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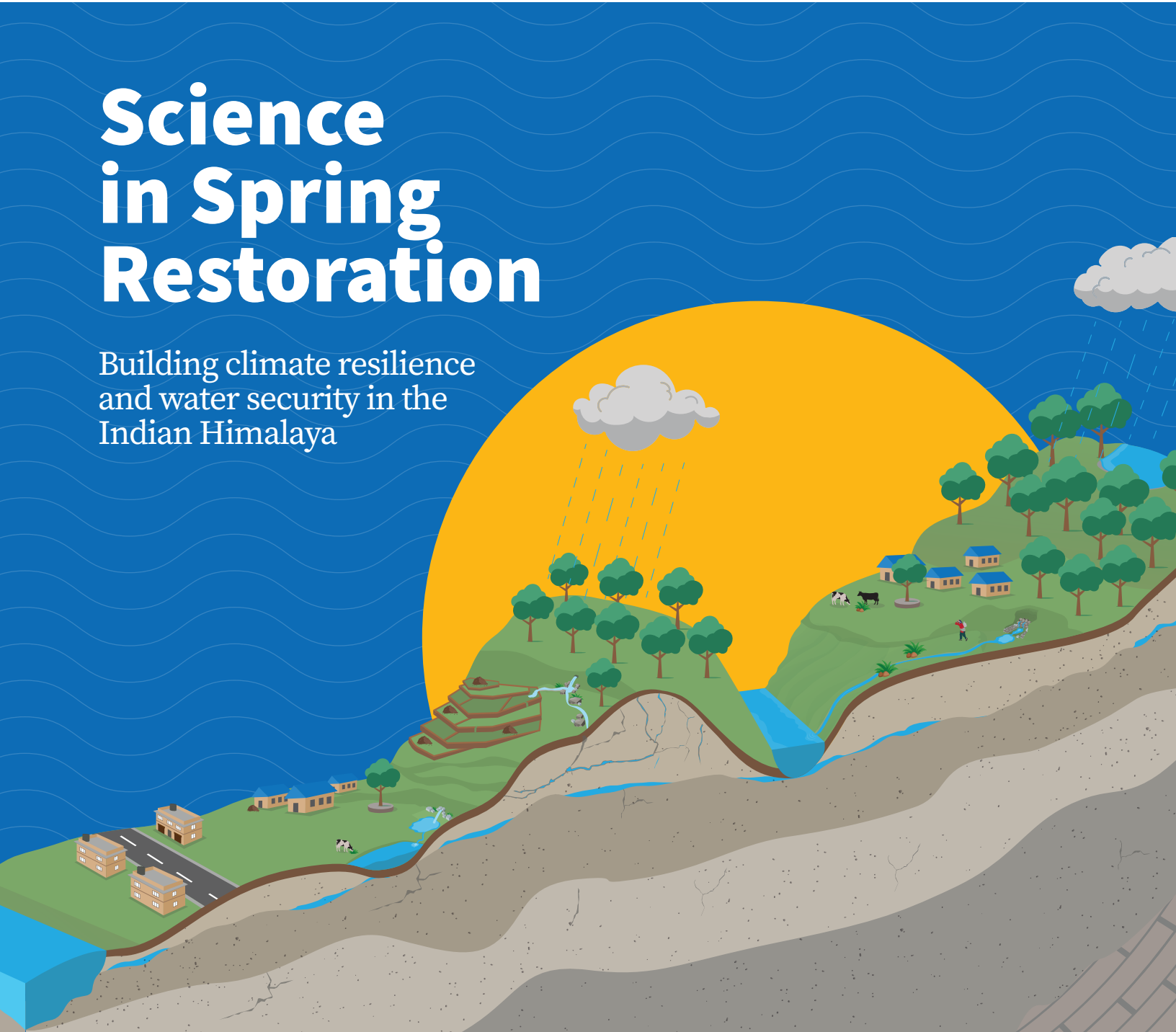
Science in Spring Restoration

Building climate resilience and water security in the Indian Himalaya



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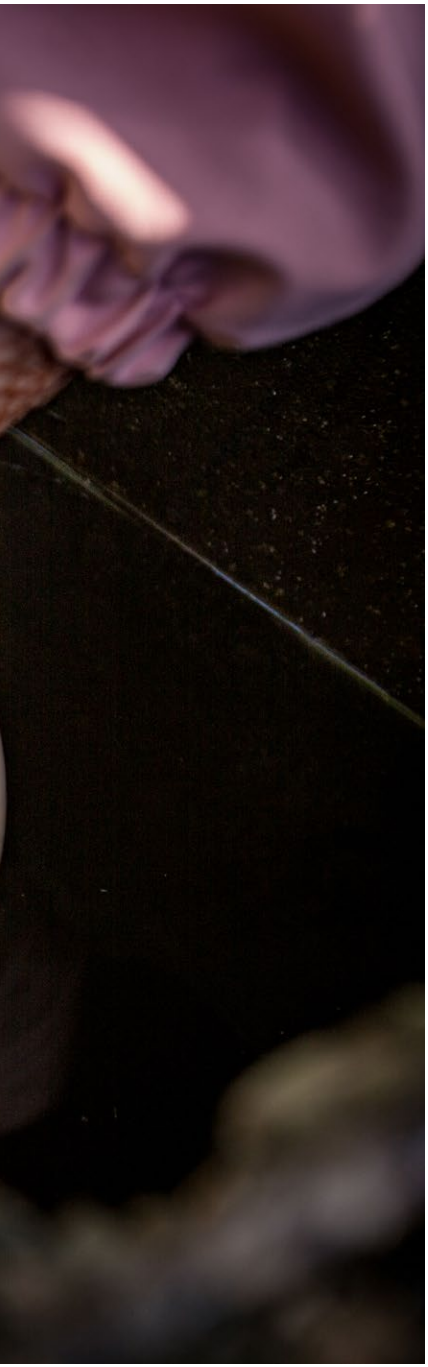
Science in Spring Restoration

Building climate resilience and water security in the Indian Himalaya



Content

Introduction

Springs are the primary source of water for many mountain communities in the Indian Himalayan Region (IHR) – the section of the Himalaya within India, spanning across all or parts of thirteen Indian states and union territories, namely Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Ladakh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Uttarakhand, and West Bengal.

Approximately 50 million people's lives and livelihoods in the IHR are sustained by spring water and mountain aquifer systems; another 100 million people visit this region for various purposes, but mainly as tourists (NITI Aayog, 2018). Spring water is used to meet the drinking, domestic, agricultural and livelihood needs of many Himalayan communities, and are also important for economic and cultural activities. At the same time, howsoever small it may seem, spring water remains critical in providing essential ecosystem services in and beyond the Himalayan region. Springs contribute significantly to baseflows, the flow of water that seeps into streams through delayed subsurface pathways. Baseflows help to keep water flowing in streams and rivers between precipitation events, and even during extended periods of drought.

These resources are depleting due to various factors including climate variability and climate change, land degradation and increasing impervious areas, haphazard infrastructure development, loss of local knowledge and practices, growing instances of natural hazards, and a lack of governance systems. Nearly 50 percent of the estimated three million springs in the IHR have either dried up or their flow has decreased[1] which has led to increased water insecurity for many communities (NITI Aayog, 2018).

The drying up of springs causes acute water stress, bringing new hardship, especially for women and children, who bear the primary responsibility of fetching water. The drying of springs is leading to increasing uncertainty for public rural water supply schemes, as most schemes depend on springs for their water. Drying springs have dire consequences for the sustainability of Himalayan landscapes, river systems, ecosystems, and biodiversity, and the people who depend on them.

[1] NITI Aayog, 2018. Working Group I: Inventory and Revival of Springs in the Himalayas for Water Security

Development and implementation of science-based springshed management in the IHR

To address the issue of drying springs and deterioration of water quality across the IHR, the International Centre for Integrated Mountain Development (ICIMOD), and its partners have implemented an action research initiative entitled 'Development and implementation of science-based springshed management in the IHR'. The initiative is supported by the Swiss Agency for Development and Cooperation (SDC) through the Strengthening Climate Change Adaptation in the Himalayas (SCA-Himalayas) project. The objective is to support and strengthen the capacity of state actors and institutions for spring rejuvenation in the IHR.

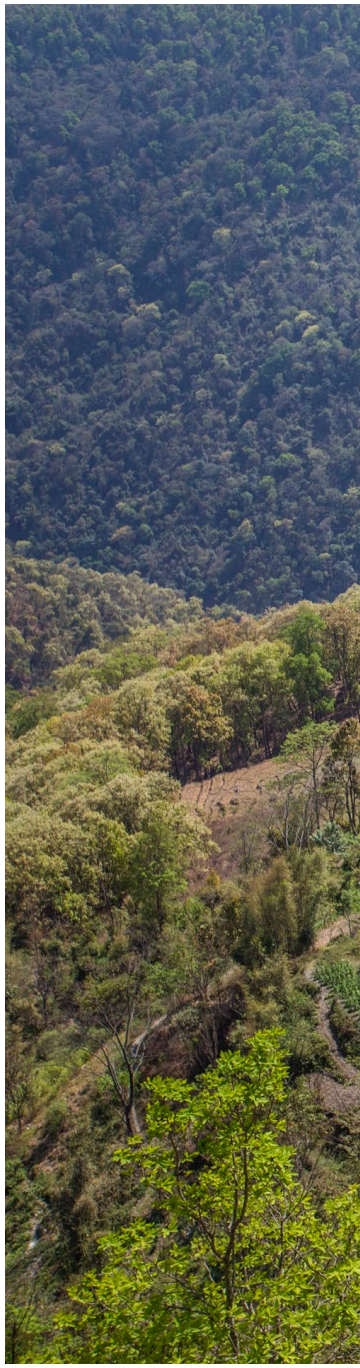
Definition of action research

Action research[2] is a research method that aims to simultaneously investigate and solve an issue by conducting research and taking action at the same time. There are two common types of action research: participatory action research and practical action research.

