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Application of Eight-step Methodology for Reviving Springs and Improving Springshed Management in the Mid-hills of Nepal

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Why Revive Springs in the Mid-hills of Nepal?

Springs are the main source of water for millions of people in the mid-hills of the Hindu Kush Himalaya (HKH). Both rural and urban communities depend on springs to meet their drinking, domestic and agricultural water needs. There is increasing evidence that springs are drying up, or their discharge is reducing throughout the HKH. As a result, communities are facing unprecedented water stress. The exact extent of this problem is not well known, given the dearth of scientific studies.

Springs are an integral part of the groundwater system. However, the science of hydrogeology that governs the occurrence and movement of water in underground aquifers is not well understood in regions that depend upon springs. This often results in misconceptions regarding springs. This, in turn, creates misaligned policies that exacerbate the problem. Springs are also part of complex socio-technical and informal governance systems with pronounced gender and equity dimensions, and these systems are not well understood. Again, such lack to understanding leads to inappropriate policies and interventions. Climate change and change in bio-physical landscape (e.g. land-use and vegetation) are widely implicated in the drying of springs. But there is very little systematic knowledge to effectively link climate change, vegetation change and spring discharge, especially because of large data uncertainties. This is an urgent area for research and knowledge generation. Rapid socio-economic and demographic changes and infrastructure (dams, roads etc.) have also impacted springs. But again, the exact nature of change is difficult to understand due to a dearth of studies. This is another important knowledge gap that needs to be filled.

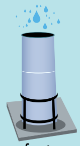
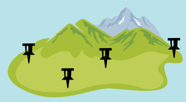
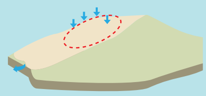
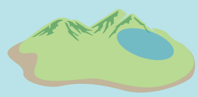
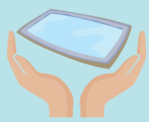
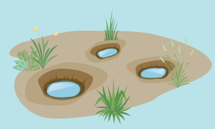
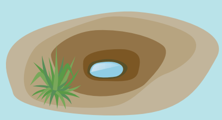
The drying of springs, which comes with its own set of consequences, is a regional phenomenon that cuts across the HKH – from Afghanistan all the way to Myanmar. A few local and national organizations have started scientific studies and policy advocacy on springs, but more needs to done, especially given the extent of the problem and its regional and local dimensions. In this context, ICIMOD with support from CGIAR's WLE Program, has initiated work on understanding the physical and governance issues related to springshed management and use this knowledge to influence policymaking in the region.

Development of the Eight-step Methodology through a Consultative Process

How can we revive drying springs in various parts of the HKH? To answer this question, we have developed an eight-step methodology for reviving springs, and for better management of springsheds. This research methodology was developed consultatively by a wide range of stakeholders who met in Gangtok, Sikkim, during the "Himalayan Springs Stakeholder Dialogue and Meeting: Framing a Common Methodology and Approaches for Springshed Management Workshop" from 23-26 November 2015. The meeting was organized by ICIMOD in collaboration with The Mountain Institute India (TMI), the Government of Sikkim's Rural Management and Development Department (Dhara Vikas Programme), and the Advanced Centre for Water Resources Development and Management (ACWADAM), Pune, India. Sikkim's Rural Management and Development Department had developed a Dhara Vikas Handbook as a part of its spring revival programme. Our eight-step methodology builds on that, but is more comprehensive and interdisciplinary in approach.

Figure 1: **A step-by-step methodology for reviving springs and springshed management**

