

Nepal Water Conservation Foundation
(NWCF)

Study Brief

Enabling Climate Resilient Water Governance: Learnings from Syangja District, Nepal

March 2025

The Context

In the context of skewed pattern of 'too little and too much water' in the Himalaya, balancing the demand and supply of water in Nepal's hilly towns has always been a tough challenge where over 80% of annual rainfall occurs in just four months of monsoon and rest of the period remains mostly dry. Studies have revealed that climate change and rapid urbanization have added vulnerability to the water sources, built systems and institutions, which they may not be able to withstand the eminent crisis.¹ ²Adopting the principle of 'Climate Adaptive and Equitable Water Management Practice', the approach of the study consisted case studies of highly affected areas, spring inventory, household survey and a series of expert consultations with municipal officials and community leaders. The timing of the study was coincided with monsoon season that provided an opportunity to deal with topics like climate, water, agriculture, forests, human infrastructures and livelihoods, among others. Excerpts of the study are drawn here wider dissemination.

Study Approach

Climate Adaptive Equitable Water Management Practice (CAEWMP)³ was adopted as a participatory approach to engage with the community and municipal officials. In an effort to contribute to the municipal initiatives to address the ongoing water and climate issues, an interdisciplinary team of researchers conducted a study in the Galyang Municipality to Waling Municipality of Syangja District between July and December 2024. Both bio-physical and socio-political analyses of the contexts were carried out as depicted in the Figure 1.

1 Bajracharya, Roshan M., Ngamindra Dahal, Kaustuv R. Neupane, Vishal Singh, Riyan Habeeb, Urban Water Security Challenges in the Nepal and Indian Himalaya in the Context of *Climate Change, Resources and Environment*, Vol. 9 No. 1, 2019, pp. 9-18. doi: 10.5923/j.re.20190901.02

2 Pandey, C.L.; Bajracharya, R.M. Climate Adaptive Water Management Practices in Small and Midsized Cities of Nepal: Case Studies of Dharan and Dhulikhel. *Sustain. J. Rec.* 2017, 10, 300–307.

3 Ojha, Hemant, Kaustuv Raj Neupane, Chandra Lal Pandey, Vishal Singh, Roshan Bajracharya and Ngamindra Dahal, 2020: Scarcity Amidst Plenty: Lower Himalayan Cities Struggling for Water Security. *Water* 12(2):567. DOI:10.3390/w12020567

Key Messages

Problems

Weather Hazards: Increased frequency and intensity of extreme weather events have threatened lives and livelihood of local communities, particularly the farmers and low-income households.

Recurrent damages to the critical infrastructures: Improper landuse changes and constructions activities coupled with fragile geology have exacerbated the losses and damages of lives, properties, infrastructures and the livelihoods at varied scales in the municipal level.

Disproportionate Impact: Multiplicity of the changing climate hazards has heightened the risks and added differential impacts on people with disability, elderly, children, women, poor and marginalized.

Causes

Capacity gaps in municipal institutions: Efforts to build capacity of the municipal institutions remain grossly inadequate to fill the gaps of policy alignment with development practices. Inadequate preparedness has been the major cause to withstand the disasters.

Climate insensitive critical infrastructures: Improperly designed roads and human settlements, particularly rural road expansion using earthmovers, have exacerbated vulnerability of landslides, flooding, and erosion. Engineering practices fail to integrate climate, disaster, and environmental concerns.

Recommended actions

Promote public policy dialogues for climate aligned infrastructural build up: Municipal institutions can avoid mistakes by promoting informed dialogues on review and reflections of developing critical infrastructures.

Strengthen institutional capacity: Supporting municipal officials in strengthening planning, monitoring and evaluation related to local development initiatives can be effective to overcome the climate induced challenges. It can be achieved through integration of training, research, technology and system along with community participation and developing an accountability mechanism.

Mainstream climate resilient practices: Mainstreaming climate resilient practices of local communities in combination with modern technologies into policies and practices is crucially important to avoid the adverse consequences of the climate shocks and unpredictable weather events.