Participatory action research emphasises that participants should be members of the community being studied, empowering those directly affected by outcomes of said research. In this method, participants are effectively co-researchers, with their lived experiences considered formative to the research process.

Practical action research focuses more on how research is conducted and is designed to address and solve specific issues.

By implementing both participatory and practical action research, this project's focus is on increasing the capacity and ability of future practitioners, rather than contributing to a theoretical body of knowledge.



[2]George, T. (2024, January 12). What is action research? | Definition & Examples. Scribbr. https://www.scribbr.com/methodology/action-research/

About the initiative

The initiative aims to improve policies and programmes on springs through action research using a Gender Equality and Social Inclusion (GESI) approach and emphasises participatory research conducted with, for, and by the people involved. It involves cycles of action and reflection and aims to enable change through innovation and demonstrating proven solutions for reviving springs.

The initiative adopts a six-step science-based protocol for springshed management[3] (Shrestha et al., 2018). This practical and holistic approach integrates hydrogeology with socio-economic and governance dimensions to provide a comprehensive understanding of springs and their surrounding ecosystems.

The work focuses on pilot locations in the States of Himachal Pradesh and Uttarakhand in the Western Himalaya; Sikkim and Manipur in the Eastern Himalaya; and Ladakh, a union territory.

The initiative has strengthened the capacities of diverse stakeholders in GESI-responsive springshed management, developed an online Decision Support System (DSS), and prepared guidelines for the implementation and scaling of springshed interventions tailored to the varied contexts of the Indian Himalayan Region (IHR).

[3]Shrestha, R., Desai, J., Mukherji, A. S., Dhakal, M., Kulkarni, H. Y., Mahamuni, K., Bhuchar, S., & Bajracharya, S. (2018). Protocol for Reviving Springs in the Hindu Kush Himalaya: A Practitioners Manual. ICIMOD. https://doi.org/10.53055/icimod.735

Protocol for Reviving Springs in the Hindu Kush Himalaya: A Practitioners Manual

Logical framework of initiative

Impact

Strengthened water security and enhanced socio-ecological and climate resilience through springshed management in the IHR.

Outcome

Springshed management mainstreamed into national and state-level policies and district-level plans in the IHR, while ensuring both practical and research-based evidence from the ground.

Outputs

Evidence-based knowledge generated through action research to inform planning and implementation

Improved knowledge and skills for mainstreaming and scaling up springshed management through capacity building of practitioners and decision makers.

Policy and decision-making processes are supported to scale up springshed management across the IHR.

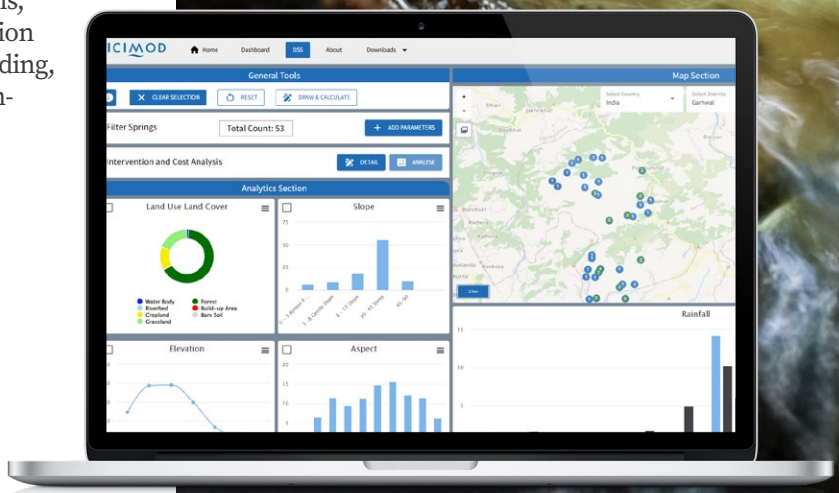
Project findings are strategically communicated at local, national, regional, and global levels to inform and influence policy and practice.

Decision Support System

The Decision Supporttem (DSS) is an interactive online portal that provides comprehensive informaton on spring locations, discharge data, socioeconomic parameters, and more. Its primary objective is to support the advancement of spring revival solutions across the Hindu Kush Himalaya (HKH) through regional knowledge exchange.

Built on the six-step springshed management protocol, the DSS has two key components: visualization and decision support. It is designed to guide decision-makers in implementing and scaling springshed management approaches in SCA-Himalays project pilot states of the Indian Himalayan Region (IHR). The platform offers tools that help users analyse available data and develop a tailored menu of measures for spring rejuvenation.

Beyond policy and planning use, the DSS also serves academia, research institutions, and other stakeholders by supporting action research, enhancing scientific understanding, building capacity, and informing decision-making processes.

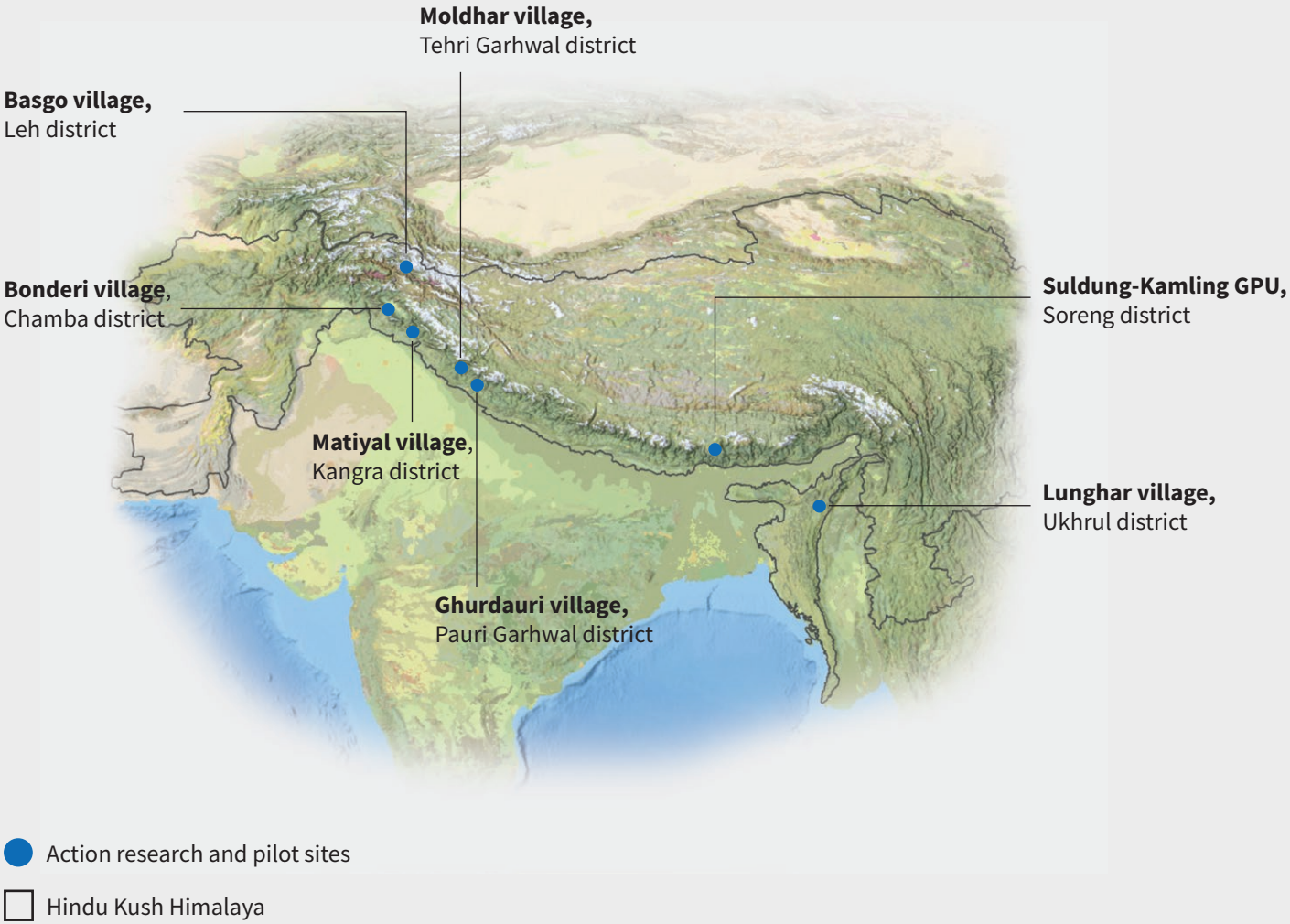


Decision Support System (DSS)