The eight-step method

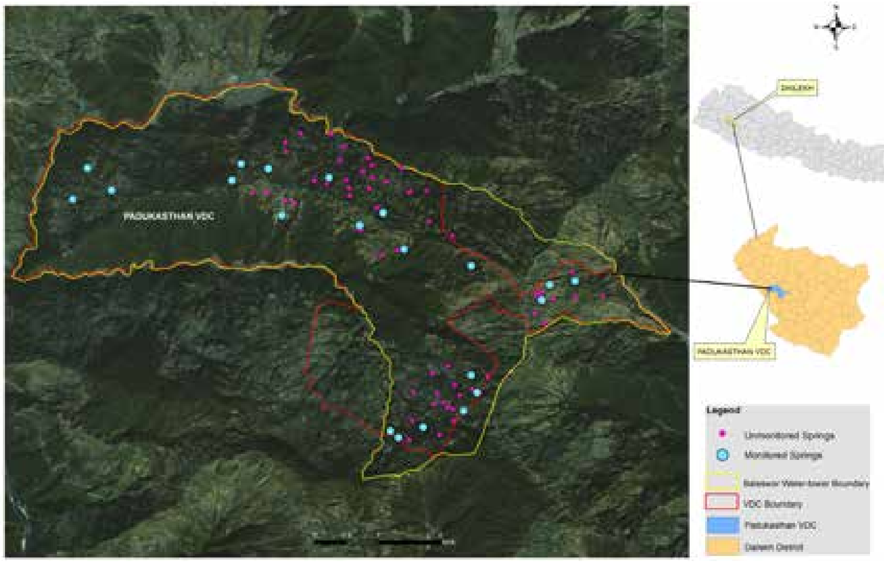
STEPS	SUB-STEPS	LEADS TO	
I. Comprehensive mapping of springs and springsheds	1.1: Collect background information of identified area 1.2: Reconnaissance survey 1.3: Map springs and collect data 1.4: Delineate springshed area	 Delineation of water tower	 Comprehensive map of springs
II. Setting up a data monitoring system	2.1: Data collection (why, who, where, what, how) 2.2: Data storage and management 2.3: Data analysis (software development, app development) —Hydrograph/basic software 2.4: Share data with community	 Setting up of raingauge station	 Hydrometeorological data in Excel
III. Understanding social and governance aspects	3.1: Analyse existing institutions and systems of management using: questionnaire survey, focused group discussions, key informant interviews, and communication and dialogue with community and public policy makers	 Management of spring by the local community	 Questionnaire survey tool
IV. Hydrogeological mapping	4.1: Obtain geological map of the area 4.2: Observe geology during transect walk: latitude, longitude, elevation, spring location, geological observations and measurements 4.3: Create a base map using Google Earth/Toposheet	 Excel format of hydrogeological data	 Google-based base map
V. Creating a conceptual hydrogeological layout of springshed	5.1: Create a geological map based on the transect walk 5.2: Draft cross-sectional layout	 Geological map of spring and springshed	 Cross-sectional layout
VI. Classifying spring types, identify mountain aquifer and recharge areas	6.1: Identify spring and aquifer types 6.2: Delineate recharge area	 Example of spring types	 Outline of recharge area
VII. Developing springshed management protocols	7.1: Hydrogeological inventory for springsheds 7.2: Negotiable and non-negotiable land use and land cover change 7.3: Institutional mechanism 7.4: Conservation and intervention, measures of recharge and discharge area 7.5: Develop operational and maintenance guidelines	 Revival activities using voluntary labour	 Recharge structures
VIII. Measuring the impact of spring revival	8.1: Impact study 8.2: Continuous monitoring	 Before	 After

Application of the Eight-step Methodology for Spring Revival in Nepal

ICIMOD, in partnership with ACWADAM and Helvetas, developed and applied this eight-step methodology for reviving springs in two locations in Nepal – Sindhupalchok in eastern Nepal, and Dailekh in western Nepal. The study was funded by the CGIAR Research Program on Water, Land, and Ecosystems (WLE). This short research highlight describes the work undertaken in Dailekh district where water scarcity is acute.

