

NMHS-FINAL TECHNICAL REPORT (FTR)
Demand-Driven Action Research Project Grant

NMHS Reference No.:	NMHS/MG-2016/004 31/03/2016	Date of Submission:	3	0	0	6	2	0	2	0
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PROJECT TITLE

ESTABLISHMENT OF GENE POOL, PROPAGATION AND *EX-SITU* CONSERVATION OF SELECTED SENSITIVE HIGH ALTITUDE MEDICINAL AND AROMATIC PLANT SPECIES AND NATURE INTERPRETATION SITE (NIS) FOR CREATING AWARENESS AMONG THE VARIOUS STAKEHOLDERS

Project Duration: from (31/03/2016) to (30/06/2020)



Submitted to:

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NMHS-Final Technical Report (FTR) *template*
Demand-Driven Action Research Project

DSL: Date of Sanction Letter

DPC: Date of Project Completion

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Part A: Project Summary Report

1. Project Description 31/03/2016

i.	Project Reference No.	NMHS/MG-2016/004, 31/03/2016		
ii.	Type of Project	Small Grant	Medium Grant	Large Grant
iii.	Project Title	<i>Establishment of gene pool, propagation and Ex-Situ conservation of selected sensitive high altitude medicinal and aromatic plant species and Nature Interpretation Site (NIS) for creating awareness among the various stakeholders.</i>		
iv.	State under which Project is Sanctioned	Uttarakhand		
v.	Project Sites (IHR States covered)(Maps to be attached)	Tungnath (3600 masl) and new site at Baniyakund (2460 masl), Chopta(Attached along with maps).		
vi.	Scale of Project Operation	Local	Regional	Pan-Himalayan
vii.	Total Budget/ Outlay of the Project	Rs. 2,07, 96,000 (Rupees Two Crore Seven Lakh Ninety Six Thousand only)		
viii.	Lead Agency	High Altitude Plant Physiology Research Centre (HAPPRC), HN Bahuguna Garhwal University, Srinagar (Garhwal), Uttarakhand -PIN: 246174		
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ix.	Project Implementing Partners	NA
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	<p>Prof. A. R. Nautiyal, Director, High Altitude Plant Physiology Research Centre (HAPPRC), H.N. Bahuguna Garhwal University, Srinagar (Garhwal), Uttarakhand PIN: 246174 Telephone: 01346-252172, 251733; Fax: 252070; E-mail: arnautiyal@gmail.com; happrc@gmail.com</p>

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).

Background:

Medicinal and aromatic plants (MAPs) represent a consistent part of the natural biodiversity endowment of many countries. The role and contributions of medicinal and aromatic plants to healthcare, local economies, cultural integrity and ultimately the well-being of people, particularly the rural poor have been increasingly acknowledged over the last decade. The demands of the majority popular for medicinal and aromatic plants have been met by indiscriminate harvesting of spontaneous flora, including those found only in higher Himalayan region. This has resulted in severe loss of habitat and genetic diversity and resulted as scarcity of quality and quantity of planting material of the medicinal and aromatic plants particularly the sensitive plant species *i.e.* rare, endangered, threatened and endemic ones for various purposes. In connection to this the sustainable management and

conservation of these sensitive plant species are important not only because of their value as potential therapeutics, but also due to worldwide reliance on traditional medicinal plants for health. Effective conservation strategies for medicinal and aromatic plant should take place within four main areas: *ex-situ* and *in-situ* conservation, research, education and extension and this will definitely help in maintaining the viable plant populations, particularly sensitive species of medicinal and aromatic importance in the long run. Therefore, this proposal is aimed to establish the gene pool, propagation (seeds, vegetative parts, *in vitro*), multiplication, *ex-situ* conservation, development of nature interpretation site and large scale planting materials to minimize the scarcity of planting materials of sensitive plant species and generation of base line data on climatic change and global warming within the stipulated time period of the project for the purposes of scientific studies, cultivation and product development. Initially **it was estimated that minimum 15 lakh seedlings/ propagules of selected species will be developed in the project and simultaneously 10.0 h (approximate 500 nali& 500 farmers) land will be covered under cultivation of the selected species in selected blocks of Uttarakhand in the project. The extension of the available and generated agro-technology and scientific information in the project also will be transferred to real users through training, exposure visit and organizing educational tours. The project activities have been done in selected clusters of Ukhimath block (Kalimath & Makku clusters) of District Rudraprayag, Ghat (Site Cluster) and Dewal (Ghesh cluster) blocks of District Chamoli, Kaphkote block (Jhuni cluster) of District Bageshwar, Dharchula Block (Duktu cluster) of Pithoragarh and Mori block (Harkidoon cluster), Bhatwari block (Mukhwa cluster) of Uttarkashi District, respectively.**

Objectives:

1. Ensure the *Ex-situ* maintenance of various listed sensitive plant species (rare, endangered, threatened and endemic ones) of medicinal and aromatic importance in 2.5 ha of land and establishing site for nature interpretation for long run scientific studies and for use of various stakeholders.
2. Development of the site (Alpine Research Station, Tungnath) as an educational tourism spot.

