NITI Aayog

Report of Working Group I
Inventory and Revival of Springs in the Himalayas for Water Security

Contributing to
Sustainable Development in Indian Himalayan Region

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Cover photo: Kaila Bhaji Dhara, between Gangtok and Namchey, Sikkim

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Preface

The Himalayas are the largest and tallest mountain range in the world, spanning 8 countries viz., Afghanistan, Pakistan, China, India, Nepal, Bhutan, Bangladesh, and Myanmar and covering an area of about 43 lakh km^2. Nine major perennial rivers viz., Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Tarim, Yangtse and Yellow River have their origins in the Himalayas. More than 30 peaks of the Himalayas rise to heights of 7,620 m (25,000 ft) or more, including Mount Everest (8,848 m), the world's highest mountain. Nearly 1.5 billion people depend on the Himalayas for water, food and energy. The Indian Himalayan Region (IHR) spans 10 hill States viz., Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and two partial hill States – Assam and West Bengal. Nearly 50 million people reside in the IHR alone.

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, while in Meghalaya all villages in the State use springs for drinking, irrigation and for livestock. 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 winter rain, the problem of dying springs is being increasingly felt across the Indian Himalayan Region. A survey in Sikkim found that the water production has declined in half of all springs in the State – a dangerous sign that aquifers are depleting in a State which is almost entirely dependent on springs for drinking water. Similar effects are being observed in nearly all the mountainous regions of India. Besides, water quality is also deteriorating under changing land use and improper sanitation.

Of late, efforts to preserve and save springs from drying up and efforts to recharge them are gaining momentum. A few State governments, Civil Society Organizations (CSOs) and Non-Governmental Organisations (NGOs) are actively contributing towards programmes to promote awareness of the importance of springs, and to build capacities to protect, develop and manage "springsheds" across the country. At the community level, most spring protection efforts have a similar programmatic approach: mapping of springsheds through hydrogeology; restoration, protection and/or augmentation of recharge; monitoring and management of springs; and, dissemination, outreach and sharing of knowledge.

The success of spring restoration, and of the Springs Initiative hinges on the enthusiastic participation of all the entities concerned. Firstly, there are the communities that use springs. It is important that they are convinced of the need to conserve their springs, understand how it is done, and are willing to assume responsibility for managing their springs. In most cases, therefore, the demand for spring restoration needs to come from such communities. The crises surrounding water necessitates that spring water management be taken up at the regional scale. Handholding by and support of State and local governments are of

crucial importance. The fact that some of the success stories have been led by a few State governments clearly demonstrates the important role that they can play in effective mobilisation of resources and implementation of springshed management programmes. Such programmes have been participatory, involving local communities, NGOs, CSOs and implemented through a science-based management approach. These efforts must be replicated by other States too. Moreover, there is also an urgent need to take up a national level initiative focused on rejuvenation, restoration and management of Himalayan springs.

In order to bring the issue of springshed management to centre stage in the context of sustainable development in the Indian Himalayan Region, NITI Aayog, vide its notification No.P.12018/12/2016-RD dated 2 June 2017, constituted a Working Group on "Inventory and Revival of Springs of Himalaya for Water Security" as one of 5 thematic Working Groups for Sustainable Development of the Indian Himalayan Region. The broad objective of setting up of this Working Group was to take stock of the magnitude of the problem (drying of springs, spring water quality), review related policies across IHR to ascertain adequacy and gaps; review existing initiatives and best practices including inventorization and spring revival by different agencies across IHR, ascertain to what extent learning from all the best practices and some of the step-wise methodologies is being integrated into spring-related work and ways to strengthen it. Further, it is equally important to assess the challenges faced by the existing initiatives and suggest policy and practice action for the short, medium and long terms.

Several Agencies/Institutions have been part of this group. These include representatives of Department of Land Resources (DoLR), Government of India; Ministry of Environment, Forest & Climate Change (MoEF&CC); Central Ground Water Board (CGWB); Rural Management & Development Department (RM&DD), Government of Sikkim; Advanced Center for Water Resources Development and Management (ACWADAM), Pune, and International Centre for Integrated Mountain Development (ICIMOD), Kathmandu. The Department of Science & Technology (DST) was designated as the lead institution with Dr. Akhilesh Gupta, Adviser, DST as the convener to finalise a report on the theme.

Since the subject of Himalayan Springs entail a number of science, society and policy issues, there was need to involve and initiate consultation with many other stakeholders that include Ministries, Departments, national and State level institutions, NGOs, CSOs and individuals associated with the subject.

The first stakeholder consultation was convened on 8 August 2017 at the Department of Science and Technology. As many as 40 participants belonging to government, non-governmental and autonomous organizations attended. A number of recommendations emerged from the deliberations. The meeting also set up a drafting team to prepare the report based on inputs received from various stakeholders and team members.

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New Delhi
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As Convener of the Working Group I: Inventory and Revival of Springs in the Himalaya for Water Security set up by NITI Aayog, I would like to thank all individuals and institutions which participated in the stakeholder meeting on 8th August, 2017 for their valuable contributions and inputs for drawing up recommendations and preparation of this report.

I am indeed extremely indebted to **Dr. V.K. Saraswat**, Hon'ble Member, NITI Aayog for showing his trust on DST and undersigned by assigning the important task of convening the Working Group on Himalayan Springs and for his invaluable guidance and support. He has always been a source of inspiration to the Working Group.

I am also grateful to **Prof. Ashutosh Sharma**, Secretary, Department of Science & Technology for chairing the meeting of stakeholders and providing his constant encouragement and support without which the task could not have been completed.

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I am thankful to all the member institutions of the Working Group for responding to my request and participating in the deliberations. A number of other institutions and individuals who have been contributing to the springshed management work were also requested to provide their inputs and participate in the stakeholder meeting. I thankfully acknowledge their valuable inputs. I am extremely thankful to all the members of drafting team for their useful inputs and contributions.

I place on record my heartfelt appreciation and sincere thanks to **Dr. Himanshu Kulkarni** of ACWADAM who did a splendid job of coordinating, seeking inputs from drafting team and other stakeholders and developing a draft report. I also take this opportunity to thank Ms. Karishma Khadka who worked closely with Dr. Aditi Mukherji of ICIMOD and provided editorial assistance and helped in finalizing the report. I also thank Shri BMS Rathore for useful suggestions and discussions during the course of finalization of the report.

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At the end, I wish to thank all the scientists of SPLICE/CCP Division in DST especially my colleagues; **Dr. Nisha Mendiratta**, Scientist-G & Associate Head, **Dr. Susheela Negi**, Scientist-D and **Dr. Rabindra Panigraphy**, Scientist-C for providing their valuable support.

Akhilesh Gupta

Acronyms and Abbreviations

ACWADAM	Advanced Center for Water Resources Development and Management
ANCA	Api-Nampa Conservation Area
ATREE	Ashoka Trust for Research in Ecology and the Environment
BARC	Bhaba Atomic Research Center
BFEs	Bare Foot Engineers
BRLF	Bharat Rural Livelihood Foundation
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CEDAR	Centre for Ecology Development and Research
CGWB	Central Ground Water Board
CHIRAG	Central Himalayan Rural Action Group
CPWD	Central Public Works Department
CSOs	Civil Society Organizations
DoLR	Department of Land Resources
DPR	Detailed Project Report
DRDO	Defense Research and Development Organisation
DST	Department of Science and Technology
ECS	Eleutherian Christian Society
GBPNIHESD	GB Pant National Institute of Himalayan Environment and Sustainable Development
GCF	Green Climate Fund
GEC	Groundwater Resource Estimation Committee
GIZ	German Cooperation for International Development
GoI	Government of India
GSI	Geological Survey of India
HESCO	Himalayan Environmental Studies and Conservation Organization
HKH	Hindu Kush Himalaya
HSS	Himalayan Seva Sangh
HUC	Himalayan University Consortium
ICIMOD	International Centre for Integrated Mountain Development
IHCAP	Indian Himalayas Climate Adaptation Programme
IHR	Indian Himalayan Region
IIFM	Indian Institute of Forest Management
IIT	Indian Institute of Technology
KRP	Key Resource Person
LEDEG	Ladakh Ecological Development and Environmental Group
MBDA	Meghalaya Basin Development Authority
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoWR	Ministry of Water Resources
NABARD	National Bank for Agriculture and Rural Development
NGOs	Non Governmental Organizations
NIH	National Institute of Hydrology
NMHS	National Mission on Himalayan Studies
NMSHE	National Mission for Sustaining Himalayan Ecosystem
O&M	Operation and Maintenance
PGWM	Participatory Groundwater Management
POs	Partner Organizations

PRI	Panchayati Raj Institution
PSI	People's Science Institute
R&D	Research and Development
RM&DD	Rural Management and Development Department
SASE	Snow and Avalanche Study Establishment
SCI	System of Crop Intensification
SDC	Swiss Agency for Development and Cooperation
SDGs	Sustainable Development Goals
SHC	Spring Health Card
SWI	System of Wheat Intensification
VWSCs	Village Water and Sanitation Committees
VWSPs	Village Water Security Plans
WASH	Water, Sanitation and Hygiene
WIHG	Wadia Institute of Himalayan Geology
WLE	Water, Land and Ecosystem
WWF	World Wildlife Fund

Executive Summary

Springs are the main source of water for millions of people and their livestock in the 10 States and 4 hill districts of the Indian Himalaya Region (IHR). Both rural and urban communities depend on springs for their livestok and for the drinking, domestic, and agricultural water needs. There is increasing evidence that springs are drying up or their discharge is reducing throughout the IHR, and indeed, throughout the entire Hindu Kush Himalayan (HKH) region stretching from Afghanistan all the way to Myanmar. Erratic rainfall, seismic activity and ecological degradation associated with land use change for infrastructural development are impacting mountain aquifer systems. It is reported that half of the more than three million perennial springs in IHR States have either already dried up or become seasonal, resulting in acute water shortages across thousands of Himalayan villages. There are also concerns about the quality of spring water. There is dearth of scientific studies that estimate contribution of springs to base flow of large Himalayan rivers. It is evident that springs contribute a large share of base flow, and possibly more than glaciers, ice and snow.

In the past, most water conservation programmes in the IHR and elsewhere were based on the concept of watershed. A watershed is a unit of land where the rain that falls drains out through a common point; in other words, a watershed separates two drainage units. Watersheds are easy to demarcate and hold great appeal for policy makers and implementers alike. However, the watershed concept only accounts for surface water movement over slopes, while movement of spring water which is groundwater, is determined by underlying geology, and the nature and slope of such rocks underneath the surface. The concept of watershed, therefore, cannot account for water which travels outside watershed boundaries, through rock beds that slope towards an adjoining watershed. For spring revival, the appropriate unit is the springshed – the unit of land where rain falls (recharge area), and then emerges at discharge point, the spring. Given the folded and faulted nature of Himalayan geology, springsheds often cover more than one watershed; in other words, the recharge area of a spring in one watershed, may as well lie in an adjoining watershed and spring revival programmes have to be cognisant of this. This calls for a paradigm shift from watershed to springshed as an appropriate unit of intervention in the IHR. This misunderstanding of what constitutes springs, and how they are recharged, led to overall policy neglect of springs, and overall focus of India's groundwater policy remained focused around development of water sources like wells and tubewells in the plains.

In recent years, there has been an upsurge of studies and initiatives to address spring management in India, given the seriousness of the emerging crises around springs. These have been mostly community-centric initiatives that have looked at distribution rather than regeneration, although they have helped in mitigating the rural water crises to some extent. The concept of springshed management – that is management of the area of recharge of springs, down to the area of discharge, is now getting increasingly well-ingrained in the form of pilots of varying scales across the Himalayan States, and more recently in Bhutan and Nepal. The first systematic initiative was undertaken through the Dhara Vikas Programme by the Rural Management and

Development Department (RM&DD), Government of Sikkim, even as smaller pilots using the same concept were being undertaken across States like Himachal Pradesh, Nagaland and Uttarakhand as part of Forest Panchayats constituted under the Forest Act. The concept of springshed management entails that recharge areas be correctly identified through the use of simple field based hydrogeology and community knowledge and appropriate recharge measures are then undertaken to recharge springs. This report summarizes the step-wise methodology that has been developed and tested by various non-government organisations (NGOs) across the IHR. First developed as a planning tool under Dhara Vikas, the eight-step methodology is increasingly being used and customised through a variety of processes, e.g. the protocol of springshed management in different parts of the HKH through the ICIMOD-ACWADAM partnership.

The Working Group deliberated at length on the terms of references and expected outcomes of the group as outlined in the NITI Aayog's notification No.P.12018/12/2016-RD dated 2nd June, 2017 and came out with several general and specific recommendations. The most important recommendation of the group is to launch a National Programme on Regeneration of Springs in the Himalayan Region. The programme will entail several short, medium and long-term actions.

Short-term actions: Phase I – for first 4 years

The intensive phase (first four years) will essentially include launching the spring revival programme in one vulnerable block in each of the mountain States. This phase will include partnerships and collaborations designed to provide technical, financial and institutional support while building local capacity with the objective of adapting the programme to the local context and enable scaling up from this resource block from the fourth year onwards. Vulnerability will be defined on the basis of spring depletion in spring-dependent regions that are not supplied through piped water supply schemes, e.g. regions in the middle Himalayas with higher population density are likely to be more vulnerable than the higher Himalayas. Strong monitoring and evaluation with proper scientific instrumentation, with the involvement of local Block Development staff, educational institutions and NGOs, must be ensured so that the learnings from the programme are well documented. The outputs of the first phase would be trained manpower, experience in instrumentation, costing templates, training manuals with expertise and experience at the local level. These outputs must converge with specific requirements of the State as well as identifying national level policies needed to scale up such projects. This phase will involve the following broad set of activities:

- Systematic mapping of springs across the IHR States. As the process of springshed management unfolds in one block in every State, basic inventory of all springs must begin and be completed in the first phase itself. Survey of India, Forest Survey and Revenue Survey maps and satellite imageries will be used to develop digital maps and data base with a clear mandate on sound 'ground truth' evidence. The data base mandate should be very clear and apart from geotagged referencing, must include clear information on the discharge of the spring, water quality and dependency on the spring. A historical narrative on spring sustenance or depletion may also be provided.
- Creation of a web-enabled database/web portal on which the springs can be mapped/tagged. All State government departments, Research and Development (R&D) institutions and NGOs working on springs

and spring-shed management will upload data on the web-portal. The software will provide for reconciliation of the data and identification of problem sites and will enable access by the public.

- Capacity building activities, focusing on creation of a cadre of para-hydrogeologists will be needed and can be taken up through Skill India Initiative. Creating trained manpower through multiple partnerships and collaborations will form part of the first phase. The programme could be integrated with National Mission for Sustaining Himalayan Ecosystem (NMSHE) implemented by Department of Science and Technology (DST) and National Mission on Himalayan Studies (NMHS) implemented by Ministry of Environment, Forest and Climate Change (MoEF&CC), scientific institutions and Climate Change Cells in the Himalayan States set up under NMSHE.
- Organising a national level workshop for policymakers and decision-makers in order to sensitize them on the issue of drying-up of springs and the crucial role of spring-shed management in the overall development of the communities must become an annual event during this phase. International participation of experts from ICIMOD and other HKH countries like Bhutan which are implementing similar programs should be considered to share experiences.
- Awareness and education of communities regarding spring water management under a changing climate can play a crucial role in springshed management.

Medium-term actions: Phase II – 5th – 8th years

The knowledge – network phase of the following four years will involve handing over the programme to the State governments who can use existing funds (State budget, plus funds generated through Compensatory Afforestation Fund Management and Planning Authority (CAMPA)) to scale up this initiative to other larger areas, making it possible to reach as many springsheds as possible. Some States such as Himachal Pradesh, Uttarakhand, Sikkim, Meghalaya and Nagaland are already piloting spring-revival through a variety of programmes. This work could be leveraged for achieving some scale during the medium-term phase. Such initiatives could be integrated in land use plans that are suggested by other Working Group.

The programme should be integrated with the on-going development activities of the States, whether through dedicated springshed programmes or through a strong link-up with allied programmes such as Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). The programme would continue to provide scientific inputs and analysis, organize coordination workshops, exposure visits, documentation and function around the short-term pilots, as a knowledge and learning process under the programme. The detailed design and planning will have to be State specific and may therefore deviate from the broad aspects/guidelines given below.

- Mainstreaming and convergence of springshed management with other developmental programmes will be required to facilitate greater synergies with government schemes at this stage. For instance, a focus on forest quality in critical water recharge zones of springs is of great significance and such zones have to be protected. In such areas, where aquifer recharge is high, special efforts should be made to provide local communities with access to fuel for cooking (through better implementation of Ujjwala and other schemes) so as to reduce forest degradation. This will benefit recharge in these critical zones, while ensuring effective convergence. Similarly, recharge zones of most critical springs should be protected

from infrastructure development through appropriate policies.
- A digital atlas of springsheds could be developed as a clear output in the second phase. This would also help in the periodic assessment of groundwater resources in the country.
- Awareness and education of communities regarding spring water management.

Long-term actions: Phase III – Beyond 8th year

All springs and springsheds would need to be covered during the long-term phase, the duration of which can be decided at the end of the medium-term action plan. Standardisation of the springshed management process would be more or less established by the end of Phase II. However, resources will have to be mobilised for scaling up and reaching out to diverse geographies and communities in a challenging landscape. Hence, the idea of developing a proposal for the Green Climate Fund (GCF) on springshed management covering the IHR is suggested here, in order to access financial resources required for implementation on a large scale. Bhutan is preparing a similar proposal on springshed revival for the GCF. There are newer financial opportunities including development bonds that could be explored. Further, there is scope for mobilisation of resources through instruments such as NMSHE where spring-water conservation could also have a bearing on India's commitments under the global climate change regimes. Moreover, given the dependence of mountain communities on spring water for meeting their drinking water needs, springshed revival contributes to meeting commitments under the Sustainable Development Goals (SDGs), especially SDG 6 (including safe water). The link to SDGs could facilitate multi-stakeholder collaborations required for effective implementation of springshed management.

Indicative actions would involve:

- Linking the livelihoods of communities with interventions related to revival of springs in ensuring the sustainability of such interventions beyond the lifespan of the project.
- Building local institutions and institutional mechanisms for springshed management would include capacity building of communities to undertake such activities in the long-term and also equipping them to take up operation and maintenance. Establishment of a national registry for springs in the form of a Spring Health Card (SHC), to periodically evaluate the health of the springs in time and space could become an established practice to ensure sustained flow of information from one side and crucial guidance, facilitation and hand-holding from the other.
- Awareness and education of communities regarding springwater management.

A Detailed Project Report (DPR) would be needed for developing a National Programme as outlined above. A national level brainstorming will also be required for taking up such an initiative.

Background

NITI Aayog convened a meeting on "Sustainable Development in Mountains of Indian Himalayan Region (IHR)" under the chairmanship of Dr. VK Saraswat, Member, NITI Aayog on 7th April, 2017 to discuss the action agenda for sustainable development of IHR. A number of Ministries, organizations, institutions, Civil Society Organizations (CSOs) and NGOs participated in the meeting. NITI Aayog identified five thematic areas for deliberations. These include:

- Revival of Springs
- Sustainable Tourism
- Transforming Shifting Cultivation
- Building Skill and Entrepreneurship Landscape and
- Data for Informed Decision Making

After detailed presentations on each of these themes followed by deliberations and discussion, 5 Working Group were formed with a lead institution to spearhead the group to achieve the identified action points of each theme.

