Report of the NITI Aayog Working Group on

# INVENTORY AND REVIVAL OF SPRINGS IN HIMALAYAS FOR WATER SECURITY

as part of initiatives on
***Sustainable Development of Mountains of Indian Himalayan Region***

Submitted to

## *NITI Aayog*

सत्यमेव जयते
Government of India
Ministry of Science & Technology
**DEPARTMENT OF SCIENCE & TECHNOLOGY**

**December, 2017**

# PREFACE

The Himalayas are the largest and tallest mountain range in the world, bordering 8 countries viz., Afghanistan, Pakistan, China, India, Nepal, Bhutan, Bangladesh and Myanmar covering an area of about 43 lakh Sqkm$^2$ where 9 major perennial rivers viz., The Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Tarim, Yangtse and Yellow River have their origin. More than 30 peaks of the Himalayas rise to heights of 7620 m (25,000 ft) or more, and one of these, Mount Everest (8848 m), is the world's highest mountain. Nearly 1.5 billion people depend on Himalaya for Water, Food and Energy. The Indian Himalayan Region (IHR) is the part of the Himalaya within India, spanning 10 hill States viz., Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and two partial hill, states - Assam and West Bengal. Nearly 50 million people reside in the Indian Himalayan Region (IHR) alone.

Mountain springs are the primary source of water for the 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 and/or irrigation. 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 are today facing the threat of drying up. Spring discharge is reported to be declining due to increased water demand, changing land use patterns, and ecological degradation. With the climate change manifested in the form of rising temperatures, rise in rainfall intensity, 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, the efforts to preserve and save springs from drying up and the consequent efforts to recharge them are gaining momentum. A few State governments, Civil Society Organizations and 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 of spring protection efforts utilize a similar programmatic approach. These include; mapping of springsheds through hydrogeology; restoration, protection and/or augmentation of recharge; monitoring and management of springs, 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, that they understand how it is done, and that they be willing to assume the responsibility of managing their springs. In most cases, therefore, the demand for spring restoration needs to come from such communities. The crises surrounding water make it necessary 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 demonstrate the important role that the governments can play in effective implementation of springshed management programmes. Such programmes have been participatory involving communities at local scale, NGOs, CSOs and were implemented through a science-based management approach. Such 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 at the 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 2nd June, 2017 has constituted a Working group on "Inventory and Revival of Springs of Himalaya for Water Security" as one of the 5 Working Groups. The broad objective of setting up of this working group was to take stock of the magnitude of the problem (drying of springs, quality of water from springs), review related policies across IHR and to ascertain its

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 in short, medium and long terms.

A few agencies/institutions have been identified as participants to this group. These include; representatives of Department of Land Resources, Govt. of India; Ministry of Environment Forest & Climate Change; Central Ground Water Board; Rural Management & Development Department, Govt. of Sikkim; ACWADAM. Pune and International Centre for Integrated Mountain Development (ICIMOD), Kathmandu. The Department of Science & 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 Working Group has been given a deadline of three months for submission of its report to NITI Aayog.

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 meeting of the stakeholder consultation was convened on Tuesday the 8th August, 2017 at the Department of Science & Technology. As many as 40 people belonging to government, non-governmental and autonomous organizations participated in the meeting. Based on deliberations, a number of recommendations were brought out. The meeting also set up a drafting team to prepare a draft report based on inputs received from various stakeholders and team members.

New Delhi
December 29, 2017

**Akhilesh Gupta**
Adviser, Department of Science & Technology &
Convener, Working Group-I :Inventory and Revival of
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# ACKNOWLEDGEMENTS

As Convener of the Working Group-I : Inventory and Revival of Springs of 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 VK 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 band providing his constant encouragement and support without which the task could not have been completed.

I am so thankful to **Dr Ashok Kumar Jain**, Adviser, NITI Aayog who has provided so much motivation and support for taking up this initiative. I gratefully acknowledge his suggestions and guidance during the Stakeholder meeting on 8th August,2017. I am also thankful to his colleagues in NITI Aayog especially **Shri Neeraj Srivastava**, Director, Ms Monika Singh, and others for their constant support.

I am thankful to all the member institutions of 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 would also like to express my gratitude to a few experts viz., **Prof S.K.Dube,** Former Director, IIT, Kharagpur, **Prof SP Singh**, Former VC, HNB Garhwal University and **Shri Mukul Sanwal**, Former diplomat and Joint Secretary in MoEF & CC for their very valuable suggestions and guidance during the stakeholder meeting and also for providing critical comments on the draft report.

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

**Akhilesh Gupta**

New Delhi
December 29, 2017

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*Note: A large proportion of the illustrations and photographs have been borrowed from various presentations made by the above-mentioned institutions. While each illustration is not credited individually, the report collectively acknowledges the institutions from whose presentations such illustrations have been borrowed.*

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**INVENTORY AND REVIVAL OF SPRINGS IN HIMALAYAS FOR WATER SECURITY** set up by NITI Aayog, Government of India as part of initiatives on

***Sustainable Development of Mountains of Indian Himalayan Region***

# EXECUTIVE SUMMARY

The Indian Himalayan Region is spread across 12 Indian states stretching across a length of 2500 km and width of 250 to 300 km. The IHR is home to over 50 million people. Most of northern India's river systems originate in the Himalayan region, either through glacial melt or in the form of springs. Springs are the main source of water for millions of people in the Himalayas. Both rural and urban communities depend on springs for meeting their drinking, domestic and agricultural water needs.

There is increasing evidence that springs are drying up or their discharge is reducing throughout the Himalayan region. The erratic rainfall pattern, seismic activity and ecological degradation associated with land use change for infrastructural development is putting huge pressures on mountain aquifer systems. It is reported that half of the perennial springs have already been dried up or have become seasonal resulting into acute water shortage for drinking and other domestic purposes across hundreds of Himalayan villages. It becomes clear, therefore that any significant depletion in such spring flows at river origins will surely impact the flow of rivers. The magnitude of the problem is exemplified by the high dependency of Himalayan populations on spring water on one hand and the depleting – deteriorating status of springs on the other. The ignorance of springs in the larger context of rivers, watersheds and aquifers is also a reason for great concern as such ignorance has led to large gaps in practice and policy in developing any strategic national response to spring water management in India. Besides, depletion, of late, there has been increasing concern about the quality of spring water. Contamination originating from two different sources - geogenic and anthropogenic - can lead to deterioration of spring water supplies. Microbial content, sulphates and nitrates are mainly due to the anthropogenic causes. Fluoride, arsenic and iron contamination is mainly derived from geogenic sources. Spring management is slowly becoming a nationally pertinent problem, more important for the Himalayan population than

ground water is for those living in the plains**,** and hence there is an urgent need to address these issues in a holistic and scientific manner.

Most policies were blindfolded about spring water in India. Like wells that constitute human-made structures for groundwater access, aquifers feeding springs are being pumped to extract water with no scientific assessment around questions of equity and sustainability. Like wells as human-made sources of accessing aquifers, springs were protected as discharge points of the aquifer that provide access of water to people in their natural, often pristine state. 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 tube wells into the ground to create access to groundwater. It is perhaps this single reason that has kept policies away from springs, often taking spring water for granted.

There has been an upsurge of studies and initiatives to address spring management in India in recent years, given the seriousness of the emerging crises around springs These have been mostly community-centric initiatives that have looked at distribution rather than regeneration, though they greatly helped mitigating the rural water crises to some extent. The concept of springshed management is now quite well-ingrained in the form of pilots of varying scales across the Himalayan states. The first systematic initiative was undertaken through the *DharaVikas Programme* by the Rural Management and Development Department (RM&DD), Government of Sikkim, even as smaller, deeply incisive 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 is best summarised through a step-wise methodology to which all this piloting has significantly contributed. First developed as a planning tool under DharaVikas, 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 Himalayan Region through the ICIMOD-ACWADAM partnership.

In order to bring the issue of springshed management to the 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$^{nd}$ June, 2017 constituted 5 Working

Groups on Sustainable Development in Mountains of Indian Himalayan region. "***Inventory and Revival of Springs of 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. The Department of Science & Technology (DST) has been designated as the lead institution to finalise a report on the theme. The broad objective of setting up of this working group was to take stock of the magnitude of the problem (drying of springs, quality of water from springs, regeneration of springs), review related policies across IHR to ascertain its 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 best practices and a standard protocol of implementation are being integrated into spring work and ways to strengthen it; assess challenges faced by the existing initiatives and suggest policy and practice action in short, medium and long term.

The first meeting of the stakeholder consultation was convened on Tuesday, the 8th August, 2017 in the Department of Science & Technology. The meeting was attended by almost all key institutions and individuals engaged in spring management. The meeting deliberated various issues at length and brought out several recommendations covering a list of short, medium and long term actions.

One of the most important recommendations of the group was to launch a holistic National Programme on Regeneration of Springs in the Himalayan Region.. This might pave the way to overcome a majority of challenges outlined in the report. The programme may 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 so as to enable scaling up from this resource block from the fourth year onwards. Vulnerability will be defined on the

basis of focusing on spring depletion issues 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 instrumentation in conjunction 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 polices needed to scale up such projects. This phase will involve the following broad set of activities:

- Systematic mapping of springs across the Himalayas. 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 wherever available and satellite imageries will be used to develop digital maps and data base with a clear mandate on sound 'ground truth' evidence..
- 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.The software will provide for reconciliation of the data and identification of problem sites and will enable access by the public.
- Capacity building activities and communication between the States will be useful in taking the agenda of spring-shed management forward. 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 DST and National Mission on Himalayan Studies (NMHS) implemented by MoEF&CC, scientific institutions and State 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 countries with mountain areas could be considered to share experiences.

**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 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.

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 MGNREGS (like the Dhara Vikas programme of RM&DD, Sikkim or the more recent programme of convergence between springshed management and MGNREGS of Government of West Bengal). 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, therefore, may deviate from the broad aspects/guidelines given below.

- Mainstreaming of spring-shed management with other developmental programmes is required to facilitate greater convergence with government schemes at a substantial scale. For instance, a focus on forest quality in springsheds / critical water recharge zones is of significance. 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) and access to quality fodder so as to reduce forest degradation, and damage to the understory. This will benefit recharge in these critical zones, while ensuring effective convergence.
- Building close and effective partnerships between Government Departments, R&D Institutions/Universities and community based NGOs.

- 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.
- Reviving springs and sustaining them requires a combination of scientific knowledge (hydrogeology) and the community's sense of ownership of the resource. Hence, resource mobilisation for techno-scientific as well as socio-economic contexts becomes important.

**Long-term actions – Phase III : (Beyond 8$^{th}$ 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 within a challenging landscape. 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. There are newer financial opportunities including development bonds that could be explored. Further, there is scope of exploring mobilisation of resources through instruments such as NMSHE where spring-water conservation could also have a bearing on India's commitments to the contribution towards climate change regimes. Moreover, given the dependence of mountain communities on spring water for meeting their drinking water needs, SDGs especially SDG6 (including safe water) can be easily explored. The application of SDGs could facilitate multi-stakeholder collaborations required for effective implementation of springshed management.

Indicative actions would involve:

- Linking the livelihoods of the communities with the interventions related to revival of springs in ensuring the sustainability of such interventions even 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 become equipped in the operation and maintenance activities.

- Awareness and education of communities regarding springwater management under a changing climate can play a crucial role in spring-shed management.
- Development of adaptive strategies based on hydrogeological investigation and demand-supply model for vulnerable springs. Consideration of climate change projections and likely future impacts is required while identifying and implementing spring-shed 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.
- 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 on the other side.

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

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# 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;

i. Revival of Springs
ii. Sustainable Tourism
iii. Transforming Shifting Cultivation
iv. Building Skill and Entrepreneurship Landscape and
v. Data for Informed Decision Making

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

Following 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 of 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 –

i. Department of Land Resources, Govt. of India;
ii. Ministry of Environment Forest & Climate Change;
iii. Central Ground Water Board;

iv. Rural Management & Development Department, Govt. of Sikkim;
v. ACWADAM, Pune and
vi. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.