3. Development of the large scale planting materials (approximate 15 lakh seedlings) to meet out the growing demand of planting materials by different stakeholders for the purpose of new investigation and cultivation/plantation.
4. Observation on baseline climatic information (*i.e.* minimum and maximum temperature, humidity, rainfall, snow fall etc.) of the project site and observation on growth and yield of selected species under simulated conditions (OTCs)
5. Transfer of developed information, technology and planting materials (elite one) to farmer/CBOs for livelihood opportunity through cultivation (approximate 10 ha lands) and marketing as well as ex situ conservation.
6. After completing all the administrative formalities and receiving the grant from NMHS project office, the actual work of the sanctioned project could be undertaken in the month of July 2016 as adopting following methodology.

Methodology:

The proposed project work has been carried out at an altitude of 3400 m a.s.l. and 2200 m a.s.l. at Tungnath & Pothibasa, within the premises of High Altitude Plant Physiology Research Centre, HNBGU (A Central University), Srinagar (Garhwal) and selected districts of Uttarakhand.

1. **Demarcation and fencing of area (0-3 months):** To achieve the goal of project as per proposed objectives, in the first step- demarcation and fencing of the area for establishment of new site has been done.
2. **Preparation of land (0-3 months):** Following the demarcation and fencing of lands, the demarcated land has been dugged for preparation of nursery beds, installation of water supply, water storage tanks, composting pits, shade and polyhouse, polytunnel, mulching, weather monitoring system, OTCs, etc.
3. **Purchasing and installation of required instruments/ equipments (0-6 months):** To achieve the goal of project as per objectives; the proposed/sanctioned instruments/ equipments in project has been purchased as per departmental procedure following the GFR 2017.
4. **Preparation of nursery beds and establishment of different types of infrastructure facility (0-6 months):** After completing the land preparation work, the nursery beds has been prepared for seed sowing, plantation of seedlings of different species collected from different areas/agencies and simultaneously water supply line, water storage tanks, composting pits, shade and polyhouse, polytunnel, mulching, weather monitoring system, OTCs, Oil Distillation Unit, Solar Power Generating System has been installed.

5. Collection of seeds, seedlings, etc. from different areas/Agencies (3-12months): The project staff has been collected seeds, seedlings and other propagules from different areas /agencies working in conservation of bio diversity.

6. Plantation and sowing of planting materials (3-12 months): After successful collection of planting materials the project staff has been done scientific work on multiplication of planting materials through seeds and vegetative means.

7. Propagation, multiplication, establishment and production of large scale planting stock (12-24 months): To achieve the goal of project as per proposed objective, the propagation of species showing difficulties in conventional propagation methods, the project staff used *in vitro* propagation (tissue culture) method for propagation of plants and then propagated plants has been established at project site. At the same time the selected species has been multiplied through rhizomes/ runners/ root cuttings/ stem cuttings and strengthening and raising of large scale planting materials (at least 15 lakh plants of selected species)at project site as well as in Institute's Green House using existing resource of the Centre.

8. Development of site as educational tourism spot (12-36 months):In addition to field research station, Tungnath, one new site has been developed at Baniykaund with the help of Forest Department and villagers of Ushada as Nature Interpretation and Germplasm Bank of selected species and promote the site as educational tourism spot among students from different schools and other stakeholders through organizing education tours/ exposure visits.

9. Establishment of OTCs and studies under simulated conditions (12-36 months): Selected species will be planted inside the Open Top Chambers (OTCs) and their growth and yields has been assessed under ambient and higher CO₂ concentration time to time intervals.

10. Recording of weather data (0-36 months): To know the any changes in climatic parameters, the project staff has been recorded the weather information i.e. minimum and maximum temperature, humidity, rainfall, soil temperature and even snow fall with the help of weather monitoring system and also manually within the stipulated project time.

11. Diffusion of technical/ scientific information and distribution of planting materials and cultivation (12-36 months): As the Centre has already developed preliminary agro-techniques for some important high altitude medicinal plant species and to take these species in cultivation, the group of farmers and CBOs have been selected and aware about their medicinal plants diversity and cultivation technology form day first of the project. After the successful establishment of the gene pool and *ex-situ* conservation and nature interpretation site, the local villagers and other stakeholders have been called to visit the site and after that the project staff delivers the technical/ scientific information and importance of

the site before the visitors. Simultaneously, the communication made with farmer/CBO and planting materials (seeds/ seedlings/rhizomes) of selected species has been provided to them as per their demand and requirements for plantation/cultivation and promotion of conservation. Also, numbers of on and off farm skill development programme has been organized time to time in project areas.

12. Monitoring and research trials for technology improvement report writing submission and presentation (0-36 months): The project staff involved in project have immediately start the implementation and monitoring of proposed project work. The scientific observations on development and establishment of planting materials have been done. The analysis of active constituent of planting materials collected from different areas is remaining for technology standardization. The progress of the project work has compiled time to time and submitted to funding agency (NMHS PMU) and also present the progress and findings of the project before the members of project evaluation committee.

