NMHS-Himalayan Institutional Project Grant

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research and Demonstrations

NMHS Grant Ref. No.:	**GPBNI/NMHS-2018-2019/**

Date of Submission:	1	5	1	0	2	0	2	3
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PROJECT TITLE (IN CAPITAL)

CREATING CLIMATE-RESILIENT COMMUNITIES IN MID HILLS OF UTTARAKHAND: INTERVENTIONS TOWARDS FORESTS AND WATER

Project Duration: *from* (**21.02.2019**) *to* (**30.09.2022**).

***Submitted to*:**

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DSL: Date of Sanction Letter

Date of Project Completion

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

DPC:

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

Part A: Project Summary Report

1. Project Description

i.	Project Grant Ref. No.:	GBPNI/NMHS-2018-19/							
ii.	Project Category:	Small Grant	✓	Medium Grant		Large Grant			
iii.	Project Title:	Creating Climate-resilient Communities in Mid-Hills of Uttarakhand: Interventions Towards Forest & Water							
iv.	Project Sites (IHR States/ UTs covered)	Nainital, Uttarakhand (Site Map attached as **Annexure A**)							
v.	Scale of Project Operation:	Local	✓	Regional		Pan-Himalayan			
vi.	Total Budget:	0.46 (in Cr)							
vii.	Lead Agency:	Centre for Ecology Development and Research (CEDAR)							
	Lead PI/ Proponent:	Dr. Vishal Singh, Executive Director (Centre for Ecology Development and Research (CEDAR))							
	Co-PI/ Proponent:	Dr. Badrish Mehra (Central Himalayan Rural Action Group(CHIRAG)) Dr. Ghazala Sahabuddin (CEDAR) Dr. Anvita Pandey (CEDAR)							
viii.	Implementing Partners:	Central Himalayan Rural Action Group (CHIRAG)							
	Key Persons (Contact Details, Ph. No., E-mail):	Dr. Vishal Singh, Executive Director, Contact No.: 7906454173 E-mail: vishal@cedarhimalaya.org							

2. Project Outcomes

2.1. Abstract/ Summary

Background: Mountain springs are the primary source of water for both rural population of Himalayan region. A vast majority of population depends on springs as a primary and only source of water. As per a rough estimate, there are five million springs across India, out of which nearly 3 million are in the IHR alone. Despite the key role that they play, springs have not received their due attention, and many are drying up. Spring discharge is reported to be declining due to increased water demand, land-use change, and ecological degradation. With climate change and rising temperatures, rise in rainfall intensity and reduction in its temporal spread, and a marked decline in the winter rain, the problem of dying springs is being increasingly felt across the Indian Himalayan Region. CEDAR and CHIRAG have come forward in this initiative through NMHS to revive the Himalayan Springs and through field-based interventions and derive policy recommendations on the same. **Objectives/ Aim**: The main focus of the study was to strengthen the forest-water-community interlinkages by involving interaction amongst biophysical, social, and economic components. The project activities focused on understanding the ground realities through participatory socio- hydrogeological research and exploring solutions in consultation with community leaders and other stakeholders. Training of para hydro-geologists and women empowerment were key to the project. (i) Inventorization and status assessments of springs in the selected area. (ii) Assessment of environmental and anthropogenic impacts on springs discharge. (iii) Demarcation of critical water zones and rejuvenation through forestry, soil and water conservation methods. (iv) Developing climate adaptive water management solutions based on socio- economic and biophysical factors. (v) Developing para-hydrogeologists for spring management and conservation. **Methodology/ Approach**: In order to achieve the proposed objectives, the study was conducted in Mukteshwar region of Nainital district using a nine-step approach to carry out the spring recharge work. This holistic approach covered all the aspects of the work including implementation of the spring recharge activities, community mobilization, awareness and advocacy. Democratically formed Water User Committees (WUCs) were the nodal institutions solely responsible for successfully carrying out project implementation along with research staff, managing and mobilizing the community members and strengthening themselves in terms of capacity building. The nine-step approach included: 1. Feasibility Survey, 2. Baseline Survey, 3. Formation of Village Level Water User Committees (WUC), 4. Community Capacity Building, 5. Hydro-geological Survey, 6. Treatment Plan, 7. Implementation, 8. Advocacy and Awareness, 9. Monitoring and impact assessment. **Results:** The study was able to create an inventory of 8 springs in the Ramgarh Cluster of Uttarakhand, out of which 3 springs were selected for intervention based on a variety of factors viz. the need, dependency of the community, stakeholders, willingness to participate, and the scope to carry out the spring recharge activities. These three springs were revived using the nine-step methodology. The study also led to an enhanced understanding and awareness of springshed management and spring recharge work among the local community. Community members were trained as Para-Hydrogeologists in a variety of techniques including water discharge monitoring, water quality testing, etc. **Conclusion, and Recommendations**: Among the key learnings from the project was the need for sustainable mechanisms to be put in place for the longevity of such interventions. This study ensured the sustainability of the project by creating and training community youth leaders and key resource persons to ensure post-project operation and maintenance. A separate fund was also created by the community members for the operation and maintenance as well as to take up activities for spring recharge.

2.2. Objective-wise Major Achievements

S#	Objectives	Major achievements (***in bullets points***)
1	Inventorization and status assessments of springs in the selected area.	• 8 springs and villages geotagged. • Feasibility assessment of the three selected springs for springshed treatment completed. Household surveys were conducted to assess the dependency on each spring
2	Assessment of environmental and anthropogenic impacts on springs discharge	• 53 household surveys were conducted which included 156 men, 133 women and 148 children. Out of the total 355 beneficiaries, 32 beneficiaries belonged to the Scheduled Caste category. Water user committees were created, and village level training workshop provided to address pressure on springs. 1,112 hours of training imparted to 144 individuals.
3	Demarcation of critical water zones and rejuvenation through forestry, soil and water conservation methods	• Hydro-geological mapping was done to determine critical water recharge zones. • Vegetation cover was promoted in 4 ha of land through 2,500 plantations, Direct Seed Sowing. • Eradication of Eupatorium has been completed in the selected villages.
4	Developing climate adaptive water management solutions based on socioeconomic and biophysical factors	• Policy recommendations shared with stakeholders

5	Developing para-hydrogeologists for spring management and conservation	• Para hydrogeologists have been trained for implementation purpose and long-term data monitoring. • 6 Youth leaders were trained (out of which 50% were women). • 1 centralized capacity-building training was conducted for the identified para-hydrogeologists on Spring Discharge Monitoring, Geo-Hydrology and Water Quality Testing. • 2 Trainings cum Exposure visits were organized for the identified para-hydrogeologists, youth leaders and water user committee members to understand the on-ground spring recharge work and its impact

