

Final Technical Report - 2020

Survey and Mapping of Medicinal and Aromatic Plants from Alpine Regions of Uttarakhand and Developing Uttarakhand- Alpine Information System

Under
National Mission on Himalayan Studies (NMHS)



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Implementing Organization



उत्तराखण्ड अंतरिक्ष उपयोग केंद्र
विज्ञान एवं प्रौद्योगिकी विभाग
उत्तराखण्ड

Partner Organization



Submitted to



GB Pant National Institute of Himalayan Environment
and Sustainable Development, Kosi-Almora

Under

National Mission on Himalayan Studies (NMHS)



Ministry of Environment, Forest & Climate Change,
Government of India

Template/Pro forma for Submission

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research Project Grant

NMHS Reference No.: NMHS/SG-2016/009

Date of Submission:

1	3	0	5	2	0	2	0
d	d	m	m	y	y	y	y

PROJECT TITLE (IN CAPITAL)
SURVEY AND MAPPING OF MEDICINAL AND AROMATIC PLANTS (MAPS) AND OTHER
RET/NTFPS FROM ALPINE REGIONS OF UTTARAKHAND AND DEVELOPING
UTTARAKHAND- ALPINE INFORMATION SYSTEM (UK-AIS)

Project Duration: *from* (31.03.2016) *to* (31.01.2020).

Submitted to:

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DSL: Date of Sanction Letter

3	1	0	3	2	0	1	6
d	d	m	m	y	y	y	y

DPC: Date of Project Completion

3	1	0	1	2	0	2	0
d	d	m	m	y	y	y	y

Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	NMHS/SG-2016/009					
ii.	Type of Project	Small Grant	√	Medium Grant		Large Grant	
iii.	Project Title	Survey and Mapping of Medicinal and Aromatic Plants (MAPs) and other RET/NTFPs from alpine regions of Uttarakhand and Developing Uttarakhand- Alpine Information System (UK-AIS)					
iv.	State under which Project is Sanctioned	Alpine region of Uttarakhand					
v.	Project Sites (IHR States covered) (Maps to be attached)	Uttarakhand					
vi.	Scale of Project Operation	Local	√	Regional		Pan-Himalayan	
vii.	Total Budget/ Outlay of the Project	Sanctions-Rs.0.36 (in Cr), received – Rs. 0.27 (Cr)					
viii.	Lead Agency	Uttarakhand Space Application Centre (USAC)					
	Principal Investigator (PI)	Dr. Gajendra Singh					
	Co-Principal Investigator (Co-PI)	Er. Shashank Lingwal					
ix.	Project Implementing Partners	Uttarakhand State Biodiversity Board					
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	Member Secretary Uttarakhand State Biodiversity Board 423, Indira Nagar Colony, Dehradun – 248006 Phone: 0135 – 2769886					

2. Project Outcome

2.1. **Abstract** (not more than 500 words) [it should include background of the study, aim, objectives, methodology, approach, results, conclusion and recommendations).

