Promoting Conservation of threatened plant species in the west Himalayan Region - A participatory approach

Final Technical Report (Year 2018-2021)
Funded by: National Mission on Himalayan Studies (NMHS)

Principal Investigator: Dr. Indra D. Bhatt
Researchers: Dr. Amit Bahukhandi (Technical Expert)
Dr. Kuldeep Joshi (Trainer)
Mr. Hement Singh(Project Assistant)
Mr. Laxman Singh(Field Assistant)

GovindBallabh Pant National Institute of Himalayan Environment
Kosi- Katarmal, Almora

Template/Pro forma for Submission

NMHS-Himalayan Institutional Project Grant

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research and Demonstrations

NMHS Reference No.:	GBPNI/NMHS-2017-18/MG-19	**Date of Submission:**	3	0	1	1	2	0	2	1
			D	**d**	**m**	**m**	**y**	**y**	**y**	**y**

PROJECT TITLE (IN CAPITAL)

PROMOTING CONSERVATION OF THREATENED PLANT SPECIES IN THE WEST HIMALAYAN REGION-A PARTICIPATORY APPROACH

Project Duration: *from* (**26-2-2018**) *to* (**30.11.2021**).

***Submitted to*:**
Er. Kireet Kumar
Scientist 'G' and Nodal Officer, NMHS-PMU
National Mission on Himalayan Studies, GBPNIHE HQs
Ministry of Environment, Forest & Climate Change (MoEF&CC), New Delhi
E-mail: nmhspmu2016@gmail.com; kireet@gbpihed.nic.in; gupta.dharmendra@gov.in

***Submitted by*:**
[*Dr. Indra D. Bhatt*]
[*G.B. Pant National Institute of Himalayan Environment Almora*]
[*Contact No.:09411703802*]
[*E-mail: idbhatt@gbpihed.nic.in*]

DSL: Date of Sanction Letter

2	6	0	2	**2**	**0**	**1**	**8**
d	d	m	m	y	y	y	y

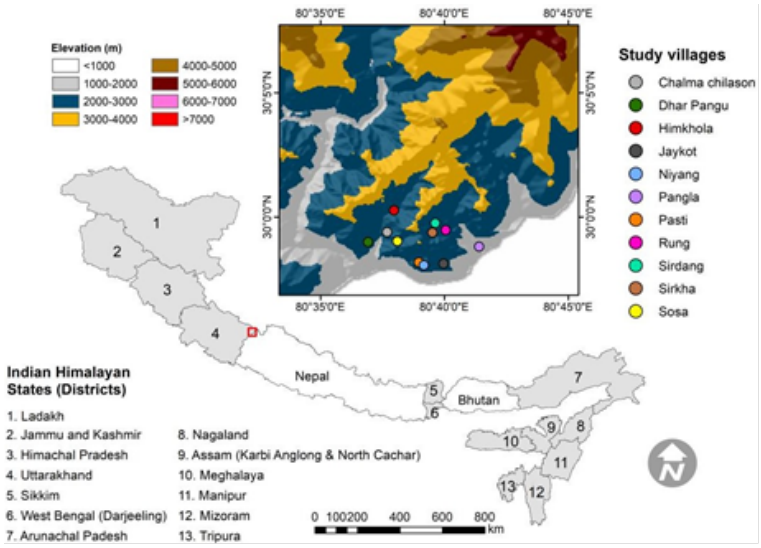
Completion

DPC: Date of Project

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

Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	GBPNI/NMHS-2017-18/MG-19								
ii.	Type of Project	Small Grant		Medium Grant	/	Large Grant				
iii.	Project Title	Promoting Conservation of threatened plant species in the west Himalayan - a participatory approach								
iv.	State under which Project is Sanctioned	Uttarakhand								
v.	Project Sites (IHR States covered) (Maps to be attached)	Chaudas area, Pithoragarh district (29° 59' 22" N ; 80° 39' 31" E)  								
vi.	The scale of Project Operation	Local		Regional		Pan-Himalayan				
vii.	Total Budget/ Outlay of the Project	97,22,000								
viii.	Lead Agency	G.B. Pant National Institute of Himalayan Environment Almora								

	Principal Investigator (PI)	Dr. Indra D. Bhatt
	Co-Principal Investigator (Co-PI)	Dr. Ranbeer S. Rawal
ix.	Project Implementing Partners	Forest Department, Uttarakhand Sri Narayan Ashram Trust, Dhrachula
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	Dr. Indra D. Bhatt Scientist 'F' GBPNIHE Almora Contact 9411703802 E-mail idbhatt@gbpihed.nic.in

2. Project Outcomes

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

The conservation of medicinal plants is receiving attention all across the globe keeping in view the resurgence of interest in herbal medicines. With the increasing demands, medicinal plants are being explored from their natural source, which is affecting their availability in nature. This has promoted the conservation of such species through *in-situ* and *ex-situ* methods to improve their availability for end users and release the pressure of exploitation from their natural habitats. In addition, it is pertinent to establish germplasm repositories to fulfill the need for planting material for the cultivation process in farmer's fields and establishment of market strategies for uplifting the economic condition of local inhabitants. The aim of the project is (i) to develop species-specific protocols for recovery/reintroduction of threatened species, (ii) to establish a demonstration of threatened Himalayan medicinal plants at different altitudes, (iii) to promote the cultivation of threatened medicinal plants at farmer's fields, (iv) to develop market linkages for selling of cultivated produce and (v) to sensitize diverse stakeholders group towards promoting conservation of threatened medicinal plants.

A need base assessment survey was conducted in the fourteen different villages of Chaudas area, Pithoragarh district, and documented the requirements of villagers. As a result, seven potentially medicinal plant species namely *Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus* and *Valeriana jatamansi* were selected and identified for cultivation at farmer's fields (900-2750 m asl). Plant materials such as seeds, rhizomes, and seedlings of selected species were collected and procured from various high-altitude nurseries of government and private agencies. Thereafter, species specific propagation packages of each species through different methods (i.e. seed germination, *in-vitro* propagation, hydroponics technique, and vegetative propagation) were developed. Propagated planting materials were transferred to the nurseries for acclimatization and hardening at high-altitude regions (Sri Narayan

Ashram) before distributing to the farmers. Various sensitization workshops, capacity building programmes, buyers-sellers meets, and hands-on training on the agro-technique of medicinal plants were organized at the village level for sensitization.

A total of 172 farmers from 11 villages have initiated cultivation of selected seven plant species in 125 nali (2.5 ha) land after the intervention of the project. Similarly, species-specific protocols of 7 species using different propagation methods were developed (i.e. seed germination for *Angelica glauca, Cinnamomum tamala, Saussurea costus*; vegetative propagation for *Allium stracheyi, Picrorrhiza kurrooa,* and *in-vitro* propagation technique for *Valeriana jatamansi*). Over 46 lakh plants of selected species were produced. Simultaneously, 14 demonstration sites (11 villages, 1 Sri Narayan Ashram, 2 school conservation models) were established along the elevation gradient (900-2750 m) in the region. These sites have functioned as *ex-situ* sites/mother nurseries. The nursery developed at Sri Narayan Ashram is being maintained for the conservation and production of threatened medicinal plants. Germplasm of 15 high-value threatened Himalayan species are maintained in the Sri Narayan Ashram, and function as a demonstration site and capacity building center. A total of 21 awareness programme, field orientation workshops, and agro-techniques-based hands-on training on medicinal plant cultivation were conducted in the region, and a total of 1579 stakeholders (male 1111; female 468) were sensitized towards promoting the conservation of threatened medicinal plants. In addition, progressive farmers were registered at the Herbal Research and Development Institute (HRDI) Gopeshwar, and certification of cultivated produce was done with the Quality Council of India (QCI) New Delhi under the certification scheme for medicinal plant produce (VCSMPP). For the development of market linkages for selling cultivated produce and providing direct benefit to farmers, a buy-back arrangements were facilitated, and a Memorandum of Understanding (MoU) was signed between traders and farmers. Synergy was established between farmers and ongoing schemes of line agencies like MNERGA, Bhesaj Sangh, etc. These efforts provided opportunities for the farmers to develop their skills and knowledge's for the cultivation and conservation of threatened medicinal plants

All these efforts help to promote a cluster-based approach to promoting medicinal plant cultivation in the Chaudas area. This is the first of its kind intervention where cultivated produce was directly sold to end users and all the steps from the sensitization to capacity building/skill development, collection of propagules to certification, registration to buyback arrangements were facilitated.