The Department of Science & 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 7extent 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 groups 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 2nd 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/govt organizations and institutions; International organizations and NGOs. The list is given below-

**Ministries and Government Departments, Institutions**

- Niti Aayog
- Ministry of Water Resources
- DST
- Dept. of Land resources, GoI
- Ministry of Environment, Forest & Climate Change, GoI
- Geological Survey of India
- Central Ground Water Board
- National Institute of Hydrology (NIH), Roorkee
- Wadia Institute of Himalayan Geology, Dehradun
- BARC, Mumbai
- GB Pant Institute, Almora
- SASE, DRDO, Chandigarh
- IIT Roorkee
- Rural Management & Development Department, Govt. of Sikkim
- Government of West Bengal

**International Organisations**

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

**Non Governmental Organisations**

- ACWADAM. Pune
- ATREE, Bangalore
- People's Science Institute, Dehradun
- Chirag,
- Grampari
- Arghyam
- Himmothan
- Bharat Rural Livelihood Foundation (BRLF)
- Prasari, West Bengal
- 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, WB; MoEF&CC, DoLR, Prasari, Himmothan; ECS, Nagaland
- **Hydrological Mapping** – CGWG, 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 & 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 & Technology. Dr Ashok Kumar Jain, Adviser, NITI Aayog, Prof SK Dube, Former Director, IIT Kharagpur, Prof SP Singh, Former VC, HNB Gharwal 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 report was also finalized.

# CHAPTER-I: INTRODUCTION

# CHAPTER-I

## INTRODUCTION - SETTING THE CONTEXT

The Indian Himalayan Region is spread across 12 Indian states stretching across a length of 2500 km and width of 250 to 300 km. It is bounded by $27^0$ 57' - $37^0$ 5' N latitudes and $72^0$ 40' - $97^0$ 27' E longitudes. It is not just the physical bearing of these mighty mountains that hold us in awe, but the Himalayas assume great significance to the people of India- socially, culturally and economically. The Himalayan eco-system is home to over50 million people who eke out their lives and livelihoods from this great region. Most of northern India's river systems originate inthe Himalayan region, either through glacial melt or in the form of many springs that dot the mountainous landscape of the region. 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 meeting 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*

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. The erratic rainfall pattern, seismic activity and ecological degradation associated with land use change for infrastructural development is posing huge pressures on mountain aquifer systems. It is reported that half of the perennial springs have already dried up or have become seasonal resulting into acute water shortage for drinking and other domestic purposes across hundreds of Himalayan villages. Continued crisis will consequently affect lives of millions of people in the mountains. A large section of the population of the Himalayan Region depends on natural spring water for fulfilling their domestic and livelihood needs such as drinking water, sanitation and irrigation. The dependency of majority of the population on spring water implies that with changing climatic conditions and rainfall pattern, a large number of villages, hamlets and settlements are facing potential drinking water shortage. In fact, half of the perennial springs have already dried up or have become seasonal and thousands of villages were currently facing acute water shortage for drinking purposes about 8-10 years ago, a figure that may be relevant even more so today.

What is even more important to note is the fact that while glaciers are easily 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, a high dependency on one hand and an increasing sensitivity to depletion on the other, make Himalayan Springs a source that has become greatly vulnerable in the current context, despite their being part of a strong heritage, traditions and cultures in the region. It becomes important to recognise springwater depletion as a nationally pertinent problem and begin to address it straightaway through preventive and corrective measures.


*Spring-fed spouts inside a temple in Kathmandu (above) and a spring in Ladakh with a symbol of its worship (below)*

| State name | Number of villages with springs | Total number of villages | Percentage of villages which report having springs | Spring Channel based surface flow irrigation | 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 | 2086 | 5589 | 37.3 | 15 | 4953 | 0.3 |
| Assam | 2997 | 26395 | 11.4 | 265 | 2815 | 9.4 |
| Manipur | 1405 | 2581 | 54.4 | 0 | 516 | 0.0 |
| Meghalaya | 3810 | 6839 | 55.7 | 246 | 8220 | 3.0 |
| Mizoram | 453 | 830 | 54.6 | 1252 | 5371 | 23.3 |
| Nagaland | 639 | 1428 | 44.7 | 27 | 20765 | 0.1 |
| Sikkim | 425 | 451 | 94.2 | 29 | 1485 | 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** | **12177** | **45676** | **26.7** | **1837** | **44635** | **4.1** |
| Himachal Pradesh | 2597 | 20690 | 12.6 | 29 | 11655 | 0.2 |
| Jammu & Kashmir | 3313 | 6553 | 50.6 | 0 | 4698 | 0.0 |
| Uttarakhand | 594 | 16793 | 3.5 | 20182 | 31176 | 64.7 |
| **Western Himalayan states** | **6504** | **44036** | **14.8** | **20211** | **47529** | **42.5** |
| **All Himalayan states** | **18681** | **89712** | **20.8** | **22048** | **92164** | **23.9** |

***Table 1: Statistics of spring population across the entire Himalayan states***

*Source: Col (2) and Col (3) are from District Census Handbook, 2001 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 MOWR, GOI and Col (7) is derived from Col (5) and (6)*

*Note: The table is based on secondary data and is only representative. Real-world estimates, both in terms of numbers and percentages are likely to be quite different from the representative figures in the table. percentages are likely to be quite different from the representative figures in the table. For instance, it is hard to believe that only 3.5% of villages in Uttarakhand depend on spring water supply. The real figure would be way higher than the estimate provided in this table.*

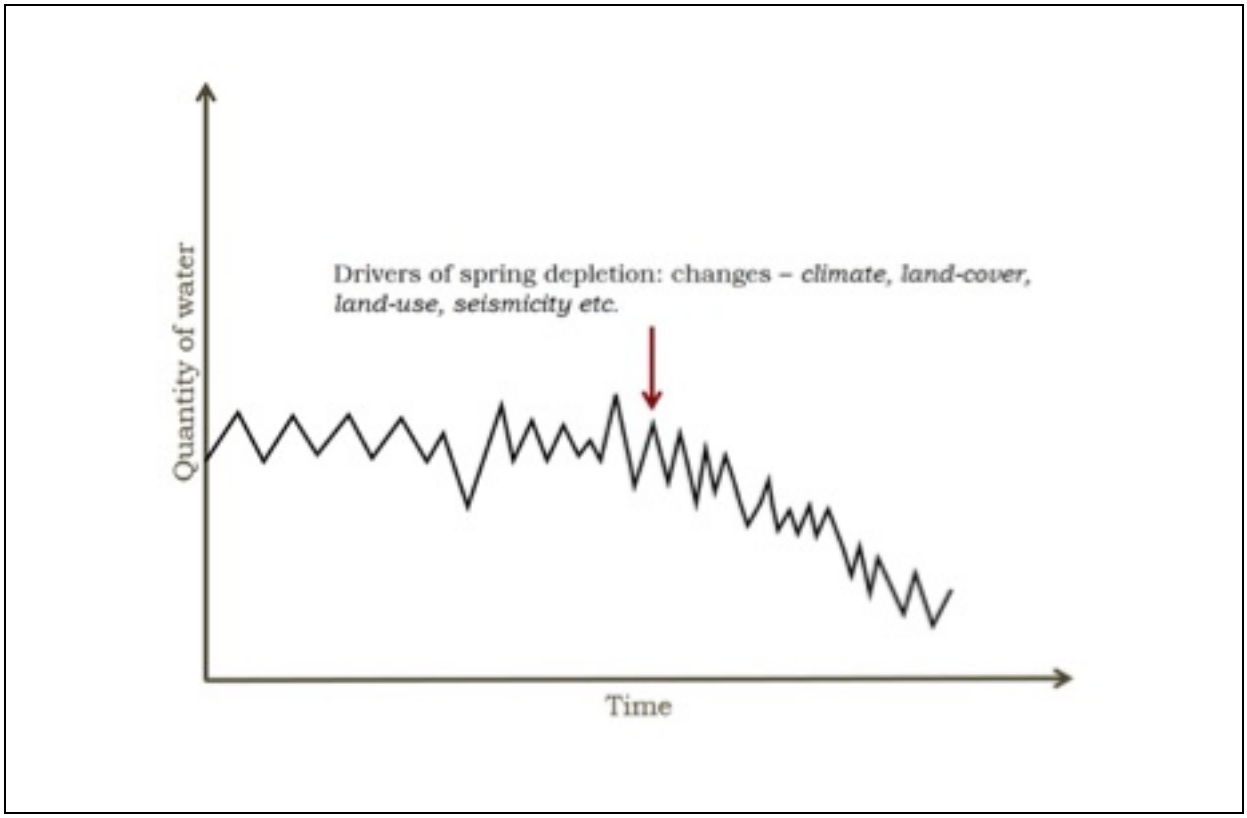
# CHAPTER-II: MAGNITUDE OF THE PROBLEM-MAJOR ISSUES AND CHALLENGES

# CHAPTER-II

## 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. Most villages are located at high altitudes as scattered hamlets; they 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, face problems of drinking water and irrigation. Nearly 4/5th 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 60000 villages in the Indian Himalayan Region. With growing urbanisation in the region, it is also imperative to consider the nearly 500 growing townships and 8 to 10 cities that are rapidly increasing the demographic pressures on water resources in the region. Many growing urban centres also depend on springs and with the tourist pressure only growing, it is anybody's guess as to the growing gap between water demand and availability in the region. 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 operating 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.




*Reduction in Spring Discharge reported across the entire Himalayas*

Mountain environment systems have come into great focus due to their great value, their fragile nature and the increased vulnerability that they face. The Himalayas are not only the tallest mountain range in the world but are perhaps more dynamic than any other region in the world. 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 development-push in the mountain ranges and a changing climate pose threat 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 etc. The prospect of achieving environmental security for 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 meant

disturbances in the water security inside forests and national parks and their fringe areas as well. The problem, therefore, transcends the entire spectrum of dependents and dependencies, from rural and urban water 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 at 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. Most rivers originate as springs in their headwaters. 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 especially originate in the mid-hills (900 to 2000 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 spring water practiced across the entire Himalayan landscape.

*Significance of springs in maintaining flows in the rivers throughout the year*

Depletion of spring water, unfortunately, has led to the development of many unsustainable and impractical alternatives. People resort to immediate coping mechanisms like transport water using pack animals, bicycles, motorcycles and tankers especially during the lean season or during prolonged dry spells during drought years. The drudgery to women is particularly worth mentioning here; when springs run dry, women of the house manually carry water from springs below their village as springs in their village dry up during the lean season. In effect, the cost of inaction has to be 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 1000 meters 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*

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 rest of the spring related issues, very little regarding contamination of springs is documented. 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 of 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.

R*egional springscapesof India, overlaid to a Google Image*

# CHAPTER-III: GAPS IN KNOWLEDGE, PRACTICE AND POLICY

# CHAPTER-III

## 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 depleting – deteriorating status of springs on the other. The ignorance of springs in the larger context of rivers, watersheds and aquifers is also a reason for great concern as such ignorance 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 sources of accessing 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 GEC Methodology (2016).

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 it. 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 in meeting 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 springwater 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 cannot be complete 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 initiative 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.

## Gaps in Practice and Policy

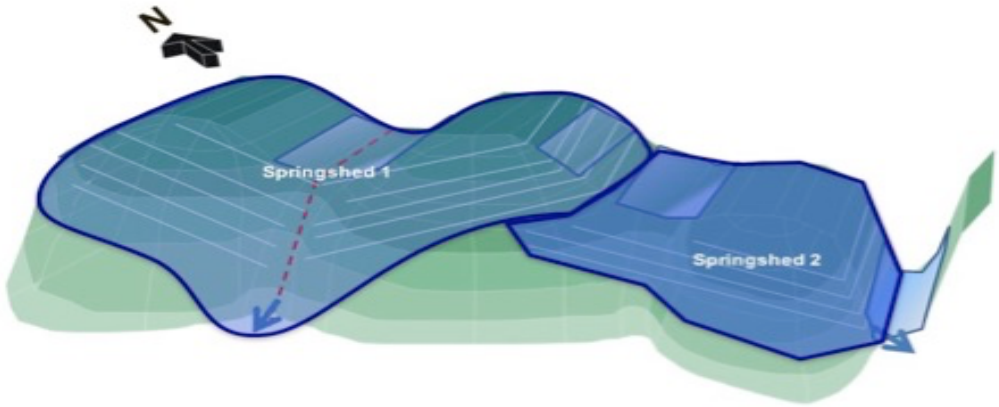
- Springs are the *de facto* groundwater resources of the hills and mountains. Their recognition as such is virtually missing from both water supply and water conservation programmes at large scales. While there are growing examples of integrating the concept of groundwater management with springshed management from many areas in the region, the effort is small as compared to the need.