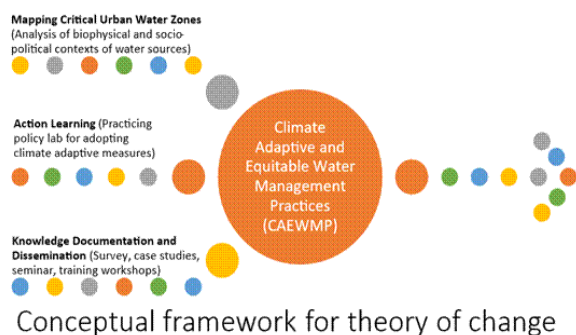


Figure 1 Study framework

Findings

1. Growing Climate Vulnerability: The Andhi Khola River drains the central part of the Syangja District and serves as the lifeline for thousands of populations including the residents of Galyang Municipality and Waling Municipality. Its densely populated landscape is undergoing rapid change because of expanding networks of roads, water supply systems and settlements across the pockets of riverine plains. A dense network of tributaries and floodways in the basin indicates its characteristics as a high rainfall zone during monsoon (Figure 2). Facilitated by the Siddhartha Highway linking Pokhara to Butwal, the Andhi Khola River bank is an emerging marketplaces and urbanization such as Waling, and, settlements closer to the river banks have added climate vulnerability from multiple fronts, namely, risks of floods, landslides, shortage of water supply and basic urban amenities. Extreme rainfall events and improper management of developmental activities have heightened the risk of floods, landslides and water depletion. Together, the landscapes of the Andhikhola highlight the urgent need for sustainable management practices that balance development with ecological preservation.

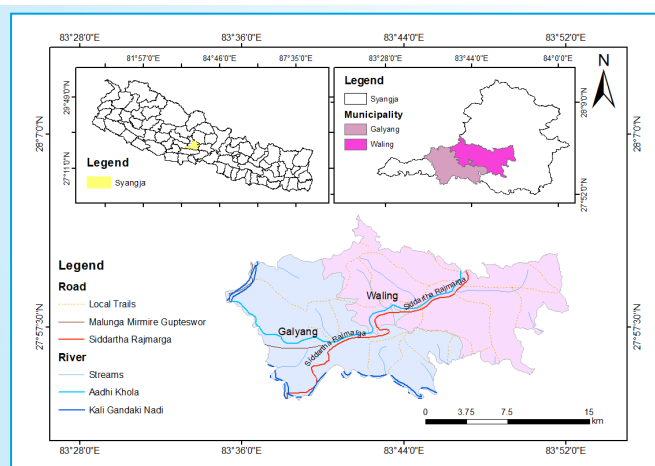


Figure 2 Study Area

(Credit: Study Team, 2025)

2. Landuse and Seismic Vulnerability: The geological features of Galyang and Waling region are composed of three major formations: The Upper Nawakot Complex, Lower Nawakot Complex, and Sirkot Formation (Figure 3). The Upper Nawakot Complex is predominantly made up of Benighat slates, while the Lower Nawakot Complex consists of Dhading dolomite and the Nourpaul Formation⁴. These formations contribute to the region's geological complexity and susceptibility to seismic activities and land-use challenges. The lithostratigraphic composition of the area is diverse, featuring slates, quartzite, dolomite, limestone, and Phyllites. Among these, quartzite exhibits highly fractured joints, making it more susceptible to structural instability. Besides Phyllites, limestone is also highly susceptible to weathering. Additionally, the presence of geological structures such as ripple marks further highlights the dynamic nature of the region's geological history⁵.

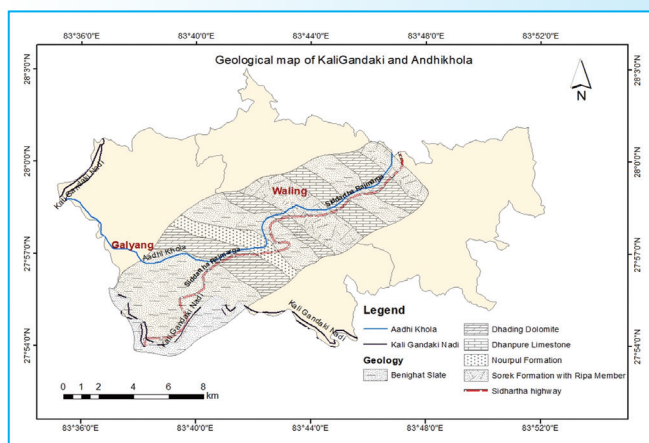


Figure 3 Hydrogeological Map of Kali Gandaki and Andhi Khola

(Credit: Study Team, 2025, Adopted from Dhital et al., 2002)

3. Declining Springs: An inventory of spring was developed through field survey focusing on the major springs in Galyang and Waling. A total of 28 springs were documented, of which 18 springs were documented in Waling, and 10 in Galyang. Majority of the springs are artesian type

