

Documenting Methodologies and Community Impacts of Groundwater Recharge Interventions

Almora District, Uttarakhand, India

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March 20, 2024

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Abbreviations and Acronyms

APL – Above Poverty Line

BPL – Below Poverty Line

GC – General Caste

HKH – Hindu Kush Himalaya

ICIMOD – International Centre for Integrated Mountain Development

IHR – Indian Himalayan Region

lps – Litres per second

OBC – Other Backward Class

PSI – People’s Science Institute

SC – Scheduled Caste

MGNREGA – Mahatma Gandhi National Rural Employment Guarantee Act

Executive Summary

A water crisis is currently unfolding in the Himalayan region. Climate change, forest degradation, and various factors contributing to changes in traditional systems of water management have led to the drying of natural springs and impacted drinking water access across the Kumaon region of the Indian state of Uttarakhand. Systems of naula (natural spring) management used for the last several hundred years were, in most cases, no longer being used to maintain naulas in favor of piped water schemes. To address this issue People's Science Institute, Lakshmi Ashram and local villagers partnered to promote the recharge of these natural springs. This report covers the methodologies and outcomes of the recharge interventions for naulas in Jhupaulchaura area of Someshwar, Uttarakhand.

Interactive sessions held with local stakeholders revealed that the outcomes of the naula recharge were extremely beneficial to the community. Women specifically benefited from time saved by not hauling water, increased confidence, and participation in community organizing and resource management. Collective knowledge gathering allowed the community to learn about technical aspects of springs and incorporated some aspects of their local knowledge into components of the recharge interventions. Analysis of the involvement of factors such as local governance showed that the integration of government could be improved to institutionalize local management at the village level and further enable the community to act as water stewards.

This analysis of processes involved, community perceptions, and outcomes of spring recharge interventions develops a better understanding of how the spring recharge interventions impact people of differing positions within the community and genders. Spring recharge projects may lead to more resilient communities and increase the sustainability and management of their water resources. As it is critical to improve projects of this nature, documentation of this work will help benefit all stakeholders.

Introduction

Mountains around the world are known for their significance to water resources, often being referred to as global water towers. The Hindu Kush Himalaya (HKH) region is home to nine major river basins that provide water to 1.4 billion people in Asia (*Himalayan Glaciers*, 2012). The Himalaya are an extremely sensitive and vulnerable ecosystem due to intense rainfall and heavy anthropogenic modification (Panwar, 2020). Factors related to climate change including increasingly erratic and intense precipitation events, changing seasonality of precipitation, and anthropocentric disturbance are significant in the area (Ahsan et al., 2022). These factors are disrupting the stability and reliability of water resources for people in the IHR.

Mountain springs are a historically abundant and important water source in the parts of the western IHR (Panwar, 2020). Climate change has numerous impacts on mountain water systems that can affect springs. These changes include but are not limited to altered precipitation patterns, timing of precipitation events, infiltration rates, and warmer temperatures (Thapa et al., 2023). The changes to precipitation patterns have resulted in increased intensity of rainfall events which means water does not have time to infiltrate into shallow groundwater before running off. Less than 5% of annual rainwater runoff and snowmelt recharges these underground aquifers (Thokchom et al., 2021). This, along with more erratic storms, has stressed existing water resources and reduced the amount of water that returns to aquifers and can be accessed for human use.

The Kumaon Region of Uttarakhand, India has a rich history of traditional water management systems including naulas, dharas, and infiltration ponds called chals and khals (Bhandari & Kaur, 2023). Naulas are covered springheads or small stepwells that have structures protecting the subsurface water resource. Dharas are springs that are tapped to flow out of an outlet. Both function as critical sources of drinking water that have been used in some cases for several hundreds of years. They are also significant parts of Uttarakhand's culture, traditions, and are seen as sacred spaces (Bhandari & Kaur, 2023). With proper care and maintenance these sources offer reliable and sustainable access to many rural people. Within this demographic, those who are marginalized by gender, caste, and socioeconomic status are impacted the most, having limited access to government piped water supplies due to geographical and financial barriers.