Following the above meeting, NITI Aayog vide its notification No.P.12018/12/2016-RD dated 2nd June, 2017 constituted 5 Working Groups on Sustainable Development in Mountains of Indian Himalayan Region. "*Inventory and Revival of Springs in the Himalaya for Water Security*" was one such thematic area identified by NITI Aayog. A few Agencies/Institutions have been identified as participants to this group. These include representatives of:

- Department of Land Resources (DoLR), Government of India;
- Ministry of Environment Forest and Climate Change (MoEF&CC);
- Central Ground Water Board (CGWB);
- Rural Management and Development Department (RM&DD), Government of Sikkim;
- Advanced Center for Water Resources Development and Management (ACWADAM), Pune; and
- International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.

The Department of Science and Technology (DST) has been designated as the lead institution with Dr. Akhilesh Gupta, Adviser, DST as the convener to finalise a report on the theme.

The broad terms of reference for the above Working Group are given below.

- To take stock of the magnitude of the problem (drying of springs, quality of water from springs).
- To review related policies across IHR to ascertain its adequacy and gaps.
- To review existing initiatives and best practices including inventorisation and spring revival by different agencies across IHR. Ascertain to what extent learning from best practices and 8 steps methodology is being integrated into spring work and ways to strengthen it.

- To assess challenges faced by the existing initiatives.
- To suggest policy and practice action in short, medium and long term.

The notification mentioned that the Working Group may have the liberty of co-opting other members as deemed fit to best suit the overall objective of the sustainable development of IHR. The Working Group may utilize the existing data available with government organizations, universities, research institutions, international organizations, etc, as enough data is available rather than doing fresh research for collecting data.

As per the above notification, the Working Group will submit their reports to NITI Aayog with a period of 3 months that includes a month period for inter-thematic consultations.

Soon after the receipt of NITI Aayog notification dated 2 June 2017, the immediate task was to map the institutions, organizations and individuals who are engaged in springshed management work in the country. Since the subject of Himalayan Springs entails a number of science, society and policy issues, there was need to involve and initiate consultation with a range of stakeholders that include ministries, departments, national and State level institutions, NGOs, CSOs and individuals associated with the subject. A list of such stakeholders who have been involved in spring water management research, training and work on the ground was drawn up for initiating the consultation. The list was prepared in 3 categories viz., Ministries/ government organizations and institutions; international organizations, and NGOs. The list is given below:

Ministries and Government Departments, Institutions

- NITI Aayog
- Ministry of Water Resources (MoWR)
- Department of Science and Technology (DST)
- Department of Land Resources (DoLR), Government of India (GoI)
- Ministry of Environment, Forest and Climate Change (MoEF&CC), GoI
- Geological Survey of India (GSI)
- Central Ground Water Board (CGWB)
- National Institute of Hydrology (NIH), Roorkee
- Wadia Institute of Himalayan Geology (WIHG), Dehradun
- Bhaba Atomic Research Center (BARC), Mumbai
- GB Pant National Institute of Himalayan Environment and Sustainable Development, Almora (GBPNIHESD)
- Snow and Avalanche Study Establishment (SASE), Defense Research and Development Organisation (DRDO), Chandigarh
- Indian Institute of Technology (IIT), Roorkee
- Rural Management and Development Department (RM&DD), Government of Sikkim
- Government of West Bengal

International Organisations

- International Centre for Integrated Mountain Development (ICIMOD), Kathmandu
- Swiss Agency for Development and Cooperation (SDC)
- German Cooperation for International Development (GIZ)

Non Governmental Organisations

- Advanced Center for Water Resources Development and Management (ACWADAM), Pune
- Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore
- People's Science Institute (PSI), Dehradun
- Central Himalayan Rural Action Group (CHIRAG)
- Grampari
- Arghyam
- Himmothan
- Bharat Rural Livelihood Foundation (BRLF)
- Prasari, West Bengal
- Himalayan Environmental Studies and Conservation Organization (HESCO), Dehradun

The next step was to identify issues concerning springshed management and the potential roles and contributions that these organizations/institutions can plan based on their expertise and experience. This exercise was important with the view that they could possibly be invited for consultations in their relevant areas of work. A broad categorization of work being undertaken by various organizations and institutions was then prepared as under-

- Mapping of springs – GSI, CGWB
- Data monitoring, background research – ICIMOD, NIH, WIHG, BARC, Kumaun Univ., HESCO, ATREE, IIT Roorkee
- Social and governance issues – ICIMOD, PSI, CHIRAG, Govts of Sikkim, Meghalaya, West Bengal; MoEF&CC, DoLR, Prasari, Himmothan; Eleutherian Christian Society (ECS), Nagaland
- Hydrological mapping – CGWB, ACWADAM, PSI, CHIRAG
- Springshed recharge – CGWB, States
- Resources – GIZ, BRLF, SDC
- Hydrological and social impacts – ICIMOD
- Capacity building – ICIMOD, SDC

After completion of the above exercise, a background note was developed outlining issues like, spring management that includes hydrological, hydrogeological, social and ecological aspects; magnitude of the problem; drying up and depletion of springs; contamination of spring water; revival and rejuvenation and inventorization; major gaps in practice and policy; best practices and success stories of springshed management in India; 8-step methodology for spring management and revival, etc. The background note was sent to all possible stakeholders for their comments and inputs. Thereafter, the first meeting of the

stakeholder consultation was then convened on Tuesday, the 8th August, 2017 in the Department of Science and Technology.

The meeting of the stakeholders was successful as almost all key institutions and individuals engaged in spring management attended the meeting and participated in the discussion. There was a clear consensus on developing a national springs programme. The meeting was opened by Prof. Ashutosh Sharma, Secretary, Department of Science and Technology. Dr. Ashok Kumar Jain, Adviser, NITI Aayog, Prof. SK Dube, Former Director, IIT Kharagpur, Prof. SP Singh, Former VC, HNB Garhwal University; Shri Mukul Sanwal Former JS, MoEF&CC; Prof. SK Dash, Emeritus Prof, IIT Delhi; Dr. Akhilesh Gupta, Adviser, DST, and representatives of a number of leading government institutions, Ministries , International organizations and NGOs attended the meeting. As many as 40 delegates participated in the above meeting.

The meeting deliberated various issues at length and brought out several recommendations covering a list of short, medium and long term actions that include; need for initiating a National Programme on spring management; an institutional mechanism; capacity building needs; organizing national and international events and building regional cooperation. A drafting committee for preparation of the report was also finalized.

Chapter 1
Introduction

Introduction – Setting the Context

The Indian Himalayan Region (IHR) is spread across 10 States and 4 hill districts Indian States stretching across a length of 2,500 km and width of 250 to 300 km. Besides the physical bearing of these mighty mountains the Himalayas are of great social, cultural and economic significance for the people of India. The IHR is home to over 50 million people who eke out their lives and livelihoods in these mountains. Most of northern India's river systems originate in the Himalayan region, fed either by glacial melt or the many springs that dot the mountainous landscape. The Himalayas, aptly known as 'the water tower of the earth', are therefore a major source of fresh water for perennial rivers such as the Indus, the Ganga and the Brahmaputra.

Springs are the main source of water for millions of people in the Himalayas. Both rural and urban communities depend on springs for their drinking, domestic and agricultural water needs. Most water supply schemes that have been laid in the areas have their origins in a spring. Table 1 provides a summary of information regarding the number of villages that report springs and the number of surface flow irrigation schemes, which actually originate from springs in various mountain States in India.

A dried-up spring during lean summer season (Photo: ACWADAM)

There is increasing evidence that springs are drying up or their discharge is reducing throughout the Himalayas. The Himalayan ecosystem is quite fragile and susceptible to several changes caused due to both natural dynamism and anthropogenic interventions. Erratic rainfall, seismic activity and ecological degradation associated with land use change for infrastructural development are impacting mountain aquifer systems. It is reported that half of the perennial springs have already dried up or have become seasonal resulting in acute water shortages across hundreds of Himalayan villages. If this crisis persists it will affect lives and livelihoods of millions of people in the mountains. A majority of the population of the IHR depends on natural spring water for their domestic and livelihood needs such as drinking water, sanitation and irrigation. This implies that with changing climatic conditions and rainfall pattern, a large number of villages, hamlets and settlements are facing potential drinking water shortages. In fact, thousands of villages reported acute drinking water shortage about 8-10 years ago, a figure that may be higher and even more relevant today.

While glaciers are generally considered to be the source of the mighty Himalayan rivers, most of them have their origin in the form of springs. The non-glacial rivers clearly show how hundreds of springs provide the flows in stream and river channels even during the dry season. Any significant depletion in such spring flows at river origins will surely impact the flow of rivers. Hence, high dependency on one hand and an increasing sensitivity to depletion on the other, make Himalayan springs greatly vulnerable in the current context, despite their being part of heritage, traditions and cultures in the region. It is important to recognise spring water depletion as a nationally pertinent problem and address it immediately.

Spring-fed spouts inside a temple in Kathmandu (Photo: ACWADAM-ICIMOD, Water, Land and Ecosystem (WLE) project)

and a spring in Ladakh with a symbol of its worship (Photo: ACWADAM _ Ladakh Ecological Development and Environmental Group (LEDEG))

Table 1: **Statistics of spring population across the Himalayan States**

State name	Number of villages with springs	Total number of villages	Percentage of villages which report having springs	Spring channel based surface flow irrigation schemes	Total number of surface flow irrigation schemes	Percentage of spring channel based surface flow irrigation systems
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Arunachal Pradesh	2,086	5,589	37.3	15	4,953	0.3
Assam	2,997	26,395	11.4	265	2,815	9.4
Manipur	1,405	2,581	54.4	0	516	0.0
Meghalaya	3,810	6,839	55.7	246	8,220	3.0
Mizoram	453	830	54.6	1,252	5,371	23.3
Nagaland	639	1,428	44.7	27	20,765	0.1
Sikkim	425	451	94.2	29	1,485	2.0
Tripura	141	875	16.1	2	341	0.6
West Bengal (only Darjeeling)	221	688	32.1	1	169	0.6
Eastern Himalayan States	**12,177**	**45,676**	**26.7**	**1,837**	**44,635**	**4.1**
Himachal Pradesh	2,597	20,690	12.6	29	11,655	0.2
Jammu & Kashmir	3,313	6,553	50.6	0	4,698	0.0
Uttarakhand	594	16,793	3.5	20,182	31,176	64.7
Western Himalayan States	**6,504**	**44,036**	**14.8**	**20,211**	**47,529**	**42.5**
All Himalayan States	**18,681**	**89,712**	**20.8**	**22,048**	**92,164**	**23.9**

Source: Col (2) and Col (3) are from District Census Handbook, 2011 of each district in a State, Col (4) is derived from Col (2) and (3); Column (5) and Col (6) are from 4th Minor Irrigation Census of Ministry of Water Resources (MoWR), GoI and Col (7) is derived from Col (5) and (6).

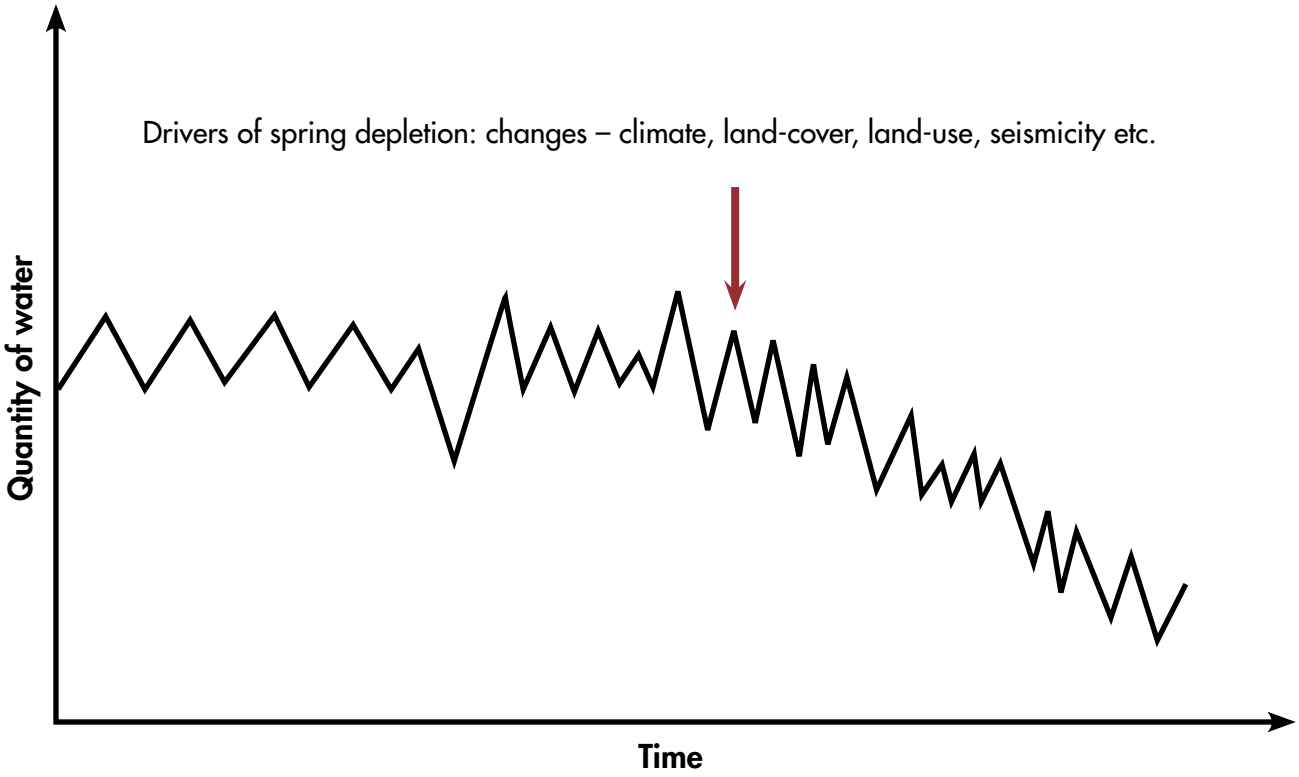
Note: The table is based on secondary data and is likely to be gross under-estimation because of the ways springs are defined, or not defined. Real-world estimates, both in terms of numbers and percentages are likely to be quite different from the figures in the table. For instance, it is hard to believe that only 3.5% of villages in Uttarakhand depend on spring water.

Chapter 2
Magnitude of the Problem – Major Issues and Challenges

Springs are the fundamental source of drinking water for the majority of the rural Himalayan population. Even the most conservative estimates state that 60% of the residents living in the region depend upon spring water. Villages and hamlets in the high altitudes are at a great disadvantage as most of the fresh water flowing through streams originating in the Himalaya is not readily accessible to them. People living in the lower reaches of mountains and the foothills of the Himalaya are more likely to benefit from such surface water flows in streams and rivers. The upland inhabitants, therefore, have trouble meeting their drinking water and irrigation needs. Nearly four fifth's of the Himalayan population is directly involved in agriculture. While 12.5% of total land area is cultivated, only 11% of the cultivable land is under irrigation, almost 64% of which is fed by natural springs.

There are over 60,000 villages in the IHR. With growing urbanisation, it is also imperative to consider the nearly 500 growing townships and 8-10 cities that are rapidly increasing the pressure on water resources in the region. Many growing urban centres also depend on springs and with the expansion of tourism there is an increasing gap between water demand and availability. Moreover, it is believed that nearly half of the perennial springs have already dried up or have become seasonal and tens of thousands of villages are currently facing acute water shortage for drinking and other domestic purposes. Nearly 60% of low-discharge springs that provided water to small habitations in the Himalayan region have reported clear decline during the last couple of decades. The number of functional springs in the Almora region, for example, has gone down from 360 to 60 over the last 150 years, a reduction to one-sixth, clearly a cause of grave concern.

Mountain environment systems have come into focus due to the value of their ecosystem services, their fragility and increased vulnerability to change. The Himalayas are not only the tallest mountain range in the world but also perhaps the most dynamic. Derived largely out of the plate tectonics of the collision or docking of the Indian and Eurasian Plates, the mountains are quite complex due to the interplay of topography, geology and constantly changing physiographic regimes. Hence, the Himalayas are not only fragile physical systems that are susceptible to constant movement of earth material but also vulnerable on many different counts. Further, the increasing push for development and a changing climate pose threats to the stability of such mountain systems and make natural resources such as groundwater constantly susceptible to such changes. While the major concerns may seem purely ecological, the protection and management of natural resources are strongly related to forestry, agriculture, livestock and other sectors. The environmental security of the population is strongly dependent on these resources for livelihoods. As a matter of fact, spring depletion has not only affected people, but has also had serious impact on forests and wildlife. Many natural watering holes for wildlife are in the form of springs and seeps. Depletion has led to



water insecurity inside forests and national parks and on their fringes as well. The problem, therefore, transcends the entire spectrum of dependents and dependencies, rural and urban to forests and wildlife.

It is useful to embed the growing problem of spring water depletion within the context of mountain environmental systems, including the reference to mountain aquifers. Springs have provided water to the mountain communities for centuries and the revival of this traditional source of water is extremely important for the region's sustainable growth. Moreover, as mentioned earlier, nearly every single river in India has its origins in springs, with the origins bearing not only a hydrological significance but also symbolising culture and heritage around spring water as the source of the revered Himalayan Rivers. Hence, springs and rivers enjoy a very close relationship that is reflected in innumerable ways. Any change in spring hydrology has clear ramifications on river hydrology, whether in the headwater regions, where springs manifest themselves as sources of rivers, or in the lower-reach plains of river systems where they contribute almost invisibly as base flows to river channels.

A large share of the groundwater flux ends up in springs and consequently in rivers. River rejuvenation will be incomplete without a clear focus on spring revival. At the same time, rivers are kept alive throughout the year, particularly in a monsoonal climate, primarily due to discharge from groundwater as springs and seeps along their river channels. The groundwater discharge from aquifers to river channels leads to the base flow in such rivers. Hence, spring water depletion, without our knowing it, affects flows in rivers and their revival holds great significance in the rejuvenation and restoration of rivers such as the Ganga, the Narmada, the Krishna, the Godavari and the Cauvery, not to mention the many smaller rivers that originate

in the mid-hills (900 to 2,000 m) of the Himalaya and confluence rivers like the Yamuna and Ganga. Moreover, while we tend to pay a lot of attention to the culture around our rivers, Himalayan culture attributes a high value to springs and many cultural activities are still prevalent around spring water. Any further inaction will not only lead to physical consequences in the form of spring depletion and contamination, but also to the erosion of the rich culture and heritage around springs and spring water across the entire Himalayan landscape.

Significance of springs in maintaining flows in the rivers throughout the year – Spiti Valley (Photo: ACWADAM-Ecosphere)

Depletion of spring water, unfortunately, has led to the development of many unsustainable and impractical alternatives. People resort to immediate coping mechanisms like transporting water using pack animals, bicycles, motorcycles and tankers especially during the lean season or during prolonged dry spells in drought years. The drudgery of women is particularly worth mentioning here; when village springs run dry, women are forced to manually carry water from springs below their village during the lean season. In effect, the cost of inaction is mainly borne by rural mountain women who are already overburdened with firewood and fodder collection, household chores and as caregivers to the family and livestock.

The alternatives to resolve the crises, through public investments, are not always effective. For instance, the proliferation of multi-village larger water supply schemes from springs/streams higher up in the mountain range will progressively become difficult to operate as springs dry up as a consequence of changing climate, land-use and land-cover. Similarly, multistage pumping schemes from rivers – often 1,000 metres below – may neither be feasible nor cost-effective for scattered villages and upslope, with dwindling base flow contribution to such a river as springs along its upper courses dry up.

