NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research Project Grant

NMHS Reference No.:	NMHS/MG-2016/005

Date of Submission:	2	4	0	9	2	0	1	9
	d	**d**	**m**	**m**	**y**	**y**	**y**	**y**

PROJECT TITLE (IN CAPITAL)

SUSTAINABLE USE OF SIKKIM HIMALAYAN BIODIVERSITY FOR SOCIO-ECONOMIC DEVELOPMENT OF MOUNTAIN VILLAGES WITH SPECIAL REFERENCE TO *Ophiocordyceps sinensis*, *Hippophae salicifolia*, *Docynia indica* AND *Rhus chinensis*: TECHNOLOGY DEVELOPMENT, ALTERNATIVE LIVELIHOOD AND CONSERVATION

Project Duration: *from* **(01.04.2016)** *to* **(31.03.2019**).

***Submitted to*:**
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NMHS-Final Technical Report (FTR) *template*

Demand-Driven Action Research Project

DSL: Date of Sanction Letter

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

Completion

DPC: Date of Project

3	1	0	3	2	0	1	9
d	d	m	m	y	y	y	y

Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	NMHS/MG-2016/005
ii.	Type of Project	Small Grant [ ] Medium Grant [√] Large Grant [ ]
iii.	Project Title	Sustainable use of Sikkim Himalayan Biodiversity for socio-economic development of mountain villages with special reference to *Ophiocordyceps sinensis*, *Hippophae salicifolia*, *Docynia indica* and *Rhus chinensis*: Technology development, alternative livelihood and conservation
iv.	State under which Project is Sanctioned	SIKKIM
v.	Project Sites (IHR States covered) (Maps to be attached)	SIKKIM
vi.	Scale of Project Operation	Local [√] Regional [ ] Pan-Himalayan [ ]
vii.	Total Budget/ Outlay of the Project	₹ 0.94196 (in Cr)
viii.	Lead Agency	SIKKIM UNIVERSITY
	Principal Investigator (PI)	DR. DHANI RAJ CHHETRI
	Co-Principal Investigator (Co-PI)	DR. ARUN CHETTRI DR. GHANASHYAM SHARMA DR. BHARAT KUMAR PRADHAN
ix.	Project Implementing Partners	1. Sikkim University 2. The Mountain Institute India 3. State Biodiversity Board, Govt. of Sikkim

	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	Dhani Raj Chhetri 9434368399 drchhetri@cus.ac.in

Project Outcome:

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

The state of Sikkim is very rich plant diversity and many medicinal plants are found in high altitude areas. However, only a few have been exploited commercially, lack of knowledge, technology, marketing channel etc. being the main constraints. The present project aimed to utilize the hitherto unused biodiversity components especially wild fruits for the uplift of mountain villages. The 4 species selected have not been utilized for any product development and no known research institute is working on this line. These are i). *Ophiocordyceps sinensis* Berk. (*Yartsa Gunbu*) *which* is highly prized in international market. Its collection and trade have improved the socio-economic status in some Himalayan regions, however, in Sikkim, the resource is untapped formally and therefore, there is a huge potential for its sustainable exploitation. ii). *Hippophae salicifolia* D. Don *(Achuk)* is an important medicinal plant and is effective in ameliorating lung problems, respiratory infections, high blood pressure, heart disorders, gastric ulcer, digestive disorders and memory loss. Though this is a multipurpose species, it is one of the least utilized locally. Therefore, this plant has the potential to bring about prosperity in poverty-stricken regions. *iii). Rhus chinensis* Mill. *(Bhakmilo)* has long been used by folk medicine practitioners for its therapeutic effects on diarrhoea, dysentery, liver, diabetes and inflammation and shows immense nutraceutical and pharmaceutical potential. iv). *Docynia indica* Decne. (*Mel*) plant yields wild edible fruit which is known for its great nutritive importance The fruit is used against blood dysentery, nausea and as an appetizer in the Sikkim Himalaya. For a long time the fruits of these plants are well known for the treatment of infectious diseases, digestive and it also showed hypoglycaemic and hypolipedmic effect. There has not been any thorough phytochemical and nutritional analysis of these fruits from Sikkim Himalaya, therefore, this project.