https://hkhsprings.icimod.org/dss

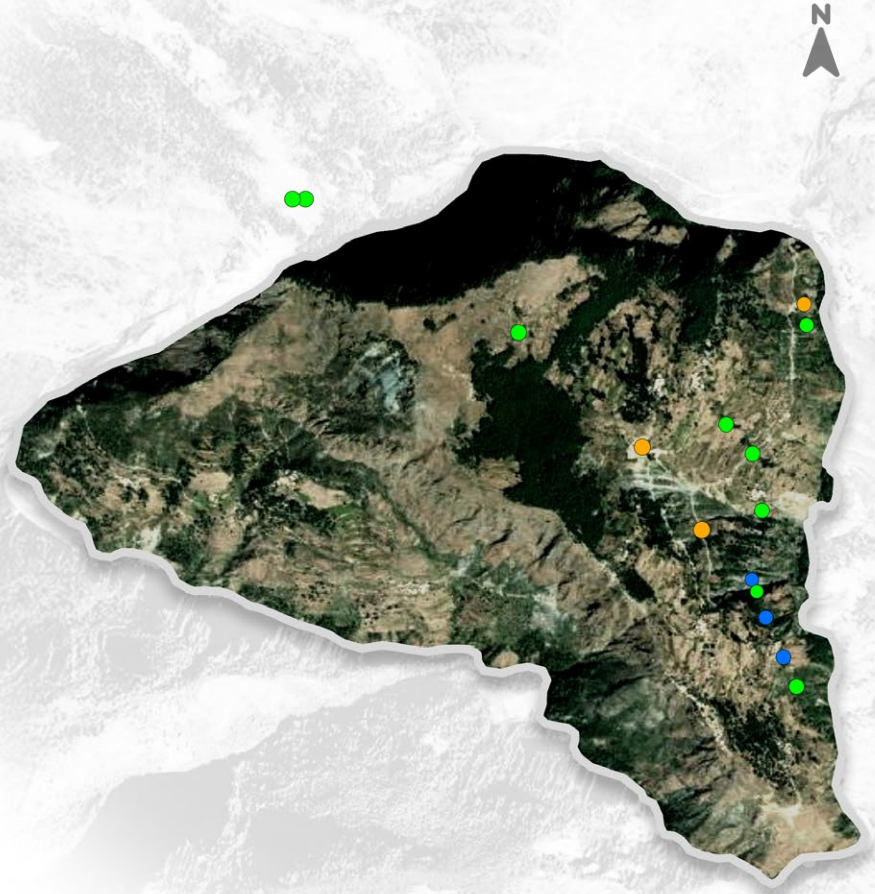
Action research pilot sites

Based on the interactions with all the stakeholders during the scoping mission of the project, pilot sites in seven villages were selected. The inventory included a reconnaissance of 81 springs out of which 39 springs were identified for monitoring and 19 for spring revival interventions.



