Demystifying Hydrogeology: Training barefoot hydrogeologists in the Himalayas

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25-29th September 2016 | 43rd IAH congress | Montpellier, France | CORUM CONFERENCE CENTER

ICIMOD | ACWADAM

Abstract no. 2127

Springs: A lifeline for communities in the midhills

Springs, also called dhara, mool, kuwa, naula, and chasma, are, the most important source of water for millions of people in the midhills of the Hindu Kush Himalayas. Spring water is used for drinking, irrigation, domestic, and religious purposes. They also perform important ecological functions, like supporting local vegetation and wildlife and maintaining baseflow in rivers.

Uses of springs

Drinking and domestic uses | **Irrigation** | **Ecological services**

Springs are drying

There is increasing anecdotal evidence from across the HKH that springs are drying up, leading to acute water stress. This evidence is largely anecdotal as few systematic and scientific studies have been conducted on this topic.

Why are springs drying?

- Climate change, especially rainfall
- Land and land use changes
- Socioeconomic and demographic changes

Drying of springs leads to:

- Drinking and domestic water insecurity in rural and urban areas
- Irrigation water insecurity in hills
- Poor ecosystem services – e.g. low baseflow and human wildlife conflicts

Genesis of the eight-step methodology

Given the importance of springs, and lack of scientific studies and growing evidence that springs are drying or their discharge is declining, researchers and practitioners from the region came together in December 2015 in Gangtok, Sikkim in an ICIMOD and ACWADAM organized workshop and collaboratively developed a common methodology for understanding the science, social science and implementation activities needed for revival of springs.

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Integrating physical with social, and science with implementation

The uniqueness of this methodology lies in its power of integration. Given the complexity of the issue and urgency of dealing with it, our methodology integrates aspects of physical and social sciences, and is just as useful for researchers as it is for field practitioners. The step-wise approach is relatively easy to follow and each step generates scientific information while also allowing project implementers to invest in infrastructure that will help revive springs.

Training barefoot hydrogeologists

A week-long training course has been designed for researchers, NGO partners, and government officials. Two trainings have been conducted and more are planned. In addition, special trainings have been conducted for village communities using pictorial training manuals.

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

The way forward

This methodology is now being deployed by ICIMOD and its partners in various locations in India and Nepal. Through the CGIAR Research Program on Water, Land and Ecosystems, work is being done in Dailekh and Sindhupalchowk districts of Nepal and in Nainital district of Uttarakhand, India. Similar work is also being undertaken under the HI-AWARE project (in Nuwakot district, Nepal, and Darjeeling district, West Bengal, India) and the Kailash Sacred Landscape Conservation and Development Initiative (Darchula district, Nepal, and Uttarakhand, India). Over the next five years, it is expected that this methodology will be applied in all countries of the HKH.