Objectives/ Aim:

1. Population and habitat assessment, ecological niche modelling and conservation of *Ophiocordyceps sinensis*, *Docynia indica* and *Rhus chinensis* in the Sikkim Himalaya
2. Impact of climate change on the ecology of the selected species
3. Value chain analysis, establishment of forward and backward linkages, and prospects of Access and Benefit Sharing of the selected species
4. Nutritional and nutraceutical analysis of *Hippophae salicifolia*, *Docynia indica* and *Rhus chinensis* for value addition of products
5. Extraction and development of marketable product from *Docynia indica* and *Rhus chinensis*
6. Development of Policy guidelines for the entire value chain by involving relevant government and other associated agencies

Methodology: Field survey in the study sites and Ecological Niche Modelling was undertaken for the study of population and ecology. The impact of climate change on the species was assessed through questionnaire survey on the people's perception, FGD and PRA. Value chain analysis was done through market survey and cost-benefit analysis. Nutritional analysis, was done by biochemical analysis of the fruits of *Hippophae salicifolia*, *Docynia indica* and *Rhus chinensis* and value added products were developed from the fruits of *Hippophae salicifolia*, *Docynia indica* and *Rhus chinensis* following standard protocols. Policy guidelines on the value chain of *Ophiocordyceps sinensis* was developed in collaboration with the relevant government and other marketing agencies through discussions, multi-institutional meetings and workshops.

Approach: Collaborative activities among the different partners as per the specific mandate of each partner. Multi-institutional consultations for development of policy, involvement of self-help groups and community based organizations for transfer of technology.

Results: Assessment of habitat and ecological niche modelling of the selected species. Developed propagation technology and transferred the same for *Hippophae salicifolia, Docynia indica* and *Rhus chinensis* to target beneficiaries. Development of value chain for *Ophiocordyceps sinensis*. Nutraceutical and phytochemical analysis of three fruits and value added product development from the fruits of *Hippophae salicifolia, Docynia indica* and *Rhus chinensis*.

Conclusion: Nutritional status of the target fruit species determined.. Propagation protocols developed and the saplings of the same distributed to the beneficiaries in order to conserve the species. Value added product developed for the economic benefit of the target people.

Recommendations: Collaboration with the Government of Bhutan and Nepal for evolving joint policy on *Ophiocordyceps sinensis.* Collaboration with the institutes in Nepal for development of value added products from the seeds of *Hippophae salicifolia*. Government of Sikkim should provide marketing facilities for the developed products.

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
1.	Population and habitat assessment, ecological niche modelling and conservation of *Ophiocordyceps sinensis*, *Hippophae salcifolia, Docynia indica* and *Rhus chinensis* in the Sikkim Himalaya	Filed survey and population assessment of *D. indica*, *H. salicifolia* and *R. chinensis*. Habitat suitability map through Niche Modeling developed for *Docynia indica.* Occurrence data for *R. chinensis* (RC) and *H. salicifolia* were collected from all districts of Sikkim. Ecological niche modelling has been developed and habitat identified for reintroduction of *H. salicifolia* and *R. chinensis.* Population data were collected for *O. chinensis* and ENM developed for the same
2.	Impact of climate change on the ecology of the selected species	1.Based on field observation and interaction with indigenous communities during FGDs and interviews the species namely *Rhus chinensis, Docynia indica* and *Hippophae salicifolia* are not impacted much by recent climate changes scenario, except some irregular fruiting due to erratic rainfall patterns 2. On the basis of our survey, it is found that natural regeneration of target species was good. 3. Tree growth and fruiting was as per phenological season 4. Fruit production per tree is same as before 5. Leafing and flowering is normal in our observations This concluded that the target species are climate-adaptive (unaffected by the climate change impacts) Similarly, some underutilized species from this part of Himalaya are unaffected by the climate change impacts