- 4 Dhital, M. R., Paudel, L. P., Thapa, P. B., & Ando, H. R. (2002). Stratigraphy and structure of the inner Lesser Himalaya between Kusma and Syangja, Western Nepal. *Journal of Nepal Geological Society*, 27, 25–37. <https://doi.org/10.3126/jngs.v27i0.31970>
- 5 Adhikari, B. & Suwal, M. (2013). Hydrogeological Study in Bangsing Deurali VDC, Syangja. *An Ecosystem-based Adaptation in Mountain Ecosystem in Nepal*. 10.13140/RG.2.1.4565.7127.

as they maintain perennial flow round the year. Some others were fracture, gravity, and sediment types of springs which are also perennial in most cases. Discharge fluctuations or the declining trends of flow are the major concerns as they depend on these vital sources for daily domestic supply. Springs are traditionally managed by the community. Also a few cases of privately owned springs were identified. The Galyang and Waling municipalities, local residents continue to experience water scarcity. In Waling, the daily water supply of 2.14 MLD falls far short of the 8.01 MLD demand, forcing many communities to rely on natural springs. However, these springs are rapidly declining in both flow and availability, further exacerbating the crisis. Springs that once sustained hundreds of households are drying up, further worsening the crisis.

In Galyang, 70.8% of residents can collect water within an hour, while 29.2% take more than an hour. Similarly, in Waling, 90.4% have access within an hour, but 9.6% still require more time. For example; “Local residents claim that Baasghari Spring has a drastic drop in users from 500 to just 100 households over the past five years due to reduced water flow”. Similar patterns are observed in other springs, leaving residents with limited alternatives. With both piped-line water and natural sources dwindling, urgent action is needed to implement sustainable water management solutions and prevent worsening shortages. As shown in Figure 5, nearly 30% of residents in Galyang and 10% in Waling must travel over an hour to collect water, highlighting the urgent need for localized supply solutions.

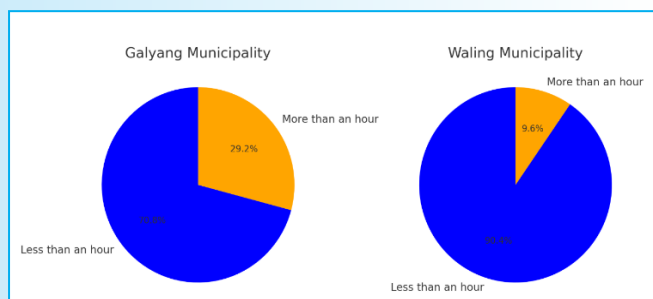


Figure 5 Duration to collect the alternative source of water

4. Infrastructural Vulnerabilities: A single storm of rainfall that occurred in the first week of July 2024 had devastating impacts on road networks, water supply systems, agriculture lands, crops and houses (Figure 6). Years of investments and progress were lost. Nevertheless, efforts to rebuild and restore normalcy started soon after the incident. By the end of monsoon, although the progress to resume services were impressive, there was a serious lack of informed debates over the causes and consequences of development policy to avoid a similar nature of climate events in the days ahead. Normally, rainfall above 50-100 mm in a day is considered heavy, and anything exceeding 100 mm is categorized as extreme, especially in hilly regions.

Figure 6 highlights the extreme rainfall events recorded over six days in Galyang, Waling, and Putalibazar, of Syangja district causing significant devastation in the region. Waling experienced the highest total rainfall of 625 mm in a week, with an extreme event on July 6, when 236 mm fell in a single day. Similarly, Galyang received 475 mm in total, with the most intense rainfall (190.2 mm) on July 5. Putalibazar recorded 480.6 mm, peaking on July 7 with 169 mm.

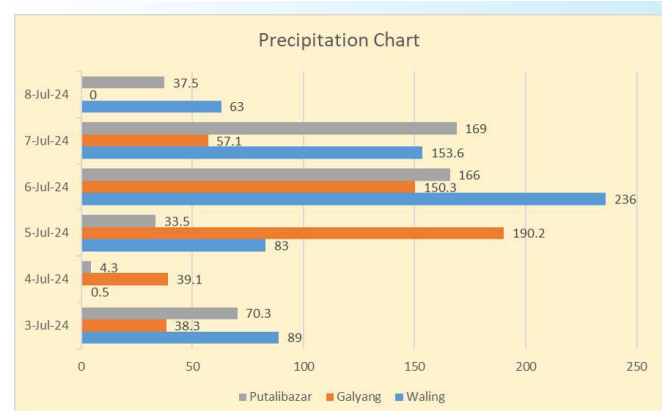


Figure 6 Precipitation graph of Syangja from July 3-8 2024

Land displacement in Lalyang: The Lalyang, with over 60 families forced to evacuate their houses on the night of July 5, 2024 after a 475mm rain storm hit the prosperous settlement of Galyang. Agricultural land displaced by over six feet, and multiple houses developed cracks, making them unsafe. The area's fragile lithology, combined with poor drainage and intensive paddy farming

process, contributed to this instability. The senior citizens from the local community reported that such a destructive storm was rarely experienced in their lifetime.