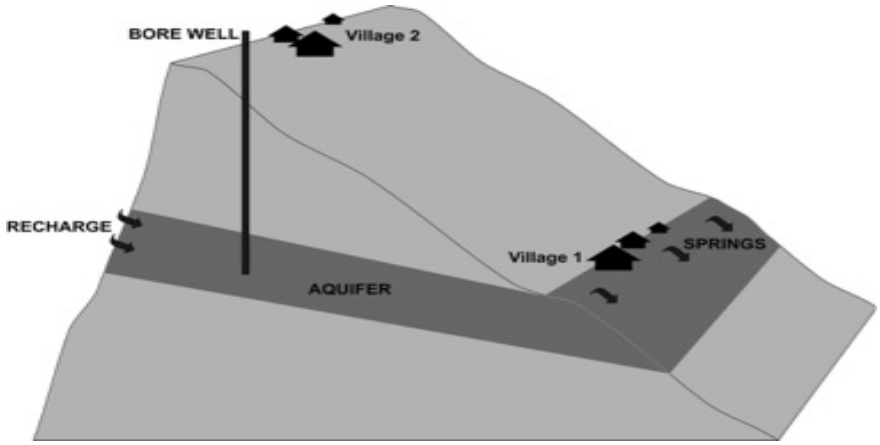
- National Mission for Sustaining the Himalayan Ecosystem (NMSHE) under the National Action Plan on Climate Change (2010) – The topic of springs and spring management has been mentioned in the NMSHE document under the broader topic of 'Sustainable urbanization in Mountain Habitats'. However, there is a need for a balanced approach covering urban as well as rural context to address the problem of reduced springs discharge. Moreover, the integration of science and communities in the approaches to spring-water management under NMSHE would be a most welcome inclusion.

- 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 has been no specific emphasis on springs and springshed management in the document, or for that matter, the connection between springs and groundwater.

- 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 productivities, to provided access to drinking and domestic water and to enable industrial growth is leading to a competition not only between uses and users of groundwater but 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 not is it clearly mandated as a paradigm shift in any water policy documents





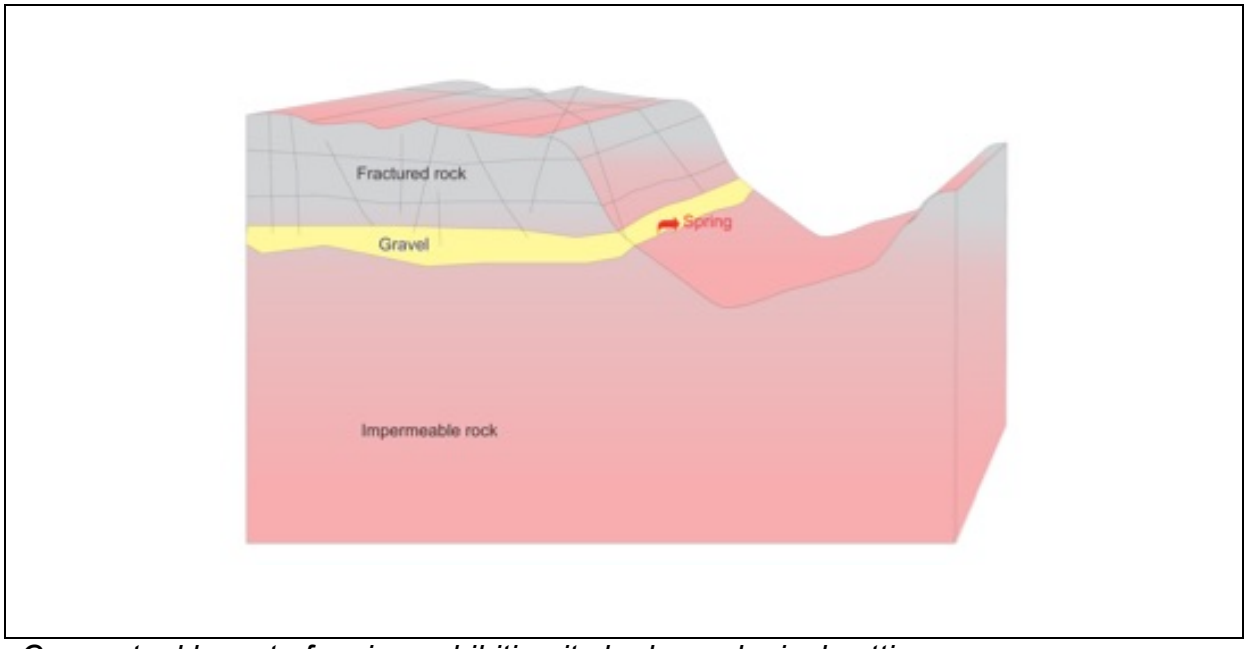

*The concept of 'springsheds' (above) integrates springs, aquifers, watersheds and the catchment areas (recharge zones of the aquifers feeding springs), while also considering socio-ecological factors such as the tradeoffs between boreholes drilled in aquifers that discharge to springs (below)*

# CHAPTER-IV: SPRINGSHED MANAGEMENT IN THE HIMALAYAN REGION: REVIVAL THROUGH RECHARGE

# CHAPTER-IV

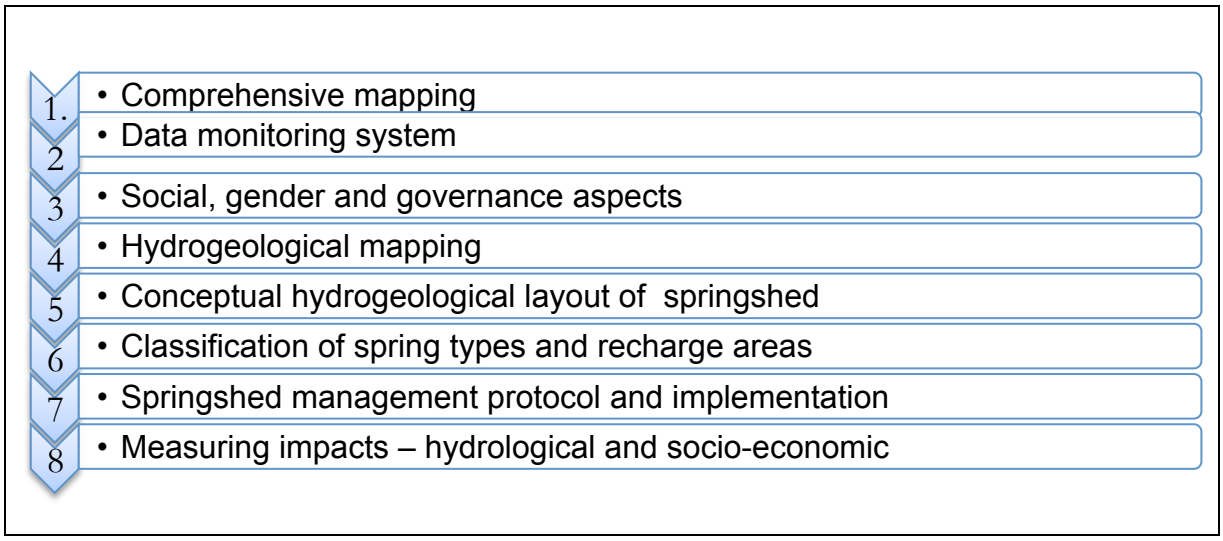
## SPRINGSHED MANAGEMENT IN THE HIMALAYAN REGION: REVIVAL THROUGH RECHARGE

Springs have been providing water to both humans and ecosystems for hundreds of thousands of years. Before humans began practicing agriculture, hunting-gathering communities must have depended on springs before they began excavating the ground through wells. 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 the village needs in the past. In recent times, both the quantity (discharge) and quality of water issuing from the springs is reported to be undergoing depletion and contamination respectively. 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 emerged as a ray of hope to mitigate spring water depletion in the Himalaya and is slowly also 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-centric initiatives that harbour hope in mitigating the crises. The concept of springshed management is now quite well-ingrained in the form of pilots of varying scales across the Himalayan states and in neighbouring Nepal. The first systematic initiative was undertaken through the *DharaVikas Programme* by the RM&DD, Government of Sikkim, even as smaller, deeply incisive pilots using the same concept were being undertaken across States like 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 DharaVikas, 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*

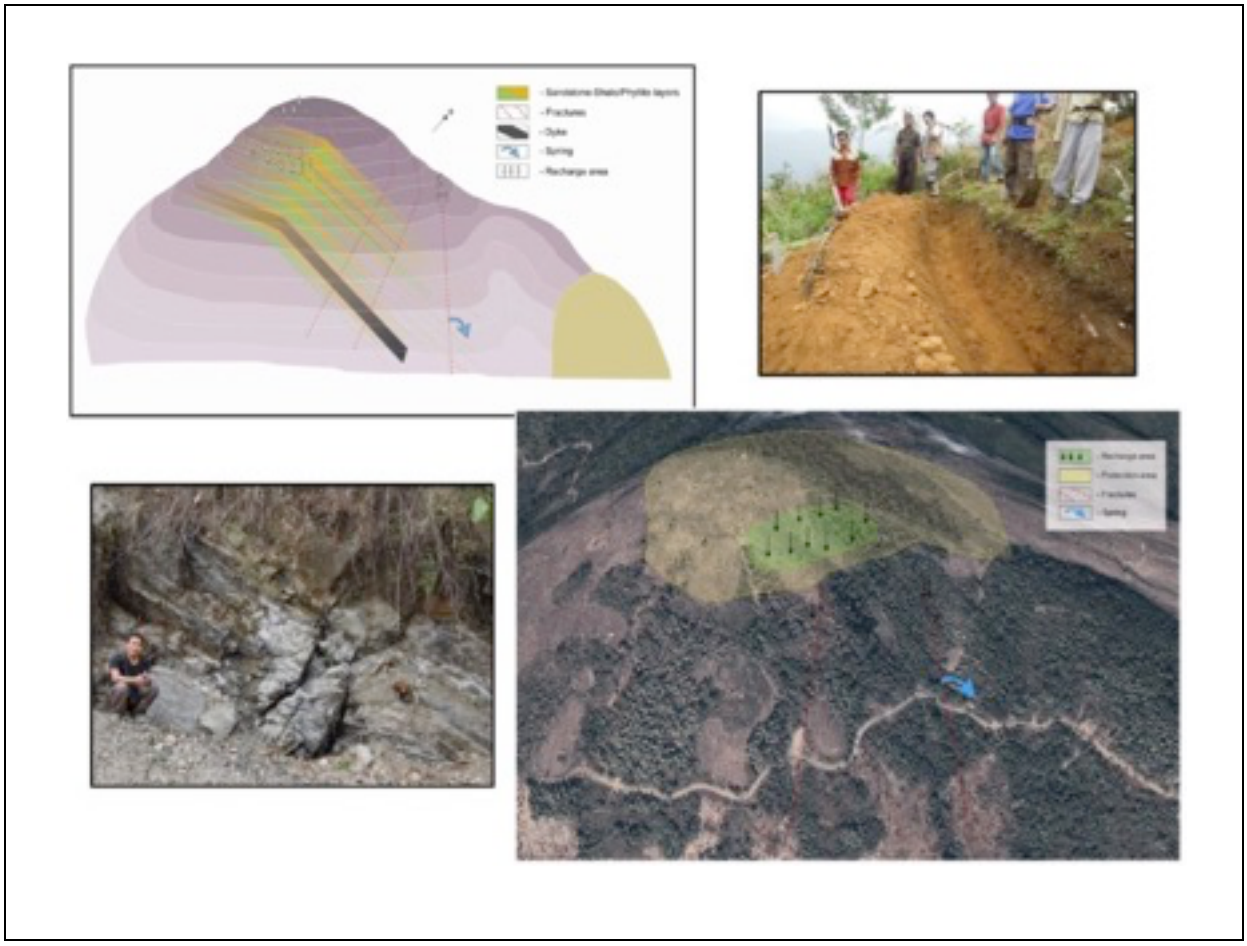
Springshed management includes various aspects of water management, ranging from hydrology to governance of natural resources. The methodology has been able to successfully integrate natural science with social sciences, hydrogeology with engineering and research with implementation while ensuring the common thread of community involvement and skill developing 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 science and appropriating engineering solutions to enhance recharge are not enough. In addition, there is also a need to address demand side challenge to ensure the satisfaction of the current water requirement 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 compliment hydrology and hydrogeology in the management of the precious spring water resource in the mountains. This entire process gains further value and utility, if acknowledged by the constitutional governance system in the mountain villages. Whether these are

institutions like 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:

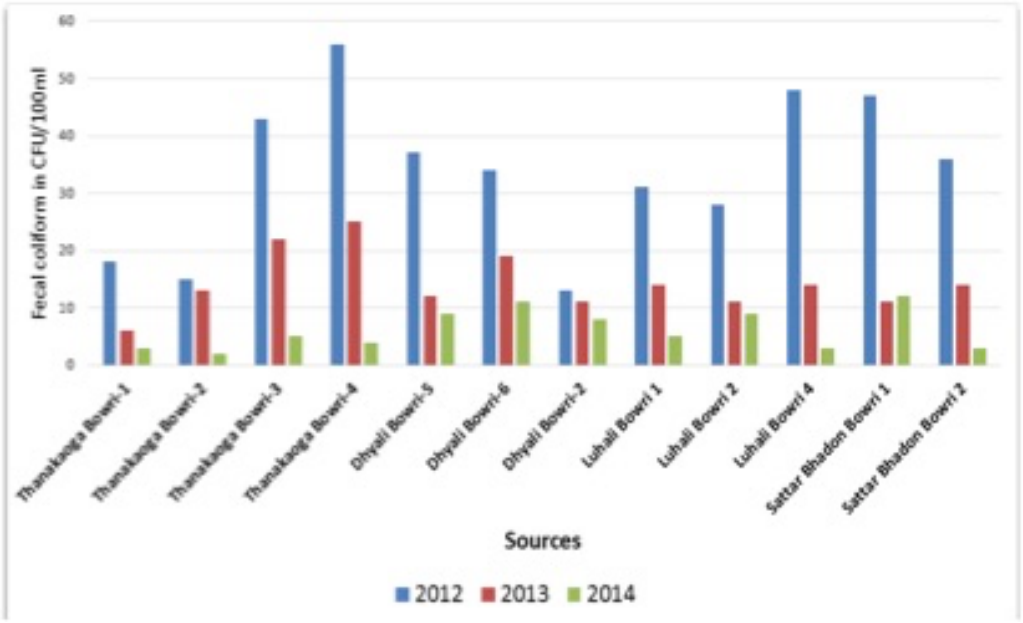
- Assessment of the hydrogeological controls on the springs (at micro level)
- Recharge potential of the spring through spring-shed development measures (at micro level)
- Maintenance and protection of springs
- Effective monitoring of the spring discharge and water quality during planning, implementation 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 in an effort to address the issues. 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-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 partnership in springwater

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 – LuhaliPanchayat area through a comprehensive springshed management approach. Improved spring discharge, especially during the lean season through systematic recharge measures based on hydrogeological mapping has been the most significant impact. 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.

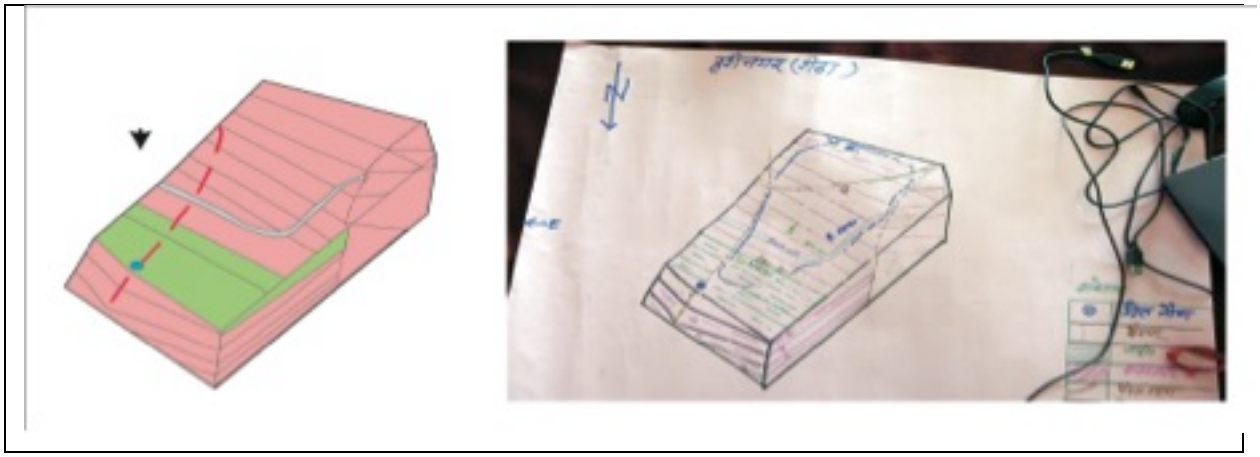



*PSI's springshed management interventions also led to improvement in the water quality of springs*

- **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 that helped impact more than 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 so as to positively impact the summer water security of many such habitations.



*Chiragparahydrogeologist'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 under various partnerships have taken the concept of springshed management to scale, 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 WASH have been the two major types of impacts of this work.

- **CAMPAIGN FOR SPRINGS:**

  **HIMALAYA SEVA SANGH**has worked for spring water conservation and restoration through a campaign-for-communities mode in Uttarakhand. Combining traditional wisdom with modern knowledge, HSS has also used socio-cultural tools to create awareness and sensitization of communities

leading to a large-scale awareness building impact regarding springs in the region.

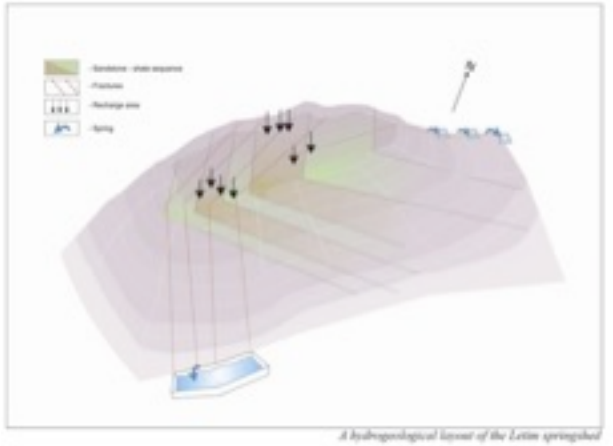
- **DHARA VIKAS & MGNREGS– CONVERGENCE WITH MAINSTREAM**

  **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. Skills in para-hydrogeology were built, knowledge transfer was efficiently achieved leading to an impact that estimate an 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 DharaVikas 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 DharaVikasprogramme of RM&DD in Sikkim State*

- **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 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 been the improved discharge of springs, especially during the lean seasons following the work and community demands from other villages for similar work.



Summary of proposed catchment treatment plan

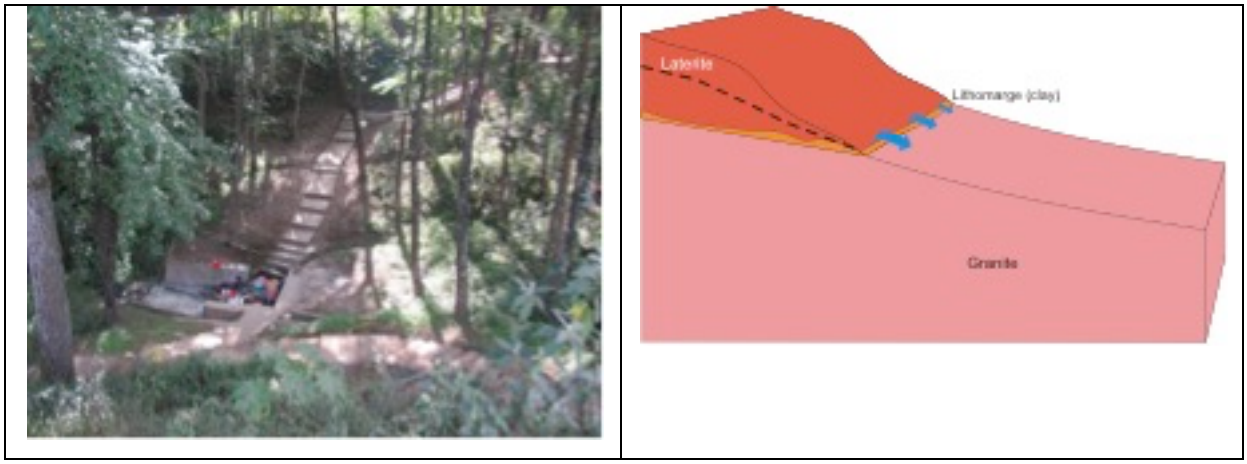
| Village | Spring | Area for recharge(ha) | Area for protection(ha) | Treatment measures suggested |
|---|---|---|---|---|
| Longra | Chenyak | 1.2 | 6.5 | Recharge pits, Staggered trenches |
| Yanggi | Waoshui | 15 | 60 | Contour trenches |
| Noksen | Okfhem | 1.5 | 10 | Staggered trenches |
| Litem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

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

- **LAND RESOURCES DEPARTMENT (TASKED WITH WATERSHED MANAGEMENT), RURAL DEVELOPMENT DEPARTMENT AND THE SOIL AND WATER CONSERVATION DEPARTMENT OF THE STATEOF NAGALAND**are likely to come together for a concerted effort of reviving springs in a few hundred villages across the State. The capacity building effort and design development for the programme have already begun through a multi-partner collaborative effort.

- **BUILDING CAPACITIES AT SCALE FOR SPRING REVIVAL:**

  **GOVT. OF MEGHALAYA (THROUGH THE MEGHALAYA BASIN DEVELOPMENT AUTHORITY - MBDA)** began work on mission mode, to map 60000 springs and create a first-cut plan for spring water management on 5000 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 are undergoing training through the Springs Initiative partners during the last 3 years.




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

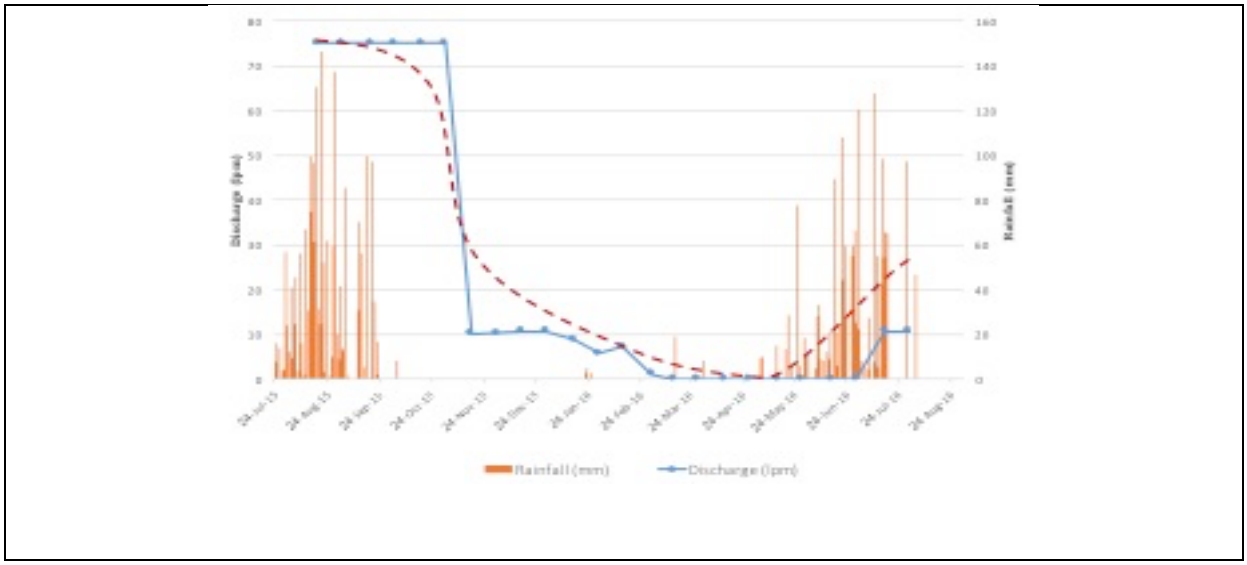
- **PROTECTION OF A CRITICAL WATER RECHARGE ZONE (SPRINGSHED):**

  Work done by CEDAR to rejuvenate lake Sukhatal, an ephemeral lake perched above Nainital. Locals were already aware of, and studies by National Institute of Hydrology (NIH) and others had shown 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 water infiltration. The degradation to Sukhatal has been one of the reasons behind the huge fall in lake levels and also lowered flow of springs. Awareness work by CEDAR and citizen groups have helped bring awareness to the issue 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 being considered.