Approach:

Considering all the difficulties, the project work has been done on action oriented approach involved survey in different high altitude villages of district Uttarkashi, Tehri, Rudraprayag, Chamoli, Pithoragarh and Bageshwar for knowing current cultivation status of selected species and farmer's awareness about importance of medicinal and aromatic plants cultivation and their conservation in natural condition. Simultaneously, identification and establishment of new site, organization of farmers skill upgradation and awareness programme, collection of planting material particularly seeds of different selected species from different natural populations and multiplication of plants from mother stock available at Alpine Field Research Station, Tungnath, newly developed site Nature Interpretation Site (NIS) Baniyakund and Pothibasa for development of large scale seedlings of the selected species for farmers distribution and promotion of cultivation and conservation.

Results:

After successful implementation (July 2016 to upto 30st June 2020) of the sanctioned project objectives following results have been achieved within 4 years of the project.

1. Overall 175 villages of six hills district of Uttarakhand have been surveyed/ covered under project for promotion of cultivation of selected species.

2. 01 new site as Nature Interpretation Site (NIS) and Germplasm Bank of selected species has been established at Baniyakund (2460m asl), Chopta in **1.0ha** of land for nature lover and as educational tourism spot.

- 3. Numbers of sanctioned items i.e.** water supply line, water storage tanks, composting pits, shade and polyhouse, polytunnel, mulching/ composting facility, weather monitoring system, OTCs, Oil Distillation Unit, Solar Power Generating System has been purchased and successfully installed.
- 4.** Over all **14** on farm (Field/cluster level workshop/plants distribution & awareness) and **04** off farm induction/training/conference programme have been organized.
- 5. 01 two days** field level exposure visit for selected villagers/farmers from Kumaun and Garhwal region of Uttarakhand and **08 one day** educational tours for school students from different Govt. & Private schools of Srinagar (Garhwal) have been organized at Nature Interpretation Site (NIS) Baniyakund (2460 m asl), Chopta.
- 6.** Approximate **10.88 kg** of seeds of 13 selected species has been collected from different natural sites of the species.
- 7.** Approximate **12.5 lakh seedlings** of different selected species have been developed inside Greenhouse condition at HAPPRC (550 m asl) and shifted to Baniyakund (2460 m asl), Chopta and Pothibasa (2200 m asl) for further growth, plantation and to meet out the demand of farmers.
- 8. More than 1 Lakh seedlings** of different species have been provided to villagers/farmers of different high altitude areas of district, Pithoragarh, Bageshwar, Chamoli, Rudraprayag, Tehri Garhwal and Uttarkashi of Uttarakhand for expansion of area under cultivation of selected species.
- 9.** Approximate **>5.0 lakh** seedlings of different selected species have been planted in Nature Interpretation Site (NIS) and Germplasm Bank, at Baniyakund (2460 m asl), Chopta.
- 10.** Overall **3353** villagers/students, teachers and leaders (**2116 Male and 1237 Female**) have been sensitized and benefitted from **09** districts of Uttarakhand within stipulated time period under project.
- 11.** Approximate **12.5** ha of farmers land of **65** villages and **1.0 ha** of govt. land has been covered under cultivation/plantation of selected species.
- 12.** Climatic information regarding the temperature, humidity, rainfall and snowfall from high altitude areas i.e., Pothibasa, Baniyakund and Tungnath of the project site has been successfully recorded.
- 13.** Assessment of impact of elevated CO₂ on growth and yield of selected species using Open Top Chambers (OTC's) established at Tungnath site is still going on.
- 14.** Collection of scientific information on growth performance, morphological variability of selected plants is still on progress.

15.04 selected species namely, *Saussurea obvallata*, *Dactylorhiza hatagirea*, *Paris polyphylla* and *Malaxis muscifera* has been investigated for improving seed germination, field establishment and measurement of growth with different parameters and agrotechnology.

Conclusion:

To conduct the R&D work for welfare of mountain people and conservation of highly important bio-resource, the project entitled “establishment of gene pool, propagation and *ex-situ* conservation of selected sensitive high altitude medicinal and aromatic plant species and Nature Interpretation Site (NIS) for creating awareness among the various stakeholders” was sanctioned in the month of March, 2016. After successful execution of the project objectives approximate **12.5** ha of farmers land of 65 villages of high altitude areas of Uttarakhand state has been engaged in cultivation of various selected species. The promotion of cultivation of these species insures the additional income to farmers and simultaneously conservation of these species in their natural habitats.

Recommendations:

After the successful initiation of the project numbers of villagers are eager to cultivate selected species as source of additional income. Keeping in view following recommendations have been made under the project.

- **Continuous interaction with stakeholders of the project for long run sustainability of medicinal plants cultivation.**
- **Continuous up gradation of knowledge developed under the project for use in public welfare (economic upliftment & conservation of resource for future generation)**
- **Continuous organization of skill upgradation programme for promotion of large scale cultivation of MAPs in high altitude villages/ areas.**
- **Strengthening and popularization of market demand of raw material and appropriate price of produce of MAPs to farmers.**
- **Continuous documentation, threat assessment, sustainable harvesting, establishment of herbal garden, basic botany and taxonomy of medicinal plants particularly high value RET species.**
- **Continuous coordination among the govt. R&D institution, officials of forest departments, non-government institutions and ultimate stakeholders /beneficiaries i.e., growers and buyers.**
- **Continuous promotion of the availability of base material for study of morpho-genetic variability, propagation, active constituent’s analysis, improvement.**

- Continuous development of large scale planting materials of selected plant species for meeting out the growing demands of planting materials.
- Regular monitoring of cultivation fields of farmers and evaluation of farmer income through cultivation of selected MAPs.
- Research on development of appropriate propagation technology and high yielding variety of high altitude medicinal and aromatic plants for *ex situ* cultivation.

