival of the species. Murti (2001) has enlisted 115 species of medicinal value from the region. Chauhan (1988, 1989, 1990, 1996, 1999), Jain (1991), Bhattacharya and Uniyal (1982), Rai et al. (2000) have done extensive studies on MAPs of the region. Goraya and Ved (2017) enlisted 36 Himalayan medicinal plant taxa that are in high commercial demand by the herbal industries.

Nested in the Western Himalaya, the state of Himachal Pradesh (30° to 33°N and 75° to 79° E) is known for its rich biological diversity. It covers an area of 55,673 km² with >3,300 distinct plants species (Rana and Rawat, 2017). Based on extensive floristic studies, a number of workers have documented plant species richness of Himachal Pradesh. For example, in an extensive floristic inventORIZATION, Chowdhery and Wadhwa (1984) published 'Flora of Himachal Pradesh' in three volumes with a comprehensive list of 3200 species of flowering plants. Aswal and Mehrotra (1994) published a comprehensive account of

the flowering plants (985 species under 353 genera) of Lahaul and Spiti, representing semi-arid and cold desert areas of the state. Singh and Rawat (1999) documented 832 species of vascular plants belonging to 427 genera under 128 families from the Great Himalayan National Park. Sekar and Srivastava (2009) enlisted 513 species of vascular plants from Pin valley. Chawla et al. (2012) reported 911 species of vascular plants belonging to 881 species of angiosperms and gymnosperms distributed among 102 families and 433 genera and 30 species of pteridophytes from Kinnaur. According to Rawat (2007), the alpine areas of Lahaul and Spiti are one of the major hot spots of wild MAPs in the Western Himalaya. Unfortunately, these remote valleys such as Lahaul, Pangi, Spiti, Kinnaur lying in the cold-arid regions of Himachal Pradesh are relatively less studied in terms of floristics and MAPs diversity. The information on recent levels of trade of MAPs are available only from a few localities of the Western Himalaya (Rawat 2007). Like other areas, these areas have also been facing additional stress due to over-exploitation of forest resources, including the unscientific and premature harvesting of MAPs from the wild, which functions parallel to the illegal and hidden markets thus, putting tremendous pressure on the wild resource base resulting in the dwindling populations and precarious livelihoods of local communities (Kala, 2000; Mathela et al. 2020). The rising demand of herbal products has caused excessive harvesting of many of the important MAPs from these regions, putting their wild population at the risk of extinction. Keeping aforementioned aspects in view, the current study was proposed which aims to study selected Medicinal and Aromatic Plant (MAP) species in Lahaul and Pangi landscape of Himachal Pradesh with focus to ensure sustainable harvesting and cultivation by (i) identifying usage patterns of MAPs, and (ii) studying existing value chains. In order to address the project objectives, the present study has been categorized into 12 key tasks (Table 1).

Project activities

Aim	<ul style="list-style-type: none">• To ensure sustainable harvesting and cultivation of Medicinal and Aromatic Plant (MAP) species
Objectives	<ul style="list-style-type: none">• Identify usage patterns of MAPs• Study existing value chains
Approach	<ul style="list-style-type: none">• 10 Medicinal and Aromatic Plant Species• 12 Key Tasks

Table 1. Proposed key tasks of the study

Sr.no.	Key Tasks
1.	Ethno-botanical documentation of MAP species
2.	Identify and list MAPs with significant economic end usage in the landscape
3.	Select five MAPs each in two categories
4.	Assessment of distribution, abundance and conservation of the listed ten species identified as per the criteria above in the landscape
5.	Study of value chains for the ten listed species
6.	Understand the role of ten MAPs in livelihoods of respective communities and assess how businesses pertaining to these MAPs operate under the existing economic and legal framework
7.	Create one pilot project to demonstrate Access and Benefits Sharing (ABS) model in the project landscape
8.	Design sustainable harvesting and collection protocols
9.	Areas of high conservation value
10.	Cultivation tools and techniques of MAPs in respective landscape
11.	Access and Benefit Sharing (ABS)
12.	Hold consultative workshop with stakeholders

2. Study area

The Lahaul and Pangi landscape lies between the Dhauladhar-Pir Panjal and Zaskar ranges in Himachal Pradesh in the upper catchment of Chandrabhaga (Chenab) forming a transition zone between the Greater and Trans-Himalaya. This landscape is contiguous with Doda and Zaskar region of Jammu and Kashmir in the North and spread over an area of nearly 8000 km². The landscape is mostly tough, mountainous, dotted with a number of remote valleys. The lowest elevational limit of Pangi is ca. 2000m at Sansari Nala and ranges over to 6,000m comprising the lofty peaks adjacent to the Zaskar range. Beautiful valleys in Pangi include Sural, Hudan, Seichu and Parmar, the way through which leads to Zaskar range (**Plate 1**). Biogeographically, Pangi landscape falls in the transition zone of the Greater Himalaya and the Trans-Himalaya. Pangi is a remote, rugged and poorly developed tribal area. One of the reasons for its remoteness is rugged topography cut into deep gorge by river Chenab that flows initially in the western and subsequently north-westerly direction. Much of the landscape lies in the rain shadow zone of Pir Panjal having scanty rainfall (<800 mm) and relatively high snowfall. Lahaul valley comprises of two major tributaries of the Chenab River viz., Chandra and Bhaga (**Plate 2**).

The region has crystalline high mountains interspersed with lush pastures that remain the favorite grounds for the nomadic Gaddi herders of lower Himachal Pradesh. While Pangi lies in the north-west of Himachal Pradesh bordering J&K, Kinnaur is in the east bordering Uttarakhand and China. Pangi is positioned approximately between 32°11'30"-33°13'06"N and 75°45'~77°03'33"E. There are 16 panchayats and 54 inhabited villages in Pangi tehsil. The area of Pangi tehsil is spread over 1601 km² with a population 18,868 (Census 2011). Lahaul lies between 32°61'92" N and 77°37'84" E. There are 132 villages with the population of approx. 10,199 (Census 2011). Location of the focal landscape i.e., Lahaul and Pangi in Himachal Pradesh along with forest cover and villages are shown in **Figure 1 and 2**.

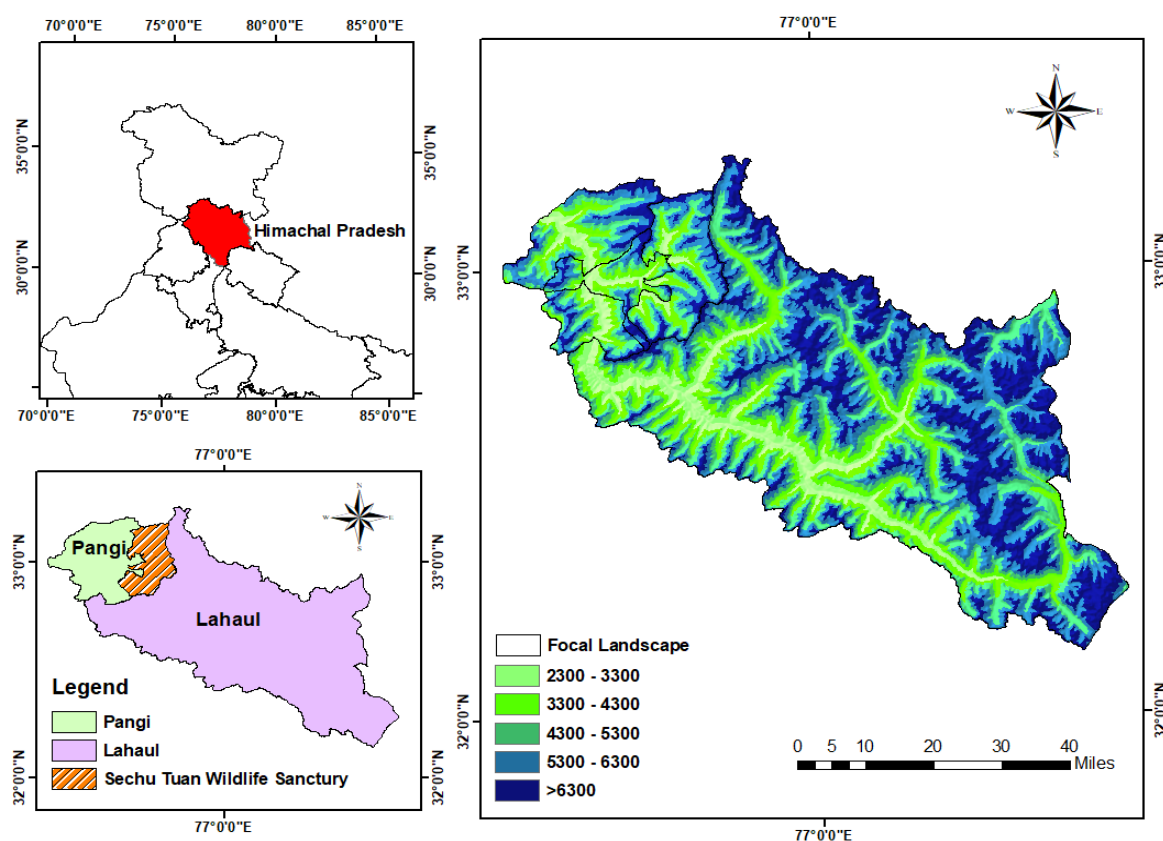


Figure 1: Map showing Lahaul and Pangi landscape in Himachal Pradesh.

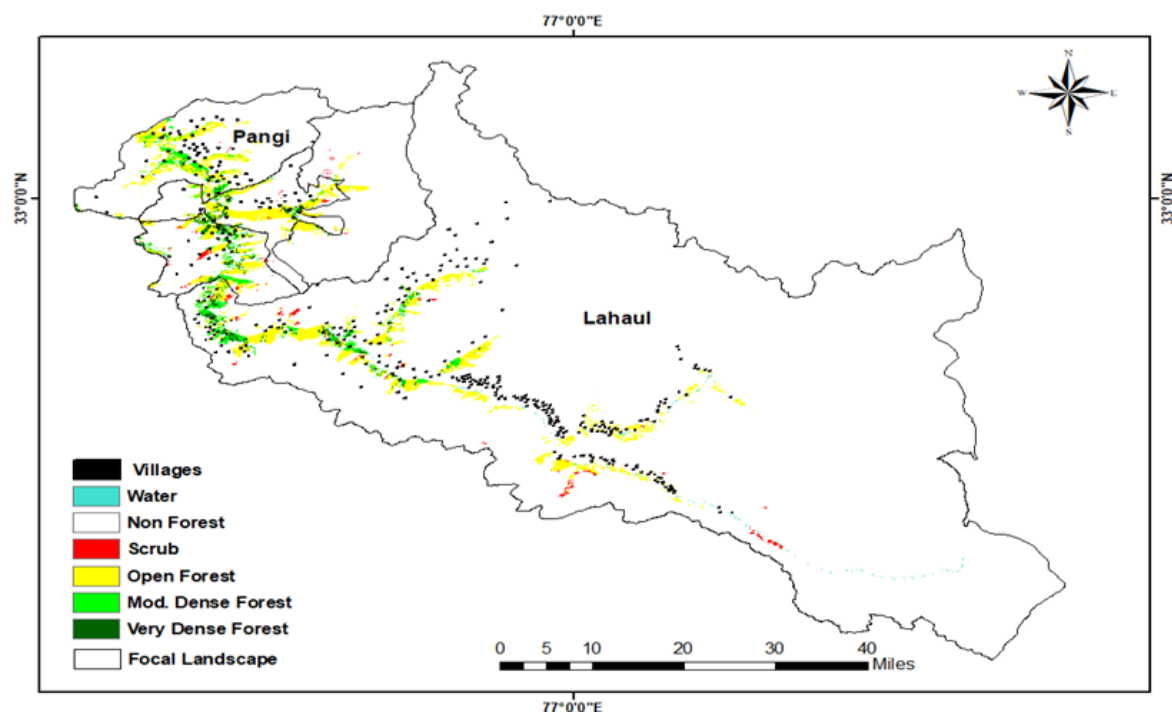


Figure 2: Map showing forest cover and villages in the focal landscape.



Plate 1: Pangi valley: (a) A spectacular view of an alpine meadow in Chasak Bhatori (Seichu valley); (b): *Betula* forest in Hudan Bhatori and (c): Majestic view of Sural valley. 📷 Amit Kumar



Plate 2: Lahaul valley: (a) Enchanted view of Chandrabhaga river Monika Sharma; (b) Hamlet at Miyar valley Amit Kumar; (c) An adhwari amidst coniferous forest enroute Hadsar. 📷 Amit Kumar

3. Materials and Methods

Consultative stakeholder workshops were conducted at the Himalayan Forest Research Institute (HFRI), Shimla which helped in selection of 10 MAP species for the present study. To complete the proposed 12 key tasks under this project, information was collected through primary and secondary sources. The primary data was collected using semi-structured open-ended and closed-ended questions including individual interactions and group discussions. Surveys were carried out in selected villages and markets in the focal landscape. The selected villages in Lahaul include seven villages namely, Khanjar, Salgran, Gaigot, Tindi, Udaipur, Urgos and Thanpattan and 11 villages namely, Sural Bhatori, Hundan Bhatori, Chasak Bhatori, Killar, Mindhal, Sechu, Ghisal, Kuthal, Sach, Dharwas and Karyas in Pangi. Information by an average of 15 (20) respondents from each village based on age, education and experience was documented. Women were specifically encouraged to share their views and information. The secondary information was gathered from offline and online sources such as scientific research articles, reports, books, dissertations, PhD thesis and using numerous databases, such as google scholar, researchgate, Taylor and Francis online, springer-link followed by a visit to various research institutions in the state and HP Forest Department, HP State Biodiversity Board, HP Medicinal Plant Board and Line Departments. The project objectives and corresponding methods linked to the key tasks have been addressed as follows:

3.1 Key Task 1 and Key Task 2

- Literature review by consulting reports, research papers, documents and other published literature.
- Collate secondary information from published literature and primary data from field using structured questionnaire.
- Collate and analyze the available data on cultivation of MAPs among SFDs, NGOs and research institutions.

3.2 Key Task 3 and Key Task 4

- Consultation with different stakeholders.
- Literature review for secondary information on baseline, livelihood status with special focus on focal species contribution; develop data collection formats; visit collection sites.
- Identify traditional and modern tools techniques and procedures associated with propagation and cultivation of MAPS; highlight the best practices.

3.3 Key Task 5 and Key Task 6

- Detailed field surveys to identify and list MAPs of significant economic end usage.
- Identify industries that are currently accessing MAPs from the project landscape.
- Suggest package of practices for the focal species for adoption in the landscape and SFD.

3.4 Key Task 7 and Key Task 8

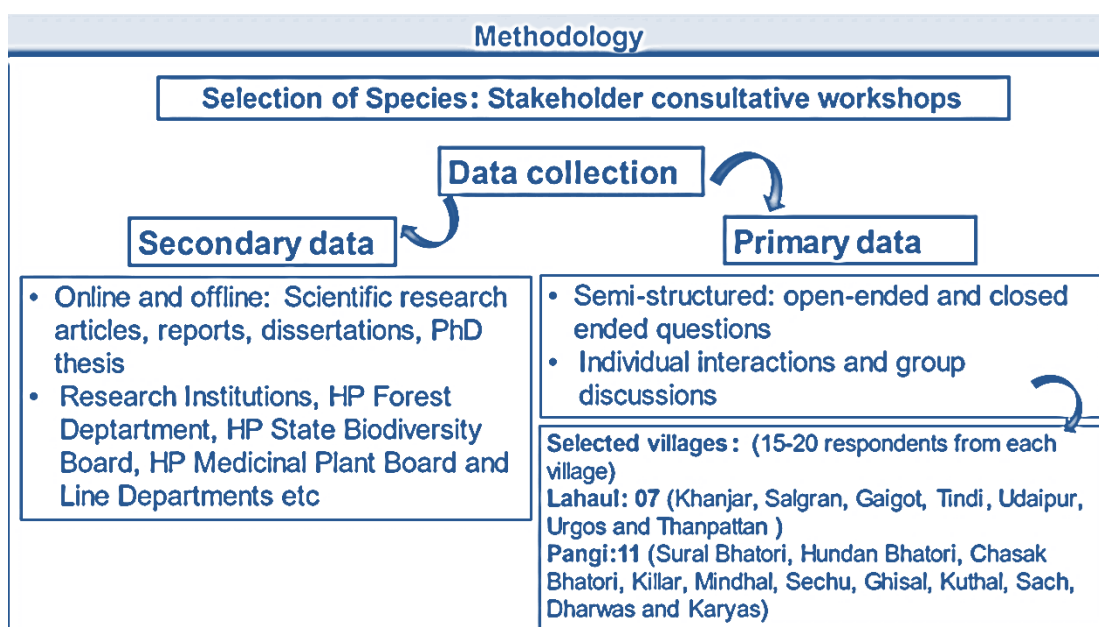
- Examine distribution and abundance data of focal species and develop interim distribution maps.
- Collate information on prevailing harvesting techniques from published literature and field sources by using structured questionnaire.
- Prepare draft report highlighting the key findings and lessons from the project and design workshop sessions and plan for the event.

3.5 Key Task 9 and Key Task 10

- Primary data collection through field studies for select data deficient species.
- Analyses of focal species data on distribution, threat intensity, and other ecological & social-economic parameters.
- Conduct the workshop with stakeholder groups (40-50 members) to discuss the findings including identification of tentative potential ABS cases.

3.6 Key Task 11 and Key Task 12

- Hold consultations with forest officials, local subject experts and scientists.
- Evaluation of sites and document the program proceedings; highlight the key points discussed and recommendations during the workshop.



4. Results and discussion

4.1 Key Task 1: Ethno-botanical documentation of MAP species

The IHR is home to many medicinal and aromatic plants that are predominantly found in the wild at high elevations. Of the 30,000 known medicinal plant species of the world, about 8,000 are reported in India (Kumar and Katakam, 2002). In India, utilization of plants for medicinal purposes has also been documented in ancient texts (Charak and Bala, 1996). Several workers have explored the country in terms of medicinal plant diversity such as Shiva (1996) concluded that of the 17,000 species of higher plants reported from India, ca. 7500 are known to have medicinal uses. Ved (2008) reported that about ca. 6000 species have medicinal value that contributes about 34% of the total plant wealth of the country. The locals conventionally depend on the traditional medicinal system or Amchi system (*Sowa-Rigpa*) of medicine (Namgyal and Phunstong, 1990). IHR harbours about 1748 species of medicinal plants that includes 1685 angiosperms, 12 gymnosperms and 51 pteridophytes (Samant, 1998); 675 species of wild edible plants (Samant and Dhar, 1997); 279 species of fodder plants (Samant et al. 1998); 118 species of essential oil yielding medicinal plants (Samant and Palni, 2001) and 155 species of sacred plants (Samant and Pant, 2003).

4.1.1 Medicinal and aromatic plant wealth of Himachal Pradesh

Documentation of MAPs from the Himachal Pradesh started with a contribution of Chopra et al. (1956), who provided a detailed account on the distribution and indigenous uses of 1200 medicinal plants of the state. Later, Chauhan (1984) collected 738 species (649 dicots and 89 monocots) of MAPs belonging to 107 families from Pabbar valley, Shimla. Gupta (1998) explored Churdhar and Rohtang regions and reported a total of 195 species of MAPs belonging to 139 genera under 53 families. Chauhan (1988) identified 50 MAPs that are facing commercial exploitation. Also, 20 plant species have been suggested which are exterminating in their natural habitats. According to Chauhan (1999), Himachal Pradesh supports 700 MAPs. Based on a review, Badola (2001) reported a total of 360 medicinal plants species belonging to 246 genera under 111 families from Himachal Pradesh. Subsequently, as a result of survey carried out in Himachal Pradesh, Sharma et al. (2003) listed 22 commercially important MAPs in terms of their distribution pattern, marketability and local uses. Nilay (2004) reported 403 species of MAPs belonging to 311 genera and 101 families from Nahan. Viraj (2005) collected a total of 253 species of MAPs belonging to 171 genera and 61 families between 1800m (Karcham) to 4800m (Chitkul kanda) amsl in Sangla valley, Himachal Pradesh. According to Meenakshi (2006), 376 species of MAPs belonging to 228 genera under 87 families are found in Kinnaur Forest Division. Chauhan (2006)

documented ca. 376 species of MAPs in Kinnaur Forest Division, Kinnaur. Shivani (2007) reported 215 species belonging to 185 genera under 56 families from Kamlah Range, Jogindernagar Forest Division. Samant et al. (2007) identified a total of 643 species of medicinal plants from Himachal Pradesh. Ranjan (2009) reported 263 species belonging to 183 genera under 83 families from Dodra-Kawar, Shimla. According to Urvashi (2009), Daranghati Wildlife Sanctuary harbors a total of 214 species of MAPs belonging to 168 genera under 78 families. Rana and Samant (2011) recorded a total of 270 species of medicinal plants belonging to 197 genera under 84 families from Manali Wildlife Sanctuary. Samant et al. (2011) reported 36 species (32 genera under 28 families) representing trees (18 species), herbs (08 species) shrubs (07 species) and ferns (01 species) that were used for curing cancer by the local inhabitants of Himachal Pradesh. Sharma and Shamant (2014) reported 402 species of medicinal plants belonging to 266 genera under 98 families from Parbati valley. Sharma et al. (2014) explored Banjar valley, Kullu and recorded 357 species of medicinal plants belonging to 237 genera under 98 families. An inventory of medicinal plant species in Kalatop-Khajjiar Wildlife Sanctuary, Chamba reported a total of 239 species belonging to 185 genera under 85 families (Kumar et al. 2018). Kumari et al. (2018) identified 400 species of medicinal plants belonging to 303 genera under 111 families from the central Himachal Pradesh. Devi et al. (2019) reported 390 species of medicinal plants belonging to 241 genera under 89 families in Kanawar Wildlife Sanctuary, Kullu. Rana et al. (2019) recorded 83 species belonging to 75 genera and 49 families having ethno-botanical uses in Churah sub-division, Chamba. Singh et al. (2019) reported 120 species belonging to 61 families of MAPs from Chopal Forest Division. Recently, Rana et al. (2020) reported 78 medicinal plant species belonging to 47 families that cure 13 human ailments in Churah subdivision, Chamba.

4.1.2 Ethno-botanical studies in Lahaul and Pangi landscape

Himachal Pradesh is a repository of MAPs and, the immense traditional knowledge associated with the conventional utilization of these plants. Consumption of plants resources in day-to-day lives has been an old age practice for the local communities. For example, as per Srivastav et al. (1991) 41 ethno-botanical species were utilized by Gaddi, Swangla and Bhot tribes in Lahaul and Spiti, Himachal Pradesh. Gupta (1991) also made collection of folk medicines in Himachal Pradesh, covering parts of Lahaul valley. Singh and Kumar (2000) worked on ethno-botanical wisdom of *Gaddi* tribes in the Western Himalaya. Sood et al. (2001) carried out an extensive study on ethno-botanical wealth of 133 villages in Lahaul and Spiti. According to Sharma and Lal (2005), the agro-pastoral communities still depend on household remedies for healthcare. As per Thakur (2007), Pangi landscape supports 241 species of medicinal plants belonging to 151 genera under 56 families. In an extensive ethno-botanical survey of cold desert of Ladakh and Lahaul & Spiti, Chaurasia et al. (2007) observed that 35% of total flora has medicinal value.

The widely used medicinal plants include *Acotinum heterophyllum*, *Colchicum luteum*, *Dactylorhiza hatagirea*, *Ephedra gerardiana*, *Hippophae rhamnoides*, *Inula racemosa*, *Rheum webbianum* and *Saussurea lappa* in the traditional systems of Indian medicine including Sowa Rigpa system (Amchi system). Sarin (2007) enumerated plant species of economic importance in Lahaul and observed their extensive use in pharmaceutical and cosmetic industries. Samant et al. (2007) identified a total of 643 species of medicinal plants from Himachal Pradesh including Lahaul and Pangi landscape. Sharma et al. (2008) enumerated medicinal plants of Lahaul and Spiti. Jishtu and Goraya (2008) identified six unique habitats such as moist meadows, Juniper woodland and sub-alpine scrub, alpine dry scrub, alpine mixed communities and riverine scrub with respect to medicinal taxa of high conservation significance in cold deserts of Lahaul and Spiti. Singh et al. (2009) recorded 354 species of medicinal plants belonging to 208 genera under 76 families in Lahaul valley. Sharma et al. (2011) recorded a total of 354 species of MAPs belonging to 208 genera and 76 families in Lahaul valley. Prakash et al. (2018) reported 17 species of medicinal orchids belonging to 11 genera from Pangi landscape. Recently, Kumar et al. (2020) documented 31 threatened medicinal plants from forested and moist shady habitat of Lahaul valley.

4.1.3 Government schemes and other initiatives on MAPs

The Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Government of India under its centrally sponsored scheme of National AYUSH Mission (NAM) has been providing financial assistance as subsidy to farmers to encourage cultivation of herb or medicinal plants throughout the country. Presently, 140 medicinal plants species have been prioritized for supporting cultivation throughout the country for which the subsidy is provided to farmers. The main components of the scheme includes (i) Medicinal Plants Conservation and Development Areas (MPCDAs), (ii) Engaging eco-task force for rehabilitation of critical medicinal plant habitats, support to Joint Forest Management Committees/Panchayats/Van Panchayats/Self Help Groups/Biodiversity Management Committees (BMCs) for setting of local cluster for value addition, drying, warehousing and augmenting marketing infrastructure, etc (iii) Awareness building, exposure visits, education and capacity building of stakeholders through information education and communication and (iv) Aushadhi Vanaspati Mitra Program.

4.1.4 Subsidies or Incentives

- (i) State Medicinal Plant Board: Technical hand holding, nursery, drying yards, primary processing facilities, storage warehouses and other assistance (financial & technical) as per National AYUSH Mission (NAM) guidelines.
- (ii) Research-cum-facilitation centre (RCFC): National Medicinal Plants Board, Ministry of AYUSH, Government of India has approved the establishment of RCFC-Northern Region at Research

Institute in Mandi district with a grant of INR 149.60 lakhs per annum for a period of five years. The RCFC will be vital for infusing an element of entrepreneurship among exiting medicinal plants growers/farmers apart from inspiring youth to engage in this activity.

4.1.5 Cultivation, value addition and processing of medicinal and aromatic plants

Under Swarnajayanti Gram Swarozgar Yojana (SGSY), the Government of India has approved a project title “skill development of rural youth through grameen labs” for the state. A total project cost of INR 250 lakhs per project. This scheme is 100% centrally sponsored. Under this scheme, 5000 rural youths will be trained as per their requirement.

4.1.6 Schemes under Himachal Pradesh Forest Department

(i) Van Smaridhi Jan Samridhi

A scheme to enhance economic returns to the rural households engaged in collecting and selling of non-timber forest produce (NTFP) including medicinal plants through interventions at strengthening the wild NTFP resources base and improving post-harvest handling, value addition and marketing. The major components of the schemes are:

- (a) Identification and formation of Community User Group (CUGs): Identification and formation of CUGs by the Biodiversity Management Committees (BMCs) and formation of clusters for capacity building and other works.
- (b) Allocation of forest areas to CUGs: Allocation of forest areas to each CUG and involving them in NTFP resources strengthening in the allocated forest areas.
- (c) Multi-layered augmentation plantations to strengthen NTFP resource base: Strengthening of the resource base of NTFPs by CUGs in identified forest areas in vicinity, through multi-layered augmentation plantation/cultivation of native NTFP and medicinal species.
- (d) Harvesting, post-harvest handling and developing marketing facilities: Standardizing wild harvest and post harvest handling methods viz. cleaning, drying, grading, packaging, certification for select NTFP species and setting up facilities for post handling and value chain development at select pilot locations and development of marketing facilities.
- (e) Developing Geo-Indicating brand name: Developing a common geo-indicating brand name for the select NTFPs and creating data base as well as literature.
- (f) Involvement of BMCs: The BMC has to maintain a People’s Biodiversity Register (PBR) on information about the details of the availability and knowledge of local biological resources which includes medicinal plants, their use or any traditional knowledge, details of the collection of fees imposed and details of the benefits derived and the mode of their sharing.

(ii) Registration of growers for cultivation of medicinal plants.

Every grower intending to cultivate medicinal plants listed in schedule “II” on his/her private land shall get himself/herself registered with the concerned Divisional Forest Officer (DFO) by paying a registration fee of Rs. 100. A list of MAP projects in Himachal Pradesh is provided in **Table 2**.

Table 2: Major projects on MAPs in Himachal Pradesh.

S.No.	Name of the project	Tenure	Duration	Funding agency
1.	Micro-propagation and <i>in-vitro</i> conservation of two endangered Medicinal plants <i>Inula racemosa</i> and <i>Nardostachys jatamansi</i>	--	--	Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, HP
2.	Conservation and propagation of medicinal plants in Kullu	5 year	2008 to 2013	NMPB (HPFD)
3.	Conservation and propagation of medicinal plants in Kangra	5 year	2008 to 2015	NMPB (HPFD)
4.	Strengthening of medicinal plant resources in Chamba and Sirmour	5 year	2009-2015	NMPB (HPFD)
5.	Conservation development and sustainable management of priority wild medicinal plant species in Himachal Pradesh	5 year	2010-2015	NMPB (HPFD)
6.	Strengthening of high-altitude medicinal plants resources in trans- Himalayan districts of Lahaul and Spiti and Kinnaur	5 year	2012-2017	NMPB (HPFD)
7.	Exploring anti-microbial potential of few important medicinal and aromatic plants of HP and green synthesis of silver nano-particles of the plant extracts	3 year	2016-2019	NMHS (HP University)
8.	Standardization of nursery technology for mass propagation of selected medicinal plant species	6 year	2000-2007	NWPF (HFRI)
9.	Development of suitable model for inter-cropping of commercially important medicinal plants with horticultural plantations in temperate region of HP	3 year	2003-2006	HFRI
10.	Assessment of existing stock and scaling up productivity of selected high value Himalayan medicinal plants through biological and biotech approaches	4 year	2002-2006	Ministry of Health & Family Welfare New Delhi (GB Pant Institute, HP)

S.No.	Name of the project	Tenure	Duration	Funding agency
11.	Preparation of a management plan for medicinal plants in the catchment area of Parbati	3 Year	2005-2008	NHPC, Bhuntar-Kullu (GB Pant Institute, HP)
12.	Assessment of endemic, threatened and high value medicinal plants of cold desert areas in IHR	4 Year	2012-2016	CSIR, New Delhi (GB Pant Institute, HP)
13.	Improvement of infrastructural facilities in the Botanical Garden for conservation of rare endangered and threatened plants in the Arboratum at Mohal Kullu	4 Year	2009-2013	MoEFCC (GB Pant Institute, HP)
14.	Studies on diversity and conservation status of plants in the proposed cold desert Biosphere Reserve of Trans and North West Himalaya	9 Year	2005-2014	MoEFCC (GB Pant Institute, HP)
15.	Assessment of medicinal and aromatic plant species on their collection, usage, demand, markets, price trends and life cycle in Lahaul and Pangi landscape in Himachal Pradesh under the SECURE Himalaya project	2 Year	2019-21	UNDP-GEF

4.2 Key Task 2: Identify and list MAPs with significant economic end usage in the landscape

The overall international trade in medicinal plants and their products sector alone is expected to amount five trillion USD by the year 2050 and the present national market for herbal drugs is estimated at ₹40 billion, which is also expected to increase by 16% in the next 3-4 years (Semwal, 2019). Himachal Pradesh is a repository of 24 of the 100 most important medicinal plant species traded in the country (Kapta, 2015). The state exports around 2,500 tons of medicinal plants, whereas, the legal annual trade in medicinal plants is approximately ₹10 crore at current market prices (Kapta, 2015). Subsequently, the state government earns about ₹40 lakh per annum from export permits for medicinal plants (Kapta, 2015).

Based on field surveys during 2019-2020, landscape level stakeholder consultations and extensive review of literature, the current study identified a total of 30 MAPs species with significant high (20 species) and medium (10 species) economic end usage in the Lahaul and Pangi landscape (**Table 3**).

Table 3: List of MAPs with significant economic end usage in Lahaul and Pangi.

Sr.No.	Tradable MAPs	Trade name	Source of origin	Economic use
1.	<i>Aconitum heterophyllum</i>	Atish, Patish	Wild	High
2.	<i>Aconitum violaceum</i>	Patish	Wild	High
3.	<i>Angelica glauca</i>	Chora, Choraka	Wild	High
4.	<i>Arnebia benthamii</i>	Ratanjot	Wild	Medium
5.	<i>Arnebia euchroma</i>	Ratanjot	Wild	Medium
6.	<i>Bergenia stracheyi</i>	Pashanbed	Wild	High
7.	<i>Betula utilis</i>	Bhojpatra/Bhuj	Wild	High
8.	<i>Bunium persicum</i>	Kala jeera	Wild	High
9.	<i>Carum carvi</i>	Singhu jeera	Cultivated/Wild	High
10.	<i>Corylus jacquemontii</i>	Thangi	Wild	High
11.	<i>Dactylorhiza hatagirea</i>	Salampanja	Wild	High
12.	<i>Dioscorea deltoidea</i>	Singli mingli	Wild	Medium
13.	<i>Ephedra gerardiana</i>	Somlata	Wild	Medium
14.	<i>Fritillaria cirrhosa</i>	Kakoli/Jangli lehsun	Wild	High
15.	<i>Hippophae rhamnoides</i>	Seabuckthorn, Chharma	Wild	High
16.	<i>Hippophae salicifolia</i>	Seabuckthorn, Chharma	Wild	Medium
17.	<i>Hyssopus officinalis</i>	Dhoop	Wild	Medium
18.	<i>Inula racemosa</i>	Manu	Cultivated	High
19.	<i>Juglans regia</i>	Akhrot	Cultivated/Wild	High
20.	<i>Juniperus semiglobosa</i>	Jau, Hauber	Wild	Medium
21.	<i>Jurinea macrocephala</i>	Dhoop	Wild	Medium
22.	<i>Morchella esculenta</i>	Gucchi	Wild	High
23.	<i>Nardostachys jatamansi</i>	Jatamansi	Wild	Medium
24.	<i>Picrorrhiza kurroa</i>	Karu	Wild	High
25.	<i>Sinopodophyllum hexandrum</i>	Bankakri	Wild	High
26.	<i>Pinus gerardiana</i>	Chilgoza	Wild	High
27.	<i>Polygonatum verticillatum</i>	Salam mishri	Wild	High
28.	<i>Rheum australe</i>	Revandchini	Wild	High
29.	<i>Rheum webbianum</i>	Revandchini	Wild	Medium
30.	<i>Saussurea costus</i>	Kuth	Cultivated	High

4.3 Key Task 3: Select five MAPs each in two categories

Collection and harvesting of medicinal plants have been practiced in the Himalayan region since time immemorial. The increased commercial demand, unorganized and over harvesting practices has caused decline in wild population of several medicinal plant species. Unfortunately, premature harvesting is the major threat to the survival of important MAPs in the present scenario, that eventually leads to decline in its natural population, regeneration and survival.

Based on five workshops and three internal review meetings which involved experts from various institutions and departments such as National Medicinal Plant Board, HP State Medicinal Plant Board, HP State Biodiversity Board, HP State Forest Department, GB Pant National Institute of Himalayan Environment & Sustainable Development, Himalayan Forest Research Institute, Himalayan Research Group, Wildlife Institute of India, UNDP-India, Himachal Pradesh Agriculture Department, Regional-cum-Facilitation Centre, local NGOs, local inhabitants and local traders (**Annexure 1**), a total of 10 species were selected from Lahaul and Pangi landscape, Himachal Pradesh for the current study. The selection of MAPs was based on two focal categories, (i) highest quantum of collection (HQC) and (ii) highest threat perception (HTP) due to removal and usages (**Table 4; Plate 3 and 4**).

Table 4: Selected MAPs in the Lahaul and Pangi landscape.

Sr.no.	Scientific name	Trade name	Family	Distribution range (m)	Focal category
1.	<i>Aconitum heterophyllum</i> Wall. ex Royle	Atis	Ranunculaceae	2200-4200	HTP
2.	<i>Dactylorhiza hatagirea</i> (D.Don) Soó	Hatajari, Salampanja	Orchidaceae	2400-3500	HTP
3.	<i>Picrorhiza kurroa</i> Royle. ex Benth	Kadu	Plantaginaceae	3000-5000	HTP
4.	<i>Sinopodophyllum hexandrum</i> (Royle) T.S.Ying	Ban kakri	Berberidaceae	2500-4200	HTP
5.	<i>Rheum australe</i> D.Don	Archa, Revandchini	Polygonaceae	3000-4500	HTP
6.	<i>Bunium persicum</i> Boiss	Kala jeera	Apiaceae	1800-3500	HQC
7.	<i>Polygonatum verticillatum</i> (L.) ALL.	Salam mishri	Asparagaceae	2500-3700	HQC
8.	<i>Rheum spiciforme</i> Royle	Revandchini	Polygonaceae	3600-4800	HQC
9.	<i>Rheum webbianum</i> Royle	Revandchini	Polygonaceae	2400-4300	HQC
10.	<i>Aconitum heterophyloides</i> (Brüh) Stapf (syn. <i>A. deinorrhizum</i> Stapf)	Mohra	Ranunculaceae	3500-4500	HQC

Note: *Fritillaria cirrhosa* D.Don (Jungli lehsun) was studied additionally in the present study as the species falls under HQC.



Plate 3: Selection of MAP species based on High Threat Perception.

📷 Amit Kumar and Navendu Page



Plate 4: Selection of MAP species based on High Quantum of Collection (HQC).

📷 Amit Kumar, GS Goraya and Gajendra S. Rawat

4.4 Key Task 4: Assessment of distribution, abundance and conservation of the listed 10 species identified as per the criteria above in the landscape

Of the selected MAP species viz., *Bunium persicum*, *Fritillaria cirrhosa*, *Dactylorhiza hatagirea*, *Picrorhiza kurroa*, *Aconitum heterophyllum*, *Aconitum heterophylloides*, *Rheum speciforme* and *Rheum australe* show scanty distribution, whereas, *Sinopodophyllum hexandrum*, *Rheum webbianum* and *Polygonatum verticillatum* are fairly well distributed in the Lahaul and Pangi landscape. The selected MAP species are restricted to a narrow geographical range with rigid ecological adjustments that makes the species difficult to invade new areas for survival and development. The bulk demands of *Bunium persicum* and *Aconitum heterophyllum* in Lahaul and *Fritillaria cirrhosa*, *Picrorhiza kurroa* and *Dactylorhiza hatagirea* in Pangi for its medicinal value cause the over-exploitation of wild resources. Due to continuous exploitation and habitat destruction, aforementioned species are becoming rare. The details on potential source areas, their distribution or habitat, abundance, collection pressure, impact on survival, nativity and threat status have been provided in Table 5 and 6.

Table 5: Details on the potential source areas, distribution, collection pressure and impact on survival of selected MAP species.

Species	Potential source areas	Distribution/Habitat	Collection pressure	Impact on the survival of species
<i>Fritillaria cirrhosa</i>	Sural bhatori, Chasak bhatori, Hadsar, Thanpatan, Bharotu, Kadu nala, Mindhal	Rocky and grassy slopes amidst shrub species such as <i>Lonicera</i> spp., <i>Rosa</i> spp and <i>Salix</i> spp.	Highly destructive, unselective, unmanaged and premature harvesting; uprooting of entire plant for bulb	Threat to its natural population, regeneration and survival
<i>Picrorhiza kurroa</i>	Kadu nala, Chasak bhatori, Sural bhatori, Hadsar, Hudan bhatori	Glacial flats, cliffs and rock's crevices	Destructive, unselective and unmanaged; uprooting of entire plant for rhizome	Threat to its natural population, regeneration and survival
<i>Aconitum heterophyllum</i>	Hadsar, Sural bhatori, Chasak bhatori, Hudan bhatori, Kadu nala	Alpine to sub-alpine open slopes, grassy meadows and upper oak/coniferous forest	Destructive, unselective and unmanaged; uprooting of entire plant for tuberous root	Threat to its natural population, regeneration and survival
<i>Aconitum heterophylloides</i>	Luj, Hadsar	Forest understorey	Unmanaged	Threat to its natural population

Species	Potential source areas	Distribution/Habitat	Collection pressure	Impact on the survival of species
<i>Dactylorhiza hatagirea</i>	Sural bhattori, Hadsar, Chasak bhattori	Alpine meadows and sub-alpine bio climates	Destructive, unselective and unmanaged; uprooting of entire plant for tuberous root	Threat to its natural population, regeneration and survival
<i>Rheum webbianum</i>	Hadsar, Hudan bhattori, Kadu nala, Chasak bhattori, Sural bhattori	Rocky hillsides of alpine areas	Unselective and unmanaged	Threat to its natural population
<i>Rheum australe</i>	Miyar valley, Mindhal	Open alpine slopes on rocky ground and grassy slopes	Unselective and unmanaged	Threat to its natural population
<i>Rheum speciforme</i>	Jispa-Baralacha	Open drier areas	Unmanaged	Threat to its natural population
<i>Bunium persicum</i>	Miyar valley, Mindhal, Kadu nala	Sub-alpine meadows and dry scrubby slopes	Highly destructive, unselective and unmanaged	Threat to its natural population
<i>Polygonatum verticillatum</i>	Sural bhattori, Hadsar, Hudan bhattori, Kadu nala, Chasak Bhattori	Forests, shrubberies, open slopes and shady rocky places	Unselective and unmanaged	Threat to its natural population
<i>Sinopodophyllum hexandrum</i>	Sural bhattori, Hadsar, Hudan bhattori, Kadu nala, Chasak Bhattori	Open rocky slopes and shady coniferous forests	Unselective and unmanaged	Threat to its natural population

Table 6: Habitats, nativity and threat status of selected MAP species

Species	Habitats	Nativity	Threat status (Goraya et al. 2013)	Part (s) used	Reference
<i>Bunium persicum</i>	I, II, IV, V	South As, Persia	Vulnerable	WP	Prakash et al. (2020)
<i>Aconitum heterophyllum</i> *	I, II, III, IV	Reg Himal	Critically Endangered	Rt	Devi et al. (2019); Samant et al. (2007b); Singh et al. (2009)
<i>Aconitum heterophylloides</i>	I, VII	Reg Himal	Critically Endangered	Rt	Goraya et al. (2013)
<i>Dactylorhiza hatagirea</i>	I, II, IV, V	Reg Himal	Critically Endangered	Rt	Prakash et al. (2018); Singh et al. (2009)
<i>Fritillaria cirrhosa</i>	I, II	Reg Himal	Endangered	Bb	Devi et al. (2019); Samant et al. (2007b); Singh et al. (2009)

Species	Habitats	Nativity	Threat status (Goraya et al. 2013)	Part (s) used	Reference
<i>Picrorhiza kurroa</i>	I, II, III, IV	Reg Himal	Critically Endangered	Rt, Rhm, Lf, St	Devi et al. (2019); Samant et al. (2007b); Singh et al. (2009)
<i>Sinopodophyllum hexandrum</i>	I, II, III, IV	Reg Himal	Endangered	WP	Devi et al. (2019); Singh et al. (2009)
<i>Polygonatum verticillatum</i>	I, II, III, IV	Europe As Bor	Endangered	Rh	Devi et al. (2019); Samant et al. (2007b)
<i>Rheum australe</i>	I, II, III, IV, V, VII, VIII	Reg Himal	Endangered	Lf, St	Prakash et al. (2020); Samant et al. (2007b)
<i>Rheum webbianum</i>	I, II, III, IV, V, VII, VIII	Reg Himal	Vulnerable	St	Prakash et al. (2020); Singh et al. (2009)
<i>Rheum speciforme</i>	II, IV, VIII	Reg Himal	Near Threatened	Rt	Goraya et al. (2013)

*Abbreviation used: I=Shady moist; II=Dry; III=Degraded; IV=Rocky; V=Bouldary; VI= Riverine; VII=Moist alpine slope and VIII=Dry alpine slope; Rt= Root; WP = Whole plant; Bb= Bulb; Fr=Fruit; Rh=Rhizome; Lf=Leaf; St=Stem; Reg Himal= Himalayan Region; South As= South Asia; As =Asia; Bor= Borealis; †: Endangered as per IUCN (Ved et al. 2015).

The population density of the selected species in Himachal Pradesh varies according to the location and elevation. Besides this, the species of the north-west Himalaya have been strictly localized with thin-scattered populations bound to ecological niches (Beigh et al. 2006). The density of all the selected species varies within the range of 0.03-5.3 (ind/m²) in Himachal Pradesh, whereas, in Uttarakhand, the range is 0.03-4.40 (ind/m²) (Table 7 and 8).

Table 7: Density of selected species in Himachal Pradesh and Uttarakhand.

Sr.no.	Species	Density (ind m ⁻²)		Reference
		Himachal Pradesh	Uttarakhand	
1.	<i>Aconitum heterophyllum</i>	1-3.7	1-6.3	Singh et al. (2008); Uniyal et al. (2006); Nautiyal et al. (2002); Rawat et al. (2016)
2.	<i>Dactylorhiza hatagirea</i>	0.03-3.58	--	Singh et al. (2019)
3.	<i>Sinopodophyllum hexandrum</i>	0.72-2.0	--	Kala (2005)
4.	<i>Rheum</i> spp.	0.5-5.3	1.93-4.24	Uniyal et al. (2005); Singh et al. (2005); Rawat et al. (2016)
5.	<i>Polygonatum verticillatum</i>	0.07-0.56	2.60-4.40	Butola and Badola, (2008); Verma and Kapoor, (2014); Lohni et al. (2013)
6.	<i>Picrorhiza kurroa</i>	0.07-0.38	0.03	Uniyal et al. (2011); Arya et al. (2013)

Table 8: Abundance of selected MAPs based on populations (including Lahaul and Pangi) studied in Himachal Pradesh

Sr.no.	Species	Populations	Density (ind/.25 hec)
1.	<i>Aconitum heterophyllum</i>	37	2-700
2.	<i>Dactylorhiza hatagirea</i>	45	20-1350
3.	<i>Picrorhiza kurroa</i>	35	15-1350
4.	<i>Sinopodophyllum hexandrum</i>	76	3-440
5.	<i>Rheum australe</i>	44	7-119

*Source: Dr. S.S. Samant

4.4.1 Strategies of addressing the gaps in conservation, management and livelihood enhancement of primary collectors.

Utilization of locally occurring MAPs is integral to the socio-economy of the locals inhabiting remote areas of Lahaul and Pangi landscape. Apart from their use in healthcare, petty trade of medicinal plants forms an alternative income generating source of local communities. Therefore, any effort at strengthening the herbal sector in the region will go a long way in benefiting and improving the living standard of these communities. Wild collection of medicinal plants raises a number of complex environmental and social issues that must be addressed locally on a case-by case basis. For example, the root should be harvested at maturity stage, otherwise it starts decaying from the core, therefore, ecologically non-destructive systems of collection should be employed. Any ban imposed on collection of roots, therefore, is counter-productive and needs be replaced with rotational harvesting system to promote sustainable utilization of resources. Further, developing commercial scale agro-techniques for the cultivation and harvesting of high-altitude species such as *Bunium persicum*, *Aconitum heterophyllum*, *Fritillaria cirrhosa*, *Picrorhiza kurroa* and *Dactylorhiza hatagirea* and their transfer to the potential growers will also be helpful in conservation and sustainable management of these species. Subsidies or incentives to the medicinal plant growers would help promote cultivation of MAP species. Harvesting of medicinal plants may be allowed on rotational basis and the forests can be opened for such harvest in cyclic mode.