1) **Background:** Uttarakhand projected as “Herbal State of India”, is well known for its rich array of high value Medicinal and Aromatic Plants (MAPs) since ancient time. However, despite the national, state and scattered local initiatives on management, conservation and sustainable utilization of MAPs, there still wide gaps exist in our knowledge and understanding in availability of Medicinal and Aromatic Plants (MAPs) resource base in the Himalayan region particularly remote parts of Uttarakhand. This calls for rapid survey, geo-spatial mapping and ecological assessment of high value MAPs, RET and NTFPs from alpine region of the Uttarakhand state and preparation of web-portal for the species. The major **objectives** were: (1) to assess the distribution and abundance of commercially important MAPs, RET (rare, endangered and threatened) and NTFPs from alpine regions of Uttarakhand, (2) to generate a spatial distribution and abundance database of MAPs, (3) to develop web based Uttarakhand Alpine Information System (UK-AIS) and 4) to suggest management strategies for future monitoring of MAPs. **Methodologies:** We used Cartosat-2 and LISS-IV merged product and Landsat-8 data for delineating various thematic layers to predict the extent of MAPs using various Ground Control Points (GCPs). GCPs were collected based on extensive surveys over 80 alpine meadows of the state. Availability (individuals/m²) in each meadows were assessed using Rapid Mapping Exercise (RME) (4 plots at every 50m distance, total 40plots in one transect) and consulting various herbarium and published literature. **Results:** Of the total MAPs reported from the alpine region of the state, 70 RET and highly exploited species (6 shrubs, 1 climbers, 1 parasite and 62 herbaceous) were prioritized for assessment, of which nine were endangered, three critically endangered, four vulnerable, and seven were near threatened. Of the total surveyed meadows, top 10 high MAPs richness-representing meadows were Gidara, Tungnath, Kedarnath, Pindari, Ralam, Sundardhunga, Mathmaheshwar, Khatling, Sundardhunga and Rudranath. Niche modeling, density, frequency and abundance of all the species suggested that *Aconitum balfourii* (critically endangered), *Aconitum heterophyllum*, *Angelica glauca* (endangered) and *Malaxis muscifera*, *Aconitum violaceum* (vulnerable) have least potential distribution in the state. **Conclusion and Recommendations:** i) Owing to variability in topography, climate, natural distribution of MAPs, anthropogenic pressure, site/meadow specific management plans should be made for management of MAPs across the alpine landscape. ii) Grazing by mules and heavy bodied animals in the alpine region should be discouraged. iii) The number of tourists in the alpine meadows should be restricted and proper documentation of their visit should be made. iv) Rrestoration of degraded habitats should be made by plantation of native species with the help of local communities during June-July months.

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
	To assess the distribution and abundance of commercially important MAPs, RET (rare, endangered and threatened) and NTFPs from alpine regions of Uttarakhand	Distribution map of 74 Medicinal and Aromatic Plants (MAPs) were developed for the alpine region of the Uttarakhand.
	To generate a spatial distribution and abundance database and ecological characteristics of MAPs for alpine region,	Abundance database of 74 species were prepared for the alpine region of the state.

	To develop web-based Uttarakhand Alpine Information System (UK-AIS),	Web based information system is developed and the information about the medicinal plants is being uploaded.
	To evolve strategies for sustainable harvest, future monitoring and conservation of medicinal and aromatic plants.	Two (02) management plan of medicinal and aromatic plants of Pindari and Dayara alpine meadows were prepared.

2.3. Outputs in terms of Quantifiable Deliverables*

S. No.	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations made, if any, and Reason thereof:
1.	Distribution and density maps (low, and high densities/suitability) of MAPs.	Distribution and density maps (low, mid and high densities) (Nos.).	Potential distribution map of 74 Medicinal and Aromatic Plants (MAPs) and status (density, frequency, abundance) of the species across meadows also assessed.	--
2.	Minimum of two CDH (conservation, develop and harvest) plans, each for Kumaon and Garhwal region will be developed.	<ul style="list-style-type: none"> Manual on Sustainable Harvest Strategies along with Conservation and Long-term Assessment of MAP species (Nos /species). CDH (conservation, development and harvest) plans along with comparative analyses (Nos.). 	<ul style="list-style-type: none"> One (01) Management plan of MAPs of Pindari alpine meadows were prepared. The management plan of the Pindari area is being implemented by the Uttarakhand Forest Department. 	The MLE committee recommended to develop the management plan instead of CDH plan (Conservation, Development and harvest).
3.	Web-based information system comprising of current and past data sets.	Web-based Online Information System of Distribution and Abundance Patterns of Commercially important MAPs, RETs and NTFPs from the Alpine regions of Uttarakhand (UK-AIS) (Data Nos).	All the information of the project is being uploaded in the web based information system developed under the project.	--

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(*) As stated in the Sanction Letter issued by the NMHS-PMU.