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
1.	To develop species-specific protocols for the recovery/reintroduction of threatened species	(i) Species-specific protocols for 7 medicinal plants i.e. *Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus,* and *Valeriana jatamansi* were developed. • The seed germination method was used for *Angelica glauca, Cinnamomum tamala, Saussurea costus*.

		• The conventional vegetative propagation technique was used for *Allium stracheyi, Hedychium spicatum, Picrorrhiza kurrooa*. • *In-vitro* propagation technique (plant tissue culture) was followed for *Valeriana jatamansi*. Through various means (i.e., seed germination, vegetative propagation, tissue culture) a total of 46 lakh seedlings were produced. The seedlings of *Allium stracheyi* (1,00,000 No.), *Angelica glauca* (20,000 No.), *Cinnamomum tamala* (1,00,000 No.), *Hedychium spicatum* (30,00,000 No.), *Picrorrhiza kurrooa* (3,00,000 No.), *Saussurea costus* (1,00,000 No.) and *Valeriana jatamansi* (10,00,000 No.) were distributed to the farmers for cultivation in their fields of Chaudas region, Pithoragarh.
2.	To establish demonstrations of threatened Himalayan medicinal plants at different altitude	(i) A total of 14 demonstration sites (11 Villages; 1 Sri Narayan Ashram; 2 School conservation models) were established in the Chaudas area, Pithoragarh. • Three demonstration sites at lower elevations (900-1200 m) for the cultivation of *C. tamala, H. spicatum, V. jatamansi* were established, i.e., Jaykot, Pangla, and Ghasku villages. • Four demonstration sites at mid-elevation (1201-2000 m) for the cultivation of *A. stracheyi, H. spicatum, V. Jatamansi, S. costus, P. kurrooa* were established, i.e., Pasti, Niyang, Chalmachilanso, Palankari villages. • Four demonstration sites at higher elevations (2001-2700 m) for the cultivation of *A. stracheyi, A. glauca H. spicatum, V. Jatamansi, S. costus, P. kurrooa* were established, i.e., Sosa, Srikha, Sridhang, Himkhola villages. (ii) One demonstration and learning center (DLC) was established at Sri Narayan Ashram, Pithoragarh (2750 m). The center maintained the germplasm of 15 different high-value Himalayan species including the target species of the project. (iii)Two school conservation models were

		established at Government Inter College Pangu (2600 m) and Primary School Sosa (2500 m). Germplasm of 5 species, viz. *A. stracheyi, H. spicatum, V. Jatamansi, S. costus, P. kurrooa* is being maintained in the schools.
3.	To promote the cultivation of threatened medicinal plants at farmer's field	• A total of 172 farmers from 11 villages have initiated the cultivation of medicinal plant species at 125 nali (2.5 ha) land. • The farmers of Chaudas region were trained in agro-techniques of medicinal plant cultivation through various hands-on training workshops. • The progressive farmers of Niyang, Sosa, Pasti, Palankari, Chhalmachhilason, Srikha, Sridang, and Himkhola villages have initiated cultivation of *Hedychium spicatum* (50 farmers; 80.5 nali), *Saussurea costus* (8 farmers; 13 nali), *Picrorrhiza kurrooa* (50 farmers; 12.5 nali), *Valeriana jatamansi* (12 farmers; 10 nali), *Allium stracheyi* (10 farmers; 13 nali), and 42 farmers of Jaykot, Pangla and Ghasku have planted *C. tamala* (3000 saplings) in their fields. • A synergy between farmers and ongoing schemes of Government Line agencies such as MNERGA, Bhesaj Sangh Pithoragarh, Herbal Research and Development Institute (HRDI) Gopeshwar, and National Medicinal Plant Board (NMPB) New Delhi was developed and facilitated to framers of Chaudas region for the cultivation of medicinal plants.
4.	To develop market linkages for selling cultivated produce	• A total of 172 progressive farmers from 11 villages were registered at Herbal Research and Development Institute (HRDI) in Gopeshwar, Uttarakhand. • Certification of cultivated produce of medicinal plants was done through the Quality Council of India (QCI), New Delhi under the Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP). • For selling cultivated produce of selected medicinal plant species and providing direct benefits to farmers, the buyback arrangements were facilitated between farmers and buyers such as Human India, Srinagar, Surkunda Jadi Buti Samuh, Bageshwar, and Bhesaj Sangh,

		Pithoragarh and a Memorandum of Understanding (MoU) was signed with farmers and buyers.
5.	To sensitize diverse stakeholders group towards promoting the conservation of threatened medicinal plants.	(i) A total of 21 events (5 sensitization workshops; 8 field orientation workshops; 8 capacity building and value addition training programme) were organized during the project period. (ii) A total of 1579 stakeholders (male 1111; female 468) were sensitized and built their capacity for cultivation and conservation of threatened medicinal plants.

2.3. Outputs in terms of Quantifiable Deliverables*

Quantifiable desirable	Monitoring indicators	Progress made against deliverables in terms of monitoring indicators	Supportive documents (PDF, Words, Excel, GPG, TIFT
1	2	3	4
Species specific protocols for threatened medicinal plants at different altitudes (3 No)	No. of species-specific protocols for highly threatened species at the identified altitudes	• Species-specific propagation protocols for 7 species namely *Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus,* and *Valeriana jatamansi* have been developed. i. Seed germination - *Angelica glauca, Cinnamomum tamala, Saussurea costus* ii. Vegetative propagation - *Allium stracheyi, Picrorrhiza kurrooa, Hedychium spicatum* iii. Tissue culture - *Valeriana jatamansi* *iv.* Hydroponics – *Valeriana jatamansi*	Annexure - 1
Field-based conservation model of threatened	No. of conservation and demonstration model established	A total of 14 demonstration sites/conservation models (11 Villages; 1 Sri Narayan Ashram; 2 School conservation models) were established	Annexure - 2

medicinal plants at selected schools (11 Village)		along the altitudinal gradient in the Chaudas area, Pithoragarh. • Three demonstration sites for the cultivation of *C. tamala, H. spicatum, V. jatamansi* in Jaykot, Pangla and Ghasku (900-1200 m) • Four demonstration sites for cultivation of *A. stracheyi, H. spicatum, V. Jatamansi, S. costus, P. kurrooa* in Pasti, Niyang, Chalmachilanso, Palankari (1201-2000 m) • Four demonstration sites for cultivation of *A. stracheyi, A. glauca H. spicatum, V. Jatamansi, S. costus, P. kurrooa* in Sosa, Srikha, Sridhang, Himkhola (2001-2700 m) • A demonstration and learning center (DLC) in Sri Narayan Ashram, Pithoragarh (2750 m) • Two school conservation models in Government Inter College Pangu (2600 m) and Primary School Sosa (2500 m)	
Develop the reintroduction site of threatened medicinal plants	No. of reintroduction sites developed	A total of 6 reintroduction sites were developed for targeted species, i.e., (i) *C. tamala* in Pangla and Ghasku villages (ii) *H. spicatum, V. jatamansi* in Niyang and Pasti villages (iii) *S. costus, P. kurrooa* in Srikha, Sridhang villages	Annexure – 3
Sensitization of stakeholder groups on medicinal plant conservation and cultivation	No. awareness raising/capacity building programmes on MPs conservation, promotion, and cultivation (No. of youths, No. of woman, No. of	• A total of 21 events (5 sensitization workshops; 8 field orientation workshops; 8 capacity building and value addition training programme) were organized during the project activity. • A total of 1579 stakeholders (No. of youths - 366, No. of woman - 468, No. of farmers 745) benefited.	Annexure-4