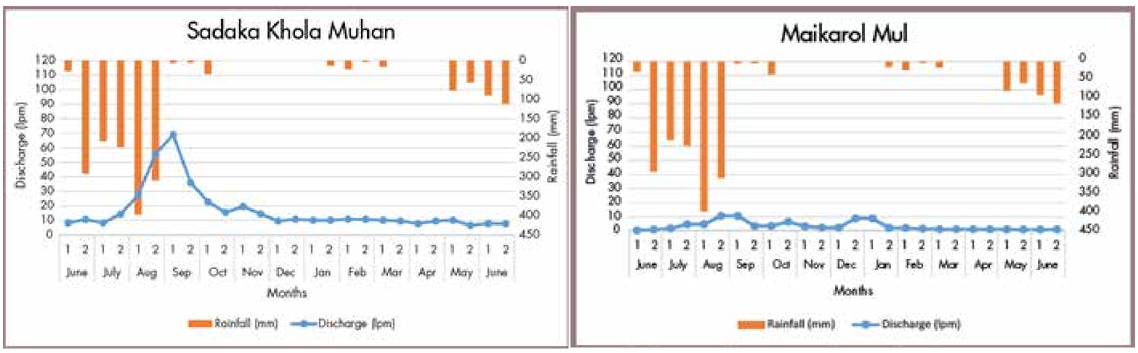
Step 1: **Comprehensive mapping of springs:** The Water Use Master Plan (WUMP) data prepared by Helvetas Swiss Intercooperation for four Village Development Committees (VDCs) – Paduka, Badalamji, Nepa and Naulekatuwal – in Dailekh provided a strong basis for identifying potential villages for spring revival. In addition, a reconnaissance visit to these four VDCs to assess the local geology, land use, settlements and location of springs resulted in a comprehensive mapping of springs along with preliminary understanding of local hydrogeology, and social and governance issues. Altogether, 106 springs were identified in Dullu area. Among them, Baleshwor water tower in Dullu (Paduka VDC) with an area of 22.32 sq.km was found to be the most suitable applied research area.

Figure 2: **Comprehensive map of springs in Paduka VDC, Dullu, Dailekh, showing monitored springs**



Step 2: **Setting-up of data monitoring system:** A rain gauge was installed at Dullu in Dailekh (latitude 28° 51′ 46.7″ N and longitude 81° 36′ 17.7″ E at an elevation of 1,432 masl). Two local people (one man and one woman) were trained in collecting rainfall and spring discharge data. Of the 106 springs mapped in Dullu, 21 were identified for long-term monitoring based on a number of criteria, such as whether or not the spring discharge has seen long-term decline, and the number of households (especially marginalized households) dependent on springs. These springs have now been monitored for more than a year. We have identified springs that show high discharge versus those that show low discharge. This baseline data is useful in deciding which springs need to be revived.

Figure 3: **Examples of a high discharge spring (left) and a low discharge spring (right)**