HIMACHAL PRADESH STATE

Bonderi Village, Chamba District



15
Total springs

3
Springs inventorised, treated, and monitored

3
Springs inventorised and monitored

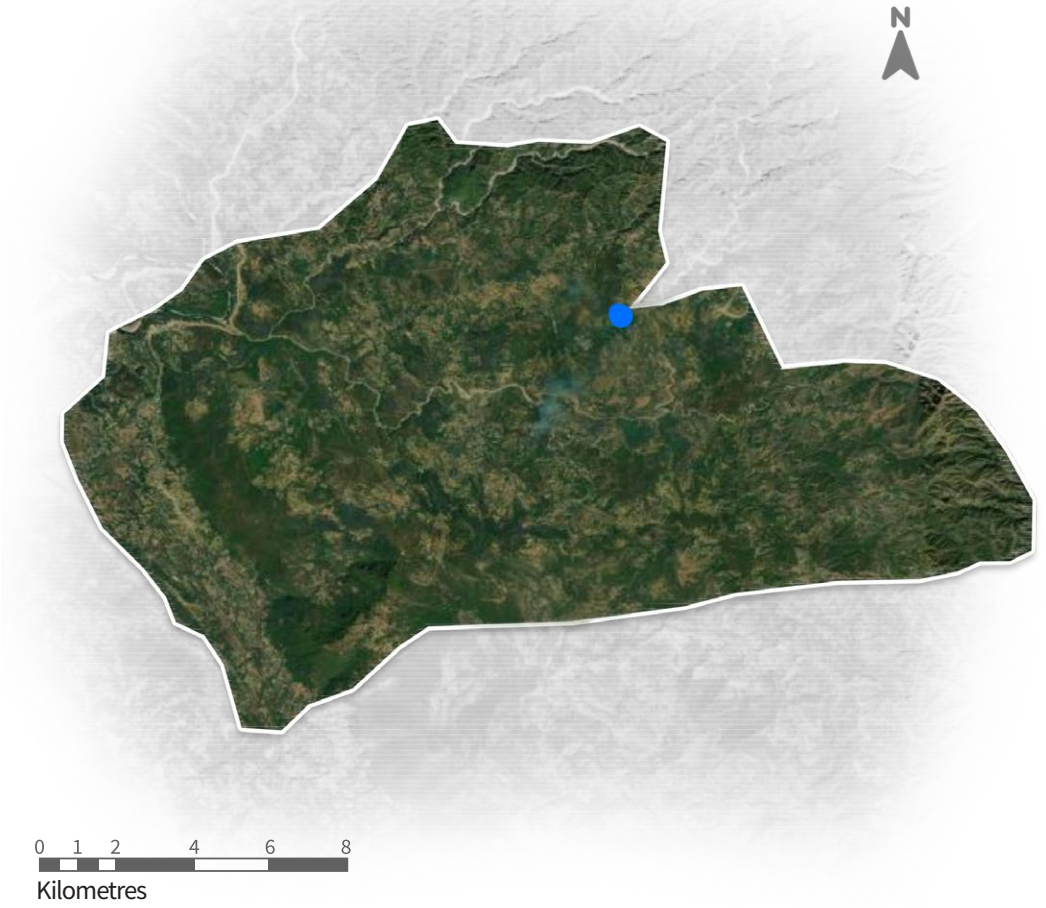
9
Springs inventorised only

184
Households dependent on the selected springs

Total members
1020

HIMACHAL PRADESH STATE

Matiyal Village, Kangra District



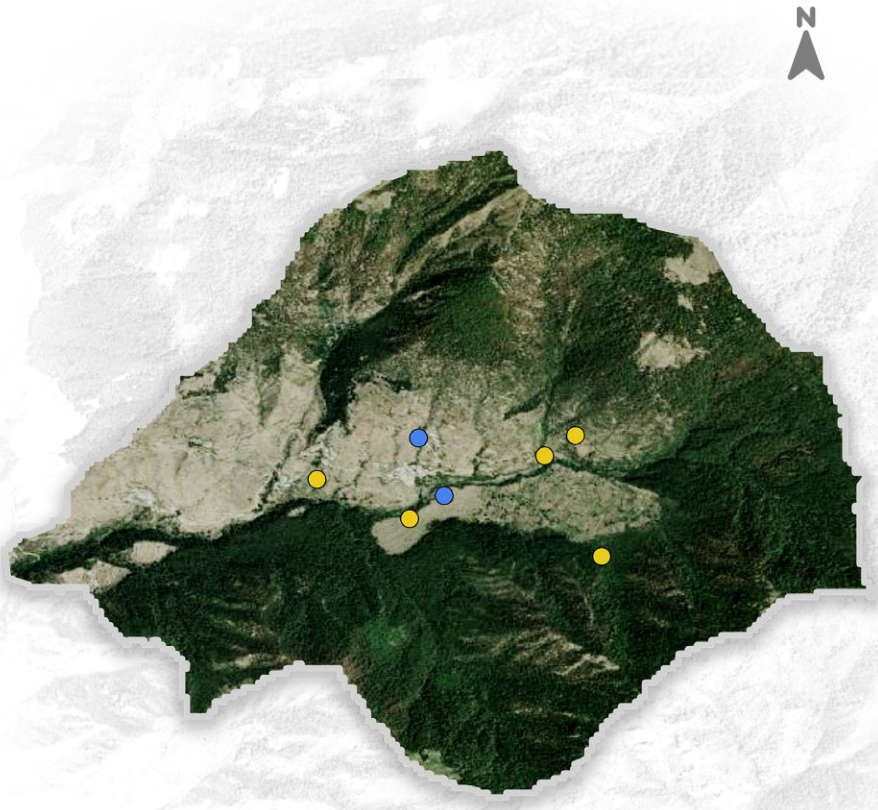
1
Total springs

1
Springs inventorised, treated, and monitored

16
Households dependent on the selected springs

UTTARAKHAND STATE

Moldhar Village, Tehri Garhwal District



7
Total springs

2
Springs inventorised, treated, and monitored

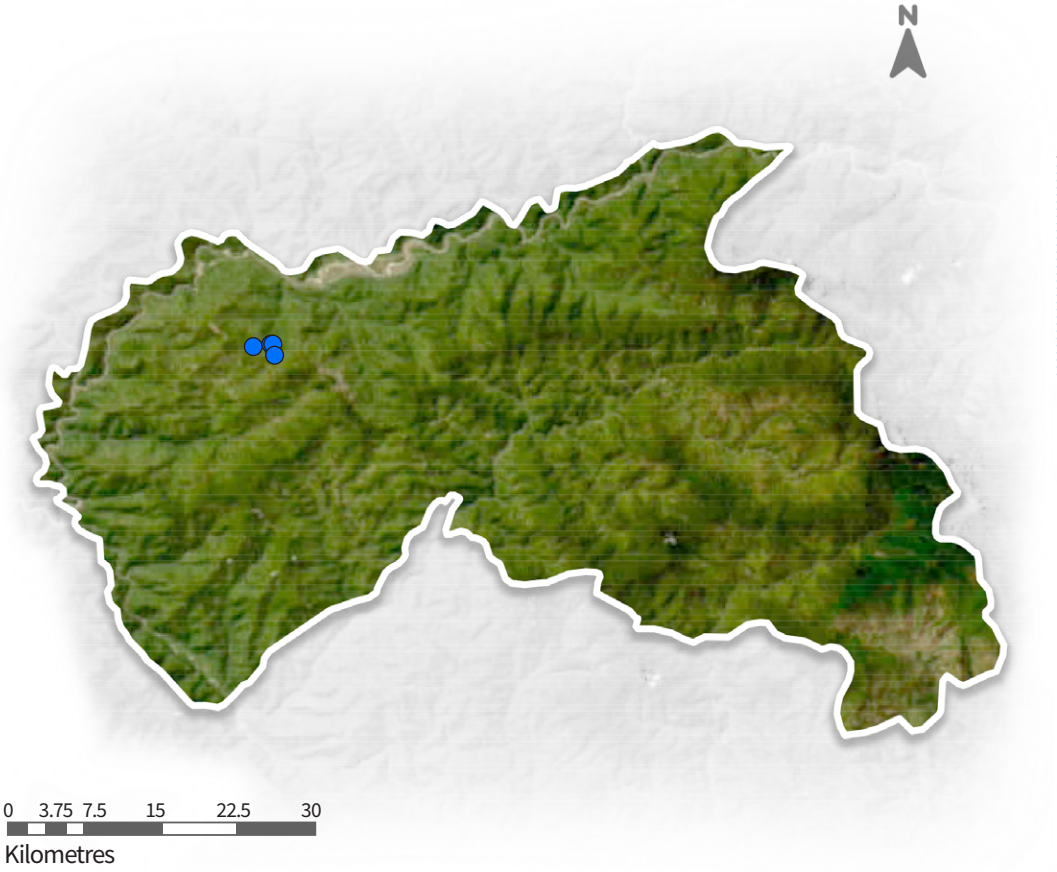
5
Springs inventorised only

154
Households dependent on the selected springs

Total members
956

UTTARAKHAND STATE

Ghurdauri Village, Pauri Garhwal District



4
Total springs

4
Springs inventorised, treated, and monitored

58
Households dependent on the selected springs

● Springs inventorised, treated, and monitored

LADAKH UNION TERRITORY

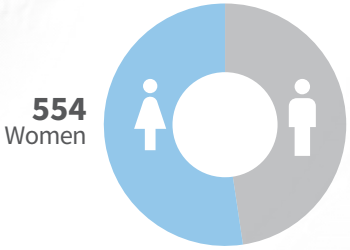
Basgo Village, Leh District

2
Total springs

2
Springs inventorised, treated, and monitored

191
Households dependent on the selected springs

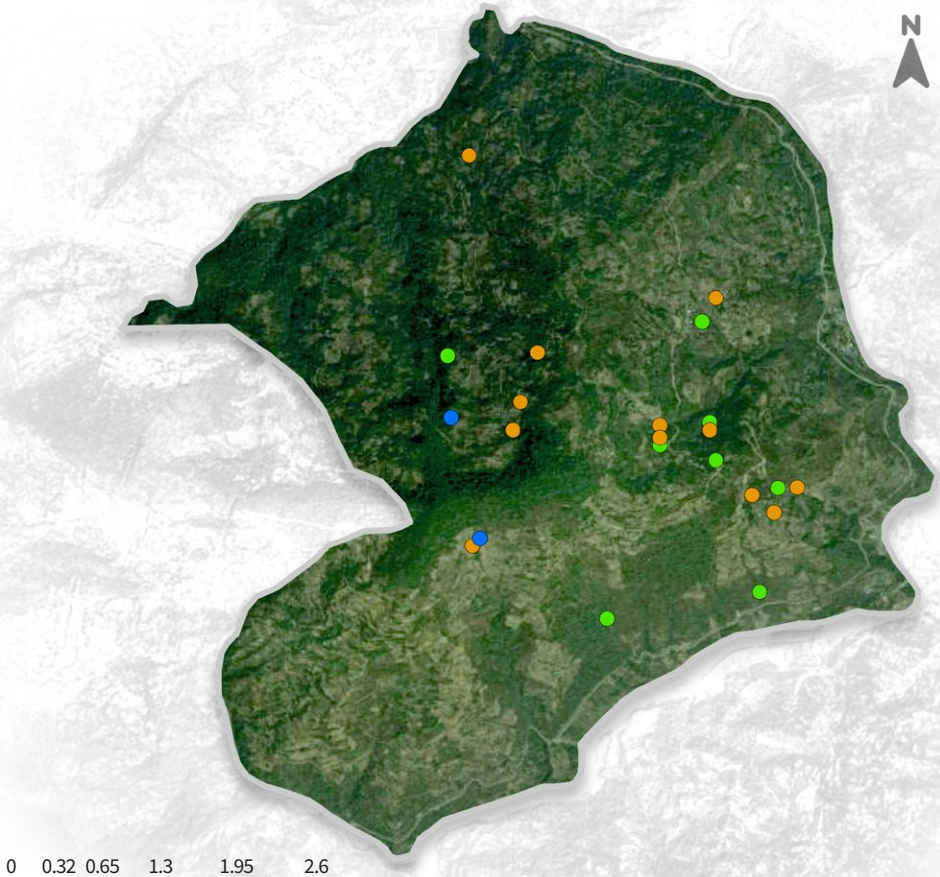
Total members
1,058



● Springs inventorised, treated, and monitored

SIKKIM STATE

Suldung-Kamling Gram Panchayat, Soreng District



22
Total springs

2
Springs inventorised, treated, and monitored

12
Springs inventorised and monitored

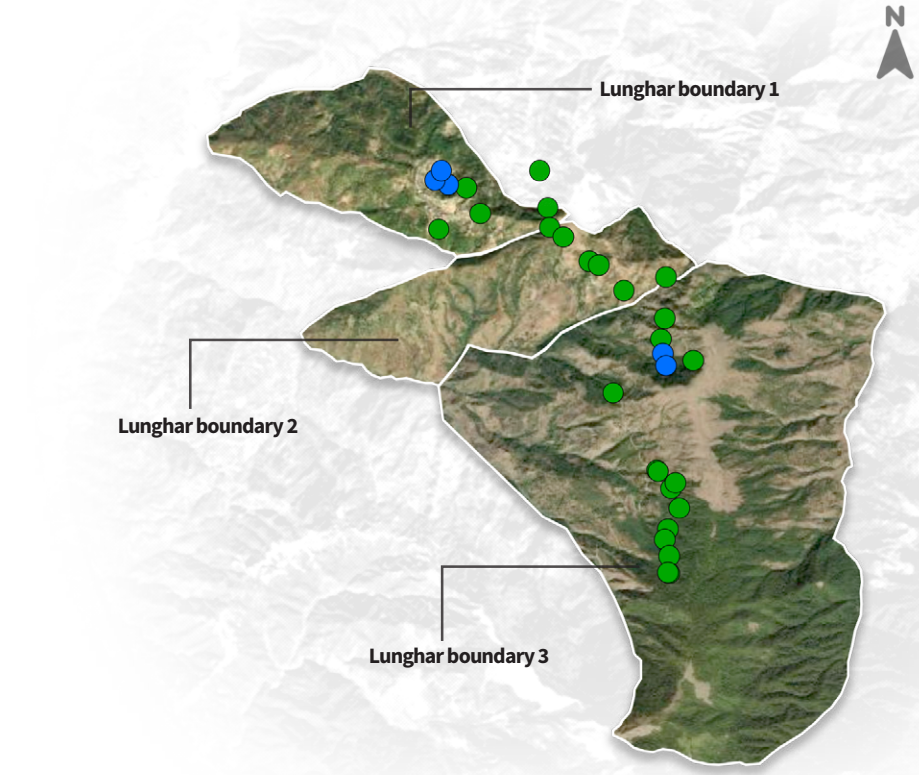
8
Springs inventorised only

650
Households dependent on the selected springs

Total members
1,917

MANIPUR STATE

Lunghar Village, Ukhrul District



0 1 2 3 4
Kilometres

- Springs inventorised, treated, and monitored
- Springs Inventorised

30
Total springs

5
Springs inventorised, treated, and monitored

25
Springs inventorised only

113
Households dependent on the selected springs

Total members
570

Approach and methodology

The initiative adopted a structured, six-step science-based springshed management protocol, beginning with an inventory of springs and mapping of springshed areas. This was followed by the establishment of data monitoring systems to track rainfall, spring discharge, and water quality. Hydrogeological studies were conducted to identify potential recharge areas, where recharge interventions were then implemented. The impacts of these interventions were assessed in terms of improvements in water quantity, water quality, and the socioeconomic benefits for local communities.

