

# Strengthening local capacities for resilient agriculture water management in Nepal's mid-hills: A case study from Bisdeutar, Indrawati

Jibesh Kumar KC, Shisher Shrestha, Aashika Adhikari and Rabina Koju

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## Authors

**Jibesh Kumar KC**, Research Officer - Resilient Water Management and Livelihoods, International Water Management Institute (IWMI), Kathmandu, Nepal

**Shisher Shrestha**, National Researcher - Renewable Energy, Water & Climate Change, IWMI, Kathmandu, Nepal

**Aashika Adhikari**, Consultant - Climate Action Program, IWMI, Kathmandu, Nepal

**Rabina Koju**, Agriculture Officer, Indrawati Rural Municipality Office, Nawalpur, Sindhupalchowk, Nepal

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**Front cover photo:** Farmers from youth to elderly participate in learning sessions on engaging multiple stakeholders in local agricultural development. (*photo:* Aayush Niraula, IWMI)

**Back cover photo:** Women farmers in Bisdeutar review extension materials during a training on socio-technical innovations for efficient water use practices. (*photo:* Aayush Niraula, IWMI)

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# Key takeaways

- **The marginalized communities of Nepal's mid-hills face a common set of challenges**, where they struggle with persistent poverty, entrenched social exclusion, and high rates of out-migration. Their agricultural livelihoods are further burdened by prolonged water scarcity, inadequate irrigation infrastructure, and poor market access for their products.
- **Agricultural development is hindered by limited knowledge** of high-value crops, efficient irrigation methods, and integrated farming systems. These challenges are compounded by gender imbalance in decision-making and weak institutional linkages.
- **A phased system approach was adopted** to effectively identify capacity gaps and implement targeted interventions, ensuring that community needs were addressed in a context-specific and inclusive manner.
- **Among agriculture water management interventions, farmers prioritized micro-irrigation, agroforestry, and soil moisture conservation** sequentially. Notably, women farmers ranked soil moisture conservation as their highest priority.
- **The capacity enhancement strategies included regular farmer-to-farmer knowledge sharing sessions** led by local Multistakeholder Agriculture Knowledge Hub (MSAKH) champions. Training and decision-making included women and marginalized groups. Training sessions focused on farmers' immediate needs, such as tomato cultivation and efficient moisture conservation technologies, and integrated farming technologies.
- **Tailored engagement strategies** such as separate focus group discussions for women, men and youth during capacity needs assessment, flexible scheduling of training events to accommodate women's availability, localized facilitation, and context-sensitive training delivery, significantly enhanced the participation of women and youth in community mobilization processes.

# 1. Introduction

Climate change threatens Nepal's agriculture with crop failures, reduced yields for many crops, soil degradation, and increased pest and disease outbreaks, all contributing to high adaptation costs (Dawadi et al., 2022). Irrigation is one of the most critical adaptation strategies. Yet, despite the country's abundant water resources, over 60% of irrigable lands lack reliable irrigation access (Khadka et al., 2021). This challenge is especially acute for over 80% of farmers who are smallholders, cultivating less than one hectare of land that is typically fragmented into three plots and without year-round irrigation (NSO, 2023). Consequently, these farmers are highly vulnerable to erratic rainfall, water scarcity, and drought, which directly threaten their prime livelihood option.

These climate-induced vulnerabilities are further amplified in the mid-hill regions, where rugged topography and limited irrigation infrastructure constrain agricultural productivity. Without improved water accessibility and management, farmers are unable to diversify crops, adopt modern agriculture practices, or secure stable incomes. Therefore, strengthening local capacities for agriculture water management is critical to ensure food security, sustain livelihoods, and build climate resilience.

Previous studies indicate building resilience requires not only technological innovations, such as modern lift irrigation and efficient water use technologies, but also strong institutional mechanisms that ensure continuity of support and effective knowledge transfer (Dinesh & Vermeulen, 2016). At the policy level, Nepal's Agriculture Development Strategy (2015–2035) recognizes this very need. The strategy emphasizes technology adoption, efficiency, and human resource development as key drivers of agriculture transformation (GoN, 2016). However, translating these policy ambitions into practice remains a challenge. Many local communities still lack sufficient technical support and integrated services by a number of stakeholders, leaving promising initiatives unsustainable despite high initial investments and community efforts.

In this context, this technical brief draws lessons from IWMI's socio-technical innovations<sup>1</sup> within a marginalized and climate-vulnerable community in Nepal's mid-hills. According to the Scaling Readiness framework developed by CGIAR (Schut et al., 2020), scaling such innovations requires not only enabling policies and stakeholder engagement but also continuous capacity building, as technical and institutional readiness are key indicators for sustained adoption and impact.