Drudgery to women for collecting water from springs (Photo: ACWADAM-ICIMOD Godavari Project)

Depletion in spring discharge is not just a one-dimensional problem. In recent years, there has been increasing concern about the quality of spring water, but as with the rest of spring related issues, there is very little documentation regarding contamination of springs. Contamination originating from two different sources – geogenic and anthropogenic – can lead to deterioration of spring water supplies. Microbial

content, sulphates and nitrates are primarily because of anthropogenic reasons. Fluoride, arsenic and iron contamination is mainly derived from geogenic sources. For example, coliform bacteria in spring water may be derived from septic tanks, household wastewater, livestock facilities, and manure lagoons in the source area or in the aquifers feeding springs. Similarly, nitrate sources include septic tanks, household wastewater, agricultural fertilizers, and livestock facilities, or in some instances – natural deposits.

At a larger national scale, a gross estimate of nearly 200 million Indians depending upon spring water across what can be aptly labelled as the 'springscapes' of India – mainly the Himalayas, Western Ghats, Eastern Ghats, Aravallis and other such mountain ranges – implies that more than 15% of India's population depends on spring water. At the same time the Himalayas have not found due importance in mainstream programmes even as part of the larger national water management discourse. It is imperative that this gets corrected in the light of ensuring water security for all needs across India's diverse landscapes. The Himalayan region is clearly the largest 'springscape' representing a landscape that hosts the highest number of springs in the country. Springwater management provides not only an effective, eco-friendly and community-centric solution to correct the Himalayan Water Syndrome but seems the best approach for efficient, equitable and sustainable water management in the region called the 'water tower' of India.

Regional springscapes of the Himalayan Region, overlaid on a Google image (Photo: ACWADAM)

Chapter 3
Gaps in Knowledge, Practice and Policy

The magnitude of the problem is exemplified by the high dependency of Himalayan populations on spring water on one hand and the deteriorating status of springs on the other. The neglect of springs in the larger context of rivers, watersheds and aquifers is also a reason for great concern as it has led to large gaps in practice and policy in developing any strategic national response to spring water management in India.

First and foremost, springs are natural sources of water. Unlike wells that constitute human-made structures for groundwater access, springs cannot be pumped to extract water. While wells are human-made structures to access aquifers, springs are natural discharge points of the aquifer that provide access of water to people in their natural, often pristine state. It is perhaps this single reason that has kept springs out of policy or policies away from springs. Most of India's water policies were designed around the 'development' of water, whether in the form of large structures such as dams or in the form of sinking wells into the ground to create access to groundwater. Spring water emerges on to the surface naturally and therefore did not receive much attention. Moreover, much of the so-called 'development' of water occurs in areas that are flat or have gentle slopes and the perception that groundwater occurs in flatter areas than in lands that have steep slopes may have precluded the attention that springs deserved until the current crises emerged. In fact, the CGWB's periodic assessment of India's groundwater resources ignored springs because of the slope criterion of '20 percent'. This assessment states that areas bearing more than 20% slope will largely be out of the ambit of the national groundwater assessment which now stands rectified in the draft Groundwater Resource Estimation Committee (GEC) Methodology (2016). The current methodology has included the monitoring of springs with a special mention of 'hot springs' in different areas of the Himalayan Region.

The sections below highlight the major gaps around knowledge and consequently in the practice and policy around spring water.

Knowledge Gaps

- It may be obvious to many that springs represent groundwater discharge. However, they have hardly found a place in mainstream education that was as important as that accorded to wells and other aspects of groundwater. Hence, knowledge on spring hydrology remains limited to some centres, mainly in the ivory towers of higher education in different disciplines. Groundwater is the water that occurs and moves under the surface of the earth in saturated pore spaces of rocks or rock material. Aquifers are system of rocks/rock material, capable of storing and transmitting water to such springs and to wells. Springs are point sources of groundwater discharging from these aquifers. The extent of Himalayan aquifers, their geometry and hydrological parameters exhibit large variation influencing spring behaviour. Historically, and even in the more recent past, springs did not feature in the mainstream

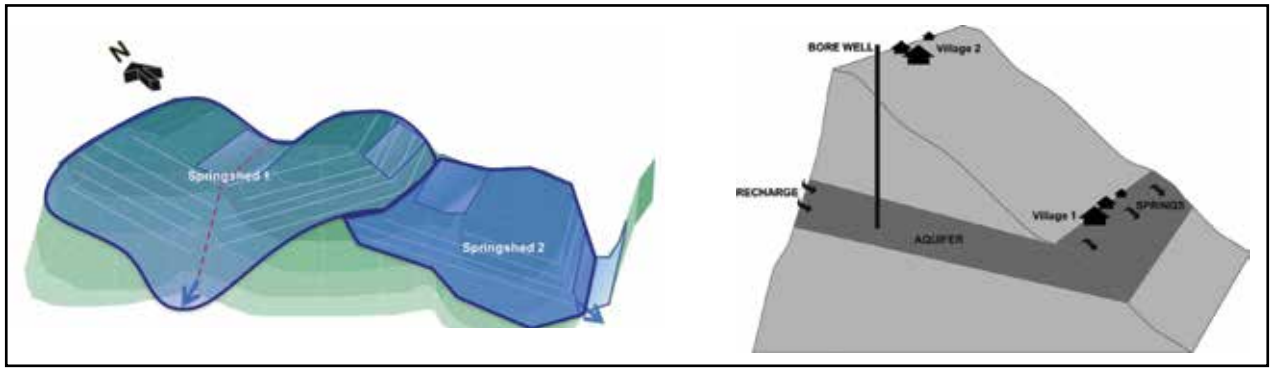
assessment of groundwater resources. As a matter of fact understanding of springs is incomplete without the study of the aquifers feeding them. Hence, the only focus on systematic approaches to springs was on the supply side, where water supply engineering focused on mechanisms to tap spring water and distribute it over various distances to meet domestic and other needs. The systemic functioning of springs as parts of aquifers and watersheds has been one of the biggest gaps in our knowledge system.

- While there is a deep-rooted culture around springs in the Himalayas, springs have seldom been considered part of the larger heritage discourse in India. One must remember that spring water requires not just an understanding of the underlying geology and surface hydrology, but also an incisive understanding of traditional practices and culture around springs both of which have significant socio-economic and governance dimensions. Also, spring hydrology is incomplete without an understanding of vegetation factor – type and nature of forests, the type of vegetative land-cover in the springshed and the type of vegetation used in springshed conservation programmes. The sustainable management of spring water is clearly linked not only to multiple disciplines such as hydrogeology, social systems, economic trade-offs, gender and equity dimensions, but also to the interdisciplinary nature of responses to some of the crises surrounding spring water.
- While there is significant traction on the impacts of climate change and variability on water resources in the Himalayas, long-term data pertaining to both climate parameters and spring discharge at high granularity is missing until now. Hence, establishing a clear relationship between climatic factors and spring depletion is difficult to obtain at the moment. Similarly, documentation of various initiatives and institutions working on the multiple aspects of spring management is also missing. It will be difficult to plan, design and manage spring water in a region without an exhaustive database pertaining to multiple parameters for the region.

Practice and Policy Gaps

- Springs are the de facto groundwater resources of the hills and mountains. Their recognition as such is virtually missing from both water supply and water conservation programmes at large scales. While there are growing examples of integrating the concept of groundwater management with springshed management from many areas in the region, the effort is small as compared to the need.
- In the National Mission for Sustaining the Himalayan Ecosystem (NMSHE) under the National Action Plan on Climate Change (2010), the topic of springs and spring management finds mention under the broader topic of 'Sustainable Urbanization in Mountain Habitats'. However, there is a need for a balanced approach covering urban as well as rural contexts to address the problem of reduced spring discharge. Moreover, the integration of science and communities in the approaches to spring water management under NMSHE would be a most welcome inclusion. Bringing science to bear upon the practice of efficient and equitable spring water management will logically bring about a greater degree of sustainability to mountain water management. Moreover, if science, coupled with appropriate technology, can become a strong component of policy frameworks on mountain water, it would ensure that the principle of water being a common pool resource is followed through both in programmes and policy on Himalayan waters.

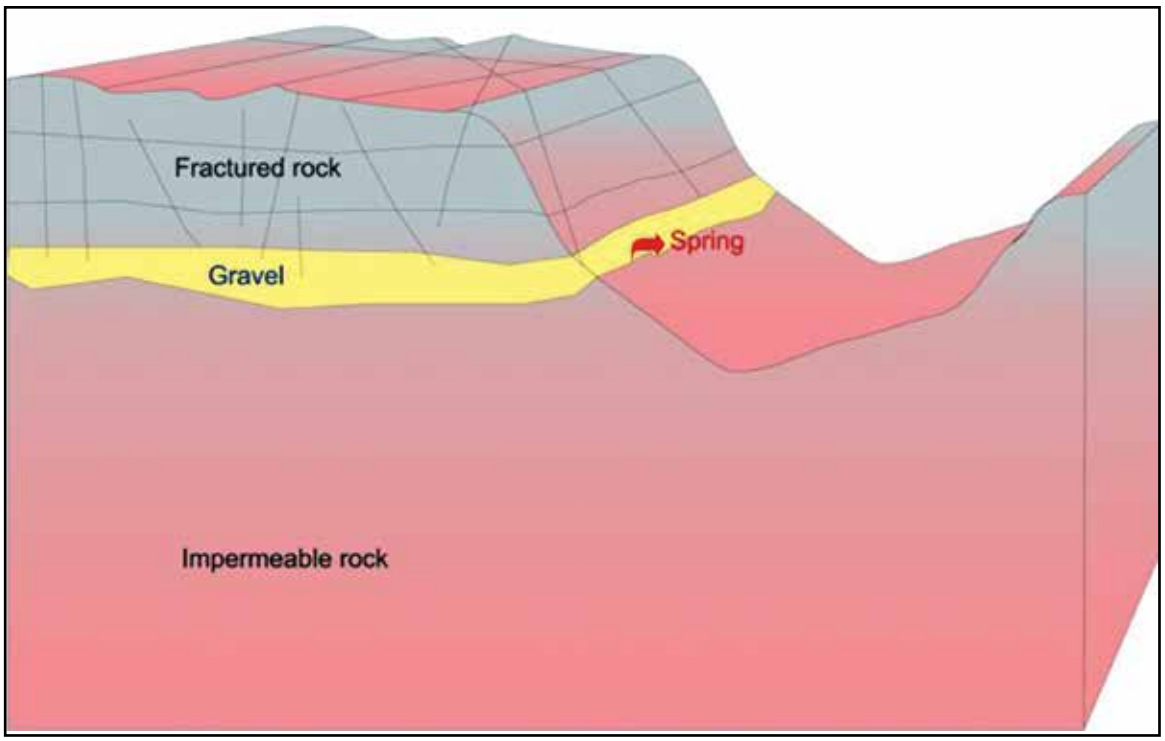
- National Water Policy (2012) – The Himalayan region has been mentioned in the National Water Policy only in the context of consideration of environmental issues while planning. There is no specific emphasis on springs and springshed management in the document, or for that matter, the connection between springs and groundwater, or springs and river flows.
- Neglect of springs in planning of Urban Water Supply: When water supply for hill towns is considered, typically engineering solutions are provided as the first line. Project reports are made that aim to lift water from distant downstream rivers. More often than not, however, major springs are available near the town which can be tapped for water by gravity or at most small lift schemes. Protecting these springs and their springsheds often offers low cost and sustainable solutions.
- Large scale drilling in the mountains to improve agricultural productivity, provide access to drinking and domestic water and enable industrial growth is leading to competition between uses and users of groundwater and between natural (springs) and anthropogenic sources (wells) that tap a common resource (aquifers). This might lead to a conflict between two types of sources tapping the same aquifer in addition to affecting the sustainability of river flow. This paradox of sources and the resource is neither brought into improved practices of water management nor is it clearly mandated as a paradigm shift in any water policy documents.



The concept of 'springsheds' (left) integrates springs, aquifers, watersheds and the catchment areas (recharge zones of the aquifers feeding springs), while also considering socio-ecological factors such as the trade-offs between boreholes drilled in aquifers that discharge to springs (right)

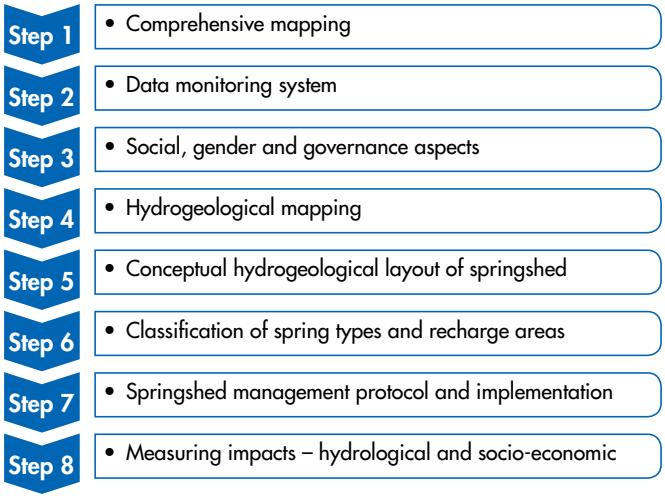
Chapter 4
Springshed Management in the Himalayan Region: Revival through Recharge

Springs have been providing water to both humans and ecosystems for thousands of years. Before humans began practicing agriculture, hunting-gathering communities must have depended on springs before they began excavating wells for groundwater. Traditionally, spring water is considered clean and pure due to the natural filtering that occurs during infiltration and its movement through shallow and deep aquifers, as the case may be. Water from springs sufficed for village needs in the past. In recent times, both the quantity (discharge) and quality of water issuing from the springs is reported to be declining. Springs are clearly influenced by infiltrating water, whether it is rainwater or snowmelt in cold regions. Moreover, this water must find a place underneath the surface where it is stored and moves until it reaches the surface of the earth again. Hence, springs are a consequence of recharge to and discharge from aquifers, all of which must be understood and managed by the involved communities. Springshed management has emerged as a ray of hope to mitigate spring water depletion in the Himalaya and is slowly spreading to the other 'springscapes' of India and its neighbourhood regions.



Conceptual layout of spring exhibiting its hydrogeological setting

While the crisis around spring water in the Himalaya was developing and stories of springs drying up began emerging during the last 15 years, there have been several community-led initiatives that offer hope in mitigating the crises. The concept of springshed management is now quite well-ingrained in the form of pilot initiatives at varying scales across the Indian Himalayan States and in neighbouring Nepal. The first systematic initiative was undertaken through the Dhara Vikas Programme by the RM&DD, Government of Sikkim, even as smaller, deeply incisive pilots using the same concept were being undertaken in Himachal Pradesh, Uttarakhand and Nagaland. The concept of springshed management is best summarised through the 8-step methodology developed under the Dhara Vikas Programme and subsequent approaches based on this methodology. The evolution of a protocol for springshed management through all of these experiences has contributed to building up a critical mass of pilots in different parts of India. First developed as a planning tool under Dhara Vikas, the eight-step methodology is now being brought out as a detailed manual explaining the protocol through the ICIMOD-ACWADAM partnership. However, for the purposes of this report, a broad methodology involving eight clear steps, is listed in the graphic below.



Eight-step methodology for springshed management, first developed under the RM&DD initiative and then modified for wider scaling out through the ICIMOD-ACWADAM partnership

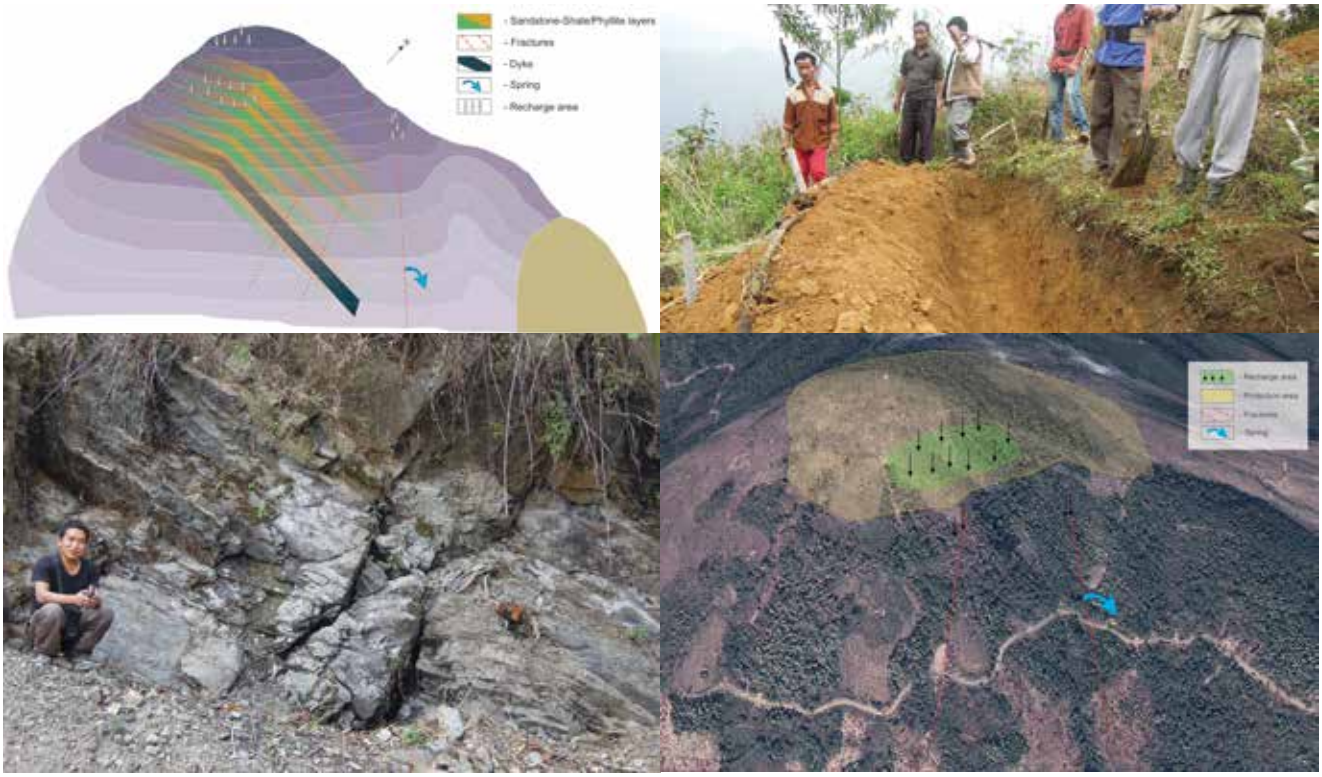
Springshed management includes various aspects of water management, ranging from hydrology to governance of natural resources. The methodology has been able to successfully integrate natural science with social sciences, hydrogeology with engineering and research with implementation while also ensuring the common thread of community involvement and skill development throughout. While there is scope for further improvement, ratification and impact assessment of some of these initiatives has shown encouraging benefits on social, economic and environmental fronts.

Any investigation of springs involves a synthesis of two fundamental branches of science – hydrology and hydrogeology. Hydrology is primarily concerned with the study and understanding of how water moves on the surface while interacting with underground water, whereas the science of hydrogeology deals mainly with water inside rocks and rock material, i.e. groundwater along with its chemical, physical and environmental characteristics. Moreover, associated sciences such as pedology or soil-science and forestry are also important. For the sustainable development and management of springs, it is important to understand aspects of hydrology and hydrogeology. The study of springs and the design, planning and action around spring water management involves:

- Hydrogeologic and hydrologic characterization of the spring type on the basis of simple tenets of hydrogeology, drainage (discharge) and recharge area, and recharge and discharge parameters, such

as water quantity and quality.

- Reliable analysis of spring discharge and water quality, achieved by collecting discharge and quality data of springs, also helps in understanding the conjoined system of watersheds and aquifers, together called springsheds.
- The mapping and description of springsheds leads to the demarcation of recharge zones for aquifers feeding springs. Once mapped, these recharge areas become sites for customised watershed measures such as forestation, soil and water conservation techniques like bunds, trenches and ponds. Improving the recharge regime through such measures leads to improvement in spring discharge and quality.