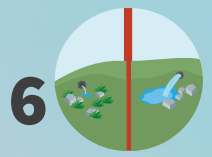
To operationalise the springshed management approach, an interdisciplinary team—comprising experts in watershed and river basin management, hydrogeology, social and governance systems, community-based adaptation, Nature-based Solutions (NbS), and environmental impact assessment—developed Village Water Security Plans (VWSPs). These plans included surface and groundwater source mapping, analysis of the village's institutional systems, assessment of water demand and supply, and mapping of both social and hydrological vulnerabilities. Participatory Rural Appraisal (PRA) tools such as focus group discussions, transect walks, and key informant interviews were used to ensure community involvement and contextual relevance.

An online Decision Support System (DSS) was developed to support planning and implementation. Based on the six-step protocol for springshed management, the DSS integrates visualisation tools and decision-making support for scaling and replication.In the three states of Manipur, Uttarakhand, and Himachal Pradesh, as well as the union territory of Ladakh, a spring-centric approach was adopted, focusing on key spring per site. In contrast, Sikkim implemented a broader aquifer-centric approach aimed at reviving multiple springs across a shared aquifer.

To institutionalise capacity building and develop a cadre of trained resource persons at both national and sub-national levels, the initiative employed a need-based Training of Trainers (ToT) approach.

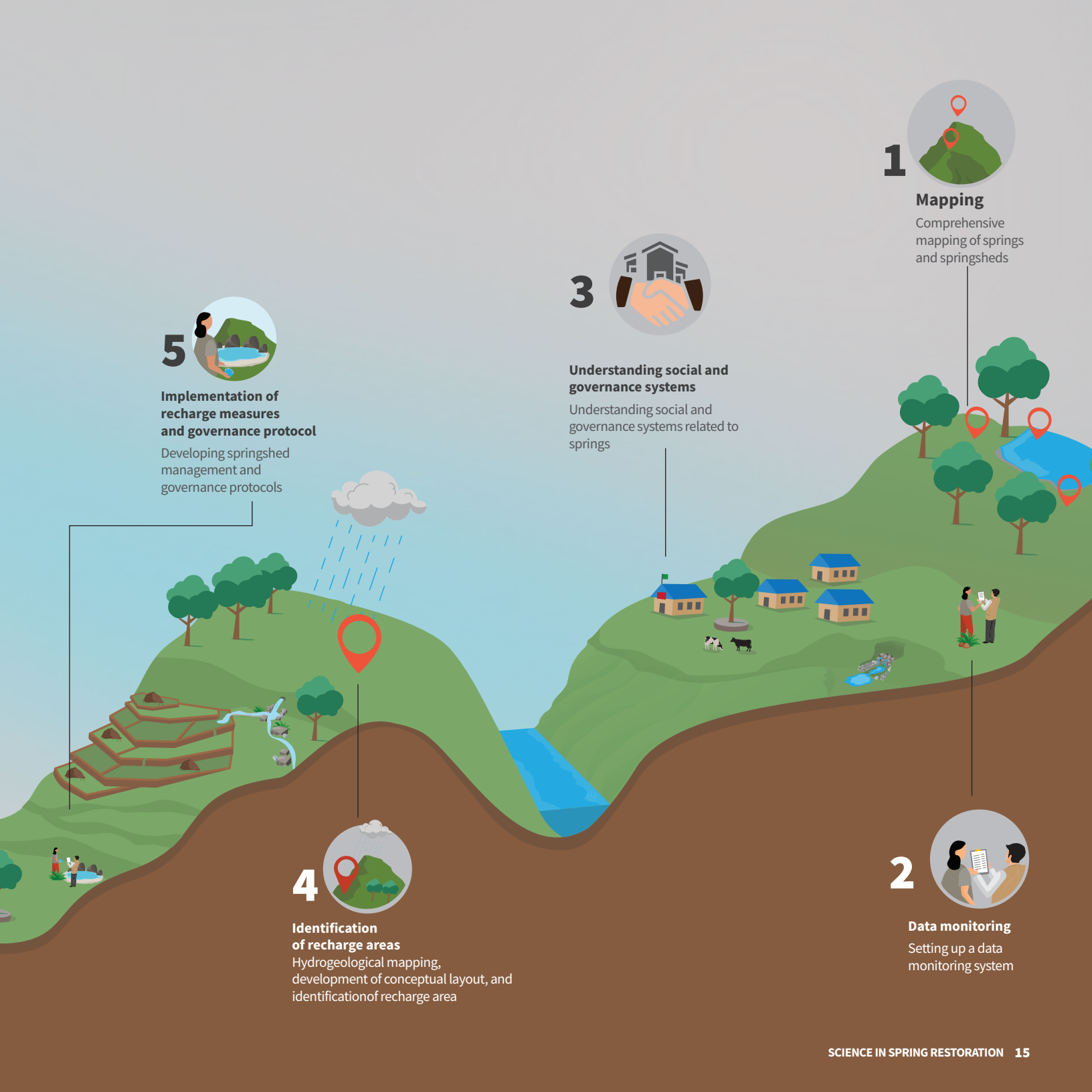
Community Resource Persons (CRPs) were identified and trained at each pilot site. Their responsibilities include collecting data on spring discharge, rainfall, and other weather parameters, as well as mobilising local communities for springshed-related activities. A total of 15 CRPs (including five women) were engaged across the five project locations: two in Manipur, four in Sikkim, three in Uttarakhand, four in Himachal Pradesh, and two in Ladakh.

Six step protocol for spring revival



Monitoring impact

Measuring impacts of spring revival activities


1
Mapping
Comprehensive mapping of springs and springsheds
2
Data monitoring
Setting up a data monitoring system
3
Understanding social and governance systems
Understanding social and governance systems related to springs
4
Identification of recharge areas
Hydrogeological mapping, development of conceptual layout, and identificationof recharge area
5
Implementation of recharge measures and governance protocol
Developing springshed management and governance protocols

Monitoring and instrumentation

For research validation and impact assessment, spring flow, water quality, and rainfall at all sites were monitored. To further validate the recharge areas identified through the hydrogeological methods, isotopic studies were conducted specifically in Uttarakhand and Sikkim.

Isotopic tracer study
Environmental isotopes act as natural tracers, as waters from different sources having undergone different processes have distinct isotopic fingerprints.

Isotopic fingerprints of rainfall are different at different altitudes. By comparing the isotopic composition of rainfall and spring water, we can estimate the altitudinal range at which rainfall infiltrates the ground and contributes to specific spring outlets.

In springshed management, the isotopic method is used to identify and validate recharge areas. This technique complements conventional hydrogeological approaches for delineating recharge zones. Isotope analysis helps establish a clear connection between rainfall and spring discharge, providing valuable insights into the origin and movement of groundwater.

39

Manual monitoring of the spring flow and in-situ spring water quality tests

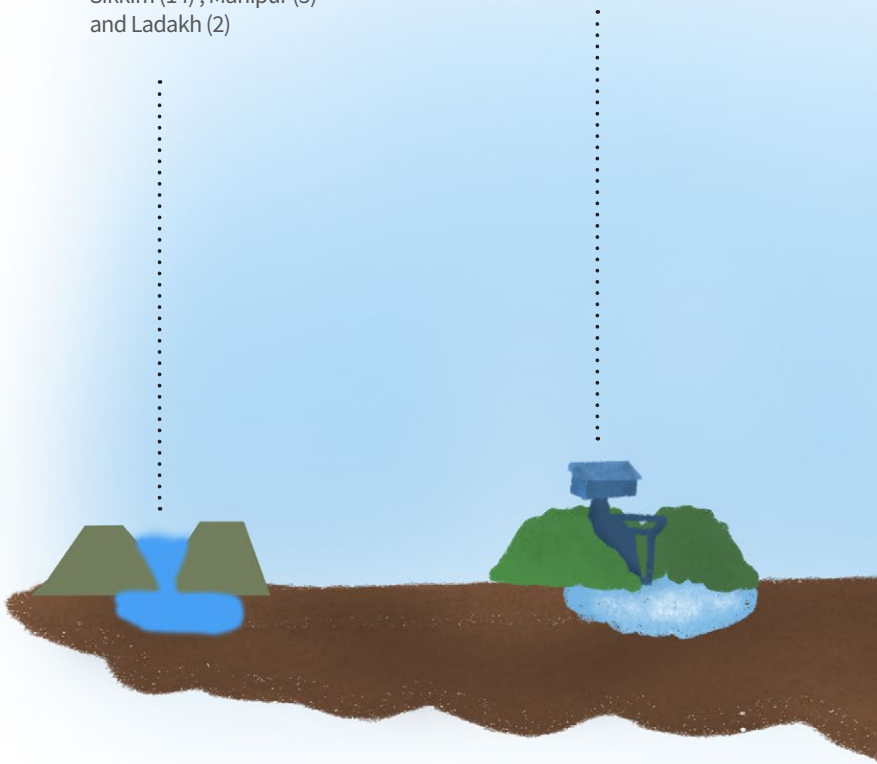
(electrical conductivity, pH, total dissolved solids, salinity, temperature)