3.	Value chain analysis, establishment of forward and backward linkages, and prospects of Access and Benefit Sharing of the selected species	Value chain analysis for *O. sinensis* done Enclosure: 'A'
4.	Nutritional and nutraceutical analysis of *Hippophae salicifolia*, *Docynia indica* and *Rhus chinensis* for value addition of products	Proximate and nutritional analysis for *H. salicifolia*, *D. indica*, and *R. chinensis* completed). Both qualitative phytochemical analysis and Quantitative phytochemical analysis completed for *H. salicifolia*, *D. indica*, and *R. chinensis*. Anti-oxidant activity analysis completed for *H. salicifolia, D. indica*, and *R. chinensis* fruits. Enclosure-'B'
5.	Extraction and development of marketable product from *Docynia indica* and *Rhus chinensis*	Value added product developed from (*Hippophae salicifolia, Docynia indica* and *Rhus chinensis*) Nutritional analysis of Jam and Chuk developed from *D. indica* and *R. chinensis* completed. Enclosure-'C'
6.	Development of Policy guidelines for the entire value chain by involving relevant government and other associated agencies	Based on the field interaction with local communities and market survey, SWOT analysis were done and value chain up gradation strategies were recommended for *O. chinensis* Enclosure 'D'

2.3. Outputs in terms of Quantifiable Deliverables*

S. No.	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations made, if any, and Reason thereof:
1.	Habitat assessment and Ecological Niche Modelling methods developed.	Monitoring in comparison to the baseline information to be provided by proponent	ENM developed for all the 4 target species i.e., *H. salicifolia, D. indica, R. chinensis* and *O. sinensis*.	Nil
2.	Establishment and standardization of protocol for value added product development (*Hippophae salicifolia, Docynia indica* and *Rhus chinensis*) communities	No of communities benefitted (Nos).	Value added product developed from ((*Hippophae salicifolia, Docynia indica* and *Rhus chinensis*). Ninety households benefitted	Nil
3.	Standardization of propagation techniques for selected species.	Methods and knowledge products developed and published out of the projects (Nos.)	Habitat distribution model developed for *Docynia indica* using bioclimatic parameters, field survey and ENM tools. **Publications:** 1. Chettri A, Pradhan A, Sharma G, Pradhan BK and Chhetri DR : Habitat distribution modelling of seabuckthorn (*Hippophae salicifolia* D. Don.) in Sikkim, Eastern Himalaya, India. *Indian Journal of Ecology*,45 (2): 266-269 (2018) 2. Sharma GS, Chettri S, Pradhan BK, Chettri A and Chhetri DR: Indigenous knowledge and phytochemical screening of medicinal *chuk* from *Rhus chinensis*, *Docynia indica*, and *Hippophae salicifolia* in the Sikkim Himalaya. *Indian Journal of Traditional Knowledge*,	Nil

			18(2): 250-260 (2019). 3. Mahanta J, Chettri A, Pradhan A and Chhetri DR: Nutritional and antioxidant attributes of *Rhus chinensis*, an edible wild fruit from Sikkim Himalaya. (Communicated to *International Food Research Journal-31/01/2019*) 4. Sharma GS, Chettri S, Pradhan BK, Chettri A and Chhetri DR: General ecology, traditional knowledge and economic potential of *Rhus chinensis*, *Docynia indica*, and *Hippophae salicifolia* in the Sikkim Himalaya. (Book chapter *communicated to NMHS-2018).* 5. Chhetri DR, Rai S, Chettri A, Pradhan A, Pradhan BK and Sharma GS: Evaluation of phytochemical, nutritional and antioxidant potential of edible wild fruit, *Docynia indica* (Wall.) Decne. from Sikkim, Eastern Himalaya. (Book chapter communicated to NMHS-2018). 6. Bharat Kumar Pradhan, Ghanashyam Sharma, Bindhya Subba, Santosh Chettri, Arun Chettri, Dhani Raj Chettri, Aditya Pradhan: Commercialization of caterpillar fungus, *Ophiocordyceps sinensis* in the Sikkim Himalaya (India): People's perception and prospects. Communicated to Journal *Mountain Research and*	