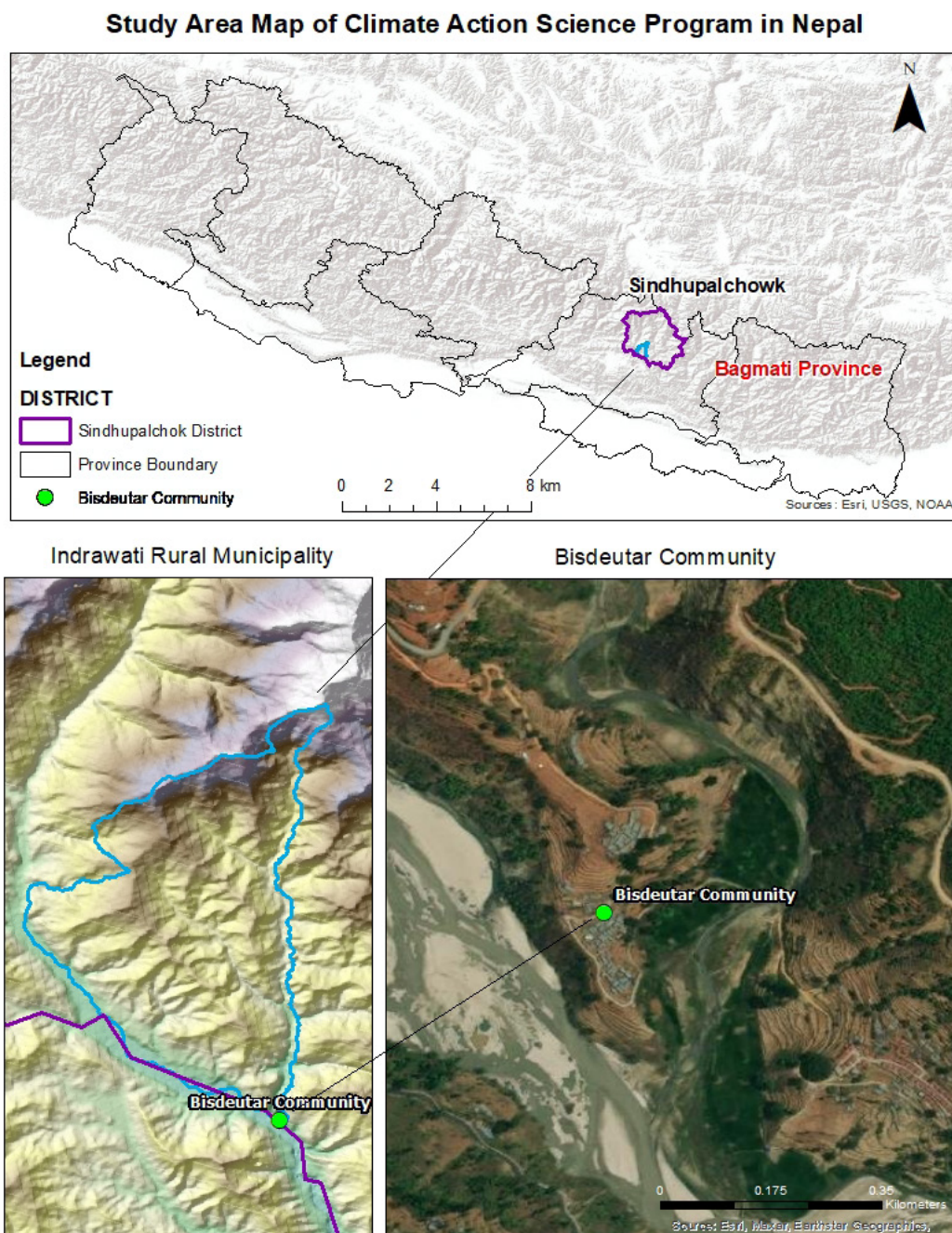
Central to interventions in Bisdetar was a solar-powered water lifting system aimed at enhancing livelihoods and improving water resilience for the Indigenous people. Surrounding this core innovation, a suite of complementary activities is explored, including enabling policy landscape, stakeholder engagement, capacity building, and market linkages. Agriculture capacity building is emerging as one of the most critical enablers for long-term impact in terms of converting water access to sustained farm income. The brief presents identified key capacity gaps in the local context and proposes a packaged capacity enhancement strategy that can sustain livelihoods and promote climate adaptation.

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<sup>1</sup> Socio-technical innovations refer to solutions that integrate both technological tools and social processes, such as institutions, behaviors, and stakeholder coordination to create sustainable change.