2. Objective-wise Major Achievements

Sr. No.	Objectives	Major achievements (in bullets points)
1.	Ensure the <i>Ex-situ</i> maintenance of various listed sensitive plant species (rare, endangered, threatened and endemic ones) of medicinal and aromatic importance in 2.5 ha of land and establishing site for nature interpretation for long run scientific studies and for use of various stakeholders.	<ul style="list-style-type: none"> • During the entire project period 12.5 lakh seedlings of different selected species have been raised so far. • More than 1.0 ha of land acquired from forest department and Ushada Vanpanchayat and developed as nature interpretation site at Baniyakund (2460 masl), Chopta. • Approximately 5.0 lakh plants of the selected species have been planted in different beds at the site for long run scientific studies and for easy availability of <i>ex-situ</i> planting material (seeds, vegetative propagules). These plants are being maintaining as gene pool of the selected species.
2.	Development of the site (Alpine Research Station, Tungnath) as educational tourism spot.	<ul style="list-style-type: none"> • In addition to Alpine Research Station, Tungnath, one new site in more than 1.0 ha of land has been established as nature interpretation site and germplasm bank of selected species and promoting the site for educational tourism spot at Baniyakund (2460 masl), Chopta. The developed site is well equipped with infrastructure <i>i.e.</i> polyhouses, shadehouses, composting facility, weather monitoring system and field lab cum accommodation facility (Temporary hutment).
3.	Development of the large	<ul style="list-style-type: none"> • During the entire project period approximate

	scale planting materials (approximate 15 lakh seedlings) to meet out the growing demand of planting materials by different stakeholders for the purpose of new investigation and cultivation/plantation	<p>10.88 kg of seeds of 13 selected species have been collected from alpine field station, Tungnath and different high altitude areas of Uttarakhand.</p> <ul style="list-style-type: none"> • Approximate 12.5 lakh seedlings of the selected species have been developed so far under project (Maximum 9 lakh seedlings of Kutki and minimum 100 seedlings of <i>Fritilariya roylei</i>).
4.	Observation on baseline climatic information (i.e. minimum and maximum temperature, humidity, rainfall, snow fall, etc.) of the project site and observation on growth and yield of selected species under simulated conditions (OTCs).	<ul style="list-style-type: none"> • Climatic information (i.e. minimum and maximum temperature, humidity, rainfall, snow fall, etc.) has been recorded manually as well as with the help of Weather Monitoring System. The highest snowfall (90 inches/ 7.5 ft)) was recorded in the month of March, 2020 at Tungnath (3600 m asl), while minimum snowfall (1.0 inch) was recorded at Bhujgali (2800 m asl) in the month of November 2017, 2018 and 2019 • Measurements of plant growth under simulated conditions (OTCs) are going on. Plants placed under CO2 + Temperature condition (OTC 1) and only CO2 condition (OTC 2) is performing well in comparison to plants placed in control condition (OTC 3).
5.	Transfer of developed information, technology and planting materials (elite one) to farmer/CBOs for livelihood opportunity through cultivation (approximate 10 h lands) and marketing as well as ex situ conservation	<ul style="list-style-type: none"> • Agro-technology and general information manual (Hindi & English) of 13 selected species have been developed, published and distributed among interested and selected farmers. • Overall 175 villages have been surveyed/ covered under project for knowing current cultivation status and promotion of cultivation under project. • Over all 14 on farm (Field/cluster level

		<p>workshop/plants distribution & awareness) and 04 off farm induction/training/conference programme have been organized successfully in different places of Uttarakhand and HAPPRC Srinagar.</p> <ul style="list-style-type: none"> • Overall 3353villagers/students, teachers and leaders (2116 Male and 1237 Female) have been sensitized and benefitted from 09 districts of Uttarakhand. • Overall >1 Lakh seedlings of selected species have been distributed for promotion of cultivation of proposed species during the project period (2016-2020). • Over all 12.5 ha of farmers land of 65 villages of selected Districts (06) of Uttarakhand has been engaged/ covered under cultivation against the proposed target of 10.0 ha of land.
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2.2. Outputs in terms of Quantifiable Deliverables*