2.3. Outputs in terms of Quantifiable Deliverables*

S#	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations, if any, & Remarks thereof:
1	Inventorization and status assessments of springs in the selected area.	No. of New Database/ Datasets generated on the identified spring dynamics (No.)	• 8 springs were inventoried and a feasibility survey was carried out, through which, 3 springs were selected for recharge work. The database for the same is attached as **Appendix 7** to this report. Map of the springs inventorized under the feasibility survey is attached as **Appendix No. 4.**	None
2	Assessment of environmental and anthropogenic impacts on springs	No. of spring rejuvenation (No.)	Recharge activities were carried out in 3 springs selected via a feasibility survey.	None

	discharge			
3	Demarcation of critical water zones and rejuvenation through forestry, soil and water conservation methods		• Hydro-geological mapping of the three springs was done and recharge maps were created. Vegetation cover was promoted in 4 ha of land through 2,500 plantations, Direct Seed Sowing	None
4	Developing climate adaptive water management solutions based on socioeconomic and biophysical factors	Policy/ strategic framework/ drafts and Legislative Mechanisms (No.) in context of Water Security Action Plan;	• Policy Recommendations attached as **Annexure No. 6**.	None
5	Developing para-hydrogeologists for spring management and conservation	No. of Capacity Building (No. of Rural Youth, No. of SC/ST/Women, and Total No. of Beneficiaries);	• No. of capacity building workshops for KRPs - 1 • No. of on-field training cum exposure visits – 2 • Total beneficiaries of the project - 355 • No. of community members trained as para-hydrogeologists - 6 • No. of women trained as para-hydrogeologists – 3 (50%) **(Appendix 15)**	None

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

S#	Particulars	Number/ Brief Details	Remarks/ Attachment
1.	New Methodology/ Technology developed, *if any*:	6 steps methodology of ICIMOD, Nepal was detailed into 9 steps methodology which included strong community perspective	NA
2.	New Ground Models/ Process/ Strategy developed, *if any*:	NA	NA
3.	New Species identified, *if any*:	NA	NA
4.	New Database established, *if any:*	Database of 3 Springs in Ramgarh Cluster of Nainital District established.	NA
5.	New Patent, *if any*:	NA	NA
	I. Filed (Indian/ International)	NA	NA
	II. Technology Transfer, *if any*:	NA	NA
6.	Others, *if any*	NA	NA

Note: Further details may be summarized in DPR Part-B, Section-5. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

3. New Data Generated over the Baseline Data

S#	New Data Details	Status of Existing Baseline	Addition and Utilisation New data
1	Baseline data was collected for the 3 villages – Nathuwakhan, Gajar and Uchyura. Information such as Household data, livestock data and water usage per capita was collected.	No baseline existed prior to the project.	The new data collected during this project will help in planning future interventions in the region.

4. Demonstrative Skill Development and Capacity Building/ Manpower Trained

S#	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	**ST**	**Women**	**Total**
1.	Workshops	1	Dissemination of study findings			8	37
2.	On-Field Trainings	2	Training of the community to provide hands on experience.			13	24
3.	Skill Development	3	Capacity building training of the identified para-hydrogeologists in water discharge monitoring, water quality testing, etc.			-	9
4.	Academic Supports	4	Dissemination of study findings			**9**	**37**

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

S#	Linkages /collaborations	Detail of activities (No. of Events Held) *	No. of Beneficiaries
1.	Sustainable Development Goals (SDGs)/ Climate Change/INDC targets addressed	The study incorporates the “Catch the Rain” initiative of the Jal Shakti Abhiyan through promoting rooftop rainwater harvesting in the villages.	Local communities living in the selected villages.

6. Project Stakeholders/ Beneficiaries and Impacts

S#	Stakeholders	Support Activities	Impacts in terms of income generated/green skills built
1.	Line Agencies/ Gram	Group meetings with the	Consensus was reached

	Panchayats:	community members were organized with support from the Gram Panchayats.	among the community members regarding the use of private land and van panchayat land for recharge work, and community contribution to recharge work.
2.	Govt Departments (Agriculture/ Forest/ Water):		
3.	Villagers/ Farmers:	All recharge activities were planned and carried out with prior consent from all the villagers since large parts of the recharge zone came under private land.	The locals became more aware of the need to protect their natural resources. Rules were made among the community members regarding the use of the spring.
4.	SC Community:		
5.	ST Community:		
6.	Women Group:	Local women were trained as para-hydrogeologists and WUC members. They participated in recharge activities and also assisted the project team in carrying out hydro-geological surveys.	Women empowered as a result of these activities and have started taking more interest in the decision making processes regarding their natural resources

7. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	14,80,880	15,30,000	36.73%
II.	Travel	6,26,400	5,67,707	13.63%
III.	Expendables &Consumables	-	-	-
IV.	Contingencies	2,32,000	2,52,463	6.06%
V.	Activities & Other Project cost	13,72,700	10,28,419	24.69%
VI.	Institutional Charges	4,80,000	5,00,000	12.00%
VII.	Equipments	3,15,000	2,87,272	6.89%
	Total	**45,06,980**	**41,65,861**	**100.00%**
	Interest earned	56,231		
	Grand Total	**45,63,211**		

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*)

S. No.	Name of Equipments	Cost (INR)	Utilisation of the Equipment after project
1.	GPS - I	16,636	The equipment has been utilized for the purposes of the study. The Automatic Weather Station (AWS) will be used for further monitoring and data collection purposes.
2.	GPS - II	16,700	
3.	Laptop - Lenovo	37,400	
4.	Geological Hammer	13,629	
5.	Compass	3,182	
6.	Digital Camera	36,121	
7.	Automatic Weather Station (AWS)	93,975	
8.	Sign Board	15,695	
9.	Minor Equipment purchase by CHIRAG for trenching , fencing soil work and plantationwork	53,934	Forest Fire Management inCatchment Area
	TOTAL	**INR 2,87,272**	