Plate 5: Field team exploring MAPs in the focal landscape.

4.5 Key Task 5: Study of value chains for the ten listed species

Medicinal plant species are used since time immemorial as traditional home remedies. Extraction of valuable MAPs from the wild for commercial utilization is usually done by the local communities or less educated, low wage laborers who are many a times unaware about the commercial value of these MAPs. The stakeholders are less aware of the market trends associated with these MAPs, both at the national and international levels. The raw drugs collected by local people are usually sold by them in crude form fetching them prices that are much lower than the market price. The local trader does some cleaning and grading adding value to the material fetching higher prices. Value addition of the medicinal plants is a vital element for commercial utilization by knowing the true medicinal value of the raw drugs, and can be achieved directly and indirectly. Direct method involves improving the quality of the cultivated or collected plant material whereas, indirect method involves quality assurance of the plant material or the semi-processing of the material to a value-added product (Saravanan, 2009). The value chain of raw drugs thus sees value addition at various levels along trade chain adding to the price. When it comes to the final produce, the value enhancement is fairly high as at this stage various other components get added to the material and processessing and management costs are also added. The present study illustrated indicative increase in the percentage of the price from the raw material to the final product by 49% and 192% in *Bunium persicum* and *Picrorhiza kurroa* respectively (Figure 3; Table 9).

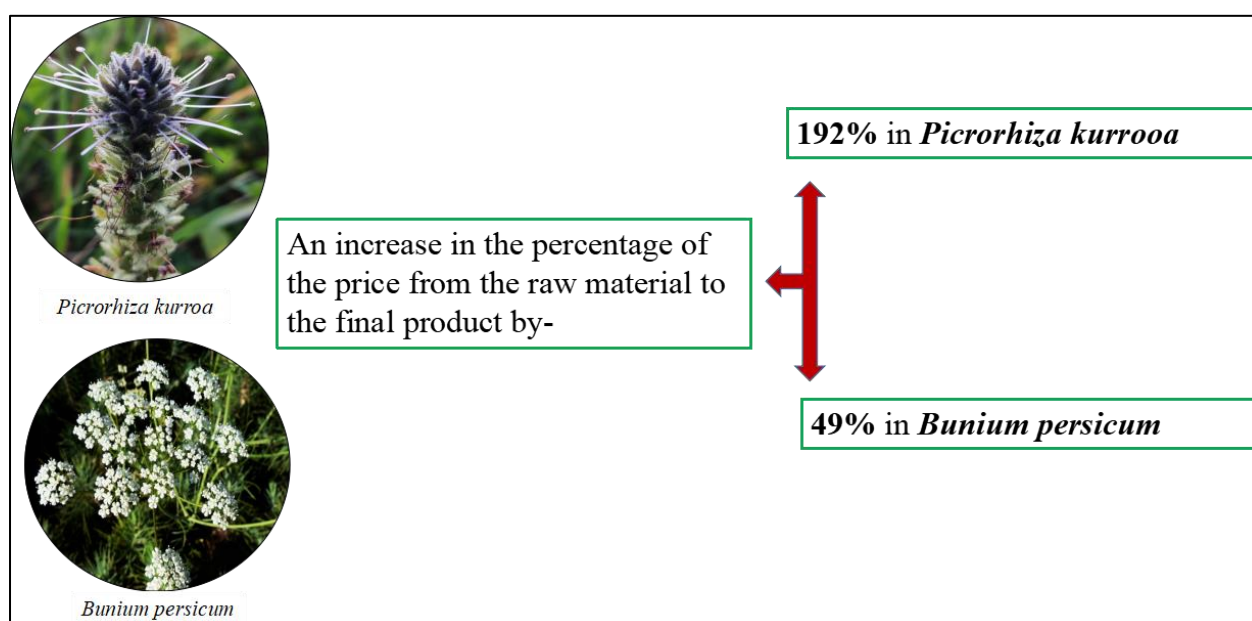


Figure 3: Value chain analysis for Kadu and Kalazeera.

Table 9: Value addition in the final product from raw medicinal plant.

Species	Part Used	Uses/Properties	End product	Raw material (Price in Kg)	Product after value addition	Price of the final product in the market (eg.)	Value added (%)
<i>Picrorhiza kurroa</i>	Root	Dyspepsia, chronic diarrhea, and scorpion sting	Rohitkyadi churna (Powder), Arogyavardini vati (Tablet), Dardnasak oil (Syrup), Heptogen capsule (Capsule)	1500-2000	Kutki Livertone, spices, Kutki powder, Kutki supprime	100gm pack Rs. 512	192%
<i>Aconitum heterophyllum</i>	Root	Expectorant, febrifuge, anthelmintic, anti-diarrhoeal, anti-emetic, and anti-inflammatory	Ashtvardhak, atis shirin	4500-5000	*	*	*
<i>Rheum australe</i>	Leaves	Gastritis, stomach problems, blood purification, menstrual problems and liver diseases	Kaulo bokra Powder, bread,	*	Bread, Chatani, Cosmetics	*	*
<i>Bunium persicum</i>	Seed	Antispasmodic, carminative, anti obesity and lactogage	Spice and flavoring agent in foods and beverages such as bread cooking, rice, yoghurt, cheese and in confectionery products	2200-2500	Baked into breads, added to curry pastes and blends, or steamed with rice to give it a distinctive fragrance, especially in Northern Indian meat and rice dishes, Zeera biskit, Zeera laddu, Zeera Namkeen	Zeera biskit Rs. 35/10gm.	49%
<i>Polygonatum verticillatum</i>		Cardiotonic, antiperiodic, demulcent, diuretic, energizer, aphrodisiac, sedative, hypoglycemic, antitumor and so on	Chyavanprasha, Sudarshana Churna, Taila (oil), Ghritam (medicated clarified butter), Churana (powder)	*	Rumi mastagi, Salab	10 gm Rs. 350	*

Species	Part Used	Uses/Properties	End product	Raw material (Price in Kg)	Product after value addition	Price of the final product in the market (eg.)	Value added (%)
<i>Fritillaria cirrhosa</i>	Bulb	Antiasthmatic, antirheumatic, febrifuge, galactagogue, haemostatic, ophthalmic and oxytocic	Astavarga, Chyavanprash	12000-18000	*	*	*
<i>Dactylorhiza hatagirea</i>	Root	Root is used as sweet, cooling, emollient, astringent, aphrodisiac, demulcent, rejuvenating and nervine tonic and also as a nutritional supplement	Patanjali Youvan Chourna,	*	*	*	*
<i>Sinopodophyllum hexandrum</i>	Root	Typhoid fever, jaundice, dysentery, chronic hepatitis, scofula, rheumatism, skin diseases, tumorous growth, kidney and bladder problems	Aanticancer drug etoposide and teniposide.	200-400	Chatani	*	*
<i>Rheum webbianum</i>	Leaves	Renal function disorders, hyperlipidemia, cancer and improves the memory in senile patients	*	*	Bread, Chatani, Cosmetics	*	*

* Lack of information on the final product.

Note: The increase in the prices of final products vis-à-vis the cost of raw material realized by the wild gatherers is only indicative, as most of the raw drugs are used in formulations having many other constituents, and undergo elaborate processing procedure.

4.5.1 Export data

The year wise information on export of MAPs and number of collectors was collected from Lahaul and Pangi Forest Divisions (FDs). In Lahaul, the export of *P. kurroa* (Kadu) was 95 quintals (qtls) in the year 2018-2019 and 38 qtls in 2019-2020. The export of *F. cirrhosa* (Jangli lehsun) was 28.2 kg in the year 2017-2018 and *S. hexandrum* (Bankakri) was 50 qtls in the year 2019-2020.

In Pangi, exported quantity of *F. cirrhosa* (Jangli lehsun) ranged between 108.41 qtls to 85 qtls from 2017-18 to 2020-21. The details of the year wise average market price, exported quantity and income generated from selected MAPs in Pangi is provided in **Table 10**.

Table 10: Export data of selected MAPs in Pangi

Species	Year	Exported quantity (qtl.)	No. of collectors
<i>Fritillaria cirrhosa</i>	2017-2018	108.41	25
	2018-2019	46.25	16
	2019-2020	51.5	13
	2020-2021	85	02
<i>Sinopodophyllum hexandrum</i>	2017-2018	01	01
	2020-2021	22	03
<i>Picrorhiza kurroa</i>	2017-2018	18	03
	2018-2019	120.4	11
	2019-2020	107	10
	2020-2021	118	10
<i>Aconitum heterophyllum</i>	2017-2018	10	01
<i>Polygonatum verticillatum</i>	2018-2019	0.2	01
<i>Rheum australe</i>	2020-2021	09	01

Table 11. List of forest produce and permit fee in Pangi FD, Chamba (Source: HPFD).

Sr.no.	Botanical name	Trade name	Part used	Permit fee INR/qtl	Export fee/qtl
1.	<i>Aconitum heterophyloides</i>	Mohra	Tuber	7500	-
2.	<i>Bunium persicum</i>	Kala zeera	Seed	2000	2000
3.	<i>Aconitum heterophyllum</i>	Atis/Patis/Karvi Patis	Tuber	5000	-
4.	<i>Dactylorhiza hatagirea</i>	Samalpanja/Hathjadi	Tuber	6000	-
5.	<i>Fritillaria cirrhosa</i>	Jangli lehsun, Kakoli	Bulb	10000	-
6.	<i>Picrorhiza kurrooa</i>	Kadu/Kutki	Rhizome	1000	540
7.	<i>Sinopodophyllum hexandrum</i>	Bankakdi	Root and Fruit	250	-
8.	<i>Polygonatum verticillatum</i>	Salammishri/Mahameda	Rhizome	1000	1000
9.	<i>Rheum australe</i>	Revandchini, Chukri	Root	200	-
10.	<i>Rheum webbianum</i>	Revandchini, Chukri	Root	200	-

4.5.2 Trade route and market chain

The trade of wild MAPs works as per the provisions of Himachal Pradesh Forest Produce (Regulation of Trade) Act, 1982 under which the trader has to procure export permit for the consignment of such produce intended to be taken out of the area of collection. In Lahaul and Pangi, a total of 12 and 31 permits, respectively were issued to different traders for the export of MAPs in 2017-2018 (**Annexure 2 and 3**). In the focal landscape, the major market/traders of the selected species can be categorized as Village level (for example Udaipur in Lahaul and Killar in Pangi), Regional level (Manali, Kullu and Bhuntar) and City level (Hyderabad, Amritsar, Lucknow and Delhi). In Lahaul, the trade of MAPs is confined to major markets viz., Hyderabad, Amritsar, Lucknow and Delhi whereas, in Pangi, raw material is mainly traded to the markets of Amritsar and Delhi (**Figure 4-11**). **Figure 7, 8, 9, 10 and 11** show trade routes of *P. kurrooa* and *F. cirrhosa* in the Pangi landscape (2017-2020).

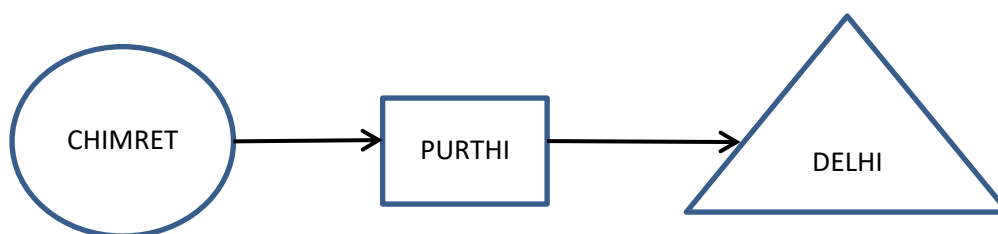


Figure 4: Trade route of *Frittilaria cirrhosa* in the Lahaul landscape.

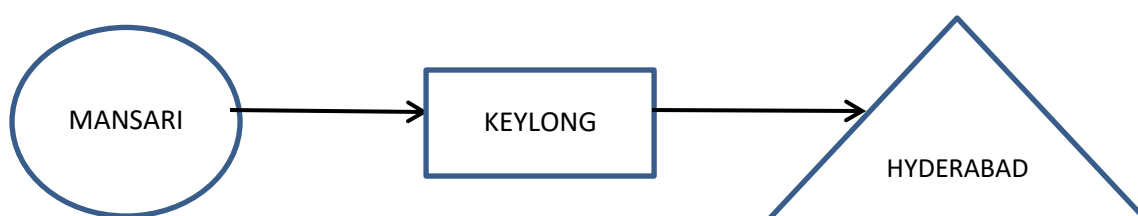


Figure 5: Trade route of *Sinopodophyllum hexandrum* in the Lahaul landscape.

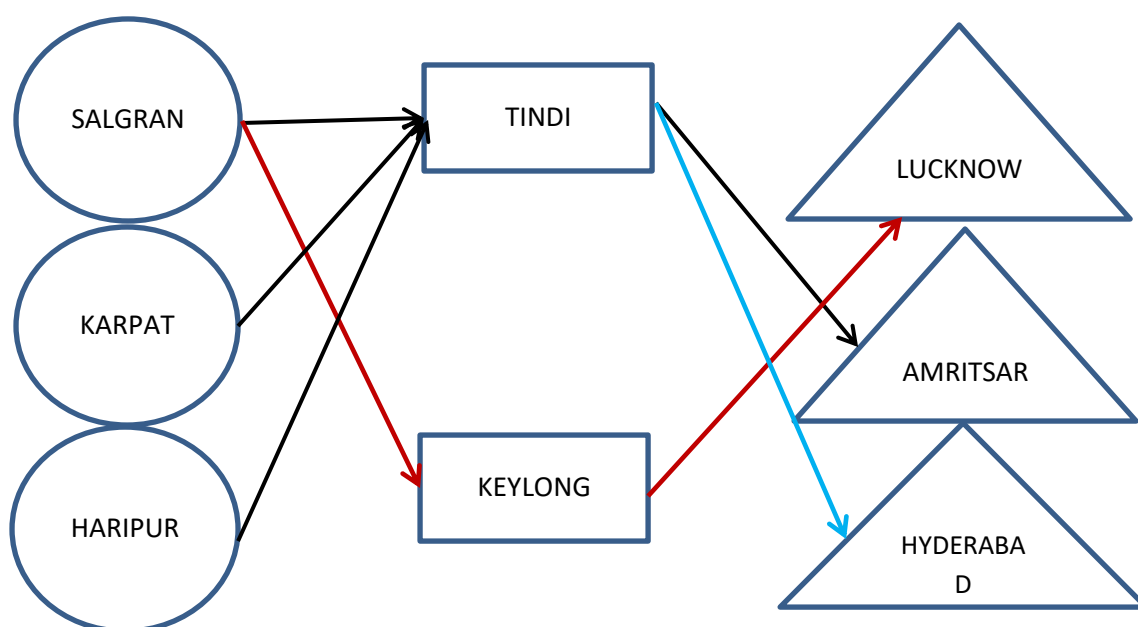


Figure 6: Trade route of *Picrorhiza kurroa* in the Lahaul landscape.

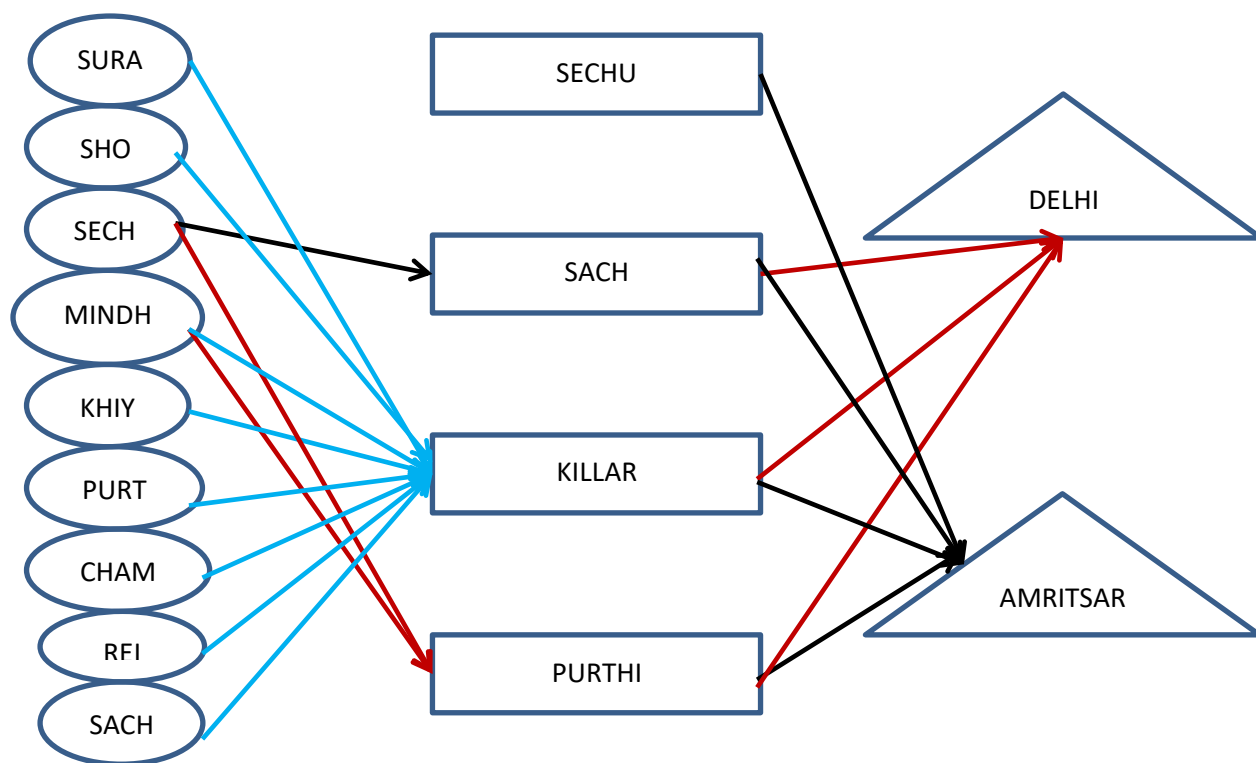


Figure 7: Trade route of *Picrorhiza kurroa* in Pangi (2017-2020).

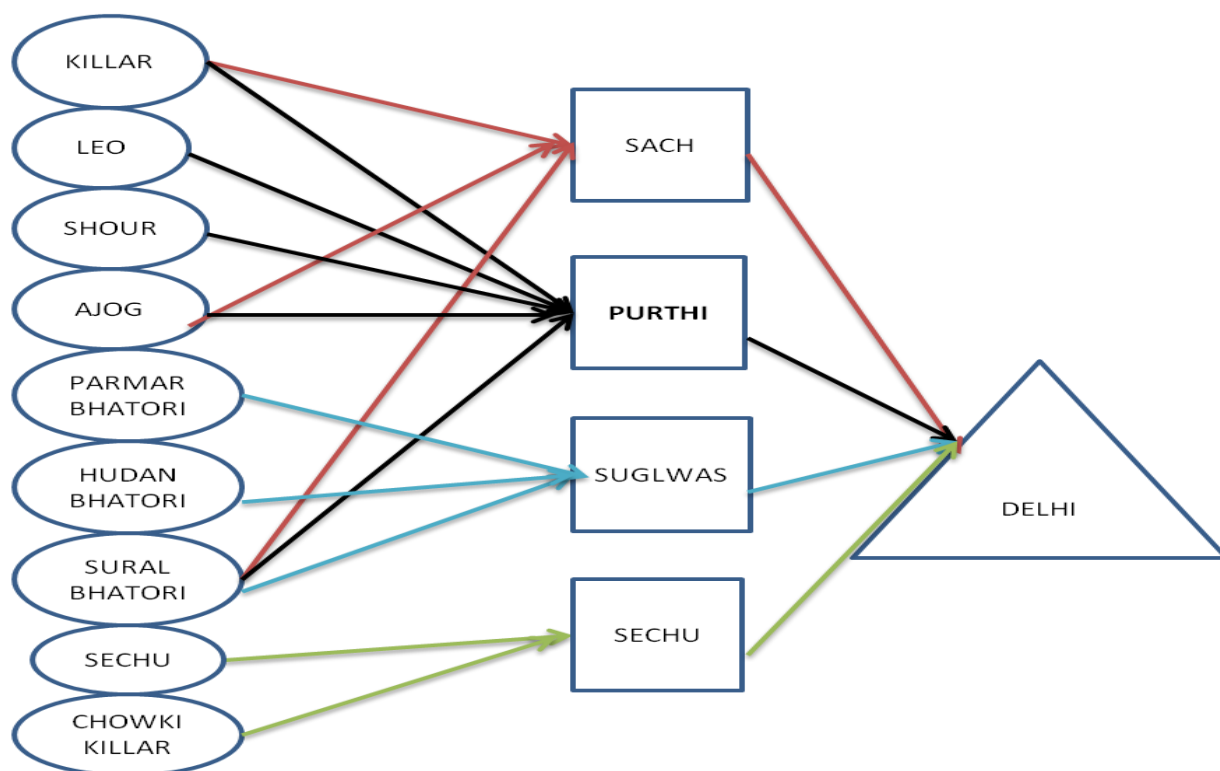


Figure 8: Trade route of *Fritillaria cirrhosa* in Pangi (2017-2018).

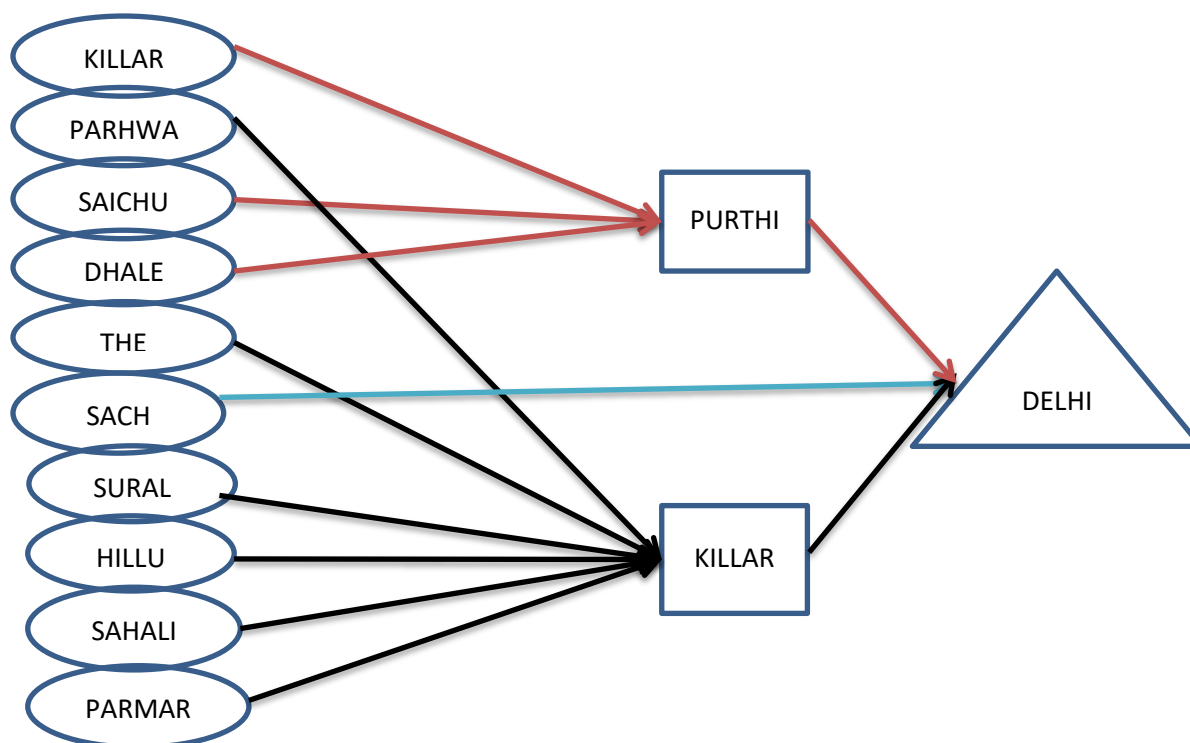


Figure 9: Trade route of *Fritillaria cirrhosa* in Pangi (2018-2019).

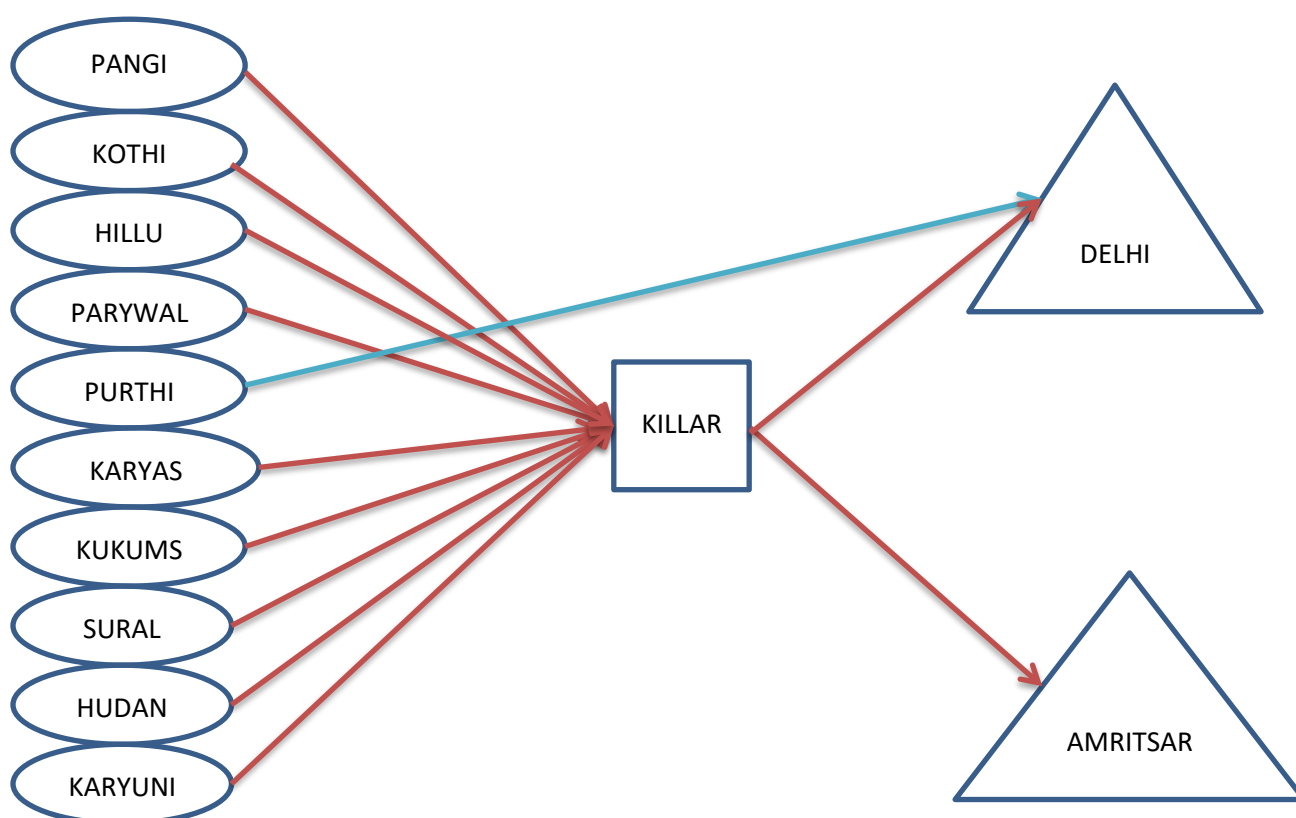


Figure 10: Trade route of *Fritillaria cirrhosa* in Pangi (2019-2020).

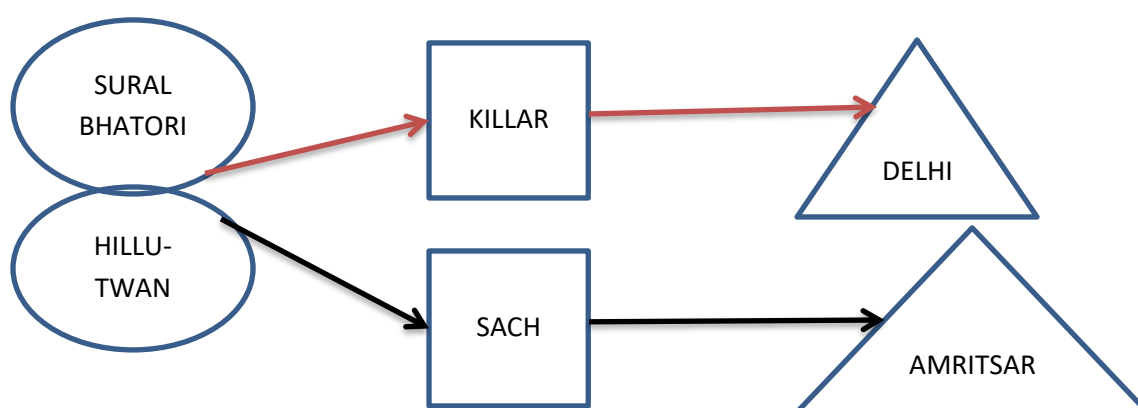


Figure 11: Trade route of *Fritillaria cirrhosa* in Pangi (2020-2021).

4.5.3 MAPs collectors in the focal landscape

As per the data collected from the HPSFD, the number of collectors for each landscape Lahaul and Pangi landscapes has been analyzed for the year 2019-2020. The results illustrated approximately 20 growers of Kuth solely from the Lahaul. Similarly, the collectors from Pangi includes 1 (Kala zeera), 4 (Salampamja), 8 (Chukri), 11 (Patish), 24 (Kuth), 35 (Bankakdi), 124 (Jungli lehsun) and 203 (Kadu).

4.5.4 Price of selected MAPs based on current study

The price along the trade chain was studied from the production level in landscape villages, small aggregation markets in towns and large *mandis* (markets) in cities. The result illustrated an increase in the price of MAPs as it moves from village to city i.e., main market hub that demonstrates value addition to the product, the detail of which has been provided in **Table 11**.

Table 11: Average market price (Rs.)/kg \pm SE of MAPs in Lahaul and Pangi (village/town/city): Based on current study N=15.

Place		Species (Rs.)/kg \pm SE				
		Kadu	Salampanja	Kadwa Patish	Jungli Lehsun	Kala jeera
Village	Mindhal	1333.33 \pm 72.01	2233.33 \pm 145.30	4500 \pm 288.68	7333.33 \pm 1201.85	2233.33 \pm 145.30
	Purthi	1283.33 \pm 49.07	3666.66 \pm 440.96	4333.33 \pm 881.92	11666.66 \pm 881.92	2866.66 \pm 233.33
	Killar	16.66 \pm 13.61	2766.66 \pm 145.30	4166.66 \pm 600.93	7666.66 \pm 881.92	2333.33 \pm 88.19
	Hudan Bhattori	1150 \pm 62.36	2233.33 \pm 145.30	--	13333.33 \pm 881.92	4166.66 \pm 1172.37
Town/City	Udaipur	700 \pm 47.14	3233.33 \pm 145.30	1766.66 \pm 145.30	9666.66 \pm 881.92	2800 \pm 100
	Keylong	933.33 \pm 54.43	2266.66 \pm 145.30	4000 \pm 288.68	16000 \pm 2000	2833.33 \pm 202.76
	Manali	716.66 \pm 82.78	5000 \pm 288.68	9000 \pm 577.35	16333.33 \pm 3382.96	--
	Amritsar	2100 \pm 169.97	3660.66 \pm 33.33	10000 \pm 1154.70	17666.66 \pm 1452.97	3100 \pm 208.17

4.5.5 Average fortnightly market price of selected species

The data was collected from e-Charak (2020) and analysed using standard statistical tools. The selected species such as *P. kurroa*, *S. hexandrum*, *R. australe* and *A. heterophyllum* were analysed and major cities were considered for comparison in the price of medicinal plants from 2017-2019 in different markets (Figure 12, 13, 14 and 15).

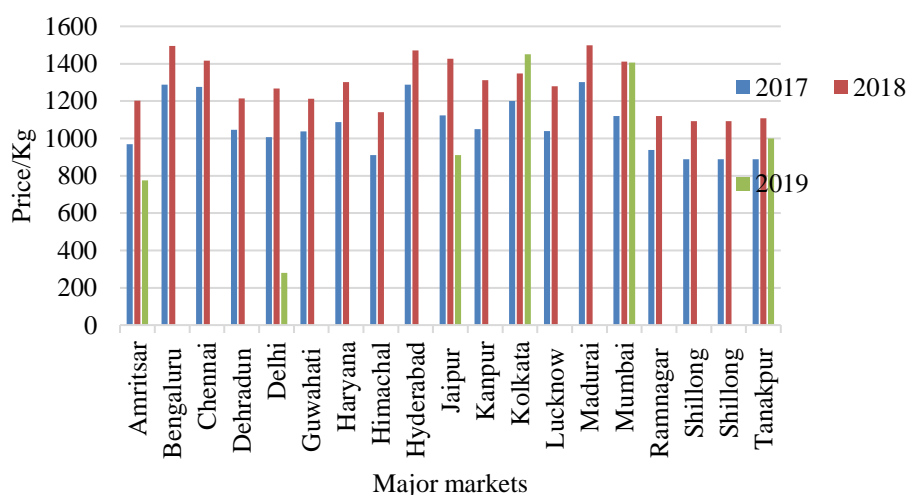


Figure 12: Average fortnightly market price of *Picrorhiza kurroa* in the major markets of India.

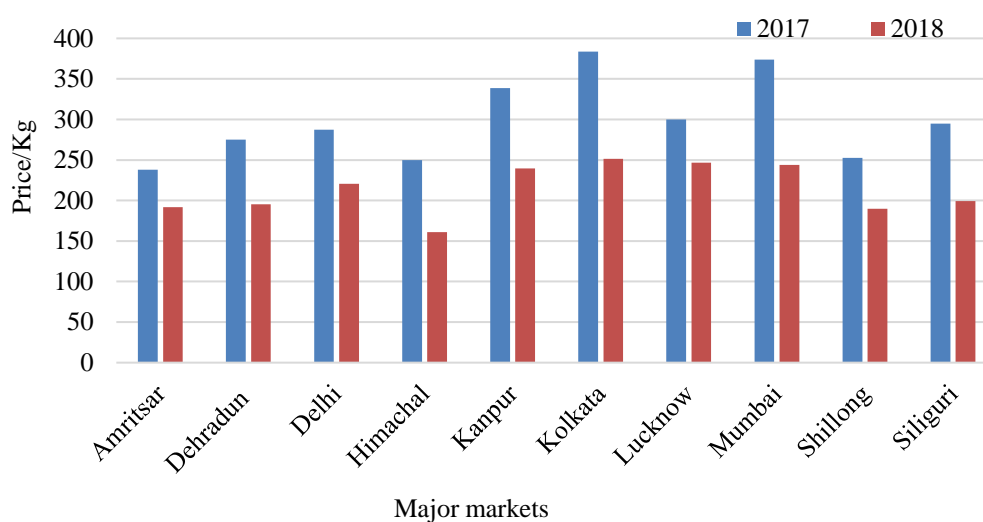


Figure 13: Average fortnightly market price *Sinopodophyllum hexandrum* in the major markets of India.

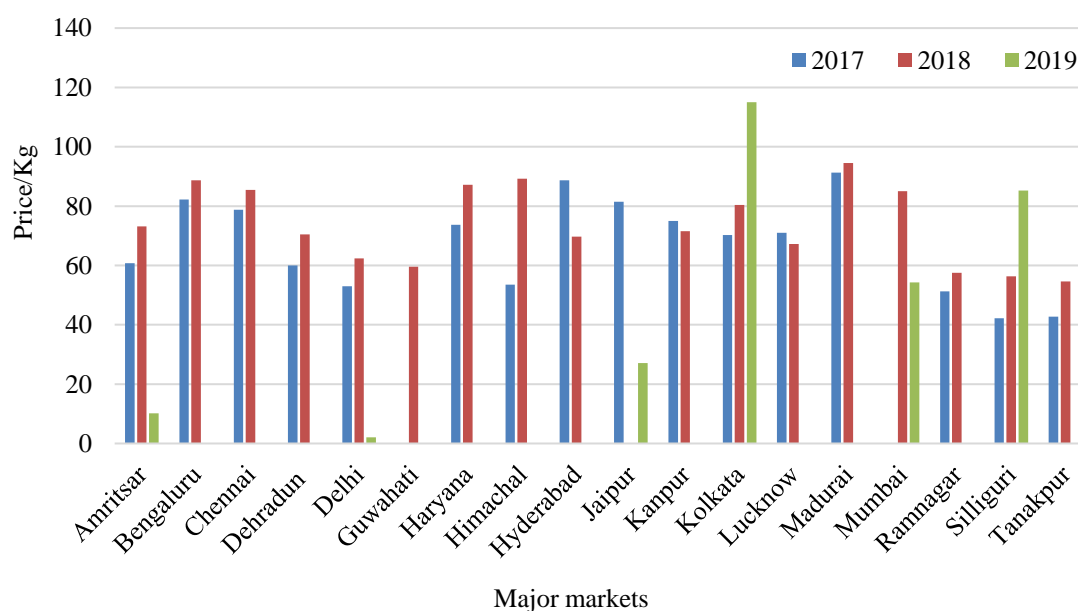


Figure 14: Average fortnightly market price *Rheum australe* in the major markets of India.

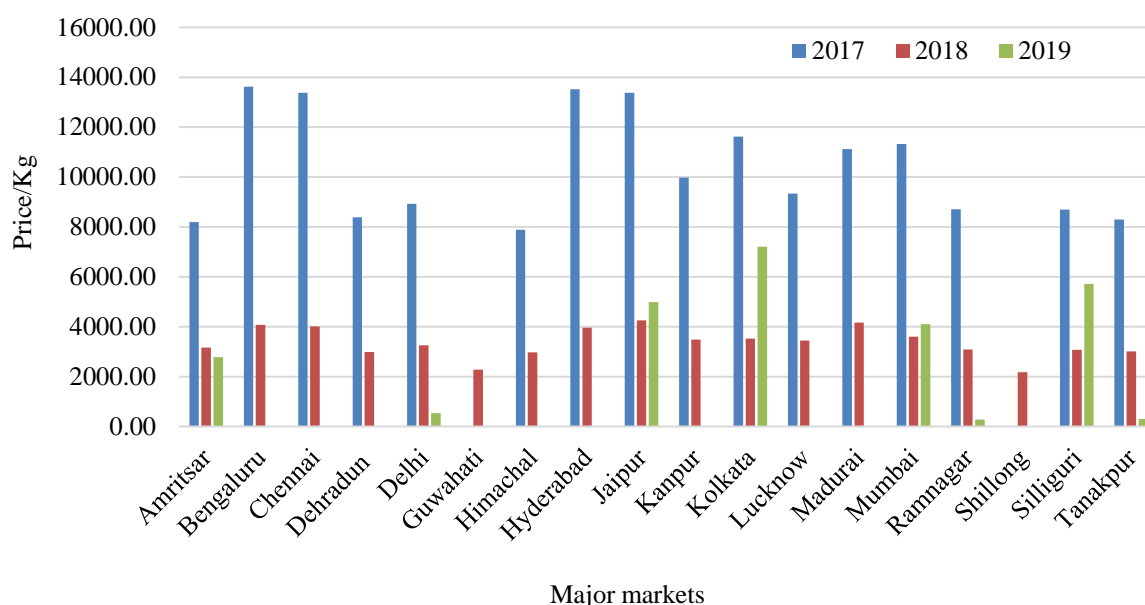


Figure 15: Average fortnightly market price of *Aconitum heterophyllum* in the major markets of India.

4.6 Key Task 6: Understand the role of ten MAPs in livelihoods of respective communities and assess how businesses pertaining to these MAPs operate under the existing economic and legal framework

The medicinal and aromatic plants not only are an important part of culture but, also an important source of subsistence, livelihood and health security for the locals. A major part of their subsistence is derived from nature and therefore, the local inhabitants have immense ethno-botanical knowledge through experimentation and modifications since centuries. The Lahaul landscape itself has about 354 species of medicinal plants, the occurrence of 41.4% of native species, 35.7% of near endemic species and 2% of endemic species shows the high conservation value of the area (Samant et al. 2009). Whereas, in Pangi, 83 plant species belonging to 75 genera and 49 families have been observed to have ethno-botanical uses, mostly categorized as food plants, fruit plants, fodder plants, household and ethno-medicinal plants (Rana et al. 2019). Medicinal herbs are one of the most important non-timber forest products in the Lahaul and Pangi landscape, however systematic survey as regards the assessment of available stock of these MAPs is fairly lacking.

The prevalent trade of MAPs is an important livelihood generation source for the locals of Lahaul and Pangi landscape. The remote agro-pastoral localities such as Chasak Bhatori, where the routes are treacherous and terrain is rough, the inhabitants lack the basic medical facilities, therefore primarily and conventionally depend in the traditional Amchi system of medicine (Sowa-Rigpa) for treatment of every possible ailment. The focal species namely, *Aconitum heterophyllum* (Kaur), *Bunium persicum* (Kala

zeera), *Dactylorhiza hatagirea* (Hathjari), *Fritillaria cirrhosa* (Jangli lehsun), *Picrorhiza kurroa* (Kutki, Kadu), *Sinodophyllum hexandrum* (Bankakri), *Polygonatum verticillatum* (Salam mishri), *Rheum australe* (Chukri) and *R. webbianum* (Chukri) selected for study in the landscape, find use in the households from culinary practices to traditional phytotherapy of both humans and animals. In Lahaul, for instance, *Bunium persicum* locally known as Kala zeera has become an important part of the Lahaul's tradition, finding use in the households since time immemorial for the treatment of fever, cold, cough, abdominal pain, loss of appetite, back pain, liver problems, dysentery in domestic animals and is mostly collected from the wild. Similarly, *Rheum australe*, locally known as Chukri has been consumed religiously through generations, it is believed to cure abdominal pain, appetite, asthma, bronchitis, fever, cuts, dysentery, laxative, eye disorder, sprain, swelling, ulcers and wounds.

The healing properties of the secondary metabolite extracts of the MAPs have scientifically been proven to have medicinal and aromatic properties, and therefore have developed a very high market demand, *F. cirrhosa* locally known as Jangli lehsun for instance, fetches as much as 10,000 INR kg⁻¹ in the market, although local consumption was not reported in the landscape. Owing to the declining population of Jangli lehsun, extensive regional assessments of MAPs in Himachal Pradesh have also categorized this species into 'Endangered' category (Ved et al. 2003; Goraya et al. 2013).

An idea of the entrepreneurship in the area based on this sector, its contribution in the local economy with indicators like people involved in trade or harvesting/collection as livelihood etc could provide the information for deciding priority of this sector in overall livelihood and sustainable NRM strategy. Recently, based on the traditional knowledge of the village folk, cultivation and commercialization of sea-buck thorn *Hippophae rhamnoides*, vernacularly known as Charma has started at local level in the Lahaul landscape. Miss Rigzin Dolma from Myar valley in Lahaul, has utilized her ancestrally passed on traditional knowledge in making domestic products from Charma. She prepares jams, juices, tea etc., from the plant parts and, sells these products to her customers all over the country. She is also involved in designing and stitching the traditional clothes of Lahaul, that are sold all over the town. Her entrepreneurial skills have been welcomed and appreciated in many trade fairs including the annual fare at Pragati maidal, Delhi, multiple times. Such initiatives are important towards the alternate sources of income generation, putting less pressure on the already degrading natural resources and sustainable utilization of natural resources. Such initiatives must be appreciated and replicated elsewhere in the landscape as well. Furthermore, the given steps can be taken in this direction.

- First and the foremost immediate steps should be taken to identify the status of MAPs
- Compilation of traditional source of knowledge and information regarding identification and utilization of MAPs by local people is necessary to keep indigenous technical knowhow alive
- For the important drug yielding plants, detailed scientific investigation is necessary for evolving better methods of cultivation, processing
- Large scale cultivation of MAPs should be encouraged so that their ruthless exploitation from the natural zone is checked.
- In-situ conservation of MAPs by strengthening and sustainably maintaining MPCDAs
- Capacity building and training for identification, collection, storage, handling and marketing should be arranged for the local people. Formation of co-operatives will play an important role in eliminating the middlemen and maximizing the returns
- Nurseries and demonstration plots should be created at suitable places and from there planting stock of medicinal plants should be given to farmers at nominal rates so as to induce them to undertake cultivation of these herbs on their holdings, where production of food crops is not economical

The selected focal species play an important role in the livelihoods of the respective communities in the Lahaul and Pangi landscape. Based on personal interviews having open-ended and semi-structured questionnaire surveys along with secondary data, ethno-botanical information was gathered from 28 villages of Lahaul and Pangi landscape (**Table 12**).

Table 12: Ethno-botanical information of the selected species.

Species	Nature of consumption	Quantum of collection (MT)	Time spent on collection/ processing	Plant part used	Average market price Rs/kg	Local consumption	Commercial consumption
<i>Aconitum heterophyllum</i>	Cold, cough, diarrhoea, fever, gall bladder, abdominal pain, piles, vomiting	200-500*	July-September	Roots	2800-3600	✓	✓
<i>Bunium persicum</i>	Fever, cold, cough, abdominal pain, loss of appetite, back pain, liver problems, dysentery in domestic animals	--	May-July	Fruit, arial parts, whole plant, seed	2500-3000	✓	✓
<i>Dactylorhiza hatagirea</i>	Wounds, fractures, cough, cold, cuts, sexual disability, rheumatism, blood purifier, tonic, paralytic affections	--	July- October	Tuber	3500	✓	✓
<i>Fritillaria cirrhosa</i>	No local use is known but is heavily traded from the landscape	--	July-September	Bulbs	1000-13000	x	✓
<i>Picrorhiza kurroa</i>	Blood purification, arthritis, asthma, cold, dyspepsia, diarrhoea, influenza, fever, stomach ailments, laxative, neck pain, internal wound.	200-500*	July-October	Root, stem, leaf, rhizome	2000-5000	✓	✓
<i>Sinopodophyllum hexandrum</i>	Used topically for skin lesions and warts, remedy of ophthalmia, venereal warts	--	June-September	Whole plant	211	✓	✓
<i>Polygonatum verticillatum</i>	General weakness, aphrodisiac, ingredient in Astavarga	--	July-September	Tuber	--	✓	✓
<i>Rheum australe</i>	Abdominal pain, appetite, asthma, bronchitis, fever, cuts, dysentery, laxative, eye disorder, sprain, swelling, ulcers, wounds	500-1000*	August-October	Stem, leaf, arial part	--	✓	✓
<i>Rheum webbianum</i>	A potential source of dietary fiber, anti-microbial, anti-oxidant and anti-diabetic properties, Abdominal disorder, boils, wounds	--	August-October	Root, leaf	--	✓	✓

*Source: Ved and Goraya (2008)

A large part of the raw material of MAPs collected from the wild is procured in the crude form by the middlemen (local aggregators/ traders) at lower prices, adding to the value as one moves up in the value chain. The markets in the landscape can be categorized as (i) Local level e.g., Udaipur and Keylong, (ii) Regional/Town level e.g., Manali, Bhuntar and (iii) City level e.g., Amritsar and Delhi. It was realized that the market rates of almost all the MAPs increased tremendously from local to town and further up in the city level. *Aconitum heterophyllum*, for instance, procured at an average of Rs. 2000 kg⁻¹ in Udaipur, sells at about Rs. 3,500 kg⁻¹ in Manali, touching a one time high of Rs. 10,000 kg⁻¹ in Manali in the year 2019-2020.