- **SPRING REGENERATION– A PAN-HIMALAYA INCEPTION**

  **INTERNATIONAL CENTRE FOR INTEGRATED MOUNTAIN DEVELOPMENT (ICIMOD),**a regional learning and knowledge-sharingcentre of the Hindu Kush Himalayas based out of Kathmandu, in partnership with ACWADAM, helped build its own perspective and capacity on spring water management. ICIMOD also piloted the concept of springshed management with many of its partners in different countries in the region. Capacity building, piloting and the development of an 8-step methodology of springshed management were 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 2016 earthquake on springs (red-line is the pre-earthquake hydrograph while the blue line shows the current – seasonal – status of the spring*

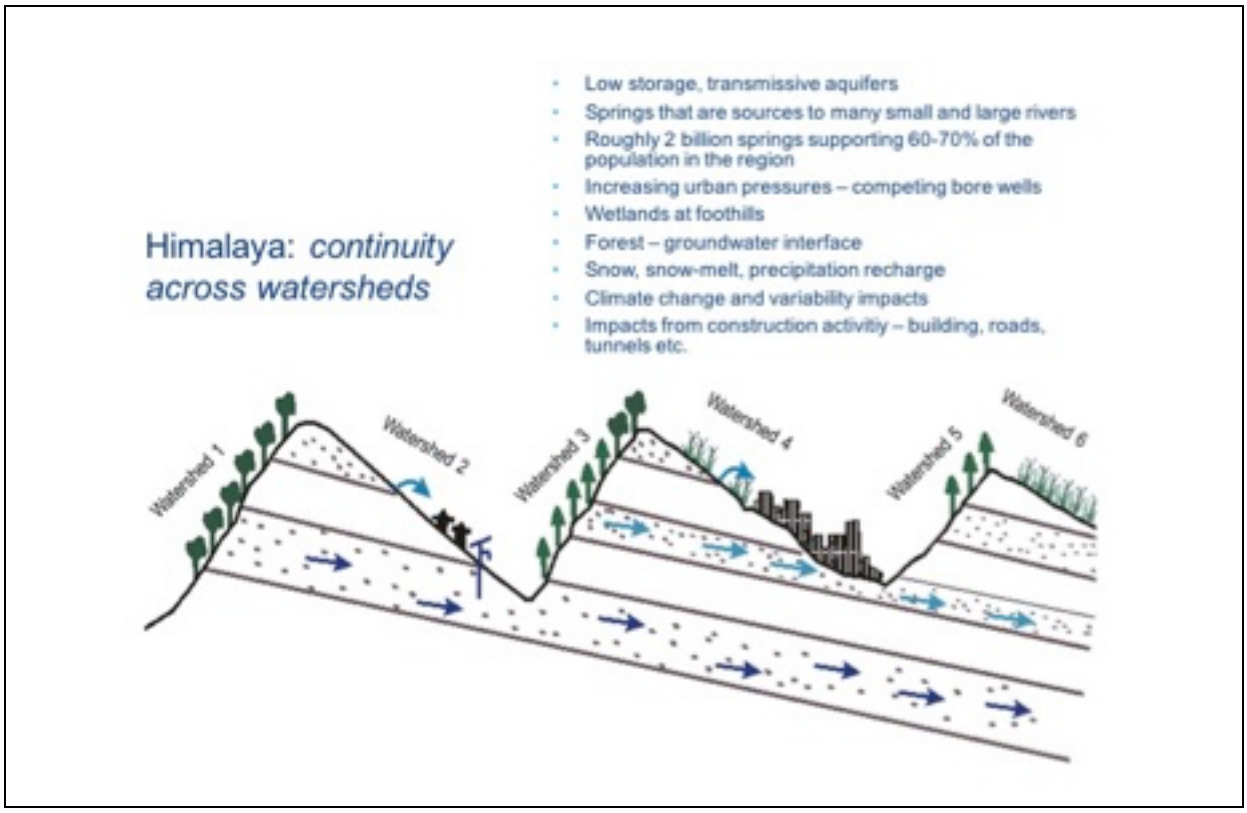
- **SPRINGSHED MANAGEMENT IN THE HILL DISTRICTS OF WEST BENGAL:**

  **RURAL DEVELOPMENT DEPARTMENT OF WEST BENGAL**initiated a pilot on 50 springs in the 4 hill districts of West Bengal through a partnership involving the **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 about springs at the grass-roots and integration of springshed management plans with the DPRs for MGNREGS.

- **KNOWLEDGE, TRAINING AND FACILITATION:**

  **ADVANCED CENTER FOR WATER RESOURCES DEVELOPMENT AND MANAGEMENT (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 the input of hydrogeology and aquifers, into spring water conservation and management work. Demystification of science, development of para-hydrogeology skills and large-scale hand-holding that required fieldwork in challenging conditions have been the hallmark of this work. Most significantly, the model of collaboration that is so crucial for springshed management success has been one of the largest outcomes of this input, in parallel to 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 in partnership with various partners*

- **THE SPRINGS INITIATIVE**

  **ARGHYAM** is supporting spring-based water security work since 2007 in the mountain ranges of India. While the early phase of this work focused on the reticulation 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 of the 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 Indian Himalayan Region. Institutions like **ATREE, GBPIHED, IIT-ROORKEE, NATIONAL INSTITUTE OF HYDROLOGY, WADIA INSTITUTE OF HIMALAYAN GEOLOGY, BARC, HESCO** etc. 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.

*Team of Para hydrogeologist participating in planning of springshed management activities*


*Active women participation during the barefoot hydrogeologist training*


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

*Hydrogeologist from CHIRAG, Uttarakhand carrying out geological field mapping*

# CHAPTER-V: BUILDING TRACTION IN SPRINGSHED MANAGEMENT: SCALING OUT CAPACITY FOR INCREASED COVERAGE

# CHAPTER-V

## BUILDING TRACTION IN SPRINGSHED MANAGEMENT: SCALING OUT CAPACITY FOR INCREASED COVERAGE

In mountainous regions, community mobilization around water can be challenging, energy intensive and an exhaustive task because of complex hydrology and hydrogeology and due to the scattered nature of habitations. Protection and conservation of springs in the mountains through watershed programmes must include due consideration to underlying geology and understanding of the basic hydrogeology. The purpose behind such efforts must be to impact spring discharge and quality alongside ensuring both livelihoods and ecological security. Some civil society partners have worked closely with certain State Governments in building knowledge and skills around springwater management in regions as diverse as the Himalaya. Such partnerships and collaborations have meant providing hydrogeological inputs to programmes on conservation and recharge of springs.

Apart from the capacity building of partner organizations, comprehensive action research for facilitation of the on-going projects is required. Moreover, the development of a knowledge base that could facilitate and encourage workers in the region to partake groundwater resource augmentation and protection ventures with regard to springwater are important. Many such interventions and experiments have yielded satisfactory results in the spring-shed or spring development programmes. The major impacts of the work under Arghyam's Springs Initiative, for instance, has improved water security in some 1000 villages, developd training material in six languages, trained nearly 9000 people from across institutions, helped five states taking up separate spring-related initiatives, improved health and hygiene and better quality of life for women and girls (Arghyam, 2017).

However, whereas these numbers may seem impressive, they are just the 'tip of the iceberg' considering the need for a larger-scale effort. 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 compliment basic field hydrogeology and community participation. Due to the difficulty 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. Creating an inventory of springs itself is an effort that requires resources for the basic inventorisation of springs (investments to the effect were not made even until now). 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 – (HR and Finances) and scale itself

Although the task of revival of Himalayan springs is gigantic, this can be achieved through a coordinated combined national, state and local level initiatives involving all possible stakeholders and partners including governments, 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-VI: GENERAL RECOMMENDATIONS

# CHAPTER-VI

## GENERAL RECOMMENDATIONS

The meeting of the stakeholders held on 8th August,2017 in DST came up with several recommendations under five broad action areas. These include; Mapping Springs, Implementing revival of springs; Capacity building, Policy and Cross-cutting issues. These actions are enumerated in the following paragraphs.

## 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 spring-shed management will upload data on the web-portal.
    - 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 in nature..
    - 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 simple and effective method for typology of aquifer heterogeneity and pathways.
    - Involvement of local community, NGOs and State Agencies for mapping in the process of mapping, making it a participatory process

- Establishment of a national registry for springs

3. Synergies between R&D Institutions/Universities and community based Non-governmental Organisations to provide assistance to 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 a community's sense of 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 – structure 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 spring-shed management.
   - Snow retention and snow meltwater collection is an effective means of spring recharge in high altitude regions.
   - Demand management is a challenge – especially, 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 is required in ensuring the long-term sustainability of such interventions even 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.

5. Development of adaptive strategies(risk management as an adaptation measures to climate change impacts) based on hydrogeological investigation

and demand-supply model for vulnerable springs. Consideration of climate change projections and likely future impacts is required 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 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.
   - 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 skilled human resources through training and capacity building programme – a cadre of young professional and community based resource persons (para-hydrologists). This will help in efficient use of resources allocated for spring-shed management.
   - BARC can provide training in the field of isotope hydrology.
   - Capacity building at the community level including 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 spring-shed management in varying climatic conditions.
   - For institutionalization of knowledge a common curriculum and a training manual needs to be developed.

## D. POLICY

8. The Government should launch a national mission/programme on springshed management. More emphasis on springs and springshed management in

Himalayan Region is required in National and State level policies as a comprehensive ecosystem services and (climate adaptation measure).

- A status report on Himalayan springs with inventorisation, current status of springs, reasons for depletions/drying and initiatives of spring revival across Himalayan States should be produced.
- The Government should identify a nodal R&D institution/University for carrying out mapping exercise and for developing approaches for spring-shed 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 Govt. 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. Greater attention is required during pre-monsoon/summer season when demand is highest due to tourism season and spring discharge is at its lowest. In addition, there are more frequent incidences of forest fires during this season.
- The question of forest and private lands and their interplay in the springshed concept also becomes important because in many cases, large parts of the recharge zones for springs fall within forests and optimising springshed-related activities cannot be complete without the co-operation of the Forest Department.

9. The central government should promote regional efforts and platforms to exchange experience and knowledge on spring-shed management in the Indian Himalayan Region as well as the Hindukush Himalayan Region. This is critical for rejuvenating transboundary springs (e.g.; recharge zone in Bhutan and spring outlet in India (West Bengal)).

10. The State governments across the Indian Himalayan Region (and also non-Himalayan States) need to take a proactive role in mapping and revival of springs as their depletion/drying has socio-economic implications. Although some states (e.g. Sikkim) have started doing this activity but it needs to be strengthened by capacity building of the relevant stakeholders at the State level. Need for convergence between departments.
    - Need to link with the regulations/existing rules and institutions that can govern spring-shed management and administrative arrangements. Also need to review traditional systems for conserving water (traditional systems vary across Himalayan States).
    - Mainstreaming of spring-shed management with other developmental programmes at the national and in particular at the State level is required to facilitate more convergence with government schemes (e.g. MGNREGA in Sikkim).
    - 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 spring-shed management needs 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. Should be integrated with Environmental Impact Assessment and Environmental Management Plan.

# CHAPTER-VII: NATIONAL PROGRAMME ON SPRINGSHED MANAGEMENT: A PROPOSAL

# CHAPTER-VII

## NATIONAL PROGRAMME ON SPRINGSHED MANAGEMENT : A PROPOSAL

There was unanimity among the stakeholders who participated in the meeting of 8th August,2017 that there is an urgent need to launch a National Programme on Springshed Management. This national programme on Himalayan Springs could clearly pave the way to overcome the challenges outlined in the previous chapters and recommendations brought out as part of stakeholder meeting. However, before discussing the programme, it would be relevant to state why such a programme is necessary. The following factors provide a clear insight into this felt need. All these factors are of national interest:

- Springs form the sources of many small and large rivers in India. Almost all non-Himalayan Rivers and many Himalayan Rivers originate in the form of thousands of springs in the catchment areas. Many of these springs have been revered through historic periods either in the form of a symbolic temple or with the tribal legacy of 'sacred groves'.
- Springs directly support either the whole or part of the water need of more than 15% of India's population.
- The drying down of many springs has led to great distress for mountain populations, 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) alongside improved recharge, efficient supply and equitable demand hold the key to protecting and conserving springs.

With the above 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 committee itself. While there could be a larger programme at Pan-India scale, this

report is restricted to the programme in the Himalayan Region. The programme may involve research, management and protection of say 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.

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 an action – research programme 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 regions falling inthe Indian Himalayan Region, where communities depend upon spring water for both, 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.

A strategic approach to springshed management must have both, a development component and a research component. The development component would enable the 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, provide help in regular monitoring and evaluation and updating the national springs web portal. The crucial elements of these components are listed below.