Representative illustrations of a few key steps in springshed management – clockwise from lower left – a parahydrogeologist at a rock exposure, conceptual layout of a springshed, a contour infiltration trench as part of spring-water recharge and the polygons for recharge and protection measures in a springshed

However, conducting scientific tests and taking up appropriate engineering solutions to enhance recharge are not enough. In addition, there is also a need to address the demand side challenges to ensure that water requirements are met in times of limited resource availability by augmenting the efficiency of water use. At a local scale, this implies the involvement of the community, educating various stakeholders, especially the communities depending on spring water as well as those located in the recharge zone about resource protection, preventing contamination of the aquifer that supplies water to springs and land use management and control. Hence, social, economic and ecological sciences must also complement

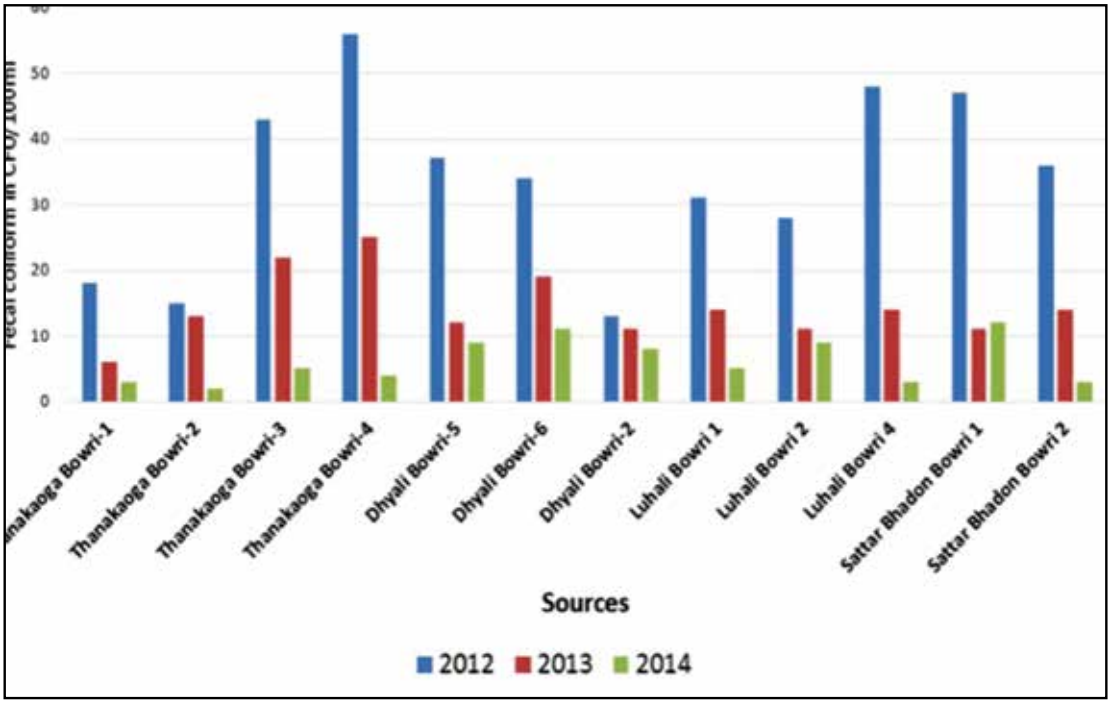
hydrology and hydrogeology in the management of precious spring water resources in the mountains. This entire process gains further value and utility when acknowledged by the local governance institutions in the mountain villages. Whether these are institutions like Village Water and Sanitation Committees (VWSCs) that have a specific water and sanitation focus, or more formal systems like the Gram Sabhas of Gram Panchayats or Village Councils, springshed management pilots have been able to integrate such institutional reform into the process, strengthening it further.

Spring water management must be integrated with community-management of groundwater resources. Involvement of the community in development, monitoring and maintenance of springs is essential and an achievable task, as there are cultural and religious beliefs that motivate people to protect springs. Any programme attempting to develop this natural resource must broadly involve the following sets of activities:

- Assessment of the hydrogeological controls on the springs (at micro level).
- Recharge potential of the spring through spring shed development measures (at micro level).
- Embedding the micro-level perspective in the macro-picture of the water resources in a region.
- Maintenance and protection of springs.
- Effective monitoring of the spring discharge and water quality during planning, implementation and impact assessment stages.
- Active participation of the community at all stages including during the stage of knowledge generation.

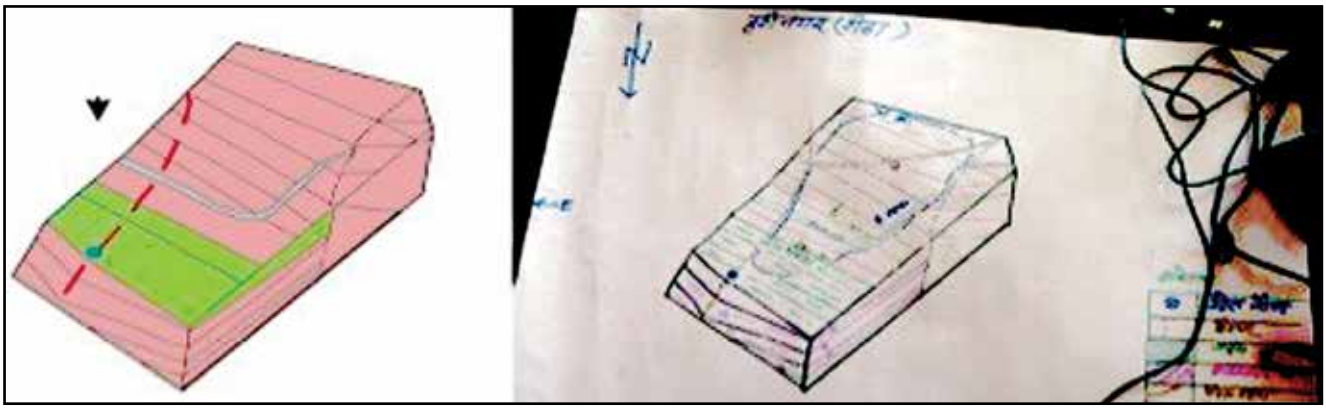
Using the above paradigm, several examples of understanding and managing spring systems in the Himalayan Region have emerged. Some of these have used demystified knowledge and information alongside community participation to develop and pilot the concept of springshed management. These are clear examples that must not only be emulated but also be mainstreamed. Their approaches may have been varied but have followed a common template of combining elements of science and technology, community participation and governance through formal institutions at various levels. Building capacity has been an integral and common thread running across these efforts. Together, they have created certain impacts that are path-breaking and offer hope for designing a pan-Himalayan programme on springs. The examples listed below are not exhaustive by any means, but are clearly symbolic of the range of locations and institutions involved in the effort and the importance of partnership in spring water management. There could be others that need to be included in this listing which would make the case even stronger for a more consolidated effort on this front.

- **Springs and Participatory Groundwater Management in Sirmour District of Himachal Pradesh:** People's Science Institute from Dehradun has used the concept of Participatory Groundwater Management (PGWM) to manage spring water in the Thanakasoga – Luhali Panchayat area through a comprehensive springshed management approach. The most significant impact has been improved spring discharge, especially during the lean season, through systematic recharge measures based on hydrogeological mapping. Protection and conservation of the natural recharge area for the aquifers feeding this spring system has also led to improved quality of spring water over a three-year period. Demand management protocols have also been developed in close co-ordination with the local communities.



PSI's springshed management interventions also led to improvement in the water quality of springs

- **Springs Revival through Para-hydrogeology:** Central Himalayan Rural Action Group (CHIRAG) was instrumental in bringing hydrogeology to bear upon its work related to spring conservation and recharge in the Kumaon region of Uttarakhand. With the help of ACWADAM, a groundwater knowledge institution from Pune, CHIRAG developed a team of para-hydrogeologists who mapped springsheds, monitored spring discharge and quality and identified a spring typology for the region of work that led to piloting recharge and demand management measures in over 100 springs in three districts of Kumaon region. Their work also involved institutionalization of springshed management in some of these villages. Their work was able to restore, to various degrees, the lean-season spring discharge and positively impact the summer water security of many habitations.



CHIRAG parahydrogeologist's draft construction of the conceptual layout of a springshed in Kumaon Region

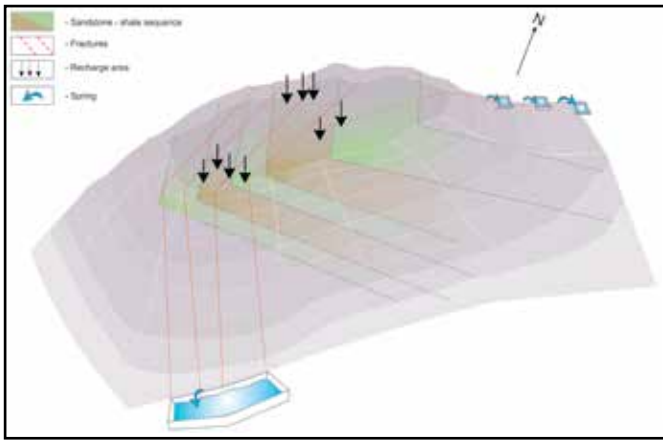
- **Mission Spring Revival – Scaling up the Hydrogeology based Model:** HIMMOTHAN, a society under Sir Ratan Tata Trust, Dehradun has taken the concept of springshed management to scale through various partnerships, largely in Uttarakhand but also through the Tata Trusts in Nagaland. Improved water security through systematic springshed management measures and distribution of spring water under the concept of Water, Sanitation and Hygiene (WASH) have been the two major impacts of this work.

- **Campaign for Springs:** Himalaya Seva Sangh (HSS) has worked for spring water conservation and restoration through a campaign-for-communities mode in Uttarakhand. Combining traditional wisdom with modern knowledge, HSS has used socio-cultural tools to create awareness and sensitize communities leading to a large-scale awareness building impact regarding springs in the region.

- **Dhara Vikas and MGNREGS – Convergence with Mainstream:** Rural Management and Development Department (RM&DD), Government of Sikkim undertook a 4-5 year programme to rejuvenate 700 springs that included the development of a step-wise, multidisciplinary methodology. This programme was built on partnerships between the Government Department, communities and Civil Society Organisations and involved transfer of knowledge and skills in para-hydrogeology to local communities. The programme led to an estimated annual recharge augmentation of the order of 900 million litres through a one-time investment of 1 paisa per litre. Most of the investment came through a convergence model of using donor funding (research, capacity building and facilitation) with MGNREGS (for implementation works). One of the largest impact of this programme has been the visibility and outreach, including exposure visits not only from other States and Institutions in India but also from overseas. The stimulus provided by this model to prompt work in other States is perhaps the largest impact Dhara Vikas has created. BARC undertook isotope research to confirm some of the impacts, clearly outlining how some springs receive water from a set of multiple aquifers.

Springshed trenches complemented by vegetative measures were part of Dhara Vikas Programme of RM&DD in Sikkim State.
(Photo: Government of Sikkim, RM&DD)

- **Demonstration, Piloting and Potential in Scaling Out:** Eleuthrian Christian Society (ECS) was instrumental in piloting springshed management through a programme support by Tata Trusts that led to improved water security in more than 10 locations in the two most challenged districts of Nagaland – Mokokchung and Tuensang. Subsequently, ECS also worked in 5 districts to demonstrate springshed management for improved WASH impacts last year. The largest impact of this work has



Summary of proposed catchment treatment plan

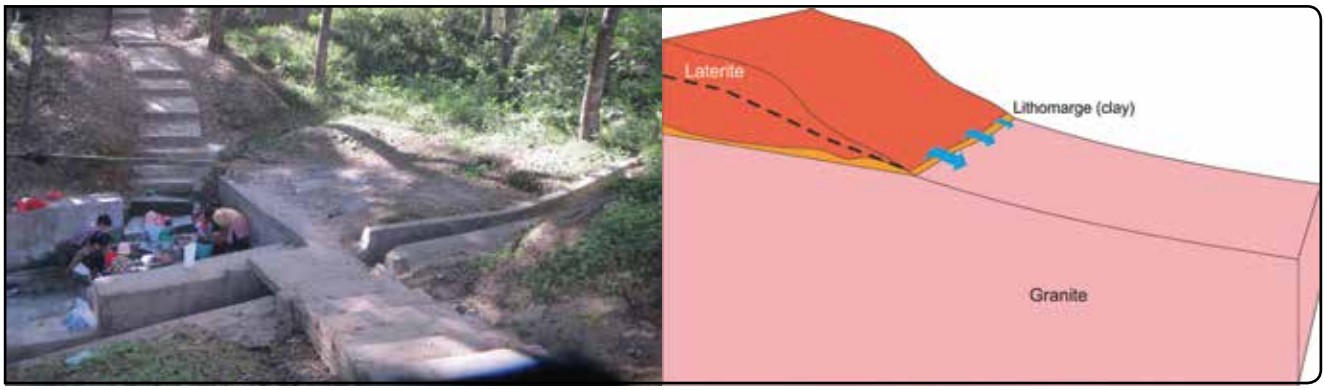
Village	Spring	Area for recharge(ha)	Area for protection(ha)	Treatment measures suggested
Longra	Chenyak	1.2	6.5	Recharge pits, Staggered trenches
Yangpi	Waoshui	15	60	Contour trenches
Noksen	Okthem	1.5	10	Staggered trenches
Litem	Litem	0.8	17	Recharge pits
Sangdak	Chenyak	5.2	35	Contour/Staggered trenches

Layout for springshed treatment and summary of proposed catchment treatment plan implemented through the Tata Trust – ECS partnership in Nagaland

been the improved discharge of springs, especially during the lean season, and demands from other villages for similar intervention.

- **Land Resources Department (Tasked With Watershed Management), Rural Development Department and the Soil and Water Conservation Department of the State of Nagaland** are likely to come together for a concerted effort at reviving springs in a few hundred villages across the State. The capacity building and design development for the programme have already begun through a collaborative multi-partner effort.

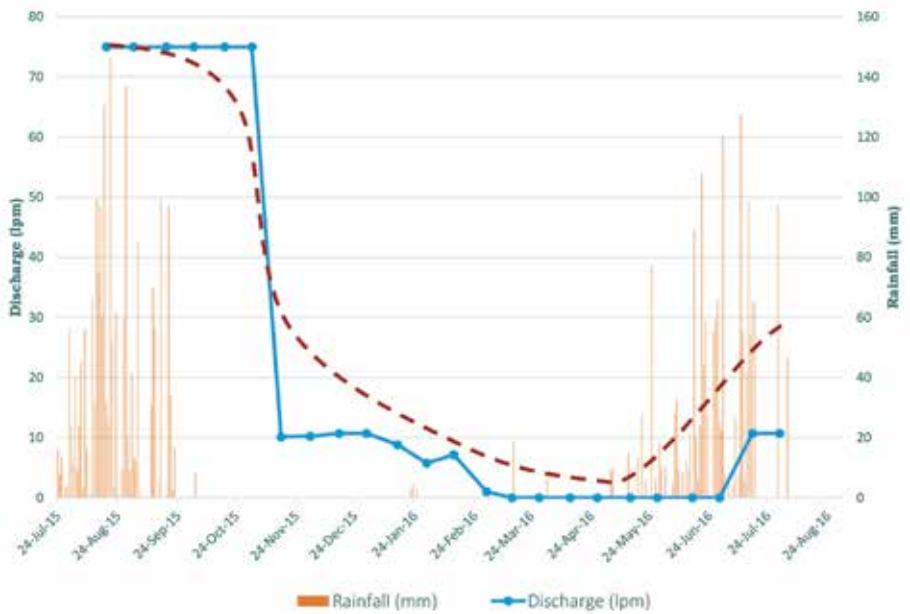
- **Building Capacities at Scale for Spring Revival:** Government of Meghalaya (through the Meghalaya Basin Development Authority (MBDA) began work on mission mode to map 60,000 springs and create a first-cut plan for spring water management of 5,000 springs in 11 districts over the next four years. Regular capacity building efforts for the Soil and Water Conservation Department, Water Resources Department and volunteers have been organized through the Springs Initiative during the last 3 years.



Spring in Shillong town with a conceptual layout prepared in collaboration with MBDA

- **Protection of a Critical Water Recharge Zone (Springshed):** CEDAR has worked to rejuvenate Sukhatal, an ephemeral lake perched above Nainital. Studies by National Institute of Hydrology (NIH) and others confirmed what locals knew of the importance of Sukhatal to the recharge of lake Nainital and springs such as Pradadhara. 50% of the subsurface recharge of Nainital was estimated by NIH to occur from this 2 ha recharge zone. However, encroachment into Sukhatal, overland pumping of water and dumping of debris on the surface of this critical recharge zone has decreased infiltration. The degradation to Sukhatal has been one of the reasons behind the huge fall in lake levels and reduced discharge of springs. The work of CEDAR and citizen groups has helped raise awareness and the bureaucracy and policy makers are now working together to protect the recharge function of this lake. Plans that were being drawn up to cement the base of Sukhatal – which would have completely destroyed its recharge function – have been dropped and more sustainable solutions are now being considered.

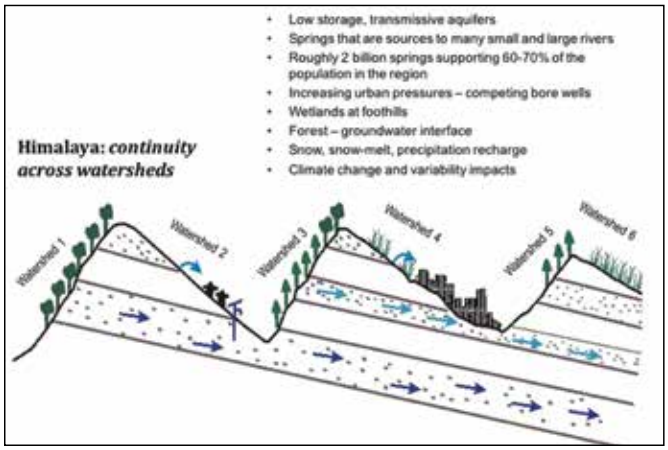
- **Spring Regeneration – A Pan-Himalaya Inception:** International Centre for Integrated Mountain Development (Icimod), a regional learning and knowledge-sharing centre of the Hindu Kush Himalaya based out of Kathmandu, in partnership with ACWADAM, helped build regional perspective and capacity on spring water management. ICIMOD has piloted the concept of springshed management with its partners in different countries in the region. Capacity building, piloting and the development of an 8-step methodology for springshed management have been the outcomes of this work, apart from advocacy for national programmes in a few countries, including India.



Birta-ko-dhara in Sindhupalchok district of Nepal – impact of the April 2015 earthquake on springs (red-line is the pre-earthquake hydrograph while the blue line shows the current – seasonal – status of the spring

- **Springshed Management in the Hill Districts of West Bengal:** Rural Development Department of West Bengal initiated a pilot project for 50 springs in the 4 hill districts of West Bengal through a partnership involving the Panchayati Raj Institution (PRI), Rural Development Department, PRASARI (an NGO working closely with PRIs), and ACWADAM. Apart from convergence of small donor funds with MGNREGS, early results are showing impacts from improved capacity and knowledge about springs at the grassroots and integration of springshed management plans with the DPRs for MGNREGS.