Figure 6 Landslides causing the road blockage making locals difficult to get access to the markets for daily needs

5. Differential Impacts: Access to safe water indicates a key aspect of climate vulnerability. The study revealed a differential spectrum of vulnerability across the wards of Galyang and Waling. Majority of ward areas have already achieved the target of making safe water accessible to the communities and working towards the goal of making it available to each household. However, there are a significant number of communities struggling for access to safe water most of the time in a year. A household survey undertaken during the monsoon season of 2024 is presented in the Figure 7. Communities in ward number 5 and 6 of Galyang and ward number 11 and 14 of Waling found themselves in trouble due to the poor access to safe water. For the majority population, the agriculture sector is the number one source with 86% (combined as the major and contributing one) followed by remittance (53%) as depicted in the Figure 8.

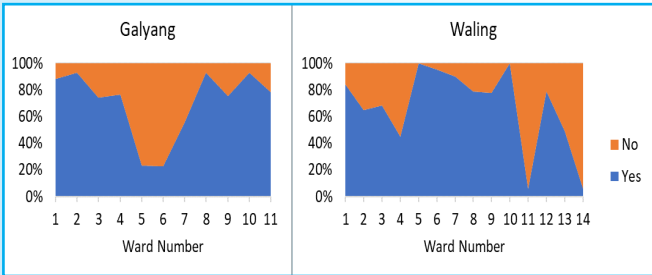


Figure 8 Reliable tap water access in different wards of Galyang and Waling Municipality

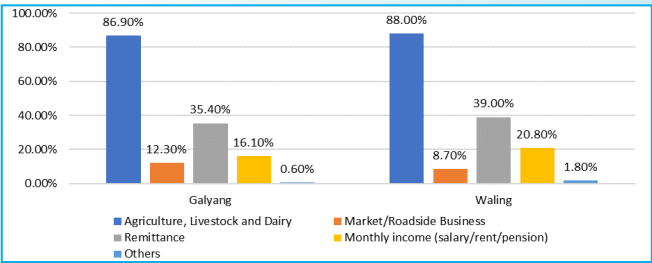


Figure 9 Major Source of Income in Galyang and Waling

Household income and diversity of sources is another important parameter to assess vulnerability of a community. Nearly 88 % of the households depend on agriculture, livestock and dairy business for major source of income to support livelihoods.

Infrastructural Damage by Chitdada Cloudburst

A cloudburst in Ward 10 of Galyang Municipality (June 2024) destroyed roads, bridges, and farmlands across Khaskuna, Saidar, and Bhutdada. The extreme rainfall caused flash floods, damaging irrigation systems and displacing families, leaving them vulnerable to food insecurity and water shortages.

6. Sources of Geophysical Vulnerability:

Unpredictable landslides, debris flow and flashfloods in the seasonal tributaries pose major risks to the lives and property in the vulnerable areas of the studied municipalities. Historical events often provide clues to identify the characteristics of vulnerable locations. Although the July rainfall storms caused severe hardships to the local communities, they also provided such an opportunity to locate the vulnerable communities and regions for better planning in the future. Once weakened landscape by the severe storm, the subsequent rainfall events led to accelerate further landslides and erosion, thus, damaging the critical infrastructures. In monitory terms, reporting the costs of losses was a challenging task in absence of capacity and practice to estimate the damages except for immediate relief and temporary resumption of the services. Following the July climate incident, Galyang Municipality and Waling Municipality reported the costs of temporarily restoring

the road networks, watery supply system and distributing relief materials about Rs. 8 million and Rs 50 million respectively. This doesn't include the costs of reconstructions of the damaged bridges, households, and water supply schemes. Landslides destroyed seven houses displacing the families.



Figure 10 Flood vulnerable terraces

The landslides in the areas have blocked many transportations route along with Siddhartha highway that have cut off access to the markets and other essential services during the monsoon. This has made the daily activities difficult for many isolated communities.