## 2. Community context

Bisdeutar is a typical village of Nepal's mid-hills, situated in the Indrawati Rural Municipality of the Sindhupalchowk District (Figure 1). Nestled above the confluence of the Indrawati and Jhyadi rivers, the settlement is inhabited by the highly marginalized and indigenous Majhi community<sup>2</sup> of Nepal. Historically, the Majhi community depended on the riverine landscape for their livelihoods, engaging in fishing, boating, and related subsistence activities. Due to the changing socio-economic and natural conditions, the community in Bisdeutar now primarily relies on wage labor, subsistence agriculture, livestock rearing and remittance to sustain their livelihoods.



**Figure 1.** Study area map of Bisdeutar village, Indrawati Rural Municipality – 11, Sindhupalchowk.

<sup>2</sup> The Majhi community is recognized as a highly marginalized indigenous group based on developmental indicators including literacy and education, income, wealth, land holding, and other assets (NFDIN, 2022).

The community comprises 55 households, mostly engaged in subsistence farming. Some cultivate vegetables and fruits with the occasional surplus sold in nearby markets of Siphaghat, Dolalaghat, and Kuntabesi, located between 10 and 30 kilometers from the village. With improved production and quality, farmers could potentially tap larger markets such as Banepa and Kathmandu. Despite the village being only a three-hour drive from the country's capital, Kathmandu, poor road connectivity, often disrupted during the monsoon, remains a major obstacle.

A baseline survey conducted by IWMI in 2024–2025 highlighted the following key agricultural challenges:

- Prolonged water scarcity and inadequate irrigation infrastructure
- Limited agricultural labor in the village due to 56% partial and 27% full household migration
- Climate-induced disasters, including landslides, floods, and drought, which damage agricultural lands and crops, and affect agricultural productivity
- Limited access to water resources constrain income-generating activities, particularly for youth and women. The burden of water collection for domestic use continues to fall on women, restricting their participation in other productive, educational, or community activities.
- Emotional strain on residents and crop losses due to climate-induced disasters and the absence of irrigation infrastructure
- Poor road access during monsoon, which restricts market opportunities

In addition to these agriculture-water challenges, there is limited institutional engagement in the village. Located at the edge of the municipality's boundary, the village is an hour's walk away from the ward office, which struggles to provide adequate outreach due to poor transport, unclear mandates, and budget limitations. Although the Bodgaun Jagaran Agriculture Cooperative, comprising twenty members from Bisdeutar (sixteen of whom are women), offers savings, credit services, and agricultural subsidies, its influence is far weaker in Bisdeutar than in Bodhgaun due to remoteness.

The 2015 earthquake caused severe damage and devastation in Bisdeutar, killing 14 people and destroying homes and livelihoods. While reconstruction efforts restored household infrastructure, agricultural development and livelihood support received far less attention. For instance, kitchen garden provisions were largely neglected during housing construction.

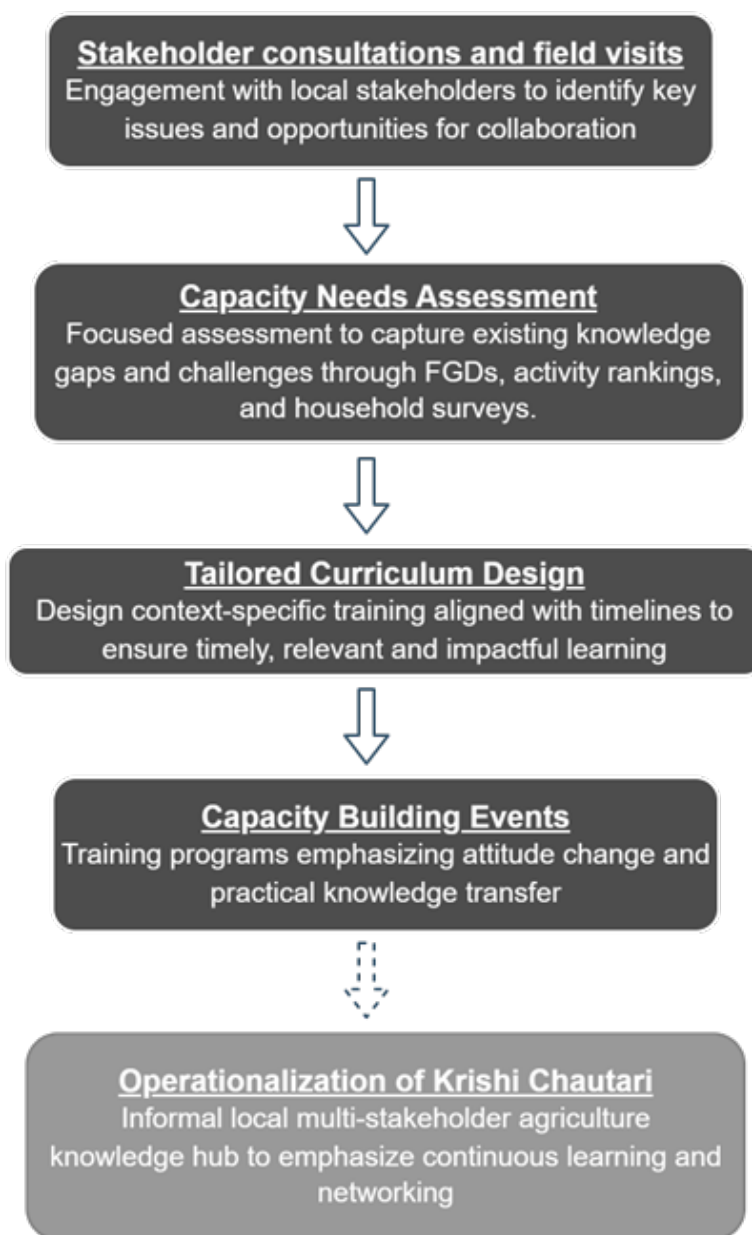
Residents depend on a small spring for drinking and cooking, though its flow is seasonal and often unreliable. For bathing, laundry, and dishwashing, they rely on river water. Against this backdrop, IWMI commissioned a solar lift system (SLS) in December 2024 to facilitate water access through groundwater pumping from the banks of the Indrawati River. The SLS has the potential to serve the domestic water needs of 55 households and irrigate approximately 5.5 hectares of land, which has opened the door for agricultural transformation in the community.