Despite improvements in piped water infrastructure, the water is often erratic or flows at very low volumes making it difficult to rely on. Communities, in anticipation of piped water security, have neglected the maintenance of their traditional naula systems, resulting in increased workloads and travel distances for women to other perennial water sources. The neglect has resulted in naulas with low water levels and poor water quality, leading the structures to fall into states of disrepair. These naulas no longer provide suitable water for drinking and other domestic uses. Because domestic labor, such as agriculture, caring for livestock, caring for children, gathering fuel wood and forest

biomass, cooking, cleaning, and fetching water, is the responsibility of women, they are disproportionately impacted by naula degradation and subsequent water insecurity. The heavy workload is extremely physically demanding and consumes most of their time, especially when piped water is not available. This is frequently the case in the summer when the climate is dry. Communities have recognized that it is within their ability and control to restore the naulas and improve their access to reliable water sources.

This report focuses on naulas that have been restored through the work of local communities, People's Science Institute (PSI), and Lakshmi Ashram. Naulas in the Jhupulchaura area (Chanoli naula, Faulta naula and SC naula) were specifically studied for this report, but these partnerships have restored 49 naulas in total. PSI is a scientific NGO based in Dehradun. They work throughout the country, focusing on the central-western Himalaya area. As the technical partner they provided hydrogeological, engineering, water quality and project management aspects of the project. Lakshmi Ashram, a Gandhian philosophy organization based in Kausani supporting education for girls and development opportunities for women was an implementation partner, in this project. Lakshmi Ashram has also been involved in various other environmental and social development projects within the community. With the combined efforts of these organizations and the community water users, the naula restoration work in Jhupulchaura was conducted from 2017 – 2022.

Methodology

Methodology of our study

The process of this study began with the identification of the Jhupulchaura area Gram Panchayat as the study area. This was determined together with the community based on the availability of the local coordinator and the activities that were undertaken in that area. Our project team then conducted interactive sessions over the course of a week with as many stakeholders as possible. These stakeholder meetings were organized to maximize ease of participation. Considerations including the time, venue, and duration were made to ensure that participants were minimally inconvenienced. Sessions were organized by the local project coordinator of Lakshmi Ashram.

The stakeholder session participants were as follows:

- Local para worker and project coordinator
- GC and SC water user groups (since two separate groups had been established during the intervention by Lakshmi Ashram)
- The coordinator from PSI
- Representatives/members of Lakshmi Ashram

- Zila Panchayat member
- Members from local women's groups
- Gram Pradhan's husband (original plan was to interview Gram Pradhan herself)
- Head of Van Panchayat
- Village Health and Sanitation Committee

Interactive sessions with stakeholders were critical to ensure that as many perspectives as possible were represented. The sessions included individual interviews, group interviews, and focus group discussions. To gather as much input as possible, certain sessions involved participatory activities such as the drawing of a map by women from the villages with details on the locations of naulas, water tanks, and major landmarks (see appendix 4). Prior consent and signatures were taken for all the participants with a written and oral description of the study and how the information would be used. The study focused on both the technical and social aspects of the recharge interventions to develop a clearer understanding of how traditional knowledge systems and emerging knowledge from academic and research institutions interact and are supported by one another.

Limitations

The research method was adapted to account for various unanticipated events occurring throughout the data collection process. However, the key objectives were not impacted. The data collection format was chosen to best suit the context, culture, and the community's needs. Questionnaires were designed for specific stakeholder groups and used to guide the interactive sessions, although they did not follow a strict structure. Most sessions were done in Hindi with translation to English. Many interviews were conducted as open forum group discussions which were the most effective for ensuring that participants were comfortable and felt supported while sharing and to maximize efficiency with a single translator. Due to these considerations, limitations exist on the accessibility of direct quotations from individuals in the results section. However, this research still captures the key points of the naula recharge interventions conducted in the Jhupulchaura area.

Community Sharing Session

A critical component of the study design was to share the outcomes with the community and to provide them with our analysis of the naula recharge processes and impacts. Upon the conclusion of the study, a community sharing session was hosted in the village to ensure that the knowledge and understandings from this study were shared with the community. This event was held to help the village members be more aware of the existing situation, revisit the processes involved, outcomes which had emerged, and reasons behind the recharge work (appendix 1). This important session was also to give

people an opportunity to decide how to proceed in their future courses of action. Members of surrounding communities were also invited to the community sharing event and refreshments were provided (appendix 2).