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

9. Quantification of Overall Project Progress

S. No.	Parameters	Total (Numeric)	Remarks/ Attachments/ Soft copies of documents
1.	IHR States Covered	*1, Uttarakhand*	
2.	Project Site/ Field Stations Developed	*3 - Nathuwakhan, Gajar I, Gajar II*	*The detailed treatment plans for each project site are attached as* ***Appendix 1.***
3.	New Methods/ Modeling Developed	*NA*	*NA*
4.	No. of Trainings arranged	*4*	*Attendance sheets for the trainings attached as* ***Appendix 3.***
5.	No of beneficiaries attended trainings	*33*	*Attendance sheets for the trainings attached as* ***Appendix 3***
6.	Scientific Manpower Developed (Phd/M.Sc./JRF/SRF/ RA):	*NA*	*There was only a post for JPF under the project.*
7.	SC stakeholders benefited	*NA*	*NA*
8.	ST stakeholders benefited	*NA*	*NA*
9.	Women Empowered		*Details of the Water User Committees of the 3 villages along with participation from men and women is attached as* ***Appendix 13.***
10.	No of Workshops Arranged along with level of participation	*1*	*37* *Attendance Sheet for the Workshop – "Springshed Management – Learnings and Way Forward" attached as* ***Appendix 3.***

11.	On field Demonstration Models initiated	*Mandir Naula, Nathuwakhan*	*Mandir Naula, Nathuwakhan was developed as a demonstration model in the first year and later, the recharge work on the other two springs was carried out in a similar manner. The detailed treatment plans for each project site are attached as* ***Appendix 1***
12.	Livelihood Options promoted	**Livelihood opportunities were provided to the locals while the project was ongoing by engaging them in construction activities in the recharge zones.**	*The record of people employed under the project for recharge activities has been attached as* ***Appendix 16***
13.	Technical/ Training Manuals prepared	**1**	*Technical manual for training is being attached as* ***Appendix 5***
14.	Processing Units established	**NA**	*NA*

15.	No of Species Collected	**NA**	*NA*
16.	New Species identified	**NA**	*NA*
17.	New Database generated (Types):	**NA**	*NA*
	Others (if any)	**NA**	*NA*

Note: Further details may be summarized in DPR Part-B. Supporting materials may be enclosed as annexure/ appendix separately to the FTR.

11. Knowledge Products and Publications:

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:	*NA*	*NA*	*NA*	*NA*
2.	Book Chapter(s)/ Books:	*NA*	*NA*	*NA*	*NA*

3.	Technical Reports	3	*NA*	*NA*	Annual Technical Reports for the project submitted to NMHS.
4.	Training Manual (Skill Development/ Capacity Building)	1	*NA*	*NA*	*Training manual developed for para-hydrogeologists has been attached as* ***Appendix 5***
5.	Papers presented in Conferences/Seminars	*Manuscript in progress*	*NA*	*Water (3.530)*	*NA*
6.	Policy Drafts/Papers				
7.	Others:	*NA*	*NA*	*NA*	*NA*

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

Particulars	Recommendations
Utility of the Project Findings:	Since a large proportion of the geographical area of Uttarakhand is under forests, the recharge areas of springs are also under the jurisdiction of the Forest Department. Mechanisms to allow better collaboration between communities and the Forest Department needs to be looked at. In addition to springshed management, nature-based solutions such as Rainwater Harvesting should be encouraged in tandem for better preparedness and increased resilience against water crises.Incentive mechanisms between upstream and downstream communities in form of PES (Payment for Ecosystem Services) could be initiated.

Replicability of Project/ Way Forward:	The nine-step methodology used in the project has been developed by CHIRAG and is already used for the revival of 400 springs across Uttarakhand and Himachal Pradesh. Because of the flexible nature of methodology in terms of the treatment plan and recharge work, the methodology can be moulded to fit the specific requirements of each area where recharge work is being undertaken. Since the methodology focuses on community engagement, the needs of the locals can also be addressed.
Exit Strategy:	Capacity building of the community is an essential step towards ensuring the sustainability of the project. Mechanisms ensuring financial security of each Water User Committee (WUC) also need to be put in place. Moreover, it is important that all the beneficiaries feel a sense of responsibility and accountability towards their natural resources. During the project, a fund was created with each WUC to which each of the beneficiary households had to contribute. The WUC members have bene organizing meetings and handling the budgets for their respective committees since the start of the project. The identifies para-hydrogeologists have been trained in a variety of essential skills. Hence, the WUC's have been capable enough to continue monitoring and recharge work in the future,if needed.

Dr. Vishal Singh

(**PROJECT PROPONENT/ COORDINATOR**)

(Signed and stamped)

EXECUTIVE DIRECTOR
CENTER FOR ECOLOGY
DEVELOPMENT & RESEARCH

Dr. Vishal Singh

(**HEAD OF THE INSTITUTION**)

(Signed and Stamped)

EXECUTIVE DIRECTOR
CENTER FOR ECOLOGY
DEVELOPMENT & RESEARCH

Place: Dehradun

Date: 16/10/2023

PART B: PROJECT DETAILED REPORT

1 EXECUTIVE SUMMARY

Mountain springs are the primary source of water for rural households in the Himalayan region. For many people, springs are the sole source of water. For example, a major proportion of drinking water supply in the mountainous parts of Uttarakhand is spring based. Despite the key role that they play, springs have not received their due attention, and many are drying up. Spring discharge is reported to be declining due to increased water demand, land-use change, and ecological degradation. With climate change and rising temperatures, rise in rainfall intensity and reduction in its temporal spread, and a marked decline in winter rain, the problem of dying springs is being increasingly felt across the Indian Himalayan Region.

CEDAR and CHIRAG came forward in this initiative to revive the Himalayan Springs and through on field experiences demonstrate a policy-level inference. This collaboration looked at the Springshed Management techniques in a 9-step approach that CHIRAG has pioneered and work on building communities' capacities on the subject, apply a research based intervention to revive 3 springs and in tandem build community level youth leaders.

Broadly, four types of activities were undertaken under this project –

- **Participatory social- ecological research** with the aim of understanding the CC impacts and vulnerability; local issues, options and concerns. This component includes both social and ecological research and extensive interactions with local people. Social research focused on dependency on natural water resources and local problem identification by local people with the goal of assessing vulnerability. Hydrogeological research involved recharge zone mapping.
- **Community and government interactions/ consultations** to come up with workable solutions. Such consultations were undertaken through workshops with government officials and local people.
- **Implementation of key adaptation activities (as identified through participatory research and local consultations).**
- T**raining and capacity-building** of a chosen set of 'youth leaders' to take the project goals and ideas forward within each village. Youth leaders were given training for undertaking the participatory research/consultation components and then linked to implementation activities in the project site.

Specific attention was paid to the inclusion and involvement of community members, especially women at each step of the project. The community members were consulted throughout the decision-making process and were involved with the project team during the implementation phase as well.