Following the intervention, the community in Bisdeutar has begun cultivating mustard on dry uplands and is now seeking support to expand the irrigated area through a distribution pipeline, alongside agriculture capacity building. There is an urgent need for agricultural training, timely technical assistance, and stronger institutional linkages. Farmers require practical skills to manage water resources efficiently, diversify crops, and adopt resilient farming practices. At the same time, local institutions must be strengthened to plan, coordinate, and sustain interventions beyond short project cycles.

### 3. Key methodological steps

IWMI launched a technical intervention for a solar lift system (SLS) in Bisdeutar in April 2024, responding to a request from the Indrawati Rural Municipality. A pre-feasibility assessment, conducted over two scoping visits, evaluated thirteen sites against gender and social inclusion, climate vulnerability, and financial criteria. Bisdeutar was prioritized due to the dire need to address water challenges, its geographical remoteness, and concentration of marginalized groups.

Following water access for agricultural development, a phased system approach has been adopted to identify capacity gaps and plan and implement interventions, ensuring that community needs are well understood and addressed in a context-specific and inclusive manner. This method drew learnings from studies conducted under the CGIAR Initiative on Mixed Farming Systems (MFS) in similar mid-hill areas (Koirala et al., 2024). The key methodological steps followed are presented in Figure 2.



**Figure 2.** Methodological steps followed for capacitating farmers adopting a system approach.

## 4. Stakeholder consultations

Following the SLS installation, IWMI conducted seven separate stakeholder consultations with the municipal agricultural section, local government officials, sub-division forest office, local nongovernmental organizations (NGOs), and Bisdeutar community members. Additionally, seven targeted key informant interviews (KIIs) were conducted with local vegetable shops, agrovets, and collection centers in nearby areas, including Melamchi, Nawalpur, and Siphaghat. Four field visits to Bisdeutar were conducted after commissioning the SLS.

The consultations were instrumental in understanding the changing local context, local market opportunities and challenges, stakeholder assumptions, and ascertaining the influencing factors. These engagements collectively revealed a critical need for capacity strengthening and social mobilization support in the Bisdeutar community.

## 5. Capacity needs assessment

To gain a more granular understanding of the need for capacity strengthening to support the SLS activity, a focused capacity needs assessment was conducted to capture the community's existing knowledge, agricultural practices, water management challenges, and aspirations. In April 2024, four gender- and age-disaggregated focus group discussions (FGDs) were held in Bisdeutar and Bodgaun (Figure 3). Insights from Bodgaun, a community located closer to the ward office with better access and services, provided valuable comparative context for the challenges faced in remote Bisdeutar.

During the FGDs, activity scoring exercises were used to gauge community preferences for agriculture water management interventions (Figure 4). Each participant was given votes to allocate across seven possible interventions, including rainwater harvesting, community mobilization, multiple water use systems, conservation agriculture, agroforestry, and micro irrigation (drip and sprinkler) (Figure 5).