- **Knowledge, Training and Facilitation:** ACWADAM has been a key knowledge partner in nearly all the above partnerships, either formally or informally. ACWADAM's role has been to embed scientific understanding, particularly knowledge regarding hydrogeology and aquifers, into spring water conservation and management work. Demystification of science, development of para-hydrogeology skills and hand-holding that required fieldwork in challenging conditions have been the hallmark of this work. The most significant outcome of this work is this model of collaboration that is so crucial for springshed management success, matching the physical impacts of improved spring discharge and quality across the region.



Conceptual framework for Himalayan groundwater systems developed as part of ACWADAM's understanding of Himalayan springsheds with various partners

- **The Springs Initiative:** ARGHYAM has been supporting spring-based water security work since 2007 in the mountain ranges of India. While the early phase of this work focused on the provision of safe water, most partners began addressing the question of declining spring discharge. The use of science with traditional knowledge led to the springshed management approach. Arghyam was able to bring all of this work together through the coalition of partners into the Springs Initiative in 2014. A coalition of 15 members now, the work has spread to 10 States across the country with clear presence in 5 Himalayan States.

- **Research, Technology and Data:** Seminal work on hydrological and applied research on springs has been going on for at least a couple of decades in the IHR. Institutions like ATREE, GBPNIHESD, IIT-ROORKEE, National Institute of Hydrology, Wadia Institute of Himalayan Geology, BARC and HESCO have been conducting research on a variety of aspects dealing with spring hydrology from different hydro-ecological zones of the Himalayas. The research, including isotope studies, has also brought to light the significance of springs in the region, the increasing problems

surrounding spring water and approaches to understanding springs better. Improved data collection, collation and analyses has been the major components of some of the more recent initiatives, a few of which have also been able to converge into the springshed management activities undertaken by Civil Society Organisations in different areas of the region.

A team of para hydrogeologist participating in planning of springshed management activities (Photo: CHIRAG-ACWADAM-Arghyam)

Women participating in the barefoot hydrogeologist training (Photo: ACWADAM-ICIMOD WLE Project)

Research students from different countries participating in Himalayan University Consortium (HUC) held in July 2017 in Kathmandu, Nepal hosted by ICIMOD (Photo: ICIMOD-ACWADAM)

Hydrogeologist from CHIRAG, Uttarakhand carrying out geological field mapping (Photo: ACWADAM-CHIRAG)

Chapter 5
Building Traction in Springshed Management: Scaling out Capacity for Increased Coverage

In mountainous regions, community mobilization around water can be challenging, energy intensive and arduous because of complex hydrology and hydrogeology and the scattered nature of habitations. Protection and conservation of springs in the mountains through watershed programmes must take into account the underlying geology and understanding of basic hydrogeology. The purpose behind such efforts must be to impact spring discharge and quality to ensure livelihood and ecological security. Some civil society partners have worked closely with certain State governments to build knowledge and skills around spring water management in diverse regions of the Himalaya. Such partnerships and collaborations have focused mostly on providing hydrogeological inputs to programmes on conservation and recharge of springs.

Apart from capacity building of partner organizations, comprehensive action research for facilitation of the on-going projects is required. Moreover, it is important to develop a knowledge base that could facilitate and encourage workers in the region to take up groundwater resource augmentation and protection ventures with regard to spring water. Many such interventions and experiments have yielded satisfactory results in the springshed or spring development programmes. Arghyam's Springs Initiative, for instance, has improved water security in some 1,000 villages, developed training material in six languages, trained nearly 9,000 people from across institutions, helped five States taking up separate spring-related initiatives, improved health and hygiene and quality of life for women and girls (Arghyam, 2017).

While these numbers are impressive, they are just the 'tip of the iceberg' considering the scale of the crisis. There is a pressing need to expand the scope and scale of such springshed programmes in the mountain ranges for upgrading the understanding of groundwater science considering a complex scenario of changing socio-economic conditions under the footprint of climate change and variability. Comprehensive research activities such as isotope-tracer studies are needed to complement basic field hydrogeology and community participation. Due to the difficulties imposed by terrain, and the lackadaisical approach to groundwater-related data and information, borehole data (or any other such data for that matter) is non-existent. Future initiatives need to target these issues and effectively address the community level issues that impede the implementation of systematic groundwater management programmes in the Himalaya. Such research initiatives need monetary investments that only large organizations, State and national agencies are capable of. The links to advocacy efforts to influence policy will develop only on the back of strong action research programmes that are inclusive of the aforementioned factors.

Hence, there is a need to take existing efforts to scale, given the gap between scales of piloting and the magnitude of the problem. There are two basic challenges in scaling out these initiatives. Firstly, there is

lack of capacity in existing systems to take up quality work on springshed management. Developing large-scale capacity through formal systems of education and creating large-scale capacity on the ground are required. The actual field activities involved through the 8-step methodology require investments that are not readily available at the moment. Even a basic inventorisation of springs requires significant resources (investments to the effect have not been made this far). This also highlights the need to think beyond conventional resource mobilisation around a springshed programme, since no such programme existed in India before. Hence, the effort at scaling up pilots, good practices and action research runs into challenges on three fronts viz., capacity, resources (human resources and finances) and scale itself. A first step in this direction would be to conduct a national workshop on springs that, among other issues, will be able to identify organisations that already have information on springs and have existing inventories on the location of springs in different regions. All such information can be compiled on a common platform to develop a national inventory of Himalayan springs just as an inventory of rivers and watersheds is available with different Ministries.

Although the task of revival of Himalayan springs is gigantic, this can be achieved through coordinated national, State and local level initiatives involving all possible stakeholders and partners like governments, civil society, community and people at large. The task needs to be sustained over a period of time involving several short, medium and long-term actions.

Chapter 6
General Recommendations

The meeting of the stakeholders held on 8 August 2017 in DST came up with recommendations under five broad action areas. These include mapping of springs, implementing revival of springs, capacity building, policy and cross-cutting issues. These actions are detailed below.

A. Mapping Springs

1. Systematic mapping of springs across the Himalayas is critical, as springs can provide 20% of the water in mountains and support vital ecosystem services.
2. Creation of a web-enabled database/web portal on which the springs can be mapped/tagged. All State Government Departments, R&D institutions and NGOs working on springs and springshed management will upload data on the webportal.

    ◊ Mapping to include detailed hydrological, geo-tectonic, morphological, meteorological, land use and demographic details.
    ◊ Follow a selective methodology – based on current approaches including the 8-step methodology and more recent protocol of approaches. Application of isotopes to identify origin/source of springs can be an important tool. Hot-spot analysis to identify vulnerable springs must also be included.
    ◊ Aquifer mapping should be undertaken by CGWB in regions where springs are prominent. Customisation of aquifer mapping approaches may also be necessary, including making the process more participatory.
    ◊ Use high frequency sampling of spring discharge to extract diurnal cycle due to evapotranspiration as a basis for land-cover interventions.
    ◊ Flow duration curves of springs can be a simple and effective method for typology of aquifer heterogeneity and pathways.
    ◊ Involvement of local community, NGOs and State Agencies in the process of mapping to make it a participatory process.
    ◊ Establishment of a national registry of springs.

3. Synergies between R&D Institutions/Universities and community based Non-Governmental Organisations to provide assistance for scientific assessments both during the planning and impact phases.

B. Implementing Revival of Springs

4. Reviving springs and sustaining them requires a combination of scientific knowledge (hydro-geology) and community ownership of the resource.

- ◊ Focus on 'aquifer' as the unit for planning and integrate watersheds and aquifers for a 'springshed' approach.
- ◊ Recharge area protection/source area protection in the form of "spring sanctuaries'' including measures prohibiting land use change in recharge/source area. Enhance understanding of correlation between recharge and utilisation of forest land, soil, agriculture and water.
- ◊ Basic engineering measures and structures combined with vegetative measures and management are need for revival. Identification of local level management practices/traditional knowledge (and practices) for springs is needed to strengthen the plans for springshed management.
- ◊ Snow retention and snow meltwater collection is an effective means of spring recharge in high altitude regions.
- ◊ Demand management is a challenge, especially around ensuring a more judicious, efficient and organised system of water distribution, utilisation conservation and management of water/springs.
- ◊ Linking the livelihoods of the communities with the interventions related to revival of springs can ensure long-term sustainability of such interventions beyond the lifespan of the project. For example, spring revival yields not only water but also biomass (from the recharge zone), which enhances livelihood opportunities. Similarly, rejuvenation of springs within forest areas supports flora and fauna.

5. Development of adaptive strategies (risk management as an adaptation measure to climate change impacts) based on hydrogeological investigation and demand-supply model for vulnerable springs. Climate change projections and future impacts must be considered while identifying and implementing springshed management activities.
6. Regular long-term monitoring of springs is needed, particularly in water scarce regions in the Himalayas, for identifying site specific groundwater recharge measures. R&D institutions should work with community organisations in monitoring the springs, including developing protocols for reporting.
   - ◊ Maintain a few permanently monitored springs of 3-4 distinct typologies in each district for assessing impacts of climate and land-cover change.

C. Capacity Building

7. Create a cadre of young professionals and community-based resource persons (para-hydrologists) through training and capacity building programmes. This will help in efficient use of resources allocated for springshed management.

   - ◊ BARC can provide training in the field of isotope hydrology.
   - ◊ Capacity building at the community level, including for PRIs (water committee), on springshed management is essential to improve groundwater literacy, and help in long term management of springs and sustainability of interventions.
   - ◊ The community based organisations should take lead in generating awareness amongst communities regarding impacts of drying/depletion of springs and the importance of springshed management in varying climatic conditions.

- ◊ For institutionalization of knowledge a common curriculum and a training manual needs to be developed.
- ◊ Capacity building needs have been strongly expressed by many States, given that there are newer components in the approach to spring conservation through springshed management as compared to more conventional, business-as-usual approaches. Mapping and technical capacity enhancement are two key inputs that are in demand across many States in the IHR.

D. Policy

8. The Government should launch a national mission/programme on springshed management. Springs and springshed management in Himalayan Region needs to be emphasised in National and State level policies as a comprehensive ecosystem services and climate adaptation measure.

- ◊ A status report on Himalayan springs including inventory and current status of springs, reasons for depletion/drying and spring revival initiatives across Himalayan States should be produced.
- ◊ The Government should identify a nodal R&D institution/University for carrying out mapping exercise and developing approaches for springshed management.
- ◊ The subject of springs transcends several ministries. The Ministry of Water Resources has been envisioned to be the nodal agency but in our understanding Ministry of Environment, Forests and Climate Change (MoEF&CC), Ministry of Tribal Affairs, Ministry of Rural Development, Ministry of Drinking Water and Sanitation, and key institutions like State government groundwater agencies may have a larger role to play for taking the work forward. Hence, there is a need for inter-ministerial coordination.
- ◊ Policy should also look at meeting water demand in the mountains which cannot be fulfilled by springs alone. This is particularly true of the pre-monsoon/summer season when demand is highest due to tourism and spring discharge is at its lowest. In addition, forest fires are more frequent during this season.
- ◊ The question of forest and private lands and their location in the springshed becomes important because large parts of the recharge zones of springs often fall within forests and springshed-related activities cannot be taken up without the co-operation of the Forest Department.

9. The Central government should promote regional efforts and platforms to exchange experiences and knowledge on springshed management in the IHR, as well as the larger Hindukush Himalayan Region. This is critical for rejuvenating transboundary springs (e.g. recharge zone in Bhutan and spring outlet in West Bengal, India).

10. State governments across the IHR (and also non-Himalayan States) need to take a proactive role in mapping and revival of springs as depletion/drying has socio-economic implications. Although some States (e.g. Sikkim) have initiated this activity it needs to be strengthened by capacity building of the relevant stakeholders at the State level. This also requires convergence between Departments.

- ◊ Need to link with the regulations/existing rules and institutions that can govern springshed management and administrative arrangements, as well as review and link with traditional systems for conserving water (traditional systems vary across Himalayan States).
- ◊ Mainstreaming of springshed management with other developmental programmes at National and in particular at the State level to facilitate more convergence with government schemes (e.g. Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in Sikkim). It is likely that some of the programmes may require some tweaking of guidelines in order to accommodate provisions for convergence with springshed management activities. However, much of the systematic springshed management activities can be seamlessly integrated into programmes like MGNREGA and watershed management.
- ◊ Capacity building activities under NMSHE and communication between the State Climate Change Cells will be useful in taking the agenda of spring-shed management forward.

E. Cross-Cutting Issues

11. Scientific knowledge from assessments on status of springs and techniques of springshed management need to be translated into simple language and communicated for policymaking and development of climate adaptation projects.

- ◊ Understand effects of mining, infrastructure development and urbanisation on the springs. This should be integrated with Environmental Impact Assessment and Environmental Management Plan.

Chapter 7
National Programme on Springshed Management: A Proposal

There was unanimity among the stakeholders who participated in the meeting of 8 August 2017 on the need to launch a National Programme on Springshed Management. This national programme on Himalayan Springs could help overcome the challenges outlined in the previous chapters and take forward the recommendations of the stakeholder meeting. However, before discussing the programme, it would be relevant to State why such a programme is necessary and in the national interest:

- Springs form the sources of many small and large rivers in India. Almost all non-Himalayan rivers and many Himalayan rivers originate from springs in the catchment areas. Many of these springs and their catchments have been revered through history either in the form of a symbolic temple or through the tribal legacy of 'sacred groves'.
- Springs directly support the partial or complete water needs of more than 15% of India's population.
- The drying of springs has led to acute water shortages and great distress for mountain populations along with their livestock, both rural and urban.
- The need to identify, conserve and protect the recharge areas of springs becomes important not just for local sustainability but also for the sustenance of our river systems.
- Integrating the understanding of the resource (mostly groundwater) with improved recharge, efficient supply and equitable distribution is key to protecting and conserving springs.

With this background, this note proposes a further push for a national programme on spring water management in India. The proposal has emerged through discussions with various stakeholders, experts and with the members of the Working Group. While there could be a larger pan-India programme, this report restricts itself to the Indian Himalayan Region. The programme may involve research, management and protection of about half a million springs across the region. The programme, to begin with, could be anchored by the NITI Aayog, given its very strategic and national importance. There is need to prepare a Detailed Project Report for initiating the above programme. States that are already implementing their version of springshed management can further improve the design and efficacy of their programmes through a flagship national programme. While the States will continue to implement the programme, their programme efficiencies can be further sharpened through a set of standard protocols or guidelines under the national programme. Given that programmes like MGNREGS have been linked with springshed management, it is even more important for a centralised, facilitative role in key aspects of a common set of guidelines and guidance under the national programme on springs.

The programme must envisage a multidisciplinary, collaborative approach of managing springs and will involve building upon the existing body of work on spring water management. The programme can be

designed on the concept of action–research as part of a hydrogeology-based, community–support system on spring water management. It can integrate other disciplines such as social sciences and ecology in building multidisciplinary dimensions that can help sustain this effort in the long run. The programme will be relevant to all the States in the Indian Himalayan Region, where communities depend upon spring water for domestic and livelihood needs. Community centred action research interventions are not only essential but also indispensable for resource conservation in eco-fragile systems like the Himalaya, Western Ghats and Eastern Ghats.

It is important to remember that each Himalayan State has its biophysical and socio-political uniqueness. Hence, it is important to work with each State and design the specific implementation strategy of springshed management that is appropriate to the conditions in the State. Moreover, the success of a State-level springshed management programme hinges on an institutional host to anchor it and the integration of various line departments in the State to efficiently implement and manage it.

It is equally important to study how the water policy of all the Himalayan States considers spring water. Including spring water management as a strong component of the water policy can be one of the tasks for policy researchers. This is also important in comprehending the transboundary nature of spring systems, especially with regard to springs located along interstate boundaries, and where administrative boundaries follow ridge-lines.

A strategic approach to springshed management must have development and research components. The development component would enable implementation while the research component could support the design, planning and impact assessment of springshed management by enabling recognition of the spring typology, identifying the recharge area, instrumenting the spring discharge and rainfall, monitoring and evaluation and updating the national springs web portal. The crucial elements of these components are listed below.

Development Components

- Geographical targeting using vulnerability assessments at the village level, including information on climate, dependency and other such aspects.
- Prepare Village Water Security Plans (VWSPs) for these villages combining dependencies and availability of local water resources.
- Identify critical springs within vulnerable villages the revival of which would help benefit a significant population in the villages and/or provide critical water supply to vulnerable and marginalised sections of the population.
- Start small pilots using ‘resource block strategy’, or clusters of springs in pre-identified blocks of some districts in each of the Himalayan States, focusing on critical springs in vulnerable Gram Panchayats as a priority.
- Develop a cadre of trained para-hydrogeologists while creating capacity across the entire range of government Departments and Ministries dealing with or connected with springs, water supply and sanitation in the Himalayan Region. This should include the Department of Forests in all the States as many springs originate in forests or have their recharge zones in forest areas.

- Develop a national spring atlas, monitoring discharge and rainfall data in the resource blocks to begin with but quickly progressing to the entire State and to the Himalayan Region as a whole.
- Implement spring revival plans in the identified resource blocks using the cadre of para-hydrogeologists and through convergence with programmes like MGNREGS. Also, seek gap-funding or top-up-support for knowledge and skill building to ensure effectiveness in implementing the eight-step methodology.

Research Components

- Develop long-term spring observatory by instrumenting a few springs and streams in the resource blocks selected above.
- Develop baseline and controls so that other covariates such as rainfall, land use and land cover change are accounted for and the increase in lean period discharge of the springs can be directly attributed to the artificial ground water recharge works.
- Initiate participatory mapping of recharge areas by convergence with trained para-hydrogeologists and with a clear focus of core recharge areas for implementing recharge measures as well as zones of protection to ensure conservation and retention of pristine areas that are the natural recharge areas for many springs.
- Evaluate the initiative using the composite criteria of relevance, effectiveness, impact, efficiency and sustainability that RM&DD (Sikkim) has recently adopted.
- Take up natural isotope studies for benchmarking the identification of recharge areas of springs through the para-hydrogeologist model. These studies could also be useful in impact assessment and quantification of hydro-socio-ecological impact.
- Update the information on the national springs portal on a monthly basis so that the portal is dynamic and becomes a potential platform for tracking the progress of spring performance.

Conventional approaches involving structured, time-consuming research, although necessary, are unable to contribute significantly to effective policy discourses. For research to transform into a crisis-resolving intervention, community participation is crucial. Capacity building of implementing agencies and other stakeholders is imperative and of strategic relevance; it must be based on robust knowledge systems that combine traditional local knowledge, action research, participatory learning and decision support. A programme on spring water management must be designed based on partnerships and collaborations because spring water management must be integrated with community management of groundwater resources. Involvement of the community in development, monitoring and maintenance of springs is essential, as there are cultural and religious beliefs that motivate people to protect springs. Any programme attempting to develop this natural resource must broadly involve the following sets of activities:

- Assessment of the hydrogeological controls on the springs (at micro level).
- Recharge potential of the spring through springshed development measures (at micro level).
- Maintenance and protection of springs.
- Effective monitoring of the spring discharge and water quality during planning, implementation and impact assessment stages.
- Active participation of the community at all stages including during the stage of knowledge generation.

Programme goal

Ensuring sustainable, efficient and equitable usage and management of spring water in the Himalayan Region of India.

Programme objectives and potential outcomes

The objectives and outcomes are best envisaged when considered in three clear phases of the programme – intensive phase, the knowledge-networking phase and the scaling out phase. We have labelled these as short, medium and long term phases. Each phase is described in some detail below.