Key Challenges:

1. Missing climate resilient approach: The three-dimensional impacts of inappropriate development activities have been reported. Inadequate study of the site, lack of comprehensive planning, and unsupervised implementation are identified as the three critical elements for achieving climate resilient development. Without proper planning and consideration of environmental impacts, these unmanaged development activities create long-term vulnerabilities for both the environment as well as communities. For example; The use of the heavy earth moving machines like dozers or other equipment's during the construction activities can greatly disturb the lands and other underground water systems. The unplanned road construction destabilizes the slopes and leads to soil erosion, landslides or also may disrupt the natural water flow system. The poorly designed

roads fail to provide reliable transportation during the monsoon, as landslides and blockages occur frequently. As a consequence, cutting of the slopes without the proper reinforcement have triggered many natural vulnerabilities.

2. Growing Multi hazards risks: Three dimensional hazards- fragile geology, extreme weather and inappropriate infrastructural building has made the ongoing approach of development unsustainable and expensive. The nexus of the three hazards emerges as the mega hazards when a triggering event exceeds a normal threshold limit. A combined impact of the cascading nature of these three hazards was seen experienced during the extreme rainfall event in July. As a consequence, the Siddhartha Highway linking Pokhara to Butwal was blocked for three days. Farmers were severely affected from a number of fronts- irrigation systems destroyed, hundreds of hectares of productive agricultural lands were lost along with the standing crops, and hundreds of families from several settlements were displaced due to landslides. However, the losses of water sources and systems emerged as the most serious impacts from which thousands of families faced emergency situations without water supply for their daily needs.



Figure 10: Interdisciplinary study team with community members and municipality ward chairperson

3. Capacity gaps in Municipal Institutions: Municipal institutions play a critical role in managing disaster response, recovery, and preparedness, but many face significant limitations. The municipal institutions are functioning with bare minimum requirement of knowledge, capacity and resources leading to poor delivery of the services.

Limited understanding of accountability, support mechanism for mobilizing local resources and effective policy provisions is evident not only the ward offices- the front doors of municipality for community services but at the municipal secretariat as well. The decentralized municipal institutions can play a critical role in managing disaster response, recovery, and preparedness in spite of significant limitations. These institutions often lack the financial resources, technical expertise, and manpower needed to address the scale of challenges posed by multiple hazards. The repeated occurrence of natural disasters has overwhelmed existing systems, hindering timely and effective relief efforts. Some key areas where municipal institutions require sustained support include:

- **Disaster Preparedness and Response:** Enhancing early warning systems, emergency response mechanisms, and community engagement to reduce the impact of hazards.
- **Infrastructure Rehabilitation:** Rebuilding roads, bridges, schools, and other critical facilities to ensure they are disaster-resilient.
- **Livelihood Restoration:** Supporting affected families especially marginalized groups, single women, and people with disabilities to recover their income sources and adapt to changing environmental conditions.
- **Capacity Building:** Providing training and technical assistance to municipal staff to improve planning, coordination, and execution of disaster risk reduction initiatives.



Figure 11 Mayor Guru Prasad Bhattarai moderating the municipal policy dialogue with expert panel members at Galyang, Syangja

4. Increasing Vulnerability in the emerging town:

Emerging settlements, often developed without adequate planning, are especially susceptible to disasters. Lack of proper infrastructure, such as drainage systems, reinforced buildings, and accessible evacuation routes, leaves these areas exposed to hazards. Existing settlements, though more established, also require upgrades to improve resilience and reduce vulnerabilities. Addressing these challenges calls for better urban planning, infrastructure development, and relocation of the most at-risk communities. Disaster-resilient housing, early warning systems, and risk-sensitive land-use planning are essential to protect lives and property. Additionally, community awareness and preparedness programs can empower residents to respond effectively to future threats.

- **Inadequate Environmental Safeguards:** The rapid expansion of roads and settlements without proper planning has led to serious environmental and geological problems. Many roads are constructed without assessing slope stability and geological conditions, causing landslides, soil erosion, and drainage disruptions, especially during heavy rainfall. Poor road alignment also alters river flows, increases sedimentation, and raises flood risks, putting nearby communities in danger.