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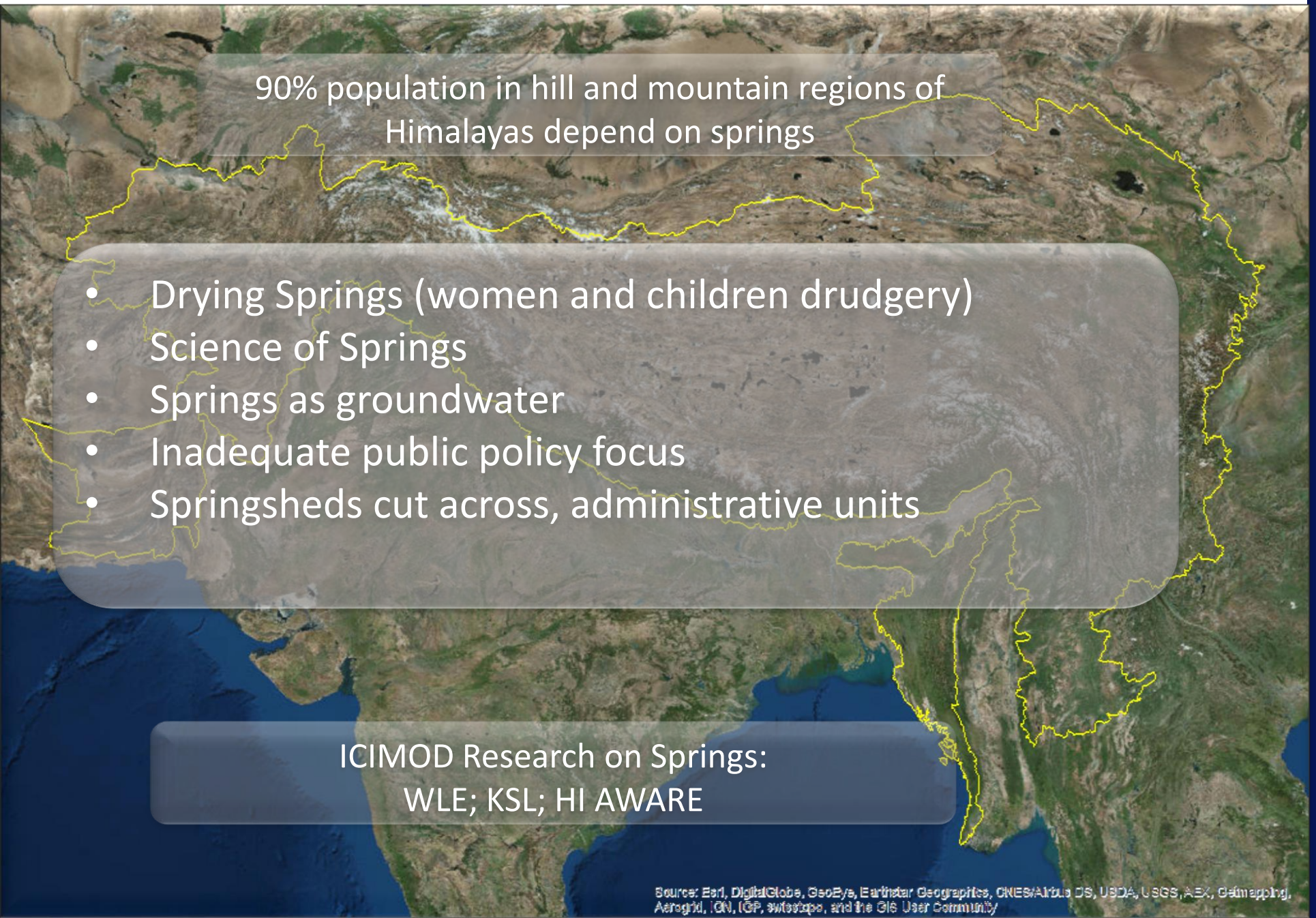
Elixir of Life – Mid Hills of Hindu Kush Himalayas as basis for Water Security



90% population in hill and mountain regions of Himalayas depend on springs

- Drying Springs (women and children drudgery)
- Science of Springs
- Springs as groundwater
- Inadequate public policy focus
- Springsheds cut across, administrative units