	farmers and Total no. of stakeholders benefited		
Established market linkages for produce of selected medicinal plants	No. of market linkages established and farmers/stakeholders benefited	• Market linkages for the production of selected medicinal plants have been established with different agencies i.e., Dabur representative (Human India, Srinagar, Surkunda Jadi Buti Samuh, Bageshwar), and Bhesaj Sangh, Pithoragarh. • An MoU was facilitated and signed between farmers and buyers as per the buyback arrangements. • Certification of cultivated produce of Medicinal plants was done through the Quality Council of India (QCI) New Delhi under Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP) • A synergy between farmers and ongoing schemes of Government line agencies such as MNREGA, Bhesaj Sangh Pithoragarh, Herbal Research and Development Institute (HRDI) Gopeshwar, and National Medicinal Plant Board (NMPB) New Delhi was developed and facilitated to farmers of Chaudas region.	Annexure-5
Field manuals for high-altitude MPs cultivation	Other publications & Knowledge products	• Training Manual - 1 • Agro-techniques-based flyers – 7 (Hindi, English) • Research Paper (International – 5; National - 1) • Popular Article - 5 • Conference (State Level) – 1	Annexure – 6

(*) 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/ Brief Details	Remarks/ Attachment

S. No.	Particulars	Number/ Brief Details	Remarks/ Attachment
1.	New Methodology developed	Methodologies for the propagation of 7 medicinal plants developed	Annexure 1
2.	New Models/Processes/Strategies developed	14 demonstration sites have been established at different locations in the Chaudas area	Annexure 2
3.	New Species identified	Not Applicable	
4.	New Database established	Not Applicable	
5.	New Patent, if any	Not Applicable	
	I. Filed (Indian/ International)	Not Applicable	
	II. Granted (Indian/ International)	Not Applicable	
	III. Technology Transfer (if any)	Not Applicable	
6.	Others (if any)	Not Applicable	

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	Not Applicable	
2.	Diffusion of High-end Technology in the region	Not Applicable	
3.	Induction of New Technology in the region	Not Applicable	

4.	Publication of Technological / Process Manuals	Training Manual - 01	अमित बहुखण्डी, कुलदीप जोशी, इन्द्र दत्त भट्ट, सुबोध ऐरी "प्रशिक्षण मैनुअल नर्सरी प्रबंधन एवं औषधीय पौंधों की खेती" *गोविन्द बल्लभ पंत राष्ट्रीय हिमालयी पर्यावरण संस्थान, कोसी कटारमल अल्मोड़ा,* संस्करण प्रथम -आइ.एस.बी.एन. (978-93-5607-656-3)

	Others (if any)	• Agro-technology flyers - 7 • Research Paper (International – 4; National - 1) • Popular Article - 5	• Flyers (Bilingual) based on Agro-technology of 7 high values threatened medicinal plants viz. *Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus, Valeriana jatamansi*. **International** • Jugran AK, Rawat S, Bhatt ID, Rawal RS (2021). Essential oil composition, phenolics and antioxidant activities of *Valerianajatamansi* at different phonological stages. *Plant Biosystems-An International Journal Dealing with all Aspects of Plant Biology*, 155 (4), 891-898. (Impact Factor 1.90) • Pandey V, Bhatt ID, Nandi SK (2021). Seasonal trends in morpho-physiological attributes and bioactive content of *Valeriana jatamansi* Jones under full sunlight and shade conditions. *Physiology and Molecular Biology of Plants,* 27 (2), 327-340.(Impact Factor 3.023) • Pandey V, Tiwari DC, Dhyani V, Bhatt ID, Rawal RS, Nandi SK (2021). Physiological and metabolic changes in two Himalayan medicinal herbs under drought, heat and combined stresses. *Physiology and Molecular Biology of Plants,* 27 (7), 1523-1538.(Impact Factor 3.023) • Joshi K, Adhikari P, Bhatt ID, Pande V (2022). Source dependent variation in phenolics, antioxidant and antimicrobial activity of *Paeonia emodi* in west Himalaya, India. *Physiology and Molecular Biology of Plants*, 28 (9), 1785–1798. (Impact Factor 3.023) • JoshiK, Adhikari P, Bhatt ID, Pandey A (2022). Antimicrobial potential of leaf, rhizome and *in vitro* propagated callus of *Paeoniaemodi*Wallich Ex Royle (Himalayan Peony). *Vegetos*, 1-12.(Impact Factor 0.469) **Popular Article (s)** • Joshi K, Bahukhandi A, Parihar NS, Rawat S, Bhatt ID (2019). Promoting conservation of threatened plant species in west Himalayan region through cultivation- a participatory approach. ENVIS Bulletin Himalayan Ecology, 27,45-48. (ISSN 2455-6815)

			• Bahukhandi A, Joshi K, Mehta DS, Farshwan D (2019). IBD celebration at Chaudas valley, Pithoragarh, Uttarakhand. ENVIS Newsletter on Himalayan Ecology, 16(1), 3. • अमितबहुखण्डी, कुलदीप जोशी, इन्द्र दत्त भट्ट(2019) चैदास घाटीमेंउच्चमूल्य के औषधीय पादपोंकासंवर्धन एवं कृषिकरण,*सन्नजू*, (6,7), 36. • अमित बहुखण्डी, कुलदीप जोशी, नरेन्द्र परिहार, इन्द्र दत्त भट्ट(2020) चैदास घाटी के सीमावर्ती क्षेत्रों में उच्च हिमालयी बहुमूल्य औषधीय पौधों के कृषिकरण द्वारा आजीविका वृद्धि हेतु एक पहल, *सन्नजू*, 7 (8), 40-41. • Amit Bahukhandi,Indra D.Bhatt, Kuldeep Joshi, Dharma C. Attri (2021). Importance of *Cinnamomumtamala* for restoration of degraded land, West Himalaya. *Envis Bulletin Himalayan Ecology*, *29*, 60. **State Level Awards and Honors** • Kuldeep Joshi, Young Scientist Award for 'Promoting conservation of threatened plant species in West Himalayan region- a participatory approach'in 14th State Science Congress, 2020 organized by Uttarakhand State Council of Science and Technology (UCOST), Dehradun, India. **Paper Communicated (s)** • AmitBahukhandi, Indra D. Bhatt, Arun K. Jugran, Kuldeep Joshi, PushpaKewlani, Deep C. Tewari. (2022). Cultivation of *Valerianajatamansi* Jones: an opportunity to improve livelihood options and conservation of the species. *Plant Physiology and Biochemistry*. • Deep C. Tiwari, AmitBahukhandi, VeenaPandey, VibashDhyani, NarendraParihar, Indra D. Bhatt (2022). Propagation and morpho-physiological responses of two important Himalayan medicinal herbs under different growing conditions. *Plant Physiology Reports*.