Sr. No.	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations made, if any, and Reason thereof:
1.	Raising 15 lakh seedlings through different propagation methods (minimum 15 lakh seedlings/pro pagules of selected species).	Number of seedlings developed, planted and distributed	Approximate 12.5 lakh seedlings of different species have been developed within the stipulated project period. Approximate >5 lakh seedlings of various listed sensitive plant species have been planted for <i>ex situ</i> maintenance at Tungnath (3400 m asl), Baniyakund (2460m asl) and Pothibasa (2200m asl). The plants are well growing and will be used	-

			for long run scientific studies. More than 1 Lakh seedlings of different selected species have been distributed.	
2.	Development of one new site for nature lover and as educational tourism spot.	In addition to Alpine Research Station, one new site developed	In addition to Alpine Research Station, Tungnath, one new site has been developed in 1.0 ha of land at Baniyakund (2460 m asl), Chopta for nature lover and as educational tourism spot.	
3.	Development of large number of seedlings (approximate 15 lakh seedlings).	Collection of seeds/ propagules and development of large number of seedlings	To develop large number of seedlings, approximate 10.88 kg seeds of different selected species have been collected and from different natural pockets of the selected species and about 12.5 lakh seedlings of different selected species have been developed within stipulated time period of the project through different means including tissue culture.	
4.	Generation of baseline data on climatic and increased CO2 concentration will help in identifying the assumption of climatic change and its effect on	Collection of weather information/ data from project site.	Climatic information (i.e. minimum and maximum temperature, humidity, rainfall, snow fall, etc.) from project site has been collected manually as well as through Automatic Weather Monitoring System. The effect of elevated CO2 on growth and yield of selected species under OTCs, established at Tungnath (3400m asl) has	

	plant growth		also been monitored.	
5.	<p>1. Provide planting materials to different stakeholders particularly farmers and community organizations for plantation/cultivation.</p> <p>2. Conversion of 10ha land into cultivation of selected high value species.</p>	<p>Planting materials provided to farmers, numbers of training programme organised and area covered under cultivation.</p>	<p>To initiate and strengthen the cultivation of selected species, 175 villages of six hills district of Uttarakhand has been surveyed and more than 1 Lakh seedlings of different species have been provided to villagers/farmers of different 65 villages of high altitude areas of district, Bageshwar, Pithoragarh, Chamoli, Rudraprayag, Tehri Garhwal and Uttarkahsi</p> <p>To transfer the information regarding the selected MAP species, 14 one day and 04 two days field/cluster level workshop/plants distribution programmes has been organized. 01 two days field level exposure visit cum training programme of selected farmers has been organized to Ghesh villages of district chamoli which is developed as model village for cultivation of selected MAPs under project. Simultaneously number of exposure visits and educational tours for farmers and school students at Nature Interpretation Site (NIS), Baniyakund, Chopta, Rudraprayag has been</p>	

		<p>successfully organized.</p> <p>A total of 3353 farmers/ villagers/students/teachers/leaders (2116 Male and 1237 Female) from 09 district of Uttarakhand have been sensitized under programme. After regular interaction with farmers/villagers, out of proposed 10.0ha of land, about 12.5 ha of farmers land of 65 villages has been engaged/ covered under cultivation of selected MAPs under project.</p>	
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(*) As stated in the Sanction Letter issued by the NMHS-PMU.

2.3. Strategic Steps with respect to outcomes

Sr. No.	Particulars	Number/ Brief Details	Remarks/ Enclosures
1.	New Methodology developed	Agrotechnology of 4 selected species for cultivation in farmers fields has been developed.	The cultivation trail of the developed technology is remaining.
2.	New Models/ Process/ Strategy developed	Developed one new site as nature interpretation site and germplasm bank or <i>ex situ</i> conservation model for nature lover and as educational tourism spot at Baniyakund, Chopta (2460 m asl).	Approximate >5.0 lakh seedling of different selected species has been planted in the site. The maintenance and growth assessment work of the plants is going on. The established plants can be used as gene pool, propagation material and <i>ex-situ</i> conservation studies in long run.
3.	New Species	04 species has been	04 species namely, <i>Saussurea</i>

	identified	identified for development of cultivation technology (Agrotechnology)	<i>obvallata</i> , <i>Dactylorhiza hatagirea</i> , <i>Paris polyphylla</i> and <i>Malaxis muscifera</i> has been investigated for improving germination, field establishment and growth measurement.
4.	New Database established	To know the current cultivation status of high altitude medicinal and aromatic plants, 175 villages has been surveyed and baseline data has collected.	The data collected from 175 villages of six hilly districts of Uttarakhand will be helpful in in making strategy for expansion of cultivation area of high altitude medicinal and aromatic plants.
5.	New Patent, if any	Nil	
	I. Filed (Indian/ International)	Nil	
	II. Granted (Indian/ International)	Nil	
	III. Technology Transfer(if any)	1. Agro-technology and general information manual (Hindi & English) of 13 selected species have been developed and distributed among selected/ interested farmers during on and off farm workshop/ training programmes.	To share the scientifically proven technology/ knowledge with farmers, the developed and distributed Agro-technology and general information manual of selected species will help to farmers in gear up the cultivation and expansion of cultivation area for producing raw materials of selected species in bulk without any physical presence of experts/technocrats.
6.	Others (if any)	Nil	