Uttarakhand (11), Himachal Pradesh (7) Sikkim (14) , Manipur (5) and Ladakh (2)

7

Automated monitoring of spring flow using flumes with automatic stage data loggers installed in springs

Uttarakhand (1) Himachal Pradesh (2) Sikkim (2) and Manipur (2)



7

Rain gauges for manual rainfall measurement

Uttarakhand (2), Himachal Pradesh (2), Sikkim (1), Manipur (1), Ladakh (1)

21

Detailed water quality tests in laboratory for spring sites

(alkalinity, chloride, total hardness, calcium, magnesium, total coliform, fecal coliform, sodium, potassium, iron, nitrate, phosphate, sulphate, etc.)

Uttarakhand (4), Himachal Pradesh (4), Sikkim (8) and Manipur (5)

4

Automatic weather stations (AWS) for weather parameters

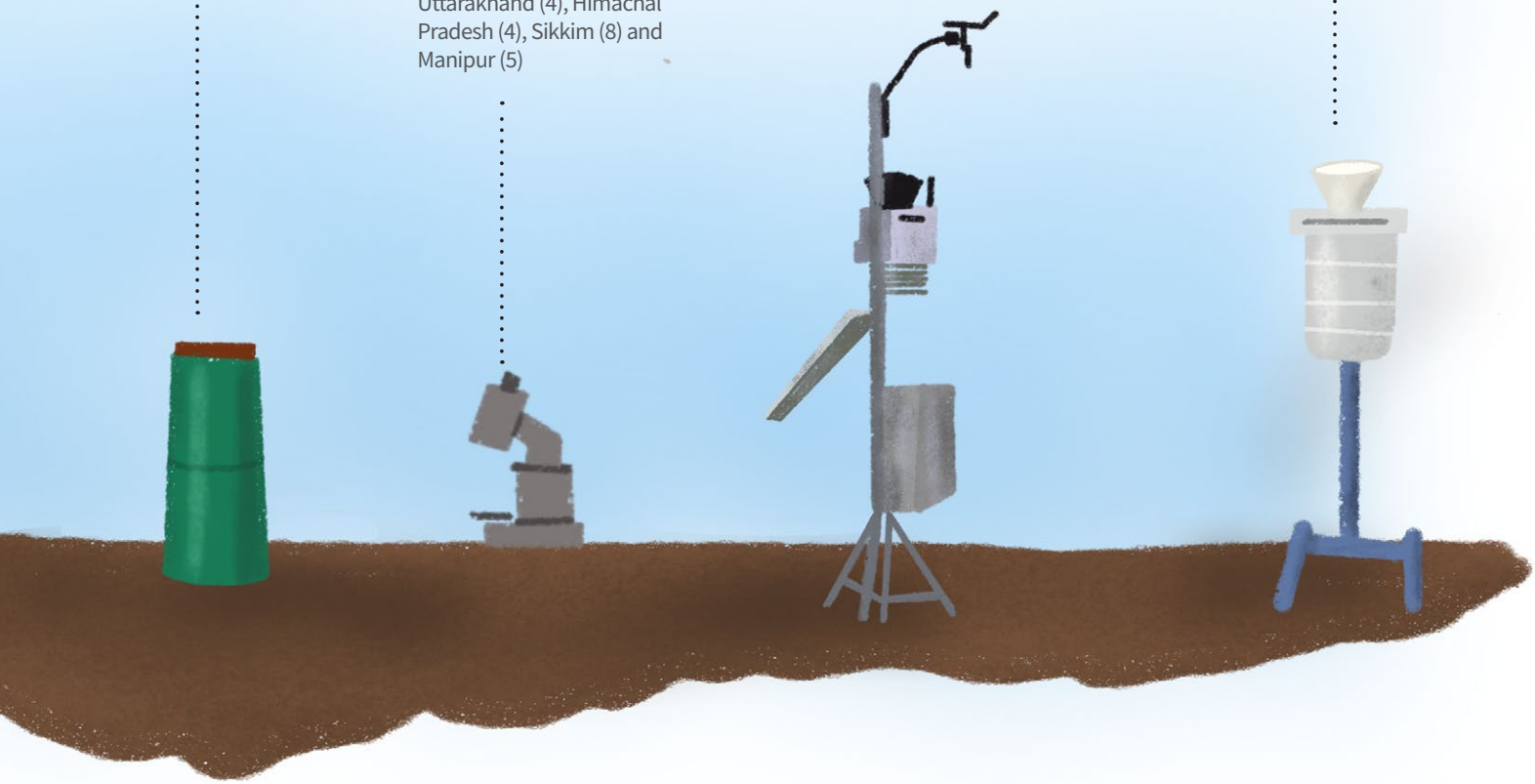
(precipitation, wind, speed and direction, solar radiation, atmospheric pressure and relative humidity)

Uttarakhand (1), Himachal Pradesh (1), Sikkim (1), Manipur (1)

4

Isotope samplers for rainfall and spring flow co-relation

Uttarakhand (3), Sikkim (1)



Collaboration and convergence

Adopting a collaborative approach significantly enhances the effectiveness and long-term sustainability of springshed management efforts. The experiences and insights gained from the SCA-Himalayas project have been pivotal in fostering convergence with national and sub-national institutions. These learnings are now being leveraged to scale and adapt springshed management approaches across other parts of the Hindu Kush Himalayan (HKH) region through ongoing programmes and strategic partnerships.

Through our collaboration, following convergences have taken place:

Pilots and scaling

The **Rural Development Department (RDD), Sikkim** contributed both technically and financially to establishing recharge interventions in the pilot sites.

The **Directorate of Environment and Climate Change (DoE&CC), Manipur** financially and technically supported springshed management implementation in Shirui village, drawing on learnings from the SCA-Himalayas project.

Capacity building

The **State Institute of Rural Development (SIRD), Sikkim** invested in Training of Trainers (ToT) programmes on springshed management, with the aim of strengthening institutional capacity to deliver training for practitioners.

The **Forest Department, Manipur,** under its Community-Based Sustainable Forest Management (COSFOM) programme, is scaling springshed management for water resource conservation. ICIMOD is supporting this effort through a series of capacity-building trainings under the Himalayan Resilience Enabling Action Programme (HI-REAP), funded by the UK's Foreign, Commonwealth & Development Office (FCDO, formerly DFID), drawing on the learnings and experiences from the SCA-Himalayas project.

The **Department of Forest and Environment, Government of Sikkim,** and the **Watershed Management Directorate, Uttarakhand,** developed Detailed Project Reports (DPRs) for the Upper Rothak watershed in Sikkim and selected districts in Uttarakhand (Almora, Pithoragarh, and Pauri) respectively. These were direct outcomes of training under the SCA-Himalayas project and are aligned with WDC-PMKSY 2.0 Watershed Development Component-Pradhan Mantri Krishi Sinchayee Yojana to institutionalise springshed management.

Policy convergence

The SCA-Himalayas project, in collaboration with UKID's HI-REAP programme, co-organised a national policy workshop for **NITI Aayog** to accelerate the scaling of springshed management efforts across India.

The **HKH Springs Alliance**, supported by SCA-Himalayas project and HI-REAP, was established as a collaborative platform to link science, policy, practice, and investment communities for advancing springshed management.

Building on the initiative's momentum, HI-REAP supported the **Directorate of Environment and Climate Change (DOECC), Manipur,** along with other government departments, in co-developing a state-level roadmap for springshed management.

The **Department of Land Resources (DoLR), Government of India** was supported by SCA-Himalayas project and HI-REAP in shaping the design of the emerging National Spring Scheme, currently under consideration.

Key achievements

Building on a structured and science-based approach to springshed management, the initiative has made tangible progress in strengthening institutional capacity, fostering community participation, and promoting sustainable water management practices to enhance water security. The achievements are structured around four core pillars: evidence-based knowledge and information, improved knowledge and skills, strategic communication of findings and GESI integration. These pillars have enabled the generation of actionable insights, empowered local actors, and informed policies at multiple levels for scaling and sustainability.

Evidence-based knowledge and information

39 springs monitored

19 springs treated

Recharge interventions implemented in over **173** hectares

Four states and one union territory have implemented action research and the six-step protocol

Uttarakhand, Himachal Pradesh, Sikkim, Manipur and Ladakh

Recharge interventions implemented in more than 173 hectares of land.