ICIMOD Research on Springs:
WLE; KSL; HI AWARE

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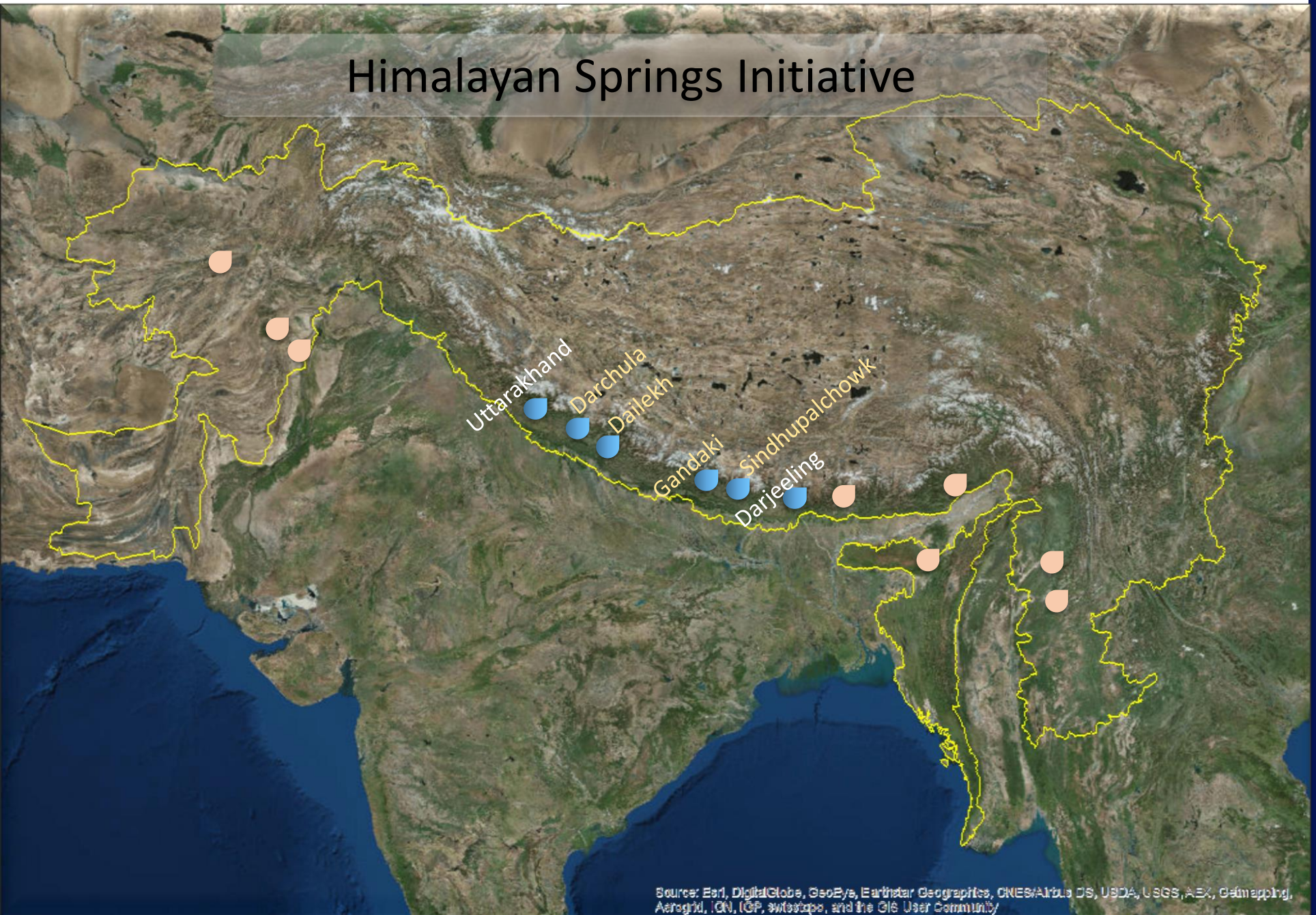
Advocacy of Springs in Hindu Kush Himalayas



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Water resources in the Himalaya

- Glaciers
- Snow
- Rivers

Lowland perspective

- Lakes
- Streams
- Springs

Mountain perspective

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Springshed ‘lens’ for water security