Technical Methods

The naula restoration process began with a community meeting where a drinking water problem was identified within the village. The drinking water problem could have been the result of poor water quality of existing water resources, insufficient supply, or maintenance issues. To develop a scientific understanding of the water issue(s), geologists and hydrologists from PSI surveyed the springs in the area. Their goals were to understand the geographic scope of the water problem in which springs experienced a reduction in discharge. They then prepared a spring inventory to determine which springs were the most critical for intervention. A detailed technical report was prepared for each spring including a 3D model and a geologic report of the subsurface. The 3D model is particularly useful for communicating the technical aspects of groundwater movement to the community. The report was created in consultation with the community and the para workers.

Thorough baseline testing for water quality, including parameters like pH, TDS, fecal coliform, and more, was performed and any concerns addressed and considered in the long-term water testing plan. The parameters for monitoring were determined by the baseline test, land use, and anthropogenic concerns in the area. Testing for water quality and discharge were implemented both during the recharge work and in the long-term monitoring plan. Training for para workers on monitoring methods was done by PSI staff in Dehradun and in the village. Discharge in lps was measured weekly using the water level drop method (appendix 3). Data on the collected parameters were shared with PSI on regularly by the para workers.

The recharge work was then conducted by the water user groups established by Lakshmi Ashram with the instruction of the technical experts. This involved plantations of species known in traditional knowledge for storing large amounts of water. These plantations were decided in consultation with the women who suggested species based on their local knowledge and experience including trees like Banj oak (*Quercus leucotrichophora*), kaphal (*Myrica esculenta*), mahal (*Pyrus pashia*) and grasses like Napier grass (*Pennisetum purpureum*). These species benefit groundwater infiltration by absorbing water, so it is not lost as runoff. The water users also dug contour lines along slopes called nalis, which force water to flow into the hillside and allow it to infiltrate. Strategically located trenches, called chal khal, were also dug to collect water for infiltration.

Maintenance and repairs were done on the naula structures where needed, and the naulas were cleaned. The goal was to channelise water flow into the naula which stops it

from flowing in different directions, repairing the roof structures to ensure that debris doesn't fall into the naula and contaminate it. Overgrown vegetation was removed, and the paths were cleaned and cleared to maintain the overall cleanliness of the area.

Social Methods

In tandem with the hydrogeologic surveys and project planning, community involvement and organizing occurred that allowed the technical spring recharge work to be successful and sustainable. A project coordinator and para worker responsible for community organizing, training other members of the community, and monitoring was hired from the community and worked to establish the social networks and institutions essential for the project. Water users for each naula were identified within the community and nominated together with the community. The water user groups then collectively developed norms, rules, and regulations on the use and maintenance of the naulas. Besides these, they ensured monitoring of these community norms which they collectively followed. Water user groups decided together with technical agencies, and para workers, their participation in field level activities.

The para workers ran awareness campaigns in the community to gather support and ensure that the water user agreements were established. The awareness program in this case was done through a participatory method, local theatre, that showed the benefits of the water users' organizing as part of the project. Para workers were extremely active in the project process. They were tasked with many roles including training, supervising data collection, maintaining records, and checking on the project's progress.

The water user groups were organized and overseen by the project coordinator while they conducted the work on plantations, digging, and cleaning. They were paid for their time on the project through the government funded program of MGNREGA which guarantees rural people's right to 100 days of paid work. The water user groups also contributed through voluntary labour by donating portion of their wages to the project and those funds were used on the project and for community development by purchasing utensils, and other items which are collectively owned and shared for events.

Outcomes

Technical (Hydrologic)

The naulas in the study area that were selected for intervention were successfully recharged and able to provide a sustainable water supply. Water levels increased in the naulas and existing water quality concerns were addressed. Resulting discharge levels were high enough to ensure that water levels were maintained.

Identification of Catchment Areas

Part of the technical process involves identification of the spring's catchment area within the watershed. Having this knowledge gives the community significantly more control over their water resources. In the community, it was commonly believed that the catchment area was generally located close to the naula. However, there was not a scientifically determined hydrologic catchment area. This meant that villagers didn't know where to protect from development and they may have even been unknowingly polluting or disrupting the ground water channels in that area. With this information, they are able to maintain cleanliness and protect that specific area from potential ecological damage like construction, loss of vegetation, and pollution.