2.4. Strategic Steps with respect to Outcomes (in bullets)

S. No.	Particulars	Number and Brief Details	Details of Attachment/ Supporting Document
1.	New Methodology developed:	-NA-	--
2.	New Models/ Process/ Strategy developed:	MaxEnt computer package is used for all the 74 species using 09 variables viz., digital elevation model (DEM), slope, aspect, land use/land cover, Euclidean distance from the drainage line, vegetation type map, Geomorphology and degradation other than the 19 bio-claim variables.	--
3.	New Species identified:	-NA-	--
4.	New Database established:	Detailed distribution and abundance data of 74 highly exploited/ RET medicinal and aromatic plants were assessed over 90 alpine meadows of the Uttarakhand state.	--
5.	New Patent, if any:	-NA-	--
	I. Filed (Indian/ International)	-NA-	--
	II. Granted (Indian/ International)	-NA-	--
	III. Technology Transfer(if any)	-NA-	--
6.	Others (if any):	A web based information system is developed and all the information collected during the study being uploaded in the portal.	--

3. Technological Intervention

S. No.	Type of Intervention	Brief Narration on the interventions	Unit Details (No. of villagers benefited / Area Developed)
1.	Development and deployment of indigenous technology	NA	

2.	Diffusion of High-end Technology in the region	NA	
3.	Induction of New Technology in the region	NA	
4.	Publication of Technological / Process Manuals	NA	
	Others (if any)	NA	

4. New Data Generated over the Baseline Data

S. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data
1.	Extent and abundance of about 70 MAPs across various meadows (landscape level) of the state	Only point locations were available for the site-specific areas.	The extent and abundance information of above 70 species will help to design the conservation strategies of meadows with more efficiently.
2.	Extent and Abundance of MAPs across various protected areas in the alpine region	Only information of few PAs were available in detail (eg., Valley of flowers, Kedarnath WS)	The overall status of MAPs across various PAs will help to re-strategies the management strategy
3.	Synthesis of past knowledge available and gap analysis	There are only about 300 research papers are published on MAPs from the alpine region of the state. Most of the studies are site specific, limited studies are at landscape level.	A detailed review of existing literature and identification of gap area can help to identify the focused areas for future study.
4.	Web based information system for MAPs	No such information system is available	The information system would be helpful for wide stakeholders to understand the overall pattern of MAPs in the alpine region.

5. Demonstrative Skill Development and Capacity Building/ Manpower Trained

S. No.	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	ST	Woman	Total
1.	Workshops	1	Status of MAPs in alpine landscape	-	20	20	35
2.	On Field Trainings	2	Field based training on MAPs				20
3.	Skill Development	01 Junior project fellow (JPF) and 01 (Field Assistant)	Assessment of MAPs (JPF is Enrolled for Ph.D. from Kumaun University, Nainital)				02
4.	Academic Supports	--	--				

Others (if any)	--	--				
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6. Linkages with Regional & National Priorities (SDGs, INDC, etc)/ Collaborations

S. No.	Linkages /collaborations	Details	No. of Publications/ Events Held	Beneficiaries
1.	Sustainable Development Goal (SDG)	The work help to address the SDG goal no. 16. (Life on Land) by providing information of 70 key MAPs of the region. The information may be useful to provide the access and benefit sharing arising from these MAPs of the region	--	About 90 Gram Panchayats of the alpine region may be benefited.
2.	Climate Change/INDC targets	--		
3.	International Commitments	--		
4.	Bilateral engagements	--		
5.	National Policies	--		
6.	Others collaborations	--		

7. Project Stakeholders/ Beneficiaries and Impacts

S. No.	Stakeholders	Support Activities	Impacts
1.	Gram Panchayats	About 90 Gram Panchayat are benefiting by providing the information of MAPs for developing People Biodiversity Register (PBR)	Assisted in the preparation of PBR of the alpine region of the landscape (viz., Darma valley)
2.	Govt Departments (Agriculture/ Forest)	Uttarakhand Forest Department Sheep & Wool Development Board	❖ Information used the management for Pindari region ❖ The management plan of Dayara area is under implementation process. Used the livestock availability information in the management of resource distribution and disease control