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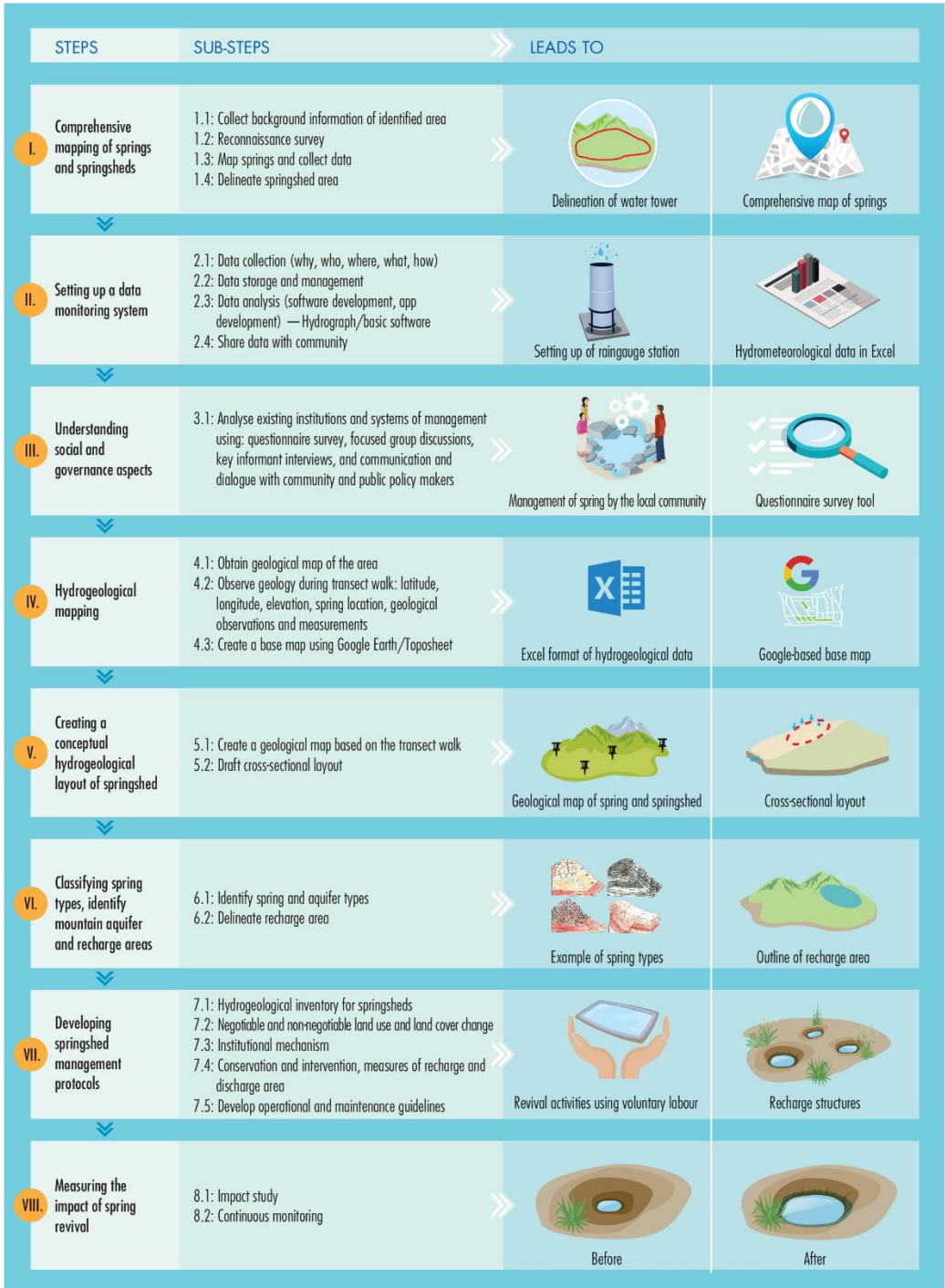
Reviving springs as a solution: Methodology and approaches

Step 1	• Mapping of springs and springsheds
Step 2	• Setting up data monitoring system
Step 3	• Understanding spring governance systems
Step 4	• Hydrogeology mapping
Step 5	• Creating a conceptual hydrogeological layout
Step 6	• Classification of spring type, aquifer, recharge
Step 7	• Springshed management protocol and implementation
Step 8	• Measuring impacts – hydrogeological and socio-economic



Applying the Eight-Step Methodology to Revive Springs in Dailekh, Nepal

RESEARCH PROGRAM ON Water, Land and Ecosystems

CGIAR

ICIMOD

Background and purpose

Springs are the main source of water for millions of people in the midhills of the Hindu Kush Himalayas. There is increasing anecdotal evidence from across the region that springs are drying up, leading to acute water stress.

ICIMOD has partnered with ACWADAM and Helvetas to apply an 8-step methodology for understanding spring systems and their management, including recharge and conservation at the landscape scale with the objective of identifying and reviving drying springs. The study is funded by the CGIAR Research Programme on Water, Land, and Ecosystems (WLE).