Another important part of identifying the catchment area is that in the future if there are issues with the water level in the naula associated with that catchment area, then they can be addressed. The association gives the community the ability to act on potential problems before they have significant impacts on the water supply. This could include clearing debris, fixing contour lines, or re-digging trenches to maximize the infiltration potential. Having the connection between the catchment area and the naula allows the community to exercise greater autonomy over their water resources and enables them to act more effectively as stewards of the naula without needing outside assistance.

Increased Knowledge of Water Quality

The water quality monitoring regularly conducted by the para workers creates a water quality dataset that gives the community knowledge about their drinking water quality. This data and monitoring of water quality should result in reduced waterborne illness risks, as potential disease-causing contaminants like fecal contamination will be identified and can then be addressed. There is also the ability to assess the data for potential environmental contamination. With this information, the community can take corrective actions as necessary such as adding bleaching powder or suggesting that drinking water is boiled before use. Long term data monitoring is an essential tool for ensuring that the naulas continue to be a safe and clean water supply.

We found, however, that knowledge of water quality details was very limited, especially for the para workers who were trained on and tasked with monitoring. When asked, the para workers could not remember information like parameter units, and one was not confident about which water quality parameters were tested. This likely indicates that they were not retaining the information they were trained on over the long-term.

Gender

Water accessibility is a significant concern for women, as they are intimately involved in procuring and transporting it back to their homes. Fetching water is traditionally considered women's work. Therefore, women and girls are best poised to work for water conservation in their communities. This is true for the study area, where almost all water related work including planning, implementation, and monitoring of the recharge project was undertaken by women. Members of the community also indicated that many of the working-aged men had left the villages to seek employment in cities. This gender biased rural to urban migration impacts the demographics and dynamics of the community.

Increase in Women's Confidence

The naula recharge project along with other projects undertaken by Lakshmi Ashram have made an impact on women's confidence and perceptions of themselves as change makers. One component of advancing the goal of gender equality is giving women more influence and decision-making power. All the women stakeholders who were asked about their feelings regarding their participating in the naula recharge work said that they felt more confident in themselves and their ability to bring about change in their community. One member of the GC water users group said: "Ten years ago we didn't have this confidence. Now, we have started speaking for ourselves. We have changed a lot". An attendee at the SC water user's group session ended the session by saying, "We have learned to fight for our rights". They also added that their awareness of issues they can address has increased.

The increase in both confidence and awareness of issues that they feel they can address is a significant achievement for the community. While the role of gender remains an area for improvement, this social development represents a step toward the ultimate goals of gender equality. With this new level of confidence in themselves the women indicated that they were interested in participating in more projects in their community. The naula recharge work is seen as very positive by a vast majority of the stakeholders we spoke with.

Increased Participation in Community Organizing

Women reported that they were more active in community organizing around the naula recharge work and around related committees. The local water committee was not at all active before the naula recharge but is now active at least in name. Women reported that they were more likely to attend meetings now than in the past when only men would attend. This increased participation in community organizing is indicative of a level of gender based social development occurring for the women.

Time Saved by Women

Improved access to water through the recharged naulas has saved significant amounts of time for women who would have otherwise had to travel much further to collect water. The amount of time that women spent carrying water before the naula projects has decreased due to the reliable presence of local drinkable water. This has significant impacts to the way that women use their time. Since they are responsible for most household work and have limited time to complete it as well as enjoy social time and rest, it is immensely beneficial to them to be in close proximity to a secure and safe drinking water source (Scott et al., 2017).

Women reported that after the naula recharge work was completed, the time that they used to spend carrying water, a task that is done repeatedly during the day, especially during summers, has decreased significantly. One way that this benefits women is that they are now able to bathe more frequently. Previously, they stated they would bathe once in seven or eight days, now they bathe every two to three days. This improves their health and hygiene as they are less likely to have rashes and skin infections. It also allows them to spend the time saved on other productive tasks like caring for children and livestock and washing clothes.