		Uttarakhand State Biodiversity Board	Information of the important MAPs across the landscape provided. It would be useful to execute access and benefit
3.	Villagers	-NA-	
4.	SC Community	-NA-	
5.	ST Community	Various communities in the remote areas are interest to know the overall status (stock) of MAPs in their respective areas.	
6.	Women Group	-NA-	
	Others (if any)	-NA-	

8. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	871200	1130156	
II.	Travel	400000	242510	
III.	Expendables & Consumables	75000	74677	
IV.	Contingencies	75000	75000	
V.	Activities & Other Project cost	626962	364610	
VI.	Institutional Charges	--	--	
VII.	Equipments	532795	502190	
	Total	25,80,957		
	Interest earned	1,16,414		
	Grand Total	26,97,371/-		

* Please attach the consolidated and audited Utilization Certificate (UC) and Year wise Statement of Expenditure (SE) separately, *ref. Annexure I.*

9. Major Equipment/ Peripherals Procured under the Project** (if any)

S. No.	Name of Equipments	Cost (INR)	Utilisation of the Equipment after project
1.	Minor Field gears	72370/-	Some of them were in consumable in nature, those are proper in nature will be used in another NMHS funded project
2.	Printer	74820/-	Will be used in another NMHS funded project
3.	Server	355000/-	

**Details should be provided in details (*ref Annexure III & IV.*)

10. Quantification of Overall Project Progress

S. No.	Parameters	Total (Numeric)	Details of Attachments/ Supporting Documents
1.	IHR States Covered	One (01), Uttarakhand	
2.	Project Site/ Field Stations Developed	Alpine region of Uttarakhand State	
3.	New Methods/ Modeling Developed	New methodologies for Himalayan MAPs	
4.	No. of Trainings arranged	-NA-	
5.	No of beneficiaries attended trainings	-NA-	
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	Ph.D.-1 (enrolled)	
7.	SC stakeholders benefited	Nil	
8.	ST stakeholders benefited	Nil	
9.	Women Empowered	Nil	
10.	No of Workshops Arranged along with level of participation		
11.	On-field Demonstration Models initiated	-NA-	
12.	Livelihood Options promoted	-NA-	
13.	Technical/ Training Manuals prepared		
14.	Processing Units established	-NA-	
15.	No of Species Collected	Detailed database of 74 species	
16.	New Species identified	Nil	
17.	New Database generated (Types):	<i>Distribution and abundance database of over 74 species</i>	
	Others (if any)		

11. Knowledge Products (KPs) and Publications

S. No.	Knowledge Products (KPs)/ Publication	Number		Total Impact Factor	Remarks/ Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:		2 & (3 Communicated)		
2.	Book Chapter(s)/ Books:	1	1 (book is under process)		
3.	Technical Reports	1	--		
4.	Training Manual (Skill Development/ Capacity Building)	--	--		
5.	Papers presented in Conferences/Seminars		5		
6.	Policy Drafts/Papers	--	--		
7.	Others:	2 Management plans developed			

*Please append the list of KPs/ publications (with impact factor and further details) with due Acknowledgement to NMHS.

Published Paper:

1. Gajendra Singh, Naveen Chandra, Vineet Pal, LM Tiwari, MPS Bisht (2020). Observation on Phyto diversity of Sunderdunga Valley, Uttarakhand, Western Himalaya. *Indian Forester*. 145 (12): 1166-1175
2. Gajendra Singh, Naveen Chandra, Shashank Lingwal, LM Tiwari, MPS Bisht. Distribution and Threat Assessment of an Endemic and Endangered species *Angelica glauca* Edgew. in high ranges of Western Himalaya. *Journal of Herb Spice and Medicinal plant* Journal of Herb, Spices and Medicinal Plants.