2 INTRODUCTION

2.1 Background of the Project

Currently there is evidence to indicate that Himalayas are warming at a higher rate than the global average. It is a matter of great concern as (i) the region has more snow and ice than any other region in the world outside the Polar caps, (ii) Himalayas influence climate of much of the South Asia, and (iii) the Himalayan glaciers feed important river basins including the Gangetic basin, home to more than 500 million people. The criticality of sustaining the Himalayas therefore has local, regional, and global dimensions. Due to the impact of global warming the atmospheric temperature is increasing in a dramatic manner and has raised the surface air temperature of the Himalayan region by 1^0C[1]. Recent modeling studies suggest that even a rise in 1^0C, will result in severe impacts on forests, water and agriculture, through changes in agricultural productivity, forest productivity and biodiversity[2]. Impact on the people who depend primarily upon the forests and agriculture for their livelihoods will be particularly severe. A warmer climate in Himalaya will alter the hydrological cycle, enhancing extreme rainfall events and setting the stage for floods, droughts and landslides. Climate change is also likely to affect soil moisture regimes and patterns of ground water recharge and surface water flows. Along with the threat of global warming, forest degradation and deforestation will only worsen the decline of livelihoods and ecological security of hill communities.

The state of Uttarakhand has a special significance in the Himalayan region. It is central to the ancient civilizations that have flourished in and around the Gangetic basin, as well as in the Tibetan plateau. Millions of people live in the mountains, valleys, and hills of the Uttarakhand Himalaya and several times more people live in the basins downstream. The communities in the Tibetan plateau historically drew many resources from the Himalayas and the Terai. A large section of humanity therefore benefits from the water, forests, wildlife and other goods and services that originate in the mountains. Uttarakhand also boasts of a relatively stable forest-land use boundary with significant role for local communities (mandated by law) in forest and water conservation via the Van Panchayat (VP) system, Joint Forest Management and older traditions of nomadic pastoralism.

2.2 Overview of the Major Issues to be Addressed

In the mid-Hills of the Uttarakhand Himalayas, agriculture, animal husbandry and NTFP commerce are all strongly linked to forests and water security and approximately 78%[3] of the population practice hill agriculture. Most of the agriculturists depend heavily on forests for a large range of goods (both for subsistence and for cash) and the degree of dependency may increase with poverty level, due to lack of access to modern amenities. Moreover, the depletion of glaciers, increasing frequency of natural disasters, unsustainable use and degradation of watersheds are reducing water availability, changing seasonal flow patterns and increasing conflicts over dwindling natural resources. These adverse changes will be felt disproportionately by poor mountain communities, who currently have little capacity to cope with and adapt

to these changes. The role of the monsoon as the lifeline of regional agriculture may also be changing which will additionally affect biodiversity, agriculture, and hazard frequency. The fragility and inaccessibility of the Uttarakhand Himalaya, with scattered settlements and poor infrastructure, imply that these mountain areas will suffer most.

Besides warming, the Uttarakhand Himalayas are also experiencing dramatic change that is triggered by rapid economic growth, manifested in land use change, increased tourism and market linkages, changing employment patterns and increased commercial dependence on forests. Thus globalisation and increased mobility have exacerbated the marginality of the mountain valleys in some ways, though they have created new opportunities outside the region. However, our experience shows that marginalised sections of society in the hills are unable to take advantages of new opportunities while losing access to natural resources due to such depletion. More prosperous communities are more able to easily switch to market-based activities such as horticulture and tourism. Women, traditionally involved more in forest-based and household activities, are also bearing the brunt of resource depletion, as they have to work harder to obtain the same resources and maintain agricultural productivity.

There have been several projects conducted in the past on the impact of climate change in the Himalayan region. However, most of these are limited in their scope to one of either biophysical or socioeconomic factors. So far there has been little effort to connect across different critical sectors to develop adaptation strategies for the forest-dependent communities in the state of Uttarakhand, taking into account either traditional practices and or modern scientific knowledge. It has now become necessary to develop climate resilience in hill communities, which will also have benefits for regional ecological security as well as social stability in the hills. The project focuses on the major issue of water security facing the Himalayan communities today. It addresses the unfortunate state of the depleting water resources in the mountainous regions of the country and focuses on incorporating traditional knowledge into the solutions that can help empower the communities living in the region.

2.3 Baseline Data and Project Scope

Prior to this study, no formal baseline data existed for the three villages. As a part of the project, a baseline questionnaire survey, a structured questionnaire survey was conducted at the three villages, namely, Nathuwakhan, Gajar I and Gajar II among the beneficiary families of the three selected springs, i.e. Mandir Naula at Nathuwakhan and Gajar I and Gajar II springs.

The data includes the daily water usage for people and the livestock, water availability, water demand for domestic usage, water for livestock, and the landholding, cropping pattern, demography, socio-economic condition, and caste composition of the families directly dependent on the spring.

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

Project Objectives	Quantifiable Deliverables	Monitoring Indicators
• Inventorization and status assessments of springs in the selected area. • Assessment of environmental and anthropogenic impacts on springs discharge • Demarcation of critical water zones and rejuvenation through forestry, soil and water conservation methods • Developing climate adaptive water management solutions based on socio-economic and biophysical factors • Developing para-hydrogeologists for spring management and conservation	• Inventory of spring database in selected 3 villages with geo tagging in standard format • A Village Water Security Plan (VWSP) within clusters of 3 villages (SC dominated villages) for 2900 individuals in Nainital district, Uttarakhand. • Developing 10 Para hydrogeologists in 10 villages. • Revival of 10 ha of forest in catchment area. • Policy recommendation on Springshed conservation for future.	• No. of New Database/ Datasets generated on the identified spring dynamics • No. of spring rejuvenation • No. of Capacity Building (No. of Rural Youth, No. of SC/ST/Women, and Total No. of Beneficiaries); **(Appendix 9, 10, 11)** • Policy/ strategic framework/ drafts and Legislative Mechanisms (No.) in context of Water Security Action Plan; **(Appendix 6)**