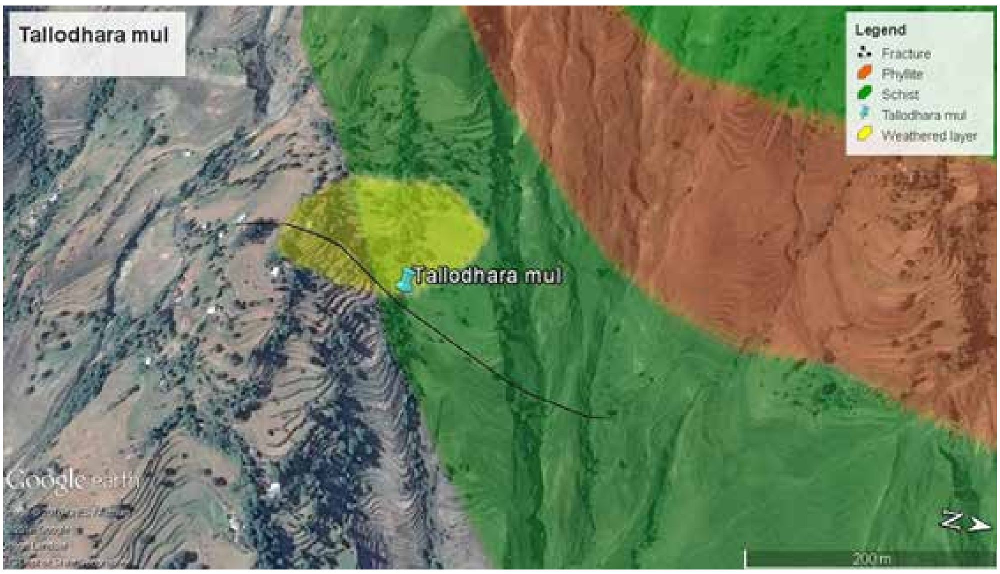


Step 3: **Understanding social, gender and governance aspects:** We collected socio-economic and governance related data through focus group discussions, key informant interviews and questionnaire surveys in order to understand current patterns of water use and ways in which communities manage their spring water resources. We found that in Dullu, eight out of 10 people who come to fetch water from a spring, are women. In the absence of piped water to communities, women often spend more than two to three hours a day collecting water. An average family of five members collects anywhere between 100–150 litres of water each day depending on the season. This means that the minimum daily water requirement of 40 litres per capita per day (lpcd) as per the government of Nepal's norm is not met. Water is used for drinking, domestic use, sanitation, irrigation, and religious purposes. Most springs do not have formal management institutions. Typically, households dependent on the springs take care of upkeep and cleanliness. Usually everyone can collect water from a spring; however, in cases of water scarcity, rules on who can or cannot collect water, how much water can be collected, and times when water can be collected are introduced. Some of the common rules include: time rationing – that is taps are opened only for a limited number of hours in a day; vessel rationing – that is, one family is allowed to bring only a certain number of vessels at a time; first come, first serve, whereby people get their turn according to their position in the queue; and locals over others – that is locals of a given VDC are allowed to collect water before those from other VDCs are allowed. However, these rules are enforced only during the dry season when discharge is low.

Figure 4: **Illustration of socio-economic survey near a spring**

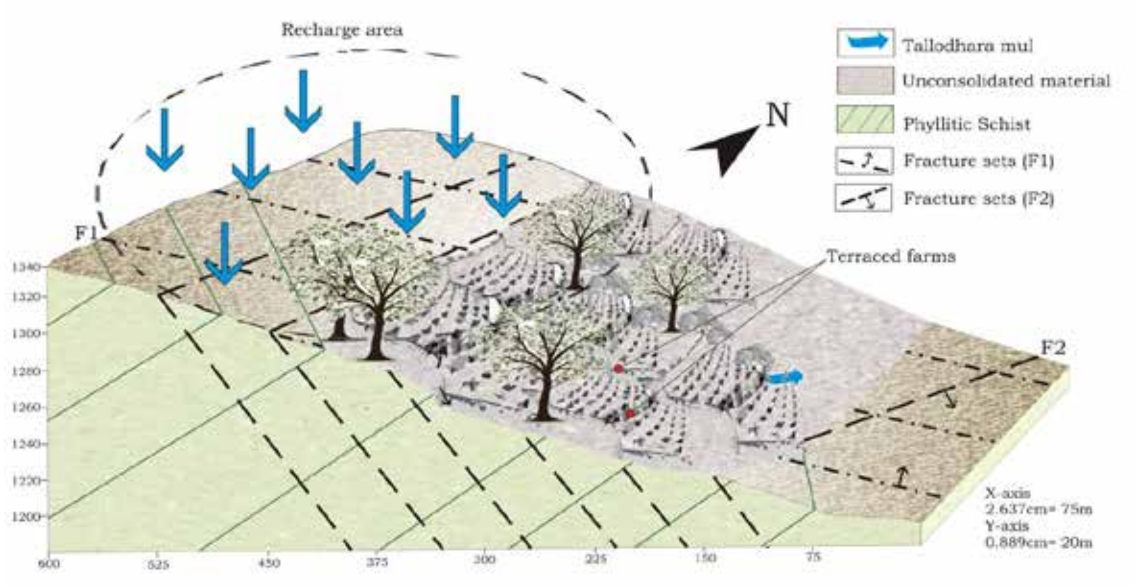
Step 4: **Hydrogeological mapping:** Hydrogeological field mapping in Dailekh involved the study of selected springs where detailed geological studies and spring monitoring were carried out. Rock types found in the field area were phyllitic schist with bands of gritty phyllite and quartz lenses. The type and nature of springs observed in Dailekh are very characteristic to the local geology and structure. Primarily, depression and fracture springs are observed, with depression springs mostly in areas of unconsolidated debris and fracture springs in areas underlain by phyllites and amphibolites respectively.

Figure 5: **Google based geological map of Tallodhara spring, Dailekh**



Step 5: **Conceptual hydrogeological layout of spring and springshed:** A conceptual model for each of the springs/spring clusters was developed. Each model included a simplified description of the geology based on the hydrogeological mapping from Step 4. Step 5 also included identifying the typology of the springs, including a reference to the aquifer system(s) (Figure 6) that the springs tap.