4.6.1 Analysis national/state level frameworks

National level framework

In order to promote medicinal plants sector, the Government of India has set up National Medicinal Plants Board (NMPB) on 24th November 2000. Currently the board is located in the Ministry of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha & Homoeopathy), Government of India. The primary mandate of NMPB is to develop an appropriate mechanism for coordination between various ministries/departments/organizations in India and implements and supports policies/programs on overall (conservation, cultivation, trade and export) growth of medicinal plants sector both at the Central/State and the International level. The fortnightly market price of MAPs is updated in the website.

Himachal State Forest Department

Himachal Pradesh State Biodiversity Board has been constituted by Government of Himachal Pradesh in 2005, in State Council for Science, Technology and Environment HP under Section 22 of the Biological Diversity Act, 2002, for conservation of diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected herewith and incidental thereto in the State.

State level framework

Forest settlements carried out in the 19th century in different erstwhile states of HP formalized the right to collect, extract and exploit the NTFPs. The collection and extraction of the MAPS herbs in the Chamba division is governed by the erstwhile Chamba State 'Chamba Minor Forest Produce, Exploitation and Export Act No. 26 of 2003 Samvat', corresponding to the year 1946 (Forest Working Plan, Chamba District). Besides land owners and the tenants, other residents of the districts as also the outsiders can collect the herbs after obtaining a permit on payment of prescribed fee. All exports have to be covered by an export license issued on payment of specified royalties and export permit fee as may be levied and enforced from time to time.

The extraction of medicinal herbs and plants, till a few decades ago was done mostly for the preparation of medicines for local use and private consumption. With the establishment of new pharmaceutical units, the demand of these medicinal plants increased manifold, which coupled with lucrative prices has seen sudden spurt in the extraction of these plants in the landscape. The local people collect the medicinal herbs during spare time and even on whole time basis by spending days together in high reach and sell them to local contractors or the agents of contractors. Collection permits are issued by the forest department on payment of a nominal fee. These agents/contractors generally fix the procurement price of medicinal herbs keeping in view the demand from the industry. The price paid by them to the local people is generally much below the prevailing market rates.

The Clause 10 of the Chamba Minor forest produce exploitation and export act provides for the closure of any dhar or particular area which has been ruthlessly and haphazardly dug or which is liable to erosion. Further, clause 11 provides that dhar grubbed out in one year will remain closed in the next in order to give it rest. But ironically these provisions have seldom been invoked. Even if a dhar is closed for a particular season, no effective steps are taken to enforce this closure. It is therefore proposed that these provisions be strictly enforced. Special patrol parties may be formed in the landscape to keep a vigil and carry out checking of permits (HPFD).



Plate 6. *Sausurrea costus* (Kuth) cultivation in Miyar valley, Lahaul. 📷 Rupali Sharma



Plate 7. A village setup along with the Chandrabhaga river, Lahaul valley. 📷 Amit Kumar

4.7 Key Task 7 and 11: Create one pilot project to demonstrate Access and Benefit Sharing (ABS) model in the project landscape

4.7.1. Background and rationale

The objectives of the Biological Diversity Act (BDA) 2002 are to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources and associated knowledge. Under Section 7 of the BDA (2002), the State Biodiversity Board (SBB) is the competent authority for granting approvals to Indian citizens (other than NRIs)/ entities (body corporate, association or organization incorporated or registered in India under any law for the time being in force which has no non-Indian participation in its share capital or management) who give prior intimation to the SBB for obtaining biological resources for commercial utilization or bio-survey and bio-utilization for commercial utilization.

Access and benefit-sharing (ABS) refers to the way in which genetic resources may be accessed, and how the benefits that result from their use are shared between the people or countries using the resources (users) and the people or countries that provide them (providers). Article 15 of the Convention on Biological Diversity (CBD) sets out rules which govern access and benefit-sharing. ABS is based on prior informed consent (PIC) being granted by a provider to a user and negotiations between both parties

to develop mutually agreed terms (MAT) to ensure the fair and equitable sharing of genetic resources and associated benefits. Access to genetic resources can lead to benefits for both users and providers. ABS ensures that the way in which genetic resources are accessed and used maximizes the benefits for users, providers, and the ecology and communities where they are found. Users seek genetic resources to deliver a range of benefits; from basic scientific research, such as taxonomy, to developing commercial products which contribute to human well-being, such as pharmaceuticals.

4.7.2. The context

Task 7 and Task 11 of the Project “Assessment of Medicinal and Aromatic Plant (MAP) species including their collection, usage, demand, markets, price trends and life cycle, focusing on landscapes in Himachal Pradesh under SECURE Himalaya Project” under MoEFCC – UNDP - GEF funded project: SECURE Himalaya (Securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems), mandates the following:

Key Task 7: Create 1 pilot project to demonstrate Access and Benefits Sharing (ABS) models in the project landscapes through following sub-tasks:

- ❖ Make an overview of the existing system of produce usage by the users/ buyers (origin of the produce, plant parts used, quantum, collection dynamics, value chain, and price).
- ❖ Identify industries that are currently accessing MAPs from the project landscapes
- ❖ Enlist BMCs and JFMCs/ Community groups involved in produce collection; evaluation of PBR data if available.
- ❖ Assess the prevailing mechanisms of ABS if any, and discuss the concerns within the framework of BDA 2002, PIC, MAT, MoEFCC guidelines on ABS 2014.
- ❖ Study the existing market forces
- ❖ Develop an ABS model by analyzing the existing system and other forces and identify further opportunities for value addition.
- ❖ Collaborate and jointly work with State BB for developing the strategy.
- ❖ Feed the data to Task # 11

4.7.3. The ABS Model Process

For Key Task 7 and its various sub-tasks, the Himachal Pradesh State Biodiversity Board (HPSBB) had been consulted to gather following basic information for the purpose of execution of the Access and Benefit Sharing (ABS) Model:

- ❖ Number of Biodiversity Monitoring Committees (BMCs) constituted

- ❖ Potential bioresources being collected from the wild for trade
- ❖ Industrial units based on natural bio resources in the state
- ❖ Traders, manufacturers and exporters of Medicinal and Aromatic Plants
- ❖ Quantum of trade and export in the state on natural bio-resources.
- ❖ JFMCs/Village Forest Committees involved in collection and trade of bio-resources
- ❖ Primary/secondary level of value addition of natural bio-resources
- ❖ List of NGOs/Cooperatives and other local organizations currently associated with the trade in natural bio-resources
- ❖ Litigations concerning trade in natural bio-resources in the State

4.7.4. The Basic Information

- ❖ Lahaul and Pangi have a total of 13 and 12 BMCs, respectively (**Annexure 4**).
- ❖ A total of 35 tradable potential bio-resources have been identified across the landscape. Of these, most resources (69%) are collected from the wild, exclusively and only 6 % bio-resources are of cultivation origin, while 25% have mixed origin both from the wild and cultivation. (**Annexure 5**).
- ❖ A total 118 industries are reportedly engaged in the use of bio-resources located in Himachal Pradesh (**Annexure 6**).
- ❖ The analyzed data revealed that the state of Himachal Pradesh has 52 traders (14 from HP and 38 from Punjab) with 6 exporters from HP (**Annexure 7**).
- ❖ There are about 45 high volume traded (HVT) medicinal plant species with sizeable wild populations in HP (**Annexure 8**).
- ❖ A total of 100 manufacturers; 97 Ayurvedic Pharmacies and 03 Homeopathies are located in different districts of Himachal Pradesh, viz., 47 in Solan, 19 in Kangra, 12 in Sirmour, 04 each in Una and Mandi, 03 in Bilaspur, 02 each in Hamirpur and Shimla and one each in Kullu and Chamba (**Annexure 9**).
- ❖ The information on export of tradable commodities in HP reveals 3883 qtls in 2000-01, 4100 qtls in 2001-02 and 4777 qtls in 2002-03 (**Annexure 10**).
- ❖ During stakeholder consultative workshops held at Pangi and Keylong, discussion was held on the issues of market forces, such as, the economic factors that affect the price, demand and availability of the tradeable bioresources with respect to ABS. After discussion and field observations, two wild (*Aconitum heterophyllum* and *Picrorhiza kurroa*) and two cultivated (*Inula racemosa* and *Saussurea costus*) MAP species have been shortlisted and suggested for ABS

model based on the market opportunities' (market channel and price of the product) and ease of cultivation or harvesting procedures (**Plate 8 and 9**).

- ❖ Possibly, one of the potential sites for ABS Village Model can be Tindi in Lahaul and Sural in Pangi.
- ❖ Quantum of trade in HP from 1995-2000 for the species *Aconitum heterophyllum* *Picrorhiza kurroa* and *Podophyllum hexandrum* was 189.2 quintal.
- ❖ No information is available on the JFMCs/Village Forest Committees involved in collection and trade of bio-resources. This is a very crucial lack of information and all attempts must be made to have this information collected for a successful and inclusive ABS Model.
- ❖ Primary/secondary level of value addition of natural bio-resources is undertaken by both NGOs and Private companies. NGOs involved in trade and value addition (using bioresources from Lahaul and Pangi) are: Lahaul Medicinal Plant Growers Cooperative Society, Spiti Eco Livelihoods, Pragya, Lahaul-Spiti Seabuckthorn Society, Lahaul Potato Growers Co-operative Marketing-cum-Processing Society Limited (LPS). Private Companies involved are: Dabur India, Seabuckthorn Indage Ltd.
- ❖ List of NGOs/Cooperatives and other local organizations currently associated with the trade in natural bio-resources name the following: Lahaul Medicinal Plant Growers Cooperative Society, Spiti Eco Livelihoods, Lahaul-Spiti Seabuckthorn Society.
- ❖ No information is available with the HPSBB on the Litigations concerning trade in natural bio-resources in the State.

4.7.5. Processes for ABS Model

1. Name of species for ABS:

Wild: *Aconitum heterophyllum* (Atis/Kour) and *Picrorhiza kurroa* (Kadu)

Cultivated: *Inula racemosa* (Pushkarmool) and *Saussurea costus* (Kuth)

2. Of the above four potential species of ABS, both *Aconitum heterophyllum* and *Picrorhiza kurroa* are under HTP category (**Table 4**). Except *Inula racemosa*, trade export data for other three species is available (**Table 10 and Annexure 10**). Also, a list of traders/collectors for the suggested four species in Lahaul and Pangi landscape has been provided (**Annexure 11**).
3. For the purpose of Model, two species, namely, *A. heterophyllum* and *P. kurroa* are identified based on their trade statistics.
4. Need for identification of the BMCs as source of collection of *A. heterophyllum* and *P. kurroa*, Tindi BMC at Lahaul and Sural at Pangi has been identified for the Model.

5. Since both these species have records of trade, there must be records with the forest department (territorial forest divisions) on the areas from where both these species are sourced for trade. The details of those areas are to be ascertained and collected by the HPSBB. It is reported that the transit of tradable commodities generally takes place through Dhalli Forest check post. The transit data available at this check post may provide useful information on the trade aspects of these two identified medicinal plant species.
6. The name of Village Panchayat in which those collection areas might be falling has to be ascertained from the secondary information. The status of constitution of the BMC and documentation of the PBR has to be found out.
7. In case, BMC is not constituted, the same has to be constituted and as a first mandatory activity of the BMC, the documentation of the PBR has to be completed listing these two ABS potential species with as much details as possible on the extent of areas covered under these species, locations, quantity available, current harvesting status and mechanism (whether harvested by JFMCs or other village level institutions, etc.), regeneration status, cultivation status, etc.
8. The information is needed on the name and other details of the firms/traders engaged in collection and trade of these species from locations of their occurrence. The rate at which trade is being negotiated has to be found out. If these two species are notified as forest species, then rate at which royalty paid to the department shall also be found out. This shall also reveal information on the total quantity of these two species under trade.
9. Whether HPSBB has received information vide Form 1 under Section 12 of HPSB Rules from concerned herbal Industries/traders that are engaged in trade using the species in question for commercial utilization? If not the HPSBB has to send notices to them under appropriate section of the BDA (2002) for compliance.
10. In case Form 1 has been received then it has to be screened to ensure that all vital information pertaining to the biological resources has been noted, especially geographical locations of collection (village, panchayat, block, taluk and district), purpose, quantities, correct common name & scientific name, wild or cultivated, sources from traders/communities/JFMCs, etc. If bought from traders, then full details of trader (s) (name, complete address, contact details et.) are needed. In case the applicant is not the one to access the biological resources, a proper and verified authorization letter would be needed. If not, the applicant has to be given reasonable time to resubmit with requisite information. Screening should also ensure that there is no such species that are under RET categories, or Normally Traded As Commodity (NTAC) for whom the ABS is not applicable (under section 40 of the BDA).

11. Applications received for value added (as defined in the BDA, 2002) are also not to be entertained besides the ones to be accessed by Indian citizens from India for the purpose of research or bio-survey and bio-utilization for research in India.
12. The local people or communities of the area including growers and cultivators of biological resources and vaidas and hakims who have been practicing indigenous medicines, except for obtaining intellectual property rights, are also excepted from the ABS regulations.
13. The purpose has to be for commercial utilization or for bio-survey and bio-utilization for commercial purposes. If the purpose noted is obtaining Intellectual Property Rights, transferring of research results related to biological resources to non-Indian/Non-Indian entity; transfer of biological resources to non-Indian/Non-Indian entity, or sending/carrying the biological resources outside India for the purpose as envisaged in the regulation 13 of the ABS Regulation 2014 of MoEF & CC, then in all these cases, the application has to be either rejected or asked to contact NBA, Chennai.
14. The HPSBB on getting the application in Form 1 may consult the concerned BMCs on the availability of the desired two species intended to be accessed mainly for the purpose of quantity to be accessed to ensure sustainable harvesting protocol. If the applicant is intending to collect the resources in different time intervals and if in large quantities, the views of the BMCs need to be taken based on the availability of the given species. The HPSBB may call for the reasons/justifications from the applicant.
15. The HPSBB may also constitute an Expert Committee on the Access and Benefit Sharing having experts drawn from different fields for conclusive examination, determination of benefits sharing and advising the HPSBB on the techno-legal issues. However, the decision has to be of HPSHH Board to be decided either to accept or reject the recommendations of the Expert Committee.
16. The benefits sharing provisions are to be followed as per the principles broadly outlined in the Guidelines on Access to Biological Resources and Associated Knowledge and Benefit Sharing regulations, 2014.
17. In case the given biological resources are to be sourced from the jurisdiction of two or more BMCs, the total amount of the benefits accrued shall be shared among them in proportion as decided by the Governing Body of the HPSBB with due diligence.
18. Once all the above aspects are taken care of, the HPSBB may give approval to the applicant for access of the said resources in form of an agreement executed between the applicant and the competent authority of the HPSBB as per Regulation 2 (2) of the ABS Guidelines of 2014.

19. However, it will be much better to empower the given BMCs from where these species are to be accessed to execute the agreement with the applicant once the PIC has been obtained and on the basis of MAT (Mutually Agreed Terms).
20. In the agreement, all mandatory provisions regarding payment of royalty to the forest department, if applicable, following of the sustainable harvesting protocols and all other mandatory permission are to be obtained by the applicant while accessing the given biological resource.
21. The HPSBB may also seek periodic reports (quarterly) from the applicant about the activities carried out on the accessed resources. After the agreement has been executed proper monitoring of the commercialization shall be carried out by obtaining annual reports from the applicant which contain the quantity of the given biological resource accessed and the products developed, gross sales etc. Annually a certificate of sales attested by a Chartered Accountant shall be obtained from the applicant.
22. The 95% of the benefits realized has to be credited in the accounts of the given BMC and remaining 5% has to go to HPSBB.
23. In addition to the ABS, the BMCs can also levy fee at a rate on mutual agreement as per Section 41 (3) of the BDA, 2002 from the applicant for accessing or collecting any biological resources for commercial purposes from areas falling within its territorial jurisdiction. This can also be shared by the BMCs with the local JFMCs or the collectors who help in the accessing of the given biological resources.
24. Both the HPSBB and BMCs shall maintain a register of Benefit Sharing containing details on the Application, approval granted, benefit sharing component fixed and received and the ultimate sharing of the amount realized.
25. The BMC has to be encouraged to prepare an Annual Plan of operation using the accrued fund for conservation and management of the key biological resources within its jurisdiction. The BMC has also to be encouraged to opt for non-monetary benefits as well, including technical hand holding, nursery, primary processing facilities, storage warehouses, capacity building of the BMC members and growers of the given resources by arranging training sessions, especially on sustainable harvesting; development of primary value addition facilities to upgrade the quality of the given accessed resource for fetching more price; transfer of technology for improved production; development of the storage and drying yard facilities in the village jurisdiction for safe storage of the resources; etc.
26. A proper long-term capacity building schedule has to be prepared and executed to empower all the 25 BMCs of both Lahaul and Spiti in all aspects of their management to perform their roles towards

implementation of the BDA, 2002, by engaging experts. These training sessions has to be in local language and more on workshop mode to expose the members and other villagers on hand-on training modules. The mock sessions on ABS may also be conducted. The involvement of local forest-based committees (JFMCs) should also be ensured as an extended arm of the BMC for handling issues concerning natural resource management.

27. The Annual Plan of Operation of the BMC may be attempted to be an integral part of the Village Development Plan. This will help in ensuring convergence of both technical and financial resources of other line departments working in the said panchayat jurisdiction.
28. The BMC is to maintain a register giving information about the details of the availability and knowledge of local biological resources which includes medicinal plants, their use or any traditional knowledge, details of the collection of fees imposed and details of the benefits derived and the mode of their sharing.
29. Frequent interactions between the HPSBB and BMCs shall help develop a complete synergy needed for implementation of objectives of the BDA, 2002, including one main objective on fair and equitable sharing of benefits arising out of commercial utilization of biological resources and associated knowledge.

4.7.6 Scopes for strategic collaboration between HPSBB and other existing institutions/departments/schemes

1. The Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Government of India under its centrally sponsored scheme of National AYUSH Mission (NAM) has been providing financial assistance as subsidy to farmers to encourage cultivation of herb or medicinal plants throughout the country. Presently, 140 medicinal plants species have been prioritized for supporting cultivation throughout the country for which the subsidy is provided to farmers. The main components of the scheme includes (i) Medicinal Plants Conservation and Development Areas (MPCDAs), (ii) Engaging eco-task force for rehabilitation of critical medicinal plant habitats, support to Joint Forest Management Committees/Panchayats/Van Panchayats/Self Help Groups/Biodiversity Management Committees (BMCs) for setting of local cluster for value addition, drying, warehousing and augmenting marketing infrastructure, etc (iii) Awareness building, exposure visits, education and capacity building of stakeholders through information education and communication and (iv) Aushadhi Vanaspati Mitra Program. This collaboration with different schemes can be initiated by the HPSBB with the active involvement of the Model BMC to add to more of value

additions, cultivation and sustainable harvesting of the identified bio-resources that will add value to the ABS mechanism.

2. The HPSBB may develop linkages with the Research-cum-facilitation Centre (RCFC) -Northern Region at Research Institute in Mandi district facilitated by the National Medicinal Plants Board, Ministry of AYUSH, Government of India for infusing an element of entrepreneurship among existing medicinal plants growers/farmers apart from inspiring youth to engage in this activity. The BMCs can also be involved in this process to build their capacity for cultivation value addition and processing of marketing of medicinal and aromatic plants.
3. The HPSBB may also make use of the provisions of “skill development of rural youth through grameen labs” under Swarnajayanti Gram Swarozgar Yojana (SGSY), Government of India, which is in operation in the State to train youths within the jurisdiction of the BMCs in various aspects of Medicinal Plants conservation and cultivation that will benefit them economically through enhanced ABS mechanism.
4. The HP SBB may also collaborate with the HP Forest Department to make use of Van Smaridhi Jan Smaridhi scheme to enhance economic returns to the rural households engaged in collecting and selling of non-timber forest produce (NTFP) including medicinal plants through interventions at strengthening the wild NTFP resources base and improving post-harvest handling, value addition and marketing. This scheme also facilitate (a) Identification and formation of Community User Group (CUGs): Identification and formation of CUGs by the biodiversity management committees and formation of clusters for capacity building and other works; (b) Allocation of forest areas to CUGs and involve them in NTFP resources strengthening in the allocated forest areas; (c) Multi-layered augmentation plantations to strengthen NTFP resource base by CUGs in identified forest areas in vicinity of native NTFP and medicinal species; (d) Standardizing Harvesting, post-harvest handling and developing marketing facilities viz. cleaning, drying, grading, packaging, certification, etc. for select NTFP species and setting up facilities for post handling and value chain development at select pilot locations, development of marketing facilities; (e) Developing Geo-Indicating brand name for the select NTFPs, which will add value to the identified bio-resources for the ABS purposes to fetch enhanced prices; (f) Registration of growers intending to cultivate medicinal plants for cultivation of medicinal plants with the concerned Divisional Forest Officer (DFO) by following the due process. This can be linked with the ABS mechanism for supply of tradable bio-resources.



***Aconitum heterophyllum* (Atis)** 📷 Navendu Page and GS Goraya



***Picrorhiza kurroa* (Kadu)** 📷 Amit Kumar and GS Goraya

Plate 8: Selected species (wild) for ABS mechanism.



***Saussurea costus* (Kuth)** 📷 Amit Kumar and GS Goraya



***Inula racemosa* (Manu, Pushkarmool)** 📷 Amit Kumar

Plate 9: Selected species (cultivated) for ABS mechanism.

4.8 Key Task 8 and 10: Design sustainable harvesting and collection protocols, and cultivation tools and techniques of MAPs in the focal landscape

Wild populations of many important medicinal plant species of the Himalayan region have drastically declined over the years due to over and unsustainable exploitation and habitat degradation. Many of these species have come under IUCN's Red List of threatened plants. Thus, there is an urgent need to initiate appropriate conservation measures to resurrect wild populations of these species towards conservation of their diverse gene pool and their continuous availability for human use. Based on secondary sources viz., offline and online (**Table 13**), the sustainable harvesting and collection protocol for selected MAPs in the Lahaul and Pangi landscape, Himachal Pradesh have been developed. The sustainable harvesting and collection framework includes following five core elements:

What to collect: The plant part or material to be harvested.

What stage: At the optimum stage of development with collection of mature and healthy material.

When: Harvesting season, month and the time of the day.

How: Different harvesting techniques for different parts, using the best practices by the assemblage of traditional and academic knowledge.

How much: Quantity depends upon species and population density. Sustainable harvesting practices should be species and location specific.

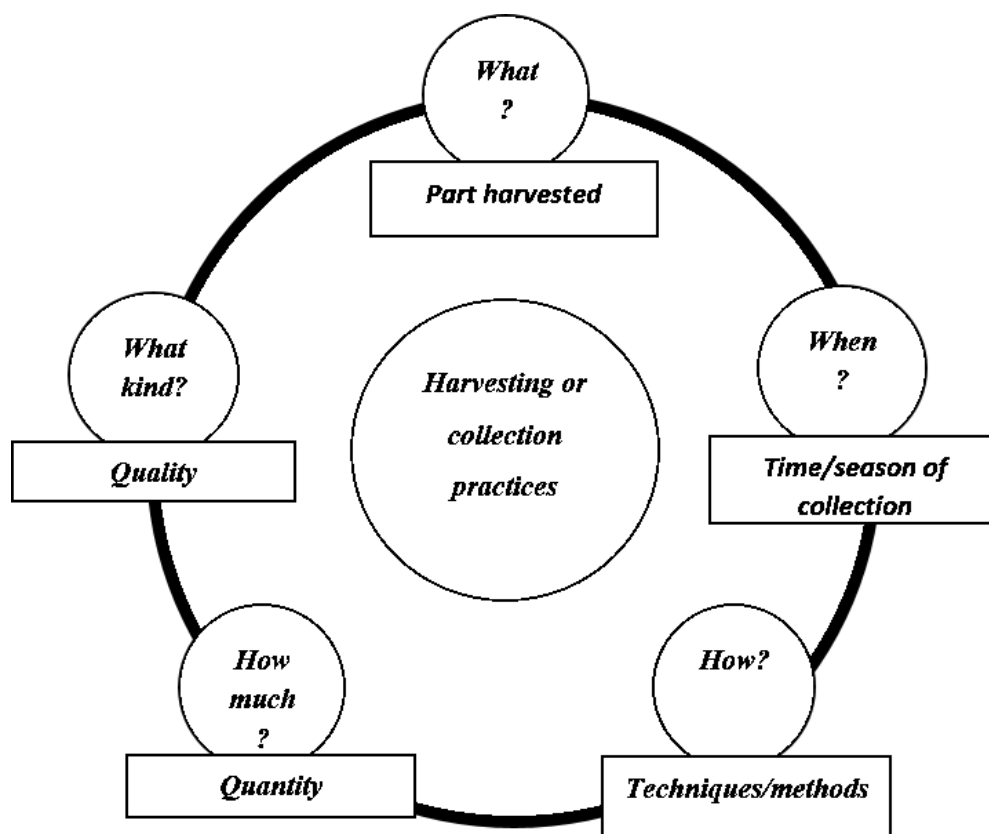


Figure 16: Sustainable harvesting and collection framework (adopted from Deepa et al. (2018).

Table 13: Existing harvesting and collection protocols of selected MAPs.

Sr. no.	Species	Reference						
		Chauhan (2001)	Samant et al. (2008)	NMPB (2008)	NMPB (2016)	Kalsang (2016)	Nautiyal and Nautiyal (2004)	Ved and Goraya (2008)
1.	<i>Aconitum heterophyllum</i>	--	✓	✓	--	✓	✓	✓
2	<i>Bunium persicum</i>	✓	✓	--	--	--	✓	✓
3	<i>Dactylorhiza hatagirea</i>	--	✓	--	✓	✓	✓	✓
4	<i>Fritillaria cirrhosa</i>	--	✓	--	--	✓	✓	✓
5	<i>Picrorhiza kurroa</i>	--	✓	✓	--	✓	✓	✓
6	<i>Polygonatum verticillatum</i>	--	✓	--	--	--	--	✓
7	<i>Sinopodophyllum hexandrum</i>	✓	✓	--	✓	✓	✓	✓
8	<i>Rheum</i> spp.*	--	✓	✓	--	✓	✓	✓

*= *Rheum australe*, *R. webbianum* and *R. spiciforme*

Detail on the aspects of species and location profile, habitat and distribution, morphology and phenology, population status, conservation status, potential threats, medicinal uses, market and trade, good harvesting and collection practices and last but not least cultivation and propagation methods has been discussed below for the selected species. The protocols have been developed by using all the important references (**Table 13**).

4.8.1 *Aconitum heterophyllum* Wall. ex Royle

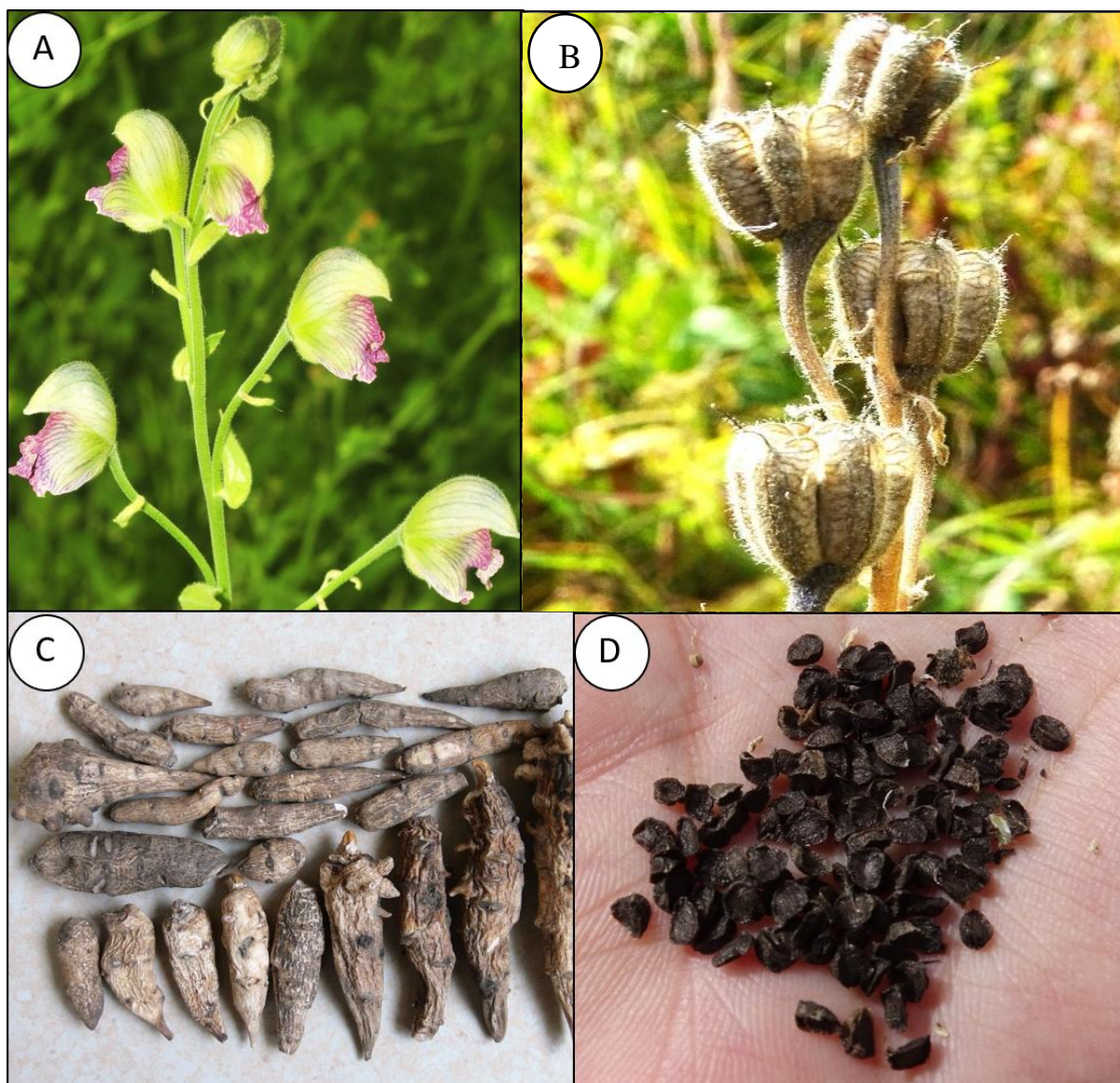


Plate 10: *Aconitum heterophyllum*; A- Flower, B- Follicle, C- Root, D- Seed 📷 A: Navendu Page; B & D: Amit Kumar; C: GS Goraya

Species and location profile

Etymology: *Aconitum heterophyllum* is a member Ranunculaceae, the buttercup family. The generic name *Aconitum* is derived from the Greek word 'akon' means an arrow possibly pertaining to its use in poisoning the tips of arrows; and the specific name '*heterophyllum*' refers to its heteromorphic (basal and cauline leaves of different shapes) leaves.

Vernacular name: Kadwa Patis, Atees and Kour

Trade name: Atees, Atis, Ativisha and Bonga

Unani name: Atees

Folk name: Patis

Ayurvedic name: Ativisha

Sanskrit name: Amrita, Aruna, Ataicha, Atisarangi, Ativisha, Bhangura, Bhringi, Madri, Ghunavallabha, Kashmira, Mahoshadha, Mridvi, Prativisha, Pravisha, Shringi, Vira, Virupa, Visha, Vishva, Shveta and Shyamkanta

Habitat and distribution

Habitat: Atis is distributed in the sub-alpine to alpine regions of the Himalaya between 2400-4500m amsl (Ved et al. 2015). It is commonly found in grassy meadows, upper Oak or coniferous forest, *Rhododendron* forest, margins of *Quercus-Abies* forest, glacial riverine, rocky moist areas, alpine dry scrub, open grassy slopes, alpine slopes, shady moist alpine slopes and forest edges (Samant et al. 2008; Bhat et al. 2014).

Global distribution: Globally, the species is distributed in Nepal, Pakistan and India. In India, Atis is found in Himalayan states namely, Himachal Pradesh, Uttarakhand and Jammu and Kashmir (Ved et al. 2015). In Himachal Pradesh, it has been recorded in Sangla, Rohtang, Churdhar, Maral Danda, Gamgul, Saru thach, Shagali thach, Chansal thach, Kangra, Mandi, Kullu, Shimla, Chamba, Lahaul and Spiti, Pangi, Dalhousie, Manali, Kinnaur, Rajgarh, Parvati valley (Samant et al. 2008). In Jammu and Kashmir, it has been reported in Saithal, Scoj and Kihoi in Anantanag, Akad Patree Nallah, Dang Tangmarg, Kandwa forest, Gulmarg, Aharbal and upper Dachigam National Park (Beigh et al. 2006). In Uttarakhand, *A. heterophyllum* has been recorded in Kharsoli, Dodital, Suki, Gangi, Gangnani, Nawali, Huri, Pilang, Sauragad, Pindarpar, Dayara, Rudranath, Kuari pass, Kyarki, Bedani, Tehri, Uttarkashi and Rudraprayag (Rawat et al. 2016).

Approximately 400 species of *Aconitum* have been reported in the world (Selvam et al. 2015). In India, 27 species of Aconites have been reported, of which 12 and 16 species are distributed in the Western Himalaya and Eastern Himalaya, respectively (Agnihotri et al. 2015). Of these, 18 species have poisonous or medicinal properties (Selvam et al. 2015). In the IHR, maximum species (13) are recorded in Sikkim followed by Jammu and Kashmir (11), Himachal Pradesh, Arunachal Pradesh and West Bengal (10 each), Uttarakhand (07), Manipur (02) and (Nagaland (01) (Agnihotri et al. 2015).

Morphology and phenology

Taxonomic description: Perennial, showy herb, erect, up to 1.2m tall. Stem long, simple or branched at the base, glabrous and puberulous above. Leaves broad, heteromorphic, basal leaves long, petioled, ovate or five-lobed and toothed, upper trifid or entire. Flowers large, 0.25cm long, helmet shaped, bright, blue or greenish-blue with purple veins, simple or somewhat spike-

like terminal racemes, rarely sub-panicled with axillary racemes, lower and upper bracts foliaceous, ovate or lanceolate, margins lobed, elliptic, entire or crenate. Follicles five, hairy.

Flowering and fruiting: August to October in the third year of growth with vibrant blue or greenish-purple flowers.

Population status

A. heterophyllum is restricted to a narrow geographical range with rigid ecological adjustments that make it difficult to invade new areas for survival and development. Besides this, the species of the north-west Himalaya has been strictly localized with thin-scattered populations to bounded ecological niches (Beigh et al. 2006). Population density of *A. heterophyllum* varies according to location and elevation for instance, the density has been reported between 1-3.7 (individuals m⁻²) in Himachal Pradesh (Singh et al. 2008; Uniyal et al. 2006). Similarly, in Uttarakhand, the density varied from 1-6.3 (individuals m⁻²) (Nautiyal et al. 2002; Rawat et al. 2016). Furthermore, Baig et al. (2014) reported 99-300 individuals of *Atis* in 4 km² in Jammu and Kashmir.

Conservation status

Whereas, *Aconitum heterophyllum* has been categorized as EN (Endangered) in the country following the IUCN Red List Criteria (Ved et al. 2015), it has been assessed as CR (Critically Endangered) in the regional CAMP workshops conducted during 2003 and 2010 due to drastic reduction of its wild populations in Himachal Pradesh (Ved et al. 2003; Goraya et al. 2013). Kumar et al. (2016) also report it under CR category due to excessive collection from the wild.

Potential threats

The species has been directed to numerous threats such as habitat loss, unsustainable harvesting practices, illegitimate trade, over-exploitation, overgrazing and also due to prolonged seed year and high seedling mortality (Belt et al. 2003; Beigh et al. 2006). Beside these, untrained and unskilled labourers, absence of forest staff at remote sites and specific site trampling also contribute to decline in its wild populations (Rai et al. 2000).

Medicinal uses

Tubers of this species find medicinal uses in Indian health care traditions, both the folk and the classical. The major uses are in fever, rheumatism and stomach ache, the tubers are also used in diarrhea, gastric trouble, headache, intestinal pain, hysteria, malaria, helminthiasis, hemorrhoids, cough, diabetes, dyspepsia, hemorrhage, vomiting and piles. The plant has several properties such as tonic, aphrodisiac, thermogenic, and expectorant, alexeteric, febrifuge, astringent, stomachic, digestive and anti-periodic. Major active chemicals constituents that contribute to its healing property includes atisine, heterotisine, histisine, heterophyllisine,

heterophylline, heterophyllidine, atidine and hitidine, aconitic acid, tannic acid, a mixture of leic, palmitic, srearcic, glycerides and vegetable mucilages are also present in addition to starch and sugar (Samant et al. 2008). It is also used in preparation of specific herbal formulations such as Balachaturbhadra churan, Ativishadi churna, Ativishadi vati, Chandraprabha vati, Khadiradi vati, Kutajghan vati and Rasnairandadi kashayam (Singh, 2017). Apart from the medicinal uses, the leaves and roots are often considered as a source of vegetable (Kunkel, 1984; Khare, 2004).

Market and trade

Tubers extracted from various *Aconitum* species in the high altitude sub-alpine and alpine meadows in the Western Himalaya are traded as raw drugs. There is a vast variation in the size and shape of Atis tubers traded in the market (**Plate 11**). Suspected adulteration of Atis with similar looking tubers of other species has been observed in the market (Goraya and Ved, 2017).



Plate 11: Market samples of *Aconitum heterophyllum*  GS Goraya

In India, all *Aconitum* species are prohibited for export if the plants are collected from the wild. Raw drug obtained from cultivated material can however, be exported. The reported total annual consumption of raw *Aconitum heterophyllum* by domestic herbal industry and rural households was 127.65 and 25.80 MT respectively, whereas, the annual trade of raw drug was assessed to be 100-200 MT (Goraya and Ved, 2017). According to Samant et al. (2008), average market price of *Aconitum heterophyllum* varied from Rs. 2200 \pm 282.84 to Rs. 4800 \pm 282.84 (Rs/kg \pm SD) in major markets such as, Kullu, Solan, Dehradun, Amritsar and Delhi (**Table 14**).

Table 14: Price of *Aconitum heterophyllum* in different markets.

Sr.no.	Market/Places	Market price (Rs/kg)	Average market price (Rs/kg \pm SD)
1.	Kullu	2200-2400	2200 \pm 283
2.	Solan	3900-4300	4100 \pm 283
3.	Dehradun	3700-4400	4050 \pm 495
4.	Amritsar	4600-5000	4800 \pm 283
5.	Delhi	3300-4000	3850 \pm 495

Based on the present study (2019-2020) on MAPs in Lahaul-Pangi landscape, Himachal Pradesh, the average market price of *A. heterophyllum* has been recorded between 1766.66±145 to unusually high 10,000±1154 (Rs/kg±SD) in major markets such as, Udaipur (Lahaul), Killar (Pangi), Keylong, Manali and Amritsar (Table 15).

Table 15: Price of *Aconitum heterophyllum* in various raw drug markets.

Sr.no.	Market	Market price (Rs/kg)	Average market price (Rs/kg±SD)
1.	Udaipur, Lahaul	2000-2500	1766.66±145
2.	Killar, Pangi	4000-6000	4166.66±601
3.	Keylong, Lahaul	3500-5000	4000±289
4.	Manali	8000-10000	9000±577
5.	Amritsar	10000-12000	10000±1155

As per HPFD (2017-2018), the estimated volume of the *Aconitum heterophyllum* tubers extracted from the Lahaul and Pangi landscape during the year 2017-18 and 2018-19 was 187 qtls. Of this volume, 104.35 qtl. of roots were collected in Pangi Forest Division, Chamba that issued 74 permits to locals/local traders for harvesting of *A. heterophyllum* in Sach, Killar and Purthi Forest Ranges (HPFD, 2018-2019). Owing to high trade *vis a vis* drastic reduction of the wild populations of *A. heterophyllum*, it has been proposed for inclusion in the Convention of International Trade in Endangered Species (CITES) appendices, but is yet to be included.

Good harvesting and collection practices

With cultivation of Atis yet to establish to commercial scale, the continuing demand of Atis by the domestic herbal industry is likely to subject wild populations to increased harvesting pressure. In Atis, tubers being the underground part need to be dug up from the soil causing adverse impact on its populations unless followed by good harvesting practices.

Good harvesting practices of Atis are aimed at getting the maximum possible yield with optimum alkaloid content on sustainable basis, and ensuring long shelf life of the produce. A look at the usual harvesting practices would reveal that in order to meet its rising market demand, Atis tubers are harvested (a) before these are fully ripe, (b) before the seeds have fully ripened and shed, (c) by deep digging of soil damaging other surrounding plants, (d) by removing the entire tubers, and (e) without giving prescribed rest to the harvested area. Some of the harvested produce gets damaged due to its poor post-harvest handling, putting greater pressure on the wild resource. It, therefore, become necessary to educate the wild gatherers about the damages done by reckless wild harvest and the advantages of the good harvesting and post-harvest handling practices.

Harvesting

In view of the sustainable harvesting framework, the following good harvesting practices are suggested for Atis

What to collect: It is the tubers that need to be harvested in case of Atis. The first and the foremost best harvesting practice are to critically identify the harvestable Atis plant before its digging up to avoid wasteful digging and damage to its young plants and other plants. The top part of the tuber has good capacity to regenerate, and as such it is desirable to chop off the top part and put it back in the dug-up hole and stump the soil around.

What stage: The plant should be harvested when the tubers are mature and seeds have ripened and are shed or ready for dispersal. It normally takes three growing seasons for the plant to reach this stage. Besides it, elevation also defines the completion of reproductive phase, for example in alpine areas, it can be achieved in the last week of October to first week of November while at lower elevation it is in the first fortnight of October. According to NMPB (2008) maximum yield per plant is obtained during the months of October-November, whereas highest active ingredient is reported during July-August. Therefore, harvesting should be done at the stage that provides optimum yield as well as alkaloid content.

When: Harvesting of Atis tubers involves digging of soil that becomes prone to erosion if it follows rainfall. The season of its harvest should, therefore, be after the rains. For Lahaul-Pangi landscape, the traditional wisdom lays down that harvesting of mature tubers from high altitude areas should be carried out after 'bees bhadon' (after mid-September). It is to be appreciated that the tubers mature by this time, the seeds have ripened, and the rainy season gets over. This season also provides the optimum yield with optimum alkaloid content.

How: Digging should be carried out with proper tools to carry out only the bare minimum digging necessary for taking out the tuber without causing damage to the adjoining plants. It is advised to separate the top portion of the tuber at site and leave it in the dug-up portion for its regeneration.

How much: As a thumb rule, only the mature tubers having one fresh whitish daughter tuber and two darker mother tubers should be harvested and all young plants to be left unexploited. Of the mature plants one third should be kept for regeneration security. One of the management prescriptions for maintaining such harvesting discipline is to revisit the harvested blocks for next harvesting at intervals of three years.

Post-harvesting handling

Good post-harvest handling of the dug-up tubers includes a series of steps from sorting to grading before transporting to market. Sorting is the first step where the unwanted plant debris is removed. The tubers are then hand rubbed or washed and then further dried to decrease the moisture content. Drying should be at room temperature or partial shade, it is important to note that direct exposure to the sun should be avoided completely. After complete drying, tubers are graded according to the age of tubers (mother or

daughter tubers) and size. The completely dried tubers can be stored in jute bags, gunny bags, woven sacks, wooden boxes and airtight polythene bags for transportation for further processing (Sharma et al. 2013).

Cultivation and propagation

Resource base of *Atis* needs to be augmented in order to meet the growing market demand of its tubers. Whereas, efforts are afoot to build its wild populations, *Atis* can also be cultivated as a cash crop by propagating through seeds, tuber segments, or young leafy stems.

For getting seeds, the *Atis* capsules (fruits) should be collected when it starts turning light brown and are ready for seed dispersal. For better germination of seeds, it should be collected from late October to mid-November during morning hours (NMPB, 2008). Pre-treatment of seeds with hot water at 45-50°C for 90 seconds enhances the germination process (Pandey et al. 2005). For future use, the seeds could also be cryopreserved at 4°C temperature and 5% moisture level (Kushwaha, 2010).

The species generally prefer sandy, loam, porous and acidic soils whereas; climate should be cool and temperate for proper growth and development of the plant. It can be cultivated at the elevation between 2200-4200m amsl. During pre-land preparation, 75-80 qtl. manure ha⁻¹ is required and the land needs to be ploughed or dug twice and left for 15-20 days. One-kilogram seed ha⁻¹ is required for sowing. Sowing should be done during October-November at a distance of 30cm x 30cm. If cultivated at lower elevation, irrigation must be done every 24 hours for six months. During winters, irrigation is required once in 15-20 days. Frequent weeding is to be done during the summers and rainy season (Samant et al. 2008). At the end of the third growing season, 1-2 daughter tubers are produced and collected during the autumn season (after the senescence of aerial shoots) and can be replanted during spring season. Generally, new plants produce leafy shoots during the first year of the growth while the cultivated plants produce flowers during the second year of growth (Paramanick et al. 2017). For vegetative propagation, top segment is preferred over middle and basal segments (NMPB, 2008).