4. New Data Generated over the Baseline Data

S. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data
	Not Applicable	-	-

	Not Applicable	-	-

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	8	Sensitization Workshop on Promotion of Medicinal plant cultivation	310	178	142	630
2.	On Field Training	8	Agro-technique-based field-orientation training programme	138	120	140	398
3.	Skill Development	5	Capacity build for cultivation and value addition	245	120	186	551
4.	Academic Supports	-	-	-	-	-	-
	Others (if any)						

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)	Not Applicable	-	-
2.	Climate Change/INDC targets	Not Applicable	-	-
3.	International Commitments	Not Applicable	-	-
4.	Bilateral engagements	Not Applicable	-	-
5.	National Policies	Not Applicable	-	-

6.	Others collaborations	• Quality Council of India (Certification of cultivated produce of medicinal plants) • Agencies like Dabur representatives (i.e., Human India, Srinagar, Surkunda Jadi Buti Samuh, Bageshwar), and Bhesaj Sangh, Pithoragarh for Buyback arrangements of cultivated produce) • Government agencies i.e., MNERGA, Bhesaj Sangh, Herbal Research and Development Institute, and National Medicinal Plant Board for developing synergy between farmers and ongoing schemes	4	(Annexure -4)

7. Project Stakeholders/ Beneficiaries and Impacts

S. No.	Stakeholders	Support Activities	Impacts
1.	Farmers	Medicinal plant cultivation	172 farmers of 11 villages of Sosa gram panchayat, Pithoragarh district have initiated the cultivation of medicinal plants in their agricultural land.
2.	Govt Departments (Agriculture/ Forest)	Demonstration model/Conservation model	A total of 2 demonstration models were developed at Government Inter College Pangu and Primary School Sosa through a participatory approach.
3.	Villagers	Promotion of Medicinal	A total of 172 farmers from 11

		plant cultivation and buy-back arrangements for marketing	villages have initiated cultivation of different species in their agricultural land and registered at Herbal Research and Development Institute (HRDI) Gopeshwar, Uttarakhand. Capacity building of farmers for medicinal plant cultivation and nursery establishment was done. Certification of cultivated produce of selected medicinal plant species was done through the Quality Council of India (QCI) New Delhi under Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP). Buyback arrangements between farmers and buyers have been facilitated. A synergy between farmers and ongoing schemes of Government Line agencies such as MNERGA, Bhesaj Sangh, Herbal Research and Development Institute (HRDI), and National Medicinal Plant Board (NMPB) was developed and facilitated.
4.	SC Community	Sensitization, awareness, training & capacity build programmes	A total of 21 events (workshops – 8; training – 8; skill development programmes – 5) were organized. A total of 693 SC communities participated.
5.	ST Community	Sensitization, awareness, training & capacity build programmes	A total of 413 ST communities participated.
6.	Women Group	Sensitization, awareness, training & capacity build	A total of 478 women's participated.

		programmes	
	Others (if any)	-	-

8. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	2952000.00		
II.	Travel	850000.00		
III.	Expendables &Consumables			
IV.	Contingencies	500000.00		
V.	Activities & Other Project cost	3840000.00		
VI.	Institutional Charges	130000.00		
VII.	Equipments	1450000.00		
	Total	**9722000.00**		
	Interest earned			
	Grand Total			

* 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 Equipment's	Cost (INR)	Utilization of the Equipment after the project
1.	Seed germinator	2,00498	Seed germination and standardization of propagation protocol of various high-value plant species of Indian Himalaya
2.	Circulatory water bath (Chiller refrigerated circulator)	2,59875	The smooth functioning of the analytical laboratory activities & experimental work
3.	All quartz double distillation output 105 litter/hr	1,28,993	The smooth functioning of the analytical laboratory activities & experimental work
4.	Soxhlet extraction heating unit 6 test	1,7110	Extraction of essential oil from selected species
5.	Soxhlet extraction apparatus flask capacity 500 ml	1,3240	
6.	Essential oil determination apparatus 5 litter	1,7110	

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

10. Quantification of Overall Project Progress

S. No.	Parameters	Total (Numeric)	Remarks/ Attachments/ Soft copies of documents
1.	IHR States Covered	1	Annexure - 2
2.	Project Site/ Field Stations Developed	1	Chaudas region, Pithoragarh district; Sri Narayan Ashram is established as a field station/demonstration site/mother nursery
3.	New Methods/ Modeling Developed	-	
4.	No. of Trainings arranged	8	
5.	No of the beneficiaries attended the trainings	398	
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	2	
7.	SC stakeholders benefited	693	
8.	ST stakeholders benefited	413	
9.	Women Empowered	478	
10.	No of Workshops Arranged along with the level of participation	8 workshops (630 stakeholders)	
11.	On field Demonstration Models initiated	14	A total of 14 demonstration plots were established in different elevations and maintained the germplasm of MPs. (Annexure 2) • Ex-situ conservation model at Sri Narayan Ashram – 1 • School conservation model - 2 • Demonstration plots in 11 different villages
12.	Livelihood Options promoted	1	Medicinal Plant cultivation and marketing
13.	Technical/ Training Manuals prepared	2	Training Manual - 1 Bilingual Flyers (Agro-technology of 7 MPs) -1 (Annexure 6)
14.	Processing Units established	1 (attached photos)	Chips preparation for value addition of *Hedychium spicatum* (Van haldi) at Sri Narayan Ashram, Pithorgargh (Annexure 4)

15.	No of Species Collected	7	The planting materials of *A. glauca, A. stracheyi, C. tamala, S. costus, P. kurrooa, H. spicatum* and *V. jatamansi* were purchased from high-altitude nurseries (Tungnath, Pothivasa, Kulsari of HAPPRC Srinagar Garhwal, Triyuginarayan GBPNIHE Almora, progressive farmers) of Uttarakhand. (Annexure 1)
16.	New Species identified	-	-
17.	New Database generated (Types):	-	-
	Others (if any)		

11. Knowledge Products and Publications:

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:	1	4	11.61	(Annexure 6)
2.	Book Chapter(s)/ Books:	-	-	-	
3.	Technical Reports	-	-	-	
4.	Training Manual (Skill Development/ Capacity Building)	1 (Training Manual) & 1 (Agro-techniques based Flyers)			(Annexure 6)
5.	Papers presented in Conferences/Seminars/State	State 1			Young Scientist Award (14th State Science Congress, 2020) organized by UCOST Dehradun

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
					(Annexure 6)
6.	Policy Drafts/Papers	-	-		
7.	Others: Popular Article	4	-		(Annexure 6)
	Research paper submission	1	3		(Annexure 6)

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

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

Particulars	Recommendations
Utility of the Project Findings	The project for the first time initiated a cluster-based approach for medicinal plant cultivation in the Chaudas area, Pithoragarh. The project finding will be utilized for the development of propagation protocols for threatened species, nursery development, and cultivation of the medicinal plant in the Chaudas area. The finding also can be utilized in the suitable locations of the targeted species for their cultivation.
Replicability of Project	The findings of the project are replicable and can be replicated on the target species all across the Himalayan region.
Exit Strategy	The synergy developed between different line agencies and buyback arrangements facilitated between growers and buyers can help the self-sustainable model of medicinal plants in the project sites.

(**PROJECT PROPONENT/ COORDINATOR**)

(Signed and Stamped)

(**HEAD OF THE INSTITUTION**)

(Signed and Stamped)

Place: ……..
Date: …../……/……

PART B: PROJECT DETAILED REPORT

The Detailed report should include an Executive Summary and it should have separate chapters on (i) Introduction (ii) Methodologies, Strategy and Approach (iii) Key Findings and Results (iv) Overall Achievements (v) Project's Impacts in IHR (vi) Exit Strategy and Sustainability (vii) References and (viii) Acknowledgement (It should have a mention of financial grant from the NMHS, MoEF&CC)

Further, description of Technical Activities, List of Trainings/ Workshops/ Seminars with details of trained resources, list of New Products developed under the project, Manual of Standard Operating Procedures (SOPs) developed, Technology developed/Transferred etc should be enclosed as Appendix.

1.0 EXECUTIVE SUMMARY

The Executive Summary of the project should not be more than 3–5 pages, covering all essential features in a precise and concise manner as stated in Part A (Project Summary Report) and Part B (Comprehensive Report).