**Figure 3.** Focus group discussion conducted with women members from the Bisdeutar community.

(photo: Jibesh KC / IWMI)



**Figure 4.** Activity scoring exercise conducted among the men group in Sirane tole, Bodgaun.

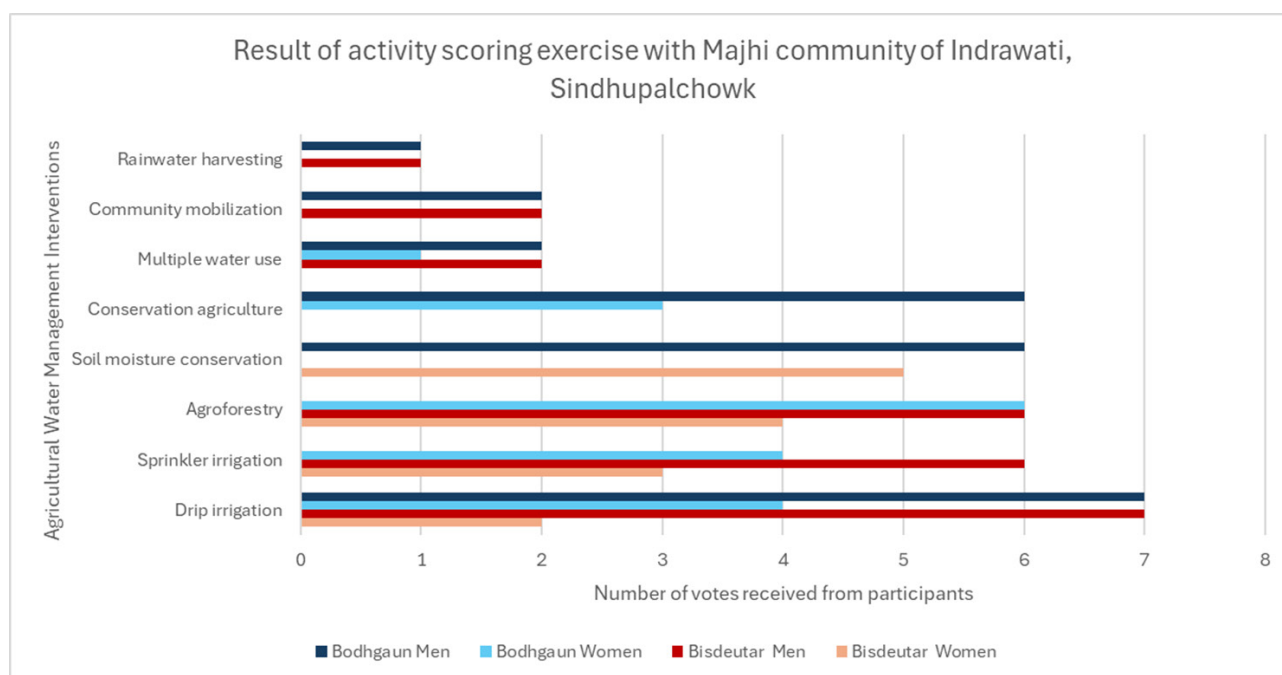
(photo: Sushma Chaudhary / IWMI)

A baseline household survey complemented the FGDs, providing further system context from a household perspective. Two surveys were conducted in Bisdeutar, one before the Solar Lift Irrigation (SLI) intervention (2024) and another after the installation (2025). Collectively, these assessments informed the design of targeted capacity-building activities for the community.

Based on the assessment, the following key findings have been identified to inform the development of effective capacity enhancement strategies for the short to medium term:

- **Farmers in Bisdeutar primarily rely on traditional cereal-based farming**, with limited knowledge of high-value and cash crop production. Although markets for locally grown vegetables and pulses (e.g., tomato and black gram) exist, access remains constrained.
- **Women and youth demonstrated significant potential for entrepreneurship**, expressing strong interest in activities such as beekeeping, mushroom cultivation, and other technical trainings. However, this capacity remains underutilized due to limited technical support and opportunities.
- **Low awareness of agricultural subsidies** and weak coordination among local institutions are two critical barriers hindering innovation in agriculture and water management.
- **Micro-irrigation was the highest overall priority.** Drip and sprinkler irrigation were ranked respectively as the most preferred interventions. **Agroforestry and soil moisture conservation were the next highest priorities.** (Results are presented in Figure 5).
- **A gap exists between individual and community needs.** Marginalized farmers prioritized interventions with direct livelihood benefits but were unable to advocate for community mobilization activities, despite their importance for long-term sustainability.