A shorter distance to a water source also benefits women's health as it reduces their drudgery. Head load carrying, the practice of transporting a burden on top of the head, raises the chances of women developing musculoskeletal problems as heavy loads place substantial stress on the spine (Geere et al., 2010). Common problems associated with head load carrying include neck and lower back pain. Having access to a closer water source reduces the amount of time spent carrying water and benefits women's health in multiple ways.

Gender Roles

A consistent theme that arose was the involvement of men in the naula recharge projects. Collecting water for domestic use is primarily considered a job for women. In various sessions we were told that since the recharge work was related to water the men considered that it was a job for women to handle. Despite asking several times, we were not able to schedule a meeting with men in the village to ask about their experiences related to the naula projects. Women from the user groups and at the community sharing meeting defended the lack of men's involvement by saying that the men were too busy or not interested in the work. They also said that men didn't participate in the physical labor part of the project because the pay from MGNREGA was less than they would have earned elsewhere, while for women, it is considered acceptable.

Knowledge and Skill Development

Women in leadership roles in the project developed knowledge and skills. Para workers and the local coordinator developed technical and social skills by working on the project. They were trained by PSI in water quality testing, discharge measurement, and the basics of geography and groundwater recharge. This project also allowed them to develop other relevant skills such as project management, facilitation, community organizing, and leadership. The development of these skills allowed the project coordinator in this village to truly embody the role of a community leader. These leadership skills are extremely important for the community and for future potential development projects that may be unrelated to water. Para workers other than the coordinator, however, did not remember the details of the technical training they received. There was also knowledge and skill development for the water users through the technical training they received in water quality testing. Together, the community showed an increase in their knowledge and skills, although most of the technical knowledge development was focused on the para workers and the project coordinator.

Community

Village communities played an essential role in the recharge project. Without the functioning of the water users as a group they would not have been able to achieve the results that were ultimately possible. There are many benefits of community driven projects and initiatives. They are more likely to be supported and carried out by people who have local stake in the processes and outcomes. With the support of people, even across certain social or economic divides in the community, a successful collaboration was possible.

Systems of Water Management

The water user groups established user agreements at the beginning of the project that outline the protocols that will be collectively followed and how they will collaboratively manage the naula. This is an understood agreement within the group. While it is not a separate written agreement it is described in meeting notes. The GC user group indicated that there had only been one past incident in which an individual violated the user agreement rules. The group said: "We shouted at them and now we are confident that everyone will follow the rules". The development of common resource management plans strengthens the resilience of the group when potential threats occur. The interdependence between the water users as a group means that they have a collective incentive to protect the naulas from pollution, overuse, and to ensure their maintenance.

The naula recharge projects are designed to put long-term management of the naulas in the hands of the community. However, members of the water user groups we

interviewed indicated they were unaware or unclear on what long-term naula management would be even though they are responsible for that management. While it is clear that the long-term management plans have been discussed, there seems to be a lack of clarity at the user level.

Community Awareness

Another outcome of the recharge project is the increase in community awareness, especially for women of many aspects regarding water resource management. Their awareness of the technical components like catchment areas and the basics of how ground water recharge occurs are complemented by their increased social awareness. Women from both water user groups said that their awareness of issues related to forests, water, and the environment had increased due to their participation in the naula project and the previous projects supported by Lakshmi Ashram such as those related to forest conservation. The village project coordinator also played an important role in the development of community awareness through informal education and information sharing.

Overcoming Caste and Class Differences

The socioeconomic classifications are divided into those who fall above the poverty line (APL) and those below the poverty line (BPL). BPL households are eligible for government assistance to meet some of their basic needs. APL households have enough resources to meet their needs and do not receive the government assistance to the same extent. Caste differences also play a role in the community. General caste, OBC and Scheduled Caste are categories representative of the castes within a community.

Of the naulas studied, water users were able to work together even though they were divided by class and caste differences. Within the GC water user group we interviewed, there were four members of the general caste and 14 OBC. Considering their socioeconomic status, seven members were APL and 12 were BPL. In the SC water user group, all six members were SC and BPL. People from different castes and classes came together for discussions in the interactive sessions, as well as to share and eat together at the final community sharing session. The ability to work together across these class and caste differences shows that the collective benefits achieved are more valuable than the potential for any conflict over these social differences.