			Development. 7. Developed Package of Practices for *Rhus chinensis* and *Docynia indica.* 8. Information brochure published on *Rhus chinensis*, *Docynia indica*, *Hippophae salicifolia and Ophiocordyceps sinensis* in English and Local language (Encl: 'M' and 'N') 9. Dhani Raj Chhetri, Srijana Mangar, Aditya Pradhan and Arun Chettri. Report on the 'Findings on seabuckthorn in Sikkim Himalaya' (Encl: 'O'). 9. Research article entitled (tentative) "**Trade Chain Analysis of *Ophiocordyces sinensis* in Sikkim Himalaya, India: a potential bio-resources for Access and Benefit Sharing"** is being prepared.	
4.	Establishment and adaptation of mechanism of organic certification in collaboration with the Directorate of Organic Mission of Agriculture and Cash Crop Development Department, Government of Sikkim.	1. Propagation and processing techniques standardized as per the guidelines/manuals developed on *Rhus chinensis*, *Docynia indica* and *Hippophae salicifolia* (Number of species 03) 2. Farmer's organic farming certificate	1. Propagation techniques are standardized for *Rhus chinensis*, *Docynia indica* and *Hippophae salicifolia.* 2. Three nurseries established at: Bering (East Sikkim) for *R. chinensis*, Sumik-Khamdong (East Sikkim) for *D. indica* Lachen (North Sikkim) for *H. salicifolia*. 3. Government of Sikkim passed a resolution in year 2003 declaring organic farming as the base of state	Nil

			and the same came into effect from 2010 thereby declaring whole state as organic state. 4. After the implementation of organic policy in state cultivation of underutilized species is considered as organic farming. 5. A good coordination is being made with the Directorate of Organic Mission of Agriculture and Cash Crop Development Department, Government of Sikkim for developing a mechanism for availing of *Organic Certificates* to farmers in lieu of production of organic food items by them. 6. We are continuously in touch with the Department personnel for availing of this Certificate.	
5.	Policy guidelines for the entire value chain in collaboration with the relevant government and other marketing agencies.	The project helped in field implementation of "*Yartsa Gumbu* (*Ophiocordyceps sinensis*) Guidelines 2016". The local community in Lachen, north Sikkim were benefitted as they were offered double price for *O. sinensis* by the buyers comparatively. ABS agreement was signed and the benefit share is being transferred to the Local Biodiversity Fund	Pradhan BK, Sharma G, Subba B, Chettri S, Chettri A, Chettri DR, Pradhan A: Commercialization of caterpillar fungus, *Ophiocordyceps sinensis* in the Sikkim Himalaya (India): People's perception and prospects (communicated to *Mountain Research and Development*)	Value chain analysis of Docynia and Rhus was not possible as the species are the underutilized and are not in much use but through the project we tried to promote these species. The value chain analysis for *Hippophae salicifolia* is under process. It could not be completed on

		of the Lachen BMC. Revenue was generated for the state.		time because of other project commitments

(*) 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/ Enclosures
1.	New Methodology developed	Propagation technology developed for 3 species: *Rhus chinensis, Docynia indica* and *Hippophae salicifolia.* Value added products developed from the above species	Farmers manual for the propagation of *Rhus chinensis* and *Docynia indica* Enclosures: 'E' and 'F'.
2.	New Models/ Process/ Strategy developed	Ecological Niche Modelling developed for 4 species: *Rhus chinensis, Docynia indica, Hippophae salicifolia and Ophiocordyceps sinensis*	Ref. Research papers
3.	New Species identified	Nil	Nil
4.	New Database established	Baseline data created on the population, habitat suability, and nutritional attributes of *Rhus chinensis, Docynia indica* and *Hippophae salicifolia.* Policy guidelines formulated for *Ophiocordyceps sinensis*	As per research papers
5.	New Patent, if any	Nil	Nil
	I. Filed (Indian/ International)		
	II. Granted (Indian/ International)		
	III. Technology Transfer(if any)		
6.	Others (if any)	Nil	Nil

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	Indigenous technology for the production of Chuk (medicinal extract concentrate) from *Rhus chinensis* and *Docynia indica* recorded modified and transmitted at the village level. The same was done on the preparation of juice from *Hippophae salicifolia*	30
2.	Diffusion of High-end Technology in the region	Nutritional and phytochemical analysis of the fruits of of *Rhus chinensis*, *Docynia indica* and *Hippophae salicifolia* was done and the lab techniques transmitted to the scientific manpower. Preliminary nutritional analysis was also done on chuk from *R. chinensis* and *D. indica* as well as jam from *D. indica*	6
3.	Induction of New Technology in the region	Propagation technology and product development from *Rhus chinensis*, *Docynia indica* and *Hippophae salicifolia*	Enclosures: 'E' and 'F'.
4.	Publication of Technological / Process Manuals	Farmers manual for the propagation of *Rhus chinensis* and *Docynia indica*	Enclosures: 'E' and 'F'