- **Gendered priorities highlight a need for inclusive planning.** Women in Bisdeutar placed high priority on soil moisture conservation, reflecting a practical focus on improving existing challenges in agriculture. In contrast, men from both sites emphasized the adoption of modern technologies such as micro irrigation, signaling interest in new solutions and innovations. These differing perspectives highlight the need to actively engage both women and men in agricultural decision-making processes, ensuring that planning and interventions integrate diverse experiences, priorities, and knowledge systems for more equitable and effective outcomes (Figure 5).
- **Significant untapped potential exists for mixed farming practices,** particularly through introducing agroforestry, fruit and fodder cultivation, and riverbed farming. Adopting such practices would not only diversify production but also reduce the workload of women, who needed to travel long distances to collect fodder and fuelwood.
- **A misalignment in development focus** was noted, with municipalities promoting livestock-based enterprises while marginalized communities showed a stronger preference for crop cultivation.
- **Local institutions play a critical role in managing water for agriculture,** including water user groups, cooperatives, and local governments. However, their effectiveness is often constrained by several factors. For example, local governments frequently face limitations in irrigation system design, budgeting, and implementation, and weak coordination among stakeholders and service providers for repair and maintenance.



**Figure 5.** Results of the activity scoring exercise with the Majhi communities of Indrawati, Sindhupalchowk.

## 6. Capacity building workshops

### Socio-technical innovation for efficient water management

Building on the findings from the needs assessment, IWMI, in collaboration with the municipality and the Community Development and Environment Conservation Forum (CDECF), a local NGO, organized a tailored two-day training in Bisdeutar (Figure 6). The program engaged 33 farmers, including 15 women, and aimed to address immediate needs, build climate resilience, and improve community livelihoods.



**Figure 6.** Daytime training session on tomato intercropping happening under the shade of a jackfruit tree. (photo: Aayush Niraula)

Drawing on lessons from the MFS Initiative, the program scaled innovations in efficient water use practices and advanced the Multistakeholder Agriculture Knowledge Hub (MSAKH) approach. The sessions focused on efficient water use, sustainable agricultural practices, and collaborative learning frameworks. They began with an introduction to the concept of MSAKH, locally referred to as *Krishi Chaudhari*, highlighting the role of active farmers, the interconnected nature of mixed farming systems, and strategies for operationalizing the hub.

Subsequent sessions covered efficient water use practices such as conservation agriculture, mulching, agroforestry, crop rotation, and intercropping. In addition, participants learned about current soil health and improvement measures supported by robust soil tests conducted in the community agricultural lands. Farmers were also introduced to irrigation methods including drip and sprinkler systems, as well as indigenous and small-scale techniques suited to local contexts.

In response to water scarcity in the mid-hills, participants explored spring conservation and watershed management strategies. A dedicated session on Multiple Use Systems (MUS) and rainwater harvesting emphasized the benefits of the solar lift system (SLS) for meeting diverse water needs and underscored the importance of community involvement in the operation and maintenance of Bisdeutar's existing infrastructure.

A practical component focused on tomato intercropping within maize was also included. This was further complemented by regular technical support at various stages of plant development by involving the nearby local lead farmer, a strategy designed to promote peer learning and address the identified capacity gaps.

By August of 2025, the community had already prepared nursery beds and planted tomato seeds for seedling production. These efforts were supported through two farmer field day sessions facilitated by the local lead farmer. To date, farmers have invested approximately NPR 28,000 (USD 200)<sup>3</sup> from their water user group funds to purchase seeds. However, sustaining this intervention requires continued financial and technical assistance, with immediate attention on the timely pesticide application to manage pests and diseases. Importantly, these capacity-building initiatives were structured using a multistakeholder knowledge hub approach, designed to promote farmer participation, collaboration, and long-term viability by strengthening local coordination.

### Soil moisture sensing training and sensor deployment

A comprehensive training on soil moisture sensing was successfully conducted in the Indrawati Rural Municipality in October 2025, engaging 15 participants from various wards, including lead farmers, cooperative members, water user associations, local NGO representatives, and municipal officials (Figure 7). The objective of the training and the following activity on data collection from farmers was to assess factors involved in the improvement of water use efficiency and crop yield at farm level. The training emphasized the critical role of soil moisture in plant growth and its relevance for smart irrigation, particularly in water-scarce areas.



**Figure 7.** Conducting soil moisture sensing training with participants from the Indrawati Rural Municipality. (photo: Aashika Adhikari, IWMI)

<sup>3</sup> 1 USD= NPR 140

Participants were introduced to the principles and practical applications of soil moisture sensing for optimized water allocation using Chameleon soil water sensors. The training included hands-on demonstrations on sensor installation and usage, enabling participants to understand how timely data can inform irrigation scheduling and enhance agricultural productivity.

As part of the field activities:

- A transect survey was conducted to assess local cropping and irrigation conditions.
- A prototype agriculture and irrigation data collection field book was tested with farmers to support consistent monitoring.
- A local staff member has been recruited to facilitate data collection and farmer engagement.