2.0 INTRODUCTION

2.1 Background of the Project (max. 500 words)

The Indian Himalayan region (IHR) extends over 2,800 km in length and 220-300 km in width, covering partially or completely twelve states of the Indian Republic, with its unique topography, diverse habitats, and varied altitudinal range (200-8000 m asl) is home to a large number of useful and economically/ecologically important species, including medicinal herbs. Many of these species are being used extensively as food and source of nutritive additives, fuel wood, fodder, fibre, and as raw or processed high-value drugs, aromatics, etc. Trade in medicinal plants is one of the important means of livelihood of the Himalayan people. With the ever-increasing human population and the requirement for plants and their products, there has been tremendous pressure on plants, and consequently a considerable threat to their survival. This serious problem is prevalent worldwide and the Himalayan region is no exception. Over the years the number of plant species has decreased at an unprecedented rate, which has put biodiversity under serious threat. In addition, medicinal plants are used to fulfill domestic needs as well as pharmaceuticals; thus the populations of many of the useful and economically/ecologically important species have depleted, and as a consequence, several species are currently listed under threatened, endangered or critically endangered status. Considering the high rate of disappearance/ depletion of plant species in their natural habitats it would be pertinent to adopt multiplication and conservation measures, both *in situ* as well as *ex situ* for conservation and sustainable utilization of medicinal plants to improve threatened status in natural habitat. In addition, it is pertinent to establish germplasm repositories to fulfill the need for planting material while reintroduction and cultivation activities take place. Considering this, the present project focuses on (i) developing species-specific protocols for Threatened Species, (ii) establishing demonstrations of threatened Himalayan medicinal plants at different altitudes, (iii) promoting the cultivation of threatened medicinal plants at farmer's fields, (iv) developing market linkages for selling of cultivated produce, and (v) sensitizing diverse

stakeholders group towards promoting conservation of threatened medicinal plants. The results of the study will help to promote the conservation of threatened medicinal plants, improve the livelihoods of farmers, and reduce the pressure on their natural populations.

2.2 Overview of the Major Issues to be Addressed (max. 1000 words)

The depletion of biodiversity is a major issue in the Himalayan region and among others, medicinal plants are, under serious threat and require immediate attention. Therefore, through the project, various issues have been addressed during the project periods. These include, (i) the availability of medicinal plants is the major challenge facing the world today. With the rate at which species are facing extinction, it is extremely important to take corrective steps to ensure the sustained availability of resources. If the depletion rate of medicinal plants continues, the entire superstructure of Traditional medicine, modern cosmetics, nutraceuticals, and even several modern drugs may crumble down. In this context, different methods of propagation of selected medicinal plants were developed and large-scale planting material was produced. The planting material of the selected species was distributed to the farmers for promoting the cultivation in the farmers' fields. This has helped to reduce the pressure on natural habitats and improved the status of threatened species. Also, planting materials are made available through the projects to the farmers. (ii) production of quality planting material is the most important issue which was addressed through the production of quality planting material for the target species during the project period. The planting material was then distributed to the farmers for cultivation in their fields. (iii) trade of the medicinal plants is the biggest driver of overall growth in the sector. In this context, a direct agreement was facilitated between the farmers and buyers so that trade of the cultivated species does not hamper. (iv) value addition of medicinal plants is the requirement of modern industry, which have the maximum concentration of active ingredients. In this context, the raw material of the *Hedychium spicatum* one of the project species was sold in the form of preparing chips. Similarly, the essential oil of the *Valeriana jatamansi*, another species of project, and *Hedychium spicatum* were used for the isolation of essential oil. These value-added products gave a better price for the species while selling to the buyers. (v) livelihood linkages of medicinal plants is another issue in this sector. This issue was addressed through organizing various capacity building, hands-on training programme, and motivating the villagers towards medicinal plant cultivation. Once they started the cultivation, then it was directly linked to their livelihood and they start earning some additional amount in addition to their routine agriculture work.

2.3 Baseline Data and Project Scope (max. 1000 words)

Baseline data of Chaudas valley was collected through the Prior rural appraisal (PRA) approach of Kyoto protocol concerning the intellectual property rights of the ethnic communities and plant resources of the study area. Formal written consent for the publication of traditional knowledge was received from all the informants, vidhyas and grampradans. The recommendations and minimum standards have followed while conducting the survey. The semi-structured questionnaire-based random surveys were performed across nine villages spanning indigenous communities in the Chaudas Valley of western Himalaya. Results reveal that there are a total of 36 herbaceous species (30 genera, 19 families) to be used to treat various diseases/illnesses. Specific indigenous uses have been recorded along with the medicine’s local formulation procedure. While the formulations use both fresh and dry material (51 percent), the dry material

is most widely used (36 percent), followed by fresh material (13 percent) and both dry and fresh. Roots/rhizome/tuber form an estimated 52.8 percent of the main raw material for medicine formulation followed by whole plant (19.4 percent), leaves (13.9 percent), seeds (11.1 percent), and fruits (2.8 percent). However, the raw material to fulfill the medicine need is collected from the wild. In this context, the scope of the project is to make available the planting material of the medicinal plants to the villagers and promote the cultivation of selected medicinal plants so as to reduce the pressure on natural habitats and improve the livelihood of the villagers. This was achieved by developing propagation protocols for the target threatened species, distribution of quality planting material for farmers, motivating farmers for cultivating medicinal plants in their fields, capacity building the farmers on medicinal plants conservation, registration of farmers to the Herbal Research and Development Institute, Gopeshwar, facilitated MoU between farmers and buyers and quality certification of cultivated produce through Quality Certification of India. All these activities motivated the farmers to grow medicinal plants in their fields in addition to their regular agricultural activities. The project also contributed toward developing a strategy for large-scale multiplication and sustainable utilization of useful medicinal plants; this would ensure not only long-term conservation planning using a participatory approach but improve the livelihood of the people of the region. The project would help in: (i) building a good research team of young scientists for continuing work on the multi-disciplinary aspects, (ii) establishing germplasm repositories which may help to make availability of planting material, and (iii) conservation and cultivation of medicinal plants using a participatory approach where the local stakeholder communities will engage, including women.

2.4 Project Objectives and Target Deliverables (as per the NMHS Sanction Order)

S.No.	**Project Objectives**	**Target Deliverables**
1	To develop species-specific protocols for recovery/reintroduction of threatened species	• Species specific protocols for 7 threatened medicinal plants have been developed and implemented at 3 different altitudinal gradients
2	To establish demonstrations of threatened Himalayan medicinal plants at different altitude	• Field-based Conservation model of threatened medicinal plants at 2 schools, 11 villages and 1 at Sri Narayan Asram established
3	To promote the cultivation of threatened medicinal plants at farmer's field	• Cultivation of threatened medicinal plants at farmers field promoted and 172 farmers initiated cultivation of medicinal plants cultivation • Three reintroduction sites of threatened medicinal plants established
4	To develop market linkages for selling cultivated produce	• Market linkages for the sale for cultivated produce of medicinal plants was established and buyback arrangements between farmers

		and buyers facilitated
5	To sensitize diverse stakeholders group toward promoting the conservation of threatened medicinal plants	• A total of 21 events (5 sensitization workshops; 8 field orientation workshops; 8 capacity building and value addition training programme) were organized and 1579 stakeholders (youths - 366, woman - 468, farmers 745) sensitized. • Field Manual for high altitude MPs Cultivation (01 No.) developed.