2.4. Technological Intervention

Sr. No.	Type of Intervention	Brief Narration on the interventions	Unit Details (No. of villagers benefited / Area Developed)
1.	Development and deployment of indigenous technology	To promote the cultivation and conservation of 13 high altitude medicinal and aromatic plants species, and knowledge improvement of villagers towards MAPs, Village survey, seedlings development, organisation of on and off farm meetings, workshop, trainings and plants distribution programme has been organised time to time.	Total 3353 farmers/ villagers/students/teachers/leaders (2116 Male and 1237 Female) from 65 villages of 06 districts of Uttarakhand has been sensitized and benefited through project activities. 1.0ha of forest land developed as nature interpretation site and germplasm bank of sensitive selected species for nature lover and promotion of educational tourism.
2.	Diffusion of High-end Technology in the region	There is agrotechnology of several species are available with institute and to disseminate this knowledge upto villagers/farmers was very important link promoting cultivation.	To diffuse the information about available agrotechnology number of on and off farm meetings, workshop, trainings and plants distribution programme has been organised time to time.
3.	Induction of New Technology in the region	After mass level seed collection from the high altitudes areas, the selected species were grown and well established upto the transplanting stage at the Centre using different low cost and high tech facility.	The villagers/ farmers of the region were sensitized about all the low cost and high tech facility of plant propagation. According to geographical conditions of the region, mostly use of low cost polyhouse, shadehouse and polytunnel has been advised to various stake holders/farmers for plant propagation.

4.	Publication of Technological / Process Manuals	Information leaflets/manuals of 13 selected species have been developed for use of various stake holders/farmers.	To disseminate the available knowledge about agrotechnology of the selected species, information leaflets/manuals has been design and published for villagers/farmers distribution.
	Others (if any)		

3. New Data Generated over the Baseline Data

Sr. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data
1.	Over all 06 districts and 178 villages of Uttarakhand state have been surveyed and covered for execution of project activities. Information collected on status of medicinal and aromatic plants cultivation helps in improvement of expansion of existing area of cultivation in region.	In addition to previous cultivation of 1.0 ha to 4.0ha, approximate 12.5 ha of farmers land covered under cultivation of selected MAPs in 65 villages of 06 districts of Uttarakhand.	New data generated during the project period will be helpful for policy maker and government about knowing the current status of medicinal plants cultivation and income of farmers by MAPs cultivation.

4. Demonstrative Skill Development and Capacity Building/ Manpower Trained

Sr. No.	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	ST	Woman	Total
1.	Workshops/ Training/ Conference	04 off farm Induction workshop/ Training/ Conference and have been	To create awareness, improvement of their knowledge about cultivation and importance of valuable medicinal	19	18	65	102 out of 362 farmers/ villagers

		organized at HAPPRC, Srinagar (Garhwal).	and aromatic plants available in their surroundings.				
2.	On Field Trainings	14 on farm (Field/cluster level workshop/plants distribution & awareness programme have been organized in different areas of Uttarakhand .	To create awareness, improvement of their knowledge about plantation, easy availability of plants for cultivation.	130	27	937	1094 out of 2456 farmers villagers
3.	Skill Development	01 field level exposure visit cum training programme of selected farmers has been organized to Ghesh village of Chamoli district which is developed as model village for	To see and adopt the cultivation of medicinal and aromatic plants, the exposure visits was organised. During the visit villagers of Ghesh interact with visitors farmers and give them tips of large scale cultivation. The interaction between ghesh villagers and visiting farmers help in skill	02	05	06	13out of 33 farmer/ villagers

		cultivation of selected MAPs under project.	development of visiting farmers.				
4.	Academic Supports	08 educational tours have been successfully organized at Nature Interpretation Site (NIS) Baniyakund, Chopta.	To create the awareness among school children about importance of biodiversity, educational tours of school children were organized. This was also intended the promotion of educational tourism and conservation importance of valuable high altitude medicinal and aromatic plants.	20	-	208	228 Out of 444 students
	Others (if any)	02 Miscellaneous development Skills Programme	To interact with technical advisors of different NGO's and to gather the informations regarding technical issues during cultivation of MAP's at farmers field.	-	-	21	21 out of 58

5. Linkages with Regional & National Priorities (SDGs, INDC, etc)/ Collaborations

Sr. No.	Linkages /collaborations	Details	No. of Publications/ Events Held	Beneficiaries
1.	Sustainable Development Goal (SDG)	SDG aims in case of High Altitude Medicinal and Aromatic Plant to provide oppurtunities to farmers/stakeholders/tourists toward the conservation of MAPs through eco-sustainable Development. SDG works on behalf of farmers to provide them better economy with harmony of nature.	-	Farmers, NGOs, Research institutes, Forest dept. and other Govt. organisation, particulary schools.
2.	Climate Change/INDC targets	Since from the last two years continuous recordings of weather data of adjoining project areas is going on.	-	Farmers, NGOs, Research institutes, Forest dept and other Govt. organisation
3.	International Commitments	-	-	-
4.	Bilateral engagements	Many NGO's and herbal product making companies are being selected as a collectors of MAP's raw product with the various stakeholders, farmers etc.	-	Emami (P). Ltd., Dabur Ltd., and Human India etc.
5.	National Policies	Through the projects schemes for promotions of RET species are being done not only for fulfilling the project major objectives but these also covers many National policies for developing medicinal plants conservation areas (MPCAs) in Uttarakahnd state.	-	Farmers, Stakeholders NGOs, Research Institutes Forest dept. and other Govt. organisation.
6.	Others collaborations	-	-	-