4.8.2 *Dactylorhiza hatagirea* (D.Don) Soó

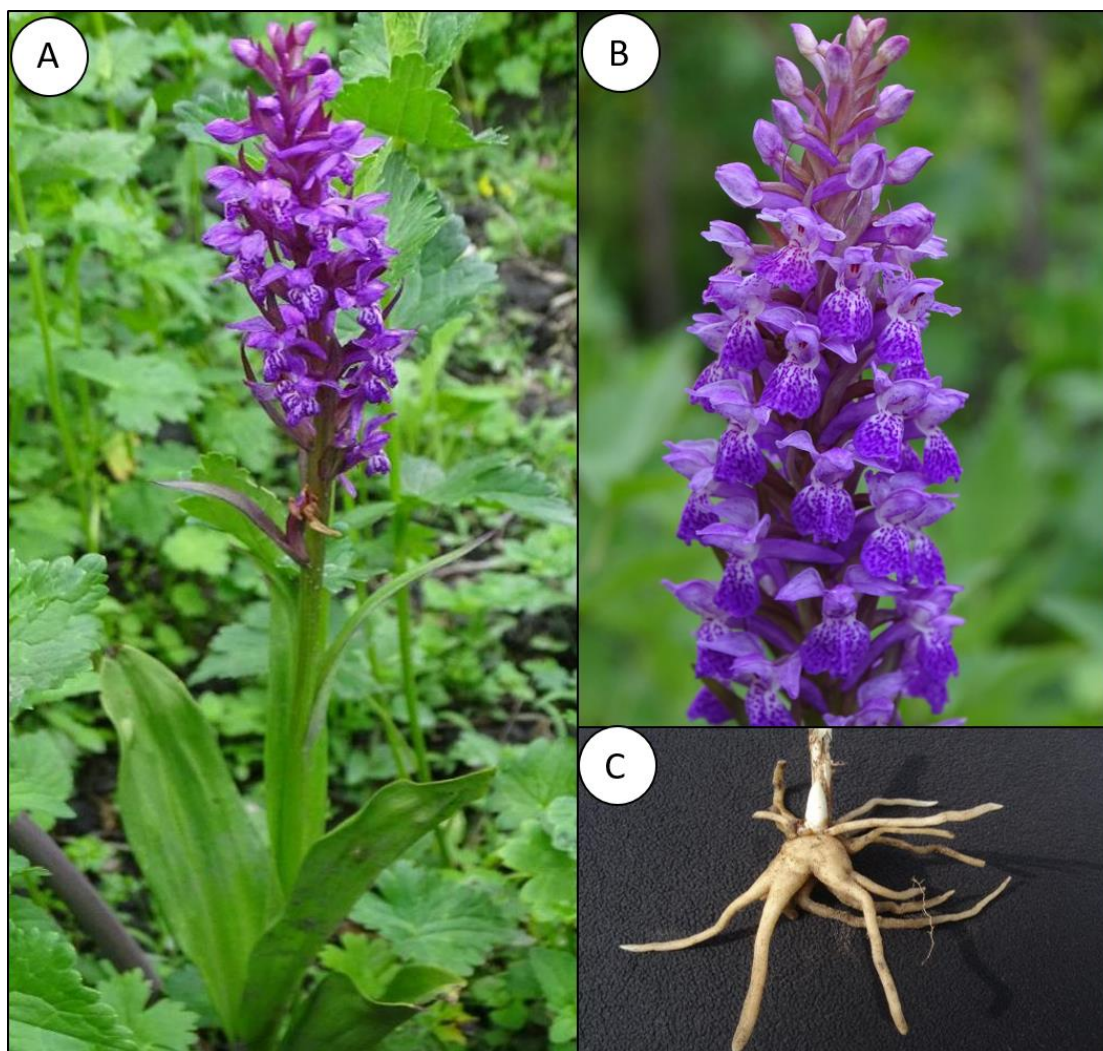


Plate 12: *Dactylorhiza hatagirea*; A-Whole plant, B- Flower, C- Root 📷 Amit Kumar

Species and location profile

Etymology: *Dactylorhiza hatagirea* is a member of the family Orchidaceae. The generic name of *Dactylorhiza* is derived from the Greek word 'daktylos' means finger and 'rhiza' means root, referring to the palmately 2-5 lobed tubers.

Vernacular name: Hathjadi, Hatpanja

Trade name: Salampanja

Unani name: Buzidan, Salab misri

Folk name: Salampanja, Hatthajari, Panja, Hathpanja, Salep

Ayurvedic name: Salampanja

Sanskrit name: NA

English name: Himalayan marsh orchid, Spotted orchids

Habitat and distribution

Habitat:

The light demanding species *Dactylorhiza hatagirea* is widely and narrowly distributed at an elevational range between 2500-5000m amsl. The species prefers to grow in open grassy slopes, alpine meadows and moist temperate places (Bhatt et al. 2005). The main associate species include *Rhododendron anthopogon*, *Nardostachys jatamansi* and *Aconitum* spp. (Prasad, 2016).

Global distribution:

The plant is native and near endemic to the IHR, its distribution extends to Pakistan, China, Afghanistan, Nepal, Tibet and Bhutan. In India, *D. hatagirea* is reported from Jammu and Kashmir, Sikkim, Arunachal Pradesh, Uttarakhand and Himachal Pradesh (Pant and Rinchen, 2012). In, Uttarakhand, it has been recorded in Kumaon and Uttarkashi. In Himachal Pradesh, Hathjadi is found in Kullu (Seraj, Chandrakhi, Parvati valley, Kanawar, Manali and Kais WLS, Lag valley, GHNP, Jagatsukh and Hamta catchment, Chhakinal), Mandi (Shikari Devi, Nargu WLS, Kamarunag), Shimla (Hattu, Chpal, Roharu, Kotgarh), Chamba (Bhamour, Dalhousi, Pangi, Satrundi), Kinnaur (Sangla and other high-altitude areas), Kangra (Chopta, Bada Bhangal), Sirmour and Lahaul and Spiti (Sisso, Koksar, Shego, Mudh, Mane, Rangrik and Spiti valley) (Kalsang, 2016).

Morphology and phenology

Taxonomic description:

Terrestrial, erect herb up to 60cm high, with palmately divided tuberoids. Leaves are broadly lanceolate or oblong-ligulate or elliptic. Flowers purplish-lilac, rose or rarely white, in many-flowered densely cylindric inflorescence (Baral and Kurmi, 2006). The special character of this plant is that, it remains erect in excessive snowfall. Inflorescence is raceme, 5.0-15.0cm long, crowded with many flowers. Flowers are purple and the bracts green, narrowly lance shaped, lower bract longer than the flowers, upper slightly shorter. Flowers are about 1.8cm long, including the curved spur. Sepals and petals are nearly equal, three of them form a hood and the two sides spread outwards. The lip is rounded and shallowly 3-lobed, spotted dark purple. Spur straight, cylindrical, nearly as long as the ovary; column very short; anther adnate to its face, cells diverging; pollinia 2, caudicles attached to 2 small globose, viscid glands enclosed in a minute pouch overhanging the broad, 2-lobed stigma.

Flowering and fruiting: June-July and August-September, respectively

Parts used: Roots and tubers

Population status

D. hatagirea is an important ornamental and medicinal plant, reduced rapidly because of low germination rate, habitat fragmentation and human over-exploitation. Lacking endosperm, the seeds of *D. hatagirea*

can germinate only with symbiotic fungi in natural conditions (Aggarwal and Zettler, 2010). The bulk demand of *D. hatagirea* for its medicinal value cause the over-exploitation of wild resources. According to Warghat et al. (2012), habitat fragmentation and population deterioration will increase mating opportunities between closely related individuals and finally result in loss of genetic diversity. As per Singh et al. (2019), population density of *D. hatagirea* varies from 0.03-3.58 individuals m⁻² in GHNP.

Conservation status

D. hatagirea has been categorized as rare (Samant et al. 2001), Critically Endangered (Kala, 2000; Goraya et al. 2013; Goraya and Ved, 2017), Endangered (Chauhan et al. 2014) and listed under appendix II of CITES (Uniyal et al. 2002).

Potential threats

D. hatagirea can be considered inherently slow growing and poorly regenerating species, because of pollinator specificity and requirement for mycorrhizal association (Bhatt et al. 2005). Due to its high medicinal and edible value, the species has great demand in national and international markets. Anthropogenic disturbances such as, grazing pressure, low rate of propagation, poor seed germination, habitat destruction, over-exploitation and unavailability of proper procedure of collection and propagation are the major factors for declining this species from its natural habitats (Pant and Rinchen, 2012).

Medicinal uses

Tubers have properties such as cooling, emollient, astringent, aphrodisiac, demulcent, rejuvenating and nerve tonic. It is useful in diabetes, hemiplegia, dysentery, phthisis, chronic diarrhea, seminal weakness, neurasthenia, cerebropathy, emaciation and general debility. A decoction of tuber is given in colic pain. Powder is used to relieve fever; it is sprinkled over wounds to check bleeding. Root is also used in urinary troubles, also used as farinaceous food (Baral and Kurmi, 2006). The major active chemical constituents that contribute to its healing property includes glucoside, a bitter substance, starch, mucilage, albumen, a trace of volatile oil and ash. The major active constituents include dactylorhins A-E, dactyloses A and B and lipids are the major constituents.

Market and trade

The annual demand of Hathjadi is approximately 5000 tons due to presence of high value secondary metabolites such as dactylorhin and dactyloses which are responsible for its pharmacological activity. Unfortunately, it has led to over-exploitation of the species from wild habitats. Local inhabitants use this high value medicinal plant for illegal trading. The local inhabitants gather dried roots of *D. hatagirea* at the cost of Rs. 100-200 kg⁻¹ (Goraya and Ved, 2017). As per rough estimates, 90 to 100 mature plants are exploited for 1 kg of dried roots. As a result, the population is declining very fast, this indicates that if

the careless factors continue to function, this species might become extinct within a few years. In India, *Dactylorhiza* species are prohibited for export if the plants are collected from the wild. Raw drug obtained from cultivated material can however, be exported. The reported total annual consumption of raw *Dactylorhiza hatagirea* by domestic herbal industry and rural households was 9.03 MT respectively, with its annual trade being about 10 MT (Goraya and Ved, 2017).

Good harvesting and collection practices

D. hatagirea is a high value medicinal plant which has been used since ages for human consumption due to its exclusive effects on human body such as sexual stimulant and aphrodisiac. These unique properties of plants are due to presence of unique secondary metabolites present in them. Collection of rhizomes should be done only after flowering of plants, for sustainable harvesting. Collection of mother plant takes place by leaving one immature tubers by filling with layer of soil with the help of sharp kuto (a small spade like hand tool). September to November is the harvesting period after seed ripening and fall. Proper care of the surrounding vegetation should be taken while rooting out the tubers of the *D. hatagirea*. Collection of plant should be done by applying rotating system. For harvesting, the rotation of the plant is 4-5 years. Sustainable harvestable amount is 80%. For the protection of rare and endangered orchid species, both *ex-situ* and *in-situ* approaches are important.

Harvesting

In view of the sustainable harvesting and collection framework, the following good harvesting practices are suggested:

What to collect: It is the tubers that need to be harvested in case of Hathjari. The first and foremost best harvesting practice is to critically identify the Hathjari plant before it's digging up to avoid wasteful digging and damage to other plants.

What stage: Tubers are harvested after five years for high yields though they can be harvested after 2-3 years also. The tubers should be collected after seed maturity in late September.

When: Harvesting of Hathjari tubers involves digging of soil that becomes prone to erosion if it follows rainfall. The season of its harvest should, therefore, be after the rains. It is to be appreciated that the tubers mature by this time, the seeds have ripened, and the rainy season gets over. This season also provides the optimum yield.

How: Digging should be carried out with proper tools to carry out only the bare minimum digging necessary for taking out the tuber without causing damage to the adjoining plants. It is advised to separate the top portion of the tuber at site and leave it in the dug-up portion for its regeneration

How much: Only the mature tubers should be harvested and all young plants to be left unexploited. Of the mature plants one third should be kept for regeneration security. One of the management

prescriptions for maintaining such harvesting discipline is to revisit the harvested blocks for next harvesting at intervals of 2-3 years.

Post harvesting

The collected tubers/rhizomes undergo various processes to get the best out of them. Sorting and grading are done for removing and separating unwanted and damaged or immature material. The cleaning of crop is done before drying and again before packaging to ensure that the tubers is of the best quality. This is followed by drying of the tubers in the sun or in shade as required, which prevents deterioration of the product and allows storage in a stable condition. After properly drying old tubers are separated from young tubers and steeped in hot water for 1 hour. The outer membranes of the tubers are removed through this process and the tubers turn light yellow in color. These are then sun dried and can be preserved for a long time. After completion of all the process the processed materials should be protected from contamination and decomposition, the dried tubers stored in airtight bags for further transporting to the market (Nautiyal and Nautiyal, 2004).

Techniques of cultivation and propagation

Dactylorhiza favors acidic and sandy loamy soil with rich organic manure and sufficient moisture. The healthy plant development and rooting requires 80-90% humidity. The flowering season starts in early June and spreads up to July end. Subsequently the fruiting season starts in August-September. It is generally propagated vegetatively using rhizomes, which is collected after flowering while it may also be propagated through seeds. During pre-land preparation, 5ton manure is required for one hectare of land. Manure requirement increases at lower altitudes and at 1800-2000 m approximately 10.0 - 15.0 t/ha manure is required. Sowing should be done during August-September at a distance of 15cm x15cm. The mature fruits are collected in September and air dried for 2-3 weeks to extract the seeds and stored at low temperature until used (Warghat 2015). Being very minute in size, seeds are mixed with sand before sowing. Seeds require symbiosis with mycorrhiza for germination and only 0.2% germination is observed under natural habitat. Tubers may be harvested after seed maturation during mid-September to October end. The plants that are developed from the tubers become ready for harvesting in two years. About 3.5 – 4 qt/ ha dry tubers could be harvested from the well-maintained field. However, being recognized as a critically endangered plant species it is recommended that only 80% tubers should be harvested as measure of *in situ* conservation (Chaurasia et al. 2007).

4.8.3 *Bunium persicum* (Boiss.) B.Fedtsch.

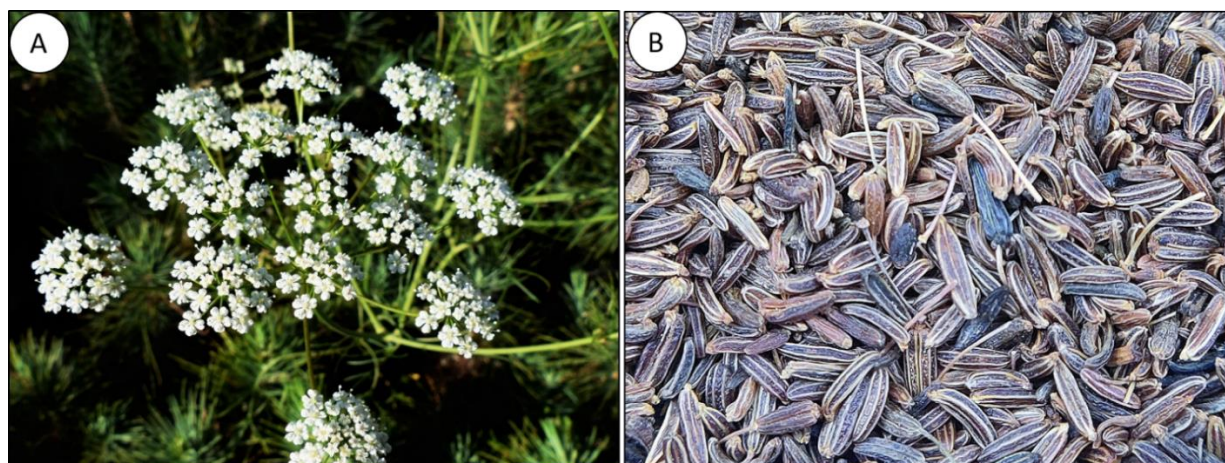


Plate 13: *Bunium persicum* (A) Flower (B) Seed 📷 GS Goraya and Sipu Kumar

Species and Location Profile

Etymology: *Bunium persicum* (Boiss.) B. Fedtsch species belongs to the family Apiaceae. The commonly used Hindi term shahi zeera may be a distortion of syahi (black in Persian) zeera. However, in the Hindustani language, the term syahi also means "inky black".

Vernacular name: Jeera (Lahaul & Spiti), Singu (Miyad), Kala Zira (Kinnaur), Black cumin, Kalajira, Umbu, Siahzira

Trade name: Kala zeera

Unani name: Kala zeera

Folk name: Kala zeera

Ayurvedic name: Kala zeera

Sanskrit name: Krishna jiira

Habitat and Distribution

Habitat:

Bunium is a perennial aromatic plant with small white or pink flowers and small brown beans growing wild in areas of Alpine dry slopes especially in Lahul & Pangi. It is Native of limited zones of the West Asia (Singh et al. 2009; Behtoie et al. 2012). The plant is likely to prefer a well-drained light to medium soil in sun or light shade. In Himachal Pradesh it is found in Lahual & Spiti, Chamba and Kinnaur, Pangi, Miyar Valley, Pattan valley, Gahar valley, Spiti and Shong at the elevation range of 2500- 4000 masl (Ravikumar et al. 2018; Gupta et al. 2012; Chauhan, 1999).

Global distribution:

A native of the temperate to subtropical zones, the plant can be grown as an annual in more tropical areas. The global distribution is mainly confined to Northern Asia, North Africa, South Europe, Southeastern Europe, Siberia and western Asia. It is found in the high-altitude regions of Iran and some parts of Afghanistan, Pakistan and Tajikistan in addition to India (Panwar, 2000; Hanelt et al. 2001). In India, it is distributed in Kashmir such as Paddar valley (Gupta et al. 2013) and Gurej valley (Goraya et al. 2013) and the high-altitude regions of Himachal Pradesh, including the Chamba, Kinnaur, Lahaul and Spiti at an elevation ranging from 1500-3500 masl (Ravikumar et al. 2018; Gupta et al. 2012; Chauhan, 1999) and, some ranges of Uttarakhand Himalaya (Chahota et al. 2017).

The genus *Bunium* contains about 166 species, including *B. persicum*, *B. carum*, *B. bulbocastenum*, *B. copticum*, *B. flexuosum*, *B. elegans*, *B. cylendricum* and *B. chaerophyllocides* that are prevalent in Central Asia, Caucasus, Crimea, and Europe (Vasilava et al. 1985).

Morphology and Phenology

Taxonomic description:

B. persicum has small (30 cm) to tall (80 cm) varieties which squeezed or expanded with large or small branches (Mandegari et al. 2012; Sofi et al. 2009). The plant is an erect, herbaceous perennial plant growing from underground tubers; it produces one or more stems that branch from the middle, growing from 40 - 60cm tall.

Flowering and Fruiting: It matures in the months of late July to August.

Conservation Status

The species is restricted to a narrow geographical range with rigid ecological adjustments that makes the species difficult to invade new areas for survival and development. *Bunium persicum* is endangered in the Himalayan region (Chauhan et al. 2020). It is also enlisted as Vulnerable (Goraya et al. 2013).

Potential Threats

The species is facing enormous threats not only due to the illegal trade and unscientific harvesting/exploitation it is subjected to, but also because of loss of its habitats, featuring unique topography and climatic conditions, due to development and degradation resulting in drastic decline in the wild populations of Kala zeera (Kala, 2000; Goraya and Ved, 2017). The fact that high demand and unorganized and destructive harvesting poses a major threat to the species and is a factor for the decline of its wild populations was also observed and found out as an outcome of the recent surveys in the Lahaul and Pangi landscape of Himachal Pradesh as part of this current study. The higher Himalayas are rich in the native and endemic biodiversity. The major threat to this habitat includes its unique topography,

physical features and harsh climatic conditions which have resulted into drastic decline of various taxa represented in the ecosystem (Kala, 2000; Srivastava, 2010).

Medicinal Uses

This plant and its derivatives are valuable compounds that have antimicrobial, free radicals scavenging, anti-parasitic, antioxidant, anti-inflammatory, anticonvulsant, antidiabetic, antiasthma, antispasmodic, antiepileptic, antiobstruction, diuretic and analgesic properties which indicate its high potential for use in the medicine and food industry (Hassanzad et al. 2018; Miraj and Kiani, 2016; Agah et al. 2013; Mandegary et al. 2012). Several therapeutic effects are explained for this plant in traditional and modern medicine. *B. persicum* is used for treating gastrointestinal and urinary disorders such as stomatitis stimulant, flatulent indigestion, dyspeptic headache, relieve of heartburn, colic, diarrhea, dyspepsia, hysteria, improving liver function and (Sofi et al. 2009). *B. persicum* is used for culinary intentions as a spice and flavoring agent in foods and beverages such as bread cooking, rice, yoghurt, cheese and in confectionery products. It has a strong earthy aroma is sharpened by frying and cooking it (Aminzare et al. 2017; Sharififar et al. 2010; Sofi et al. 2009). This plant is also used in the perfume and cosmetics (Salehi et al. 2008).

Market and Trade

The price along the trade chain was studied from the production level in landscape villages, small aggregation markets in towns and large mandis in cities. The current study result illustrated an increase in the price of MAPs when it moves from village to city. Based on field surveys, individual interviews, group discussions, visits to villages (29) and local markets. It generally collected in the month of late July-August. The high demand and monetary returns of dried seed ranged between 2500-7000 INR kg⁻¹ in 2019 and the annual estimated trade is < 10 MT (Goraya and Ved, 2017). *B. persicum* is also often adulterated with *Cuminum cyminum*, due to poor morphological identification between the two (Bansal et al. 2018). This has created ambiguity in terms of the ultimate market and real use of kala jeera in the region.

Based on WII's present study (2019-2020) on MAPs in Lahaul-Pangi landscape, Himachal Pradesh, the average market price of *B. persicum* has been recorded between 2800±100 to 3100±208.17 Rs/kg in major markets viz., Udaipur (Lahaul), Killar (Pangi), Keylong, Manali and Amritsar (**Table 16**).



Plate 14: Market sample of *Bunium persicum* © Himanshu Bargali

Table 16: Price of *Bunium persicum* in various raw drug markets.

Sr.no.	Market/Place	Average market price (Rs. /Kg) \pm SD
1.	Udaipur (Lahaul)	2800 \pm 100
2.	Killar (Pangi)	2333.33 \pm 88.19
3.	Keylong (Lahaul)	2833.33 \pm 202.7 6
4.	Manali	2500-3000
5.	Amritsar	3100 \pm 208.17

Good Harvesting and Collection Practices

Good harvesting practices are aimed at getting the maximum possible yield with optimum alkaloid content on sustainable basis, and ensuring long shelf life of the produce. The seeds sown during October-November germinate after the melting of snow in March-April. Chilling pre-treatment for 4-5 long months enhances the germination rate and is necessary for good germination. Seeds are small and therefore mixed with sand and then sown at 3-4 cm deep in soil in line.

Harvesting: In view of the sustainable harvesting framework, the following good harvesting practices are suggested

What to collect: The seeds are collected when the oldest fruits turn brown. Care is taken to avoid loss of seeds by shattering of the umbel. The crops raised through seeds take about 3 years time to bear fruits with viable seeds while the plants maintained through bulbs take less period for fruiting.

What stage: Normally the crop matures in late July or August depending on the climate and altitudes. Flowers bloom from mid-July to mid August and ripen in August. Browning of seeds indicates maturation. That means the total harvesting period lasts for 10-15 days.

When: Mature plants are harvested daily in the morning. The seeds are collected when the oldest fruits turn brown. Care is taken to avoid loss of seeds by shattering of the umbel.

Weed and pest control: Fields must remain weed free. Normally, 3 - 4 weeding operations are carried out at an interval of 20 - 25 days. In the first-year hand weeding is preferred to offer better protection to the juvenile plants. In the second year as the plants attain good height and therefore thorough weeding. White grubs and upper ground foliage attack the tubers by hairy caterpillars, armyworms and semi-loopers. Mixture of BHC / HCH or Aldrin 5% dust at the rate of 25 kg/ha is enough to control the white grub. Methyl parathion spray once in fortnight has been found effective for the diseases like semi - loopers, armyworms and caterpillars. It is suggested not to use any sort of inorganic pesticides. Spraying of biopesticides *Beauveria bassiana*, a fungus, at the rate of 5 ml per litre is very effective if the plants are well grown. In juvenile plants less concentration may be applied.

Post harvest handling: For better maturity and storage the fruit bearing harvested stalks are sun dried for 3 - 4 to 7 days depending upon the volume of the harvest and number of sunny days. The plants are spread out in loose bundles for drying. The seeds from the dried plants are separated with the help of beating sticks. The dried fruits are then threshed by hand or by threshing machines and are cleared by winnowing. The seeds are then stored in a paper bag or closed container and kept in a dark cool place. The dried seeds should be stored in airtight container. Further processing is done via steam distillation immediately after crushing. Distillation takes about 6-8 hours. The seed yield is on an average 0.5 ton/ha.

Cultivation and Propagation

Bunium requires well-drained acidic soil for optimum growth. Sandy loam soil that is rich in well-decomposed organic matter is preferred for cultivation. It can grow under semi-shade on gentle grassy slopes. Forest soil of low alpine pastureland is ideal for its growth. The species grows in the forests, grassy slopes and to some extent in the alpine pastures. High hill regions experiencing 1-5 m snow fall in winters and very low rains in summer are considered most congenial for germination, growth and development. Low rainfall during summer at flowering and seed setting stages contributes towards high yield, better flavour and quality of seeds. Kalajira is propagated mainly through seeds, but its subsequent growth and production is maintained by tubers/bulbs, which are formed 10-15 cm deep in the soil by the germinating seedlings. It requires three-four years to produce viable seeds. From the same new seed crops are raised through seed. Plants raised through 7-8 years old tuber produced more branches, an average height of 50-60 cm with 40-50 cm spread.

Land preparation and soil work: The land attains a fine tilth after 2-3 rounds of deep ploughing after which, well rotten farmyard manure is mixed with the soil at the rate of 3500 kg/ha or an equivalent of 280-300 kg/bigha. A sufficient gradient is provided to the land by ploughing and levelling of the soil for facilitating drainage.

Nursery preparation: If sown in November the germination occurs in April. Maximum 200 g seeds may also be required for gap filling in the subsequent year. The maintenance of 2 lakhs plants per ha is ideal. As the seeds are very small in size, they are mixed with sand properly. Lines of furrows are prepared around 40-50 cm apart. The seeds mixed with soil should be properly placed within the furrows at around 1.5-2 inches deep. The seeds should be immediately covered with a thin layer of soil.

Transplantation: *Bunium persicum* should be grown in full sun. Even in the partial shed its growth is hampered although it may adopt the later but yield becomes less. When large enough to handle, the seedlings are pricked out into individual pots and grown them in the greenhouse for at least their first winter. It is advisable to transplant them out into field only in late spring or early summer when there is no expectation of frosts. The plants grow about 20 -30 cm in the first year and 60-80 cm in the second year. Distance between the plants should be maintained 8-10 inches. Theoretically 10-15 cm between the rows and 15 cm between the plants are an optimum option. But distance between the individuals as well as between the rows should be 45-50 cm to achieve the maximum production.

Vegetative propagation: The species can also be propagated through bulbs. A bulb of the age of one or two years produces maximum one or two plants while from a third-year bulb 4-5 buds may be developed. Tubers also require long chilling period for better sprouting and initiation of floral primordial. 1-1.5 kg of seeds is required at first sowing and re-seeding in subsequent years requires 200 g/ha to maintain optimum plant population

Water management: The first irrigation in the form of sprinkling is given just after seed sowing. The water requirement of *Bunium persicum* is not very high. About 2-5 irrigations are sufficient for reaping a good harvest. The irrigation should preferably be given before weeding to moisten the soil and weeding becomes easier. Other optimal times for irrigation are at peak time of flowering and formation of fruits.

4.8.4 *Sinopodophyllum hexandrum* Royle

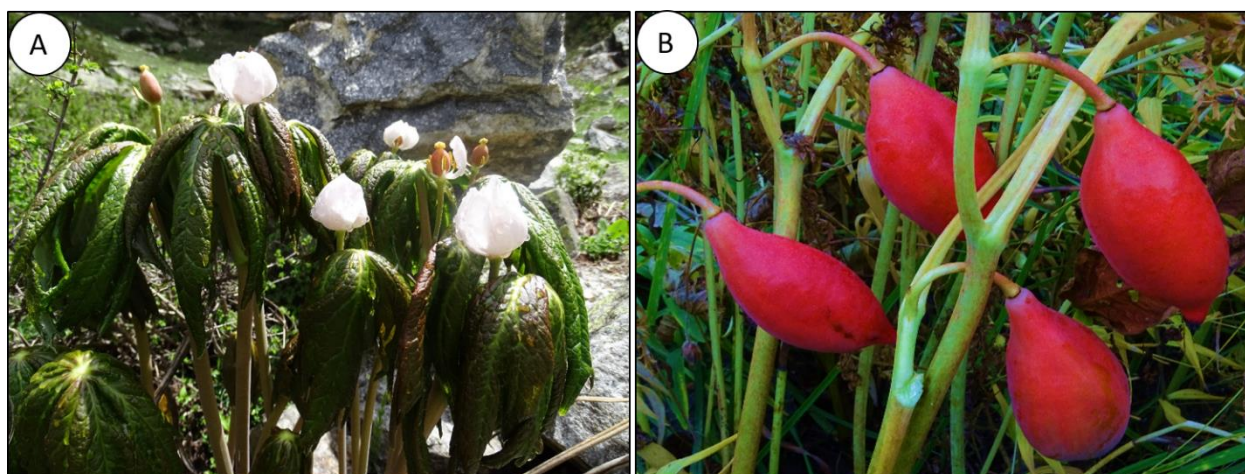


Plate 15: *Sinopodophyllum hexandrum* Royle A. Plant in flowering, B. Fruit 📷 Amit Kumar

Species and Location Profile

Vernacular name: Bankakri

Trade name: Bankakri

Folk name: Bana-kakari (Punjab), Venivel (Gujarat), Patvel (Maharashtra), Paapraa, Paapri.

Ayurvedic name: Vanyakarkati, Giriparpata

Sanskrit name: Vana vrintaka

English Name: Indian Podophyllum

Habitat and Distribution

Habitat:

Sinopodophyllum hexandrum is distributed in the sub-alpine to alpine regions of the Himalaya from 2400-4200 m above mean sea level (Rajesh et al. 2014). The species thrives best as undergrowth as well as in forests in well drained humus rich, glacial riverine, rocky moist areas, alpine dry scrub, open grassy slopes, alpine slopes, shady moist alpine slopes and forest edges (Sharma and Sharma, 2018; Pandey et al. 2007).

Global Distribution:

Globally it is distributed in the Eastern North America and in bolt continental and insular East Asia. It is mainly found in different areas of China, Yunnan, Himalaya, USA, Bhutan, Indo- China, India. Four in India, *Sinopodophyllum hexandrum* has been reported to be distributed in all the Himalayan states like Jammu & Kashmir, Himachal Pradesh, Uttarakhand and Sikkim. In Jammu & Kashmir it is reported to occur at, Daitwas forest, Gilgit Gulmarg, Jagran river bank between Kundi & Shikar, Kishenganga valley, Kanasar, Jhelum basin, Khelanmarg, Lidwas; Muzafarabad range forest, Sind Valley, Tanmarg forest, Zaskar, Mechigaon, Zozila pass, Trumba, Dagoum, Chandanwadi, Seshnag, Kargil, Pissughile,

Pahalgam, Tanmarga. In Uttarakand, it is reported from, Deoban, Kanjatra, Konain, Rudgaria Gar, Bhillangana, Panwali, Jamnotri, Jamunachatti, Barkot, Dodital, Gaumukh, KedarKanta, Dasoli, Mundali, Bhyander, Hemkund, Madhya Maheshwar, Tunganath, Pindari glacier, Kutti, Yankti river valley, Bogudiar, (Pithoragarh). In Sikkim it is reported to occur at Chamnaga, Thangu, Tsomgo, Chanaga, Thangu (Shah, 2006). In Himachal Pradesh it is reported from, Chamba, Chulkot forest, Pangi, Killar, Sach Pass, Pulga, Haranghati pass, Pandrabis, Kala Tope forest, Keylong, Kullu, Lahaul, Pulga, Kangra, Matian, Shali hills, Narkunda, Dencho, Sissoo, Koksar, Dalhousie and Shimla (Sharma and Sharma, 2018).

The genus comprises of about 22 species, where 4 species (*S. hexandrum*, *P. versipelli*, *P. aurantiocaula* and *P. sikkimensis*) are reported from the I Himalaya (Airi et al. 1997).

Morphology and Phenology

Taxonomic Description:

S. hexandrum is erect herb, glabrous, up to 30 cm tall with creeping long knotty rhizomes. Stem one or two, simple, leafy without top. Leaves alternate, palmate, up to 25 cm in diameter, deeply divided in 3-5 lobes, toothed, purple spotted. Flowers are white to pinkish in colour, 4 cm across, appear in the fork of the stem. Sepals are 3 in number and petaloid. Stamens are usually 6. Fruits are ovoid, pulpy 5 cm long and scarlet when ripe.

Flowering & Fruiting: May-June and July-August.

Population Status

S. hexandrum prefers a moist peaty soil and filtered light or shade and grow in moist open woodland (Philips and Foy, 1990; Knight, 1980). Due to continuous exploitation and habitat destruction, certain species are becoming rare. It is hardy plants which can thrive up to about -20 Celsius; it takes some years to become established but is very long lived in suitable habitat (Facciola, 1990). Young leaves may be damaged by late frost but otherwise the plants are quite hardy. Young plants produce only one leaf each year; older plants have 2-3 leaves each year (Kaul, 1997). Export of Podophyllum from the wild is prohibited for the export from India under CITES. Material from only cultivated plants is allowed for export under cover of CITES export permit and legal procurement certificate (LPC) or certifies of cultivation from the designated authorities. Of the about 113 taxa, identified as threatened in Indian Himalaya, only a few species, for example, *Sinopodophyllum hexandrum* have been studied for in Western Himalaya (Chaurasia et al. 2012). Population density of *S. hexandrum* varies according to location and elevation such as the density has been reported 0.98 ± 0.24 in valley of Flowers National Park, 0.72 ± 0.30 Kedarnath Wildlife Sanctuary, 2.0 ± 1.0 Pin Valley National Park (Kala, 2005).

Conservation Status

It has been categorized as Endangered (Chaurasia et al. 2012; Goraya et al. 2013; Kala, 2000). Critically endangered (Goraya and Ved, 2017).

Potential Threats

The massive extraction of its rootstock over the last several decades leading to destructive harvesting, habitat degradation. The species, which grow very slowly, are becoming increasingly scarce due to intensive collection, lack of cultivation and to their own biological characteristic (Guerram et al. (2012), this has led to severe reduction in its population density and the species is now listed in endangered plant species category. A species without enough genetic diversity is thought to be unable to cope with changing environments or evolving competitors and parasites. Considering the importance, threat perception and need for sustainable supply of its rootstock, there is need of not only multiplying its stock (by organized cultivation) but also assessing the relative active content concentration in its population in different agro climatic region and also in different morphotypes (Sharma and Sharma, 2018; Chaurasia et al. 2012).

Medicinal Uses

Fruits, as such or in concentrated form are the best to use in medicine. Rhizomes are used for typhoid fever, jaundice, dysentery, chronic hepatitis, scofula, rheumatism, skin diseases, tumorous growth, kidney, bladder problems, gonorrhoea, and syphilis. The *Sinopodophyllum* is used for treatment of vaginal warts. Two derivatives of podophyllotoxin, called eloposide and teniposide are employed for treatment of cancers. Root paste is applied on ulcers, cuts and wounds (Sharma and Sharma, 2018; Chaurasia et al. 2012).

Market & Trade

In India, *Sinopodophyllum* species are prohibited for export if the plants are collected from the wild. Raw drug obtained from cultivated material can however, be exported. The reported total annual trade of raw *Sinopodophyllum hexandrum* by domestic herbal industry and rural households was 0.10 MT respectively, whereas, the annual trade of raw drug was 10-50 MT (Goraya and Ved, 2017).

Good Harvesting & collection practices

S. hexandrum is collected in large number from wild by the local community due to which the reduction in the population will be seen as compared to other plant parts so for the (a) collection of rhizomes the whole plant was ploughed, (b) lack of awareness indiscriminate cutting of grasses and bushes were done by local community. This has resulted in the reduction in the population of these plants. Another reason is the change in environmental conditions which is going on constantly. Further, some plant has habitat

specificity, some have narrow range of distribution, land-use disturbances by human beings, introduction of non- native's plant species or invasive species, change of habitat, climatic changes, heavy grazing pressure, explosion of human population, fragmentation and degradation of the plant density, population restriction and genetic drift are the potential causes of destruction of medicinal plant species.

Harvesting

In view of the sustainable harvesting framework, the following good harvesting practices are suggested:

What to Collect: The tubes, fruit and the whole plant of bankakri is harvested. To avoid wasteful digging and damage to other plants, proper identification of vankakri is importance.

What Stage: The roots and rhizomes are harvested from mid-September when the tuber is fully mature or the aerial parts begin to wither and dry.

When: The collection of *S. hexandrum* is from July to September. The plant should be collected after full maturity. The best harvesting time is when the aerial parts dry properly and tuber gets fully mature to get optimum yield.

How: Digging should be carried out with proper tools to carry out only the bare minimum digging necessary for taking out the tuber without causing damage to the adjoining plants. It is advised to separate the top portion of the tuber at site and leave it in the dug-up portion for its regeneration.

How much: The youngest top portion of the rhizome cuttings of 1.0-2.5 cm in length, bearing leaf primordium led to better sprouting in *Sinopodophyllum hexandrum* when planted in June-July in well prepared soil at a spacing of 30-30 cm (Nautiyal and Nautiyal, 2004).

Post Harvesting Handling

Roots and rhizomes are harvested after drying of above ground parts; rhizome dug out and washes with the water. Roots and rhizomes are then cut into pieces of 15 to 20 cm long, and dried under sun. The dried material should be stored in clean containers or gunny bags in a cool and dry place.

Techniques of cultivation and prapogation

S. hexandrum grows well in organic rich black soils with sufficient moisture. Partially shaded places favor survival and growth of the plants at lower altitudes. It can be propagated by seeds as well as from sections of rhizomes (Nautiyal and Nautiyal, 2004; Qazi et al. 2011; Sreenivasulu et al. 2009). Under natural conditions, seeds show erratic and poor germination. The seeds germinate after remaining dormant for one or two years. The main reason for poor seed germination seems to be postharvest care of seeds (Nautiyal et al. 1987). Seeds washed with water showed better germination than unwashed seeds (Bhadula et al. 1996). During pre- land preparation, 10 t/ha manure is required and the land needs to be ploughed or dug after 4-week interval. 7-8 kg seed is required for showing. Showing should be done during March-May (Sharma and Sharma, 2018; Chaurasia et al. 2012).

4.8.5 Rhubarb (*Rheum* spp.)

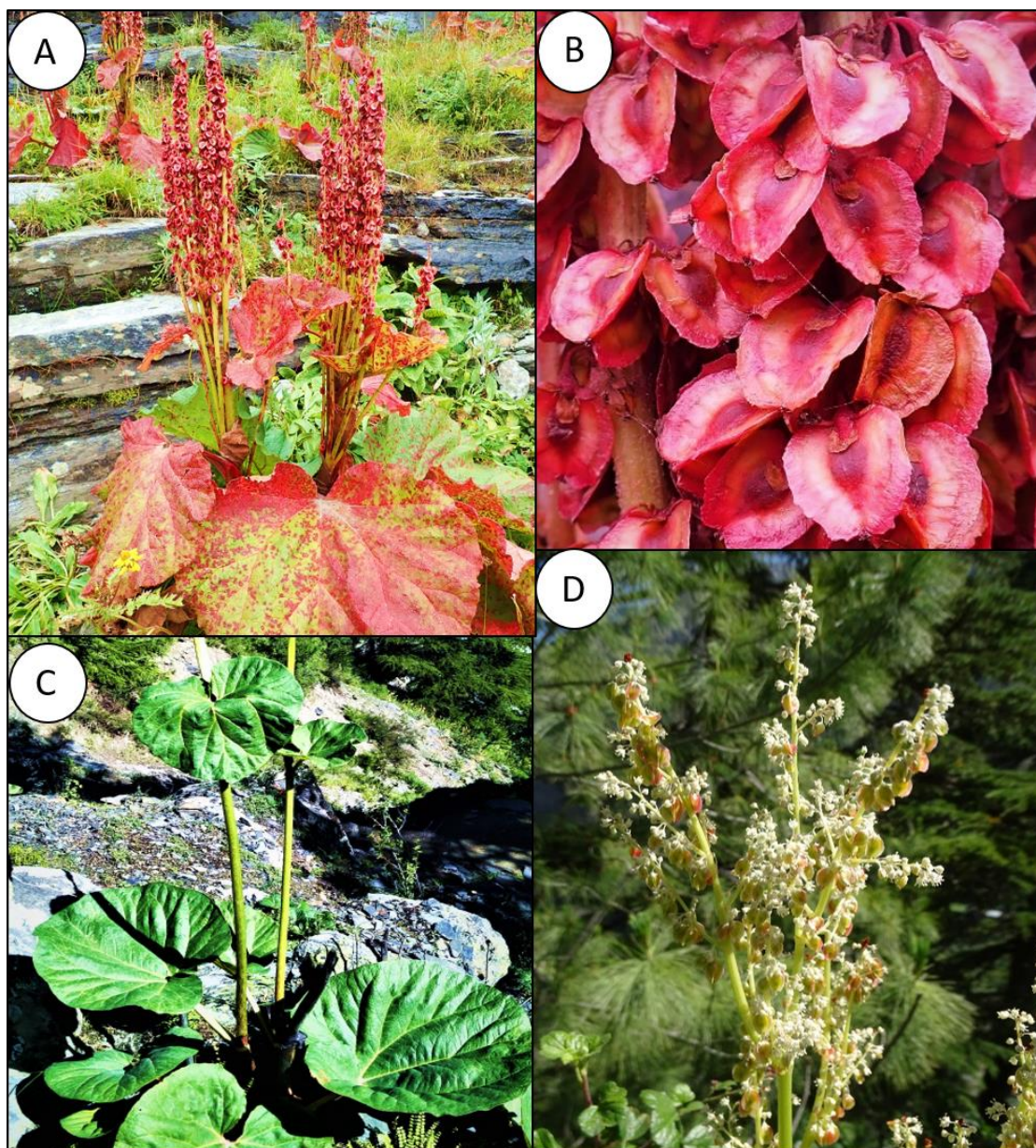


Plate 16: *Rheum* species (A-B) *Rheum australe* whole plant and Seed; (C-D) *Rheum webbianum* whole plant and flower. 📷 Amit Kumar

Species and Location Profile

Etymology: *Rheum* is a member of family Polygonaceae (buckwheat family). '*Rheum*'; is a Greek name for roots and rhizomes that was imported from Iran. Rhubarb comes from Greek word '*rha*' (river) and Latin word '*barb*' (barbarian land). In ancient times, rhubarb roots were imported by Romans from barbarian lands which were beyond the Volga or Rha River. Imported from barbarians across the Rha, the plant became Rhabarbarum. According to Lindley's Treasury of Botany, some authorities derive the name from the Greek rheo ('to flow'), in allusion to the purgative properties of the root.

Vernacular name: Himalayan rhubarb, Dolu, Revandchini, Archa, Archu, Lachhu

Trade name: Raval chini, Revan chini, Revanchini, Revanchi, Revand chini

Unani name: Revand chini

Ayurvedic name: Amlaparni, Peetmoola

Sanskrit name: Revandachini, Revatchini, Amlaparni, Amlavetasa, Gandhini, Pita, Pitamula, Pitimulika, Revatika and Soma.

Habitat and Distribution

Habitat: Revandchini plant is restricted to the temperate, sub-alpine, and alpine zones of the Himalayas from Kashmir to Sikkim, between an elevation of 3000 and 5500 masl (Tabin, 2016). It is mainly found in alpine zone on rocky soil, moraines, and crevices, between boulders, near streams in specific pockets, open slopes, rocks and shrubberies (Sankara et al. 2020). The species is hermaphrodite (has both male and female organs) and is wind pollinated species. It prefers moist and well-drained soil with medium (clay) and heavy (loam) texture with semi to no shade at all (Pandith et al. 2018).

Global distribution:

Globally the species is distributed Bhutan, China, India, Myanmar, Nepal and Pakistan. It is mainly endemic to the Himalayan region and the Indian distribution ranges from Kashmir to Sikkim. In India, it is found in Himalayan states viz., Himachal Pradesh, Uttarakhand and Jammu and Kashmir (Tabin, 2016). In Himachal it has been recorded in Rohtang pass, Rahallafall, Lahaul valley, Sangla valley, Ropa valley, Kinnaur and Pangi (Rana et al. 2014; Verma and Tewari, 2016, Pandith et al. 2018; Singh et al. 2009; Verma and Kapoor, 2010). In Sikkim the species has been recorded in Khangchendzonga Biosphere Reserve whereas, in Uttarakhand, it has been reported in Garhwal region, Valley of Flowers, Kedarnath, kyarkoti, Chamoli district and so on and in Jammu and Kashmir, Rhubarb has been reported in Saithal Kashmir, Leh and Zanaskar valley (Singh and Sundriyal, 2005; Tayade et al. 2012 and Rawat et al. 2016). More than 60 species of the genus *Rheum* have been reported in the world (Ghorbani and Hosseini, 2019) whereas, in the Indian subcontinent 07 species have been reported (Ganie et al. 2014).

Morphology and Phenology

Taxonomic description:

Rheum is a perennial herb, 1.5-3.0 m tall. Roots are very stout and thick. Leaves are radical, orbicular, or broadly ovate, very large, and 30–45 cm in diameter with long petioles. Floral characteristics: Flowers are small, dark purple or pale red in axillary panicles. The plant has three to five years of juvenile phase, followed by reproductive phase.

Flowering and Fruiting: Flowers from June-August and fruits from July-September.

Population Status

Population density of *Rheum australe* varies according to habitats, such as the density has been reported between 0.5-5.3 (individuals m⁻²) in Himachal Pradesh (Uniyal et al. 2005; Singh et al. 2005). Similarly, in Uttarakhand, the density varied from 1.93-4.24 (individuals m⁻²) (Rawat et al. 2016).

Conservation Status

Rheum australe falls under 'Vulnerable' category (Goraya et al. 2013) however, as per Previous Status (Ved et al. 2003) it falls under 'Endangered' category. *Rheum webbianum* have been assessed as Vulnerable (Goraya et al. 2013).

Potential Threats

The species mainly has been directed to numerous threats such as overexploitation for local use, overgrazing, habitat degradation rapid urbanization, selective illegal extraction and uncontrolled deforestation (Pandith et al. 2018). Beside these, construction of roads, excessive tourist flow which is usually higher than the carrying capacity of the particular health resort, industrialization, landslides (Rashid et al. 2014; Baig et al. 2014).

Medicinal Uses

The species carries many properties such as antidote, stomachic, astringent, laxative, febrifuge antitoxin, antiseptic antihelminthic, laxative, diuretic, purgative, anticholesterolaemic, antitumour and tonic with uses against diseases Asthma, Back pain, Bile disorder/Bile, Fever, Bloated stomach, Body cramp, Boils, Bronchitis, Burns, Cold, Diarrhoea, Frost bite, hematochezia, Ulcer, Cancer and so on (Rokaya et al. 2012; Zargar et al. 2011; Rawat et al. 2016). *R. webbianum* root can also be used as a dyeing substance which gives yellow color and used to dye wool and silk fibers (Tayade et al. 2012). Powdered roots are sprinkled over ulcer for healing and also used for cleaning teeth. Leaves and flowers are also edible (Nautiyal et al. 2003).

Market and Trade

The reported estimated annual trade of *Rheum webbianum* was less than 10 MT and the total annual consumption of raw *Rheum australe* by domestic herbal industry and rural households was 158.27 and 33.39 MT respectively, whereas, the annual trade of raw drug was assessed to be 100-200 MT (Goraya and Ved, 2017).