Step 1: Delineating the study area

- Area of the water tower: 22.32 km²
- Number of springs: 106
- Population: 5,213

Northerly dipping rocks dominated mostly by phyllitic schist with lenses of gritty phyllite and quartz

Mainly three types: depression and fracture and a combination of fracture and depression

Springshed management practice

Criteria's for water tower selection

- High density of low discharge springs that are drying
- High per capita dependence on springs as a source
- High dependence of marginalized and low caste people
- Overall water stress
- High community interest for implementation of project activities
- Availability of land for revival related interventions

Step 2: Long Term Monitoring of Springs

Criteria for spring selection

- Springs on which large number of households depend, especially people from dalit community
- Spring with lowest discharge in each ward

Dependency (vs discharge)			
Springs	Number of people dependent	Average discharge (litres/day)	Per capita availability (litres/day)
Sadaka Khola Mul	254	36,319	143
Maikarol Mul	335	5,011	14
Ganja Khanepani Mul	99	3,994	40
Dhara Khola Mul	141	9,961	71

High dependence vs high discharge

High dependence vs low discharge

Low dependence vs low discharge

Low dependence vs high discharge

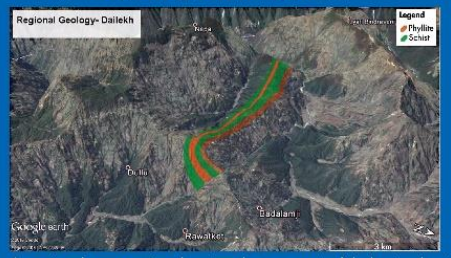
Step 3: Social, institutional, and governance aspects

8 out of 10 people who fetch water from springs are women

An average family of five members collects 100–150 litres of water each day depending on the season. Water is used for drinking, domestic, 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.

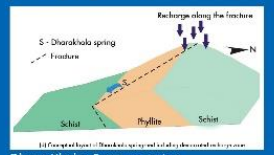
Step 4: Hydrogeological mapping



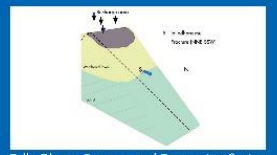
A regional perspective showing the two major lithologies that influence spring systems in the project location. Saffron indicates phyllite dominant areas, while green indicates areas dominated by schists

Step 5: Conceptual hydrogeological layout development

Nine springs selected for conceptual layouts



Dhara Khola, Fracture spring


Tallo Dhara, Fracture and Depression Spring


Tallo Dhara Mul


Dhara Khola Mul

Step 6: Spring types, mountain aquifer, and recharge area identification

Springs	Type
Bukakhali	Contact
Baspani	Fracture
Maikarol	Fracture
Batokuwa	Depression
Kathanaula	Depression
Ganja	Fracture
Dhara Khola	Fracture
Badrukh	Depression
Tallo Dhara	Fracture and depression


Recharge area demarcation: Dhara Khola Mul


Recharge area demarcation: Tallo Dhara Mul

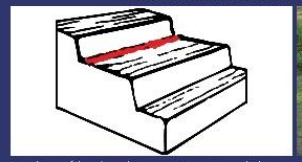
Step 7: Spring revival activities: Conservation and intervention

Five out of nine springs for which hydrogeological mapping was done were selected for revival. Most of the recharge area was found to be privately owned and with outward sloping terraces. Given the land tenure (private land) and current land management practices, the following interventions were suggested and are being carried out by local implementation partners.

Criteria for recharge intervention

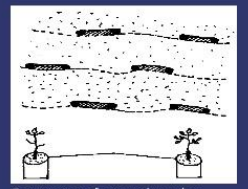
- High dependence, low discharge
- Availbility of land for intervention

Measures recommended for spring revival



Leveling of land and converting outward sloping terraces to inward sloping ones


Construction of terrace bunds



Construction of pits and trenches

Step 8: Way forward

Spring revival activities are ongoing. The project will continue measuring discharge and will conduct another round of socioeconomic surveys after the revival activities are completed in order to measure the impact of revival activities on spring discharge.

Partners

ACWADAM

HELVETAS

Way Forward

- Mainstreaming Methodology and approaches in ICIMOD HKH countries
- Training of partners – both of local communities and implementation partners
- Hosting the Regional HKH Springs Network and Portal Repository of Data from HKH
- Understanding of Hydrogeology and Social Systems
- Next IPCC report will feature a peer review work on springs
- Global and International Collaboration: eg IAH

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