3 METHODOLOGIES, STARTEGY AND APPROACH

3.1 Methodologies used for the study

CHIRAG has developed a nine-step approach to carry out the spring recharge work. This holistic approach covers all the aspects of the work including implementation of the spring recharge activities, community mobilization, awareness, and advocacy. Democratically formed Water User Committees (WUCs) are the nodal institutions solely responsible for successfully carrying out project implementation along with CHIRAG staff, managing and mobilizing the community members, and strengthening themselves in terms of capacity

building. These approaches are not only helpful in implementing the project activities but also provide adequate safe drinking water to the communities. It also creates a sense of ownership in the community towards their natural resources and the structure they built in the project period for water conservation through spring recharge activities. The list below outlines the approach:

i. **Feasibility Survey:** The potential to carry out the recharge activities for spring is assessed by studying a variety of factors such as the need and dependency of the community and different stakeholders on the springs, their willingness to participate, and the scope to carry out the spring recharge activities.

ii. **Baseline Survey:** A structured questionnaire survey called the baseline survey is carried out in the villages where springs are selected for recharge activities to understand the daily water usage of the community. The Secondary data on the annual precipitation and primary data on spring discharge are used to triangulate the findings of the baseline survey. Also, the land use data, animal husbandry, and population data are collected from the government organizations for comparison and triangulation with the primary data collected through the Baseline Survey to arrive at the water budget of the village. The litre per capita demand (LPCD) is calculated from the lean period discharge data and demography-based daily water consumption of the dependent households in the spring.

iii. **Formation of Village Level Water User Committees (WUC):** A democratic body called Water User Committee (WUC) locally referred as *Jal Upbhokta Samiti* is elected from the members of families using the spring water. Later the WUCs become the point of contact or nodal agency for spring recharge activities in the village. The WUC formation aims to give priority to the women to play a major role in the decision-making about their water resources by becoming an integral part of the committee because they are the ones who run around procuring water for drinking, cooking food and rearing animals, collecting fodder and water for the animals and doing agriculture in the villages.

iv. **Community Capacity Building:** Modules have been prepared for a series of interactive training on organization structure and roles, spring water discharge monitoring, hydrogeology, and water quality which CHIRAG conducts with the Water User Committee (WUC) members. The organizational training explains, among other things, the importance of opening and maintaining an operation and maintenance fund for the WUC.

v. **Hydrogeological Survey:** Simultaneously, a holistic hydro-geological survey is conducted where spatial data on the springs is collected; the underlying rock types, dip amount, dip direction and strike of bedrocks and fractures, the stream directions. Combined with the spring water discharge, spring water quality, and the regional rainfall data, the underlying geology of the hill being worked on and the potential recharge area is demarcated and the characteristics of the spring are hypothesized. Members of the Water User Committee (WUC) are involved in the whole exercise and are shown the procedure and the results, in the form of geological maps and conceptual layout of the hill, in order to generate interest and understanding.

vi. **Treatment Plan:** A detailed treatment plan is prepared in collaboration with the Water User Committee (WUC), which includes both proposing vegetative and engineering measures and activities according to the slope map and ground-truthing of the slopes by measuring the slope percentage and then activities are proposed and later marked with the lime powder and paint with the prior permission and No Objection Certificates(NOCs) from the Gram Pradhan and Private landowners (in case it is agricultural land).

vii. **Implementation:** The treatment plan implementation starts with calling for an open meeting called "*agree to do the meeting"* of the different stakeholders. The NOCs are obtained from private landowners and Gram Pradhan before activities are carried out by the Water User Committee (WUC). The progress is continuously monitored by the CHIRAG staff. The required measurement and rate of the work according to the measurement of the different recharge structures are conveyed to the community in the open *agree to do meeting***.** To create a sense of ownership, the WUCs are encouraged to contribute at least 30% of the total budget in the form of man-hours.

viii. **Advocacy and Awareness:** CHIRAG spreads awareness about springs at the different levels of the government machinery and community institutions, such as schools and colleges, allowing them to be apprised of the approach. CHIRAG and the members of the Water User Committee (WUC) also advocate the implementation of this approach to the government through a series of meetings and workshops at the village, district, and state levels.

ix. **Monitoring and impact assessment:** The spring discharge and its quality is continuously monitored to evaluate the impact of the program in terms quantity of spring discharge per minute across the seasons and the number of minutes it has saved for the women and men. The result thus obtained is assessed to further refine the selection of springs in the future.

3.2 Data collected and Equipments utilized

A feasibility study was conducted at 8 springs out of which, 3 were selected for the recharge work based on a variety of factors including the need and dependency of the community and different stakeholders on the springs, their willingness to participate, and the scope to carry out the spring recharge activities.

The lean period (May-June) discharge of Mandir Naula at Nathuwakhan was 0.665 LPM while the Monsoon (August-September) discharge was 7.6 LPM. The variable discharge and high dependency were one of the major factors for the selection of this spring. The LPCD of Mandir spring was found to be just 7.91 (0.665*60*24/121) which is far below the standard 55 LPCD(12th planning report of the Department of Drinking water and Sanitation) for an Indian citizen.

The minimum discharge of Uchyura Naula at Gajar I was **1.35 LPM** and the maximum discharge was **4.68 LPM**. The more or less stable discharge and high dependency were one of the major factors for the selection of this spring. The litre per capita per day (LPCD) availability of water at Uchyura Naula was just **11.64 (1.35*60*24/167)** which is far below against the national standard 55 LPCD for an Indian

citizen. In case of the Gajar Naula at Gajar II, the minimum discharge was **2.12** LPM and the maximum was 7.00 LPM. The more or less stable discharge and high dependency were one of the major factors for the selection of this spring. The litre per capita per day (LPCD) availability of water at Gajaar Naula-III is just **45.56 (2.12*60*24/67)** which is far below against the national standard 55 LPCD for an Indian citizen. The Feasibility Study data for the 8 springs is attached as **Appendix 7**. The data for water discharge and quality collected throughout the project is attached as **Appendix 12 and 14.** Later, Hydro-geological mapping of the three springs was conducted, based on which, detailed treatment plans were made. The Hydrogeological maps and Recharge Maps of the three springs are attached as **Appendix 4**. The Detailed Treatment Plans for each spring are attached as **Appendix 1**.