4. New Data Generated over the Baseline Data

S. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data
1.	Habitat suitability data on target species	N/A	New data and useful in reintroduction of species for conservation
2.	Nutraceutical attributes	N/A	New data and useful in the product labelling

3.	Phytochemical charters	N/A	New data and useful in further research

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	4 awareness workshops and 2 multi-institutional brainstorming workshops	Farmers, traditional practitioners, BMC members, JFMC/EDCs, local community and Panchayats. In the multi-institutional brainstorming workshops, Forest officials, other line department, Sikkim Organic Certification Agency (SOCA), Sikkim Marketing Federation (SIMFED), NGOs, Research institutions, etc were involved	05	190	130	254
2.	On Field Trainings	12 village level community consultations	Beneficiaries , village elders etc.	11	30	48	77
3.	Skill Development	7 capacity building training held.	Beneficiaries , research personnel etc.	04	26	55	65
4.	Academic Supports	Lab facilities for the extraction of nutraceutical from wild fruits	Various villagers	0	05	01	06
	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)	Department of Forest environment and wild Life management, Govt., of Sikkim	02	90
2.	Climate Change/INDC targets	Community consultations held to assess the effect of climate change through people's perception	12	77
3.	International Commitments	Nil	N/A	N/A
4.	Bilateral engagements	Sikkim Organic Certification Agency and Sikkim Marketing Federation ltd. (SIMFED)	01	07 project personnel
5.	National Policies	National seminar organized at Sikkim University by the three project partner groups	01	145
6.	Others collaborations	Sikkim Organic mission under Agriculture Development Department and Horticulture Department	01	07 project personnel

7. Project Stakeholders/ Beneficiaries and Impacts

S. No.	Stakeholders	Support Activities	Impacts
1.	Gram Panchayats	Community awareness programme. Transfer of technology	Early building of trust with the beneficiaries
2.	Govt Departments (Agriculture/ Forest)	Policy development, marketing support, awareness regarding organic certification	Goal oriented implementation of projects. Provision of samples for analysis.
3.	Villagers	Community awareness,	Heightened awareness,

		maintenance of nursery, conservation of target species, product development and marketing	maintenance of ecological conditions, generation of employment and entrepreneurship
4.	SC Community	Community awareness, maintenance of nursery, conservation of target species, product development and marketing	Heightened awareness, maintenance of ecological conditions, generation of employment and entrepreneurship
5.	ST Community	Community awareness, maintenance of nursery, conservation of target species, product development and marketing	Heightened awareness, maintenance of ecological conditions, generation of employment and entrepreneurship
6.	Women Group	Community awareness, maintenance of nursery, conservation of target species, product development and marketing	Heightened awareness, maintenance of ecological conditions, generation of employment and entrepreneurship
	Others (if any)		

7. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	1504800	1469490	97.6
II.	Travel	500000	794844	158
III.	Expendables &Consumables	500000	480483	96.0
IV.	Contingencies	350000	479099	136.8
V.	Activities & Other Project cost	2180000	956652	43.8
VI.	Institutional Charges	Nil	Nil	Nil
VII.	Equipments	1600000	1516838	94.8
	Total	6634800	5697406	85.8
	Interest earned	213549		
	Grand Total	6848349	5697406	

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

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

S. No.	Name of Equipments	Cost (INR)	Utilisation of the Equipment after project
1.	Camera (1) (Nikon D-700)	Rs. 86999.39	Will be used by Sikkim University in the continuation of related study and other research programme
2.	Data logger (HOBO/MX1102)	Rs. 101181.36	
3.	Soxhlet Apparatus (Borosil/3840016/3840019)	Rs.23102.84	
4.	Digital balance (Sartorious/BSA224S-CW)	Rs.122513.00	
5.	GPS (GARMIN/78S)	Rs. 34099.00	
	Digital pH meter (Hanna Instrument/H198100)	Rs.9239.00	
	Laptop (Apple US/A1708)	Rs. 100000.00	Will be used by TMII for related research.
	Camera (Canon 77D)	Rs. 100000.00	State Biodiversity Board will use for related research