**Development components**

a) Geographical targeting using vulnerability assessment at the village level, including information on climate, dependency factor and other such important aspects.
b) Prepare Village Water Security Plans (VWSPs) for these villages combining dependencies and availability of local water resources.

c) 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.
d) 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 these critical springs in the vulnerable gram panchayats as a priority.
e) Develop cadre of trained para-hydrogeologists while creating capacity across the entire section of government department and ministries dealing with or connected with springs, water supply and sanitation in the Himalayan Region. This should especially include the Department of Forests in all the States as many springs originate in the forests or recharge zones for many springs in villages and townships may lie in forest areas.
f) 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 therefore to the Himalayan Region as a whole.
g) 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**

a) Develop long-term spring observatory by instrumenting few springs and streams in the resource blocks of springs selected above.
b) Develop baseline and controls so that other covariates such as rainfall, landuse & land cover changes etc. are accounted for and the increase in lean period discharge of the springs can be directly attributed to the artificial ground water recharge works
c) Initiate participatory mapping of recharge areas by convergence with trained para-hydrogeologists above 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 have been naturally providing the value of recharge to many springs.
d) Evaluate the initiative using the composite criteria of relevance, effectiveness, impact, efficiency and sustainability that RM&DD (Sikkim) has recently adopted.

e) 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.
f) Update the information on a monthly basis on the national springs portal so that the portal is dynamic and become 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 spring-shed 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 springwater 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 are short, medium and long – term phases for the purpose of simplicity. 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 each in all the mountain states and provide 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. Ensure 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 spring-shed 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.

**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 more convergence with government schemes.
- Building close and effective partnerships between Government Departments, R&D Institutions/Universities and community, based NGOs would become necessary to build knowledge, information and skills to 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 a community's sense of ownership of the resource. Therefore, along with scientific inputs, capacity building at community level is equally important.

**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 within a harsh landscape. 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 in ensuring the sustainability of such interventions even 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 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 spring-shed management.

- Development of adaptive strategies (risk management as an adaptation measures to climate change impacts) based on hydrogeological investigation and demand-supply model for vulnerable springs. Consideration of climate change projections and likely future impacts is required while identifying and implementing spring-shed 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 on the other side.

**FINANCES**

This spring revival programme can be positioned as a government of India initiative of 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, Urban Development etc. could also adopt regions for implementing springwater management or specific components of the programme for support. Subsequently, the scaling up can be taken 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 also improvement in quality of life.

**GETTING STARTED**

This report lays down 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) document

for a national programme on spring water management, keeping the salient features of this report as reference.

*Cultural aspect related to spring water in the mountains*

The following table is indicative of the nature of activities that go into community-based spring-water management and the possible institutions who can be part of the design group. The group is derived from the methodological requirements of the programme described in this report and matches the best institutions to the methodological requirements. The group may be drawn from the institutions listed in the table below 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. The table is only indicative and is developed only for the short-term activities described in the report.

***Table 2: 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 1:5000 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 | Academia and research institutions – | Establishment of a systematic research programme within at least |

| | | | |
|---|---|---|---|
| | research | NIH, Wadia Institute of Himalayan Geology, BARC, Kumaon University, ATREE etc. | 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 & 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 | NitiAayog 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 4000 m amsl in Spiti valley*

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# APPENDIX-I :SELECT CASE STUDIES AND SUCCESS STORIES

**APPENDIX- I**

# 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. no.** | **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 SevaSangh | 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 DharaVikas& 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 | Govt. of Meghalaya (through the Meghalaya Basin Development Authority - MBDA) | Capacity building initiatives and mapping of 60000 springs and plan for spring water management on 5000 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 | GBPIHED | 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) programmeof 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, Govt. of Sikkim.

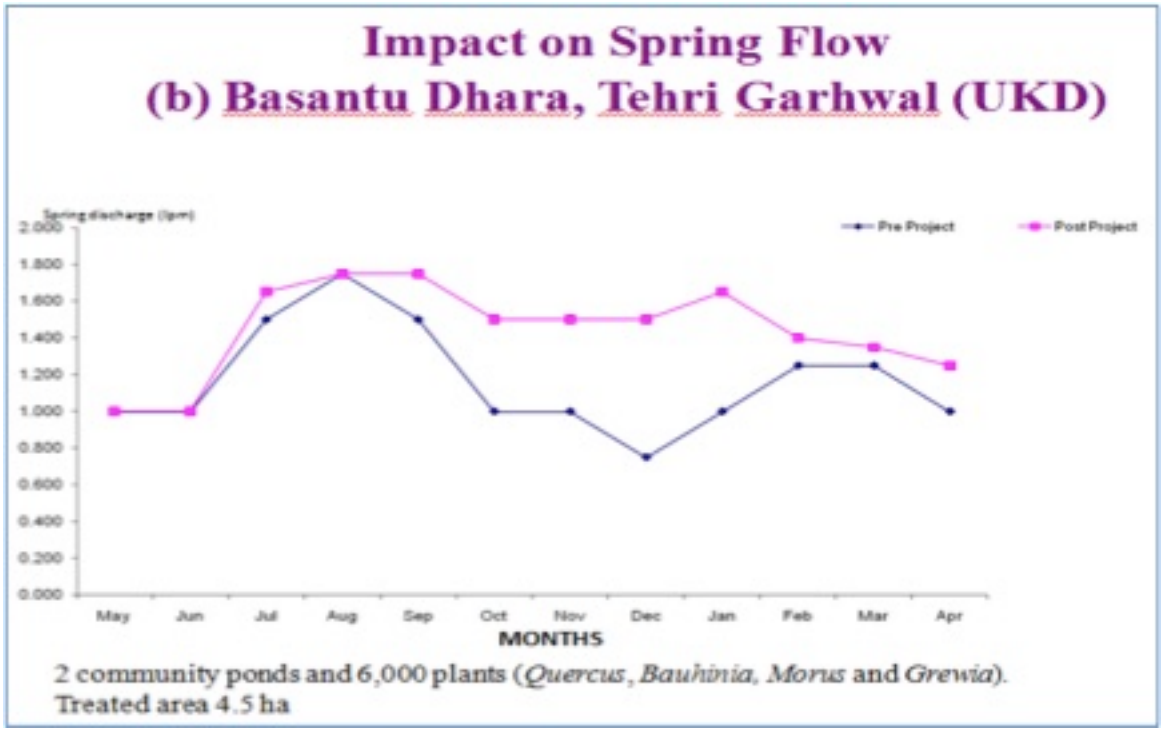
**2012-2016:** Thanakasoga Gram Panchayat (5 springs), district Sirmour, Himachal Pradesh under Participatory Ground Water Management Programme.

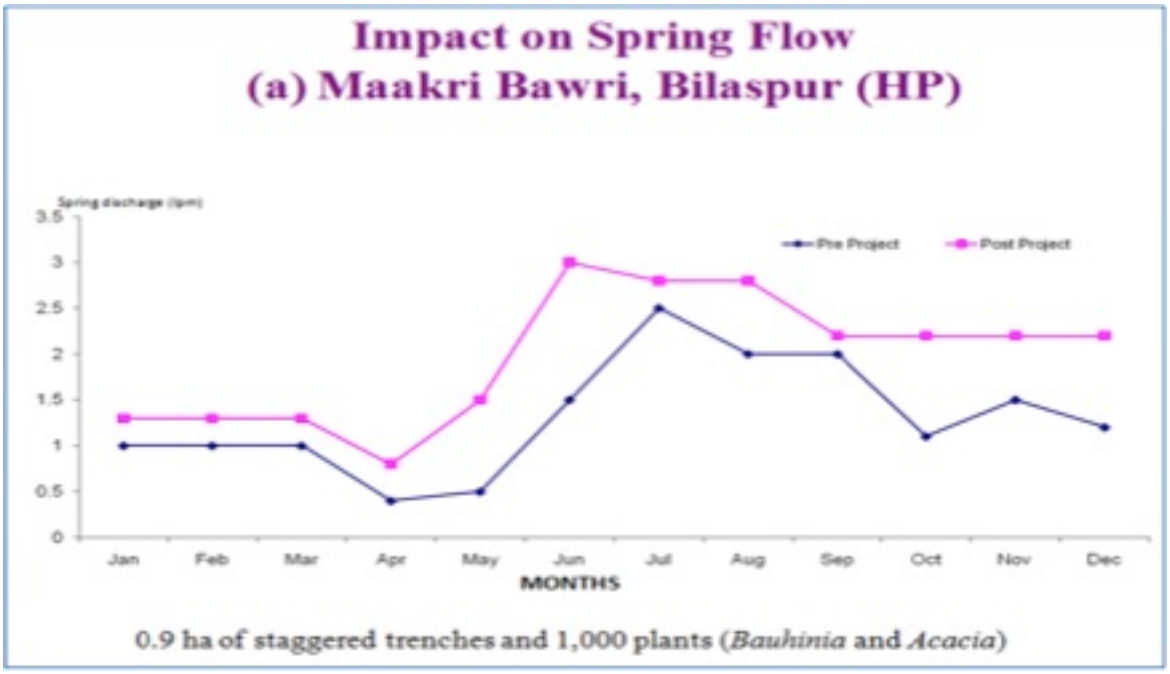
**2016-2017:** One spring in each of the 11 districts (11 springs) of Nagaland through support from Land Resources Department, Nagaland

### Springshed Work in Uttarakhand & Himachal Pradesh under CPWD Programme

In 2001-02, PSI initiated the "Resolving the Himalayan Dilemma" programme under the initiative "*HimmothanPariyojana*" 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.



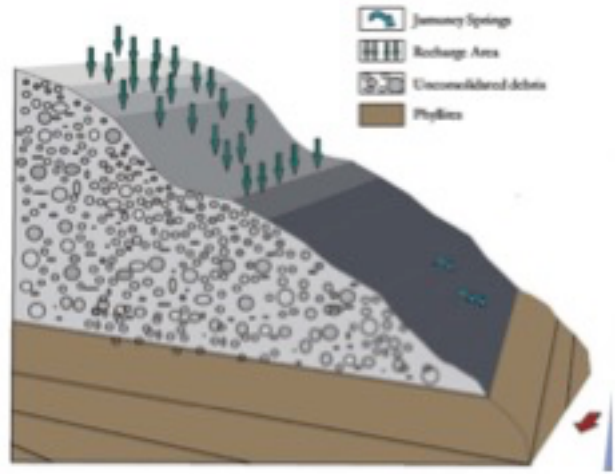
In the 11 watersheds, spring-shed development activities were undertaken creating water sanctuaries. The spring-shed development activities included engineering measures (digging of staggered contour trenches, nala treatment, brush wood check dams, loose boulder check dams, construction, gabions/retaining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

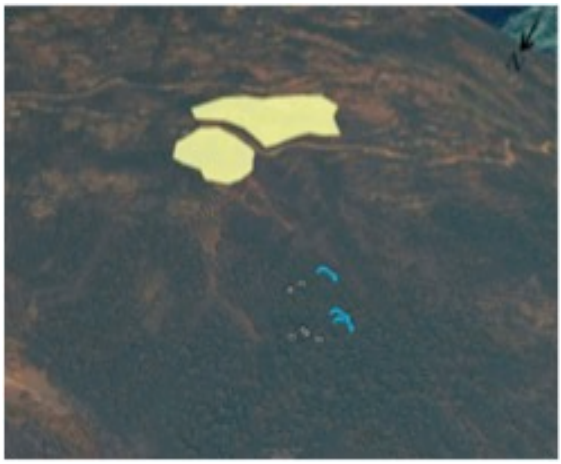
vegetative measures (fuelwood, fodder and fruit trees plantations, grassland development, and live hedge rows).

**Springshed Development programme*(DharaVikas)* in water scarce areas of Sikkim**

In 2009, PSI offered its consultancy services covering six months on springshed conservation and development programme in water scarcity areas of Sikkim with WWF-India support. PSI conducted reconnaissance field surveys of twelve spring's catchments under eight blocks of South Sikkim, West Sikkim and East Sikkim districts, assessed the present 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, Bare Foot Engineers (BFEs).





***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's 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. Looking at the successful results, springshed development work was taken up as a state level programme called *DharaVikas* by the Sikkim Government leading to the revival of 50 springs and 5 lakes. Convergence with State government (RMDD) and MGNREGA was first of its kind in the mountain states The program has brought about 900 million litres of annual ground water recharge, apart from improving domestic water availability and enhanced farm productivities.