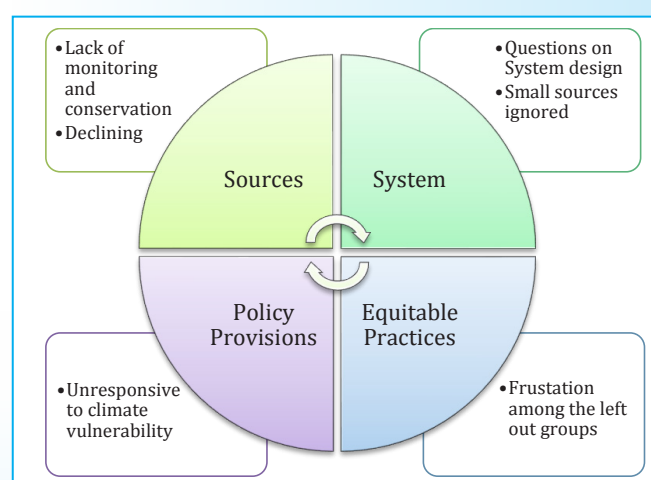


Figure 12 Four dimensions of water management issues in the Galyang and Waling region of Syangja

Ways Forward

1. Strengthen Institutional Capacity

The current approach of the municipal policy planning and budgeting system doesn't need any climate information or data to plan and execute a large-scale infrastructure building project. Limited human resources and expertise of the municipal institutions are divided into a dozen thematic divisions for delivering services through their ward offices located at distant locations. Most of the municipal budgets for civil constructions and maintenance are mobilized through informal groups, called 'Users' Committees' where issues of quality control and expert supervisions have been the major concerns. Overcoming the issues of mainstreaming climate resilient measures into water management and infrastructure building require a sustained and systematic approach. This includes a cycle of capacity need assessment, generating knowledge products and delivering the knowledge and skills to the targeted beneficiary in an impactful manner. Building databases of climate and water systems must be made a normal duty of municipal institutions that provides a basis for practicing informed policy decisions and planning. Subsequently, this helps strengthen the capacity of municipalities by enhancing transparency and governance practices of development activities.



Figure 13 Policy Dialogue with experts and municipal stakeholders

2. Optimize benefits of Nature-based solutions

Rich in forests, biodiversity and cultural heritages, the Syangja has unique opportunity to offer good practice examples of innovations to prefer nature-based solutions over conventional approaches to

build houses and other infrastructures. Instead of relying on conventional structures like concrete check dams and retaining walls, nature-based solutions (NbS) can offer cost-effective and sustainable alternatives. For instance, planting Amlisho (broom grass) across slopes combined with the strategic use of bamboo can effectively reduce soil erosion and stabilize slopes. These measures are not only economical but also easier to implement and maintain. Additionally, upstream water basin management practices play a crucial role in slope stabilization and spring conservation. Investing in studies of rainfall patterns and analyzing slope gradients can provide valuable insights for planning and implementing effective NbS, reducing the need for expensive structural interventions. Use of bamboo, bioengineering, promoting local materials, and traditional skills to promote sustainable construction and environmental conservation.

3. Promote local innovations and champions

The main motive of this study is to empower emerging and talented youth with the necessary knowledge and skills, essential to build their capacity to transform them into water champions. Similarly, experienced elders who possess valuable insights but haven't applied them meaningfully should be engaged through capacity-building initiatives by fostering intergenerational learning and collaboration to contribute effectively to water management and become water champions.



Figure 14 Empowering the youths

4. Institutional policy dialogues

The absence of a comprehensive municipal (Palika) database leads to poorly designed development plans. To ensure better decision-making, it is crucial to establish a robust database system that integrates information from internal project activities as well as findings from external studies. This consolidated system will enable evidence-based and informed policy decisions, driving more effective and sustainable development outcomes.

5. Mainstream climate resilient practices

The communities can create the proper water management practices to expand effective solutions for water issues. Sharing their knowledge and successful ideas can help municipalities adopt better approaches more quickly. For example, in Bahunthan, Waling, instead of building a impervious water fountain ground could be converted into a model plot for harvesting rainwater and recharging the groundwater that would add millions of liters of rainwater to recharge the groundwater. These recharge ponds should be properly managed to ensure they function effectively. In areas facing

water shortages, recharge ponds should be built in hilly regions, or multiple small pits should be created to help recharge groundwater.

6. Adopting proactive approaches

The current capacity gaps to enhance preparedness for responding to climate surprises and emergencies remain a critical challenge. Emergency relief focuses on providing immediate aid and resources during the disasters to minimize the damage. Proactive research emphasizes the identification of risk, studying the vulnerabilities and implementing the preventive measures to reduce the impact of disaster before they occur.



Figure 15 Local people writing about their problems faced during the monsoon season and its reason behind the calamities

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Disclaimer: The views expressed in this brief are those of contributors and may not necessarily reflect those of organizations involved in this study.

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