Recharge areas for critical springs were identified across four states and one union territory, including a landscape-level recharge area in Sikkim. Implemented measures include toe trenches, staggered contour trenches, hedgerows, planting of trees and shrubs, rooftop rainwater harvesting with infiltration pit, check dams and percolation ponds.

39 springs monitored across the four states and one union territory of which 19 were treated.

Of the 19 springs, two critical springs in Sikkim were treated using a landscape approach[4], while the remaining 17 were treated using a spring-centric approach[5].

Isotope and tracer research completed in 2 states

Uttarakhand and Sikkim

Results from Uttarakhand and Sikkim show that the recharge zones identified through the hydrogeological survey match with the isotopic study findings.

[4] Landscape approach: Assessment and revival focuses on a cluster of springs located in the same landscape or mountain.

[5] Spring-centric approach: Assessment and revival focuses on a single spring

Five Village Water Security Plans (VWSPs) were prepared.

Basgo (Ladakh), Bonderi (Himachal Pradesh), Lunghar (Manipur), Moldhar (Uttarakhand), Suldung-Kamling (Sikkim)

Findings indicated that nearly all villages faced a gap between water supply and demand. A water deficit was observed in Basgo, Bonderi, Lunghar, and Suldung-Kamling, while Moldhar reported a surplus prior to the implementation of recharge interventions in the pilot sites.

Three detailed project reports (DPRs) prepared

Almora, Pithoragarh, and Pauri districts in Uttarakhand

The reports were prepared through Uttarakhand's Pradhan Mantri Krishi Sinchayee Yojana 2.0 (PMKSY 2.0) implemented by the Watershed Management Directorate (WMD).

Action research results synthesised

Sikkim, Manipur, Uttarakhand, and Himachal Pradesh

The synthesis shows an increase in spring discharge following the interventions.

A comprehensive cost–benefit analysis (CBA) of the pilot sites has been completed, led by the South Asian Network for Development and Environmental Economics (SANDEE).

Using a discount rate of 5% and an appraisal period of 25 years, the CBA across 14 study sites has estimated private net benefits per household per month at approximately US$12 in Uttarakhand, US$12 in Himachal Pradesh, and US$7 in Sikkim.

While the analysis has provided valuable insights into the economic returns of springshed management, the social CBA component—particularly ecological benefits (such as biodiversity and cultural significance) and social benefits (including women's empowerment and community resilience)—has not been included due to time and resource constraints.

Cost–benefit analysis of springs revival in the Indian Himalayan Region
https://doi.org/10.53055/ICIMOD.1096

STORY

Best toe forward: how building trenches preserves spring water flow

Upala Shivani Dhara – a major but drying spring, which supplies water to around 80 households in Moldhar, has been one of the successful examples of the implementation of springshed management protocol. The spring's 'recharge area' is in a privately-owned, terraced agricultural field. The terraces remain barren and abandoned, only to be used for fodder collection and seasonal open grazing. Guided by our six-step protocol for springshed management, we undertook various initiatives, including the construction of "toe trenches" to enhance recharge. A toe trench is a pit constructed in each terrace field. While met with scepticism initially, a transformative exposure visit to a previously successful site kindled hope among the Moldhar community. Empowered and motivated, the women of Moldhar displayed unwavering dedication as they tirelessly built hundreds of toe trenches that not only led to improvement in spring flow but also increased fodder production from the agricultural land and ultimately enhanced their livelihood.

During the sweltering months of May and June 2022, a group of women from Moldhar persevered to build over 700 toe trenches across 3.5 hectares. This inspiring story of community involvement and women-led mobilisation demonstrates our commitment to not only reviving springs but also establishing model sites for sustainable water management, with the aim of benefiting communities across India and beyond.

STORY

Spring water flow almost doubles in Lunghar after recharge interventions

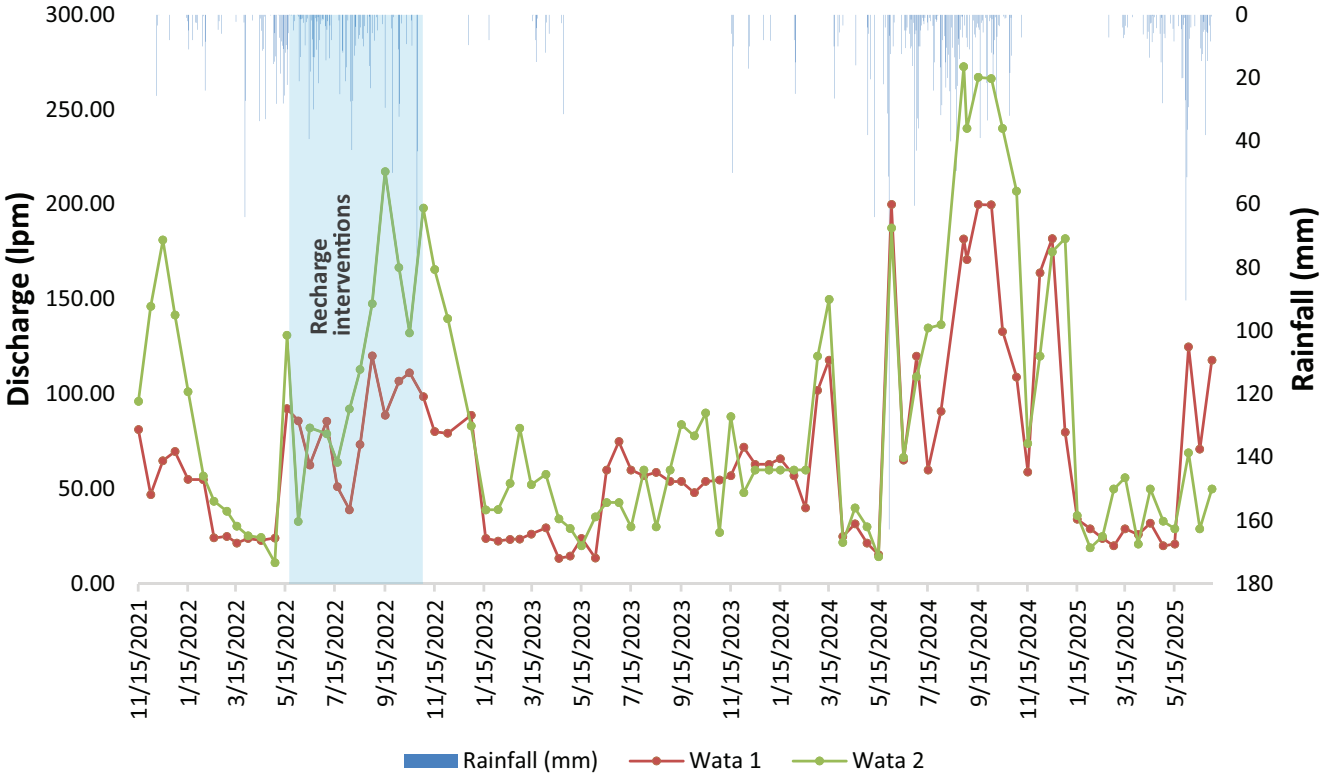
Lunghar village, located in Ukhrul district, Manipur lacks surface water sources, except for a small, now-unused pond. Traditionally, the villagers depended on multiple springs for water, with women often making at least four trips per day to fetch water. While these springs are perennial, their discharge fluctuated seasonally—during dry periods, water had to be collected early in the morning due to reduced flow later in the day.

Over time, population growth and declining spring discharge have contributed to increasing water stress. The primary water source for the village are two springs namely Wata-1 and Wata-2 located along the same slope which are connected to collection chambers. To address this water stress, spring revival interventions were undertaken. The results of the impact assessment are presented graphically below.

The hydrograph for the Wata spring system shows a marked improvement in spring flow following the recharge interventions. A noticeable increase in flow is observed during the peak season immediately after the interventions. During the lean season, spring flow has either sustained (in the case of Wata-1) or increased (in the case of Wata-2). On average, Wata-1 and Wata-2 have recorded flow increases of 23% and 48%, respectively—even with scanty winter rainfall during the monitoring period.

Methodology: Comparison of average flow before and after recharge interventions.

HYDROGRAPH OF WATA SPRING SYSTEM



Improved knowledge and skills

Capacity building is a core component of the initiative, equipping local communities with the knowledge and skills to form a cadre of trained resource persons in springshed management. To date, the following capacity building interventions have been carried out:

- 577 people (including 240 women) from 15 institutions trained on springshed management, out of which 159 received additional ToT training.
- An open access, self-paced e-course titled *Springshed management for water security, biodiversity co-benefits, and climate resilience* is being developed in collaboration with Himalayan University Consortium (HUC). The course is intended for water resource managers, environmental conservationists, policymakers, and community leaders committed to sustainable development and climate resilience.
- An online, open access Decision Support System (DSS) based on the six-step protocol for springshed management has been co-developed with partners.
- Guidelines to operationalise the springshed management component within the new Watershed Management Guidelines (India) is being initiated in collaboration with Watershed Management Directorate, Uttarakhand, which will also serve as guidelines for other Indian Himalayan states.
- Three customised training packages targeting decision makers, practitioners, officers and para-workers/CRPs have been developed for future training courses.
- The project has strengthened the capacities of mandated institutions such as the State Institute for Rural Development in Sikkim and the Watershed Management Directorate in Uttarakhand for institutionalising and scaling springshed management training courses.