Communicated Paper

1. Naveen Chandra, Gajendra Singh, Shashank Lingwal, Ishwari D Rai, LM Tiwari, MPS Bisht. Studies on Alpine Medicinal and Aromatic Plants of Western Himalaya, India: A Review. *Journal of Mountain Science*
2. Naveen Chandra, Gajendra Singh, Shashank Lingwal, Vineet Pal, Jeewan Singh Jalal, LM Tiwari, MPS Bisht. Potential distribution and status of highly used medicinal plant *Dactylorhiza hatagirea* (D.Don) Soo in Alpine region of Western Himalaya. *Tropical Ecology*
3. Naveen Chandra, Gajendra Singh, Shashank Lingwal, LM Tiwari, MPS Bisht. Population Assessment and Habitat Distribution Modelling of Endangered Medicinal Plant - *Picrorhiza kurroa* Royle ex Benth. in the Kumaun Himalaya. *Journal of Threatened Taxa*

Paper presented in conference/seminar (* Presenting Author)

1. *Naveen Chandra, Gajendra Singh, Shashank Lingwal, LM Tiwari, MPS Bisht. Spatial Distribution, Availability & Threats on Medicinal and Aromatic Plants of Alpine Region of Uttarakhand: *Angelica glauca* Edgew. A case study. International conference on medicinal, aromatic and Nutraceutical plants from mountainous area organised by **Graphic Era University during 14-16 February 2019.**
2. *Naveen Chandra, Gajendra Singh, Shashank Lingwal, LM Tiwari, MPS Bisht Population Assessment and Habitat Distribution Modelling of Endangered Medicinal Plant - *Picrorhiza kurroa* Royle ex Benth. in the Kumaun Himalaya. International conference on Global Perspective in Agriculture & Applied science for Food and Environment Security (GAAFES 2019) Organised by **Department of Geography K.U Nainital during 01-02 December 2019.**
3. *Naveen Chandra, Gajendra Singh, Shashank Lingwal, Vineet Pal, LM Tiwari, MPS Bisht. Spatial distribution, availability and threats on RETs in alpine region of Uttarakhand. **13th USSTC, UCOST, Dehradun**
4. *Naveen Chandra, Gajendra Singh, Shashank Lingwal, Vineet Pal, LM Tiwari, MPS Bisht. Vulnerability assessment of high-altitude medicinal plants from alpine region of Uttarakhand. **14th USSTC, UCOST, Dehradun**
5. *Gajendra Singh, Naveen Chandra, Shashank Lingwal, MPS Bisht, LM Tiwari. Extent, Abundance, Threats and Information Gap on Alpine Medicinal and Aromatic Plants of Western Himalaya, India: A Review. **Indian Science Congress-2020.**

12.1. Success Model(s)/ Best Practice(s) under the Project:

Parameters	Description	Details of Attached supporting documents
(1) Adaptability of the Technology:	Geo-spatial information, intensive ground surveys and latest modelling techniques were used to assess the MAPs of the region.	
(2) Acceptability (interest of the local people):	-NA-	
(3) Improvement in Ecological Variables:	Various ecological variables eg., LULC, Vegetation type map, were delineated for the area with higher scale (1:10000).	
(4) Baseline Data and Comparison with the Controlled Data:	Before the project implementation, only point locations of a few MAPs of the area (site specific area) was available. Now the extent and abundance of over 70 MAPs of the alpine region is available.	
(5) Outcomes of the Scientific Publications, Knowledge Products:	Wider dissemination of the extent and abundance information on MAPs, so that strategies for the management can be developed with more precise manner.	

12.2. Recommendation on Utility of Project Findings, Replicability and Exit Strategy

Particulars	Recommendations
Utility of the Project Findings:	<ul style="list-style-type: none"> ❖ Management of Medicinal and Aromatic plants and RETs. ❖ Identification of important plant areas. ❖ Development of Medicinal Plant Conservation Areas (MPCA)
Replicability of Project:	Yes, Similar approach can be followed for entire state and across the states to quantify the actual availability of MAPs stock in the wild.

Exit Strategy:	The collected information is being provided to NMHS, and in the web based information system for wider dissemination. Other than the various research papers (publications), a book is being developed compiling (past and present) all the information. So that wider stakeholders can use the information for management strategies.
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(PROJECT PROPONENT/ COORDINATOR)

(Signed and Stamped)



(HEAD OF THE INSTITUTION)

(Signed and Stamped)

Place: Dehradun

Date: 13/05/2020