Good Harvesting and Collection Practices

Harvesting:

In view of the sustainable harvesting framework, the following good harvesting practices are suggested:

What to collect: It is the roots and rhizomes that need to be harvested in case of *Rheum*.

What stage: In lower altitudes plant mature in the fourth year if cultivated through seeds whereas it takes more time in higher ranges.

When: Harvesting should be done in September from lower ranges and in October from Alpine areas. If the requirement is large quantity of bioactive chemical compound, then it should be harvested before senescence and to achieve the maximum amount of bioactive ingredients plant should be harvested in July-August at lower ranges and October in higher ranges.

How: Digging should be carried out with proper tools to carry out only the bare minimum digging necessary for taking out the tuber without causing damage to the adjoining plants.

Post-Harvesting Handling

The root and rhizome are cleaned, thoroughly washed to remove soil particles. Further cut into 3-4 cm long pieces and dried in partial shade or in warm air. The dried drug material is packed in gunny bags for marketing or may be stored in cold chambers (Nautiyal and Nautiyal, 2004).

Cultivation and Propagation

Seeds and rhizomes both can be used as means of propagation. Sandy and porous soil with fully decomposed farmyard manure; whereas sunny sites with high moisture favours the growth and yield of plant. First the land may be ploughed and prepared to fine tilth and made aerable followed by farmyard manure (100 quintals/hectare) as a basal dose for soil containing 1%–1.5% of organic carbon at 2200 m. At lower altitudes (1800 m), higher dose of manure (about 150–200 quintals/hectare) is desirable for maximizing the yield. The seed production ranges from 250-300 seeds per plant. About 600 g of seeds are required to raise a nursery for planting at a spacing of 50 cm × 50 cm in 1 hectare of land with 60-70% seedling survival. In temperate conditions, seeds are sown in the spring season (March–early April) with 15 cm apart where the germination of the seeds is completed within one month of sowing. No specific pretreatment is required for the seeds. Transplanting is done in the month of May when the plants are almost three months old with optimum spacing for the crop is 50 cm × 50 cm. Before transplanting half dose of nitrogen and full dose of phosphorus and potash are also applied as a basal dose. Rest of nitrogen is applied as top dressing six to eight weeks after transplantation. Irrigation is done immediately after transplantation, followed by light irrigation at four-week intervals. Light sprinkler irrigation during the summer season has proved to be useful for the growth of the crop. However, excessive watering may cause decay of underground rhizome, especially in winter months. Regular weeding/hoeing should be done at an interval of 15–30 days, during the establishment phase, initial growth phase and monsoons. Soil drenching with Carbendazim 50 at a rate of 2 g/litre of water is proven beneficial against *Fusarium* sp. infection (Anonymous 2020; Kalsang, 2016; Nautiyal and Nautiyal, 2004).

4.8.6 *Fritillaria cirrhosa* D. Don

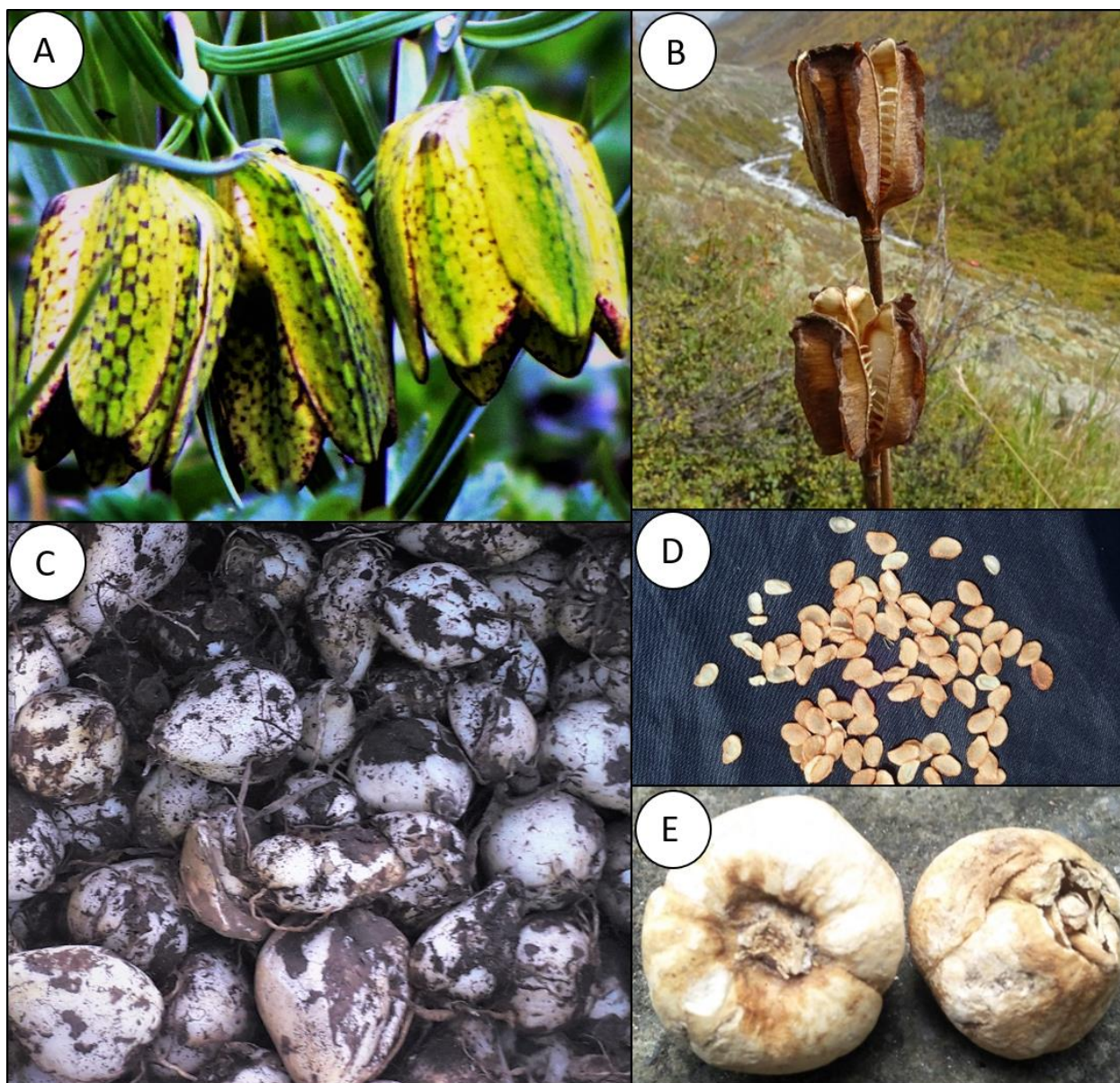


Plate 17: *Fritillaria cirrhosa*; A- Flower, B-Follicle, C- Immature bulb, D- Seed, E- Mature bulb.

📷 A-Gajendra Rawat; B, D, E-Amit Kumar; C-Himanshu Bargali

Species and Location Profile

Etymology: Also known as Kakoli, the species is an important component of a polyherbal formulation of eight herbs (asthavarga). *Fritillaria cirrhosa*, common name yellow Himalayan fritillary is an Asian species of herbaceous plant in the lily family also known as yellow Himalayan fritillary. The name *Fritillaria* comes from the Latin '*fritillus*' meaning dice-box, possibly referring to the checkered pattern on the flowers.

Vernacular name: Hindi: Kakoli, Tamil: Kakoli, Malayalam: Kakoli, Telugu: Kakoli, Kannada: Kakoli, Sanskrit: Kakoli, Ksirakakoli, Ksirasukla, Payasya, Bhutia: Chichaor, Nepal: Kakolee.

Trade name: Jangli lehsun

Vernacular name: Jangli lehsun, Ban lehsun

Ayurvedic name: Kakoli

Habitat and Distribution

Habitat:

Fritillaria cirrhosa D.Don (Liliaceae), commonly inhabiting the alpine slopes and shrubberies of the Himalaya in northwest India (Prakash and Nirmala, 2013; Khan et al. 2005), prefers to grow in open sunny meadows with moderate slope, rich in humus (Chauhan et al. 2011a), at an elevational range of 2700–4000 masl (Prakash and Nirmala, 2013). *Fritillaria cirrhosa* generally grows in open sunny slopes of temperate to alpine or sub-alpine meadows of the Himalaya at altitudes ranging from 3200–4600 masl (Chen and Mordak, 2000). This herbaceous plant grows in rocky and grassy slopes of alpine and sub-alpine regions amidst shrubberies such as *Lonicera* spp., *Rosa* spp. and *Salix* spp. Populations of *F. cirrhosa* are scattered in isolated patches throughout its distribution range.

Global distribution:

F. cirrhosa is an endangered perennial herb, distributed mainly in China, India, Nepal, Myanmar, Qinghai, Pakistan, India, Bhutan and Myanmar. It shows distribution in the Indian states of Uttarakhand, Himachal Pradesh and Jammu & Kashmir. The species is endemic to the high Himalayan ecosystems (Chauhan et al. 2011a). It occurs in western temperate Himalaya from Kashmir to Kumaon (Khare, 2007) and from Pakistan to Uttarakhand (Prakash and Nirmalaa, 2013).

Morphology and Phenology

Taxonomic distribution:

It is an erect bulbous perennial herb, attaining 18–76 cm height. Bulbs are globose, white and non-tunicate, 1.3–1.4 cm across. Flower solitary, terminal, nodding, usually creamish-green in colour. Fruit a six-rigid capsule, containing large number of flat triangular seeds arranged in six rows, seeds golden brown in colour. Has yellowish green to brownish purple bell-shaped solitary flowers, leaves are linear, lanceolate and long pointed.

Flowering and Fruiting: Flowering period last May-July, flowers generally have yellow petals with purple spots and developed nectarines. The capsules mature in September or October, and contain 80–200 seeds per capsule with 1000-grain weight for 1.96 g (Mathew, 1996).

Population Status

Fritillaria cirrhosa faces threat due to heavy harvesting pressure, anthropogenic activities, competition with other associated species and low seedling establishment. Nearly 58–77% population reduction was recorded during the last 20–30 years (Chauhan et al. 2011a). It is under pressure due to over exploitation

for commercial purposes (Kala, 2000). The market demand of this species is increasing while the supply is gradually decreasing (Ved and Goraya, 2008). Over exploitation for medicinal use has decreased its availability in natural habitats and brought this species in endangered state, making conservation and cultivation studies necessary (Chauhan, 2011).

Conservation Status

Fritillaria cirrhosa D.Don belonging is a perennial and Critically Endangered (CR) medicinal herb (Shafi et al. 2018). It is among the 36 species of globally significant medicinal plants of Western Himalaya (Bisht et al. 2016).

Owing to the declining population of *F. cirrhosa*, the species has been assessed using IUCN red list categories and criteria and has been listed as Critically Endangered in Uttarakhand and Endangered in Himachal Pradesh and Jammu and Kashmir (Ved et al. 2003; Singh et al. 2020). Extensive regional assessments of MAPs in Himachal Pradesh (Ved et al. 2003, 1998; Bisht et al. 2016; Goraya et al. 2013) have also categorized this species into Endangered category hence, restoring wild populations is very crucial. Thus, this valuable species is under multiple threat factors being a medicinally important plant, this species should be given priority for conservation through both *in-situ* and *ex-situ* methods (Chauhan et al. 2011a).

Potential Threats

Due to its strict habitat requirements, domestication and cultivation are extremely difficult. Therefore, majority of *F. cirrhosa* is still gathered from the wild. Due to over-harvesting, habitat fragmentation and over-grazing in the last decades, the wild populations and sizes of *F. cirrhosa* are rapidly decreasing and it is facing extinction (Zang et al. 2010). The species also faces threat from unorganized, premature and destructive harvesting coupled with the illegal markets functioning parallel (Mathela et al. 2020).

Medicinal Uses

It is mainly used as antitussive, expectorant and antihypertensive drugs. Its bulb is an important constituent of many medicines and health tonics (Chauhan et al. 2011b). It is a bitter tonic and gastric stimulant, cures fevers and urinary tract infections and is reported to be a remedy for 80 diseases (Sultal et al. 2013). It is used as a refrigerant, diuretic, galactagogue, expectorant and aphrodisiac. The subterranean bulb has properties such as febrifuge, galactagogue, haemostatic, expectorant, aphrodisiac, anti-rheumatic, spermatogenic and tonic whereas, the rhizome is useful in excessive thirst, rheumatic pain and haematemesis (Andola et al. 2006; Dhyani et al. 2010; Bisht et al. 2016). The bulbs of the herb are important constituents of Chyavanprash, Mahatraphala Ghritam, Jeevanthyadi Ghritam and Danwantharam. Also known as Kakoli, the species is an important component of a polyherbal formulation of eight herbs (asthavarga), however, no such medicinal uses were reported from

the local communities of Himachal Pradesh. The bulbs of *F. cirrhosa* (Chuanbeimu) have been used as traditional Chinese medicine (TCM) for a long time in China. It treats haematemesis, tuberculosis and rheumatism. It also reduces pain in pregnant woman, promotes flesh and alleviates various pains (Dhyani et al. 2010). The alkaloids from the bulbs of *Fritillaria cirrhosa* exhibit remarkable biological activity, showing hypotensive, anti-inflammatory, antitumour, antitussive, expectorant, antiasthmatic properties (Wang et al. 2014).

Market and Trade

It is one of the 18 species that are actively traded throughout the world and constitutes large scale industry; worth 400 million US dollar per annum demand in China (Luo et al. 2018). In India, market value of dry bulbs is approximately 10,000–15,000 kg⁻¹ INR in local markets (Kumar et al. 2020). In India, *Fritillaria cirrhosa* is prohibited for export if the plants are collected from the wild. Raw drug obtained from cultivated material can however, be exported. According to (Goraya and Ved, 2017) trade per annum and price of *F. cirrhosa* was found to be <10 MT with price ranging from 1200-6000 kg⁻¹ respectively. As per HPSFD, the total estimated volume of the *F. cirrhosa* extracted from the Lahaul and Pangi landscape was 108.41 qtls in the year 2017-18.



Plate 18: *Fritillaria cirrhosa* bulbs carried by local collector 📷 Himanshu Bargali

Enthusiastic collection of premature bulbs during July (instead of September-October on bulbs maturity) has resulted in the absence of perennating buds for the next growing season. For instance, premature bulbs collected by a local was more than 5kg costing INR 60,000 (**Plate 18**). Based on WII's present study (2019-2020) on MAPs in Lahaul-Pangi landscape, Himachal Pradesh, the average market price of

F. cirrhosa has been recorded between 9666.66±881.92 to 17666.66±1452.97 (Rs/kg±SD) in major markets viz., Udaipur (Lahaul), Killar (Pangi), Keylong, Manali and Amritsar (**Table 17**).

Table 17: Price of *Fritillaria cirrhosa* in various raw drug markets.

Sr.no.	Market/Places	Market price (Rs/kg)	Average market price (Rs. /Kg) ± SD
1.	Udaipur (Lahaul)	10000	9666.66±881.92
2.	Killar (Pangi)	15000	7666.66±881.92
3.	Keylong (Lahaul)	15000-20000	16000±2000
4.	Manali	12000-25000	16333.33±3382
5.	Amritsar	20000	17666.66±1452.97

According to (Goraya and Ved, 2017), 'BanLahsun' (*Fritillariacirrhosa*) witnessed a sudden spurt between 2009-10 and 2014-15 in Himachal Pradesh, Jammu & Kashmir and Uttarakhand for its bulbs. The wild populations of *Fritillaria cirrhosa* have succumbed to this high annual harvesting pressure pushing these species towards possible extinction.

Good Harvesting and Collection Practices

Due to its strict habitat requirements, domestication and cultivation are extremely difficult. Therefore, majority of *F. cirrhosa* is still gathered from the wild. Due to over-harvesting, habitat fragmentation and over-grazing in the last decades, the wild populations and sizes of *F. cirrhosa* are rapidly decreasing and it is facing extinction (Zang et al. 2010). To date, cultivation has been unable to meet the entire market demand for *F. cirrhosa* bulbs, although other *Fritillaria* species are successfully cultivated on a larger scale (Cunningham et al. 2018).

Harvesting:

In view of the sustainable harvesting framework, the following good harvesting practices are suggested: Good harvesting practices are aimed at getting the maximum possible yield with optimum alkaloid content on sustainable basis, and ensuring long shelf life of the produce. In *F. cirrhosa*, tubers form the official part and need to be dug up from the soil, thus, the procedure leads to destructive harvesting. However, if the sustainable harvesting framework is followed, the jangli lehsun plants can be harvested on sustainable basis. A look at the usual harvesting practices would reveal that in order to meet its rising market demand, *Fritillaria* tubers are harvested (a) before these are fully ripe, (b) before the seeds have fully ripened and shed, (c) by deep digging of soil damaging other surrounding plants, (d) by removing the entire tubers, and (e) without giving prescribed rest to the harvested area. Some of the harvested produce gets damaged due to its poor post-harvest handling, putting greater pressure on the wild

resource. It, therefore, become necessary to educate the wild gatherers about the good harvesting and post-harvest handling practices.

What to collect: It is the tubers/bulbs that need to be harvested in case of Jangli lehsun. The first and foremost best harvesting practice is to critically identify the plant before its digging up to avoid wasteful digging and damage to other plants, proper care has to be taken to only collect the mature bulb.

What stage: It is very crucial to avoid premature harvesting of the plant leaving no perennating structure for the next growth season. The premature bulbs are low on medicinal properties therefore; the plant should be harvested when the tubers are mature and seeds have ripened and are shed or ready for dispersal. It normally takes three growing seasons for the plant to reach this stage

When: Harvest time- August – September. The capsules mature in September or October, and contain 80–200 seeds per capsule with 1000-grain weight for 1.96 g (Chen et al. 1993; Mathew, 1996). This species can reproduce both sexually or asexually, but the former is dominant (Mathew, 1996).

How: Digging should be carried out with proper tools to carry out only the bare minimum digging necessary for taking out the tuber without causing damage to the adjoining plants. It is advised to separate the top portion of the tuber at site and leave it in the dug-up portion for its regeneration.

Cultivation and Propagation

As such there is no available cultivation and harvesting protocols for *Fritillaria cirrhosa* on a large-scale basis however, few locals have been successful in cultivating the plant on a very small scale on their landholding in the Lahaul landscape. Mr. Tok Chand from Lahaul demonstrated his method of cultivation of this species. He added that the species must be grown in sandy and loamy, moist soils that is slightly alkaline. Seeds are used for the cultivation that must be sown when ripe. The seeds start germinating in spring and, can take a year or more to germinate. Flowers are produced from three to five years from these seeds. Once they die down at the end of their growing season, divide up the small bulbs and plant them in permanent plots. The crops may take up to six years to fully mature further, the plants need to be protected from frost.

4.8.7 *Polygonatum verticillatum* (L.) All.

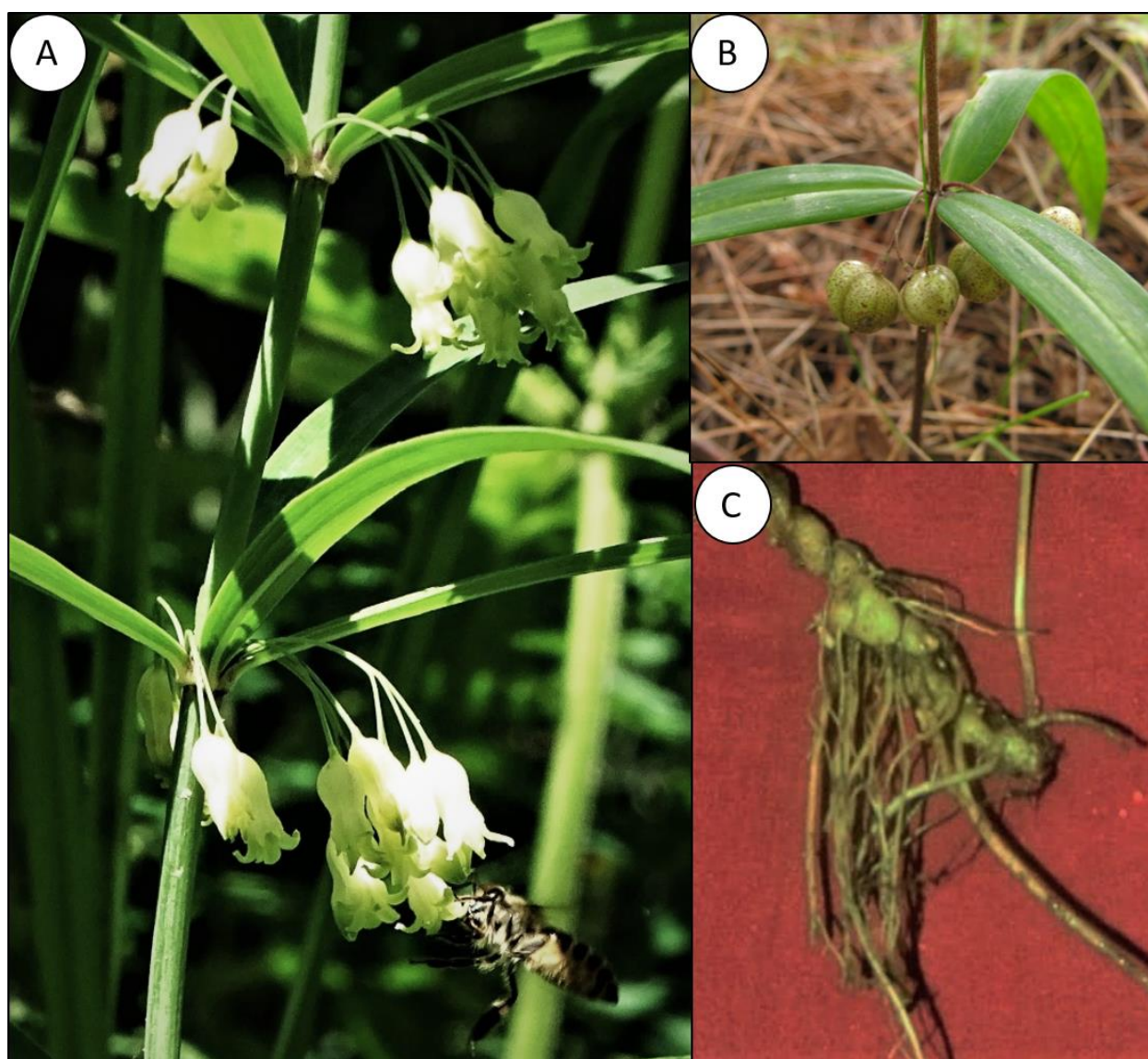


Plate 19: *Polygonatum verticillatum*; A- Flower, B- Friut, C-Rhizome 📷 Amit Kumar and Renu Suyal

Species and Location Profile

Etymology: *Polygonatum verticillatum* is synonymous with *Convallaria verticillata* belongs to the family Liliaceae. The etymological root of the binomial name *Polygonatum* is derived from the Greek 'polys' meaning many and 'gonu' meaning a small joint. *Verticillatum* is derived from the Latin 'verticitas' meaning vertical direction (<https://davisla.wordpress.com/>). According to Miller (1754) the generic name of *Polygonatum* is derived from the character of the rhizome which resembles much as yovi, a Knee, because it has many little Knees.

Vernacular name: Salam mishri, mitha dudhia, Kantula

Trade name: Salam mishri

Urdu name: Nor-e-Alam

Unani name: Medaa

English name: Whorled Solomon's seal

Hindi name: Basuchidra, Devamani, Pandura, Shakakul, Seal, Vasuchhidra, Mahamaida

Ayurvedic name: Mahameda, Medaa

Sanskrit name: Tridanti, Devamani and Vasuchhidra

Habitat and Distribution

Habitat: A rhizomatous, perennial herb usually found on moist, nutrient-rich, usually basic soils in wooded gorges, wooded river bank, moist habitat and oak forest, margins of woods and shady rocky places (Devi et al. 2019; Suyal et al. 2020). It can grow in full shade (deep woodland) or semi-shade (light woodland).

Global distribution: *P. verticillatum* is distributed in the temperate Himalaya (West Asia and Europe) at an altitude ranging between 2400 to 2800 masl (Anonymous, 2008; Chauhan, 1999). It has a worldwide distribution in Europe, Turkey, Central and North Asia, Pakistan, Afghanistan and Tibet and has been considered as the most important medicinal herb of Himalayan region (Dhyani et al. 2010). Distributed from montane to alpine Himalaya, in Himachal Pradesh it is reported in Manali wildlife sanctuary and Kinnaur whereas, in Uttarakhand it was reported from Garhwal Himalaya, Bhuna, Dunagiri, Binsar, Tungnath, Rudranath, Valley of flowers, Dayara, Niti and Nanda Devi National Park (Naithani, 1984).

Morphology and Phenology

Taxonomic description:

It is an erect rather robust plant with many whorls of narrow lanceolate leaves, bearing branched clusters of 2-3 small, pendulous, tubular and white flowers with green tips in their axils. The stem is angled and grooved, 60-120 cm long. The flowers are 8- 12 mm long, fused into a broad tube below with short triangular spreading lobes. The perianth is 6-parted and somewhat reflexed. It is found in rare, moist-shady localities of montane forests. The fruit is a berry, which at first is bright red, becoming dark purple later. The rootstock is thick and creeping.

Flowering and Fruiting:

The flowering and fruiting take place in the month of June to October (Samant et al. 2007).

Population Status

The natural habitat of *Polygonatum verticillatum* is declined in many parts of the world (a) due to over exploitation, harvest in an uncontrolled way, overgrazing and lack of awareness is the reason for the decline of this species (Bhatt et al. 2014) in some regions of the world the plant were also utilized in herbal formulations and have some market value so the local people harvest plant before maturity due to which mature seed production become very low and large number of seeds destruction also take place (Sharma et al. 2011). Furthermore, rhizome of the plant has much medicinal value so the whole plant is

uprooted from the soil which also destroys the plant. Thus, there is a need for its in-situ as well as, ex-situ conservation and propagation to conserve this important medicinal plant.

Population density of *Polygonatum verticillatum* varies according to location and elevation such as the density has been reported between 1.50 (individuals m⁻²) in Chandrabhan, Himachal Pradesh (Butola and Badola, 2008); (0.07/1.33) in Rakchham- Chitkul WLS, Kinnaur (Verma and Kapoor, 2014); 1.56 in GHNP, Kullu (NMHS Progress Report, 2018). Similarly, in Uttarakhand 4.40 plant m⁻² (Mukteshwer and Gagar) and 2.60 plant m⁻² (Bhaman gupha) (Lohani et al. 2013).

Conservation Status

The species has been categorized as 'Vulnerable' as per the CAMP report, Shimla (Ved et al. 2003).

Potential Threats

Overexploitation of rhizome and other parts for medicinal use and consequent degradation of natural habitat are reported to be the major threat to this species (Samant et al. 2007). Whereas *P. verticillatum* has been categorized as EN (Endangered) in the country following the IUCN Red List (Ved et al. 2015). Destructive harvesting has also brought about depletion and scarcity to this plant. The habitat loss by export of medicinal plants collected from wild sources finally lead to severe and irreplaceable loss of genetic stock of the species. Narrow range of distribution, land-use disturbances, introduction of non-natives, habitat alteration, climatic changes, heavy livestock grazing, explosion of human density, fragmentation and degradation of plant density, population bottleneck and genetic drift (Kala et al. 2006; Kala, 2007) are the potential causes of rarity in medicinal plant species.

Medicinal Uses

Polygonatum verticillatum is an important ingredient of Ashtakvarga and high value in medicinal herb is one of these Himalayan medicinal plants. Root used for urino-genital disorders, nerve tonic, general weakness, spermatorrhoea, haemorrhoid, leucorrhoea, anemia, gastric problems, wounds, rheumatism, aphrodisiac, appetiser, backache, menstrual troubles, vitaliser, rejuvenative, digestive, eaten as raw vegetable; Rhizomes Rheumatism, general body weakness, aphrodisiac, nervine tonic, kidney trouble, wounds, emollient, vitiated condition of pitta and vata, appetizer, glactagogue, anticancer, boils, eaten mixed with dairy products and as a tonic; Tuber as Seminal weakness, strangury, anorexia, fever, general debility, tonic, promote body heat, appetizer, aphrodisiac, nerve tonic, urinary problems, edible used as vegetable; Bulb in powdered form used for tuberculosis, general debility, as tonic, leucorrhoea, tonifying spleen, dampness, treat "xiaohe" (diabetes) and tonifying Qi; Green foliage as nutritive item utilized as vegetable, shoots are cooked with other spring herbs; Seed as in Indigestion; Whole herb as to cure appetite, nervine tonic, kidney trouble and also restores body strength.

Good Harvesting and Collection Practices

P. verticillatum is collected in large number from wild by the local community due to which the reduction in the population will be seen another reason of the reduction of plant is the rhizome of plant which have more medicinal value as compared to other plant parts so for the (a) collection of rhizome the whole plant was dug from the soil due to which large number of plant were destroyed, (b) due to lack of awareness indiscriminate cutting of grasses and bushes were done by local community moreover the cutting of plants take place along with the underground reproductive parts of the plants and the cutting also destroyed the matured seeds. This all result in the reduction in the population of these plants. Another big reason is the change in environmental conditions which is going on constantly in the different ecosystems of the world such changes also occur in Himalayan region which is the rich source of natural vegetation and home for many native plant species due to the anthropogenic destruction of natural vegetation, environmental changes and the change in the natural habitat of the plant due to the change in the geographical and climatic conditions, decreased the overall density and availability of the plants. Bisht et al. (2012) also concluded that some plant has habitat specificity, some have narrow range of distribution, land-use disturbances by human beings, introduction of non- native's plant species or invasive species, change of habitat, climatic changes, heavy grazing pressure, explosion of human population, fragmentation and degradation of the plant density, population restriction and genetic drift are the potential causes of destruction of medicinal plant species. In some areas of the world the women carry all the activities of livestock domestication and for that they collect the food and fodder from the nearby forests and due to lack of identification they also cut the medicinal plant species along with the fodder grasses. Therefore, this is one of the reasons of threatened status of these medicinal plant species.

Harvesting:

For managed and sustainable harvesting, the following good harvesting practices are suggested:

What to collect: The roots, rhizomes, tubes, bulb, green foliage, seed whole plant of Salam mishri is harvested. To avoid wasteful digging and damage to other plants, proper identification of Salam mishri is of utmost importance.

What stage: The roots and rhizomes are manually harvested from mid September when the shoots or the aerial parts begin to wither and dry.

When: The collection period is from mid-July to September. The plant should be collected after full maturity. The best harvesting time is when the aerial parts dry properly.

How: The entire plant is dug up and kept in gunny sacks. Salam mishri plant is dug out from soil to extract roots or rhizomes hence digging should be carried out with proper tools without causing damage to the adjoining plants.

Post-Harvesting Handling: After harvesting, these rhizomes are properly washed with running water to remove soil particles and rhizomes should be then cut into small slices and kept in the partial shade for drying.

Cultivation and Propagation

Seed - best sown as soon as it is ripe in early autumn in a shady part of a cold greenhouse. Sow stored seed as early in the year as possible. Germination can be slow; they may not come true to type and it takes a few years for them to reach a good size. When they are large enough to handle, prick the seedlings out into individual pots and grow them on in a shady position in the greenhouse for at least their first winter. Plant them out into their permanent positions in late spring or early summer, after the last expected frosts. Division in early spring or early autumn. Larger divisions can be planted out direct into their permanent positions. We have found that it is better to pot up the smaller divisions and grow them on in light shade in a cold frame until they are well established before planting them out in late spring or early summer. Plants reproduce vegetatively, by rhizomatous spread, but fruiting is generally poor, with recruitment from seed apparently very infrequent (Singh et al. 2009).

4.8.8 *Picrorhiza kurroa* Royle ex. Benth

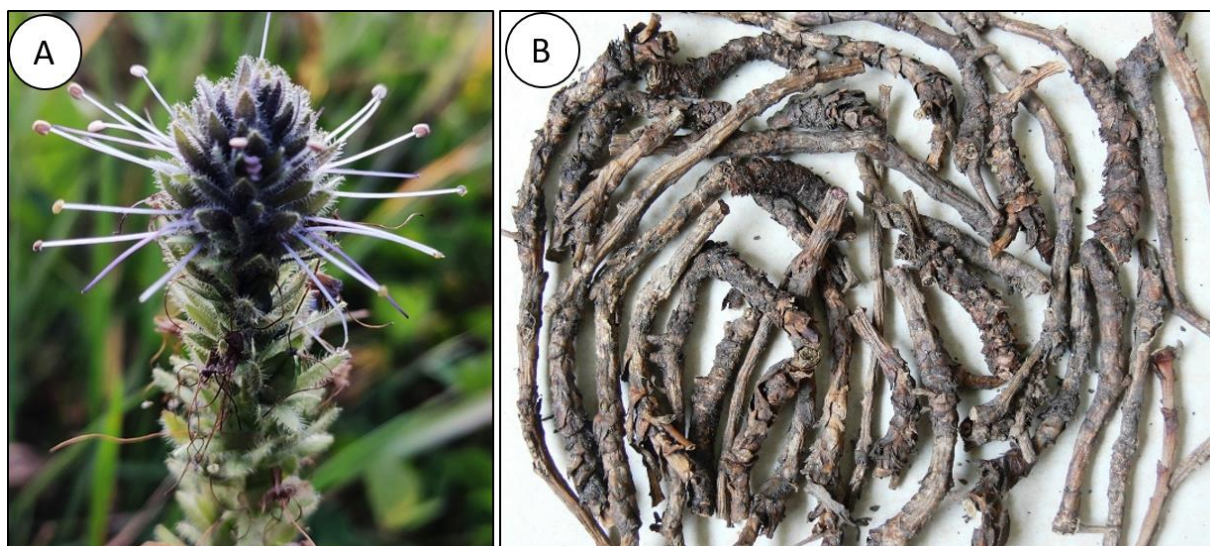


Plate 20: *Picrorhiza kurroa*; A- Flower, B-Root 📷 Amit Kumar and GS Goraya

Species and Location Profile

Etymology: *Picrorhiza kurroa* commonly known as Kutki, belongs to family Scrophulariaceae. The genus *Picrorhiza* belongs to the Greek word where 'picros' means bitter, while 'rhiza' means root and species name is taken from the Punjabi dialect 'karu' means bitter.

Vernacular name: Kali Kutki, Tikta, Katui and Katuka.

Trade name: Kutki.

Unani name: Kutki.

Ayurvedic name: Katuka.

Sanskrit name: Anjani, Aristha.

Habitat and Distribution

Habitat:

Kutki is a perennial creeping herb present in wild form in the north-western Himalayan region from Kashmir to Sikkim. Naturally Kutki grows at an elevation of 3000-5000 masl (Samant et al. 2007). It prefers moist, relatively less exposed, north-west facing slopes and, found near springs on moist rocks from timberline to alpiners. Kutki grows in wild form near springs on moist rocks from timberline to alpiners, cliffs, and the turf of glacial flats and in organic soils (Masood et al. 2015).

Global distribution:

Kutki is widely distributed in the Himalaya of Pakistan, India, Nepal, Bhutan and Southern China. In India, *Picrorhiza* is predominantly present in the north-western Himalayan regions. Kutki is found in Chota Bhagal, Himanchal Pradesh (Uniyal et al. 2006); Miar valley, Harsar, Kadu Nala and Kurched (WII, 2021), Chauras valley in Uttarakhand (Joshi et al. 2010), Zumu in Sikkim (Bhattacharjee et al. 2013) and in

Jammu Kashmir (Dawa et al. 2018). In Himachal Pradesh, it is mainly found in the higher reaches of Chamba, Kangra, Mandi, Shimla, Kinnaur and Lahaul and Spiti districts (Kumar et al. 2012).

Morphology and Phenology

Taxonomic description:

Kutki is a perennial rhizomatous herb. The leaves are flat, basal, alternate, sharply serrated, 5–10 cm long. Terminal Spikes are present, 5 lobed, 4–5 mm long, actinomorphic. Rhizome 2.5–12.0 cm long and 0.3–1.0 cm thick, sub-cylindrical, straight or curved. Root is elongated, tubular, 5–10 cm in length and 0.5–1.0 mm in diameter, straight or marginally curved mostly associated with rhizomes. Flowers are small, pale or purplish blue, borne in cylindrical spikes with long stamen. Fruits are 1.3 cm long. The fruit type is usually a 2 chambered capsule. The flowers are born in racemes, light blue or purple blue in dense terminal racemes (Kansang, 2016), fruits are ovoid capsules and contain numerous seeds.

Flowering and Fruiting: The flowering period of Kutki is from June-August with numerous small, purple flowers of 1 cm length.

Population Status

Picrorhiza kurroa comprises of restricted distribution in the alpine and sub-alpine regions where its occurrence is limited to specific habitats and for the commercial purpose it is largely being exploited from the wild (Arya et al. 2013). The regeneration status of the high conservation priority Medicinal and Aromatic Plants is low. Likewise, the density per m² of *P. kurroa* was 0.38 and the seedling per m² was 0.13 and sapling per m² was 0.07, respectively (Uniyal et al. 2011). In Uttarakhand, particularly in the Kumaun region poor relative density of the species was recorded 0.03 per m² (Arya et al. 2013).

Conservation Status

Due to unorganized cultivation and indiscriminate collection from the wild, Kutki is listed as EN 'Endangered' (Rawat et al. 2013). According to (Arya et al. 2013), the taxon is considered rare and threatened in the Himalayan region, due to the destruction of its natural habitats and overexploitation.

Potential Threats

Picrorhiza kurroa has been affected from various threats like over exploitation for commercial use, degradation of natural habitat, unsustainable harvesting practices, illegal trading and unorganized cultivation (Rawat et al. 2013). The extraction of Kutki is unselective and unmanaged, which ultimately pose a threat for its survival and regeneration capacity (Uniyal et al. 2011).

Medicinal Uses

Kutki is widely used in traditional medicine systems in India with the rhizomes valued for their effectiveness as an antibiotic, hepatoprotective, anticholestatic, antioxidant and immunomodulatory

properties (Kant et al. 2013). Local people use it to cure cough, cold, stomachache, fever, malnutrition, jaundice, diarrhea, dysentery and for veterinary purposes. The rhizome is used to treat skin disease, liver disease, indigestion problems and metabolic disorders. The plant extract also contains some important chemical constituents like carbohydrate, aromatic acids, vanillic acid and ferulic acid (Masood et al. 2015).

Market and Trade

The Underground parts (roots and rhizomes) of Kutki extracted from high altitude sub-alpine and alpine regions in the Western Himalaya are traded as crude drug (Masood et al. 2015). The annual supply of Kutki from Nepal, India and Bhutan has been estimated to 375 MT and the consumption of Kutki in different sectors in India has been estimated to 415 MT/year. Due to high market demand of Kutki, it is extracted in larger scale. As in 1980, 1.468 MT was extracted from Himachal Pradesh and 9.06 MT was extracted from the alpine ranges of Chhota Bhangal. More than 5 MT of *P. kurroa* was extracted from 12 villages of Gori valley in 2001- 2004 and up to 6 MT is extracted annually from Sikkim. During 2007–2010, the price for Kutki at the village level varied from Rs. 220 to 340/kg. A total of 200–300 plants are harvested as shoot parts and 500–600 as root parts to make 1 kg dry weight of *Picrorhiza* (Uniyal et al. 2011).

Good Harvesting and Collection Practices

Due to increased commercial demand of Kutki, unmanaged, unorganized cultivation and harvesting practices occurs that affects the wild population of Kutki. The plant should be collected after full maturity. In Kutki, the underground part (root, rhizome) is to be collected by digging out the entire plant. Sand, dirt and foreign organic particles are removed and plant part should be dried in shady places (Arya et al. 2013). Attaining maximum possible yield on sustainable basis is the main aim of good harvesting technique of Kutki. To meet rising market demand of Kutki, unmanaged and unsustainable harvesting methods is practiced and revealed that Kutki's roots and rhizomes are harvested (a) before crop mature, (b) before the shoots dry and wither (c) by digging of soil deeply damaging other surrounding plants, (d) without proper drying (e) without giving prescribed rest to the harvested area. Some of the harvested produce gets damaged due to its poor post-harvest handling, putting greater pressure on the wild resource. It, therefore, become necessary to educate the wild gatherers about the damages done by reckless wild harvest and the advantages of the good harvesting and post-harvest handling practices.

Harvesting:

For managed and sustainable harvesting, the following good harvesting practices are suggested:

What to collect: The roots and rhizomes of Kutki is harvested. To avoid wasteful digging and damage to other plants, proper identification of Kutki is of utmost importance.

What stage: The roots and rhizomes are manually harvested in September when the shoots or the aerial parts begin to wither and dry. Kutki has a life cycle of 3 years and needs 1 year for complete maturity of seeds. To get higher active contents, plants must be collected before flowering occurs. Time of completion of reproductive phase depends on the altitude. Generally, plants grown in alpine areas complete their reproductive phase during the months of September–October, while plants growing at lower altitudes complete their reproductive phase during the month of September.

When: The peak Kutki collection period is from mid-June to September. The plant should be collected after full maturity. The best harvesting time is when the aerial parts dry properly.

How: The entire plant is dug up and kept in gunny sacks. Kutki plant is dug out from soil to extract roots or rhizomes hence digging should be carried out with proper tools without causing damage to the adjoining plants.

Post-Harvesting Handling: After harvesting, the stolons and roots are washed to remove soil particles, mud and other unwanted materials. Stolons and roots are dried in shade to yield higher content of picrotin and picrotoxin. Proper drying is a critical process, because traders offer better prices for clean and dried material therefore Kutki is dried at room temperature (15-25°C). On completion of drying, the weight of fresh material is reduced by half. Drying in direct sunlight or in oven is avoided as this process decreases the active contents rapidly. Once the material is completely dried, it is packed in gunnysacks, airtight polythene lined jute bags to ensure protection from moisture (Chand et al. 2015).

Cultivation and Propagation

The cultivation of Kutki will certainly reduce the pressure on wild medicinal plant population, ensure regular supply of raw material to industries and uplift the economy of the local farmers. Picrorhiza kurroa was propagated through seeds and stolons in Styrofoam trays and nursery beds (Rawat et al. 2013). Germination of seeds was good when sown on the upper soil surface in Styrofoam seedling trays and covered with a thin layer of dry moss powder. This increases seed germination from 52 to 58% at lower altitudes. Seeds are sown during November- December in greenhouses, during March-April in beds at lower altitude and during May in the alpine area. Seedlings raised from seeds at lower altitudes are transported to higher altitudes during March and April and transplanted in nursery beds. Thus, the harvesting period can be reduced by at least six months, by raising seedlings at lower altitudes in winter and transplanting them at higher altitudes during the spring. Propagation through stolon cuttings proved more successful than cultivation through seeds. Vegetative propagation of stolon segments can be successfully done through hormonal treatments as well as through convenient and simple methods Top segments of stolons are found more suitable for multiplication. Kutki is also grown along with Foeniculum vulgare, Solanum tuberosum and Digitalis purpurea and proves quite successful, as these plants provide

favorable microclimate for better growth, retain moisture for longer time and provide shade for the better growth of Kutki (Chand et al. 2015).

4.9 Key Task 9: Areas of High Conservation Value

4.9.1 Concept of Medicinal Plants Conservation and Development Area (MPCDA)

Conservation of medicinal plants is widely believed to be best achieved under in situ conditions, as these provide opportunity to the target species of natural ecological succession. The concept of Medicinal Plants Conservation and Development Areas (MPCDAs) is one such concept of *in-situ* conservation that includes survey, documentation of existing natural population of MAPs, their geo-referencing, ascertaining threat status of various medicinal plant species traditionally obtained from the wild, identifying major causes of threat to the populations of threatened species and possible remedies, and drawing up of action plan for conservation and sustainable utilization of important medicinal plant species. It also includes capacity building of stakeholders, documentation (including a good quality pictorial directory), hosting on website, conducting pilot research studies for sustainable utilization engaging services of qualified taxonomists and other professionals, and preparation of case studies that promote conservation values and sustainability. The concept of MPCDA also includes revisiting and reviewing the status of previously designated Medicinal Plants Conservation Areas (MPCAs) established under different schemes for improving protection and conservation action. It also includes mainstreaming medicinal plant conservation in management approaches based on sound silvicultural management principles, conducting systematic survey of local medicinal and aromatic plants with medicinal value, and incorporating sound scientific principles.

4.9.2 State of the existing Medicinal Plants Conservation Area (MPCA), legal status of the areas identified as MPCDAs

Nearly 210 Medicinal Plants Conservation sites covering an area of about 40,000 ha spread across 21 States in the country have been designated so far. The concept was started earlier in 1993 when the first conservation step was taken by the United Nations Development Programme (UNDP) in the Southern States of India along with the Foundation for Revitalization of Local Health Traditions (FRLHT) as the lead organisation. Development of Medicinal Plants Sector at large being the key concern, their main aim was to preserve the potential forest zones of India with special focus on the medicinal plants conservation. 108 MPCAs were set up during the period 1992 to 2003 in 13 states of the country to carry out the conservation works in terms of management of Medicinal Plants. Taking the concept further, the National Medicinal Plants Board (NMPB) independently established 102 more MPCAs/ MPCDAs between 2008 and 2018. Encouraging cultivation of priority medicinal plant species is another initiative towards

conservation of their wild populations. This initiative in respect of 50 widely used species now meets nearly 40% of the medicinal plant demand on volume basis.

Field surveys in the sub-alpine to alpine areas of Lahaul and Pangi landscape were conducted for the identification and selection of MPCDAs during in the growing season viz., May-July 2019 and September-October 2019 and 2020. The main aim was to record information on the floral elements with a focus on MAPs along with their traditional medicinal uses and representative or dominant species. During the field work, all the species occurring in the area were recorded and the accompanying local people demonstrated fair knowledge on the vegetation of the area.

Based on semi-structured questionnaire surveys, individual interviews, group discussions, visits to villages (29), high conservation value areas, local markets, six potential sites were shortlisted and demarcated for developing as MPCDAs in Lahaul and Pangi, covering an approximate area of 2,452 ha and 1309 ha, respectively (**Table 18 -21; Figure 17-22**). All the MPCDAs are distributed in sub-alpine to alpine forest types in the landscape. The vegetation in these areas is dominated by herbs, forbs and shrubs including high value MAP species. The demarcation of the MPCDA was done based on conservation potential and usages of MAPs within context of the different ethnic cultures and traditions. The selected MPCDAs have been suggested with the aim to maintain the gene banks of the MAPs in their natural habitats as well as to conserve the traditional knowledge associated with these plants. Enumeration includes scientific names along with vernacular name, trade name, family, parts used and system of medicine where they are used. The rare and threatened high value medicinal herbs plants have also been documented from the area.

It is proposed that the local Biodiversity Management Committee and the local Joint Forest Management Committee be given equal responsibility of managing the MPCDAs from fire and illicit removals of the MAPs. It is also proposed that these committees be given responsibility of developing and managing a nursery of priority medicinal plant species of the MPCDA and use the nursery stock for augmenting populations of these species in the MPCDAs, adjoining areas and also for cultivation on available fallow agriculture land. The idea is to develop the area as a key source of authentic raw drug and planting material of the focus MAP species of the MPCDA.