The list of equipment used during the course of the project is given below –

Equipment Name	**Quantity**
GPS	01
Laptop	01
Digital camera	01
Geological Hammer	03
Compass	03
Measuring Cylinder	03
Forest Fire Beater	18
Torch Headlight Plus	06
Whistle	42
Gas Mask	06
Fire Fighting Glass	03
Fire Helmet	03
Gown Apron	03
Fire Safety Gloves	06
Forest Boot	03
Bag	03
Dangri Suit	30
Spade	80
Spade Handle	80
Hand Rake	80
Rope	03
Sickle	11
Sickle	12
Kutli	32
Kutli Handle	32
Water Bottle	03

Rake-Big	35

3.3 Details of Field Survey conducted

As a part of the baseline survey, data such as the daily water usage per household, water availability, water demand for domestic usage, water for livestock, and the landholding, cropping pattern, demography, socio-economic condition, and caste composition of the beneficiary households was collected. The village profiles of the three villages are given below -

1 Table: Village profile - Nathuwakhan

Name of Gram Panchayat	Nathuwakhan
Revenue village	Nathuwakhan
Block	Ramgarh
Tehsil	Nainital
District	Nainital
State	Uttarakhand
Distance from Block HQ (Ramgarh)	10 Km by road
Distance from Tehsil HQ (Nainital)	45 Km by road
Elevation(Height above sea level)	1820 (Meter)
Average Annual Rainfall(Nainital)	1500 mm
Total no. of households Gram Panchayat	227
Total Population Gram Panchayat	1091
Main Caste Communities	Rajput
The total area of Gram Panchayat	300.63
Total no. of benefited population	121
Total no. of benefited households	18
BPL Category of benefited households	09
APL Category of benefited households	09

(Source: Revenue Department and CHIRAG Baseline Survey Data 2019 and Census 2011)

2 Table: Village profile – Gajar I

Name of Gram Panchayat	Gajar I
Revenue village	Gajar I
Block	Dhari
Tehsil	Dhari

District	Nainital
State	Uttarakhand
Distance from Block HQ (Dhari)	3 Km
Distance from Tehsil HQ (Dhari)	3 Km
Main Caste Communities	Rajput and Brahmins
Total no. of benefited population	167
Total no. of benefited households	22
BPL Category of benefited households	17
APL Category of benefited households	00
Antyodya Category of benefited households	05

(Source: Land Record data from Revenue Department and CHIRAG Baseline Survey Data, 2021)

3 Table: Village profile – Gajar II

Name of Gram Panchayat	Gajar II
Revenue village	Gajar II
Block	Dhari
Tehsil	Dhari
District	Nainital
State	Uttarakhand
Distance from Block HQ (Dhari)	3 Km
Distance from Tehsil HQ (Dhari)	3 Km
Main Caste Communities	Rajput and Brahmins
Total no. of benefited population	67
Total no. of benefited households	13
BPL Category of benefited households	08
APL Category of benefited households	03
Antyodya Category of benefited households	02

(Source: Land Record data from Revenue Department and CHIRAG Baseline Survey Data, 2021)

There is no irrigation facility available for agriculture in Nathuwakhan but people who are living close to the river have been irrigating their crops through the pipeline. Similarly, in Gajar I and Gajar II, there is no irrigation facility available but people still grow cash crops such as green pea and fruits of all kind found in Ramgarh area.

The baseline questionnaire survey, a structured questionnaire survey was conducted at the three villages, namely, Nathuwakhan, Gajar I and Gajar II among the beneficiary families of the three selected springs, i.e. Mandir Naula at Nathuwakhan and Gajar I and Gajar II springs.

The data includes the daily water usage for people and the livestock, water availability, water demand for domestic usage, water for livestock, and the landholding, cropping pattern, demography, socio-economic condition, and caste composition of the families directly dependent on the spring.

3.3 Strategic Planning for each Activities

A hydro-geological survey was conducted to understand the geological aspects of the spring such as rock typology, underlying rock direction, dip direction of the rock, dip amount, fracture lines, and fracture direction. Once the map of the recharge area of the spring was generated in QGIS, a KML file is generated and was used to produce the slope map for the recharge area of the spring. Arc GIS was used to produce a slope map where different color indicates the percentage slope on the ground.

Once the map of the recharge area of the spring was generated through the QGIS and Google Earth, the team visited the entire area of the springshed and measured the slope of the springshed. Recharge activities were proposed with the consent of the members of *Jal Samiti*.

The slope on ground is calculated as **(slope = vertical distance/ Horizontal distance x 100)**. The slope map so obtained was used to mark and propose different recharge activities such as the following could be carried out -

a) **Deep Recharge Pits (DRPs**) (1.2x1.2x1.2) cubic meter with rock filling which is covered with soil so that land remains useful for agricultural activities are built on private agricultural lands, a horticulture plant would be planted on entire pits after the filling of it and the canopy of plants will recharge it along with catchment.

b) **Roof Rainwater Recharge Pits** are built on houses that have been falling in the springshed area, where roof rainwater is directed into deep recharge pits of (3.0x2.5x10.5) cubic meters.

c) **Contour trenches** are built on fallow and barren land, which are the open digging structure, the aim of it to check the rainwater and enhance infiltration.

d) **Percolation pits –** are built on the 35-45 degree slope area, these are open digging structures.

e) **Assist to Natural Regeneration (ANR) -** The existent tree species in the recharge area nurtured and activities such as lopping, manuring, etc. are also carried out.

f) **Plantation –** Plantation activity is also carried out in the recharge zone.

Thus, detailed surveys were conducted in the recharge zones to propose appropriate recharge structures as mentioned above. But before proposing such structures, recharge maps were created and

meetings were carried out with WUC and the different stakeholders in an open meeting to discuss the work to be done. In the regions of gentle slopes (10-20%) Khaal, contour trenches pits were planned, and in the middle slope (20-30 %) percolation pits were planned. In areas of high slopes (30-50%) plantation activities and Assisted Natural Regeneration (ANR) activities were planned.

Activity wise Time frame followed

SN.	Activity	2019												2020												2021												2022											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Hiring of research staff																																															
2	Baseline Socio economic assessment																																															
3	Vulneability /Feasibility assessment of sites																																															
4	Procurement of equipments																																															
5	Identification of village level leaders																																															
6	Involvement of village level leaders																																															
7	Expert committee Meetings																																															
8	Project evaluation																																															
9	Hydro geological mapping of spring site 1 -Nathuwakhan																																															
10	Demarcation of critical water zones at site 1																																															
11	Discharge measurements of spring sites																																															
12	Spring shed treatment of spring site 1 -Nathuwakhan																																															
13	Roof water harvesting in Nathuwakhan																																															
14	Hydro geological mapping of spring sites 1 & 2 - Gajar I and II																																															
15	Demarcation of critical water zones at sites 1 & 2 - Gajar I and II																																															
16	Spring shed treatment of spring sites 1 & 2 - Gajar I and II																																															
17	Roof water harvesting in Gajar I and II																																															
18	Knowledge product development																																															
19	Inception workshop																																															
20	Village level meetings																																															
21	Final Workshop																																															
22	Technical and Financial Report																																															
23	Final Report																																															

4 KEY FINDINGS AND RESULTS

4.1 Major Research Findings

- Treatment and implementation work at 3 springs. Revived 10 ha of forest area in the spring catchment.
- 3 water users committee was made, one at each site. Village-level training provided to address pressure on springs. 53 household surveys were conducted including 156 men, 133 women, and 148 children. The total beneficiaries of the project implementation were 355 individuals.
- Training modules developed for springshed management and discharge monitoring.
- Livelihood options generated for community members during the implementation phase of the project.
- One demonstration model was developed for replication of the implementation activity.
- Institutional collaboration developed with the Forest Department Uttarakhand.