Governance

Involvement of Government Schemes

Through MGNREGA, wages were available for the water users who did physical labor work including tree plantations, digging trenches, contour lines, and clearing vegetation. While the government funded program was used to pay women for their work, they shared that they donated part of their time by reinvesting some of their wages into the project through community development. The involvement of MGNREGA in the project allowed the women to be paid for their time, which indicates to them that their time spent participating in the recharge work is valuable. This is one method of financially legitimizing the projects by paying participants that would not otherwise be offered pay.

There seems to be a lack of other government schemes that specifically target work on naula projects. The majority of the government schemes seem to be focused on improving piped water access and probably do not offer funds for spring recharge work. There could be many factors leading to this situation. This is an issue that restricts the ability to institutionalize and legitimize naula recharge work as a way to secure sustainable water resources. This was determined through conversations with officials at the district level, authorities at the block level, as well as with the community.

Involvement of Local Self-Governance

Local self-governance bodies are the primary decision makers in villages, occupying constitutional status. They are responsible for construction and maintenance of paths, lights, and other village infrastructure through panchayat allocated funds. The Gram Panchayat, functioning at the village level, was consulted initially by PSI and Lakshmi Ashram, when approval was sought for the naula recharge project. An agreement letter was signed between the Gram Panchayat, PSI and Lakshmi Ashram. Unfortunately, following the agreement, there was limited involvement with the Gram Panchayat for the duration of the project, though Panchayat at the district level, contributed to the project. At the district level, we spoke with a member of the Zila Panchayat. The Zila Panchayat supported the water project by providing funding for construction, materials, and paying wages.

The former Gram Pradhan, a woman, who occupied that role during the first year of the naula project, was active in the naula recharge work in both official and unofficial capacities. She participated in the meetings, contributed to the physical labor along with other women, and helped with overseeing aspects of the work, like the digging of trenches. Despite our best efforts we were unable to meet directly with the current Gram Pradhan, and instead met with her husband. Constructive involvement of these bodies helps sustain the interventions and their outcomes in the long-term.

Mix of Knowledge Systems

Traditional naula maintenance and management systems have been used for over 700 years and are being maintained and blended with emerging knowledge from scientific and research institutions in ways that each enrich the other. This includes knowledge of geology, hydrology, and water quality that are being added to the collective understanding of how naulas and their catchment areas need to be maintained and looked after to ensure a sustainable water supply. As the loss of traditional knowledge systems is a serious concern, this naula recharge work represents an opportunity to maintain naulas in traditional ways supported by the scientific understanding of hydrogeology.

In this work, traditional knowledge was integrated at multiple stages of the process. In the planning stage, participatory methods were used to determine trends in the water levels of the springs with the water users. Mapping exercises were also done to determine other factors that may have impacted the naulas like land use changes, deforestation, or development. The decisions on vegetation to be planted in and around the catchment area were done in consultation with the community, particularly women, to integrate their local knowledge. Plants and tree species that are beneficial for water conservation were used for the plantations and done in catchment areas.

Recommendations

These recommendations for future naula recharge projects and collaborations are based on the findings of this study. The following are areas that could be improved to enhance the processes and outcomes of naula recharge. Recommendations are divided into categories depending on their target audience.

General

- Increase involvement with Gram Panchayat during the different stages of the project to improve the sustainability of current and potential future projects. This involvement would assist in institutionalizing naula recharge work and increase the long-term capacity for the Gram Panchayat to be a leading force in future work (see page 17 for more details).
- Invite and include men in water related meetings, implementation work involving physical labour, and proceedings so that the work can benefit the entire community and move to increase gender equality without excluding men's

participation especially in water related tasks and responsibilities. This would improve the outcome of projects by increasing buy-in and support regardless of gender. It also may provide an opportunity for men take a more active role in local water resource management (see page 14 for more details).

- Incorporate a basic level education program for local schools on naulas and management to retain community knowledge gained from naula recharge projects, raise their respect for local systems and improve local applied education.
- Village Health and Sanitation Committees should collect data on the health impacts from water borne diseases related to water quality. If they don't currently, they should be encouraged to begin collecting this data. That will allow them to track water borne diseases and community health more accurately especially with the water quality monitoring done by the water users (see page 12 for more details).
- The SC naula in Jhupulchaura should be referred to by its actual name rather than by the caste that it serves to reduce the stigmatization of the schedule caste. Likewise, GC naula should also be known by its name rather than its association to any caste.
- Develop a written agreement for water users covering protocols and management that would help formalize the local management systems. This would reduce any ambiguity surrounding how the user groups will use and maintain the naulas in the long term. The written document can be referenced in the case of potential future disagreements which could reduce the likelihood of conflict. Formalized systems also build the long-term, institutional capacity of the community to manage their resources more effectively.