Short-term actions (first four years)

The intensive phase (first four years) will essentially include launching the spring revival programme in one vulnerable block in each of the mountain States and providing technical, financial and institutional support. It will aim to build local capacity and adapt the programme to the local context so as to enable scaling up from this resource block from the fourth year onwards. This phase will also emphasize strong monitoring and evaluation with instrumentation to ensure that the learnings of the programme are well documented. The outputs of the first phase would be trained manpower, experience in instrumentation, costing templates, training manuals with expertise and experience at the local level to scale up the projects. There will be four broad sets of activities in this phase:

- Systematic mapping of springs across the Himalayas. Although some States have started doing this activity, it needs to be strengthened by capacity building of the relevant stakeholders. Hence, even while the process of springshed management unfolds in one block in every State, basic inventory of all springs must begin and be completed in the first phase itself.
- Creation of a web-enabled database/web portal on which the springs can be mapped/tagged. All State government departments, R&D institutions and NGOs working on springs and spring-shed management will upload data on the web-portal.
- Capacity building activities under NMSHE and communication between the State Climate Change Cells will be useful in taking the agenda of springshed management forward. Creating trained manpower through multiple partnerships and collaborations will form part of the first phase.Basic engineering measures – structural, combined with vegetative measures – are needed for spring revival. Identification of local level management practices/traditional knowledge (and practices) for springs is required to strengthen the plans for springshed management all of which require building capacities of local communities.
- Organising a national level workshop for policymakers and decision-makers in order to sensitize them on the issue of drying-up of springs and the crucial role of spring-shed management in the overall development of the communities must become an annual event during this phase.
- Awareness and education of communities regarding climate change and the importance of springs can play a crucial role in spring-shed management.

Medium-term actions (from 5th year to 8th year)

The knowledge-network phase of the following four years will involve handing over the programme to the State governments who can use existing funds to scale up this initiative to other larger areas, making it possible to reach as many springsheds as possible. The programme would continue to organize coordination workshops, exposure visits, documentation and function around the short-term pilots as a knowledge and learning process under the programme. As a matter of fact, some States are already designing/implementing springshed management programmes. It would be useful to map existing State-led spring water management initiatives or pilots for building up to scale. The broad aspects of the medium-term actions are listed below but the actual details would be worked out on the basis of experience gained in the short-term phase. The detailed design and planning, therefore, may deviate from the aspects given below.

- Mainstreaming of spring-shed management with other developmental programmes is required to facilitate convergence with government schemes.
- Building close and effective partnerships between Government Departments, R&D Institutions/Universities and community, based NGOs is necessary to build knowledge, information and skills and equip communities to manage springs and springsheds for the longer term.
- An atlas of springsheds could be developed as a clear output in the second phase. This would also help in the periodic assessment of groundwater resources in the country.
- Reviving springs and sustaining them requires a combination of scientific knowledge (hydrogeology) and community ownership of the resource. Therefore, along with scientific inputs, capacity building at community level is equally important.
- Awareness and education of communities regarding climate change and the importance of springs can play a crucial role in springshed management.

Long-term actions (beyond 8th year)

All springs and springsheds would need to be covered during the long-term phase, the period for which can be decided at the end of the medium-term action plan. The standardisation of the springshed management process would be more or less established at the end of phase 2. However, what would be essential to the scaling up would be the mobilisation of resources to reach out to diverse geographies and communities across the IHR. Hence, the idea of developing a Green Climate Fund (GCF) proposal for springshed management covering the IHR is suggested here, in order to access financial resources required for implementation on a large scale. Indicative actions would involve:

- Linking the livelihoods of the communities with the interventions related to revival of springs to ensure sustainability of such interventions beyond the lifespan of the project. For example, spring revival yields not only water but also biomass (from the recharge zone), which enhances livelihood opportunities. Similarly, rejuvenation of springs within forest area supports flora and fauna. Such an integration would be crucial, implying closer collaborations between operational arms of government departments and communities, especially panchayats. A policy decision would perhaps help.

- Building local institutions and institutional mechanisms for springshed management would help in capacity building of communities to undertake such activities in the long-term and also be equipped in the operation and maintenance activities.
- Awareness and education of communities regarding climate change and the importance of springs can play a crucial role in springshed management.
- Development of adaptive strategies (risk management as an adaptation measure to climate change impacts) based on hydrogeological investigation and demand-supply model for vulnerable springs. Climate change projections and likely future impacts must be considered while identifying and implementing springshed management activities.
- Regular long-term monitoring of springs is needed, particularly in water scarce regions in the Himalayas for identification of site-specific ground water recharging measures. The R&D institutions should work with community organisations in monitoring the springs, including developing protocols for reporting.
- Establishment of a national registry for springs in the form of a Spring Health Card (SHC), to periodically evaluate the health of the springs in time and space could become an established practice to ensure sustained flow of information from one side and crucial guidance, facilitation and hand-holding from the other side.

The work plan and timelines as described above under short, medium and long term actions have been presented below in Table 2.

Table 2: **Work plan and timelines of various actions under National Programme for Springshed Management**

SNo	Item of action	Short term (<4 years)	Medium term (4-8 years)	Long term (>8 years)
1	Systematic spring mapping and launch of springshed management programme			
2	Web-enabled database leading to Digital atlas of springsheds			
3	Capacity building for para-hydrogeologists			
4	National workshop for policy makers			
5	Awareness and education			
6	Participation of regional and international experts and institutions			
7	Integration and mainstreaming			
8	Building effective partnerships			
9	Blending techno-scientific and socioeconomic knowledge			
10	Integration with SDGs			
11	Link livelihoods and spring revival			
12	Building local institutions			
13	Development of adaptive strategies			
14	Long-term monitoring mechanism			
15	National registry – 'Spring Health Card'			

Finances

This spring revival programme can be positioned as a Government of India initiative of the Ministry of Water Resources, River Development and Ganga Rejuvenation for overall financial support that can also include support from various bilateral and multilateral donor agencies. In fact, many other ministries such as Ministries of Drinking Water and Sanitation, Rural Development, Tribal Affairs and Urban Development could also adopt regions for implementing springwater management or support specific components of the programme. Subsequently, the scaling up can be done by the State governments using existing funds from ongoing programmes. The cost-benefit analysis should also include the co-benefits from restoration of natural capital and improvements in quality of life.

As mentioned in the previous section under long-term action, there is need to address the issue of mobilization of resources and funds for taking up springshed management task in a holistic way. Considering the large requirement of funds for implementing a pan-Himalaya integrated springshed management programme, in addition to funds that may be allocated by the Government, we may need to explore possibility of raising funds from other sources such as development funds, Green Climate Fund (GCF), CAMPA funds and also levying a cess on visitors to the region.

Getting started

This report outlines the need, rationale and broad contours of a National Spring Water Management Programme for the Himalayan Region. Our final recommendation would be to constitute a small programme design group, which over the next six to eight months will develop a Detailed Project Report (DPR) for a national programme on spring water management, keeping the salient features of this report as reference.

Table 3 lists the nature of activities that go into community-based spring water management and the possible institutions that can be part of the design group. The group is derived from the requirements of the programme described in this report and matches the expertise of institutions to the methodological requirements. The group may be drawn from the institutions listed in the table below along with other members from the drafting committee of this report. The table attempts to describe key roles for each step of activities and the corresponding potential partners; it is only indicative and developed for the short-term activities described in the report.

Cultural aspect related to spring water in the mountains (Photo: ICIMOD-ACWADAM, Godavari Project)

Table 3: **Springshed management: template of activity, institutions and their roles**

No.	Step	Key partnerships (organisations)	Key responsibilities
1.	Comprehensive mapping of springsheds – regional mapping of geology and hydrogeology.	GSI, CGWB along with local institutions having capacities in conducting such mapping (could include Geology Departments of Universities located in a region and NGOs).	GSI to undertake high scale geological mapping (say 1:5,000 or 1:10,000) in the areas with identified clusters of springs in the Himalaya. Preparation of geological sections of the subsurface conditions for these clusters would be a necessary step. CGWB will help concerned State Departments/Agencies, local Institutions to set up spring-discharge and spring water quality monitoring systems in these clusters of springs while also establishing preliminary characterisation of these springs, including springshed mapping of the areas underlain by these clusters. In identified critical springsheds, CGWB itself would monitor the discharge and quality of springs. This would be useful in developing a system of 'benchmarking' information and data that would flow up through the processes given below.
2.	Data monitoring and background research.	Academia and research institutions – NIH, Wadia Institute of Himalayan Geology, BARC, Kumaon University, ATREE.	Establishment of a systematic research programme within at least a selection of the clusters of springs within the first pilots to intensively measure and monitor short and long duration variable frequency data sets. It would be necessary to develop analytics from these data sets for forward decision support of the field-activities and to establish a benchmarking system in partnership with CGWB (No. 1 above).
3.	Social and governance aspects.	PSI, CHIRAG, RM&DD (Sikkim), ECS, Himmothan along with different State Government Departments.	Study and dialogue with the communities, institutions, their dependency and other such social and economic factors in the spring clusters that are relevant to the management and governance of spring-water. Would also be useful to understand the degree of vulnerability of these communities to spring depletion and contamination.
4.	Hydrogeological mapping at local scales.	Springs Initiative (especially ACWADAM, PSI, CHIRAG, ECS etc.)	Conduct local-level hydrogeological mapping drawing upon the data generated in the previous 3 steps and attempt to understand the locations and size(s) of recharge zone(s) and underlying aquifers in each of the clusters.
5.	Classification of spring types and characterising springsheds.	Springs Initiative, Research Organisations.	Combine step 1, 2 and 4 to develop a typology of springs and springsheds for each cluster.
6.	Creating conceptual models for springshed recharge.	Springs Initiative, Research Organisations.	Develop short, simple profiles based on conceptual models for each spring / spring cluster specifying the recharge zones where springshed recharge can be undertaken. The nature of measures also needs to be worked out.

7.	Developing springshed management plan and protocols.	Springs Initiative Partners in respective locations and State level nodal organisations, e.g. RM&DD (Sikkim), Rural Development (West Bengal, Nagaland) and MBDA along with Soil and Water Conservation Department (Meghalaya).	Develop DPRs on the basis of Steps 1 to 6 for an implementation plan, possibly through a convergence with programmes like MGNREGS. Use step 3 to 6 in developing management and governance protocols to be shared with the community prior to implementation.
8.	Measuring hydrogeological and social impacts.	Springs Initiative, CGWB and Research Organisations.	Use various techniques and methodologies for ascertaining impacts from the spring-water management effort in each of the clusters so that improvements can be made in the next phase.
9.	Dissemination and advocacy.	NITI Aayog to co-ordinate with States and Ministries.	Continue engaging with different ministries, all States and communities in an effort to mainstream the concept and experience of the programme.

Spring emerging out at an altitude of roughly 4,000 masl in Spiti valley
(Photo: ACWADAM-Ecosphere)

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Annexure 1
Select Case Studies and Success Stories

There is great hope in the concept of springshed management evidenced through many exemplars of success in the revival of springs in the mountains of India. Several examples of understanding and managing spring systems in the Himalayan Region, in particular, have emerged during the last ten years or so. Some of these have used demystified knowledge and information alongside community participation to develop and pilot the concept of springshed management in an effort to address hydrological, social and ecological issues around spring water. These are clearly examples that must not only be emulated but also be mainstreamed. Their approaches may have been varied but have followed a common template of combining elements of science-technology, participation from communities and governance through formal institutions at various levels. Building capacity has been an integral and common thread running across these efforts. Together, they have created certain impacts that are path-breaking and hopeful in designing a Himalayan programme on springs. The examples listed below are not exhaustive by any means, but are clearly symbolic of the range of locations and institutions involved in the effort, also bearing hope in the importance of participation and collaboration through models of partnership and cooperation in springwater management. A list describing some of these efforts and the strengths of Institutions in Springwater Management have been provided below.

S.N.	Institution which led the initiative	Broad description of initiative
1	People's Science Institute, Dehradun	Springs groundwater management in the Thanakasoga – Luhali Panchayat area in Sirmour district of Himachal Pradesh through a comprehensive springshed management approach based on the concept of Participatory Groundwater Management (PGWM).
2	Central Himalayan Rural Action Group (CHIRAG) with the help of Advanced Center for Water Resources Development and Management (ACWADAM), Pune.	Springs revival through para-hydrogeology: A team of para-hydrogeologists mapped springsheds, monitored spring discharge and quality and identified a spring typology for the region of work that led to piloting recharge and demand management measures that helped impact more than 100 springs in three districts of Kumaon region.
3	Himmothan, Dehradun along with Tata Trusts, Nagaland.	Mission spring revival – scaling up the hydrogeology based model
4	Himalaya Seva Sangh.	Campaign for spring water conservation and restoration in Uttarakhand.
5	Rural Management and Development Department (RM&DD), Government of Sikkim	Rejuvenation of 700 springs through Dhara Vikas & MGNREGS programmes
6	Eleuthrian Christian Society (ECS), Nagaland with support by Tata Trusts.	Piloting and demonstrating springshed management for improved water security in more than 10 locations in Nagaland.

7	Government of Meghalaya (through the Meghalaya Basin Development Authority – MBDA).	Capacity building initiatives and mapping of 60,000 springs and plan for spring water management of 5,000 springs in 11 districts.
8	Centre for Ecology Development and Research.	Creating awareness and teaching science behind sub-surface water and recharge to groundwater in Naini Tal.
9	International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.	Capacity building, developing an 8-step methodology of springshed management, advocacy for national programme in India.
10	Rural Development Department of West Bengal in partnership with PRIs, Prasari and ACWADAM.	Springshed management for 50 springs in 4 hill districts of West Bengal.
11	Advanced Center for Water Resources Development and Management (ACWADAM)	Played a role of a knowledge partner in majority of initiatives in terms of S&T knowledge transfer, training and facilitation; developing collaborative model for springshed management through partnerships across a range of institutions and over multiple locations; promoted the strategic application of hydrogeology in spring-water management through community empowerment.
12	Arghyam	Supporting spring-based water security work, reticulation of safe water, declining spring discharge, springshed management approach using science with traditional knowledge.
13	ICIMOD	Worked in close partnership with ACWADAM and other partner organisations in taking the concept of springshed conservation and management to more than 7 countries across the HKH Region, including seeding it as part of the Himalayan University Consortium and also integrating the concept into policy dialogues with different countries in the region.
14	BARC	Isotope applications on understanding spring water in different parts of the region, including key benchmarking of studies and concepts.
15	IIT-Roorkee	Research on understanding springs as part of the larger Himalayan hydrology, including use of low-cost technology to instrument watersheds and springsheds in some areas. Measurement of spring discharge has emerged as one of the key areas in which IIT-R is engaging other partners to develop key research ideas.
16	Wadia Institute of Himalayan Geology	Pioneered the concept of correlating Himalayan Geology with the understanding of springs in various contexts, including integrating spring water management as part of wider disaster management strategies in the region, given overarching issues of climate change.
17	GBPNIHESD	One of the first comprehensive reportage on spring water depletion has emerged as part of the institutions surveys on water in the Himalayan Region. Currently involves training and research on springs across different landscapes of the Himalayan Region.
18	National Institute of Hydrology	Research and training in hydrology across a vast spectrum of Himalayan conditions has progressively included spring water as an important aspect.
19	SASE	Springs as part of larger disaster and climate mitigation programmes especially in the higher altitude regions of the Himalaya.

Note: Swiss Agency for Development and Cooperation (SDC) and GIZ have also contributed significantly to the springshed management work in the Himalayan Region through their various programmes. These include Indian Himalayas Climate Adaptation Programme (IHCAP) and Supporting State Strategies on Climate Actions (3SCA) programmes of SDC and Climate Change Adaptation – North Eastern Region of India (CCA-NER) programme of GIZ.

A. People's Science Institute, Dehradun

People's Science Institute, Dehradun has experience in springshed development work for more than a decade now. It has undertaken springs' rejuvenation initiatives at the following locations:

2002-2006: Uttarakhand and Himachal Pradesh (18 springs) under watershed development programmes

2009-2011: South, West and East districts of Sikkim (12 springs) in collaboration with Rural Management and Development Department, Government of Sikkim.

2012-2016: Thanakasoga Gram Panchayat (5 springs), district Sirmour, Himachal Pradesh under Participatory Ground Water Management Programme.

2016-2017: One spring in each of the 11 districts (11 springs) of Nagaland through support from Land Resources Department, Nagaland

Springshed Work in Uttarakhand and Himachal Pradesh under Central Public Works Department (CPWD) Programme

In 2001-02, PSI initiated the "Resolving the Himalayan Dilemma" programme under the initiative "*Himmothan Pariyojana*" supported by Sir Ratan Tata Trust. The objective was to provide training and development support to 15 voluntary organisations in the States of Uttarakhand and Himachal Pradesh for undertaking participatory natural resources management projects on a watershed basis, each in an area of about 500 ha over a period of four years. Between 2002 and 2006, eleven watershed development projects were undertaken by PSI with local partner organizations (POs) to help the communities to meet their basic needs (water, food, fodder, fuel wood and employment) through participatory processes.

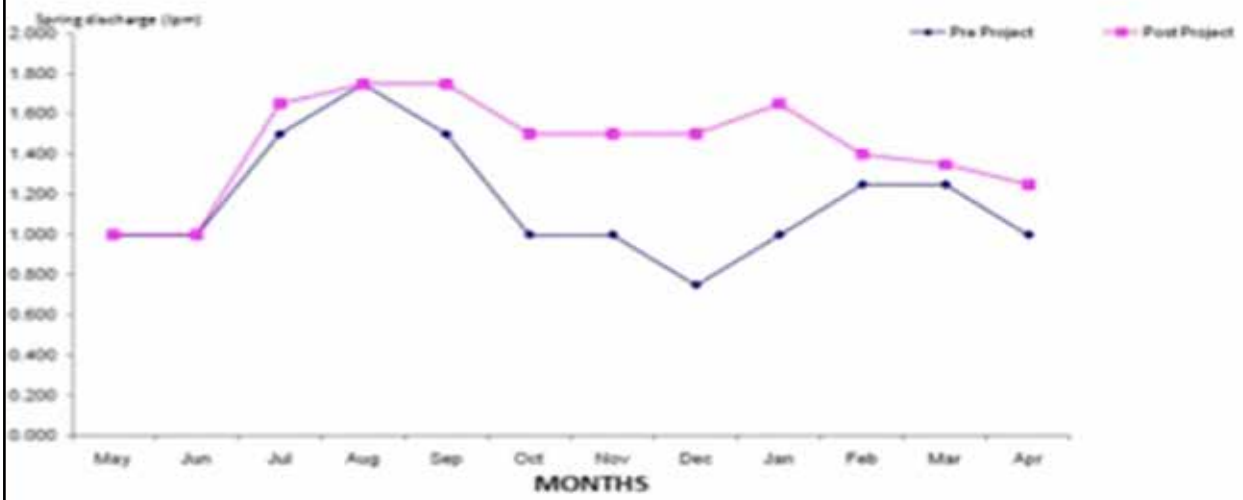
In the 11 watersheds, spring-shed development activities were undertaken creating water sanctuaries. The spring-shed development activities included engineering measures (digging of staggered contour trenches, nala treatment, brush wood check dams, loose boulder check dams, construction, gabions/retaining walls/ spurs, diversion drains) and vegetative measures (fuelwood, fodder and fruit trees plantations, grassland development, and live hedge rows).

Springshed Development Programme (Dhara Vikas) in water scarce areas of Sikkim

In 2009, PSI offered its consultancy services on springshed conservation and development programme in water scarce areas of Sikkim with World Wildlife Fund (WWF)-India support. Over six months, PSI conducted reconnaissance field surveys of twelve spring catchments under eight blocks of South Sikkim, West Sikkim and East Sikkim districts, assessed the status, and identified appropriate catchment treatment interventions to rejuvenate the springs.