To ensure equitable and context-relevant deployment of soil moisture sensors, techno-socio-economic and site-specific criteria were applied in selecting installation locations. These criteria were thoroughly discussed with stakeholders during the dedicated consultation meeting. Representatives from various wards actively contributed to the selection process, emphasizing the importance of inclusive representation across all wards within the Indrawati Rural Municipality. Their inputs helped guide transparent and locally grounded decisions, reinforcing community ownership and relevance of the intervention.

To date, 30 soil moisture sensors have been installed across tomato, cauliflower, cabbage, and potato plots, including 3 sensors in Bisdeutar. An additional 20 sensors are planned for deployment in potato fields following planting.

Sensor data will be collected throughout the crop growing season until the end of 2025. This initiative is expected to generate valuable insights into soil moisture dynamics and irrigation scheduling, contributing to optimal water allocation and improved agricultural productivity in the region.

## 7. Operationalizing the local Multistakeholder Agriculture Knowledge Hub

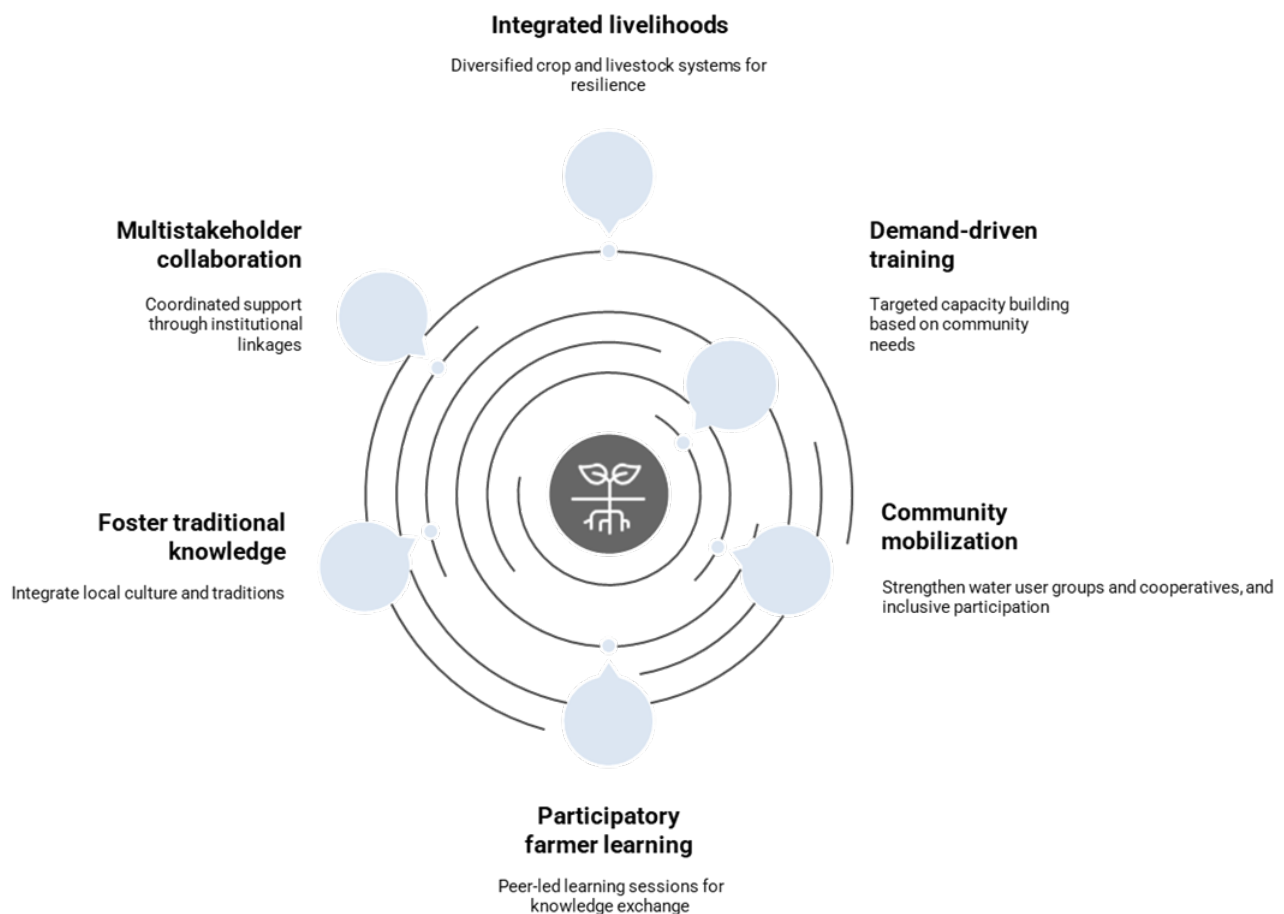
To ensure the sustainability of these capacity-building efforts, operationalizing a local Multistakeholder Agriculture Knowledge Hub (MSAKH) became the next critical step. This hub serves as a platform not only to share farmer-to-farmer learning but also to function as a medium to foster peer-collaboration between farmers, local government, technicians, and NGOs (Koirala et al., 2024).