6. Project Stakeholders/ Beneficiaries and Impacts.

Sr. No.	Stakeholders	Support Activities	Impacts
1.	Gram Panchayats	Trainings, Exposure Visits, Plants distribution, Cultivation	During the entire project period 18 on and off farm field /cluster/ Gram Panchayats level workshop/plant distribution programme has been organized in different cluster of Kumaun and Garhwal region onfarmers awareness about importance of medicinal and aromatic plants conservation and cultivation for additional income. The process of development of cultivation of medicinal and aromatic plants as strong livelihood and additional income source is still on progress.
2.	Govt Departments (Agriculture/ Forest)	14 field /cluster level workshop/plant distribution programme conducted in collaboration to near forest department on this field.	The process of development of cultivation of medicinal and aromatic plants is still on progress.
3.	Villagers	During the entire project period 3353 villagers/students/teachers (2116 Male and 1237 Female) have been sensitized and benefitted from 09 districts of Uttarakhand.	Regular conversation with farmers/villagers regarding strengthening and area expansion/development of cultivation of medicinal and aromatic plants is still on progress.
4.	SC Community	171 SC communities' farmers have been sensitized and benefitted from 07 districts of Uttarakhand.	“
5.	ST	50 ST communities' farmers	“

	Community	have been sensitized and benefitted from Pithoragarh districts of Uttarakhand.	
6.	Women Group	1237 Women farmers have been sensitized and benefitted from 06 districts of Uttarakhand.	“
	Others (if any)	-	

7. Financial Summary (Cumulative)

Sr. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	4345732.00	4345682.00	99.99%
II.	Travel	400000.00	393795.00	98.44%
III.	Expendables & Consumables	800000.00	718094.00	89.76%
IV.	Contingencies	313147.00	313147.00	100%
V.	Activities & Other Project cost	4268000.00	4018438.00	94.15%
VI.	Institutional Charges	-	-	-
VII.	Equipments	7500000.00	68,52,731.00	91.36%
VIII.	Other expenditure (Bank Charges)	-	633	
	Total	1,76,26,879.00	1,66,42,520.00	94.41%
	Interest earned	839644.00		
		(Total bank interest was accrued Rs. 1239297 in received grant and out of this Rs. 399653 was adjusted by NMHS-PMU in IInd installment of the project grant)		

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

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

Sr. No.	Name of Equipments	Cost (INR)	Utilisation of the Equipment after project
1.	Automatic Weather Monitoring System	11,84,129.0	Recording of weather information of the project site.
2.	Seed germinator	5,84,100.0	Germination of seeds of selected plant species.
3.	SS field distillation Unit	2,98,000.0	Extraction of essential oil from different aromatic plants.
4.	Shadehouse	3,30,000.0	Growth and development of shade loving seedlings/plants like <i>Parispolyphylla</i> , <i>N. jatamasi</i> etc. in different climatic conditions.
5.	Polyhouse	3,90,000.0	Early germination of Seeds and seedling growth in field condition.
6.	Prefabricated Detachable Temporary Hutment	9,95,000.0	Field laboratory and accommodation for project staff during their stay in field.
7.	Photovoltaic Power Generating System	12,87,000.0	For operating and handling of Open Top Chambers data.
8.	Open Top Chambers	14,85,000.0	Assessment of effect of elevated/ increased CO2 concentration on growth and yield of selected species.
9.	Laminar Air Flow	2,47,800.0	<i>In-vitro</i> propagation of selected plant species.

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

9. Quantification of Overall Project Progress

Sr. No.	Parameters	Total (Numeric)	Remarks/ Attachments/ Soft copies of documents
1.	IHR States Covered	01Uttarakhand	Overall 09 and particularly 06 districts and 175 villages have been surveyed/ covered under project of uttarakhand for execution of project activities and information collection regarding to current status of medicinal and aromatic plants during the entire

			project period. (Attached along with maps)
2.	Project Site/ Field Stations Developed	01	In addition to Alpine Research Station, Tungnath, more than 1.0 ha of land has been acquired from forest department and Ushada Vanpanchayat and developed as nature interpretation site / educational tourism spot at Baniyakund (2460 masl), Chopta.
3.	New Methods/ Modeling Developed	-	-
4.	No. of Trainings arranged	04	04 Trainings programme arranged at HAPPRC, Srinagar for the purpose of improving the knowledge of villagers/ farmers about cultivation and importance of valuable medicinal and aromatic plants available in their surroundings.
5.	No of beneficiaries attended trainings	362	361 participants (297 male and 65 Female) attend the programme.
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	10*	10 manpower developed during the entire project period (2 Research Scientist, 03 JPF and 06 Office attended/Field assistant).
7.	SC stakeholders benefited	171	Regular conversation with different stakeholders, regarding the strengthen and development of cultivation of medicinal and aromatic plants as strong livelihood option and as additional source of income is still on progress.
8.	ST stakeholders benefited	50	-do-
9.	Women Empowered	1237	-do-