3 METHODOLOGIES, STRATEGY, AND APPROACH

3.1 Methodologies used (max. 500 words)

The present study was carried out in 11 villages of Chaudas valley (located between Kali and Dhauli rivers in the border region of two countries of Nepal and China) in the tehsil Dharchula, Pithoragarh district of Uttarakhand. The study area lies between 2000 to 3800 m asl altitudinal range. Various steps were carried out to fulfill the objectives of the study. These include, (i) Detail survey of the Chaudas valley and need base assessment, (ii) sensitization and motivation of the locals towards medicinal plants cultivation, (iii) identification of lands for nursery development, (iv) Collection of seeds and planting materials for standardization of propagation protocols, (v) development of propagation protocols for mass multiplication of the target species, (vi) Transfer of seedlings to nursery developed at Chaudas valley (Sri Narayan Ashram), (vii) acclimatization and hardening of the propagules, (viii) Preparation of lands for nursery establishment at different altitude, (ix) distribution of medicinal plants propagules to the farmers, (x) initiation of medicinal plants cultivation at farmers field, (xi) established synergy with different lien agencies, (xii) evaluate the survival percentage and growth of different species, (xiii) evaluate the phytochemical properties of cultivated produce, (xiv) registration of the farmers with Herbal Research and Development Institute, Gopeswar, (xv) certified the cultivated produce with Quality Council of India, and (xvi) establish buyback arrangement with companies, (xvii) sale of the cultivated produce

3.2. Data collected and Equipment Used (max 500 words)

Scientific data were collected on the various parameters like (i) germination percentage, mean germination time, survival percentage, (ii) the number of cuttings sprouted, sprouting percentage, rooting percentage, survival percentage, (iii) explant establishment, shoot multiplication, shoot elongation, rooting percentage, acclimatization and hardening, (iv) yield per ha, (v) percentage of useful compounds in the wild and cultivated produce, (vi) area under cultivation, (vii) number of farmers initiated cultivation, and (vii) the number of stakeholders sensitized and capacity build. In addition, need base assessment through standard questionnaires and PRA methods was carried out.

Various scientific equipment such as a High Performance Liquid Chromatography, Double distillation unit, Ultrasonic extraction unit, Grinders, spectrophotometer, tissue culture laboratory, etc. used for conducting experiments in this project.

3.3. **Details of Field Survey conducted, if any (max 500 words)**

Chaudans area is situated in the mountainous region of Dharchula, Pithoragarh district of Uttarakhand, western Himalaya, between 30°2′ N and 29°58′ N latitude and 80°35′ E to 80°40′ E longitude. Each climatic zone of the region supports different types of forest and vegetation, including sub-tropical pine forest, a gregarious formation of *Pinus roxburghii* Sarg., Himalayan moist temperateforest dominated by *Quercus semecarpifolia* Sm., *Acer caesium* Wall. *ex* Brandis, *Betula alnoides* Buch.-Ham. *ex* D.Don, *Aesculus indica* (Wall. *ex* Cambess.) Hook., *Lyonia ovalifolia* (Wall.) Drude. Whereas dry temperate forest dominated by *Pinus wallichiana* A.B.Jacks., *Abies spactabilis* Zucc., and sub-alpine dominated by *Betula utilis* D.Don, *Rhododendron campanulatum* D. Don, *R. anthopogon* D. Don. The altitude range of the study area provides a wide range of habitats for diverse floristic elements including native and endemic biodiversity that includes high-value medicinal plants. The *Bhotia* is the largest tribal group in this region, dependent for their livelihoods on forest resources and this community has its subcategories called '*Rung'* and '*Shauka'*. Study villages have a total tribal population is 1083, including 46.9 percent male and 52.4 percent female (Census 2011). A total of 108 informants, including 71 males and 37 females, between the ages of 30 and 40 years old is the dominant age class (31.6 percent) followed by 41 to 50 (27.2 percent), >60 (18.4 percent), 51 to 60 (12 percent) and ≥25 to 30 (10.8 percent). The educational background of 57 percent of informant population under 5^{th} to 10^{th} category followed by 10^{th} to 12^{th} (15.2 percent), ≥5^{th} (12.7 percent) and unrecorded category (15.2 percent), no one was above 12^{th} class. The interview was attended by all respondents and shared their traditional knowledge of alpine plants. However, the potential new medicinal records have been perceived from > 50 years old age informants. We have adopted Prior rural appraisal (PRA) approach of Kyoto protocol concerning the intellectual property rights of the ethnic communities and plant resources of the study area. Formal written consent for publication of traditional knowledge was received from all the informants, vidhyas and grampradans. The semi-structured questionnaire-based random surveys were performed across nine villages spanning indigenous communities in Chaudas Valley of western Himalaya. With the aid of a local interpreter, interviewed them in their local languages (*Rung* and *Kumaoni*) especially for older age groups. Indeed most of the informants are familiar with the *Hindi* language. We have collected the data across the following villages Chhalma chhilason (13 informants), Dhar Pangu (8), Himkhola (15), Pangla (19), Rung (11), Sirdang (16), Sirkha (5), Sosa (13) and Tanta Gaon (11). During the survey period, through random we covered around 21 percent of the total population. For surveys and data collection, the adult age ranges (≥25 years old) of both genders were considered. Originally, we showed them fresh specimens and detailed photographs that were collected/captured and thereafter species were assessed for taxonomy authentication. We then documented the conventional use of plants in the semi-structured format of questionnaire designed by G.B. Pant National Institute of Himalayan Environment (NIHE). The format of the questionnaire includes the following details (i) name, age, gender and education of the informant, (ii) name of the village, block, etc., and (iii) local name of the plant, medicinal/other uses, and plant part used (dry/fresh), local formulation, etc.

3.4. Strategic Planning for each activity with time frame (max. 200 words)

- Collected and collated primary and secondary information from diverse sources/reports about what are various medicinal plants available, pressure on the medicinal plants and how these medicinal plants can be mainstream for conservation and cultivation (0-12 Months).
- Developed/standardized species specific propagation packages of the selected species through various methods and large scale planting material produced. Propagated planting material distributed to the farmers for initiation of medicinal plants cultivation in their field (6-30 Months).
- Establishment of field nurseries/conservation models at different locations of the selected medicinal plants and various sensitization and awareness camps organized (12-30 Months)
- Synergy between lien agencies developed for promoting medicinal plants cultivation in farmers field (24-30 Months).
- Certification of cultivated produce done through Qualicy Council of India, New Delhi and registration of farmers with Herbal Research and Development Institute was done (30-45 Months)
- Buyback arrangement of the farmers with the companies was done for selling of the cultivated produce (36-45 Months).
- Reintroduction of selected medicinal plants in their natural habitats were carried out (30-36 Months)

4. KEY FINDINGS AND RESULTS – ***supporting documents to be attached.***

4.1. Major Activities/ Findings (max. 500 words)

- Species-specific protocols for 7 medicinal plants i.e. *Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus* and *Valeriana jatamansi* were developed. The seed germination method was used for *Angelica glauca, Cinnamomum tamala, Saussurea costus*. The conventional vegetative propagation technique was used for *Allium stracheyi, Hedychium spicatum, Picrorrhiza kurrooa*. *In-vitro* propagation technique (plant tissue culture) was followed for *Valeriana jatamansi*.
- Through various means (i.e. seed germination, vegetative propagation, tissue culture) a total of 46 lakhs propagules were produced. The seedlings of *Allium stracheyi* (1,00,000 No.), *Angelica glauca* (20,000 No.), *Cinnamomum tamala* (1,00,000 No.), *Hedychium spicatum* (30,00,000 No.), *Picrorrhiza kurrooa* (3,00,000 No.), *Saussurea costus* (1,00,000 No.) and *Valeriana jatamansi* (10,00,000 No.) distributed to the farmers for cultivation in their fields of Chaudas region, Pithoragarh.
- A total of 14 demonstration sites (11 Villages; 1 Sri Narayan Ashram; 2 School conservation models) were established in Chaudas area, Pithoragarh.
- A total of 172 farmers from 11 villages have initiated the cultivation of medicinal plant species at 125 nali (2.5 ha) land.
- Market linkages for the produce of selected medicinal plants have been established with different agencies i.e., Dabur representative (Human India, Srinagar, Surkunda Jadi Buti

Samuh, Bageshwar), and Bhesaj Sangh, Pithoragarh. An MoU was facilitated and signed between farmers and buyers as per the buyback arrangements.