Table 18: Proposed Medicinal Plants Conservation and Development Areas in Lahaul.

Sr. no.	MPCDA	Area (hectare)	Elevation range (m)	Key species
1.	Hadsar	325	3000-4000	<i>Fritillaria cirrhosa</i> , <i>Picrorhiza kurroa</i> , <i>Aconitum heterophyllum</i> , <i>Dactylorhiza hatagirea</i> , <i>Rheum webbianum</i> , <i>Polygonatum verticillatum</i> and <i>Sinopodophyllum hexandrum</i>
2.	Kadu Nala	368	2800-3000	<i>Fritillaria cirrhosa</i> , <i>Picrorhiza kurroa</i> , <i>Aconitum heterophyllum</i> , <i>Rheum webbianum</i> , <i>Bunium persicum</i> , <i>Polygonatum verticillatum</i> and <i>Sinopodophyllum hexandrum</i>
3.	Thanpattan	616	2800-3200	<i>Bunium persicum</i> , <i>Aconitum heterophyllum</i> , <i>Picrorhiza kurroa</i> , <i>Rheum webbianum</i> and <i>Fritillaria cirrhosa</i>

Table 19. Location of Medicinal Plants Conservation and Development Areas in Lahaul.

S.no.	MPCDA	Elevation (m)	Direction	Co-ordinates
1.	Hadsar	3000-4000	East	32°44'17.54"N 76°30'41.05"E
			West	32°41'59.70"N 76°29'36.62"E
			North	32°42'55.21"N 76°29'48.28"E
			South	32°41'26.10"N 76°30'51.80"E
			Center	32°42'9.77"N 76°30'15.39"E
2.	Kadu Nala	2800-3000	East	32°50'8.81"N 76°27'51.71"E
			West	32°49'56.10"N 76°27'7.40"E
			North	32°51'1.64"N 76°26'51.76"E
			South	32°42'10.98"N 76°27'51.25"E
			Center	32°50'1.39"N 76°27'31.72"E
3.	Thanpattan	2800-3200	East	32°52'55.07"N 76°53'21.75"E
			West	32°53'17.20"N 76°52'59.65"E
			North	32°53'38.35"N 76°53'40.99"E
			South	32°52'42.64"N 76°52'37.46"E
			Center	32°53'6.31"N 76°53'11.65"E

Table 20: Proposed Medicinal Plants Conservation and Development Areas in Pangi.

Sr. no.	MPCDA	Area (hectare)	Elevation range (m)	Key species
1.	Chasak bhatori	966	4000-4400	<i>Fritillaria cirrhosa</i> , <i>Picrorhiza kurroa</i> , <i>Aconitum heterophyllum</i> , <i>Dactylorhiza hatagirea</i> , <i>Rheum webbianum</i> , <i>Polygonatum verticillatum</i> and <i>Sinopodophyllum hexandrum</i>
2.	Hudan Bharori	548	3600-4000	<i>Fritillaria cirrhosa</i> , <i>Picrorhiza kurroa</i> , <i>Aconitum heterophyllum</i> , <i>Rheum webbianum</i> , <i>Polygonatum verticillatum</i> and <i>Sinopodophyllum hexandrum</i>
3.	Sural Bhatori	938	3500-4000	<i>Fritillaria cirrhosa</i> , <i>Picrorhiza kurroa</i> , <i>Aconitum heterophyllum</i> , <i>Dactylorhiza hatagirea</i> , <i>Rheum webbianum</i> , <i>Polygonatum verticillatum</i> and <i>Sinopodophyllum hexandrum</i>

Table 21. Location of Medicinal Plants Conservation and Development Areas in Pangi.

S.no.	MPCDA	Elevation (m)	Direction	Co-ordinates
1.	Chasak Bhatori	4000-4400	East	32°54'29.57"N 76°39'27.86"E
			West	32°54'21.41"N 76°38'6.04"E
			North	32°55'51.25"N 76°38'5.35"E
			South	32°53'10.17"N 76°39'20.92"E
			Center	32°54'35.30"N 76°38'43.25"E
2.	Hudan Bhatori	3600-4000	East	33°6'0.26"N 76°29'7.34"E
			West	33°6'13.12"N 76°28'12.79"E
			North	33°6'36.78"N 76°29'8.71"E
			South	33°5'40.42"N 76°28'16.71"E
			Center	33°6'8.29"N 76°29'55.38"E
3.	Sural Bhatori	3500-4000	East	33°9'38.86"N 76°30'36.84"E
			West	33°9'2.22"N 76°28'14.88"E
			North	33°9'41.68"N 76°29'22.00"E
			South	33°9'1.78"N 76°29'37.53"E
			Center	33°9'21.40"N 76°29'29.53"E

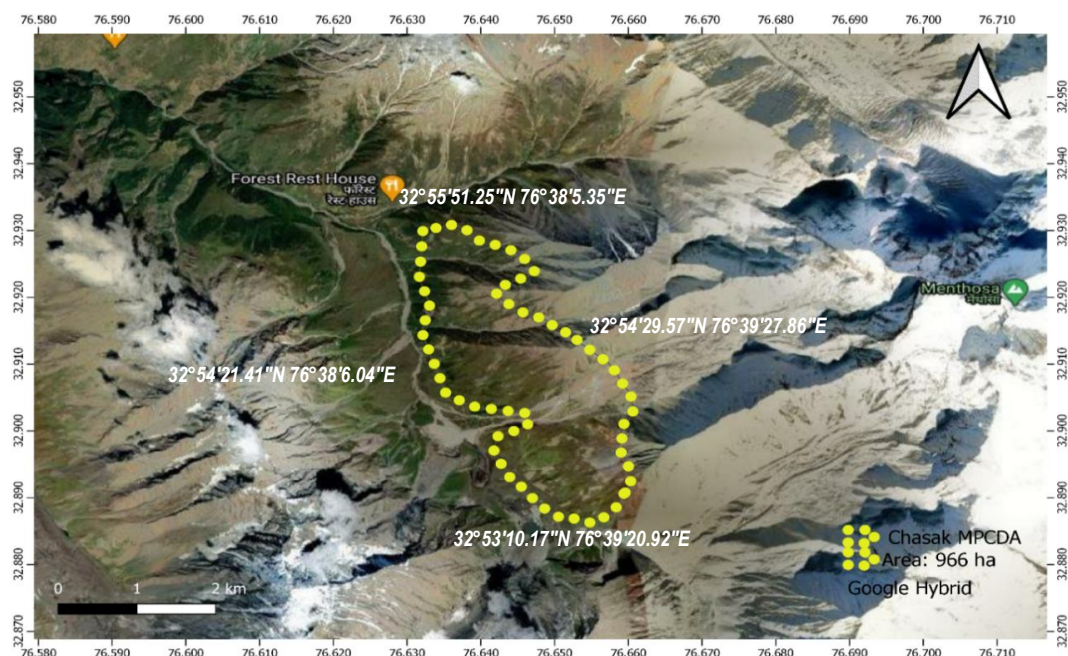


Figure 17: Map showing Chasak bhatori as a potential MPCDA.

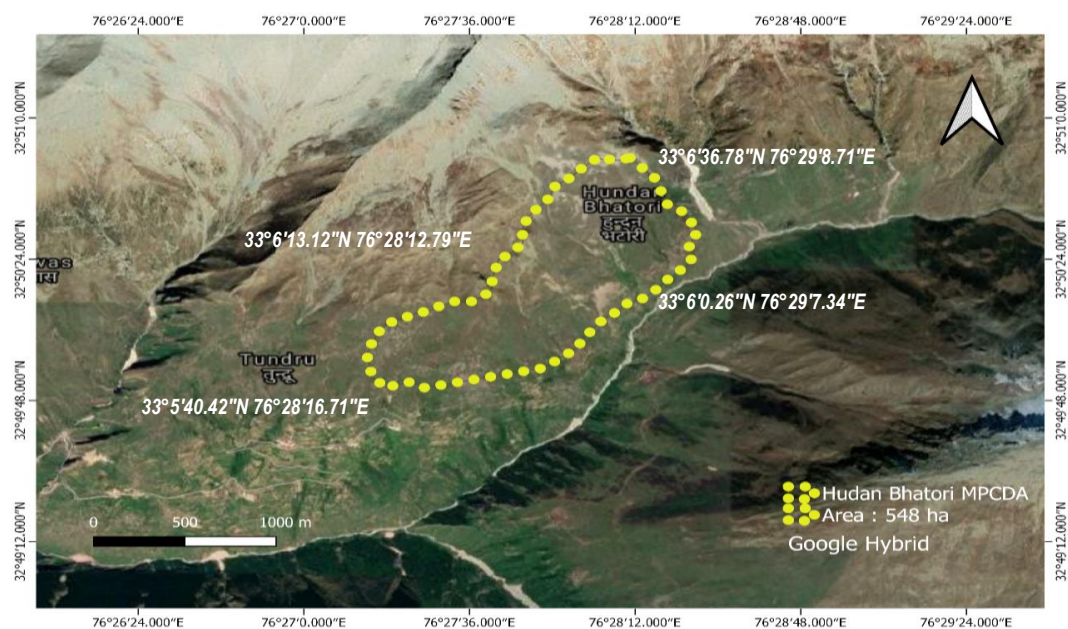


Figure 18: Map showing Hudan bhatori as a potential MPCDA.

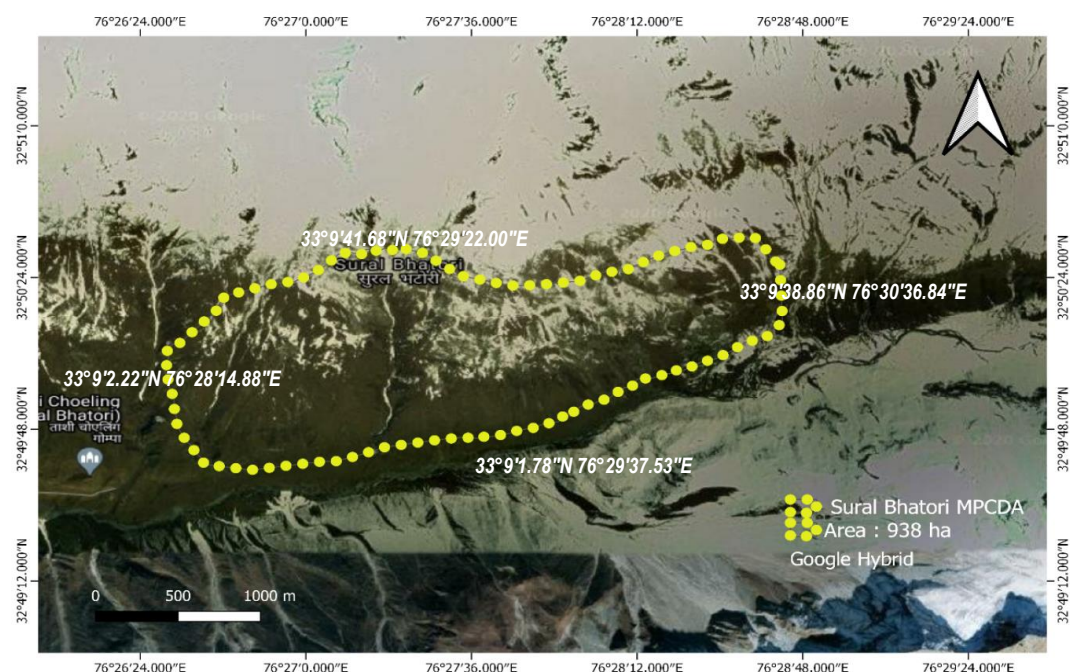


Figure 19: Map showing Sural bhattori as a potential MPCDA.

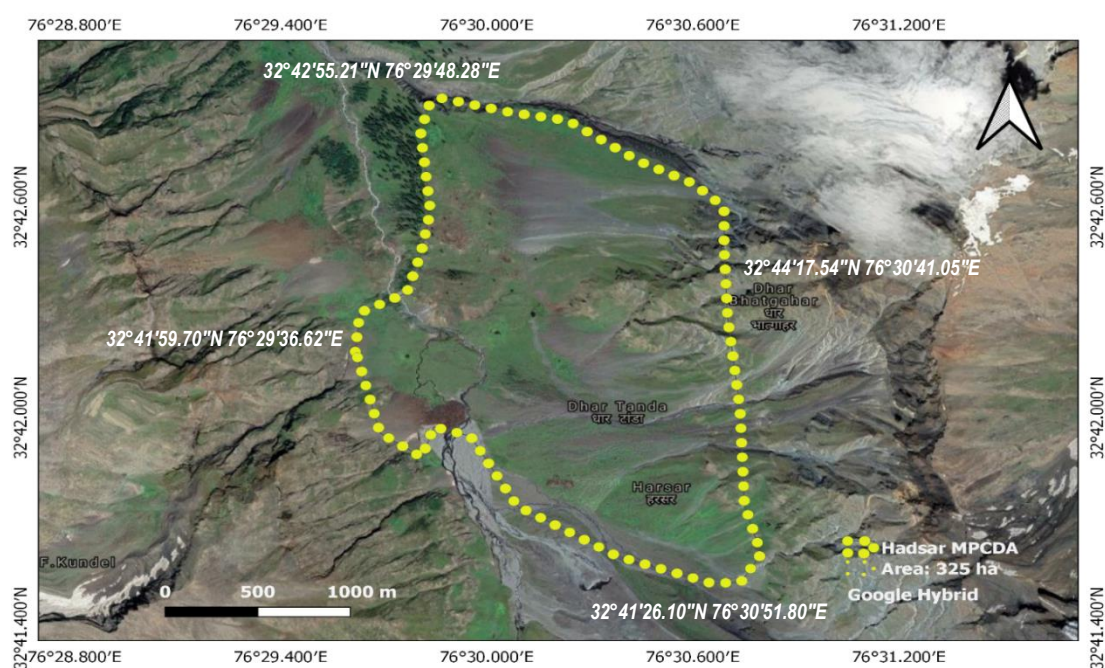


Figure 20: Map showing Hadsar as a potential MPCDA.

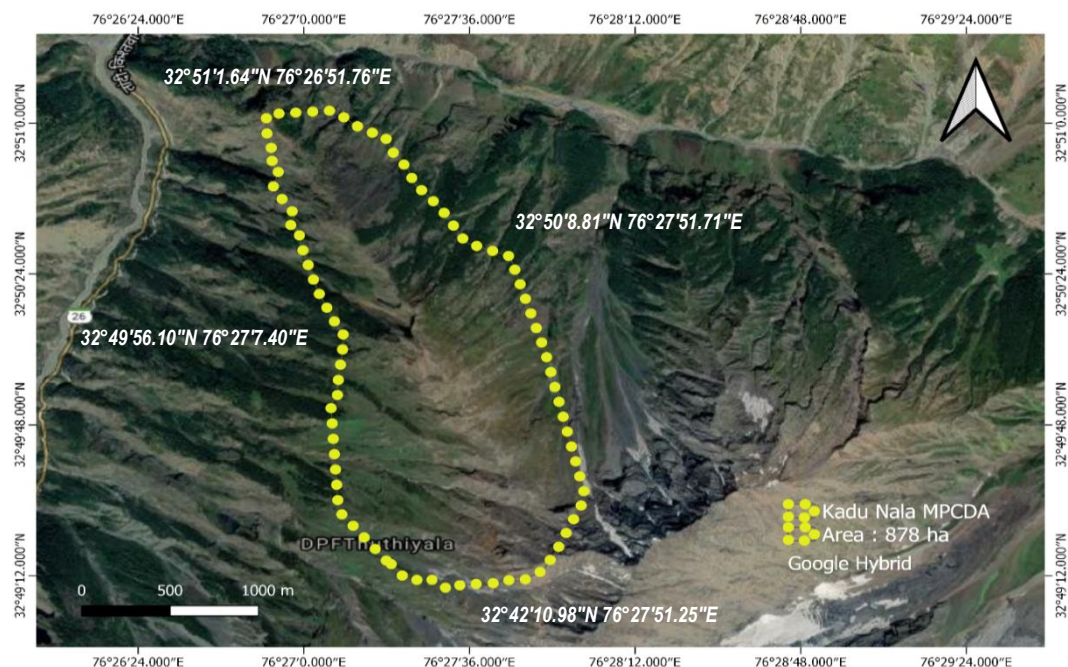


Figure 21: Map showing Kadu nala as a potential MPCDA.

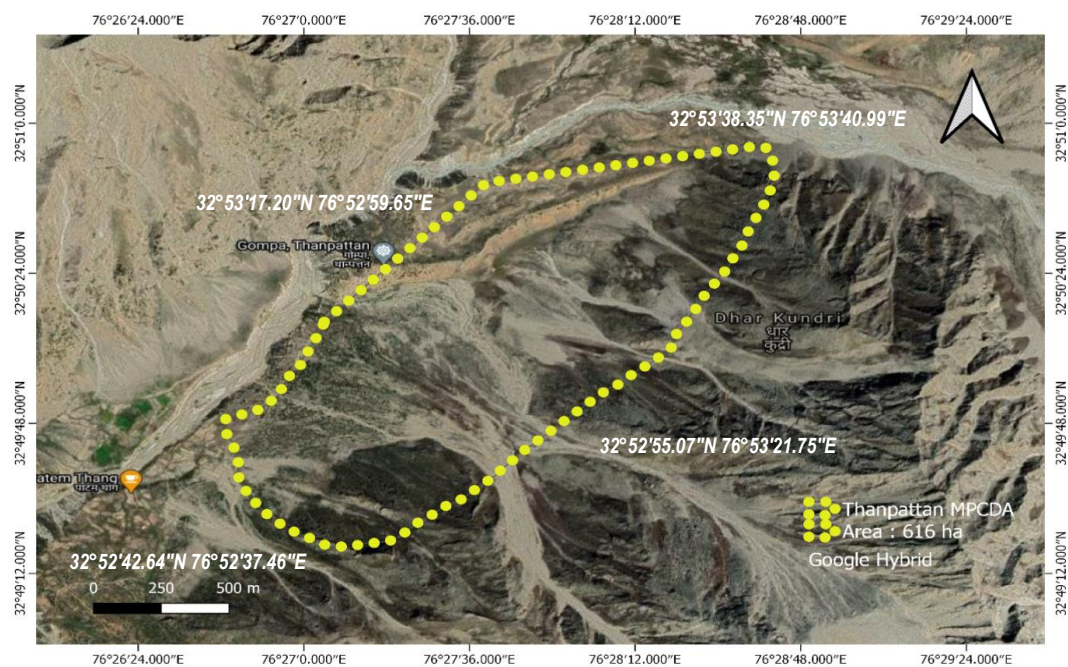


Figure 22: Map showing Thanpattan as a potential MPCDA.

4.9.3 Community led initiatives

Medicinal plants are used by traditional system of medicines, local communities and tribal people all over India. About 90% of the country's medicinal plants are found in the wild. 10% of the medicinal plants are found in land other than forest and community land (Chakraborty et al. 2012). Generally, local communities and plant collectors don't follow the practices of sustainable harvesting, unfortunately, plants are uprooted without keeping enough propagules behind for the replenishment. Medicinal plant resources have been under threat due to their over exploitation and several other factors as a result many species have become endangered and threatened (Rawat et al. 1998). The demand for medicinal plants is rapidly increasing, coinciding with a global resurgence in the demand of traditional medicine. Indian forest seems to have poor regeneration status for endangered medicinal plants species (Sukumar et al. 1992). Thus, identification and conservation of endangered medicinal plants species is an important issue. Once a species becomes extinct, the genetic resource of the species is lost forever, therefore it becomes imperative to conserve the species in its natural habitat. Establishment of MPCDAs is a way forward to conserve the germplasm resource of the native endangered, endemic medicinal plants species. Therefore, the sustainable management of MAPs in the natural areas is of prime importance.

4.9.4 Development of a conservation/management strategy

Medicinal plants are over exploited and consequently many species are on the verge of extinction. It has also been felt that the threat to species increase as the people become aware of their uses. It is, therefore, imperative to protect, conserve and propagate the floral diversity of medicinal value occurring in the forest areas. In this way the forestry sector can effectively ensure a long term in situ conservation and sustainable availability of the medicinal plants. For this purpose, earlier MPCAs and presently MPCDAs have come into the existence for conservation and management of medicinal plants in their natural habitats. A similar gene pool conservation area for *Colchicum luteum* (Kukum/ Suranjan), a prominent medicinal herb, already stands established in the forest adjoining the Udaipur Forest Rest House. Now need is to involve the local communities in these initiatives to develop these further.

4.9.5 Strategies/recommendation

Under the scheme there is one component for setting up Medicinal Plants Conservation and Development Areas (MPCDAs) in forest areas. As per the guidelines, State Forest/Wildlife Department/Forest Development Corporation/Federations/National and State Level Research Organization/Universities/Non-Government/Voluntary Organizations with expertise in the field (subject to the recommendation of concerned State Forest Department) are eligible to implement the projects on MPCDAs. Under the proposed MPCDAs, activities like augmentation of local populations of MAPs are particularly important in case of species where wild populations have dwindled on account of habitat

degradation, and unsustainable harvest. Active interest and engagement of rural communities in such conservation program is instrumental to address sustainability of the medicinal plants sector as a whole, hence financial support is also provided for community mobilization through entry point activities.

4.10 Key Task 11: Access and Benefit Sharing (ABS)

Based on the data and processes as detailed against task 7 above, the ABS mechanism can be executed by the BMCs with the identified traders/manufacturers based on the PIC and MAT to ensure equitable sharing of benefits from sustainable harvest/ use based on BDA (2002) and provisions of ABS guidelines (2014). Additionally, the potential BMCs can also execute it, where the bio-resources are traded.

4.11 Key Task 12: Hold consultative workshop with stakeholders

In order to interact amongst the stakeholder and to make the meetings more inclusive, two landscape level stakeholder consultation workshops were organized. The first workshop took place on 27th September, 2019 in Killar, Pangi with 46 participants followed by another one on 11th October, 2019 in Keylong, Lahaul with 70 participants (**Annexure 12, 13 and 14**). The main objectives were to review the data collected from the field by discussing the findings with the stakeholders and to address the issues more thoroughly. It was observed that due to decline in seasonal demand and unavailability of the state-of-art technologies for storage of perishable plant parts, collectors have to sell the produce at lower prices. Therefore, in order to optimize the benefits to the local communities and to adopt the concepts of sustainable harvesting and benefit sharing as-well-as conservation, it is important to assess the availability, market trends and the methods of collection of the MAPs along with identifying and developing their capacities.



Plate 21. Stakeholder consultative workshops held in Lahaul and Pangi landscape

5. Conclusion

Even as work on the Himalayan flora started way back in the 1820s, the studies specifically focusing on documentation of MAPs gained attention only after 1950s. Studies on the population status, abundance of MAPs and habitat assessment of threatened MAP taxa are, however, still very scanty, and require detailed studies (Samant et al. 2007). Notably, there is a general lack of literature on medicinal plants at the catchment, watershed and valley levels (Singh et al. 2009). Sudden spurt in the market demand over the years and the associated unorganized, premature and relentless harvesting of MAPs has resulted in their tremendous population decline from the wild (Badola, 2001). Other factors responsible for the decline in the populations of these economically important plant species include rapid developmental pressures, urbanization, uncontrolled grazing, habitat degradation and over exploitation (Pandey and Singh, 2017). For instance, rampant collection of *Trillium govanianum* (Nagchatri) from most of the regions of Western Himalaya has happened relentlessly over the past few years. And, although the plant is being sold at about INR 1000 to 1500 kg⁻¹ dry weight, the plant collectors, middleman and locals are neither aware about the use of the plant nor its final destination and end users (Uniyal and Datta, 2012). Similarly, exploitation of roots of *Dactylorhiza hatagirea*, *Nardostachys grandiflora*, *Valeriana wallichii*, *Jurinea macrocephala* and *Saussurea costus* (even as this species is widely cultivated in Himachal Pradesh to meet the commercial demand, some wild collection from its type locality in Jammu & Kashmir is suspected); bark of *Taxus wallichiana* and flowers of *Saussurea obvallata* may lead to their extinction from natural habitat. Wild collection of these species serves as a lucrative livelihood opportunity to the collectors. However, unrestrained extraction and livelihood dependency has led to decline in their wild population (Samant and Pant, 2003). Population assessment of the species, using standard ecological methods, in order to delineate MPCAs for *in situ* conservation of MAPs is crucial. Creating awareness, identifying and building capacities of stakeholders is the need of the hour (NMPB, 2015; Mathela et al. 2020).

In order to optimize the benefits to the local communities and adopt the concepts of sustainable harvesting and benefit sharing, it is important to assess the availability, market trends and methods for collection of MAPs including gathering information on population of selected MAPs. This will help in identifying High Conservation Value Areas (HCVAs) and delineating MPCAs for *in situ* conservation in the landscape. Additionally, identification of large traders and industries that acquire their raw materials from Lahaul and Pangi will strengthen the implementation of Access and Benefit Sharing model on pilot basis. Furthermore, identification of hidden markets viz., local, regional and national, price trends, value addition and strengthening BMCs will help in sustainable management of MAPs in the landscape. The first step towards conservation is identifying the existing population base, and information on the species

distribution and abundance. Keeping the increasing demand of raw drugs in view, it becomes important to conduct such studies on an urgent basis. Identification of the best cultivation practices, R&D to reduce long-gestation periods, cost effective technology, organic-farming, buy-back mechanisms, policy-revision in the interest of stakeholders, protocols for post-cultivation management, quality-control and awareness training are some measures in this direction. It can be concluded that in order to optimize the benefits to the local communities, and to adopt the concepts of sustainable harvesting and benefit-sharing, it is important to assess the availability, market trends and methods for collection of MAPs, including gathering information on population of selected MAPs. Some species like 'Kangra Tea' have been granted the Geographical Indication (GI) tag very recently by the government of Himachal Pradesh. Granting such GI tags to key MAP species would be an important step towards conserving these plants and plant-based products besides further improving their market potential, and boosting the region's economy by giving better returns at the grassroot levels. A major step towards species conservation can be spreading awareness on the dwindling populations amongst the stakeholders. It is also important to identify alternative sources of income for the locals to create in them confidence that wild harvest of MAPs was not the only source of cash income and, thus to dissuade them from ruthless wild harvest and to make them participate in conservation programs. Identifying and building the capacities of stakeholders including the forest officials, locals, school children, traditional healers and plant traders can help in community based natural resource management.

Further, it becomes imperative to compile traditional knowledge held by the local people regarding identification and utilization of MAPs to keep indigenous knowledge alive. For the important drug yielding plants, detailed scientific investigation is necessary for evolving better methods of cultivation and post-harvest processing. Large scale cultivation of MAPs should be encouraged so that their ruthless exploitation from the natural zone is checked. Capacity building and training for identification, collection, storage, handling and marketing should be arranged for the local people. Formation of co-operatives will play an important role in reducing dependency on the middlemen and in maximizing returns to the primary producers. Nurseries and demonstration plots should be created at suitable places and from there planting stock of medicinal plants should be given to the farmers at nominal rates so as to encourage them to undertake cultivation of these herbs on their holdings, where production of food crops is not economical.

6. Key Recommendations

The major issues adversely impacting the MAP species in the Lahaul and Pangi landscape include illegal/ over/ premature/ unorganized harvesting of Medicinal and Aromatic Plants (MAPs), high demand and non-transparent operations in the markets of MAPs. Besides these issues, few gaps such as knowledge on available stock of MAPs, lack of information on cultivation and harvesting methods of key MAP species specific to Lahaul and Pangi landscape, lack of information on end users and middlemen and inadequate information on quantity of raw material traded have been reported. These issues need to be addressed to ensure long-term conservation of the MAP resources of the landscape in a way that livelihood needs of the local communities depending on this resource are not compromised. The following key recommendations have emerged after this study:

Documentation of the Conservation Status of Key MAPs

There is a big gap in the availability of data related to conservation status including population intensity, harvesting intensity and regeneration status of the key MAPs wild collected from the area. This information is necessary to plan any worthwhile conservation action for these species in the project landscape. It is, therefore, recommended that focused studies on these aspects for the project landscape are carried out at the earliest.

Setting aside Conservation Areas around Viable Populations of Priority MAPs

The high valued and threatened MAPs viz., *Fritillaria cirrhosa*, *Rheum australe*, *Aconitum heterophyllum*, *Picrorhiza kuroa*, *Sinopodophyllum hexandrum* observed in the project landscape have scattered diminishing wild populations. Maintaining the gene pool of these species in their natural habitat is of prime importance. The present study has come up with an indicative list of sites that have viable populations of priority MAPs for establishing MPCAs/ MPCDAs for *in situ* conservation of these species. It is recommended that detailed floristic studies in these short-listed sites be carried out with specific reference to the priority MAP species, area finally demarcated and set aside as MPCA/ MPCDA for long term conservation of the gene pool of these species. The forest staff working in these sites also need to be given appropriate training in managing these sites. These conservation sites also need to be notified by the government and included in the Working Plan/ Management Plan of the area to ensure that these sites don't lose sight over time.

Strengthening of Biodiversity Management Committees (BMCs)

The state government has initiated the process to set up BMCs in the project landscape. The process, however, is rather slow and needs fast pacing. BMCs have emerged as an important instrument for conserving the local biodiversity resources and to document traditional local knowledge associated with these biodiversity resources. It is recommended that BMCs should be set up in all the villages in the project landscape in a time bound manner, members of the BMCs be imparted training in conservation methods and data gathering and management techniques, and process of preparing PBRs fast tracked. The adequately trained and empowered BMC would be of immense help in ensuring involvement of local communities in the conservation process and in developing and implementing viable practical solutions for sustainable management of the wild MAP resource base, especially for highly exploited species like 'Jangli lehsun' and 'Kalazeera'.

Value addition by adopting best Post-Harvest Management Techniques

The present practice of primary sale of the raw drugs in crude form without much post-harvest value addition fetches low prices to the primary producers. The local aggregators and traders subject this crude material to cleaning, drying and grading and getting much higher prices than those at which the material was procured from the primary producers. The practice of not adding value at the level of primary producers also causes a good percentage of the material to get decayed and damaged putting that much more pressure on the wild resources to meet their commercial demand. It is recommended that facilities for post-harvest value addition including for cleaning, sizing, drying, grading, packing and storage be set up for identified clusters of villages and the local communities organized and trained in its use so that all raw drug from the village clusters is sold only after adding post-harvest value to the material. This initiative will help the communities get better returns and reduce pressure on the wild resources.

Developing Farm-scale Agro-Techniques for Priority MAP Species

It is well documented that the demand for many MAPs is increasing by the year, putting greater harvesting stress on their wild populations. There is a need to bring some of the key MAP species under viable and remunerative cultivation. It is a pity, however, that consolidated package of agro-techniques for cultivating these species on farm scale are not available even to this day. In the absence of agro-economics of commercial-scale cultivation, the farmers are not adopting MAPs as a part of their agricultural practices. It is especially so as most of the priority MAPs of the region are long-gestation crops, and committing one's agricultural field to a crop without knowing the expected outturn from its cultivation is not tenable. It is recommended that programs at developing agro-techniques for priority MAP species along with economics of their cultivation be encouraged and supported. In the current study, sustainable harvesting and collection protocols, along with cultivation tools and techniques have been designed for the selected

(10) MAPs, although, appropriate demonstration plots showcasing such agro-techniques in different valleys of the focal landscape be set up to build confidence of the farmers in adoption of these crops in their agricultural practices.

Developing Germplasm Banks of the Priority MAP Species

One limiting factor in adopting cultivation of high value MAPs for which farmers can take risk of cultivation is the non-availability of authentic and quality germplasm in the project landscape. Some farmers who have taken to small scale cultivation of MAPs, obtain germplasm mainly in the form of root stock from the wild sources, putting added pressure on the already stressed resource base. Similar hardship of germplasm availability is also faced for taking up augmentation of wild resource in the wild. It is, therefore, recommended that commercial scale germplasm banks - nurseries and seed banks – be set up in the project landscape of the high yielding and tested cultivars of the priority species. It is highly desirable to associate the local communities in developing and managing the germplasm banks. It will help create awareness amongst the local people and develop their confidence in taking up cultivation of priority MAPs. The germplasm will also be used for strengthening resource base of the selected MAP species in their wild habitat.

Study and Monitor Impacts of Climate Change

The fragile project landscape is highly susceptible to the changing climate. Glaciers in the landscape are fast melting and many moist habitats, like the one for *Dactylorhiza hatageria*, is fast shrinking. Precipitation pattern is also changing with potential adverse impact on many more important MAP species. There is a need to study the climatic changes and monitor the same to guide develop mitigation strategies.

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Annexures

Annexure 1

Details of consultative workshops and internal review meetings of Secure Himalaya project.

Sr.no.	Meeting	Venue	Date	Agenda/Purpose
1.	First state level technical committee (SLTC)	Shimla	23-01-2019	For disseminating the rationale of SECURE Himalaya project amongst the various stakeholders, and to exchange ideas and experiences of the attendees
2.	Stakeholder consultation workshop	Himalayan Forest Research Institute (HFRI), Shimla	12-03-2019	To identify the MAPs that require immediate attention in terms of their usage and dwindling wild populations
3.	Second SLTC	PCCF office (Wildlife), Shimla	16-04-2019	To understand the progress and as a follow-up of the ongoing project activities
3.	Brainstorming meeting	New Delhi	15-05-2019	To review the proceedings of the ongoing project activities, including field data collection
4.	Third SLTC	Shimla	7-05-2019	To brief the overview and progress of the SECURE Himalaya project along with annual work plan and alternate proposed activities
5.	Fourth National Project Steering Committee	MoEF&CC, New Delhi	03-06-2019	To review the proceedings of the ongoing project activities, including field data collection
6.	Consultative Workshop	HFRI, Shimla	12-13 March 2019	To discuss the project findings and address conservation issues at the grassroot level

Annexure 2

List of number of permits/collectors/traders of the Medicinal and Aromatic Plants in Pangi (2017-2018).

Sr.no.	Name of collector/Traders	Address
1.	Shri. Madan Chand S/o Shri. Doli Ram	Vill. The Mall Road Killar, Pangi, Distt- Chamba, HP
2.	Shri. Satish Kumar S/o Shri. Dharam Dev	Vill. and Post Leo, Tehsil Pangi, Distt. Chamba, HP
3.	Shri. Yog Raj S/o Shri. Khem Raj	Vill. Shour, Post- Purthi, Tehsil Pangi, Distt. Chamba, HP
4.	Shri. Kalyan Singh S/o Shri. Doli Ram	Vill. and Post- Sural, Tehsil- Pangi, Distt- Chamba, HP
5.	Shri. Man Chand S/o Shri. Doli Ram	Vill. The Mall Road Killar, Pangi, Distt. Chamba (HP)
6.	Shri. Ram Nath S/o Shri. Sant Ram	Vill. Sural Bhatori, Post- Tai Sural, Tehsil Pangi, Distt- Chamba (HP)
7.	Shri. Lekh raj S/o Shri. Lal Chand	Vill. and Post- Sach, Tehsil- Pangi, Distt- Chamba (HP)
8.	Shri. Satish Kumar S/o Shri. Dharam Dev	Vill. and Post- Leo, Tehsil Pangi, Distt. Chamba, (HP)
9.	Shri. Babu Ram S/o Shri. Kanda Ram	Vill. and Post- Sechu, Tehsil Pangi, Distt- Chamba, (HP)
10.	Shri. Sunny Kumar S/o Shri. Sham Lal	Vill. and Post- Killar, Tehsil Pangi, Distt- Chamba, (HP)
11.	Shri. Yog Raj S/o Shri Khem Raj	Vill. Shour Post- Purthi, Tehsil Pangi, Distt. Chamba, (HP)
12.	Shri. Man Chand S/o Shri Doli Ram	Vill. The Mall Road Killar, Pangi, Distt. Chamba, (HP)
13.	Shri. Kalian Singh S/o Shri. Mansa Ram	Vill. and Post- Sural, Tehsil Pangi, Distt- Chamba, (HP)
14.	Shri. Paras Ram S/o Shri. Beer Chand	Vill. and Post- Thandal, Post- Purthi, Tehsil- pangi, Distt- Chamba, (HP)
15.	Shri. Devi Singh S/o Shri. Devi Lal	Vill. Hudan Bhatori, Post- Killar, Tehsi pangi, Distt- Chamba, (HP)

Sr.no.	Name of collector/Traders	Address
16.	Shri. Tashi S/o Shri. Karam Chand	Vill. Parmar Bhatori, Post- Killar, Tehsil- Pangi, Distt- Chamba, (HP)
17.	Shri. Prem Nath S/o Shri. Soram Jeet	Vill. Sural Bhatori, Post- Killar, Tehsil- Pangi, Distt- Chamba, (HP)
18.	Shri. Pasang S/o Shri. Amar Nath	Vill. Parmar Bhatori, Post- Killar, Tehsil- Pangi, Distt- Chamba, (HP)
19.	Shri. Bato Batan S/o Shri. Karam Lal	Vill. Parmar Bhatori, Post- Killar, Tehsil- Pangi, District- Chamba, (HP)
20.	Shri. Gian Singh S/o Shri. Tej Ram	Vill. Sural Bhatori, Post-Tai Sural, Tehsil- Pangi, Distt- Chamba, (HP)
21.	Shri. Lekh Raj S/o Shri. Lal Chand	Vill. & Post- Sach, Tehsil- Pangi, Distt- Chamba, (HP)
22.	Shri. Dina Nath S/o Shri. Dharam Singh	Vill. Ajog, Post- Purthi, Tehsil- Pangi, Distt- Chamba (HP)
23.	Shri. Neel Chand S/o Shri. Bal Dev	Vill. Dhanala, Post- Sahali, Tehsil- Pangi, Distt- Chamba (HP)
24.	Shri. Babu Ram S/o Shri. Kandu Ram	Vill. & Post- Sechu, Tehsil- Pangi, Distt- Chamba (HP)
25.	Shri. Chander Kumar S/o Shri. Nasnak	Vill. Thandal, Post- Purthi, Tehsil- Pangi, Distt- Chamba (HP)
26.	Shri. Man Singh S/o Shri. Mai Ram	Vill. & Post- Purthi, Tehsil- Pangi, Distt- Chamba (HP)
27.	Shri. Satish Kumar S/o Shri Raj Kumar	Vill. & Post- Sach,
28.	Shri. Bachan Singh S/o Shri Mahesh Das	Vill. & Post- Sechu, Tehsil- Pangi, Distt- Chamba (HP)
29.	Shri. Amar Chand S/o Shri Hamir Chand	Vill. Dhanala, Post- Sahali, Tehsil- Pangi, Distt- Chamba (HP)
30.	Shri. Raj Kumar S/o Shri. Madan Lal	Vill. Kuthal, Post- Sach, Tehsil- Pangi, Distt- Chamba (HP)
31.	Shri. Amar Jeet S/o Shri Hamiru	Vill. Mojhi, Post- Sahali, Tehsil- Pangi, Distt- Chamba, (HP)

Annexure 3

Number of permits/collectors/traders of the medicinal and aromatic plants in Lahaul (2017-2018).

Sr. no.	Name of collector/Traders	Address
1.	Shri. Chering Ram S/o Shri. Deva Ram	Village and Post- Karpat
2	Shri. Sarvan Kumar S/o Shri. Shanti Kumar	Village and Post- Goshal, Tehsil- Lahaul
3	Shri. Tobdan S/o Shri. Tashi	Village- Grimas, Post- Urnath, Tehsil- Lahaul
4	Shri. Basant Ram S/o Shri. Sangat Ram	Village- Ghari, Post- Chirmat, tehsil- Lahaul
5	Shri. Nand Lal Sharma S/o	Village- Mansari, Haripur- Kullu
6	Shri. Amar Chand S/o Shri. Madho Ram	Village and Post- Salgran, L&S
7	Shri. Amar Singh S/o Shri. Rup Singh	Village- Khanjar, Post- Gondhal, Tehsil- Keylong, L&S
8	Shri. Tashi S/o Chhering Tobye	Village- Khanjar, Post- Gondhal, Tehsil- Keylong, L&S
9	Shri. Bhagat Ram S/o Shri. Labh Singh	Village- Chhaling, Post- Karpat, Udaipur, L&S
10	Shri.Prathi Chand S/o Shri. Sobha Chand	Village- Salgran, Post- Salgran, L&S
11	Shri. Prem Nath S/o Shri. Moti Ram	Village- Bhujand, Post- Tindi, Udaipur, L&S
12	Shri. Ram Lal Thakur S/o Thakur Das	Village- Bhujand, Post- Tindi, Udaipur, L&S

Annexure 4

Potential BMCs in (a) Lahaul and (b) Pangi.

(a) In Lahaul

Sr.no.	BMC Name	Post Office	Chairman and Secretary	PBR Status
1.	Barbog	Pirkar	Chairman: Sh. Zuemed Dau (9418972372) Secretary: (9418604530)	--
2.	Goshal	Goshal	Chairman: Sh. Digvijay Singh (9459988771)	In progress
3.	Gaundhla	Guandhla	Chairman: Sh. Suraj Lal (9418378565) Secretary: Smt. Rajni Devi (9418719623)	In progress
4.	Ranika	Lot	Chairman: Sh. Anil Kumar (9418844484) Secretary: Sh. Prem Lal (9418661421)	In progress
5.	Mooling	Mooling	Chairman: Sh. Dinesh Kumar (9418318291) Secretary: Smt. Nirmala Devi (9418893900)	In progress
6.	Khangsar	Gaundhla	Chairman: Sh. Hira Lal (9418660879) Secretary: Sh. Pradeep (9418442335)	In progress
7.	Udaipur	Udaipur	Chairperson: Smt. Mani Devi (9459013813) Secretary: Sh. Ganesh Lal (9418979185)	In progress
8.	Tindi	Tindi	Chairman: Sh. Tog Chand Thakur (9418318364)	In progress
9.	Triloknath	Triloknath	Chairman: Sh. Budhi Chand (9459988955) Secretary: Sh. Nawang (9418430471)	In progress
10.	Shakoli	Trilokinath	Chairman: Sh. Karam Singh (9805120032) Secretary: Sh. Shiv kumar (8894512978)	--
11.	Nalda	Jahalma	Chairman: Mr. Sudershan Jaspa (9459631013) Secretary: Mr. Kuljeet Singh (9418002803)	--
12.	Keylong	Keylong	Chairperson: Smt. Kusum Lata (9418661443) Secretary: Smt. Pooja (8988291694)	In progress
13.	Chimrat	Chirmat	Chairperson: Smt. Prem Dassi (9459828454) Secretary: Sh. Ramesh Dogra (9418502635)	In progress

(b) In Pangi

Sr.no.	BMC Name	Post Office	Chairman and Secretary	PBR Status
1.	Luj	Luj	Chairperson: Smt. Anjana Negi (9418772747) Secretary: Sh. Dhan Dev (9418866260)	In progress
2.	Dharwas	Dharwas	Chairperson: Sh. Raj Kumar (94590-05649) Secretary: Sh. Lekh Raj	--
3.	Karyas	Karyas	Chairperson: Sh. Prakash Chand Thakur (94188-90045) Secretary: Sh. Dharam Singh (89883-17751)	--
4.	Kilad	Kilad	Chairperson: Smt. Sunit Sharma (9459934205) Secretary: Sh. Khem Raj (9418280720)	In progress
5.	Kothi (Karyuni)	Kothi	Chairperson: Sh. Roop Singh (9418661537) Secretary: Sh. Baldeb Ram (9418794346)	In progress
6.	Hudhan Bhatori	Bhatori	Chairperson: Smt. Bimla (94592-33747) Secretary: Sh. Hari Singh Chopra (94189-40919)	--
7.	Saach	Saach	Chairperson: Sh. Mahender Singh (94186-00789) Secretary: Sh. Lakshi Chand	--
8.	Mindhal	Mindhal	Chairperson: Sh. Inder Prakash, Secretary: Sh. Shanta Kumar	In progress
9.	Kumar	Kumar	Chairperson: Sh. Pasang (94590-14204) Secretary: Sh. Suresh Kumar (94186-12114)	--
10.	Shunn BMC	Shunn	Chairperson: Smt. Shiv Dassi (89887-26403) Secretary: Sh. Kashmir Lal Sharma (94590-79805)	--
11.	Rei BMC	Rei	Chairperson: Sh. Pyare Lal (94183-72692) Secretary: Sh. Rajesh Kumar	--
12.	Purthi BMC	Purthi	Chairperson: Sh. Satish Kumar (94184-42448) Secretary: Sh. Hira Lal (89883-21633)	--

Annexure 5

Potential natural bio-resources under trade in Lahaul and Pangi

Sr. no.	Tradable bio-resources	Trade name	Source of origin
1.	<i>Abies webbiana</i>	Talispatra	Wild
2.	<i>Aconitum heterophyllum</i>	Atish, Patish	Cultivated/Wild
3.	<i>Angelica glauca</i>	Chora, Choraka	Wild
4.	<i>Arnebia benthamii</i>	Ratanjot	Wild
5.	<i>Arnebia euchroma</i>	Ratanjot	Wild
6.	<i>Bergenia ciliata</i>	Bergenia, Pashanbed	Wild
7.	<i>Betula utilis</i>	Bhojpatra/ Bhoj	Wild
8.	<i>Bunium persicum</i>	Singhu Jeera	Cultivated/Wild
9.	<i>Carum carvi</i>	Kala jeera	Cultivated/Wild
10.	<i>Corylus jacquemontii</i>	Jacquemont's Hazel	Wild
11.	<i>Dactylorhiza hatagirea</i>	Salam panja	Cultivated/Wild
12.	<i>Ephedra gerardiana</i>	Somlata	Wild
13.	<i>Ferula jaeschkeana</i>	Wild Asafoetida, Hing, Hingupatri	Cultivated/Wild
14.	<i>Fritillaria cirrhosa</i>	Kakoli/Jangli lasen	Wild
15.	<i>Hippophae rhamnoides</i> subsp. <i>turkestanica</i>	Sea Buckthorn, Chharma	Wild
16.	<i>Hippophae salicifolia</i>	Willow-Leaved Sea Buckthorn, Chharma	Wild
17.	<i>Hyoscyamus niger</i>	Khurasani ajwain	Cultivated/Wild
18.	<i>Inula racemosa</i>	Manu	Cultivated
19.	<i>Juniperus communis</i>	Common Juniper	Wild
20.	<i>Juniperus semiglobosa</i>	Jau, Hauber	Wild
21.	<i>Jurinea macrocephala</i>	Dhoop	Wild
22.	<i>Lilium polyphyllum</i>	Ksheer kakoli	Wild
23.	<i>Meconopsis aculeata</i>	Patishan rooli	Wild
24.	<i>Morchella esculenta</i>	Gucchi	Wild
25.	<i>Nardostachys jatamansi</i>	Jatamansi	Wild
26.	<i>Picrorrhiza kurroa</i>	Karu	Wild
27.	<i>Sinopodophyllum hexandrum</i>	Bankakri	Wild
28.	<i>Polygonatum verticillatum</i>	Salam mishri	Cultivated/Wild
29.	<i>Polygonatum cirrhifolium</i>	Salam mishri	Cultivated/Wild
30.	<i>Rheum australe</i>	Revandchini	Wild
31.	<i>Rheum webbianum</i>	Revandchini	Wild
32.	<i>Saussurea costus</i>	Kuth	Cultivated
33.	<i>Taxus wallichiana</i>	Talishpatra	Wild
34.	<i>Trillium govanianum</i>	Nagchhatri	Wild
35.	<i>Valeriana jatamansi</i>	Mushakbala	Cultivated/Wild

Annexure 6

Bio-resource based industrial units in Himachal Pradesh.