10.	No of Workshops Arranged along with level of participation	14	2456 farmers/ villagers/students/ teachers leaders (1519 Male and 937 Female) from 06 district of Uttarakhand states attended the field level awareness workshops.
11.	On field Demonstration Models initiated	(attach maps about location & photos)	(Attached Appendix -1)
12.	Livelihood Options promoted	-	Large scale cultivation of medicinal and aromatic plants has been promoted as strong livelihood option and additional source of income.
13.	Technical/ Training Manuals prepared	13	Information leaflets/manuals (Hindi & English) of 13 selected species were developed for distribution among various stakeholders and trainee farmers.
14.	Processing Units established	01 (attach photos)	Oil extraction/distillation unit for extracting essential oil from aromatic plants has been established at HAPPRC (Annexure-III) .
15.	No of Species Collected	13 (list attached)	Seeds of 13 selected species have been collected from different high altitude areas and Alpine Field Research Station, Tungnath.
16.	New Species identified	04 species has been identified for development of cultivation technology (Agrotechnology)	04 species, namely, <i>Saussurea obvallata</i> , <i>Dactylorhiza hatagirea</i> , <i>Paris polyphylla</i> and <i>Malaxis muscifera</i> has been investigated for improving seed germination, field establishment, growth and agro technology.
17.	New Database generated (Types):	-	The process of development of database regarding to conservation and cultivation of MAPs is continuously in progress.

Others (if any)	-	
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***Current Project Staff Information**

Sr. No.	Name	Qualification	Designation
1.	Dr. Y.M. Bahuguna	Ph.D.	Research Scientist
2.	Mr. Pardeep Dobhal	M.Sc.	Senior Project Fellow
3.	Mr. Jaidev Chauhan	M.Sc.	Junior Project Fellow
4.	Mr. Subham Bhatt	Intermediate	Office/Lab Assistant
5.	Mr. Girish Nautiyal	Intermediate	Field Assistant
6.	Mr. Kuldeep Singh	Intermediate	Field Assistant

10. Knowledge Products and Publications

Sr. No.	Publication/ Knowledge Products	Number		Total Impact Factor	Remarks/ Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:	01 Current Science			Effect of elevated CO ₂ on early flowering in high altitude plants
2.	Book Chapter(s)/ Books:	Nil			
3.	Technical Reports	-			
4.	Training Manual (Skill Development/ Capacity Building)	13			Training manual published on agro-technology of selected species for farmers distribution which has helpful in promotion of cultivation of selected species.
5.	Papers presented in Conferences/Seminars	02			
6.	Policy Drafts/Papers	-			
7.	Others:	01	-	-	Participated in Krishi

Sr. No.	Publication/ Knowledge Products	Number		Total Impact Factor	Remarks/ Enclosures
		National	International		
					Mela with collaboration of Uttarakhand ILSP Project.

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

Publication List:

1. Sudeep Chandra, Vaishali Chandola, M.C. Nautiyal, V.K. Purohit (2020) Elevated Co₂ causes earlier flowering in an alpine medicinal herb *Aconitum heterophyllum* Wall. *Current Science*, Vol. 118, No. 11, PP- 16-5-1651.

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

Particulars	Recommendations
Utility of the Project Findings	<p>The work performs in project on capacity building of villagers/ farmers towards cultivation practices will be very useful for large scale cultivation of selected medicinal and aromatic plants in Uttarakhand.</p> <p>The new site established as nature interpretation site and germplasm bank of selected species will be useful for nature lover as well as further research on selected MAPs in near future.</p> <p>The established germplasm of selected species can be useful for seed formation and multiplication of plants.</p> <p>The <i>ex situ</i> germplasm of different selected species established at Baniyakund, Chopta will be helpful in conservation and increase of <i>in situ</i> plants population.</p>
Replicability of Project	<p>The large scale cultivation of selected species can minimize or check the over exploitation of the species from wild, full filled the high industrial demand of raw material and generate the additional income of villagers/ farmers. To ensure the all, the cultivation models developed in project will be definitely replicating other hill districts/states of India as well as in other countries of same climatic conditions.</p>

Exit Strategy	<p>Please describe the Exit Strategy of the project, self-sustaining and benefitting the stakeholders and local community:</p> <p>After the successful execution of project objectives, the Area occupied for establishment of gene pool, propagation, multiplication and <i>ex-situ</i> conservation of selected sensitive medicinal and aromatic plant species get fully developed. Simultaneously, villagers/ farmers aware trained and engaged in cultivation of medicinal and aromatic plants under project have to in position of saleing their raw material/ produce and getting additional income that time the project activities will be stop and work to be handover to institute for regular maintenance of the site by minimum use of resources. The developed area under project will be useful asset as conservation model for MOEF&CC/ GBPNIHESD, host Institute, different stakeholders of nearby areas as well as future generation in terms of education, research and extension of the existing bioresource, and will also indicate the sustainability of the model in long run. The regular supply of the planting materials and visit of the staff of the host institute in farmers/CBOs fields also sustain the activities in long run after funding ceases.</p>
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(PROJECT PROPONENT/ COORDINATOR)
(Signed and Stamped)

Place:.....(HEAD OF THE INSTITUTION)

Date:...../...../.....

(Signed and Stamped)