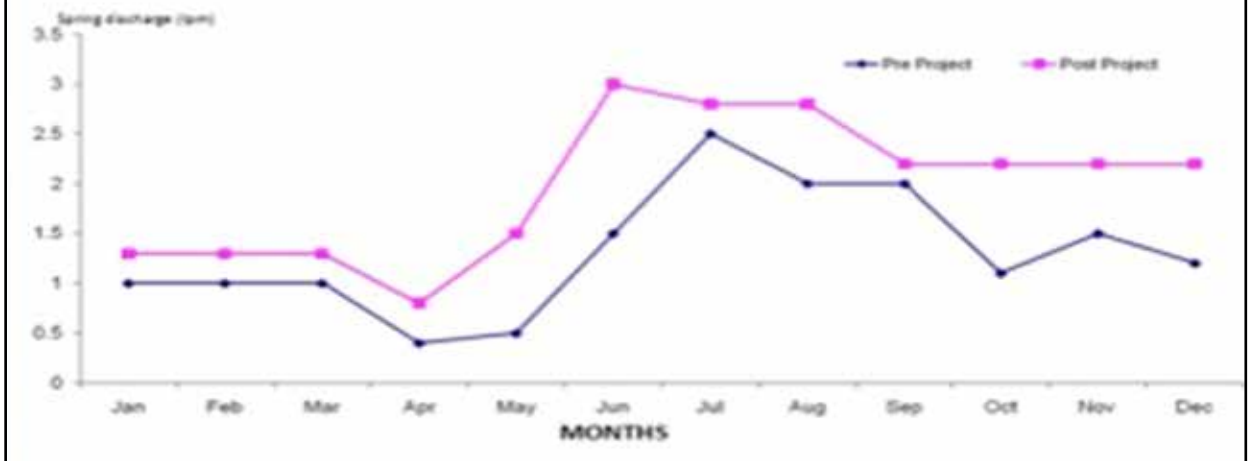
PSI and ACWADAM jointly conducted capacity-building exercises through training workshops and field demonstrations for a group of persons identified by RM&DD, which included Field Facilitators, Block JEs, and Bare Foot Engineers (BFEs).

Impact on Spring Flow
(b) Basantu Dhara, Tehri Garhwal (UKD)

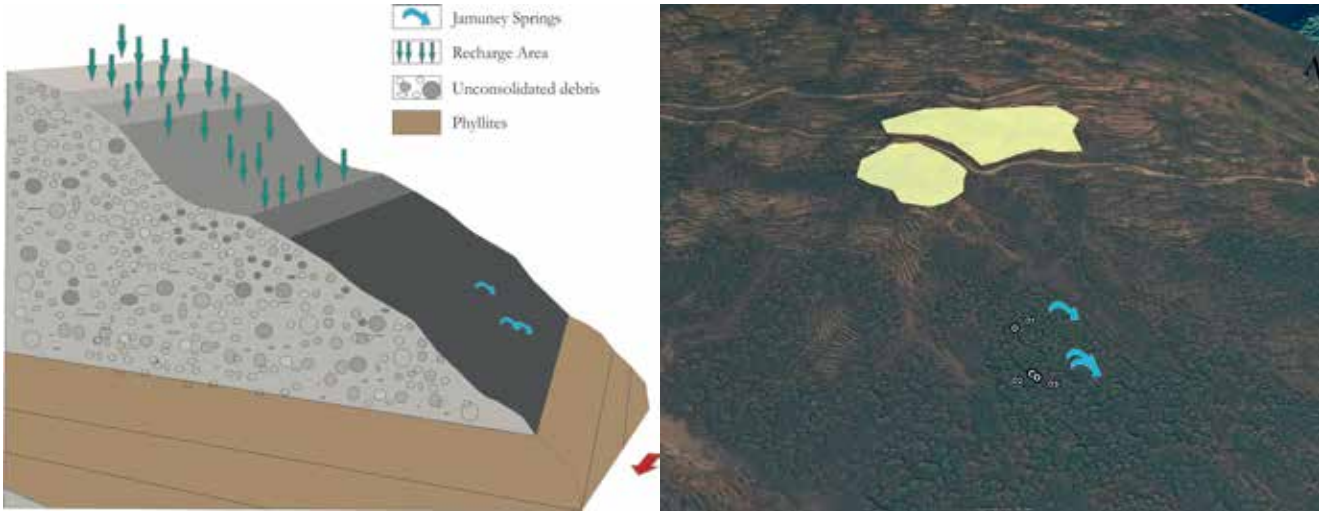


2 community ponds and 6,000 plants (*Quercus*, *Bauhinia*, *Morus* and *Grewia*).
Treated area 4.5 ha

Impact on Spring Flow
(a) Maakri Bawri, Bilaspur (HP)



0.9 ha of staggered trenches and 1,000 plants (*Bauhinia* and *Acacia*)



Hydrogeological layout of Jamuney spring Recharge area identification and demarcation

Recharge measures such as staggered contour trenches, silt detention trenches, field bunds, live hedgerows, plantation of fruit and fodder trees and grasses were implemented in the identified and mapped recharge areas for spring rejuvenation. Implementation costs for spring rejuvenation activities were borne through MGNREGA programme.

Impacts and Outcomes

The project led to the creation of resource inventory of springs for the State, preparation of village springs atlas (700 springs) and a cadre of trained parahydrogeologists. Based on the success of this project, springshed development work was taken up as a State level programme called *Dhara Vikas* by the Sikkim Government leading to the revival of 50 springs and 5 lakes. Convergence with State government (RM&DD) and MGNREGA was first of its kind in the mountain States. The programme has resulted in about 900 million litres of annual groundwater recharge, apart from improving domestic water availability and enhanced farm productivity.

The following table displays impact in a few springs in terms of improved spring discharge:

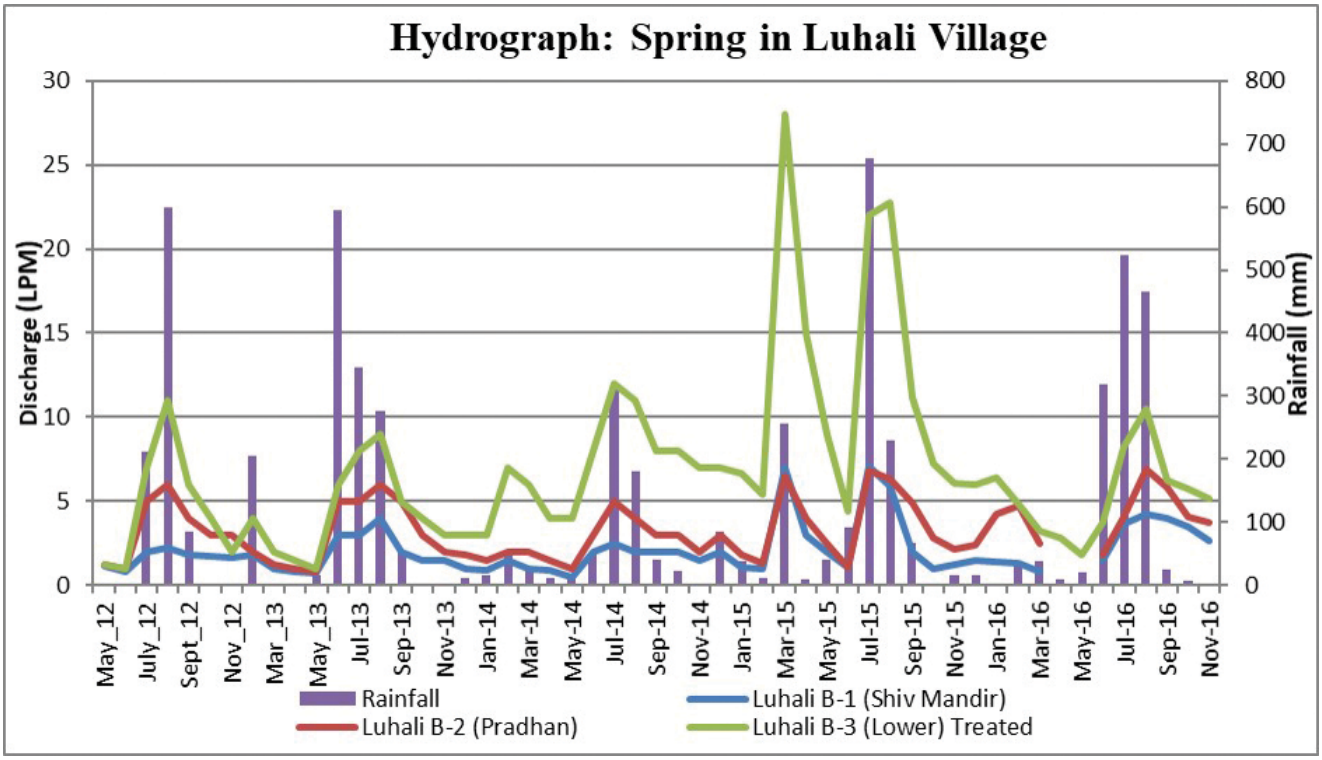
Name of Springs	Discharge March 2010 in Lpm	Discharge in March 2011 in Lpm	Increase in Discharge
Malagiri Dhara, Lungchok	7.5	15	Two times
Aitbarey Dhara, Kaluk	2	6	Three times
Dokung Dhara, Kaluk	8	30	Nearly four times
Nunthaley Dhara, Kaluk	2	10	Five times
Kharkharey Dhara, Kaluk	1	5	Five times
Chukudum Dhara, Ravangla	45	60	One and a half times
Results of springshed management under Dhara Vikas			

Community Based Spring Recharge Work in Thanakasoga Panchayat

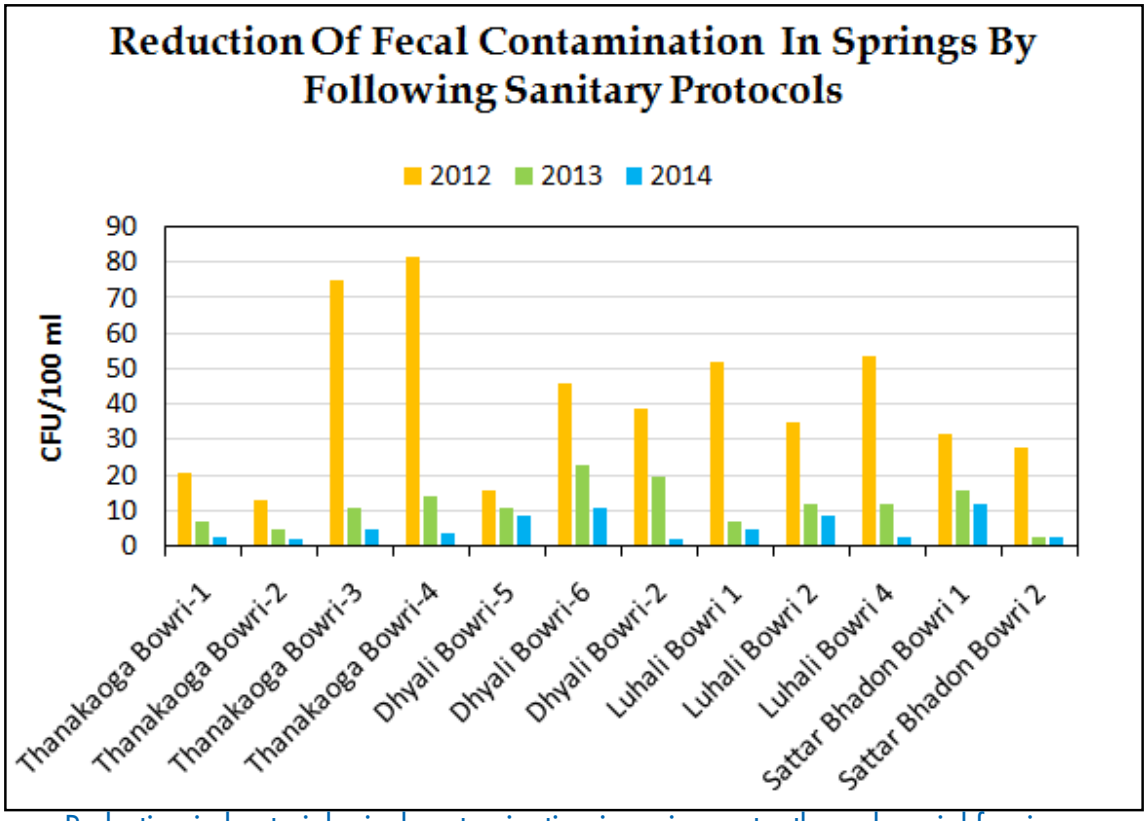
In 2011, PSI implemented a pilot project by carrying out hydrogeological studies to identify recharge areas of 5 springs in Thanakasoga Gram Panchayat, district Sirmour, Himachal Pradesh. The springs are located in 3 villages – Thanakasoga, Dhyali and Luhali. In August 2012, spring recharge interventions were carried out using physical, vegetative and social measures.

Impacts and Outcomes

1. The pilot project led to enhanced spring discharge (see hydrograph below) which led to a more equitable water sharing mechanism amongst communities and increased water availability.
2. Treatment activities in recharge area of Thana-1 baori increased flow in the Sattar bhadon gadera.
3. Increased spring discharge resulted in reduction of geogenic contaminants like iron.



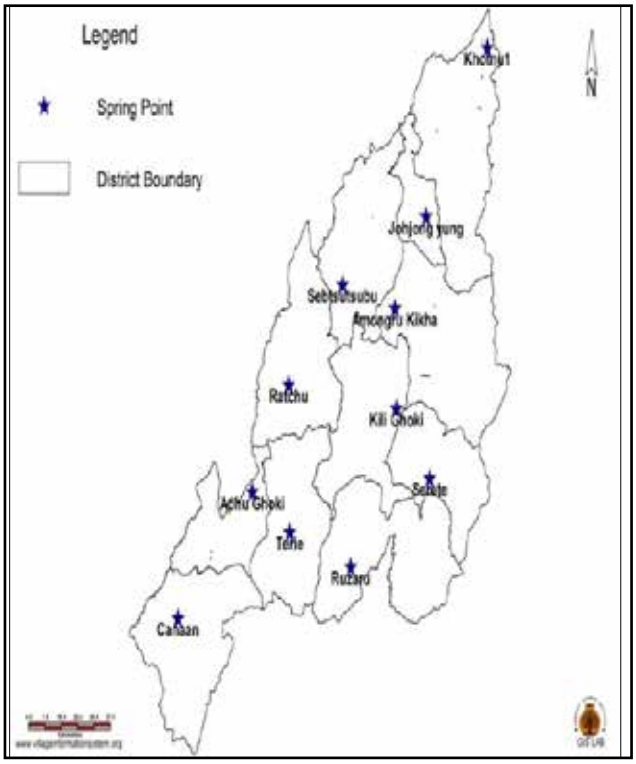
4. Enhanced spring discharge enabled increased water availability for irrigation. Villagers were motivated to try out SCI (System of Crop Intensification) and SWI (System of Wheat Intensification) techniques of farming. These techniques yield more grain with less water. With SWI technique, the average productivity of irrigated wheat went up from 2.42 ton/ha to 3.9 tons/ha for grains while the straw yield increased from 3.3 ton/ha to 4.8 ton/ha. Introducing SCI for grains, vegetables and spices helped farmers (58 out of 152 households in 3 villages) earn additional income.
5. Social fencing helped in reducing bacteriological contamination (shown in graph below) in spring water.



Reduction in bacteriological contamination in spring water through social fencing

Community Based Springshed Development in Nagaland

People in Nagaland are more dependent on springs and small mountain streams than on big rivers. Springs have been drying up primarily due to deforestation and changes in rainfall pattern. In order to rejuvenate springs, the Department of Land Resources, Nagaland initiated a one-year pilot programme to work on one spring in each of the State's 11 districts involving the local communities. PSI's role was to provide technical support and field facilitation to concerned staff from Department of Land Resources as well as communities for planning and implementation of spring recharge activities.



Springs selected for the Nagaland pilot program

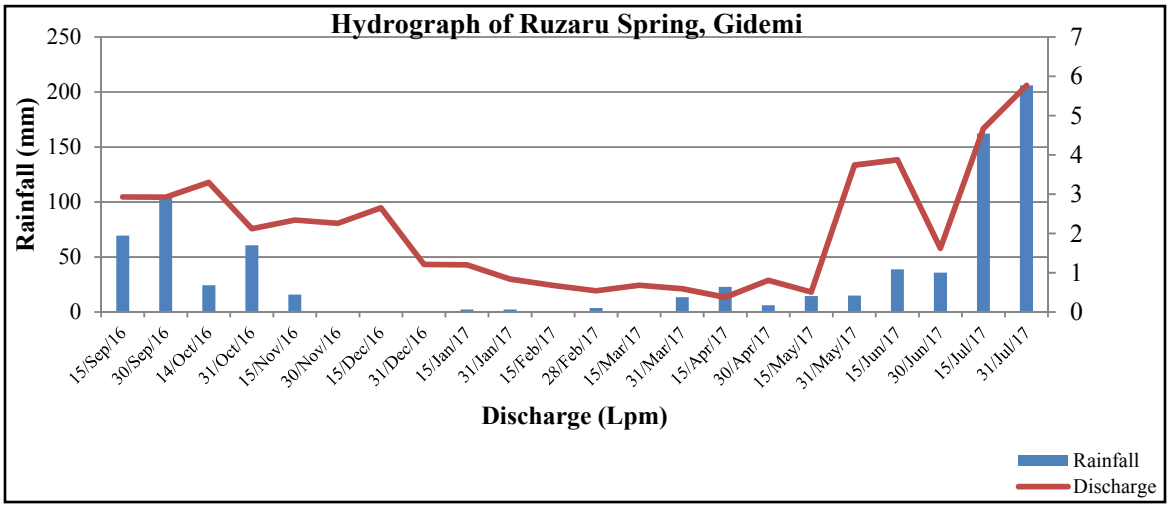
Impacts and Outcomes

The spring recharge programme has so far benefitted more than 600 households with increased availability of water, especially during the summers. The table and graph below show details of activities undertaken in one of the springs i.e. Ruzaru spring in Phek district, which led to the increase in spring discharge (shown in the hydrograph below) within a period of nine months. There are similar improvements in the discharge of other springs as well.

Details of recharge area interventions

Spring	Recharge area (ha)	Slope %	Size of trenches (m)	Number of trenches	Vertical interval (Contour)	Area of grass on bund (sq.m.)
Ruzaru	0.9	30-40	2x0.6x0.45	160	8 – 10	320

The Government of Nagaland is now looking forward to upscale and implement the springshed management programme through the MGNREGA and additional assistance from National Bank for Agriculture and Rural Development (NABARD) to cover the entire State.



Central Himalayan Rural Action Group (CHIRAG), Uttarakhand

CHIRAG began working on recharge and rejuvenation of Himalayan springs in 2008 to address the issue of reduced water availability and deterioration of water quality of springs in the Kumaun region of Uttarakhand. With technical support from ACWADAM Pune, CHIRAG focused on geology and its different aspects to address the issue of water recharge in the springs. In the initial years a lot of time and effort was invested in developing an understanding of Himalayan geology and devising scientific techniques for recharging different types of springs. At present CHIRAG is working on recharge and rejuvenation of 110 springs in 3 districts of Uttarakhand.

Community participation is a core component of the programme and communities are involved in the work through regular meetings and trainings where the concept of hydrogeology, spring formation, recharge

techniques and impact assessment are explained. They are also trained in techniques to assess water quality. The community is encouraged to work on the recharge structures themselves as well as contribute a part of their labour for the cause. The springs once recharged are handed over to the beneficiaries for management thereafter. School level workshops are also conducted to make school children aware of the concepts of hydrogeology as well as water quality. Various methods like dynamic models, PowerPoint presentations and videos are used in addition to discussions to convey the information better.