Sr.no	Name of the Industrial unit	Location
1.	M/S Nu-Tech. (India) Agro Foods Pvt. Ltd. Industrial Area, Kala Amb, Dist. Sirmour (HP)	Kala Amb
2.	M/s AIMIL Pharmaceuticals (I) Ltd, 2994/4 Street No. 17, Ranjeet Nagar, New Delhi -8	Nalagarh
3.	M/s Mayur Ind. Ltd; Maya Towers-12, Yamuna Marg, Civil Line, New Delhi	Baddi/ Barotiwala
4.	M/s Dunn Food Pvt. Ltd; 8-A/1, Model Town, Patiala	Baddi
5.	M/s PHF Foods Ltd; 923 G.T. Road, Jalandhar (Pb).	Kala Amb
6.	M/S Pfiscar Biotech Ltd., H.N.1885, Sector-15, HBC, Sonipat, Haryana.	Baddi
7.	M/S BDS Cotspin Limited, 731, HUDA, Phase-I, Sector11-12, Panipat-132103.	Baddi
8.	M/s S.K. Industries, 11/2A Pusa Road, New Delhi-5.	Parwanoo
9.	M/s Marico Industries Ltd, K.C. Marg Bandra West, Mumbai-50	Baddi
10.	M/s D.S. Foods Ltd., Indl. Area Barotiwala, Distt. Solan.	Barotiwala
11.	M/ Raj Threads India Pvt. Ltd., House No. 159 Sector-18-A, Chandigarh	Baddi
12.	M/s Vardhman Polytax Ltd., Bated Road, PO Box No. 2, Bhatinda (Pb)	Baddi
13.	M/s International Panacea Ltd., 11, Baber Lane, Bengali Market, New Delhi-1.	Baddi
14.	M/s K.C. Fibre Ltd., CFF-I, Dilkhush IE, G.T. Karnal Road, Delhi-33.	Baddi
15.	M/s HEMAN Noble Bio-Chem. Laboratories Pvt. Ltd, H.No. 13, Sector-7, Panchkula	Barotiwala
16.	M/s Hindustan Lever Ltd, Hindustan Lever House, 165/166, Backbay Reclamation, Mumbai-400 020.	Baddi
17.	M/s Cadbury India Ltd, 19, Bhulabhai Desai Road, Mumbai-400 026.	Baddi
18.	M/s Panacea Biotec United, Vill. Samlehrim, Ambala –Chandigarh Highway Lalru, Patiala, Punjab.	Malpur (Nalagarh)
19.	M/s Pooja Cortspin Pvt. Ltd., C/o Jodha Ram Bansal, House no. 1, Aggarwal Estate, Majari Road, Samana Mandi, Patiala, Punjab.	Nalagarh
20.	M/s Solan Spining Mill Pvt. Ltd. C-2, SFS, Flates, Sector-19 Rohini Delhi-85	Baddi
21.	M/s Aanart Agrochem Ltd, Divya Apartments, Nr. Mithakali, Garanala, Navrangpura, Ahmedabad-9	Rajgarh (Sirmour)
22.	M/s Himachal Indage Ltd., C/O HPMC Nigam Vihar, Shimla-2.	Pragtinagar (Kotkhai)
23.	M/s VVF Ltd, Opposite Sion Fort Garden, 109 Sion (East) Mumbai-22	Baddi
24.	M/s G.C. Fibres Ltd, Bhawanigarh Road, Samana-147 101 (Pb)	Salewal (Nalagarh)
25.	M/s Food & Health care specialities, Plot No. 297, Sector-24, Faridabad	Solan
26.	M/s Ranbaxy Laboratories Ltd, Village Ganguwala Paonta Sahib, Distt. Sirmour.	Ganguwala (Paonta Sahib)
27.	M/s Goden Terry Fabs Pvt. Ltd., C/o Kran Singh Chauhan, Near Post Office Kala Amb, Distt. Sirmour	Trilokpur (Kala Amb)

Sr.no	Name of the Industrial unit	Location
28.	M/s Himalaya Cotton Yarn Pvt. Ltd, Shramjivi Sevalaya, Opp. Surat Railway Station, Surat, Gujarat-395 001.	Banalagi (Kasauli)
29.	M/s Banke Behari Agro Mills, SCF-90, Gram Market, Sector-26, Chandigarh	Saini Majra (Nalagarh)
30.	M/S Cremica Agro Foods Ltd, G.T. Road, Jalandhar Bypass, Ludhiana.	Tahliwala (Haroli)
31.	M/S Mahaan Multi Pack (a unit of M/s Mahaan Dairies Ltd, Vill. Kunja Rampur Road, Paonta Sahib, Distt. Sirmour.	Paonta Sahib
32.	M/S Nector Lifesciences Ltd, Plot No. 110, Industrial Area, Phase-I, Chandigarh (U.T.)	Nalagarh
33.	M/S Legacy Foods Pvt. Ltd, C-48, Kailash Apartments, Kailash Colony, New Delhi.	Baddi
34.	M/S Manali Food Products, (Unit-III), Plot No. 1 & 2, Industrial Area, Shamshi, Distt. Kullu	Shamshi (Kullu)
35.	M/s Bagrrys India Ltd, Plot NO. 154, HPSIDC, Industrial area, Baddi, Distt. Solan.	Baddi
36.	M/S Mahaan Health care (A unit of Mahaan Dairies Ltd) Village Kunja, Rampur Road, Paonta Sahib, Distt. Sirmour.	Kunja (Paonta Sahib)
37.	M/s Dabur India Ltd, 109, HPSIDC Industrial Area, Baddi, Distt. Solan, H.P.	Baddi
38.	M/s Ambrozia Food Products, SCO-68-70, Sukhmani Chambers, Sector-17 A, Chandigarh.	Baddi
39.	M/s Knight Queen 3h consumers Industries Ltd, Village Kheri, Trilokpur Road, Kala Amb, Distt. Sirmour	Kheri (Nahan)
40.	M/s Emami Ltd, Stephen House, 6A, R.N. Mukherjee Road, Kolkata-700 001	Barotiwala
41.	M/s Natural Bio Products Ltd, 10/8, Sarvpriya Vihar, New Delhi-16	Ramshehar (Nalagarh)
42.	M/s Hindustan Kwaliti Walls Foods Pvt. Ltd, Brooke Fields, PB No. 3777, Maralhalli, PO Bangalore-560 037	Manakpura (Nalagarh)
43.	M/s Doon Valley Foods Pvt. Ltd, Plot No.76, IA, Gondpur, Paonta Sahib	Paonta Sahib
44.	M/s Venus Remedies Ltd, Plot No. 51-52, IA, Phase-I, Panchkula (HR)	Baddi
45.	M/s Aristo Laboratories Pvt.Ltd, H. No. 6-3-629, Anand Nagar, Kharatabad, Hyderabad-4	Baddi
46.	M/s Aristo Pharmaceuticals Pvt. Ltd, 23-A, Shah Industrial Estate Off. Veera Debai Road, Andheri (W) Mumbai-53	Baddi
47.	M/s Bhaskar Denim Ltd, 182/11, IA, Phase-I, Chandigarh	Nalagarh
48.	M/s Alliance Agrofats 133, Sector-7, Panchkula (Hy)	Baddi
49.	M/s Mahaan Nutrition (A unit of M/s Mahaan Foods Ltd), Vill. Kunja, Rampur Road, Paonta Sahib, Distt. Sirmour	Kunja (Paonta Sahib)
50.	M/s Bagrrys India Ltd, (Unit-II), X-2, Hauz Khas, New Delhi-16	Baddi/ Barotiwala
51.	M/s Sobhagia Clothing Co. 178, Col. Gurdial Singh Road, Civil Lanes Ludhiana (Pb)	Baddi
52.	M/s Dev Bhoomi Cold Chain Pvt. Ltd., 17 & 18, New Sabzi Mandi, Azadpur, Delhi	Matiana (Theog)

Sr.no	Name of the Industrial unit	Location
53.	M/s Coral Healthcare Pvt. Ltd., B-3, Block-8, Sector-6, Parwanoo, Distt. Solan, H.P.	Parwanoo
54.	M/s PNG Healthcare, Pvt. Ltd. MIG-I, Sector-3, Parwanoo, Distt. Solan. H.P.	Baddi
55.	M/s Inka Foods (P) Ltd., Ropar Road, Nalagarh, Distt. Solan, H.P.	Nalagarh
56.	M/s Jodhamal Agro Tech (P) Ltd, C/o Anil Kuthiala Director, SCI-56, Swastik Vihar, MDC Panchkula (Hy)	Kulhatiwala (Kasauli)
57.	M/s Mahaan Naturals (A unit of Mahaan Dairies Limited) Vill. Kunja Rampur Road, Paonta Sahib, Distt. Sirmour	Kunja (Paonta Sahib)
58.	M/s Alchemist Ltd, (Unit-II), SCO-12,13, Sector-9D, Chandigarh	Berson (Nalagarh)
59.	M/s Hillerest Food Pvt. Ltd, 12A, Sector-3, Parwanoo, Distt. Solan	Pargana (Nalagarh)
60.	M/s U.S. Foods Industries, Prop: Sh. Vineet Gupta, 14, Mall Road, Karnal (Hy)	Katha (Nalagarh)
61.	M/s Cadbury India Ltd. (Unit-II), Cadbury House, 19, Bholabhai Desai Road, Mumbai-400 026	Sandholi (Baddi)
62.	M/s Tirupati Medicare Limited, C/o International Cylinders (P) Ltd, 20, IA, Gondpur, Paonta Sahib, Distt. Sirmour	Patlion (Paonta Sahib)
63.	M/s Regal Snacks Pvt. Ltd, C/o Vikesh Chetal, SCO 99/2, Railway Road, First Floor, Nangal	Una
64.	M/s Safire Polymers Ltd, A-94/3, Wazirpur, IA, Delhi-52	Barotiwala
65.	M/s Panacea Biotech Ltd (Unit-II), Chandigarh Highway, Lalru, Punjab-140 501	Baddi
66.	M/s Dr. Sabharwal's Wound Care (Unit-II), H.NO. 260, Sector-6, Panchkula, HR	Bhuranwala (Barotiwala)
67.	M/s Hindustan Cocoa Products, 301, Sdesai Residency, Plot No. 88, Srinagar Colony, Hyderabad-73	Baddi
68.	M/s Sai Sugar Ltd, 104, Magnum House-II, Karampura Commercial Complex, New Delhi-15	Gagret (Amb)
69.	M/s V.R. Industries (P) Ltd, K-1466, Ansals, Palam Vihar, Gurgaon-17 (Haryana)	Katha (Baddi)
70.	M/s Hem-An-Noble Bio-Tech Laboratories Pvt. Ltd (Unit-II), Sector-7, Panchkula, Haryana	Barotiwala
71.	M/s Pankaj Spinners (P) Ltd, Vill. Mandhala, Teh. Kasauli, Distt. Solan, H.P.	Mandhala (Kasauli)
72.	M/s Biodeal Pharmaceuticals Pvt. Ltd, Vill. Saini Majra, Ropar Road, Teh. Nalagarh, Distt. Solan, H.P.	Baddi
73.	M/s Swiss Garnier Life Sciences, 21-23, Industrial Area, Mehatpur, Distt. Una, H.P.	Mehatpur (Una)
74.	M/s Sukhjit Starch & Chemicals Ltd, Sarai Road, Phagwara-144 401	Haroli (Una)
75.	M/s H.P. Yarns Private Limited, B-103, Oxford Colony, Bharatgarh Road, Nalagarh, Distt. Solan, H.P.-174 101	Nalagarh
76.	M/s KCL Food (A unit of M/s Khemka containers Ltd), Plot No. 297, Sector-24, Faridabad (Haryana)	Bata Mandi (Paonta Sahib)
77.	M/s Chemex Oil Pvt. Ltd, 19A, Jawahar Lal Nehru Road, Kolkata -700 087	Kunjhal (Baddi)
78.	M/s Navdeep Bioceuticals, 398, Phase-I, IA, Panchkula	Bhatoli Kalan (Nalagarh)

Sr.no	Name of the Industrial unit	Location
79.	M/s M & M Chocolates, H.No. 284-85, Housing Board, Phase-III, Baddi, Distt. Solan, H.P.	Baddi
80.	M/s Hill Crest Foods (Unit-II), H.No. 754, Sector 8B, Chandigarh	Berson (Nalagarh)
81.	M/s Himachal Agri Farms Pvt. Ltd., 1442, Wazir Nagar, Kotla Mubarakpur, New Delhi-110 003	Kotla Barog (Sirmour)
82.	M/s Saveer Biotech Limited, 1442, Wazir Nagar, Kotla Mubarakpur, New Delhi-110 003	Kotla Barog (Sirmour)
83.	M/s S.S. Food Industries, 694-B, Gurdev Nagar, Ludhiana (Pb)- 141 001	Kala Amb and Nalagarh
84.	M/s Hirak Biotech Limited, 4th Floor, A wing Maradia Plaza, G.G. Road, Ahmedabad (Gujarat)	Baddi
85.	M/s Elder Healthcare Limited, Elder House, C-9, Dalia Industrial Estate, Off New Link road, Andheri (W) Mumbai-400 053	Paonta Sahib
86.	M/s Samridhi Biotech Pvt. Ltd., C/o Karan Singh, Excise Colony, Kala Amb, Teh. Nahan, Distt. Sirmour, H.P.	Kala Amb
87.	M/s Lakshya Healthcare Pvt. Ltd., Plot No. 15, Sector-2, Parwanoo, Distt. Solan, H.P.	Parwanoo
88.	M/s Magnolia Impex, B-440, New Friends Colony, New Delhi-110 065	Kano, Dharampur (Kasauli)
89.	M/s ANG Lifesciences India, SCO 864, Top Floor, NAC Manimajra, Chandigarh (UT)	Baddi
90.	M/s Bio Veda Research Pvt. Ltd., J-27, Jangpura Extension, New Delhi	Dhaura Kuan (Paonta Sahib)
91.	M/s Murli Soap Pvt. Ltd, 19, Feroze Gandhi Market, Ludhiana-141 001 (Pb)	Bela Bathri (Haroli)
92.	M/s Mahaan Healthcare (Unit-II) (A unit of Mahaan Dairies Ltd.) Village Kunja, Rampur Road, Teh. Paonta Sahib, Distt. Sirmour, HP	Kunja (Paonta Sahib)
93.	M/s Innovative Textiles Pvt. Ltd, 1004, New Delhi House, 27, Barakhamba Road, New Delhi-110001	Bather (Kasauli)
94.	M/s Evolution Foods and Food Processing Limited, D-39, TTC Industrial Area, MIDC, Turbhe Navi Mumbai-400703	Baddi
95.	M/s MGR Breweries, 106-E, Kamla Nagar, Near Delhi University, Delhi-110 007	Rampur (Nalagarh)
96.	M/s Godrej Beverages & Foods Ltd, C/o Amrit Lal Jain, Ward No. 6, Nalagarh, Distt. Solan, H.P.	Ranguwal (Nalagarh)
97.	M/s Advance Food & Agro Industry, 25-A, Pocket-C, DDA SFS Flats Mayur Vihar, Phase-III Delhi-96	Badehra (Haroli)
98.	M/s Suri Agro Fresh Pvt. Ltd, C-129, New Sabzi Mandi, Azadpur, Delhi-110 033.	Rowali (Kumarsain), Distt. Shimla
99.	M/s Scotia Distilleries Pvt. Ltd., 8 Adarsh Nagar, Jalandhar Punjab-144 008	Oel, Teh. Amb, Distt. Una
100.	M/s ITC Ltd, Thapar House, 2 nd Floor 124 Janpath, New Delhi-01	Manpura (Nalagarh)

Sr.no	Name of the Industrial unit	Location
101.	M/s Marico Limited, B-2, Plot UPSIDC Industrial area, Selaqui, Dehradun, Uttranchal -248197	Dhaulakuan (Paonta Sahib)
102.	M/s Advantage Organic Naturals Technologies, Pvt. Ltd, (Prop. Sh. Rajiv Rai Sachdev) B-5, 2 nd Floor, East of Kailash, New Delhi-65	Dochi, Kandaghat, Distt. Solan
103.	M/s Scott-Edil Pharmacia Ltd, 54-55, Industrial Area, Phase-II, Chandigarh-160002	Jharmajri (Nalagarh)
104.	M/s BCC Fuba India Ltd, 4 th KM Swarghat Road, Nalagarh, Distt. Solan-174101	Swarghat Road, Nalagarh
105.	M/s Dabur India Ltd. 109, HPSIDC, Industrial Area, Baddi, Distt. Solan, H.P.-173205	Mankumajra (Nalagarh)
106.	M/s Marico Limited, E-10, MIDC Area, Ajanta Road Jalgaon, Maharashtra-425003	Baddi
107.	M/s Nestle India Limited, Nestle House, Jarandra Marg, M-Block, DLF City Phase-II Gurgaon-122002	Tahliwala (Una)
108.	M/s Doctor Foods Pvt. Ltd., SCO-1094-95, 2 nd Floor Sector-22-B, Chandigarh	Gowalthai (Bilaspur)
109.	M/s Sun Juice Private Limited, C/o Countryside Agro Produce Pvt. Ltd, A1/1 MIDC Indapur, District Pune, Maharashtra.	Baddi
110.	M/s Cipla Ltd. (Unit-IV), Village Malpur Upper, P.O. Bhud, Baddi, Distt. Solan, H.P.	Baddi/ Barotiwala
111.	M/s Kerry Ingredients India Pvt. Ltd, 706, JMD Regent Square, MG road, Gurgaon (HR)-122002	Nalagarh
112.	M/s M & M Chocolates, Unit-II, Vill. Katha, Tehsil Baddi, Distt. Solan, H.P.	Katha (Baddi)
113.	M/s Singhanian Beverages Ltd., Singhanian Kothi, 22/135, Sri Dwarika Dhish Road, Post Box No. 482, Kanpur-208001	Takrala (Una)
114.	M/s Foremost Dairies Private Ltd., 419 Block-E, New Generation Apartments, Shimla Highway, Vill. Dhakoli, Zirakpur, Distt. Mohali (Punjab)-140603	Nalagarh
115.	M/s Deluxe Integrated Cold Chain Pvt. Ltd. 15-16 New Subzi Mandi Azadpur, Delhi	Baragrana Bihal, P.O. Baragrana, Tehsil Manali
116.	M/s Purogenic Fruit Juices Pvt. Ltd., Plot No. 36 A, Phase-III, Industrial Area, Sansarpur Terrace, Tehsil Jaswan, District Kangra, H.P.	Sansarpur Terrace (Kangra)
117.	M/s S.K. Industries Unit-II, Plot No. 10, Sector-2, Parwanoo, Distt. Solan, H.P.	Parwanoo
118.	M/s Polyan Food Park Pvt. Ltd., c/o Mrs. Bector Food Specialties Ltd., Theing Road, Phillaur - 144410 (Punjab)	Singham (Haroli)

Annexure 7

List of traders and exporters.

i) Traders (Himachal Pradesh)

Sr.no.	Trader/Firm Name	Address
1.	D.M. Ajay Kumar, Vivek Kumar	Akhara Bazar, Kullu-175101
2.	Guru Kirpa Himalayan Herbs	990/5, Nr A.V.N. School, Naya Bazar, Nahan-173001
3.	Guru Nank Karyana Store	Mandir Rd, Kangra-176001
4.	Hansraj Traders	Vill-Salwahan, P.O.-Chunahan, The-Sadar, Mandi-175027
5.	Hasur Himalayan Products P. Ltd.	National Highway-21, Vill.Banala, Aut, Distt. Mandi
6.	Magna Mal Permeshwari Das	Main Bazar, Kangra-176001
7.	Mahamaya Traders	P.O. Devdhar, Tehsil-Chachiot, Mandi
8.	Nanda Medicinal Plants Traders	Vill.Mansari, P.O.-Haripur, Distt.Kullu, Manali
9.	Negi General Store	Chail Chowk, Mandi
10.	Niku Karyana Store	Kaishtha, Nagrota Bagwan-176047
11.	Nizami Genral Store	Nr Chowk Sunder Nagar-175021
12.	Sandeep Kumar & Co.	Main Bazar, Kangra-176001
13.	Shivjeet Pansari	Chail Chowk, Mandi
14.	V.K. Thakur	Chail Chowk, Mandi

ii) Exporters (Himachal Pradesh)

Sr.no.	Trader/Firm Name	Address
1.	Ayush Herbs P. Ltd.	25, Ph-I, Ind. Area, Nagrota Bagwan, Kangra-176047
2.	Hasur Himalayan Products P. Ltd.	National Highway-21, Vill. Banala, Aut, Distt.-Mandi
3.	Healing Herbs	Kandrori, Dist. Kangra-176402
4.	Horticultural Sales & Services	186/3, Jail Rd, Mandi-175001
5.	Kullu Herbals (Mfg.) Company	16, Indl Area, Shamshi, Kullu-175126
6.	Mediroma Nirgalits International	40, Indl Area, Shamshi, Kullu-175126

iii) Traders (Punjab)

Sr.no.	Trader/Firm Name	Address
1.	Agro Deals	48-B, Tagore Nagar, Ludhiana-141001
2.	Arjun Herbal Products	Bazar Wahian Wala, Amritsar-6
3.	Arora Store	New Mishri Bazar, Amritsar-143001
4.	Aryaan Herbs	Majith Mandi, Amritsar-143001
5.	Bharti Brothers	90, Bank Colony, Jamalpur, Ludhiana-141010
6.	Deepak bawa & Co.	Bawa House, Majith Mandi, Amritsar-143006
7.	Ghansham Dass Mohan Lal	Bagh Jhanda Singh, Majith Mandi, Amritsar-143006
8.	Gian Chand Ram Gopal	Majith Mandi, Amritsar
9.	H.S. Herbs	Bagh Jhanda Singh, Majith Mandi, Amritsar-143006
10.	Himalayan Traders	Katra Dullo, Amritsar-143006
11.	J. Kishore Overseas	75, Bhandari Bridge, Amritsar-143001
12.	J.H.B. Enterprises	Majith Mandi, Amritsar-143006
13.	Jagdish Commercial Services	59, Mewa Mandi, Amritsar-143001
14.	Jagdish Kumar Rajiv Kumar	Bagh Jhanda Singh, Opp Bank of India, Majith Mandi, Amritsar-143001
15.	Jay Kay International	3, College Rd, Fawara Chowk, Ludhiana-141001
16.	K. Hari Om	Majith Mandi, Amritsar-143006
17.	K.B. Enterprises	K.B. Chambers, Navrang Bldg, Majith Mandi, Amritsar-143006
18.	K.K. Marketing	Basement Sukh Sagar Dawakhana, Chowk Shiwala Sanglan, Ludhiana-141008
19.	K.K. Traders	Majith Mandi, Amritsar-143006
20.	K.L. Mehta & Co.	Bazar Wahian Wala, Amritsar-143006
21.	Kalyan Singh Mohan Lal	Bagh Jhanda Singh, Amritsar-143006
22.	Kapoor Brothers	Majith Mandi, Amritsar-143006
23.	Kishan Chand Vaishno Das	Shiva Mkt., Tunda Talab, Amritsar
24.	Kishore & Company	Majith Mandi, Amritsar-143006
25.	M.M. Trading Co.	24, Beauty Avenue, Ph-IV, Amritsar-143006
26.	Madho Ram Mohan Lal	679, Majith Mandi, Amritsar-143006
27.	Mehra Export Corporation	Katra Hari Singh, Amritsar-143001
28.	Moti Lal Sachin Kumar	Majith Mandi, Amritsar-143006
29.	Motilal & Company	155, Shastri Nagar, Amritsar-143001
30.	Mugrai Brothers	Majith Mandi, Amritsar-143006
31.	New Kashmir Trading Co.	Old Dai Hata, Ludhiana-141008
32.	Overseas Herbal Farms	Blazon Paints, St Sunet, Ludhiana-141012
33.	Pankaj Enterprises	Majith Mandi, Amritsar-143001
34.	Pars Ram Tara Chand	Majith Mandi, Amritsar
35.	Puri Brothers	163, Vijaynagar, Jalandhar-144001
36.	Raja Trading Company	Majith Mandi, Amritsar-143006
37.	Shivanditta Mal & Company	Majith Mandi, Amritsar-143001
38.	Trade Agro	48-B, Tagor Nagar, Ludhiana-141001

Annexure 8

High trade medicinal plant species with sizeable wild populations in Himachal Pradesh.

Sr.no.	Name of Species	Trade Name	Major Supply Source	Estimated Annual Trade (MT)	Price Range (Rs. kg ⁻¹)
1	<i>Abies spectabilis</i> (D.Don) Spach	Talispatra	Tm	500-1000	30-50
2	<i>Acacia catechu</i> (L.f.) Willd.	Katha	Tm	200-500	10-15
3	<i>Aconitum heterophyllum</i> Wall. ex Royle	Atis	Tm	200-500	2000-4000
4	<i>Acorus calamus</i> L.	Vach	Tr	500-1000	30-35
5	<i>Adhatoda zeylanica</i> Medic.	Adusa	Tr	2000-5000	10-15
6	<i>Aegle marmelos</i> (L.) Corr. ex Schultz	Bael	Tr	2000-5000	10-25
7	<i>Asparagus racemosus</i> Willd.	Shatavari	Tr	2000-5000	40-70
8	<i>Bacopa monnieri</i> (L.) Pennell	Brahmi	W	2000-5000	30-35
9	<i>Berberis aristata</i> DC.	Daruhalidi	Tm	500-1000	15-35
10	<i>Bergenia ciliata</i> (How.) Stern.	Pashanabheda	Tm	200 - 500	15 - 20
11	<i>Bombax ceiba</i> L.	Mochrus	Tr	100 - 200	50 - 60
12	<i>Butea monosperma</i> (Lam.) Taub.	Tesu phool	Tr	200 - 500	15 - 20
13	<i>Cassia fistula</i> L.	Amaltas	Tr	200 - 500	30 - 40
14	<i>Cassia tora</i> L.	Chakoda beeja	W	5000 - 10000	5 - 10
15	<i>Cedrus deodara</i> (Roxb.) Loud.	Devdar	Tm	500 - 1000	25 - 35
16	<i>Celastrus paniculatus</i> Willd.	Malkangani	Tr	200 - 500	48 -55
17	<i>Centella asiatica</i> (L.) Urban	Brahmi booti	W	500 - 1000	30 - 35
18	<i>Centratherum anthelminticum</i> (L.) O.Kuntze	Kali zeeri	W	500 - 1000	70 - 75
19	<i>Cinnamomum tamala</i> Nees & Eberm.	Tejpatta	Tm	500 - 1000	15 - 35
20	<i>Embllica officinalis</i> Gaertn.	Amla	Tr	16000	30 - 35
21	<i>Ephedra gerardiana</i> Wall.	Somlata	Tm	200 - 500	25 - 35
22	<i>Gloriosa superba</i> L.	Kalihari	Tr	100 - 200	600 - 750
23	<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall. ex G.Don	Kutja	Tr	1000 - 2000	75 - 100
24	<i>Juniperus communis</i> L.	Hauber	Tm	500 - 1000	35 - 45
25	<i>Jurinea macrocephala</i> (Royle) C.B.Clarke	Dhoop	Tm	1000 - 2000	60 - 150
26	<i>Litsea glutinosa</i> (Lour.) Robinson	Maida chhal	Tr	100 – 200	20-35
27	<i>Nardostachys grandiflora</i> DC.	Jatamansi	Tm	200-500	110-150
28	<i>Onosma hispidum</i> Wall. ex G.Don	Ratanjot	Tm	500 - 1000	50-60
29	<i>Oroxylum indicum</i> (L.) Vent.	Tetu chhal	Tr	1000 - 2000	20 - 30
30	<i>Parmelia perlata</i> (Huds.) Ach.	Chadila	Tm	1000 - 2000	80-90
31	<i>Picrorhiza kurroa</i> Royle ex Benth.	Kutaki	Tm	200-500	220-230
32	<i>Pistacia integerrima</i> J.L. Stewart ex Brandis	Kakar singi	Tm	150-200	90-110
33	<i>Rheum australe</i> D.Don	Revan chini	Tm	500-1000	25-30

Sr.no.	Name of Species	Trade Name	Major Supply Source	Estimated Annual Trade (MT)	Price Range (Rs. kg ⁻¹)
34	<i>Rhododendron anthopogon</i> D.Don	Talispatra	Tm	100-200	15-30
35	<i>Sapindus mukorossi</i> Gaertn.	Reetha	Tr	200-500	30-40
36	<i>Swertia chirayita</i> (Roxb. ex Fleming) Karst.	Chiraiyata	Tm	500-1000	200-225
37	<i>Taxus wallichiana</i> Zucc.	Talispatra	Tm	100-200	75-90
38	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	Arjun	Tr	2000-5000	10-15
39	<i>Terminalia bellirica</i> Roxb.	Behra	Tr	2000-5000	10-15
40	<i>Terminalia chebula</i> Retz. & Willd.	Harda	Tr	5000-10000	10-15
41	<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thoms.	Giloy	W	2000-5000	10-15
42	<i>Valeriana jatamansi</i> D.Don	Musakbala	Tm	100-200	95-100
43	<i>Viola pilosa</i> Blume	Banafsha	Tm	200-500	300-350
44	<i>Withania somnifera</i> Dunal	Ashwagandha	Tr	2000-5000	60-70
45	<i>Woodfordia fruticosa</i> (L.) Kurz	Dhai phool	Tr	2000-5000	10-15

Abbreviations used: Tr = Tropical Zone; Tm = Temperate Zone; C = Largely Cultivated (Source: Ved and Goraya, 2008)

Annexure 9 List of manufacturers in Himachal Pradesh.

a) Ayurvedic Pharmacies

District Solan

1. M/s. Himachal Ayurvedic Pharmaceuticals Works (Regd.), The Mall, Solan, H.P.-173212; Tel No. 951792-224086, 227548
2. M/s. Yogmaya Pharmacy, Shilly Raod, Distt. Solan (H.P.)-173212; Tel No. 951792-227080, 238522
3. M/s. Bindal Rasayan Shala, Bindal Colony Solan, H.P.-173212; Tel No. 951792 – 222368-69
4. M/S Sharda Ayurvedic Pharmacy, Guleria Niwas, Hospital Road, Solan, H.P. 173212
5. M/s. Shivalik Ayurvedic Pharmaceuticals, Lakkar Bazar, Distt. Solan (H.P.); Tel No. 951792-222018
6. M/s. Mayers Traders, Lower Bazar Solan (H.P.); Tel No. 951792-220542, 220510, 230054; Mob.98160-20549; Fax No. 224336
7. M/s. Indian Herbal Remedies, 141-Industrial Area, Distt. Solan-173205 (H.P.); Tel No. 951795-244266, 244299
8. M/S. Dabur India Ltd., 109, Industrial Area, Baddi, Distt. Solan (H.P.)-173205; Tel No. 951795-245191, 245277,
9. M/s. Saini Hair Herbal Product Pvt. Ltd., Baddi, Distt. Solan-173205 (H.P.); Tel.No. 23378118; Fax 91-11-23378119
10. M/s. Dabur India Ltd., Plot No. 220-221, Distt. Solan, (H.P.); Tel No. 951795-245273, 245277, 245451, 245452; Fax No. 44090
11. M/S. Ozone Ayurvedics, 34-Industrial Area Baddi, Distt. Solan (H.P.); Tel No. 951795-245463; Fax No. 245463

12. M/S/ Chikitsa Lok Pharmacy, Vill. Kathni, Sita Ram Mandir, P.O. Subathu, Distt. Solan (H.P.)-173206; Tel No. 951792-275681
13. M/S Dev Bhumi Ayurvedic Pharmacy, Chander Lok Bhawan, Sunny Side, Solan, H.P.-173212; Tel.No. 951795-223465, 223411; Fax No. 230648
14. M/s. Contour Pharmaceuticals, 167 Industrial Area, Phase-II Baddi, Distt. Solan (H.P.); Tel.No. 0172-2616116; Mob.098140-74640
15. M/S Link Herbals, Village Kirpalpur, Teh. & Distt. Solan; Tel.No.223801,223242
16. M/S Wrigley India Pvt. Ltd., Village Katha, P.O. Baddi, Solan; Tel.No.44132, 45249, 45250; Fax (01795) 44108
17. M/S Dev Pharmacy Pvt. Ltd., Plot No. 100, DIC Industrial Area, Baddi, Distt. Solan, H.P. 173205
18. M/S Lakshya Health Care Pvt. Ltd., 15-Parwanoo, Industrial Area, Sector-2, Distt. Solan, H.P.
19. M/s Lomash Pharma, Palace Hotel, Bye Pass, Solan, H.P.; Tel.No. 01792-226323, 551185
20. M/s Dharam Pal Prem Chand Ltd., 1.5 Km., Haripur Road, Village Damo wala, distt. Solan; Tel.No. 0118 (91) 4587911-14; Fax 0118 (91) 4587918
21. M/s Hemma Herbs Pvt. Ltd., 39, Industrial area, Barotiwala, Distt. Solan
Tel.No. 01792-255335, 255264, 309639
22. M/s Shree Dhanwantri Herbals, Village Kishanpura, P.O. Guru Majra, Tehsil Nalagarh, Distt. Solan (H.P.); Mob. 09417059807, 09417055807
23. M/s. Charak Pharma Pvt. Ltd., Vill. Katha, P.O. Baddi, Tehsil Nalagarh, Distt. Solan (H.P.); Tel.No. 951795-246687
24. M/S Shree Chintamani Herbal, 12-Industrial Area, Baddi, Tehsil Nalagarh, Distt. Solan, H.P.; Tel.No. 9816112527
25. M/S Ayurvet Limited Village Katha, P.O. Baddi, Teh. Nalagarh, Distt. Solan, H.P. 173205; Tel.No. 01795-247746, 247690; Tel.Fax. 01795-247746
26. M/S Hariomwala Ayurvedic Products, Village Koti, P.O. Jabli, Distt. Solan H.P; Tel.No. 098766-71107.
27. M/S Smilax Health Care Pvt. Ltd., 54-EPIP-I, Jharmajri, Baddi, Distt. Solan, H.P.; Tel. No. 01795-271062
28. M/S Coral Health Care Pvt. Ltd., Plot No. 15, Industrial Area, Sector-5, Parwanoo, Distt. Solan, H.P.; Tel. No. 01792-234335
29. M/S SAS Pharmaceuticals (H.P.), Plot No.106, EPIP, Phase-I, Jharmajri, Baddi, Distt. Solan, H.P.; Mbl. No. 9810013434
30. M/S Sarvotham Remedies Ltd., Village Katha, P.O. Baddi, Tehsil Nalagarh, Distt. Solan-173205, H.P.; Tel.No. 01795-282323, 282324
31. M/S Indian Herbs Specialities, village Manakpur, P.O. Lodhi Majra, Tehsil Nalagarh, Distt. Solan, H.P.
32. M/S HRI Cosmetics (India) Pvt. Ltd., Buranwala Village, P.O. Barotiwala, Distt. Solan, H.P. 174103; Tel.No. 01792-258878
33. M/S Mapaex Remedies Pvt. Ltd., Plot No. 1A, Export Promotional Industrial Park (E.P.I.P.), Phase-II, Thana, Baddi, Tehsil Nalagarh, Distt. Solan, H.P.; Tel.No. 01795-202447-49
34. M/S Panacea Biotech Ltd., Malpur, Baddi, Tehsil Nalagarh, Distt. Solan, H.P.
35. M/S Cheminnova Pharmaceuticals, 82/12, 82/12A, HPSIDC, Baddi, Distt. Solan, H.P.
36. M/S Paras Pharmaceuticals Ltd., 701/534, Village Sandholi, Tehsil Nalagarh, Distt. Solan-173205 (H.P.); Tel.No. 01795-245572-73, 245547

37. M/S Gayatri Bio-Organics, Kapoor Building, 1st Floor, Village Ambota, Old Kasauli Road, Parwanoo, Distt. Solan, H.P.
38. M/S Vaidya Nutraceuticals Pvt. Ltd., Village Balyana, P.O. Barotiwala, Tehsil Kasauli, Distt. Solan, H.P.
39. M/S Bharat Organics, Shiva-Shakti, Suburb, Village Rabon, Distt. Solan, H.P.
40. M/S Aimil Pharmaceuticals (India) Ltd., Saini Majra, Ropar - Nalagarh Road, Tehsil Nalagarh, Distt. Solan, H.P.
41. M/S Alchemist Ltd., Electronic Complex, Chambaghat, Solan H.P.
42. M/S Lupin Ltd. C/O M/S Simlax Health Care Pvt. Ltd., 54-EPIP-I, Jharmajri, Baddi, Distt. Solan, H.P.; Tel.No. (91-22) 56402222 MUMBAI
43. M/S Vasu Health Care Pvt. Ltd., C/O M/S Shri Dhanwantri Herbals, Tehsil Nalagarh, Distt. Solan, H.P.
44. M/S Procter & Gamble Hygiene & Health Care Ltd., C/O M/S Sarvotham Remedies Ltd., Village Katha, P.O. Baddi-173205, Distt. Solan, H.P.
Tel.No. 01795-282323, 282324
45. M/S Procter & Gamble Hygiene & Health Care Ltd., C/O M/S Mapex Remedies Ltd., Plot no. 1A (E.P.I.P.) Phase-2 Thana Village Doria, P.O. Baddi-173205, Tehsil Nalagarh, Distt. Solan, H.P.
46. M/S Charak Pharma Pvt. Ltd., C/O M/S Cheminnova Pharmaceuticals, HPSIDC, Baddi, Distt. Solan, H.P.
47. M/S Shree Baidyanath Ayurved Bhawan Pvt. Ltd. C/O M/S Vaidya Nutraceuticals Pvt. Ltd., Barotiwala, Industrial Area, Tehsil Kasauli, Distt. Solan, H.P.

District Kangra

1. M/S Bajinath Pharmaceuticals Paprola, Distt. Kangra H.P.; Tel.No. 951894-2243011, Fax No.1894-24266
2. M/S Anil Ayurvedic Pharmacy Regd., Gang Bheron, Bagli Road, Kangra, H.P.-176209; Tel.No. 01892-2322160
3. M/s Chadda Traders, 10, Industrial Area, Nagrota Bagwan, Kangra, H.P.- 176047
4. M/S The Him Medicines Processors Association, Village Moin, P.O. Chintpurni, Kangra, (H.P)- 177110; Tel No. 01876-255253; Mob. 98161-47301 (Dr. Swaran Joshi)
5. M/S Bharat Pharmaceuticals Plot No.1, Phase-II, Industrial Area, Sansarpur Terrace, Distt. Kangra, H.P. 176501; Tel.No. 276456
6. M/S Shiva Pharmaceuticals, Sabha College Road, Teh. Nurpur, Dehari, Distt. Kangra, 177101; Tel.No. 01893-255020
7. M/S Him Herbs Products & Supply Co-operative, Industrial Society, Raja-Ka-Bag, Distt. Kangra, H.P. 176001; Tel.No. 01893-233423, 233533
8. M/S Ayush Pharmaceuticals & Marketing Divison, 30, 31, 32 Phase-I, Industrial Area, Nagrota Bagwan, Distt. Kangra, H.P; Tel.No. 01892-252009, 252109
9. Rajiv Gandhi Govt. Ayurvedic Post Graduate College Pharmacy, Paprola, Distt. Kangra, H.P.; Tel.No. 01894-242064
10. M/S Kangra Valley Ayurvedic Remedies Pvt. Ltd., V.P.O. Dadh, Palampur, Distt. Kangra, H.P.; Tel.No. 01894- 252052
11. M/S Himalaya Herbal Products, Ward No.7, Jasalta, Nurpur, Distt. Kangra, H.P.; Tel.No. 01893-220336, 951863-226336, 011-7055645, 011-7865105

12. M/S Indian Medicines & Pharmaceuticals, Plot. No. 6, Phase-II, Sansarpur Terrace, Distt. Kangra, H.P.
13. M/S Kangra Hills Care & Cure Products®, 5-Industrial Area, Nagri, Tehsil Palampur, Distt. Kangra, H.P.; Tel.No. 951894-252838
14. M/S Wiltech Pharmaceuticals, 17-Industrial Area, Sansarpur Terrace, Distt. Kangra, H.P.; Tel.No. 01970-276426, 018883-236213, Fax No. 951883-242983
15. M/S Surya Pharmaceuticals, 817/5, Vinay Gali, Nurpur, Distt. Kangra, H.P.; Tel.No. 220171, 226582; Mob. 94180-14034
16. M/S Healing Herbs Kandrori, Distt. Kangra, H.P.; Tel No. 951893-244414, 244714, 244814; Fax No. 01893-244500, 0091-186-220027
17. M/S Shimla Hills Care & Cure Pvt. Ltd., Village Tikri, Tang Narwana, Tehsil Dharamshala, Distt. Kangra, H.P.; Tel.No. (Delhi) 26462885, 26435612
18. M/s Kangra Herbs Pvt. Ltd., Village Durgella, Tehsil Shahpur, Distt. Kangra, H.P.; Mob. 94181-85856
19. M/S Trojan Pharma Ltd., Plot #27, 28, 29 & 30, PH-III, Sansarpur Terrace, Distt. Kangra, H.P.

District Sirmour

1. M/s. Government Ayurvedic Ayurvedic Pharmacy, Majra, Distt. Sirmour (H.P); Tel No. 01904 - 255122
2. M/s. Regency Herbs River View Lane, Ponta Sahib Distt. Sirmour (H.P)-173025; Tel No. 01704-224435, 223431 Fax No. 01704-222645
3. M/s. Himdhar Herbal Remedies Gond Pur, Near Truck Union Poanta Sahib, Distt. Sirmour (H.P)
4. M/s. BIO Veda Action Reesearch Pvt. Ltd. Khasra No, 159/129/96, (Jamniwala Road) Vill. Dharam-Kot Panta Sahib Distt. Sirmour (H.P); Tel No. 01704-222550; Mob. 98160-27967, 98161-33222
5. M/s Panchsheel Organics, Khasra No. 492/2, Mauja Kadarapur, Teshil Poanta Sahib, Distt. Sirmour (H.P); Tel No. 01704-223124 (R); Mob. 9816484493
6. M/s. Zeon Life Sciences Ltd. (Natural Divison), Village Kunja, Rampur Road, Distt. Sirmour, Paonta Sahib-173025, Tel No. 01704-222313, 222643; Fax No. 01704-222630
7. M/S Avalon cosmetics Pvt. Ltd., 58-59, Industrial Area, Paonta-Sahib, Distt. Sirmour, H.P.
8. M/s Spans Healthcare, Khasra No. 897/60, Village Majra, Poanta Sahib, Distt. Sirmour (H.P)
9. M/s Vanesa Cosmetics, Plot No. 196/186/11/3-4, Village Johron, Indusrrial Area, Trilokpur Road, Kala Amb (H.P)
10. M/s Wonder Products, 552/80/2, Village Moginand, Kala Am, Distt. Sirmour, (H.P)
11. M/S Himalaya Drug Company, C/O M/S Zeon Lifesciences Ltd. (Natural Divison), Village Kunja, Rampur Road, Paonta-Sahib, Distt. Sirmour, H.P.; Tel.No. 918023714444 (Banglore)
12. M/S Lupin Ltd., C/O M/S Mahaan Naturals, Village Kunja, Rampur Road, Paonta Sahib, Distt. Sirmour, H.P.

District Una

1. M/S. Sudhanshu Herbs 46-A, Industrial Area, Mehatpur Distt. Una (H.P)-174312; Tel No. 01975-232550, 232950
2. M/S. National Chemicals Industries Ayurvedic Pharmacy, 89- Industrial Area, Mehatpur Distt. Una (HP)-174312; Tel. No. 01975-233478

3. M/S Himnanda Herbal (India) V.P.O. Gondpur Banehra Upper, The. Amb, Distt. Una, H.P.; Tel.No. 01796-268568; Mob. 09811441089
4. M/S Vetsfarma Ltd., Village Daulatpur, P.O. Khudd, Distt. Una, H.P.; Tel.No.91-181-2225432; Tele Fax 91-181-2457285

District Mandi

1. M/S Govt. Ayurvedic Pharmacy Joginder Nagar, Distt. Mandi, (HP); Tel.No. 01908-222048
2. M/S Saroj Pharma, Plot No. 9, Phase-I, Industrial Area, Mandi, H.P. 175001; Tel. No. 01905-235520
3. M/S Himachal Phyto Chemicals, Ner Chowk, Mandi, H.P. 175008; Tel.No. 01905-242381
4. M/S Grass Root Industries Plot No. 4, Phase-III, Industrial Area, Mandi, H.P.-175001; Tel.No. 01905-235224, 235225

District Bilaspur

1. M/S Dogra Pharma 29-Industrial Estate, Distt. Bilaspur, HP 174001; Tel.No. 01978-222574
2. M/S Kashyap Ayurvedic Pharmacy, 19-Industrial Area, Distt. Bilaspur, HP-174001; Tel.No. 01978-223440
3. M/S Dogra Drug Pharmaceuticals Veterinary Ayurvedic Medicines, Shed no. C-2, Industrial Area, Distt. Bilaspur, HP-174001; Tel.No. 01978-222574

District Hamirpur

1. M/S Dogra Pharmacy Village Dharala, P.O. Bhalet, Distt. Hamirpur, HP-176108; Tel.No. 01972-272134
2. M/S Dhanwantri Chikitsa Pharmacy, Baba Nath Bazar, Awah Devi, Distt. Hamirpur, HP-177601; Tel.No. 01972-275015

District Kullu

1. M/S Vipasha Ayurvedic Pharmacy, Shamshi, Distt. Kullu, H.P.

District Shimla

1. M/S Sharda Herbal Lab., Sharda Kunj, Sanjauli, Distt. Shimla-171006, H.P.; Tel.No. 0177-2640921
2. M/S Veer Ayurvedic Pharmacy Village Rukhla, P.O. Rawalakair Tehsil Kotkhai, Distt. Shimla, HP; Tel.No. 01783-2586789

District Chamba

1. M/S Dayanand Ayurvedic Pharmacy, Chamba, Distt. Chamba, HP-176310; Tel.No. 01899-222871

(b) Homeopathies

1. M/S Bakson Pharmaceuticals Pvt. Ltd., 12 A/1, Sector-2 Parwanoo, H.P
2. M/S Bakson Pharmaceuticals Pvt. Ltd., Shillu Kala, Parwanoo, Distt. Solan H.P.-173220; Tel. no. 01792-280032, 280003; Fax No. 01792-233562
3. M/S Vatsal Homoeopathic Pharmacy H. No. 123/9, Old Bus Stand, Mandi-175001 H.P.; Tel. No. 01905-224571; Fax No. 01905-221108

Annexure 10

Export of tradable commodities in Himachal Pradesh.