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** |
|---|---|---|---|
| MalagiriDhara, Lungchok | 7.5 | 15 | Two times |
| AitbareyDhara, Kaluk | 2 | 6 | Three times |
| DokungDhara, kLuk | 8 | 30 | Nearly four times |
| NunthaleyDhara, Kaluk | 2 | 10 | Five times |

| | | | |
|---|---|---|---|
| KharkhareyDhara, Kaluk | 1 | 5 | Five times |
| ChukudumDhara, Ravangla | 45 | 60 | One and a half times |

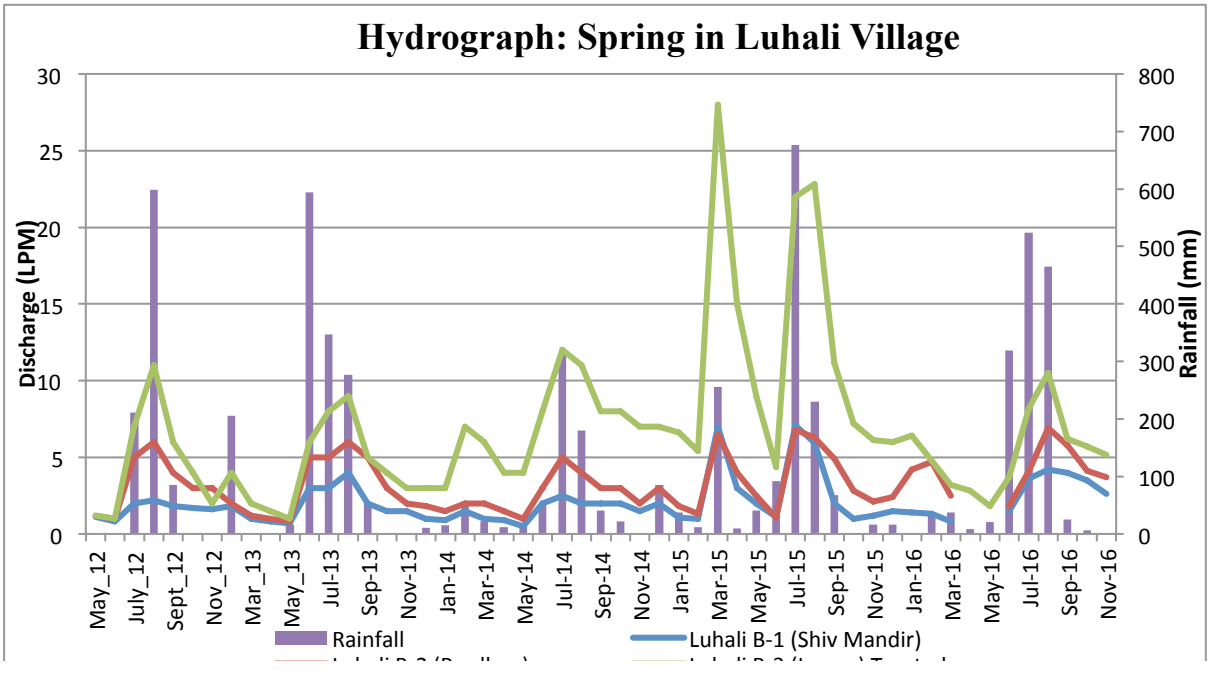
*Results of springshed management under DharaVikas*

**Community Based Spring Recharge Work in ThanakasogaPanchayat**

In 2011, PSI did a pilot project by carrying out hydrogeological studies to identify recharge areas of 5 springs in Thanakasoga Gram Panchayat, district Sirmour, H.P. 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 lead to a more equitable water sharing mechanism amongst



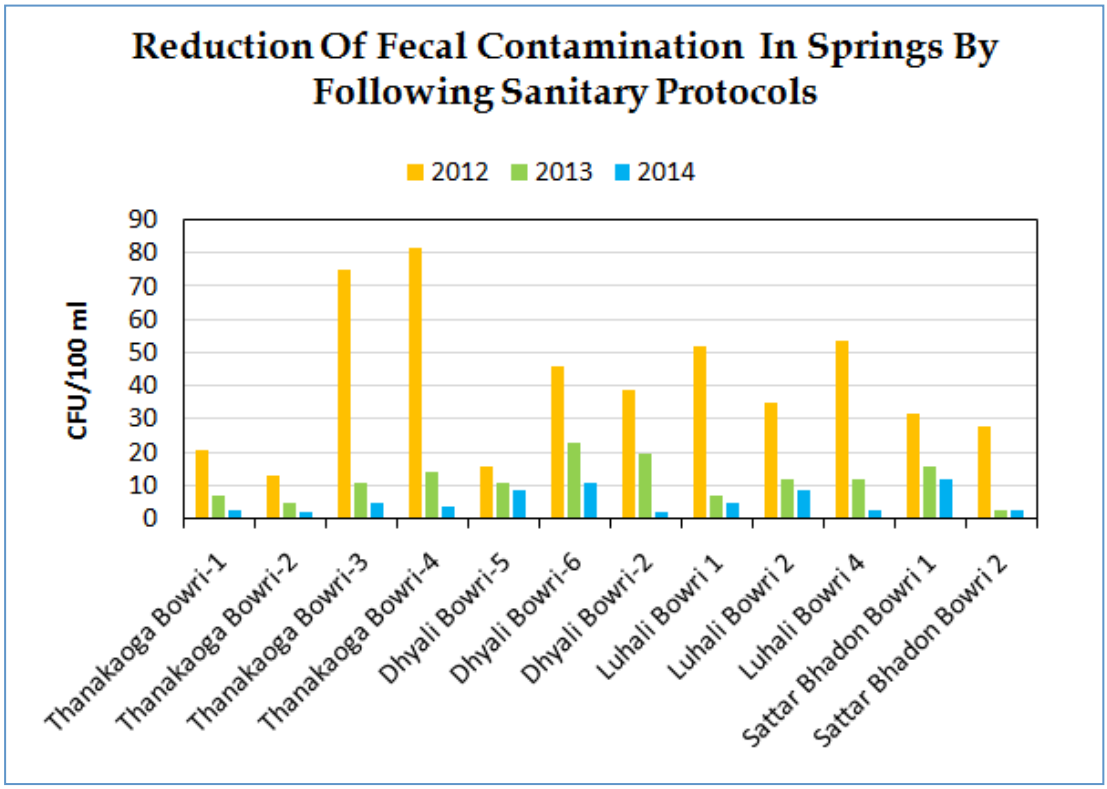
communities and increased water availability.

2. Treatment activities in recharge area of Thana-1 baori increased flow in the Sattarbhadon*gadera*.

3. Increased spring discharge resulted in reduction of geogenic contaminants like iron.

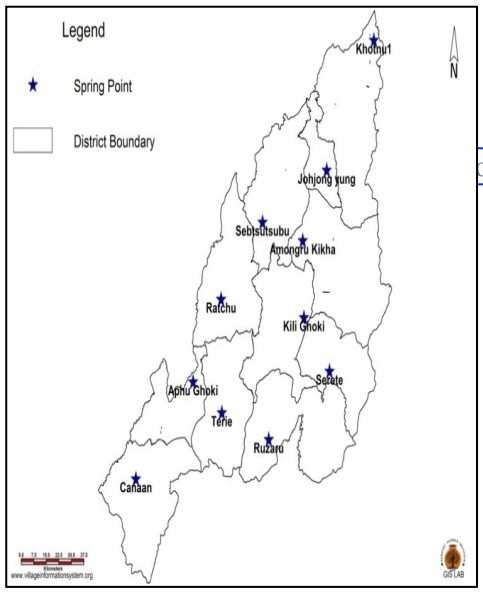
4. Enhanced spring discharge enabled increased water availability for irrigation. Villagers were motivated to try out SCI (System of Crop Intensification) and SWI (System of Wheat Intensification) techniques of farming. These techniques yield more grain with less water. With SWI technique, the average 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 Spring shed Development in Nagaland




People in Nagaland are more dependent on springs and small mountain streams than on big rivers. This is 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 program 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 persons from Department of Land Resources as well as communities for planning and implementation of spring recharge activities.

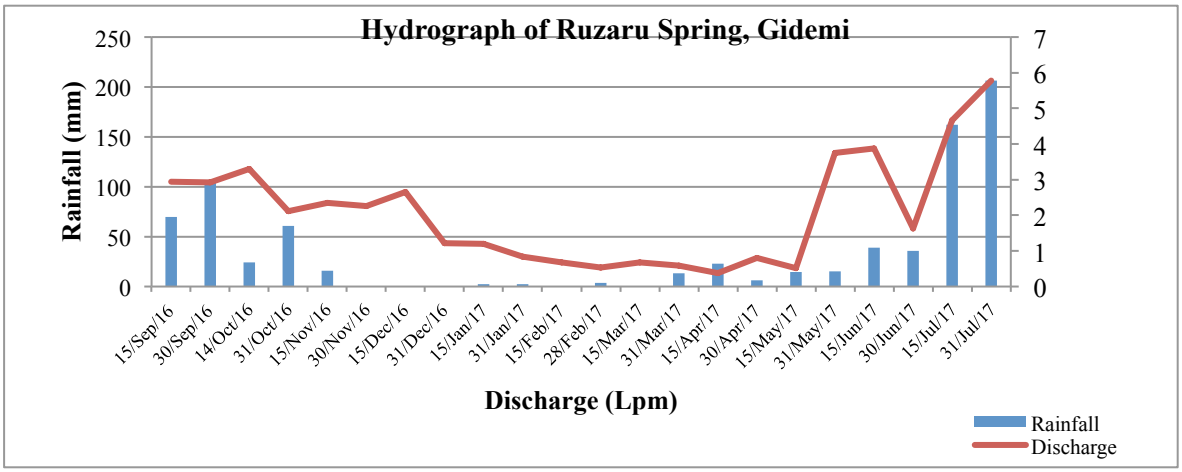
### Impacts and Outcomes

The spring recharge program 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 discharges 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 the program through MGNREGA flagship program and additional assistance from NABARD to reach out to entire state for implementing springshed management programme.

***CENTRAL HIMALAYAN RURAL ACTION GROUP (CHIRAG), Uttarakhand***

Chirag began working on recharge and rejuvenation of Himalayan springs since 2008 to try and 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 understanding of Himalayan geology and devising scientific techniques of 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 the core component of the whole work and 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.

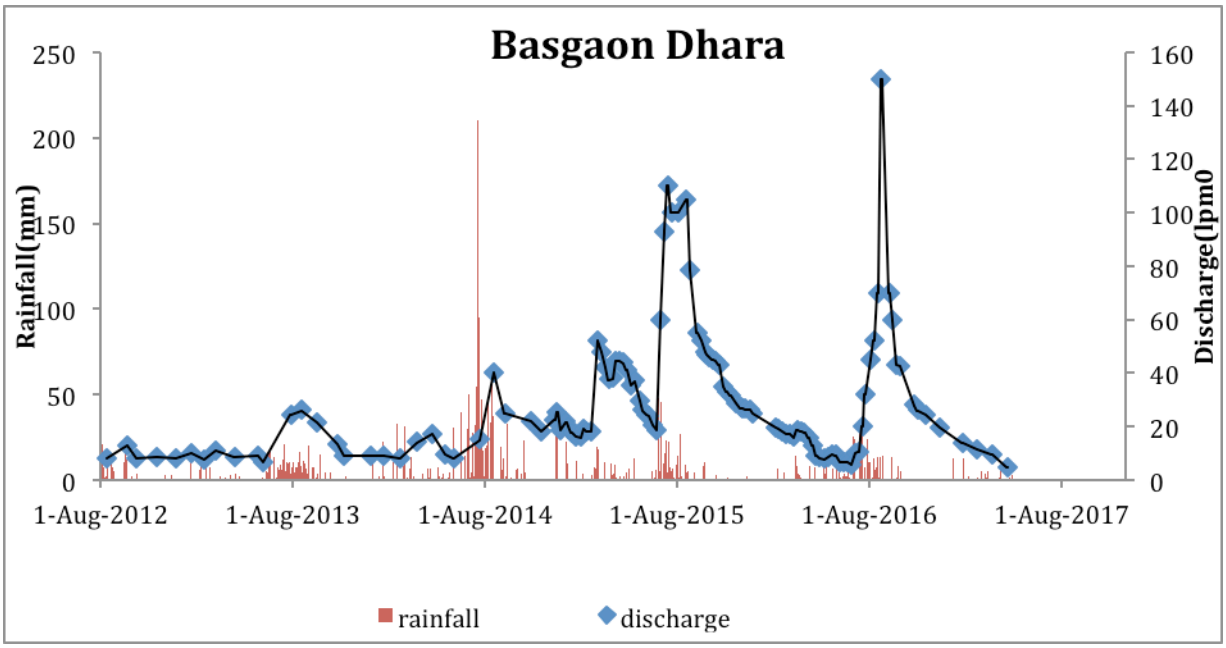
Currently, Chirag is working on two spring recharge and water distribution projects. A project is being worked on in partnership with Arghyam to recharge 70 springs through relevant recharge activities. The focus is on involving the community and building their capacity in basic geology, hydrology and water management. Since women are the most important stakeholder, 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 is undertaken to recharge 25 springs and lay a distribution system for the same. The project is expected to benefit over 1300 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 is initiated in the project. The beneficiary families will provide a decided monthly sum for the fund. Till 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 which are corroborated by the community. Shown below is the hydrograph of BasgaonDhara in which recharge activities were done during the period August-December 2014. Improvement in discharge took place from 2015.