- Developed 6 para-hydrogeologist and 5 youth leaders.

- 200 plantations under Assisted Natural Regeneration were done with the help of villagers along with the eradication of Eupatorium in the selected villages.

4.2 Key Results

Outputs

1. Livelihood (Amount and number of people benefited) generated for community members during the implementing activities like construction of recharge pit, plantation, eradication of wild species and seed sowing activity etc.
2. A judicious, efficient, and organized system of water distribution created for utilization conservation, and management of water/springs with the help of capacity building and awareness program.
3. Plantation and seed sowing activity in the spring catchment area (plant species name) will help improve biodiversity, regeneration, soil conservation and forest cover.
4. Installation of AWS will help in maintaining the inventory of meteorological data of the study site.

Outcomes

1. Enhanced spring discharge through geo-hydrological investigation and treatment of springshed areas of the 3 selected springs, which will directly improve water security to the 3 remote, vulnerable communities in the Himalayas.
2. Water User Committee works as a democratic body and gives a sense of ownership to the community members.
3. Local women and other community members trained as key resource persons and `para-hydrogeologists', who will act as an enhanced pool of resource persons with the capacity to engage with and address issues in groundwater depletion and contamination.

Envisaged Impacts

1. Improved supply of drinking water and also reduced time and energy spent on collection of the same especially aiding in reducing the drudgery of women folk.
2. Springshed development and management-oriented activities can be used in the future to train community members by following the prepared modules for a series of interactive trainings on spring water discharge monitoring, hydrogeology, and water quality.

3. Strengthened local governance of springs through knowledge transfer on the science of groundwater.
4. Long-term climate observations will allow better research and decision-making.

4.3 Conclusion of the study (maximum 500 words in bullets)

Springs are the most important source of water for the rural and urban population residing in the Uttarakhand region. Springshed management is important to sustain spring-fed and glacial river systems for sustaining river flows. The Himalayan region has a fragile, complex, and diverse and complex geological structure; hence the spring systems of Uttarakhand are sensitive, and even the minutest of changes taking place in the biophysical environment through climate or anthropogenic activities could influence the spring flows. Several governmental and non-governmental organizations are working on the revival, conservation,and discharge improvement of springs through hydrogeological techniques. These organizations have enormous data on several important parameters on springs from different parts of Uttarakhand. Some organizations have made concentrated efforts to share data through knowledge products i.e. spring atlas, *dhara janampatri* and open access online portals, and other means. Scientific advancement in spring research has progressed at a slow pace and the focus on Traditional Knowledge (TK) on springs seems to be limited. Springshed management is highly interdisciplinary, for better understanding, experts from different fields such as Forest Hydrology, climatology, hydrogeology, data scientists, modelers, and social scientists need to join hands.Awareness of the importance of springs beyond those directly involved in spring shed management is low. Capacity building and involving communities is imperative for mapping and continuous monitoring of springs Fostering and facilitating partnerships and collaborations between different stakeholders is considered to be of paramount importance for springshed management.

5. Overall Achievements

5.1 Achievement on Project Objectives

Inventorization and status assessments of springs in the selected area.

8 springs were geotagged and a feasibility study was conducted to further identify the 3 springs for recharge work. The discharge rate of each spring was measured and the dependency of the local community on each spring was then assessed. Meetings were held in the target village to assess the willingness of the community to participate in the recharge work. Based on the above factors, three springs were identified for further study. The map of the 8 geotagged springs in the region is attached as **Appendix 4**.

Assessment of environmental and anthropogenic impacts on spring discharge.

A baseline survey was conducted in the target villages to understand the water usage patterns of the beneficiaries. Periodical water quality testing was also conducted in each of the springs to understand

the kind of pollutants present in the spring water. According to the results of the water quality testing, meetings were organized with the community members to analyze their daily activities and come to a consensus on how these activities could be altered in order to protect the springs.

5.2 Interventions

Demarcation of critical water zones and rejuvenation through forestry, soil, and water conservation methods.

Hydro-geological assessments were conducted to demarcate the recharge zones of the springs. Data was collected on different geological features such as underlying rock types, rock direction, dip direction and dip amount, stream direction, deposition, springs, and fractures. Representatives from the local community were also trained and involved in the process. The rock bedding and fractures and its direction are important aspects when we try to make geological maps for spring recharge activities because, in the Himalayan region rock foliation, folding and resultant fractures are the main carriers of groundwater.

After completing the field surveys, the data points from the Geological survey were added in QGIS and based on the dip direction of different rock types found in the survey, the layers of those rocks were drawn in the form of polygons. The dip directions of fractures were used to draw fracture lines while the direction of streams and spring location were used to identify the lowest point in the Potential recharge area of the spring catchment. All the features of the geological survey were used to produce the catchment of the spring. Finally, dominant fracture lines and rock layers were used to demarcate the potential recharge area for the spring.

Afterwards, a detailed survey was conducted in the recharge zones to propose appropriate recharge structures as mentioned above. But before proposing such structures recharge maps were prepared and meetings were organized with the WUCs and the different stakeholders to discuss the work to be done. In the regions of gentle slopes (10-20%) Khaal, contour trenches pits were planned and in the middle slope (20-30 %) percolation pits were planned. In areas of high slopes (30-50%) plantation activities and Assisted Natural Regeneration (ANR) activities were planned.

5.3 On-field Demonstration and Value-addition of Products, if any

Developing climate adaptive water management solutions based on socio-economic and biophysical factors.

The data from the baseline survey was triangulated with the spring discharge data to come up with a Village Water Security Plan for each village where other sources of water such as rooftop rainwater harvesting were also suggested to the locals in order to meet demand side.

Structures of rooftop rainwater harvesting were also constructed in the houses of some of the

beneficiaries as demonstration models.