Trained
577
people

Developed
1
e-course (open access)

1
Decision Support System

3
customised training packages

Strategic communication of findings

- **Joint monitoring and co-learning visits** to five pilot sites generated actionable recommendations, including the integration of Payment for Ecosystem Services (PES) in springshed management for long-term sustainability. These insights were shared during stakeholder workshops held in Dehradun, Uttarakhand and Gangtok, Sikkim.
- **Regional workshop organised,** with a key recommendation for HKH countries to collaborate on developing an umbrella policy to guide the integration of springshed management across relevant sectors.
- **Presentation of the six-step protocol for springshed management** at key global platforms including:
  - UNFCCC Climate Change Conference (COP 26, Glasgow, 2021)
  - Asia International Water Week (March, 2022)
  - Advancing Earth and Space Sciences (AGU) Conference (December 2023)
- **Four case studies** from the pilot sites documented and disseminated to highlight key project outcomes.
- **Five pilot site factsheets** developed to support knowledge dissemination and stakeholder engagement.
- **Training video** titled *From One Spring to Many: Sikkim rolls out an aquifer-based approach to spring revival* was published.
- **Animation video** titled *Bringing Springs Back to Life* published highlighting springshed management as a nature-based solution to restore vital freshwater springs and ensure water security.

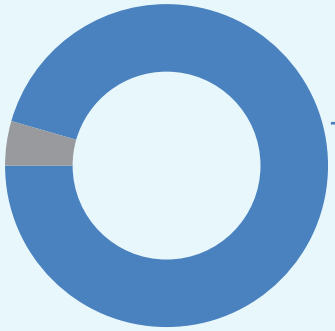
Training Video on Aquifer-Based Springshed Management

Bringing Springs Back To Life

GESI integration

The project has progressively integrated GESI principles to ensure that spring revival processes and outcomes are both equitable and sustainable. Across all pilot states, women spring users have led or co-led initiatives, actively participating in spring user committees and serving as community resource persons to monitor rainfall and spring flows. Fourteen Water User Groups (WUGs) were formed and strengthened across all five pilot sites, ensuring fair representation and active participation of women. Gender integration is clearly demonstrated, with women comprising 86% of WUG/VWSC members. They have also played key roles in implementing springshed management measures and contributed valuable insights during the cost-benefit analysis of the pilots.

Districts	No. of WUG/VWSC	Women	Men
Uttarakhand	6	34	10
Himachal Pradesh	6	142	0
Sikkim	1	14	8
Manipur	1	7	10
Ladakh	1	9	5



Women comprise

86%

of the Water User Group/ Village Water Security Committee (VWSC) members.

Challenges

Implementing springshed management initiatives across diverse and often fragile mountain landscapes is inherently complex and requires collaboration across communities, landscapes, and institutions. Several key challenges surfaced during implementation many of which may resonate with practitioners working in similar contexts.

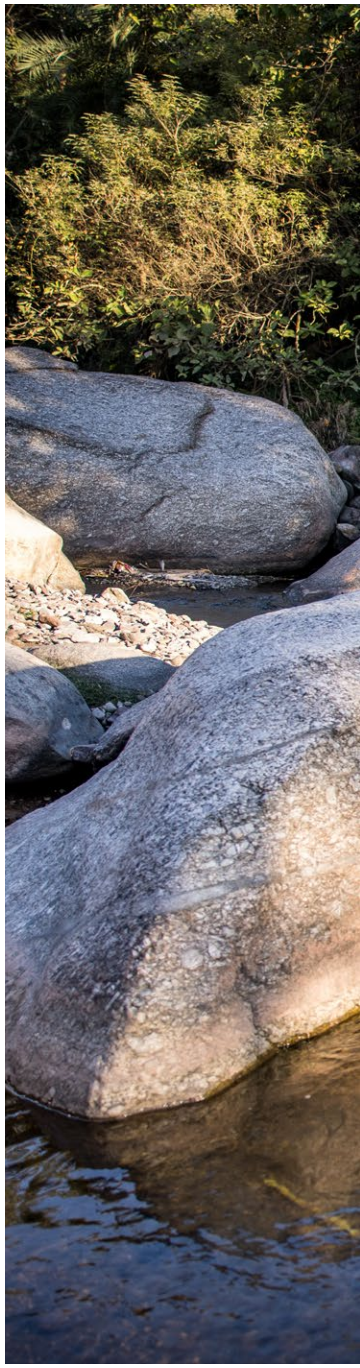
Delays in securing permissions for recharge interventions are common—particularly on private land and state forests. These delays can significantly affect implementation timelines.

Sustaining community engagement and retaining trained local resource persons beyond the project lifecycle remains a challenge. Without ongoing incentives or institutional support, there's a risk of losing critical grassroots capacity.

Protecting monitoring equipment and scientific instruments in remote, high-altitude locations is difficult due to harsh weather and accessibility issues. Occasional vandalism or theft can create problems as well.

Observed discrepancies between automatic and manual measurements highlight the need for careful site selection so that the logger can capture spring discharge accurately, separating baseflow from overland flow.

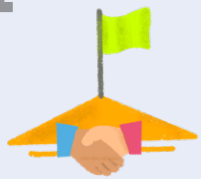
Limited institutional coordination at the local level can slow down progress. Springshed management often intersects with multiple sectors – forests, water, rural development – making convergence difficult without strong facilitation and political will.



Key messages and recommendations

Our findings from the initiative have yielded several key lessons, based on experiences gained during implementation, engagement with various stakeholders, regional workshops, and exchange visits conducted throughout the initiative's duration.

1



Rejuvenation of springs should be a local agenda. Local governments (Gram Panchayats) must be involved as they have the mandate and budget for water solutions.

2

Springshed management should address local sustainable development goals.

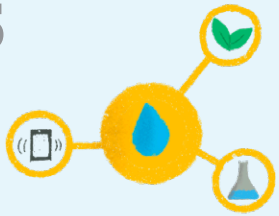
3

Springs should be developed as a reliable source of water. In areas where government piped water schemes are available, springs can serve as a backup source.

4

Water quality management must be a priority area for action, particularly in relation to the protection and management of springsheds, as degradation of these source areas directly impacts the quality of spring water.

5



Scientific knowledge, including contributions from local communities through citizen science, should guide all decisions, actions and recharge activities.

6

Convergence with springshed programmes led by national and subnational governments, along with coordination among relevant sectors, is important for the sustainability of spring water resources.

7

Incentive-based Mechanisms or Payment for Ecosystem Services (PES) should be incorporated into springshed management, particularly for repair and maintenance of recharge measures.

8

Local ownership of any action research initiative is important.

9

Even though springshed management is in national policies, for example the guidelines for New Generation Watershed Development Projects (WDC-PMKSY 2.0) developed by DoLR, strengthening state capacities is crucial for putting policies into action.

10

Gender equality and social inclusion should not just be steps in the process, but a guiding mindset throughout all aspects of springshed management—from mapping and monitoring to implementing recharge measures and assessing impact.

Partners

ICIMOD, jointly with Advanced Center for Water Resources Development and Management (ACWADAM), Indian Institute of Technology Roorkee (IITR), and People's Science Institute (PSI), along with governmental and nongovernmental partners are implementing this action research initiative.

Implementing partners

Strategic and knowledge partners

Department of Forest and Environment, Sikkim
Department of Land Resources (DoLR), Government of India
Directorate of Environment and Climate Change (DoE&CC), Manipur
Forest Department, Himachal Pradesh
Public Health Engineering/Irrigation & Flood Control Department (PHE/IFC), Administration of Union Territory of Ladakh
Rural Development Department (RDD), Sikkim
State Institute for Rural Development (SIRD), Sikkim
Watershed Management Directorate (WMD), Uttarakhand

About the International Centre for Integrated Mountain Development (ICIMOD)

The Hindu Kush Himalaya region stretches 3,500km across Asia, spanning eight countries – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. Encompassing high-altitude mountain ranges, midhills and plains, the zone is vital for the food, water and energy security of up to two billion people and is a habitat for countless irreplaceable species. It is also acutely fragile – and absolutely frontline to the impacts of the triple planetary crisis of climate change, pollution and biodiversity loss. The International Centre for Integrated Mountain Development (ICIMOD), based in Kathmandu, Nepal, is an international organisation established in 1983, that is working to make this critical region greener, more inclusive and climate resilient

About the Swiss Agency for Development and Cooperation (SDC)

The Swiss Agency for Development and Cooperation (SDC) is Switzerland's international cooperation agency within the Federal Department of Foreign Affairs (FDFA). In operating with other federal offices concerned, SDC is responsible for the overall coordination of development activities and cooperation with Eastern Europe, as well as for the humanitarian aid delivered by the Swiss Confederation. The goal of development cooperation is that of reducing poverty. It is meant to foster economic self-reliance and state autonomy, to contribute to the improvement of production conditions, to help in finding solutions to environmental problems, and to provide better access to education and basic healthcare services.

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