Currently, CHIRAG is working on two spring recharge and water distribution projects. A project is being worked on in partnership with Arghyam to recharge 70 springs through appropriate recharge activities. The focus is on involving the community and building their capacity in basic geology, hydrology and water management. Since women are the most important stakeholders, a conscious effort is made to form women-led water users group and involve them in recharge activities and decision making process. A Key Resource Person (KRP) is also selected from among the community and intensive training imparted to him/her. The KRP acts as the local knowledge source on springs and ensures sustainability of the process.

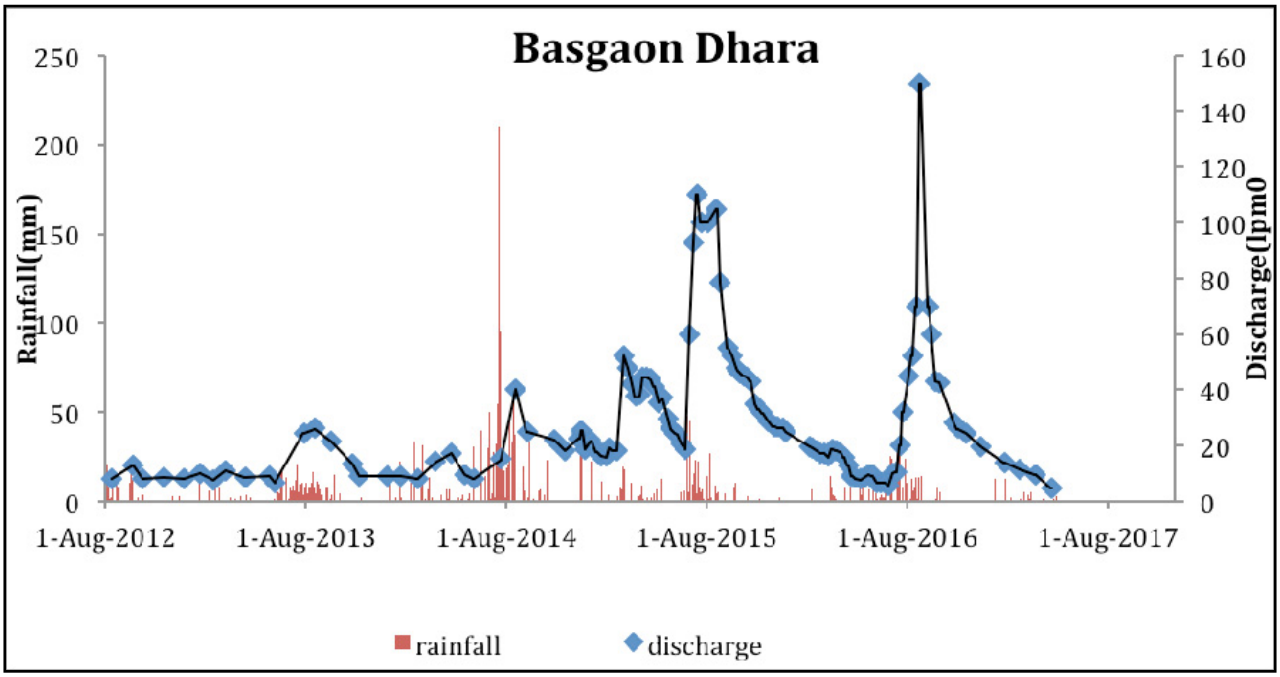
In partnership with The Hans Foundation, a separate project has been undertaken to recharge 25 springs and lay a distribution system for the same. The project is expected to benefit over 1,300 households over a period of 3 years. Under this project, a Water User Committee would be formed which would oversee all the work and take over the system put in place. Meetings and trainings are regularly conducted to make the committees aware of the concept of spring recharge and water management. A key Resource Person (KRP) is also chosen who will take the lead in managing the system. A system of Operation and Maintenance (O&M) fund to provide capital for future upkeep and management of the system has been initiated in the project. The beneficiary families will provide a decided monthly sum for the fund. As of March, over Re 1 lakh was collected as O&M fund.

Impacts and Outcomes

Many springs that CHIRAG has worked on have shown distinct improvement in discharge. This has been corroborated by the community. Shown below is the hydrograph of Basgaon Dhara in which recharge activities were done during the period August-December 2014. Improvement in discharge took place from 2015.

As part of an advocacy effort CHIRAG also conducted a workshop on importance of springshed management involving various State government departments and DMs to influence policies for springshed management at State level. Several workshops have been conducted at the block level involving the respective Block Development Officer and the Village Development Officer. Two workshops involving the District Magistrates of Bageshwar and Bhimtal districts have also been conducted. More such workshops including State government officials are planned for future.

Additionally, CHIRAG has taken steps towards understanding spring behaviour in greater detail. Two watersheds namely Ramgarh and Takula have been instrumented in Nainital and Almora districts respectively. Ramgarh watershed was instrumented in the year 2015 with automated water level recorder



and automated rain gauges. The instrumentation was done on two springs and a stream at the mouth of the watershed. The springs chosen are of different typologies with differences in the characteristics of the recharge areas and are expected to provide a detailed understanding of the spring behaviour with respect to time as well as with land use. Similarly, Takula watershed was instrumented with water level recorders on a spring and a stream at the mouth as well as automated rain gauges at 2 sites in the watershed.

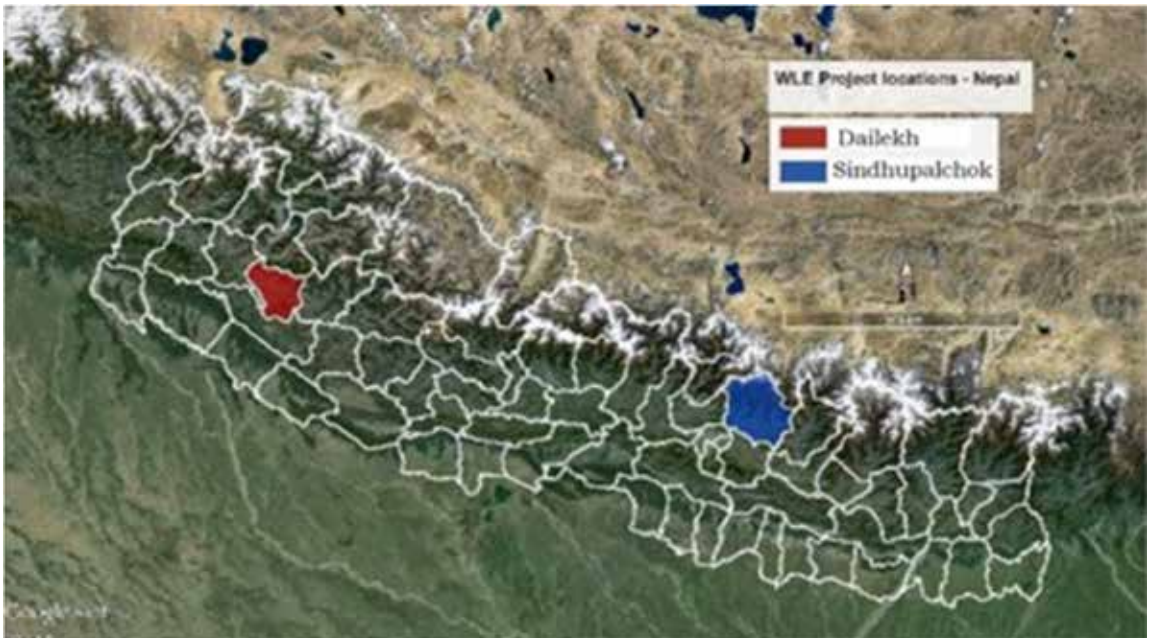
International Center For Integrated Mountain Development (ICIMOD), Nepal

ICIMOD is a regional intergovernmental learning and knowledge-sharing centre serving the eight regional member countries of the Hindu Kush Himalaya – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. ICIMOD has collaborated with ACWADAM for piloting springshed work in Nepal and India.

ICIMOD piloted springshed management in three locations in Nepal and one location in India. The project was implemented over two years and ACWADAM facilitated field studies and provided technical inputs on springshed management. The eight-step methodology for springshed management is the outcome of this partnership.

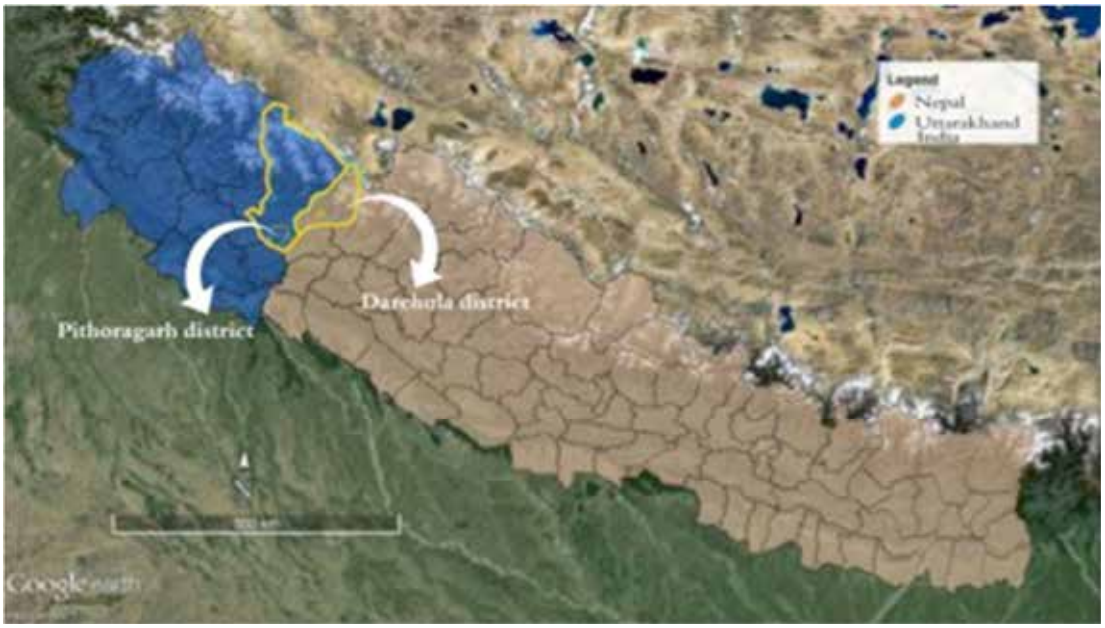
ACWADAM and ICIMOD successfully implemented springshed pilots with field support from HELVETAS in Dailekh and Sindhupalchok, Api-Nampa Conservation Area (ANCA) in Darchula and GB Pant Institute in Pithoragarh (shown in the maps).

During the course of this project, ACWADAM also undertook capacity building exercises at various levels. Training of 'barefoot hydrogeologists' in the communities contributed significantly to successful

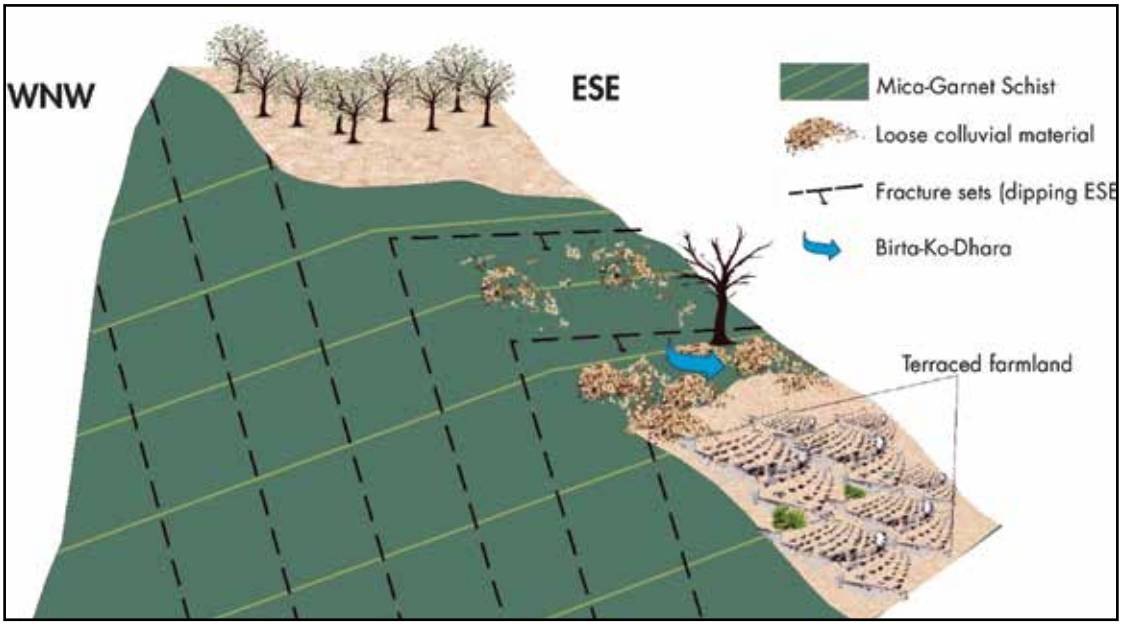


Pilot sites under Water Land and Ecosystem (WLE) programme

implementation of springshed programme in all the pilot locations. Communities were able to understand the importance and need for springshed management. They were also convinced with the hydrogeological approach which is necessary for effective implementation of springshed management programme. Besides, ICIMOD staff and other field level partners also went through exhaustive training course on springshed management to help them scale out the work to other parts of the State and country.



Pilot sites under Kailash Sacred Landscape programme

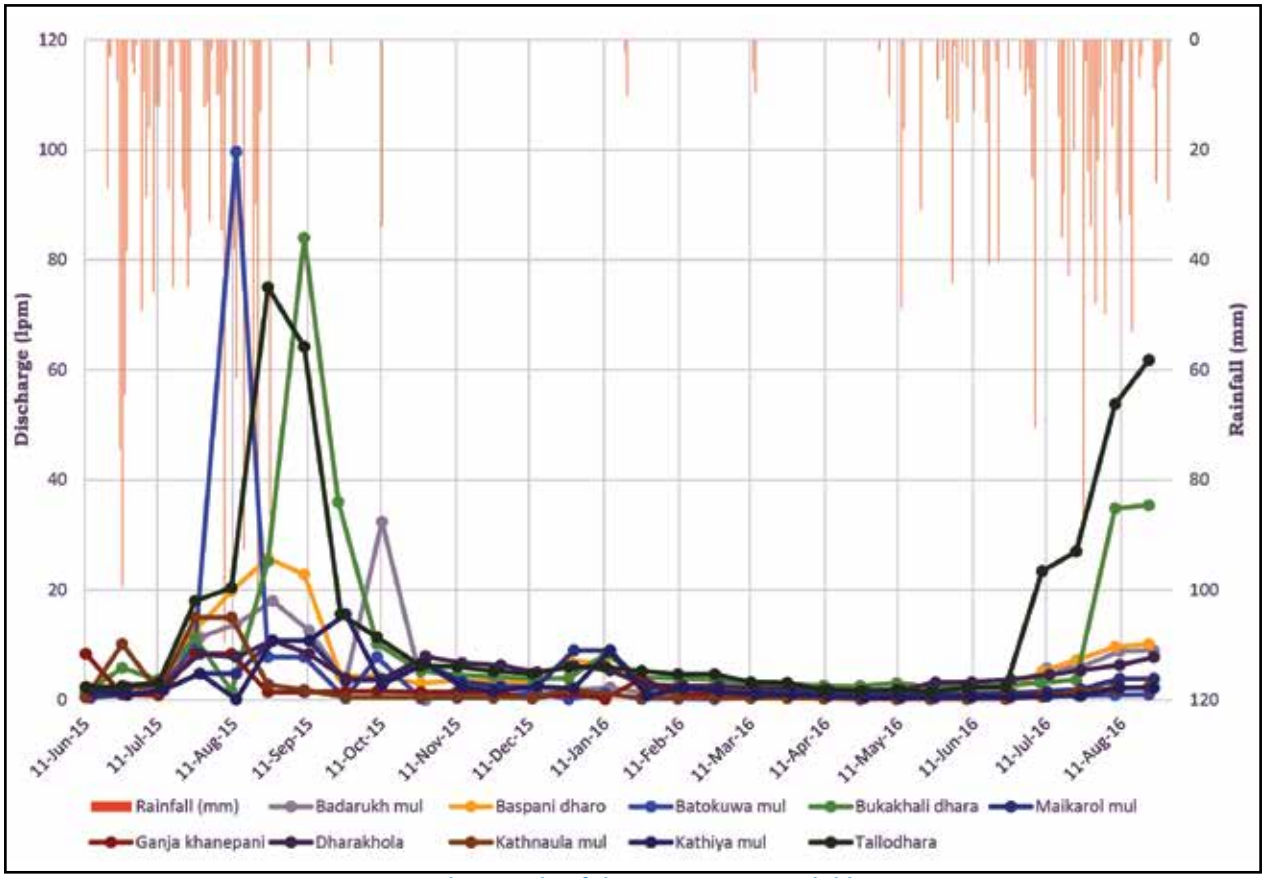


Conceptual layout of a spring in Sindhupalchok

Data monitoring systems have been established in the all the pilot sites which are collecting rainfall and spring discharge data. Implementation was done in the last year post monsoon therefore it will be useful to see data next year to measure impacts.

Barefoot Hydrogeologist training conducted in Sindhupalchok
(Photo: ICIMOD-ACWADAM WLE Project)

Geological mapping of the springsheds
(Photo: ICIMOD-ACWADAM WLE Project)



Hydrograph of the springs in Dailekh

Efforts at scale

The Sikkim Government began a State-wide springshed management programme in 2008. After piloting 50 springs with significant results, they began scaling up and have since mapped over 1,000 springs and have initiated Village Water Security Plans. Over the last five years, it is estimated that over 900 million litres of water have been recharged annually. This work involved a one-time investment of 1 paisa per litre.

More recently, other State governments have started showing interest in this approach. Meghalaya has, over the last year with help from the Springs Initiative, trained hundreds of government field staff and volunteers. Thousands of springs have been inventoried and there are plans to protect springs in nearly all villages in the State – the first such activity at this scale anywhere in the nation. The State has been able to map ~ 2,000 springs and envisages to address them in the coming years with the help of State Departments like Soil and Water Conservation, Water Resources and Rural Development that implement projects on ground. The State has initiated 3 years long term project in collaboration with ACWADAM and PSI which will incorporate exhaustive capacity building programmes for different Departments to ensure effective implementation of springshed development across the State.

West Bengal has adopted the Sikkim model of convergence with MGNREGA for springshed development. PRASARI, an NGO based out of West-Bengal is anchoring the springshed development programme in collaboration with ACWADAM in 4 districts (*Darjeeling, Kalimpong, Jalpaiguri and Alipurduar*). Nearly 35 springs across these districts have already been implemented with springshed activities. The State envisions to target more than 500 springs over the next 3 years.

Significant contribution is even made in certain parts of the Western and Eastern Ghats. Some 22 springs were addressed in Panchgani, Satara district by GRAMPARI, an NGO with the help of ACWADAM's technical support. The work also focused on building institutions within the communities in the form of *Bhujal Dharak Samiti*, which addresses the issues related to the springs in their villages. In the Eastern Ghats, Keystone Foundation has been able to demonstrate a few pilots in the Nilgiri district of Tamil Nadu. ACWADAM, along with other NGO partners, Arghyam and under the leadership of a young PMRD Fellow, initiated and completed an inventory of nearly 500 springs in three districts of Odisha recently.

Training of Block level officers of Kalimpong district, West Bengal (Photo: ACWADAM)

Training of officers from Soil and Water conservation Department, Government of Meghalaya (Photo: ACWADAM)

Photo credit: Chimi Seldon

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