Figure 6: **An example of conceptual hydrogeological layout for a spring in Dailekh**



Step 6: **Classification of spring types and recharge areas:** Recharge areas of selected springs were demarcated using hydrogeology and springshed conceptual layout maps. Most of the springs here are either depression or fracture types, and in some cases, they are a combination of both. Identification of recharge area is the most crucial step in this methodology. The hydrogeological study made it possible to move the approach to spring-water recharge beyond a conventional surface-water catchment based approach. The type of spring and the location, and the size and nature of the recharge area are decided through a hydrogeological approach. Characterizing the identified recharge area – whether it is private land or community land, or its land use (forest vs. other uses), or whether it is contiguous or scattered – helps suggest both the locations and the appropriate recharge measures.

Figure 7: **Demarcation of recharge area for Tallodhara spring**

Step 7: **Springshed management protocol and implementation:** In Dailekh, among the nine springs for which conceptual layouts along with demarcation of recharge zones were developed, five were selected for revival. Selection was made on criteria like dependency on spring, amount of discharge, feasibility in implementing revival measures or availability of land for revival activities, and community interest and involvement. Similarly, a set of measures within the recharge area has been suggested for each of the springs (Table 1).

Spring revival activities were implemented in cooperation with local communities. Much of the recharge land was privately owned and the owners (farmers) were not keen initially to dig pits and trenches in their land as per our recommendation. This required discussions with local communities and sharing results from studies. This ensured that they agreed to implement some of the other interventions, like hedge-rows and inward sloping terraces on their lands, without harming their standing crop of maize.

Table 1: **Type of spring and recharge measures suggested by ICIMOD**

Spring name	Type	Recharge measures suggested	Potential area demarcated for recharge measures (ha)
Bukhakhali	Contact spring	Contour trenches	3.88
Ganjakhanepani	Fracture spring	Contour trenches	4.29
Kathnaula	Depression spring	Contour trenches + ponds	6.74
Badarukha	Depression spring	Contour trenches + ponds	3.47
Batokuwa	Depression spring	Contour trenches + ponds	1.0
Dharakhola	Fracture spring	Contour trenches + ponds	7.84
Tallodhara	Combination type (Fracture and Depression)	Contour trenches + ponds	2.1
Buspani	Fracture spring	Contour trenches + ponds	

Step 8: **Measuring impacts – hydrological and socio-economic:** Recharge interventions were carried out in early August 2016, and we will continue monitoring spring discharge for another year in order to capture impacts. Impacts can be of various types: increase in discharge in all or a few months of the year; increase in duration of flow or reduction in number of days/months when spring discharge is low or none; improvement in water quality; and better and equitable water distribution by the community due to better understanding of the physical and social systems.

Figure 8: **An example of implementation of non-structural measures like vegetative measures**

Capacity Building and the Way Forward

Apart from piloting the eight-step methodology in the field, the project involved capacity building at various levels. A training-of-trainers module was developed and run during the early stages of the project. The training of barefoot hydrogeologists in the districts of Dailekh and Sindhupalchok not only exposed community volunteers to the skills of mapping and measurement, but also catalyzed dialogue with the respective communities, and encouraged knowledge sharing and decisions on implementation of recharge measures in these locations. Finally, the eight-step methodology was shared with institutional partners through a training-workshop on springwater management attended by participants from the academia, the government and civil society organizations from six countries from the HKH. The eight-step methodology has also helped develop a 15-day comprehensive training course on spring-water management, an unexpected but significant outcome of the project.

Springs are the water lifeline of the HKH, yet, there is a dearth of scientific knowledge on springs. Our research combines the science of hydrogeology and the social science of community action to understand and document nature and the functioning of springs, and ways of reviving millions of springs in the HKH that are facing the threat of drying up. This is geared towards generating robust and up-to-date data and information on Himalayan springs using a replicable methodology. There is also a need to build and maintain an effective regional knowledge sharing network on Himalayan springs. We are working with all relevant partners to build up a Himalayan Spring Initiative, and this project is a small step towards the larger vision of a region-wide spring network.

For further information contact

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