- Certification of cultivated produce of Medicinal plants was done through the Quality Council of India (QCI) New Delhi under Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP)
- A synergy between farmers and ongoing schemes of Government line agencies such as MNREGA, Bhesaj Sangh Pithoragarh, Herbal Research and Development Institute (HRDI) Gopeshwar, and National Medicinal Plant Board (NMPB) New Delhi was developed and facilitated to farmers of Chaudas region.
- A total of 21 events (5 sensitization workshops; 8 field orientation workshops; 8 capacity building and value addition training programme) were organized during the project period. A total of 1579 stakeholders (male 1111; female 468) were sensitized and build their capacity for cultivation and conservation of threatened medicinal plants.

4.2. Key Results (max. 500 words in bullets covering all activities)

- The propagation protocols through different conventional and tissue culture methods have been developed/refined. These methods helped to identify the best treatments for the mass multiplication of target species.
- Through various methods (Conventional and tissue culture) a total of 46 lakh plants were produced and distributed to the farmers for fulfilling the need for planting material for initiating cultivation by 172 farmers families in the Chaudas valley.
- The establishment of nurseries/conservation models at different locations of the Chaudas valley conserved the germplasm of selected medicinal plants.
- Approach for market linkages and buyback arrangements of the cultivated produce have been established. This approach helped to promote the sale of cultivated produce at the village level.
- Capacity building on the various methods of medicinal plant cultivation and conservation was carried out by organizing 21 events during the project period. This could help to build the capacity of 1579 stakeholders of different villages of Chauda valley.
- A synergy for conservation and cultivation between different line agencies has been developed, which helped the farmers to initiate medicinal plant cultivation in their field more judiciously. Registration of farmers to the Herbal Research and Development Institute and quality certification of the cultivated produce helped farmers to provide a better rate of their produce in the market.

4.3. Conclusion of the study (max. 500 words in bullets)

The project contributed and developed a strategy for large-scale multiplication and sustainable utilization of target medicinal plants in the Chaudas valley. These include the development of propagation protocols of 7 target species, production of over 46 lakhs of planting material, initiation of cultivation in 172 farmers' families, registration of farmers and cultivated produce through state/national agencies, capacity building of over 1550 stakeholders, etc. would ensure not only long term conservation plan using a participatory approach but generate economic benefits to the people of the region. Connected to this interdisciplinary goal, the project has played a vital role in

developing a team-based research culture for the Indian Himalayan region. The project also helped in: (i) building a good research team of young scientists for continuing work on the multi-disciplinary aspects, (ii) establishing germplasm repositories which is helping farmers to make availability of planting material, (iii) conservation and cultivation of target medicinal plants using a participatory approach where the local stakeholder communities are engaged, including women. All these ensured sustainable resource management even after the tenure of the project is over.

5. OVERALL ACHIEVEMENTS – *supporting documents to be attached.*

5.1 Achievement on Project Objectives/ Target Deliverables (max. 500 words)]

S.No.	Project objectives/Target deliverables	Achievements
1	To develop species-specific protocols for the recovery/reintroduction of threatened species	• Species-specific protocols for 7 medicinal plants i.e. *Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus,* and *Valeriana jatamansi* were developed. • Through various means (i.e., seed germination, vegetative propagation, tissue culture) a total of 46 lakh seedlings were produced. The seedlings of *Allium stracheyi* (1,00,000 No.), *Angelica glauca* (20,000 No.), *Cinnamomum tamala* (1,00,000 No.), *Hedychium spicatum* (30,00,000 No.), *Picrorrhiza kurrooa* (3,00,000 No.), *Saussurea costus* (1,00,000 No.) and *Valeriana jatamansi* (10,00,000 No.) were distributed to the farmers for cultivation in their fields of Chaudas region, Pithoragarh
2	To establish demonstrations of threatened Himalayan medicinal plants at different altitude	• A total of 14 demonstration sites (11 Villages; 1 Sri Narayan Ashram; 2 School conservation models) were established in the Chaudas area, Pithoragarh.
3	To promote the cultivation of threatened medicinal plants at farmer's field	• Cultivation of threatened medicinal plants at farmers field promoted and 172 farmers from 11 villages have initiated the cultivation of medicinal plant species at 125 nali (2.5 ha) land. • A synergy between farmers and ongoing schemes of Government Line agencies such as MNERGA, Bhesaj Sangh Pithoragarh, Herbal Research and Development Institute (HRDI) Gopeshwar, and

		National Medicinal Plant Board (NMPB) New Delhi was developed and facilitated to framers of Chaudas region for the cultivation of medicinal plants.
4	To develop market linkages for selling cultivated produce	• Market linkages for selling of cultivated produce developed and farmers farmers were registered at Herbal Research and Development Institute (HRDI) in Gopeshwar, Uttarakhand. • Certification of cultivated produce of medicinal plants was done through the Quality Council of India (QCI), New Delhi under the Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP). • For selling cultivated produce of selected medicinal plant species and providing direct benefits to farmers, the buyback arrangements were facilitated between farmers and buyers such as Human India, Srinagar, Surkunda Jadi Buti Samuh, Bageshwar, and Bhesaj Sangh, Pithoragarh and a Memorandum of Understanding (MoU) was signed with farmers and buyers.
5	To sensitize diverse stakeholders group towards promoting the conservation of threatened medicinal plants.	• A total of 21 events (5 sensitization workshops; 8 field orientation workshops; 8 capacity building and value addition training programme) were organized and 1579 stakeholders (male 1111; female 468) were sensitized and built their capacity for cultivation and conservation of threatened medicinal plants

5.2. Interventions (max. 500 words)

Institute during the project period made various interventions for promoting the cultivation of medicinal plants in addition to developing propagation protocols and large-scale production. The Institute developed linkages with various organizations to support and promote cultivation. These include (i) Herbal Research Institute for registration of farmers, (ii) Pharmaceutical companies for selling the produce (iii) Vesaj Sangh for fulfilling the plant material need, (iv) MNREGA for support in land preparation, (v) Forest department for reintroduction species in natural habitats, (vi) Quality Council of India for certifying the cultivated produce, and (vi) schools for creating awareness with the students and teachers. All these interventions promoted medicinal plant cultivation and 172 farmers initiated the cultivation at the project site.

5.3. On-field Demonstration and Value-addition of Products, if any (max. 500 words)

The contribution of medicinal plants in improving livelihood and earning income in the Himalayan region is well known. This became more prevalent in recent years keeping in view the increasing interest of consumers in MP-based products. As such, the Himalayan MPs are known for their unique sale price (USP) as these plants are found only in the region. Their demands in the herbal sector are growing rapidly. However, their availability in nature has been threatened due to overexploitation from nature. Keeping this in view, seven threatened MPs (i.e.

Allium stracheyi, Angelica glauca, Cinnamomum tamala, Hedychium spicatum, Picrorrhiza kurrooa, Saussurea costus and *Valeriana jatamansi*) have been promoted for cultivation in the Chaudas area. After three years of efforts, the selected species were demonstrated and cultivated in the farmers field of around 125 nali. In the villages like Niyang, Sosa, Pasti, Palankari, Chhalmachhilason, Srikha, Sridang, and Himkhola, cultivation of *Hedychium spicatum* (50 farmers; 80.5 nali)*, Saussurea costus* (8 farmers; 13 nali)*, Picrorrhiza kurrooa* (50 farmers; 12.5 nali)*, Valeriana jatamansi* (12 farmers; 10 nali)*, and Allium stracheyi* (10 farmers; 13 nali), were promoted, while *C. tamala* was planted at Jaykot, Pangla and Ghasku.