5.4 Green Skills developed in in State/ UT

6 representatives from the beneficiary group were trained as para-hydrogeologists. A series of interactive trainings on organization structure and roles, spring water discharge monitoring, hydrogeology, and water quality testing were organized where various members of the WUCs participated. On field trainings were also conducted to show success stories of spring recharge work andits implementation on the ground.

5.5 Addressing Cross-cutting Issues

The main cross-cutting theme being addressed in this project is Climate Change. The project components address several issues, such as water scarcity and forests which are directly or indirectly influenced by changing climatic conditions. Apart from this the project specifically focuses and promotes nature-based solutions and climate adaptive practices at village level for better adaptation against changing climatic patterns. These practices range from rainwater harvesting to conservation of critical recharge zones and solutions for energy resulting in low emissions, reduced forest degradation and women health, the impact of changing climatic conditions would be much larger on women hence each component is designed in a gender sensitive manner.

Learnings from the project will be shared through different mediums targeting scientists and academicians (research publications), policy makers (policy briefs), rural communities of nearby villages, NGO's working on similar direction and other the general public (through social media platforms, documentaries and material published in local language). Print and electronic media will be adopted for sensitization and knowledge transfer.

6. PROJECT'S IMPACTS IN IHR –

6.1 Socio-Economic impact

One of the main aspects of the project was to ensure women's participation throughout the study. Spring recharge work is connected to reducing women drudgery as they're generally the ones who are responsible for fetching water for the household in the region. The WUC formation gave priority to the women to play a major role in the decision-making about their water resources by becoming an integral part of the committee because they are the ones who run around procuring water for drinking, cooking food, and rearing animals, collecting fodder and water for the animals and doing agriculture in the villages

6.2 Impact on of Natural Resources/ Environment

200 plantations under Assisted Natural Regeneration were done with the help of villagers along withthe eradication of Eupatorium in the selected villages. Enhanced spring discharge through geo-hydrological investigation and treatment of springshed areas of the 3 selected springs, which will directly improve water security to the 3 remote, vulnerable communities in the Himalayas.

6.3 Conservation of Biodiversity/ Land Rehabilitation in IHR

Enhanced spring discharge through geo-hydrological investigation and treatment of springshed areas of the 3 selected springs, which will directly improve water security to the 3 remote, vulnerable communities in the Himalayas

6.4 Developing Mountain Infrastructure

A hydro-geological survey was conducted to understand the geological aspects of the spring such as rock typology, underlying rock direction, dip direction of the rock, dip amount, fracture lines, and fracture direction. Once the map of the recharge area of the spring was generated in QGIS, a KML file is generated and was used to produce the slope map for the recharge area of the spring. Arc GIS was used to produce a slope map where different color indicates the percentage slope on the ground.

Once the map of the recharge area of the spring was generated through the QGIS and Google Earth, the team visited the entire area of the springshed and measured the slope of the springshed. Recharge activities were proposed with the consent of the members of *Jal Samiti*.

6.5 Strengthening Networking in State/ UT

A democratic body called Water User Committee (WUC) locally referred as *Jal Upbhokta Samiti* is elected from the members of families using the spring water. Later the WUCs become the point of contact or nodal agency for spring recharge activities in the village. The WUC formation aims to give priority to the women to play a major role in the decision-making about their water resources by becoming an integral part of the committee because they are the ones who run around procuring water for drinking, cooking food and rearing animals, collecting fodder and water for the animals and doing agriculture in the villages.

7. EXIT STRATEGY AND SUSTAINABILITY

7.1 **Utility of project findings**

The project findings will be utilised for revival of other springs in the region. The information will be shared in open access on organisation's website. Policy recommendations will be provided based on the findings.

7.2 Other Gap Areas

Some of the ecological problems that have not been covered under this study but need immediate attention, as observed during the course of the project include –

- Fodder Scarcity - The majority of rural households in the state keep livestock with more than 70% ofthem owning at least one animal. Of the estimated 251.71 lakh mt. of fodder required per annum for the entire state, annual availability of fodder in Uttarakhand is only about 143.14 lakh mt. resulting in a shortfall of about 108.57 lakh mt.[5]
- Forest Degradation - 61% of the forest area in Himalayas experience varying levels of degradation. Oak-dominated forests provide multifarious societal and environmental benefits.

- Low agricultural yield - The contribution of agriculture to the state‘s domestic product is about 22 % (major contribution from plains) and the population dependent on agriculture for their livelihood is about 78 %.

7.3 Major Recommendations/ Way Forward

It is greatly realized across the world that community participation is essential in dealing with complex and multi-layered environmental problems. The community must be involved right from the planning phase of the project. This is a key step for leading a bottom-up change.

Sustainability of the project must be kept in mind at every step of implementation. The focus should be on empowering the local communities to ensure post-project operation and maintenance.

In order to convey the importance of springs, it should be added to the school curriculum. Regular training programs for communities and executors of developmental projects is required.

Since a large proportion of the geographical area of Uttarakhand is under forests, the recharge areas of springs are also under the jurisdiction of the Forest Department. Mechanisms to allow better collaboration between communities and the Forest Department needs to be looked at.

Post-project impact assessments and evaluation mechanisms must be put in place in order to continuously reevaluate and redesign the project based on the data and community feedback.

Providing locals with the resources to implement rooftop rainwater harvesting for their houses will not only help women but will also act as a backup water source during dry spells.

In addition to springshed management, nature-based solutions such as Rainwater Harvesting should be encouraged in tandem for better preparedness and increased resilience against water crises.

Rainwater Harvesting will be useful as communities will be encouraged to adopt a more sustainable and cost-effective mechanism for water security.

Incentive mechanisms between upstream and downstream communities in form of PES (Payment for Ecosystem Services) could be initiated.

7.4 Replication/ Upscaling/ Post-Project Sustainability of Interventions

One of the aims of this project was to build strong capacity within local communities for implementation of climate change adaptation solutions, particularly (a) in the nurturing and training of youth leaders and (b) strengthening of governance of van panchayats. The training also involved dealing with the administrative procedures and processes to take advantage of important government development schemes within Uttarakhand. Therefore, by the end of the project, local institutions and individuals were sufficiently empowered, and the incentive structures were strong enough, to take these ideas forward productively. We proposed to minimize CEDAR’s and CHIRAG’s roles by the end of the project period but will retain some local presence to continue providing advice and expertise as required by the experimental VPs. Further, the pilot projects, if successful, will form replicable models for further work in the larger project area.

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Dr. Vishal Singh

(**PROJECT PROPONENT/ COORDINATOR**)
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Date: 16/10/2023

Place: Dehradun