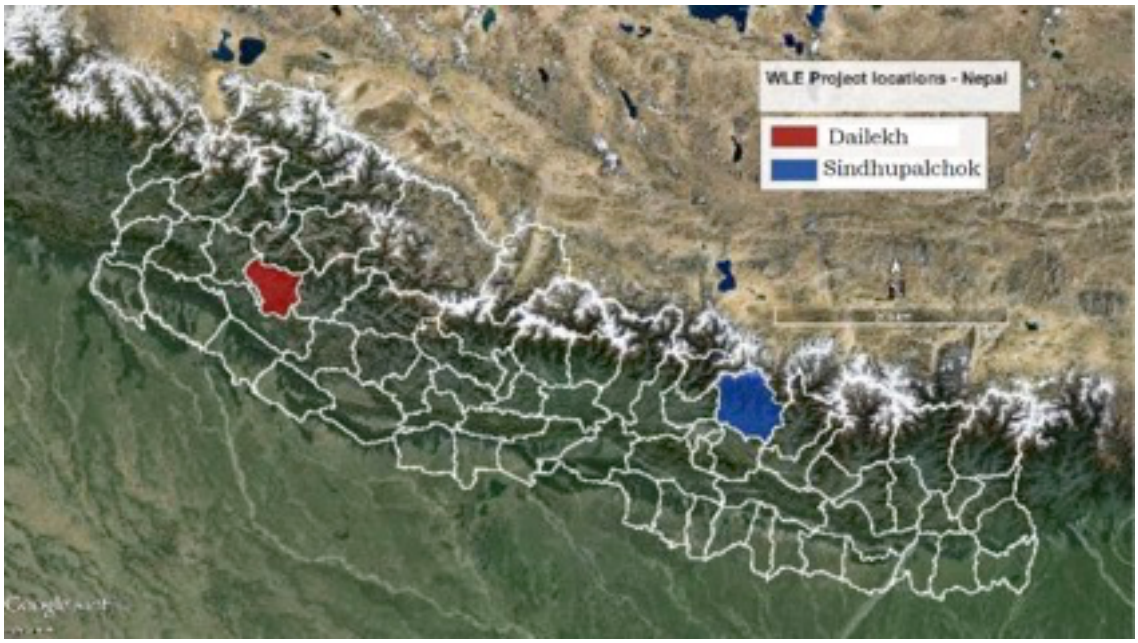

An effort is also taken at advocacy level by conducting workshop on importance of springshed management involving various state government departments and DM's to influence state policies for inclusion of springshed management at state level. Several workshops have been conducted at the block level involving 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 details. Two watersheds namely Ramgarh and Takula are instrumented in Nainital and Almora districts respectively. Ramgarh watershed was instrumented in the year 2015 with automated water level recorder and automated raingauges. 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. Takula watershed similarly was instrumented with water level recorders on a spring and a stream at the mouth as well as automated raingauges at 2 sites in the watershed.

***INTERNATIONAL CENTER FOR INTEGRATED MOUNTAIN DEVELOPMENT (ICIMOD), Nepal***

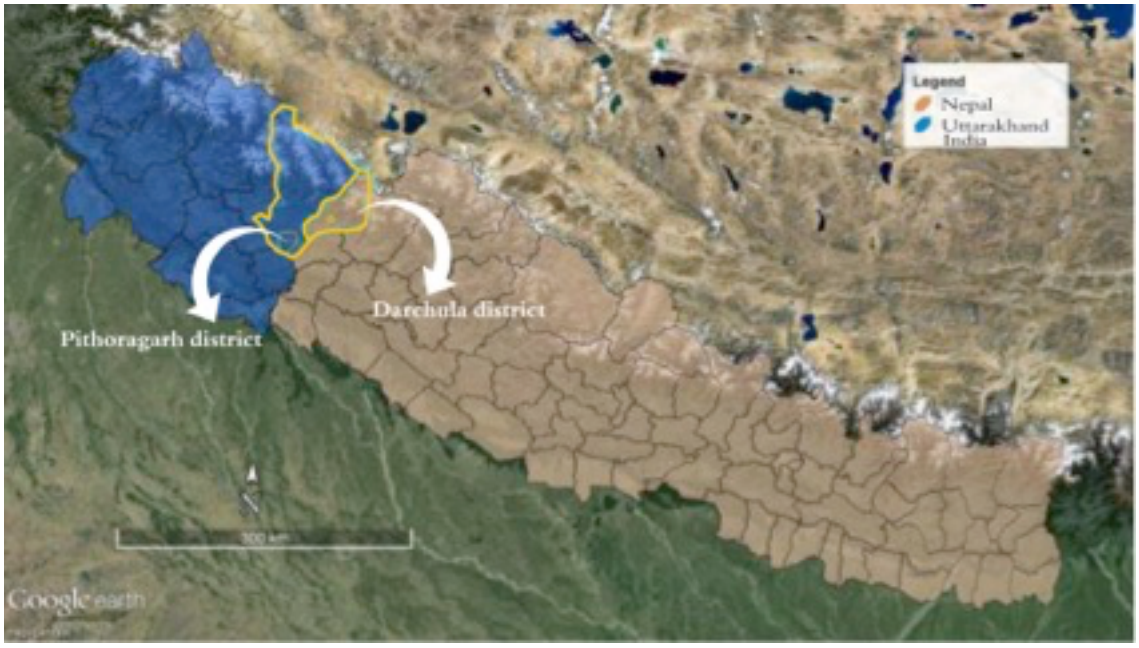
ICIMOD is a regional intergovernmental learning and knowledge-sharing centre serving the eight regional member countries of the Hindu Kush Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. ICIMOD has collaborated with ACWADAM for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

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




*Pilot sites under Water Land and Ecosystem (WLE) programme*

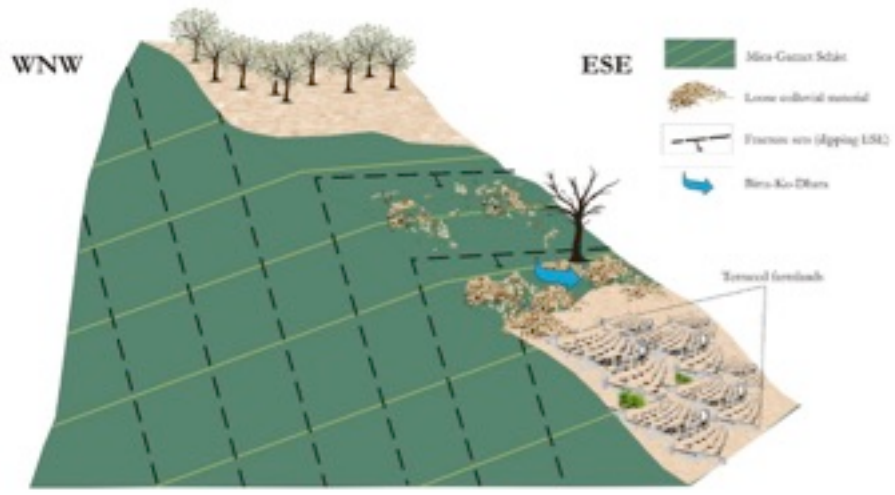
ACWADAM and ICIMOD successfully implemented springshed pilots with field support from HELVETAS in Dailekh and Sindhupalchok, Api-Nampa Conservation Area (ANCA) in Darchulaand GB Pant Institutes in Pithoragarh *(shown in the maps).*




*Pilot sites under Kailash Sacred Landscape programme*

During the course of this project, ACWADAM also undertook capacity building exercises at various levels. Barefoot hydrogeologist training for the communities made a significant impact leading to successful implementation of springshed

programme in all the pilot locations. Communities were able to understand and realise the importance and need of 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 in other parts of the state and country.

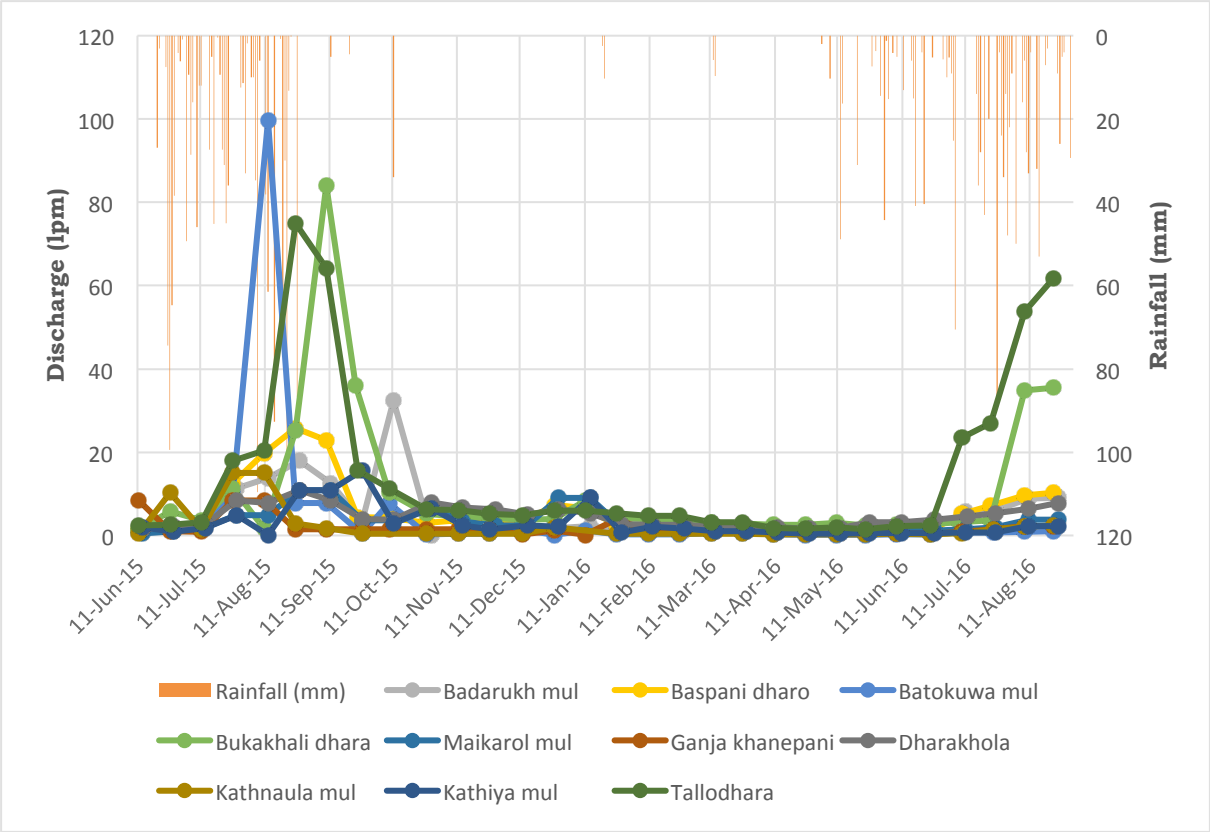



*Conceptual layout of a spring in Sindhupalchok*

*Barefoot Hydrogeologist training conducted in Sindhupalchok*

*Geological mapping of the springsheds*

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.




*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 1000 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.State has been able to map ~ 2000 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 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. State envisions to target more than 500 springs over the next 3 years.

Significant contribution is even made in certain parts of 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 institution within the communities in the form of *Bhujal Dharak Samiti,* which addresses the issues related to the springs in their villages. In Eastern Ghats, Keystone Foundation has been able to demonstrate a few pilots in the Nilgiri district of Tamilnadu. 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*

*Training of officers from Soil and Water conservation Department, Government of Meghalaya*