Value addition of medicinal plants is the requirement of modern industry, which have the maximum concentration of active ingredients. In this context, the raw material of the *Hedychium spicatum* one of the project species was sold in the form of chips. Similarly, the essential oil of the *Valeriana jatamansi*, another species of project, and *Hedychium spicatum* were used for the isolation of essential oil. These value-added products gave a better price for the species while selling to the buyers.

5.3. Green Skills developed in State/ UT (max. 500 words)

During the project period, various workshops and training programmes were organized for the conservation and cultivation of medicinal plants. A total of 21 events were organized to sensitize the different stakeholders. The capacity building of over 1500 stakeholders on the cultivation of medicinal plants was done.

5.4. Addressing Cross-cutting Issues (max. 200 words)

The Indian Himalayan Region (IHR) is known as storehouse of medicinal plants and trade in medicinal plants is one of the important means of livelihood of the Himalayan people. Therefore, the promotion of the cultivation of selected medicinal plants help to benefit the local people (villagers, farmers, including women) considerably and supported the country's pharmaceutical industries and economy of the nation through the sale of cultivated produce. Multilocational trials and identification of suitable locations of the selected medicinal plants helped to identify appropriate accessions which are resilient to climate as these plants are susceptible to environmental variations. In addition, the outcome of the project addressed different aspects of climate change in the medicinal plant growing areas along the IHR with meaningful connections to gender equality and a strong component of communication of outcomes. The results also provided the scope of promoting women's participation, particularly about sustaining livelihoods. The knowledge developed has been communicated at every step of project tenure to concerned stakeholders, using both traditional and modern techniques of print/electronic media.

6. PROJECT'S IMPACTS IN IHR – *supporting documents to be attached.*

6.1. Socio-Economic impact (max. 500 words)

The present study is first of its kind initiative where a cluster-based approach was followed for the cultivation of medicinal plants for improving the socioeconomic status of local people. During the project, through various methods, targeted species were propagated and distributed to the farmers for cultivation. Two mother nurseries (GBPNIHE and SNA) were used for the mass multiplication and distribution of species. Agriculture and barren lands were used for the cultivation of species and the land was dug out twice before plantation. The selected targeted

species were cultivated in 125 nali (2.5 ha) land of 172 farmers of the 11 villages. The farmers were registered with the Herbal Research and Development Institute, Gopeshwar for the cultivation of medicinal plants. Their produce was certified through the Quality Council of India and a buyback arrangement with buyers for selling their produce was facilitated. Through the cultivation of medicinal plants, farmers receive additional income in addition to their regular agriculture.

6.2. Impact on Natural Resources/ Environment (max. 500 words)

The local communities living in the region depend largely on natural resources occur near the vicinity of villages. The local people used these wild resources for fulfilling their daily based needs. However, the populations of various resources decline due to over-exploitation, unscientific harvesting, and human interference. All these showed a negative impact on the natural resources/ecosystem of the region. Through promoting the cultivation of medicinal plants in the Chaudas valley, the collection of resources particularly medicinal plants from the wild drastically reduced. Farmers who collected medicinal plants from the wild before the project started for their subsistence are now cultivating them in their fallow land. In this way, the natural resources particularly the status of medicinal plants are improved. In addition, the project through various sensitized programme makes the people aware of the importance of natural resources and the ecosystem. The promotion of MPs cultivation in the region through people's participation will be helpful to protect the natural environment in the future. Within a short period (3 years) it is very difficult to quantify how much the ecosystem improved and the other natural factors impacting the natural resources and ecosystem need in-depth study.

6.3. Conservation of Biodiversity/ Land Rehabilitation in IHR (max. 500 words)

The present study would be imperative for the conservation of biodiversity through the participation of local inhabitants. The local people actively took part in the conservation initiatives for the conservation of medicinal plants as well as other biodiversity resources. The cultivation of medicinal plants in the Chaudas valley, through people's participation and the establishment conservation model in the schools, opens the avenues for biodiversity conservation in the region. However, the periodic assessment of biodiversity is needed for assessing the impact of the present intervention.

6.4. Developing Mountain Infrastructures (max. 200 words)

Infrastructures for producing quality planting material, storage of cultivated produce, and value addition are required to promote medicinal plant cultivation and make an entrepreneur in the area is needed. In the present study, two greenhouses with the help of Shri Narayan Ashram Trust were built for producing quality planting material for selected medicinal plants. High-altitude nurseries were established and different conservation models were established.

6.5. Strengthening Networking in State/ UT (max. 200 words)

Institute during the project period developed linkages with (i) Herbal Research Institute for registration of farmers, (ii) Pharmaceutical companies for selling the produce (iii) Vesaj Sangh for fulfilling the plant material need, (iv) MNREGA for support in land preparation, (v) Forest department for reintroduction species in natural habitats, (vi) Quality Council of India for certifying the cultivated produce, and (vi) schools for creating awareness with the students and teachers.

7. EXIT STRATEGY AND SUSTAINABILITY – *supporting documents to be attached.*

7.1. Utility of project findings (max. 500 words)

The project finding can be utilized for (i) propagating selected medicinal plants for ass multiplication, (ii) capacity building of villagers/ farmers towards cultivation practices for large-scale cultivation of selected medicinal, (iii) nurseries developed at different places will fulfill the planting material need of farmers and also can be utilized for seed formation, (iv) the ex-situ germplasm of different selected species established at different locations will help to improve in situ plants population, (v) conservation model at schools will help to connect the students towards conservation of medicinal plants, (vi) cultivation practices will help farmers to earn additional income in addition to their agriculture.

7.2. Other Gap Areas (max. 200 words)

Three years time period is not sufficient to meet the challenges in the field for the cultivation of medicinal plants, especially in the high altitude area where the window for working is very narrow, i.e. only 6-7 months in a year are suitable for working. Motivating the local people is itself a challenge as they largely depend on natural resources and in such conditions promoting medicinal cultivation is a difficult task. This takes a long time to motivate them despite the fact there is a growing demand for medicinal plants in the pharmaceutical industries. Tough terrain and poor road connectivity are also big challenges for transporting cultivated produce. The availability of quality planting material is a major gap area. Replicable propagation techniques of most of the species are lacking.

7.3. Major Recommendations/ Way Forward (max. 200 words)

- To strengthen medicinal plants cultivation, a cluster-based approach for selected species should be followed to meet the volume of raw material
- Species-specific propagation protocols of the species are essential to meet the planting material requirement. Multilocational trials should be conducted for the identification of suitable locations for better performance with respect to survival, growth, and yield.
- The synergy between different line agencies working on medicinal plants should be developed to promote medicinal plant cultivation. Since the gestation period of medicinal plant cultivation is long, incentives for cultivating medicinal plants should be given.
- The project on medicinal plant cultivation should be at least 5-10 years for assessing the overall impact of medicinal plant cultivation. Three years' project for assessing the impacts is not sufficient.
- The assured market is required to sell the cultivated produce as most cases farmers fail to sell their produce. In this context, regular meetings with buyers and sellers should be organized.
- Certification of cultivated produce is a must for selling cultivated produce at good prices.
- Infrastructure in the high altitude region needs to be developed for better transportation of the raw material and small entrepreneurship should be developed for value addition of the produce.

7.4. Replication/ Upscaling/ Post-Project Sustainability of Interventions (max. 500 words)

The cluster-based approach followed in this project can be replicated in the other Himalayan region for promoting medicinal plant cultivation. Large-scale cultivation on one hand can fulfill the industrial demand of pharmaceutical companies at the same time reduce the overexploitation of medicinal plants from their natural sources. The cultivation of medicinal plants helps to generate additional income for the farmers. This cluster-based approach can be replicated in other hilly areas/countries with similar geographic/climatic conditions