Lakshmi Ashram

- Having a second rung of leadership in implementation of the projects would be beneficial to sustain the interventions and outcomes and offer opportunities to others in the society to emerge as leaders. If the coordinator is away from the area or indisposed, there should be a knowledgeable and established person who can assist with the project.

PSI

- Provide education refresher trainings or materials, which are easy to understand that can be referenced back in villages by para workers and members of the water user groups (see page 12 for more details).
- Written long-term management plan should be emphasised with the community to ensure that the water users are aware of their role in future technical management and have a collective vision of the long-term maintenance and management goals (see page 15 for more details).

Conclusion

The naula recharge projects were extremely successful in restoring reliable water access for the water users while also contributing to community and social development. The success of this work was due to the design and execution of the partners and the community. With the increasing impacts of climate change and changes to demographics, efforts to restore traditional methods of water management are more critical than ever. Care and maintenance of naulas has provided a reliable and sustainable water source for hundreds of years and, with this project and others done like it, those naulas can continue to provide secure and sustainable access to water.

This community driven approach has provided many co-benefits to the villages and water users. They have developed technical knowledge, deepened community bonds and have amalgamated local knowledge with emerging knowledge to restore their naulas. Women have benefitted through time saved carrying water, increased confidence, and community involvement. As the driving force behind this work, they have been instrumental in its success. These women now see themselves as more confident change makers and are able to speak up about environmental degradation.

In the Kumaon region, issues of water availability and access remain prevalent and with piped water an unreliable source, returning to naulas is a way to ensure that water systems are resilient and sustainable. Future naula recharge efforts can benefit from learning about those of the past and how communities perceive the impacts of their work.

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Acknowledgements

I would like to express my most sincere gratitude to Dr. Reetu Sogani for her support, adaptability, and overall guidance throughout the many aspects of this project. Lakshmi Ashram, the Springshed Team from People's Science Institute, and the Jhupulchaura, Chanoli, and Faulta communities, especially Maya Verma, who have my utmost appreciation for their incredible work and their willingness to share their knowledge and experiences with me. I would also like to thank the Haley Family Fund from the Clark School of Environment and Sustainability at Western Colorado University for their generous funding of this project.

I also could not have completed this process without the essential assistance of my university advisor, Gillian Bauer who worked tirelessly to support this project. Thanks also go to Ajay Rastogi who has been wonderful champion of my educational pursuits and for building the Sister Cities partnership.

Appendix

Appendix 1. Attendees participating in the community sharing event in Jhupulchaura.



Appendix 2. Charts used at the community sharing event explaining the results of the study.



Appendix 3. ICIMOD Protocol for Reviving Springs in the Hindu Kush Himalaya: A Practitioner's Manual

Water level drop method

Some springs seep into a cavity that is not clearly defined and doesn't have an outflow. Water is withdrawn using a bucket, jug, or other container (Figure 27). The discharge of these springs can be measured by removing a known volume of water and measuring the recovery time. (If resources permit, a pressure transducer can be installed in the spring to accurately measure water level fluctuation, otherwise the manual measurement described here is recommended.)

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5: Step 2: Setting Up a Data Monitoring System

The steps are as follows:

- Note the depth of the water in the spring cavity using a ruler inserted at the centre and start a stopwatch.
- Extract a known volume of water; the water level will be lower.
- Observe the rise in water level at regular intervals and stop the stopwatch when it reaches the original level.
- Calculate the spring discharge (Q) in litres per min (lpm) by dividing the number of litres withdrawn (V) by the time taken in minutes (t)

$$Q = V/t$$
- NOTE: The measurement should be repeated three times and the average value taken as the reading.

Figure 27: Discharge measurement of spring with no outlet using water level drop method



Appendix 4. The map created by members of a women's group showing the locations of naulas, water tanks, and major landmarks.