Recognizing the importance of MSAKH for sustaining impacts of interventions, a local MSAKH was established to provide communities with the regular technical support and timely connections to relevant partners they require. This approach was piloted during the training in June 2025 by linking the Bisdeutar community with a local NGO and ward-level local agricultural technician, creating a foundation for continuous technical exchange and institutional support. Stakeholders provided guidance on accessing agricultural services and subsidies from government agencies, including information on eligibility and application processes. The local ward-level technician shared practical insights on how to acquire subsidies available at both ward and municipality levels and committed to offering technical assistance when needed—particularly in subsidy acquisition and pest management. Meanwhile, the CDECF, the local NGO, is actively supporting the community and the municipality by facilitating connections with relevant governmental bodies, as well as with national and international nongovernmental organizations such as IWMI and the International Centre for Integrated Mountain Development (ICIMOD), strengthening pathways for resource access, collaboration, and sustainable development. Recognizing this successful pilot, the Indrawati Rural Municipality formally adopted

the concept and provisioned ward-level MSAKHs in its official policy and programs, ensuring institutional commitment to scale the approach across all wards. With the ongoing support of the ward office and local NGO, the MSAKH can function as a vehicle for strengthening social capital and capacity enhancement, enabling Bideutar and neighboring villages to strengthen resilience, improve agricultural practices, and build stronger linkages with local governance structures.

## 8. Capacity enhancement strategies

Drawing lessons from the capacity needs assessment and training carried out in Bideutar village, the following capacity enhancement strategies have been suggested to support livelihood upliftment in Bideutar and other marginalized communities in the mid-hills of Nepal (Figure 8). These recommendations are intended to guide local governments, grassroots organizations, and development partners in strengthening inclusive and climate-resilient agriculture systems.



**Figure 8.** Empowering farmers for sustainable agriculture through capacity enhancement strategies.

- **Capacity building and interventions based on demand:** Training topics and field interventions should emerge from needs assessments, ensuring they reflect the priorities of farmers with different social identities. Training sessions must integrate crosscutting topics including agribusiness and entrepreneurship development, gender roles and inclusion, and local cultural values to ensure an integrated approach to agriculture transformation. Women and socio-economically disadvantaged groups, who play a vital role in farming, yet are often excluded from decision-making due to power relations, must be actively included in planning, training, and leadership roles.
- **Community mobilization and social empowerment:** Beyond technical skills, community mobilization and social empowerment are essential components of capacity-building programs. This includes strengthening local water user groups and cooperatives, and engaging social mobilizers to facilitate coordination, collective action, and inclusive participation.
- **Participatory farmer-centered learning:** Strengthening local capacities requires a participatory and farmer-centered learning model. Farmers should meet in bi-weekly or monthly knowledge-sharing sessions facilitated by a lead farmer and a local social mobilizer. These forums enable farmers to share challenges, exchange lessons, and demonstrate innovative practices, such as the ongoing tomato cultivation and soil moisture monitoring in Bisdeutar, encouraging effective peer-to-peer learning.
- **Fostering traditional knowledge and cultural heritage:** Traditional knowledge and cultural practices should deserve attention as part of capacity building. For example, the Majhi community's *Koshi Puja* (river worship day) highlights their deep dependence on rivers for food (fish), water, and livelihoods. It is essential to document these traditions and ensure smooth transmission to future generations. Organizing farm days by considering their culture and traditions strengthens both cultural identity and agricultural innovation.
- **Multistakeholder collaboration and institutional linkages:** The Multistakeholder Agriculture Knowledge Hub (MSAKH) approach offers an ideal platform for delivering these strategies. By bringing together farmers, NGOs, ward-level technicians, and municipal representatives, the MSAKH enables continuous farmer-to-farmer learning, stronger institutional linkages, and timely technical support. Training sessions under this platform can involve visiting experts, coordinated by local NGOs and mobilizers, thereby embedding external knowledge into local systems.
- **Integrated and climate-resilient livelihoods:** Introducing integrated farming models that form a system combining fruits, fodder, fish, and cash crops, can diversify incomes, improve food security, and reduce women's workload. Such systems strengthen resilience to climate risks while also aligning with sustainable, climate-smart development pathways.

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