Sr. no.	Trade Name	Botanical Name	Quantity exported (Qtls)		
			2000-01	2001-02	2002-03
1	Bach/ Birch/ Bajh/Baryan	<i>Acorus calamus</i>	97	222	162
2	Talish patra	<i>Abies spectabilis</i>	313	84	218
3	Patish	<i>Aconitum heterophyllum</i>	0	142	96
4	Gudburch	<i>Acorus calamus</i>	0	0	26
5	Dungtuli	<i>Adiantum hunalatum</i>	0	0	128
6	Parshoshan	<i>Adiantum</i> sp.	0	0	180
7	Sathjalari	<i>Ainsliaea aptera</i>	246	335	103
8	Chora	<i>Angelica glauca</i>	51	104	90
9	Kashmal	<i>Berberis</i> spp.	6135	13452	5240
10	Tej patra	<i>Cinnamomum tamala</i>	680	433	105
11	Bhutkesi	<i>Corydalis govaniana</i>	12	23	233
12	Shingli mingli	<i>Dioscorea deltoidea</i>	9	0	135
13	Somlata	<i>Ephedra gerardiana</i>	0	0	210
14	Ban haldi/Kapur kachri	<i>Hedychium spicatum</i>	0	0	89
15	Patlain	<i>Heracleum candicans</i>	530	495	683
16	Datishan roots	<i>Heracleum</i> spp.	767	645	65
17	Dhoop	<i>Jurinea dolomiaea</i>	399	393	135
18	Mehndi/Mehndrhi	<i>Lichen (Parmelia perlata)</i>	692	448	637
19	Guchhi	<i>Morchella esculenta</i>	50	85	156
20	Karu/Kaur	<i>Picrorhiza kurroa</i>	68	41	281
21	Neoza	<i>Pinus gerardiana</i>	303	319	675
22	Kakra singi	<i>Pistacia integririma</i>	10	4	9
23	Bankakri	<i>Sinopodophyllum hexandrum</i>	3	3	19
24	Dori ghas	<i>Potentilla nepalensis</i>	1027	1499	781
25	Revandchini/Chukri	<i>Rheum australe</i>	462	228	646
26	Brah/Brash flowers	<i>Rhododendron arboreum</i>	0	0	238
27	Thuth	<i>Salvia moorcraftiana</i>	0	188	0
28	Kuth	<i>Saussurea costus</i>	50	0	246
29	Marigold grass	<i>Tagetes minuta</i>	2193	1165	795
30	Birhmi	<i>Taxus wallichiana</i>	275	0	35
31	Mushkbala/Nihani	<i>Valeriana jatamansi</i>	1023	505	711
32	Others	---	3883	4100	4777
Total			19278	24913	17904

Source: State Forest Department Reports

Annexure 11

List of traders/collectors for four MAPs in Lahaul and Pangri landscape (2019-2020).

In Lahaul

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
Kuth	1.	Sh. Chaman Lal, Village	Kuthar (Udaipur)	Lahaul and Spiti	45
	2.	Sh. Hira Lal S/o Moti Ram	Bhujund (Tindi)	Lahaul and Spiti	40
	3.	Sh. Prem Nath S/o Shri Moti Ram	Bhujund (Tindi)	Lahaul and Spiti	50
	4.	Sh. Sonam Angroop S/o Shri kunga Ram	Gumrang (Keylong)	Lahaul and Spiti	6
	5.	Sh. Prem Das S/o Shri Shyam Lal	Madgran (Udaipur)	Lahaul and Spiti	10
	6.	Sh. Gyan Chand S/o Late Shri Devi Dass	Shooling Kothi (Gondhla)	Lahaul and Spiti	8
	7.	Sh. Kishan Lal S/o Shri Prem Lal	Salgran (Udaipur)	Lahaul and Spiti	25
	8.	Sh. Veer Singh S/o Sh. Rigzin	Rape (Jahalma)	Lahaul and Spiti	5
	9.	Sh. Hari Chand S/o Sh. Dharam dass	Salgran	Lahaul and Spiti	2
	10.	Sh. Chran Dass S/o Shri Narain Dass	Salgran	Lahaul and Spiti	3
	11.	Sh. Rup Chand S/o Shri Sukh ram	Salgran	Lahaul and Spiti	4
	12.	Sh. Tok Chand S/o Shri Moti dass	Salgran	Lahaul and Spiti	2
	13.	Sh. Ram krishan S/o Bhag Chand	Salgran	Lahaul and Spiti	4
	14.	Shri Ram Bahadur S/o Bhag Chand	Salgran	Lahaul and Spiti	1
	15.	Sh. Man Chand S/o Jog Chand	Salgran	Lahaul and Spiti	4
	16.	Sh. Ram nath S/o Gollu	Salgran	Lahaul and Spiti	1
	17.	Sh. Vijay Chand S/o Moti Ram	Salgran	Lahaul and Spiti	2
	18.	Sh. Samsher S/o Nihal Chand	Salgran	Lahaul and Spiti	4
	19.	Sh. Bishan Dass S/o Shri Tandup	Challing (Karpet)	Lahaul and Spiti	40
	20.	Sh. Ravinder Kumar S/o Tandup	Challing (Karpet)	Lahaul and Spiti	20

In Pangi

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)		District	Quantity (Qtls)
Kadu	1.	Sh. Sonam Dorje S/o Shri Babu ram	Sural (Pangi)	Bhatori	Chamba	1
	2.	Shri Narendra Kumar S/o Sh. Dharam pal	Sural (Pangi)	Bhatori	Chamba	1
	3.	Shri Satya pal S/o Sh. Janki nath	Sural (Pangi)	Bhatori	Chamba	1
	4.	Shri Ram chand S/o Sh. Gian Chand	Sural (Pangi)	Bhatori	Chamba	1
	5.	Smt Kabita Kumari W/o Sh. Santosh Kumar	Sural (Pangi)	Bhatori	Chamba	1
	6.	Sh. Sonamjeet S/o Shri Palden	Sural (Pangi)	Bhatori	Chamba	1
	7.	Shri Sanjay kumar S/o Sh. Jai lal	Sural (Pangi)	Bhatori	Chamba	1
	8.	Shri Mahindra Kumar S/o Jai lal	Sural (Pangi)	Bhatori	Chamba	1
	9.	Shri Prem Chand S/o Parlok Chand	Sural (Pangi)	Bhatori	Chamba	1
	10.	Shri Neven kumar S/o Sh Lakshmi chand	Sural (Pangi)	Bhatori	Chamba	1
	11.	Shri Jagdesh S/o Sh. Prem Chand	Sural (Pangi)	Bhatori	Chamba	1
	12.	Shri Surinder kumar S/o Shri Sham Lal	Sural (Pangi)	Bhatori	Chamba	1
	13.	Shri Tashi Cherring S/o Sh. Mangal Das	Sural (Pangi)	Bhatori	Chamba	1
	14.	Shri Manoj Kumar	Sural (Pangi)	Bhatori	Chamba	1
	15.	Shri Jai lal S/o Sh. Brij lal	Sural (Pangi)	Bhatori	Chamba	1
	16.	Chndru Devi w/o Hari Singh	Sural (Pangi)	Bhatori	Chamba	1
	17.	Shri Bhotu devi W/o Shri Hari lal	Sural (Pangi)	Bhatori	Chamba	1
	18.	Shri Chain Lal/ S/o Sh. Lakshmi Chand	Sural (Pangi)	Bhatori	Chamba	1
	19.	Shri Rajesh Kumar S/o Sh. Giridhari lal	Sural (Pangi)	Bhatori	Chamba	1
	20.	Shri Ramesh Kumar S/o Shri Prem raj	Sural (Pangi)	Bhatori	Chamba	1
	21.	Smt Premo Devi	Sural (Pangi)	Bhatori	Chamba	1

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)		District	Quantity (Qtls)
	22.	Shri Suman Jeet S/o Sh. Palden	Sural (Pangi)	Bhatori	Chamba	1
	23.	Smt. Sumita W/o Prem raj	Sural (Pangi)	Bhatori	Chamba	1
	24.	Shri Surjeet Kumar	Sural (Pangi)	Bhatori	Chamba	1
	25.	Smt Raj Devi	Sural (Pangi)	Bhatori	Chamba	1
	26.	Shri Tashi tshering s/o Shri mangal dass	Sural (Pangi)	Bhatori	Chamba	1
	27.	Sh. Karan singh S/o Sh. Kran Chand	Sural (Pangi)	Bhatori	Chamba	1
	28.	Smt. Sonia W/o Tenzin	Sural (Pangi)	Bhatori	Chamba	1
	29.	Sh. Angmo W/o Prem Singh	Sural (Pangi)	Bhatori	Chamba	1
	30.	Sh. Tashi Chering S/o Mangal Dass	Sural (Pangi)	Bhatori	Chamba	1
	31.	Smt. Pinki Dolma W/o Gian Singh	Sural (Pangi)	Bhatori	Chamba	1
	32.	Shri Tej Ram S/o Tashi ram	Sural (Pangi)	Bhatori	Chamba	1
	33.	Shri Chering Dolma S/o Wang Dorje	Sural (Pangi)	Bhatori	Chamba	1
	34.	Shri Wang Dorje S/o Shri Tashi Dorje	Sural (Pangi)	Bhatori	Chamba	1
	35.	Shri Tojan S/o Sh. Dirja Ram	Sural (Pangi)	Bhatori	Chamba	1
	36.	Shri Sanjay Kumar S/o Dh. Chaman Singh	Sural (Pangi)	Bhatori	Chamba	1
	37.	Shri Prem kumar	Sural (Pangi)	Bhatori	Chamba	1
	38.	Shri Tenjeen	Sural (Pangi)	Bhatori	Chamba	1
	39.	Revina Kumari D/o Prem Chand	Sural (Pangi)	Bhatori	Chamba	1
	40.	Shri Dorja Ram	Sural (Pangi)	Bhatori	Chamba	1
	41.	Shri Sonam Ram S/o Tashi Ram	Sural (Pangi)	Bhatori	Chamba	1
	42.	Shri Sonam jeet	Sural (Pangi)	Bhatori	Chamba	1
	43.	Shri Karem Lal S/O Sh. Prem Nath	Sural (Pangi)	Bhatori	Chamba	1

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
	44.	Shri Dhyan Singh S/o Sh. Uday Chand	Sural Bhatori (Pangi)	Chamba	1
	45.	Shri Thakur Chand	Sural Bhatori (Pangi)	Chamba	1
	46.	Shri Shailesh Chand S/o Brij Lal	Sural Bhatori (Pangi)	Chamba	1
	47.	Shri Surinder Kumar	Sural Bhatori (Pangi)	Chamba	1
	48.	Shri Khem Lal S/o Chain lal	Sural Bhatori (Pangi)	Chamba	1
	49.	Shri Ram Kumar S/o Shri Sham Lal	Sural Bhatori (Pangi)	Chamba	1
	50.	Shri Sanjay Kumar S/o Shri Jay lal	Sural Bhatori (Pangi)	Chamba	1
	51.	Shri Chain Lal S/o Sh. Laxmi Chand	Sural Bhatori (Pangi)	Chamba	1
	52.	Shri Sujan Singh S/o Sh. Mansi ram	Sural Bhatori (Pangi)	Chamba	1
	53.	Shri Suneni S/o Warr chhering	Sural Bhatori (Pangi)	Chamba	1
	54.	Shri Prem Nath S/o Sh. Vidya ram	Sural Bhatori (Pangi)	Chamba	1
	55.	Shri Galak S/o Shri vidya Ram	Sural Bhatori (Pangi)	Chamba	1
	56.	Tashi S/o Shri Mangal Dass	Sural Bhatori (Pangi)	Chamba	1
	57.	Shri Devi Singh S/o Shri Mangal Dass	Sural Bhatori (Pangi)	Chamba	1
	58.	Shri Kuldeep S/o Sh. Bansi lal	Dharwas (Pangi)	Chamba	1
	59.	Shri Roshan lal S/o Gulab SINGH	Dharwas (Pangi)	Chamba	1
	60.	Shri Ram kumar S/O Shri Deshpal	Dharwas (Pangi)	Chamba	1
	61.	Smt. Sunita Kumari W/o Jagdish	Dharwas (Pangi)	Chamba	1
	62.	Shri Jagdish S/o Shri Sher Singh	Dharwas (Pangi)	Chamba	1
	63.	Shri Sher Shingh	Dharwas (Pangi)	Chamba	1
	64.	Shri Satish kumar S/o Shri Sher Singh	Dharwas (Pangi)	Chamba	1
	65.	Shri Hari Nath	Dharwas (Pangi)	Chamba	1
	66.	Shri Man Singh S/o Shri Dunni Chand	Dharwas (Pangi)	Chamba	1
	67.	Shri Ram Singh S/o Sh. Vir Chand	Dharwas (Pangi)	Chamba	1
	68.	Shri Bishan Dass S/o Sh. Shegra	Dharwas (Pangi)	Chamba	1
	69.	Shri Ram Krishan S/o Shri Shiv Ram	Dharwas (Pangi)	Chamba	1
	70.	Smt. Chndra W/o Sh. Vir Singh	Dharwas (Pangi)	Chamba	2
	71.	Smt. Anita Kumari W/o Raj Kumar	Dharwas (Pangi)	Chamba	2

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
	72.	Smt. Sreeta Kumari W/o Sh. Man Singh	Dharwas (Pangi)	Chamba	2
	73.	Smt. Sunita Kumar W/o Bishan Dass	Dharwas (Pangi)	Chamba	2
	74.	Smt. Gorkhi devi W/o Sher Singh	Dharwas (Pangi)	Chamba	2
	75.	Smt. Santosh Kumari W/o Uttam Chand	Dharwas (Pangi)	Chamba	2
	76.	Smt. Bendra Devi W/o Sohan Lal	Dharwas (Pangi)	Chamba	2
	77.	Smt. Lakshmi Devi W/o Ram Singh	Dharwas (Pangi)	Chamba	2
	78.	Smt. Prem Devi W/o Khem raj	Dharwas (Pangi)	Chamba	2
	79.	Smt Suggi Devi W/o Khem raj	Dharwas (Pangi)	Chamba	2
	80.	Shri Dunni Chand S/o Jagdish	Dharwas (Pangi)	Chamba	1
	81.	Smt. Ram Devi W/o Shri Dunni Chand	Dharwas (Pangi)	Chamba	1
	82.	Shri Karan Lal S/o Shri Sherga	Dharwas (Pangi)	Chamba	1
	83.	Shri Vipin Lal S/o Shri Sherga	Dharwas (Pangi)	Chamba	1
	84.	Smt. Muno Devi W/o Guljari Lal	Dharwas (Pangi)	Chamba	2
	85.	Smt Nisha Kumari W/o Sunil Kumar	Dharwas (Pangi)	Chamba	2
	86.	Shri Ram Krishan S/o Mesh chand	Dharwas (Pangi)	Chamba	2
	87.	Smt. Shankari W/o Ram Krishan	Dharwas (Pangi)	Chamba	2
	88.	Smt. Lacho Devi W/oMehash Chand	Dharwas (Pangi)	Chamba	2
	89.	Smt. Bhag Devi W/o Sh. Giridhari lal	Dharwas (Pangi)	Chamba	2
	90.	Shri Desh raj S/O Chotu Ram	Dharwas (Pangi)	Chamba	2
	91.	Smt Seeta Devi W/o shri lekh raj	Dharwas (Pangi)	Chamba	2
	92.	Shri Hemraj S/o Shri tulsi das	Dharwas (Pangi)	Chamba	2
	93.	Smt. Premo W/o Shri Desh raj	Dharwas (Pangi)	Chamba	2
	94.	Smt Reeta Devi W/o shri ram Krishan	Dharwas (Pangi)	Chamba	2
	95.	Smt Leela Devi	Dharwas (Pangi)	Chamba	2
	96.	Shri Babu ram S/o shri Bahadur singh	Dharwas (Pangi)	Chamba	1
	97.	Shri Hari singh S/o shri Sham Lal	Dharwas (Pangi)	Chamba	1
	98.	Shri Ram Singh S/o shri Sham lal	Dharwas (Pangi)	Chamba	1
	99.	Shri Ram kumar S/o shri Shiv nath	Dharwas (Pangi)	Chamba	1
	100.	Shri Pura singh S/o shri Shiv nath	Dharwas (Pangi)	Chamba	1
	101.	Smt Sato W/o Shri Pura Singh	Dharwas (Pangi)	Chamba	1
	102.	Shri Mesh chand S/o Shri Dharam chand	Dharwas (Pangi)	Chamba	1
	103.	Smt. Sum dassi W/o Shri Abtar Singh	Dharwas (Pangi)	Chamba	1
	104.	Shri Raj kumar W/o Shri Narender Kumar	Dharwas (Pangi)	Chamba	1
	105.	Smt. Rajani W/o Shri ram lal	Dharwas (Pangi)	Chamba	1
	106.	Smt. Champa W/o Shri Babu ram	Dharwas (Pangi)	Chamba	1
	107.	Shri Satish Kumar S/o shri Doli ram	Dharwas (Pangi)	Chamba	1
	108.	Shri Diya kishan S/o Shri Shiv Ram	Dharwas (Pangi)	Chamba	1
	109.	Shri Ram Singh S/o Shri Abtar Singh	Dharwas (Pangi)	Chamba	1

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
	110.	Shri Surinder Kumar S/o Sh. Ram singh	Luj Dhar, (Pangi)	Chamba	1
	111.	Shri Shyam Singh S/o Sh. Shiv lal	Luj Dhar, (Pangi)	Chamba	1
	112.	Shri. Prithe S/o Sh. Amar Singh	Luj Dhar, (Pangi)	Chamba	1
	113.	Shri Jeevan Sing S/o Sh. Laxmi Chand	Luj Dhar, (Pangi)	Chamba	1
	114.	Shri Bhupender Singh S/o Shri Dharam Singh	Luj Dhar, (Pangi)	Chamba	1
	115.	Shri Vijay Kumar S/o Sh. Mahinder Raj	Luj Dhar, (Pangi)	Chamba	1
	116.	Shri Bhagwan Singh S/o Sh. Mohan Lal	Luj Dhar, (Pangi)	Chamba	1
	117.	Shri Vikas S/o Shri Krishan Chand	Luj Dhar, (Pangi)	Chamba	1
	118.	Shri Sher Singh S/o Shri Desh raj	Luj Dhar, (Pangi)	Chamba	1
	119.	Shri Yog Raj S/o Sh. Shiv Lal	Luj Dhar, (Pangi)	Chamba	1
	120.	Shri Pari raj S/o Sh. Sanaha Ram	Luj Dhar, (Pangi)	Chamba	1
	121.	Shri Hem Raj S/o Sh. Bajer Chand	Luj Dhar, (Pangi)	Chamba	1
	122.	Shri Chain Singh S/o Sh. Hans Raj	Luj Dhar, (Pangi)	Chamba	1
	123.	Shri Raj kumar S/o Shri hem raj	Luj Dhar, (Pangi)	Chamba	1
	124.	Shri Vinod Kumar S/o Sh. Mahinder raj	Luj Dhar, (Pangi)	Chamba	1
	125.	Shri Suram lal S/o Sh. Heera	Luj Dhar, (Pangi)	Chamba	95 kg
	126.	Shri Kashi nath S/o Sh Thakur Chand	Luj Dhar, (Pangi)	Chamba	1
	127.	Shri Bil Bir S/o Sh. Desh raj	Luj Dhar, (Pangi)	Chamba	1
	128.	Shri Hans Raj S/o Sh. Bajer Chand	Luj Dhar, (Pangi)	Chamba	1
	129.	Shri Dilip Chand S/o Sh. Trilok Chand	Luj Dhar, (Pangi)	Chamba	1
	130.	Shri Anil Kumar S/o Sh. Devi Singh	Luj Dhar, (Pangi)	Chamba	1
	131.	Shri Desh raj S/o Sh. Detu ram	Luj Dhar, (Pangi)	Chamba	1
	132.	Shri Jeevan Singh S/o Sh. Prakash Chand	Luj Dhar, (Pangi)	Chamba	1
	133.	Shri Nand Lal S/o Shri Bijar Chand	Luj Dhar, (Pangi)	Chamba	90 kg
	134.	Shri narinder Singh S/o Sh. Bihari lal	Luj Dhar, (Pangi)	Chamba	1
	135.	Shri Rakesh kumar S/o Sh. Man Singh	Luj Dhar, (Pangi)	Chamba	1
	136.	Shri Krishan Kumar S/o Sh. Bansi lal	Luj Dhar, (Pangi)	Chamba	1
	137.	Shri Desh Raj S/o Sh. Shiv lal	Luj Dhar, (Pangi)	Chamba	1
	138.	Shri Nek ram S/o Sh. Pyar Chand	Luj Dhar, (Pangi)	Chamba	1
	139.	Shri Bhagwan chand S/o Sh. Mohan Lal	Luj Dhar, (Pangi)	Chamba	1
	140.	Shri Hokum Singh S/o Sh. Trilok Chand	Luj Dhar, (Pangi)	Chamba	95 kg

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
	141.	Shri Surjeet Kumar S/o Sh. Dharam Singh	Luj Dhar, (Pangi)	Chamba	1
	142.	Shri Kaka S/o Shri. Bazar Chand	Luj Dhar, (Pangi)	Chamba	1
	143.	Shri Dharam Chand S/o Sh. Hukum Chand	Luj Dhar, (Pangi)	Chamba	1
	144.	Shri Sandeep S/o Sh. Bodh Raj	Luj Dhar, (Pangi)	Chamba	95 kg
	145.	Shri Ashwani Kumar S/o Sh. Krishan Lal	Luj Dhar, (Pangi)	Chamba	95 kg
	146.	Shri Narinder kumar S/o Sh. Krishan Chand	Luj Dhar, (Pangi)	Chamba	1
	147.	Shri Mdan Lal S/o Sh. Hukum Chand	Luj Dhar, (Pangi)	Chamba	1
	148.	Shri Naresh S/o Shri Bir Singh	Luj Dhar, (Pangi)	Chamba	1
	149.	Shri Prakash Kumar	Luj Dhar, (Pangi)	Chamba	1
	150.	Shri Anku S/o Sh. Kuldeep Singh	Luj Dhar, (Pangi)	Chamba	1
	151.	Shri Sonu S/o Sh. Mohinder Singh	Luj Dhar, (Pangi)	Chamba	1
	152.	Shri Prithi Singh S/o Sh. Prem Sing	Luj Dhar, (Pangi)	Chamba	1
	153.	Shri Suresh kumar S/o Shri Brij Lal	Luj Dhar, (Pangi)	Chamba	90 kg
	154.	Smt Bimla W/o Bazer Chand	Luj Dhar, (Pangi)	Chamba	95 kg
	155.	Shri Kuldeep S/o Sh. Khan Chand	Luj Dhar, (Pangi)	Chamba	1
	156.	Shri Raj Kumar S/o Sh. Ram Dhayal	Luj Dhar, (Pangi)	Chamba	1
	157.	Shri Desh raj	Luj Dhar, (Pangi)	Chamba	1
	158.	Shri Neku S/o Shri Ram Singh	Luj Dhar, (Pangi)	Chamba	90 kg
	159.	Shri Raj Kumar W/o Shri Thakur Chand	Luj Dhar, (Pangi)	Chamba	95 kg
	160.	Smt Sunita Kumari W/o sh. Raj kumar	Luj Dhar, (Pangi)	Chamba	95 kg
	161.	Shri. Kamla Kumari w/o Sh. Pari Lal	Luj Dhar, (Pangi)	Chamba	95 kg
	162.	Shri Bicky W/o Neku Ram	Luj Dhar, (Pangi)	Chamba	1
	163.	Shri Hand Raj S/o Shri Khem Chand	Luj Dhar, (Pangi)	Chamba	1
	164.	Smt. Mensi Kumar W/o Shri Bablu Kumar	Luj Dhar, (Pangi)	Chamba	1
	165.	Shri Rajinder kumar S/o Sh. Brij Lal	Luj Dhar, (Pangi)	Chamba	1
	166.	Shri Ramesh S/o Shri Hans Raj	Luj Dhar, (Pangi)	Chamba	95 kg
	167.	Smt. Rama Devi W/o Shri Dhjyan Singh	Luj Dhar, (Pangi)	Chamba	1
	168.	Shri Hand raj S/o Shri Khem Chand	Luj Dhar, (Pangi)	Chamba	1
	169.	Shri Sher Singh S/o Sh. Hansraj	Luj Dhar, (Pangi)	Chamba	1
	170.	Shri Madan Lal S/o Shri Gyan Singh	Luj Dhar, (Pangi)	Chamba	1
	171.	Shri Dhram singh S/o Shri Ram Chand	Luj Dhar, (Pangi)	Chamba	1
	172.	Shri Shyam Singh S/o Sh. Shiv Lal	Luj Dhar, (Pangi)	Chamba	1
	173.	Smt Man devi W/o Shri Hari Singh	Luj Dhar, (Pangi)	Chamba	1
	174.	Shri gian Singh S/o Shri Hari Singh	Luj Dhar, (Pangi)	Chamba	1

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
	175.	Shri Ashwani Kumar S/o Shri Hari Singh	Luj Dhar, (Pangi)	Chamba	1
	176.	Smt Rajo W/o Shri ashwani Kumar	Luj Dhar, (Pangi)	Chamba	1
	177.	Smt Bhim Devi W/o shri bir Singh	Luj Dhar, (Pangi)	Chamba	1
	178.	Shri Ankur S/o Shri Kuldeep	Luj Dhar, (Pangi)	Chamba	1
	179.	Shri Monu S/o Shri Kuldeep	Luj Dhar, (Pangi)	Chamba	1
	180.	Smt Janca Devi W/o Shri Bir Singh	Luj Dhar, (Pangi)	Chamba	1
	181.	Shri Rinku S/o Shri Bir Singh	Luj Dhar, (Pangi)	Chamba	1
	182.	Shri Dhyan Singh S/o Shri Bir Singh	Luj Dhar, (Pangi)	Chamba	1
	183.	Debita D/o Shri Bir singh	Luj Dhar, (Pangi)	Chamba	1
	184.	Shri Keshi nath S/o Shri Thakur Chand	Luj Dhar, (Pangi)	Chamba	1
	185.	Smt. Guchi W/o Shri Kashi Nath	Luj Dhar, (Pangi)	Chamba	1
	186.	Shri Puran lal S/o Shri Laxmi ram	Luj Dhar, (Pangi)	Chamba	1
	187.	Smt Meena W/o Shri Sher Singh	Luj Dhar, (Pangi)	Chamba	1
	188.	Smt Dev Devi W/o Shri Kuldeep	Luj Dhar, (Pangi)	Chamba	1
	189.	Smt Man Devi W/o Shri Kuldeep	Luj Dhar, (Pangi)	Chamba	1
	190.	Shri Bhim Singh S/o Shri Mohan Lal	Luj Dhar, (Pangi)	Chamba	1
	191.	Smt Ram Devi W/o Shri Bhim Singh	Luj Dhar, (Pangi)	Chamba	1
	192.	Smt Sonu S/o Shri Bhim Singh	Luj Dhar, (Pangi)	Chamba	1
	193.	Smt Madhu D/o Shri Bhim Singh	Luj Dhar, (Pangi)	Chamba	1
	194.	Shri Tapu S/o Shri Bhim Singh	Luj Dhar, (Pangi)	Chamba	1
	195.	Smt Ratten Devi W/o Shri Gian Singh	Luj Dhar, (Pangi)	Chamba	1
	196.	Shri Sher Singh S/o Shri Mohan Lal	Luj Dhar, (Pangi)	Chamba	1
	197.	Shri Pritha Singh S/o Shri Sher Singh	Luj Dhar, (Pangi)	Chamba	1
	198.	Smt Prem Devi W/o Shri Bhagwan Chand	Luj Dhar, (Pangi)	Chamba	1
	199.	Smt Been Devi W/o Shri Khem Chand	Luj Dhar, (Pangi)	Chamba	1
	200.	Shri Kuldeep S/o Shri Khem Singh	Luj Dhar, (Pangi)	Chamba	1
	201.	Smt Jeeva W/o Shri Sham Singh	Luj Dhar, (Pangi)	Chamba	1
	202.	Shri Kashmir Singh S/o Shri Shiv Lal	Luj Dhar, (Pangi)	Chamba	1
	203.	Smt. Reeta Kumari W/o Trith Raj	Sural Bhatori (Pangi)	Chamba	1
Patish	1.	Smt Krien Kumari	Sural Bhatori (Pangi)	Chamba	1
	2.	Shri Shellpa S/o Sh. Krishan Kumar	Sural Bhatori (Pangi)	Chamba	1
	3.	Smt Shankuntala W/o Lakh Raj	Sural Bhatori (Pangi)	Chamba	1
	4.	Shri Rajesh Kumar S/o Desh raj	Luj Dhar, (Pangi)	Chamba	1
	5.	Narender Kumar S/o shri krishan Kumar	Luj Dhar, (Pangi)	Chamba	1
	6.	Som Raj S/o Shri Nek ram	Luj Dhar, (Pangi)	Chamba	1

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)	District	Quantity (Qtls)
	7.	Surender Kumar S/o Sh. Wajir Chand	Luj Dhar, (Pangi)	Chamba	1
	8.	Sh. Jeevan Singh S/o Laxmi chand	Luj Dhar, (Pangi)	Chamba	1
	9.	Shri Ravinder Kumar S/o Sh. Krishan Kumar	Luj Dhar, (Pangi)	Chamba	1
	10.	Shri Dhyan Singh S/o Veer Chand	Luj Dhar, (Pangi)	Chamba	1
	11.	Shri Gyan Singh S/o Sh. Tej Ram	Sural Bhatori (Pangi)	Chamba	1
Kuth	1.	Shri Kushar S/o Shri Mangal Dass	Sural Bhatori (Pangi)	Chamba	1
	2.	Shri Kram Chand S/o Sh. Dhoolu	Sural Bhatori (Pangi)	Chamba	1
	3.	Shri Kram Singh S/o Sh. Kram Chand	Sural Bhatori (Pangi)	Chamba	1
	4.	Shri Prem Singh S/o Sh. Hari Lal	Sural Bhatori (Pangi)	Chamba	1
	5.	Shri Ankush kumar S/o Sh. Krishan Kumar	Sural Bhatori (Pangi)	Chamba	1
	6.	Shri Sunil Kumar S/o Sh. Kehar Singh	Sural Bhatori (Pangi)	Chamba	1
	7.	Shri Surjeet Kumar S/o Sh. Prem Singh	Sural Bhatori (Pangi)	Chamba	1
	8.	Shri Kram Lal S/o Shri Prem Nath	Sural Bhatori (Pangi)	Chamba	1
	9.	Reeta Kumari D/o Prem Raj	Sural Bhatori (Pangi)	Chamba	1
	10.	Shri Sumit S/o Sh. Ramesh kumar	Sural Bhatori (Pangi)	Chamba	1
	11.	Smt. Sarita Devi W/o Parlok Chand	Sural Bhatori (Pangi)	Chamba	1
	12.	Sh. Dharam Chand S/o Shiv Chand	Sural Bhatori (Pangi)	Chamba	1
	13.	Shri Krishan Kumar	Sural Bhatori (Pangi)	Chamba	1
	14.	Shri Rajender Kumar S/o Prem Singh	Sural Bhatori (Pangi)	Chamba	1
	15.	Shri Mallen Chand S/o sh. Shiv Ram	Sural Bhatori (Pangi)	Chamba	1
	16.	Smt Shanti Devi	Sural Bhatori (Pangi)	Chamba	1
	17.	Smt Sukhi Devi w/o Krishan Kumar	Sural Bhatori (Pangi)	Chamba	1
	18.	Shri Sanjay Kumar S/o Kalyan Singh	Sural Bhatori (Pangi)	Chamba	1

Species	Sr.no.	Trader/Collector Name	Area (Village/P.O.)		District	Quantity (Qtls)
	19.	Smt. Sarita Devi	Sural (Pangi)	Bhatori	Chamba	1
	20.	Smt. Jamna W/O Desh Raj	Sural (Pangi)	Bhatori	Chamba	1
	21.	Smt. Jankhi	Sural (Pangi)	Bhatori	Chamba	1
	22.	Smt. Bhawan dei	Sural (Pangi)	Bhatori	Chamba	1
	23.	Smt. Helo Devi W/o Bhupender Raj	Sural (Pangi)	Bhatori	Chamba	1

Annexure 12
List of participants in the consultative workshop in Lahaul.
[23rd September, 2019]

Sr.no	Name	Village	Contact no.
1.	Jaibo	Koja	-
2.	Rooshi	Koja	-
3.	Suman Devi	Mahila mandal(kuthal)	-
4.	Shankari (MM)	Karyas	8985316639
5.	Sanjay Kumar	Jhlwas	7650932527
6.	Anjana Negi (MM)	Pradhan Luj	9418772747
7.	Tej Singh	Mindhal	9518755758
8.	Bimla (MM)	Killar	9885317047
9.	Naini Devi (MM)	Kayar	--
10.	Indira (MM)	Parwal	--
11.	Sumitra (MM)	Parwal	9418652807
12.	Ram Chandra	Ward member Ferchuni	9418290860
13.	Veer Singh Rana	B.D.C Dharwasward-2	9418255703 beersinghrana30@gmail.com
14.	Shila (MM)	Malith	--
15.	Rita Kumar, Mahila Mandal Sachiv	Malith	--
16.	Chetar Singh	Malith	9418550219
17.	Khem raj	Senior Assistant, P.O.	9418429533
18.	Parkash Kumar	Pradhan	9418890045
19.	Beer Singh	Sural Bhatori	9418773764

Annexure 13
List of participants in the stakeholder consultative workshop in Killar, Pangi.
Attendance sheet SECURE Himalaya Workshop (29th September, 2019)

Sr.no	Name	Institution/village	Contact number	Email id
1.	Nidhi Singh	WII, Dehradun	8004261042	nidhi@wii.gov.in
2.	Bhawna Pandey	WII, Dehradun	7579062921	bpandey@wii.gov.in
3.	Dr. Amit Kumar	WII, Dehradun	9012701362	amit@wii.gov.in
4.	Manisha Mathela	WII, Dehradun	8630666034	manishamathela@wii.gov.in
5.	Meghna Ghosh	WII, Dehradun	7044910363	meghmaghosh1995@gmail.com
6.	Himanshu bangali	WII, Dehradun	9627878981	himanshubargali@gmail.com
7.	Shiv Yadav	WII, Dehradun	8090434437	shiv@wii.gov.in
8.	Bhoopesh Thakur	WII, Dehradun	8219317989	bhoopesh@wii.gov.in
9.	Priya	NIPFR, Delhi	7838206171	priya.yadav@nipgr.org
10.	Man Singh	Forest Guard-Purthi	8988538872	mansinghthakur515@gmail.com

Sr.no	Name	Institution/village	Contact number	Email id
11.	Tej Singh	Forest Guard-Killar	8918743379	tejs722@gmail.com
12.	Man Singh	Forest Guard-Killar	8918736555	--
13.	Roop Singh Thakur	Forest Guard-Killar	8988786769	roopthakur83@gmail.com
14.	Rajendra Kumar	Forest Guard-Punto	8988796515	--
15.	Piar Dei	Guadi- Pangi	9418240780	--
16.	Sonu	BDO office, Pangi	9459245051	--
17.	Tarun Singh	Forest Guard-Shour	9459659534	--
18.	Sunil Kumar	Himalayan Ercapade	9459015954	kcyluigaa@gmail.com
19.	Sarita	Mahila mandal, Paroi	9459784278	--
20.	Bhinder Singh	Vill. Kulhal	8988518858	--
21.	Nam Dei	Seri phatos		--
22.	Bablu Kumar	Forest dept.	9459848061	--
23.	Hans Raj	UP-Pradhan GP Luj	9418593053	hansraj@gmail.com
24.	Suresh	Forest Guard Sahli	7649952602	--
25.	Nima Thakur	Sural Bhatori	9418710686	--
26.	Bimla Sharma	Hudan Bhatori	9459233747	--
27.	Surendra Kumar	Purthi	9418788610	--
28.	Krishan Rana	Killar (Press Dainik Jagran)	9418574549	--
29.	Turup Chand	TAC (sural)	--	--
30.	Inder Prakash	Pindpar	--	--
31.	Shiv Kumar	Forest dept., Lahaul	9418183819	himalayanibox@gmail.com
32.	Amit Mehta	UNDP-SECURE	9459020513	amit.mehta@undp.org
33.	M.K. Thaplial	R.O. Killar	9459856140	m.k.thaplial@gmail.com
34.	Garima Jasuja	NIPFP	9871976646	garima.jasuja@nipfp.org.in
35.	Sunil Kumar	Forest Guard	8988538838	suneelkumarsood@gmail.com
36.	Ravi	Mindhal, Forest Guard	8988096542	ravishandil@gmail.com
37.	Dhande	Paroi, Karyas	8988316990	--
38.	Neeraj Kumar	Forest Guard, killar	9418781088	nittu1996y@gmail.com
39.	Sunetra	Karuni	8988024461	--
40.	Abhishek Kumar	UNDP	9548562281	abhishekh.kumar@undp.org
41.	Meena Kumar	Barpanch, Mahila mandal	9418756604	--
42.	Namarta Devi	Mahila mandal	9418711875	--
43.	Ram Singh	Forest, Dhanwas	9418719292	--
44.	RC	Pangi	--	--
45.	Pranav Sharma		--	--
46.	Hansraj	Luj	--	--

Annexure 14

List of participants in the stakeholder consultative workshop in Keylong, Lahaul. Attendance sheet SECURE Himalaya workshop (11th October, 2019)

Sr.no	Name	Organisation	Contact no.	Email Id
1.	Sanjay Barnela	Sristi Institute, Bangalore	9818299212	--
2.	Dr. Nishant	Animal Husbandry Dept, Keylong	988263932	nish33ret@gmail.com
3.	Raj Kumar	Forest Dept, Udaipur	9459560326	--
4.	Sushil Kumar	Forest Dept, Thiroit	9805024671	--
5.	Samsher Singh	Forest Dept, Trilokinath	9418660270	--
6.	Vishal	Forest Dept, Salgram	8894453990	--
7.	Sushma	Forest Dept, Karpar	8988630640	--
8.	Sonam Angroo	Horticulture Dept, Keylong	9418719660	--
9.	Khubram	Forest dept, Prapatan	7650803121	--
10.	Om Prakash	R.O Udaipur	9418429824	--
11.	TC Thakur	NGO, Udaipur	9418318364	--
12.	Kushal C. Thakur	NGO, Udaipur	9418383183	--
13.	Sher Lal	NGO, Udaipur	898879630	--
14.	Bir Chand	NGO, Udaipur	--	--
15.	Dr. Ashok Singh		--	--
16.	Sapna	Forest Dept, Kardang	9459303583	--
17.	Bir Singh	NGO, Udaipur	9418356319	--
18.	Amit Kumar	Tehsildar		--
19.	Dev Raj Thakur	Forest guard, Bhujund	9418429864	--
20.	Tinkle Bhatt	Forest guard	9459017395	--
21.	Amit Mehta	UNDP	9816620513	amitmehta@gmail.com
22.	Kunj lal	Forest Guard	9882666966	--
23.	Basant lal	Forest Guard	8988232360	basantlal93@gmail.com
24.	Khem Singh	Forest Guard Chowkhang	8988020580	--
25.	Abhisehk	UNDP	9548562281	abhisehk@undp.org
26.	Satpal	Forest Guard Sirru	9459736306	
27.	Sunil Kumar	Forest Guard Gerpa	9418721018	--
28.	Anil Kumar	Forest Guard	8988810020	--
29.	Padam Dev	Technical assistant (PRO office)	9418318369	--
30.	Ajay Thakur	DFO Lahaul	9459015706	--
31.	Balak Ram	Deputy Ranger Lahaul	9418496709	--
32.	Dr. Hem Raj	DAO, Keylong	9818350423	--
33.	Rignin Dalma	Local stakeholder	9459913563	--
34.	Kunjan Sharma	Doordarshan	9418392553	--
35.	Shailesh Nagar	NRMC	9953103963	--
36.	Vivek Sharma	NRMC	9882507170	--
37.	Shreya	NRMC	9560921561	--
38.	Nikhil	NRMC	954462662	--
39.	K.Ram Narayan	NRMC	--	--
40.	Archana	DDMA, Keylong	9459430779	--

41.	Poonam	DDMA, Keylong	--	--
42.	Roshan lal	DDMA, Keylong	8988863127	--
43.	Prakash chandra	DDMA, Keylong	9418444586	--
44.	Anuradha	DDMA, Keylong	9418754323	--
45.	Shiv laham	DDMA, Keylong	--	--
46.	Dalma	Keylong, Lahual	--	--
47.	Palzum	Lahual	--	--
48.	Yangchin	Keylong	--	--
49.	Dechen	Keylong	--	--
50.	Tenzin	Keylong	--	--
51.	Arshi khan	DDMA, Keylong	--	--
52.	Nitin sharma	DDMA, Keylong	--	--
53.	Shanti	APRO office, Keylong	--	--
54.	Khem singh	Forest guard	--	--
55.	Pyare lal	Forest guard	--	--
56.	Dr. Gautam Talukadar	Scientist-E, WII, Dehradun	--	--
57.	Dr. Salvador Lyngdoh	Scientist-D, WII, Dehradun	--	--
58.	Shiv Narayan Yadav	WII, Dehradun	--	--
59.	Dr. Amit Kumar	Scientist-C, WII, Dehradun	--	--
60.	Monika Sharma	WII, Dehradun	--	--
61.	Meghma Ghosh	WII, Dehradun	--	--
62.	Manisha Mathela	WII, Dehradun	--	--
63.	Nidhi Singh	WII, Dehradun	--	--
64.	Bhawna Pandey	WII, Dehradun	--	--
65.	Himanshu Bargali	WII, Dehradun	--	--
66.	Bhoopesh Thakur	WII, Dehradun	--	--
67.	Sanjay Pradhan	WII, Dehradun	--	--

Poster - I

THREATENED MEDICINAL AND AROMATIC PLANTS OF LAHAUL AND PANGI LANDSCAPE, HIMACHAL PRADESH



Niranda Prasad

Aconitum heterophyllum; Kaur (कौर); Ranunculaceae; **Critically Endangered**



G.S. Goraya



Gyandharu Rawat

Fritillaria cirrhosa; Jaugli Lehou (जंगली लहसुन); Liliaceae; **Endangered**



Himanshu Buzgali



Amit Kumar

Sinopodophyllum hexandrum; Bunkhari (बनकहरी); Berberidaceae; **Endangered**



G.S. Goraya



G.S. Goraya

Aconitum heterophyllum; Mohra (मोहरा); Ranunculaceae; **Endangered**



G.S. Goraya

Of the 3324 plant species recorded in the state of Himachal Pradesh, 1200 species are medicinal and aromatic. As a part of the project SECURE Himalaya, the Wildlife Institute of India, Dehradun conducted an assessment of selected medicinal and aromatic plant species (MAPs) on their collection, usage, demand, markets, price trends and life cycle (2019-2020). The study reports severe threat to the MAPs predominately due to premature collection of roots, over exploitation, unorganized harvesting and illegal trade. Establishment of *in-situ* plant conservation areas, better state of the art technology in cultivation, harvesting and storage of MAPs and awareness would be the practical solution to conserve these species.



Amit Kumar

Polygonatum verticillatum; Salun mishri (सालुन मिश्री); Asparagusaceae; **Endangered**



Renu Soyal



G.S. Goraya

Bunium persicum; Kala zera (काला जीरा); Apiaceae; **Vulnerable**



Sapna Kumar



Amit Kumar

Rheum australe; Archo (अरची); Polygonaceae; **Endangered**



Amit Kumar



Amit Kumar

Dactylorhiza hatagirea; Hathigiri (हथगा जीरा); Orchidaceae; **Critically Endangered**



Amit Kumar



Amit Kumar

Picrorhiza kurroa; Kutki (कुटकी); Plantaginaceae; **Critically Endangered**



G.S. Goraya



Amit Kumar

Rheum webbianum; Chakra (चुक्की); Polygonaceae; **Vulnerable**



Amit Kumar



भारतीय वन्यजीव संस्थान
Wildlife Institute of India



Concept and Design:
Dr. Amit Kumar, Ms. Dani Yaming and Dr. G.S. Goraya
Wildlife Institute of India, Dehradun, Uttarakhand
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Poster - II

लाहौल और पांगी, हिमाचल प्रदेश के संकटग्रस्त औषधीय और सुगंधित पौधे



एकोनिटम हेरोफिलम, बौद्ध, देवनागरी: Critically Endangered



जी.एस. गोरखा
मण्डल रावत



डीटिन्टरिया तिरिहोसा, जंगली लहसुन, तिलिपसी: Endangered



हिमाचल बनीले
अमित कुमार



सिनापोडोफिलम हैन्जेडूम, बल ककड़ी, बरबेरीदेसी: Endangered



जी.एस. गोरखा



एकोनिटम हैन्जेडूम, मोहरा, देवनागरी: Endangered



जी.एस. गोरखा

हिमाचल प्रदेश में दर्ज की गई 3324 पौधों की प्रजातियों में से लगभग 1200 प्रजातियाँ औषधीय और सुगंधित पौधों की हैं। भारतीय वन्यजीव संस्थान, देहरादून ने सिक्योर हिमालय परियोजना के तहत कुछ औषधीय और सुगंधित पौधों की प्रजातियों का संग्रह, उपयोग, मांग बाजार, मूल्य रुझान और जीवन चक्र के आधार पर चयन व मूल्यांकन किया (2019-2020)। अध्ययन की रिपोर्ट गंभीर खतरे की तरफ इशारा करती है जिसमें औषधीय और सुगंधित पौधों की जड़ों का समय से पहले संग्रह, मात्रा से अधिक निकालना, असंगठित कटाई और अवैध व्यापार आदि शामिल हैं। औषधीय और सुगंधित पौधों की प्रजातियों के लिए सामरिक संरक्षण की स्थापना, आधुनिक प्रौद्योगिकी, कटाई, भंडारण और जागरूकता इन प्रजातियों के संरक्षण के लिए व्यावहारिक समाधान हो सकते हैं।



अमित कुमार

पोन्यवॉनाटम वेटीसिल्लतूम, सलम किन्ही, एकचैलेसी: Endangered



रेणु सुयाब



दुनियाँ परसिकम, काला जीरा, एपौरसि: Vulnerable



सिपु कुमार



अमित कुमार

रियुम ऑस्ट्रेल, अरवी, पोलेगोसी: Endangered



अमित कुमार



डेक्टाहोराइजा हताजिरिया, हल्वा जड़ी, अलीदेसी: Critically Endangered



अमित कुमार



पिकरिजा कुरी, कुन्ही, प्लेटाडिनेसी: Critically Endangered



जी.एस. गोरखा



अमित कुमार

रियुम वेबियनम, चुन्नी, पोलेगोसी: Vulnerable



अमित कुमार



भारतीय वन्यजीव संस्थान
Wildlife Institute of India



संकल्पना एवं रचना:

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