Details should be provided in details **(*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	01 (Sikkim)	4 districts of Sikkim, elevation ranging from 230-4200 m)
2.	Project Site/ Field Stations Developed	03	Sumik-Khamdong, Bering and Yuksom
3.	New Methods/ Modeling Developed	03	ENM for *R.chinensis, H.salicifolia, D. indica* and *O.sinensis* (Fig. 1)
4.	No. of Trainings arranged	07	At different districts of Sikkim
5.	No of beneficiaries attended trainings	65	On agro techniques, product development etc.
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	05	Trained at Sikkim University
7.	SC stakeholders benefited	15	
8.	ST stakeholders benefited	56	
9.	Women Empowered	103	
10.	No of Workshops Arranged along with level of participation	06	256 participants in total
11.	On field Demonstration Models initiated	12.... (attach maps about location & photos)	Fig-2
12.	Livelihood Options promoted	04	60 beneficiaries
13.	Technical/ Training Manuals prepared	02	For *D. indica* and *R. chinensis*
14.	Processing Units established	....Not specified in the project (attach photos)	
15.	No of Species Collected	04	*D. indica*, *Hippophae salicifolia, Ophiocordyceps sinensis* and *Rhus chinensis*
16.	New Species identified	*Nil*	*Nil*

17.	New Database generated (Types):	i.)Habitat suitability data and ii).Nutraceutical and phytochemical analysis data	*i). H. salicifolia, O. sinensis, D. indica* and *Rhus chinensis* *ii) H. salicifolia, D. indica* and *R. chinensis*
	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:	03		2.61	Enclosure: 'G', 'H' and 'I'
2.	Book Chapter(s)/ Books:	02			Enclosure: 'J' and 'K''
3.	Technical Reports				
4.	Training Manual (Skill Development/ Capacity Building)	02			Enclosure: 'L'
5.	Papers presented in Conferences/Seminars				
6.	Policy Drafts/Papers	01			
7.	Others: Information brochure	02			Enclosure: L

* 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 outcome will generate alternative livelihood options of the households involved and enhance their income level. In the process, more and more households will be involved in the cultivation and sale of the produce. The project will also encourage communities to develop Farmers Cooperatives and commercialization will be institutionalized and benefited. The agro technique developed will make cultivation strategy easier. The habitat modeling will be helpful in the introduction of the species concerned in suitable habitats for their conservation. The nutritional analysis data will aid in marketing of the produce.
Replicability of Project	This project is aimed at proving income and employment through cultivation and commercialization. It is expected that gradually more and more farmers will learn the know-how from their fellow farmers and replicate the activities. There is no problem regarding cultural acceptance as the project involves local resources and simple technology.
Exit Strategy	Please describe the Exit Strategy of the project, self-sustaining and benefitting the stakeholders and local community: Project activities will be implemented in consultation with state forest departments (SFDs), State Medicinal Plants Board, local non government agencies, traditional institutions, civil society and private sector. The project implementing institutes will provide future support regarding beneficiary awareness, transfer of technology and marketing support. The investigators will work in collaboration with Sikkim Organic Mission for organic certification even after the project is over. The Department of Botany Sikkim University. Once the community takes the initiative and their capacity enhanced with proper extension services the BMCs in lower altitudes and *Dzumsa* in North Sikkim will take the lead to continue with the cultivation and commercialization. The sustainability of the project will be high when there is higher participation and involvement of the communities. However, new self help groups will be continuously encouraged to take up similar activities and periodic monitoring will be done by the institutes to spread the activities. When a critical mass of production level is reached the State Government will be encouraged to set up a small processing unit.

(PROJECT PROPONENT/ COORDINATOR)

(Signed and Stamped)

Principal Investigator
Project No: NMHS/MG-2016/005
Department of Botany
SIKKIM UNIVERSITY
6th Mile, Tadong, 737102 Gangtok-Sikkim

Tej Kishan Kaul 24.9.19

(HEAD OF THE INSTITUTION)

(Signed and Stamped)

कुलसचिव
Registrar
सिक्किम विश्वविद्यालय
Sikkim University

Place: Gangtok
Date: 24/09/2019