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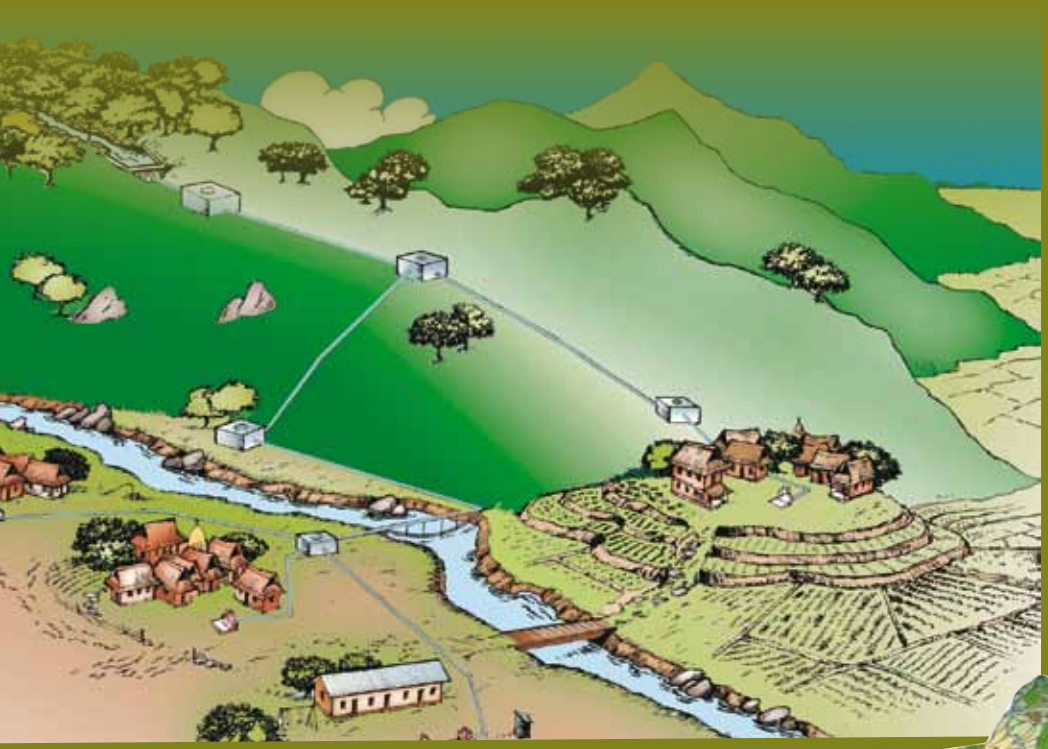
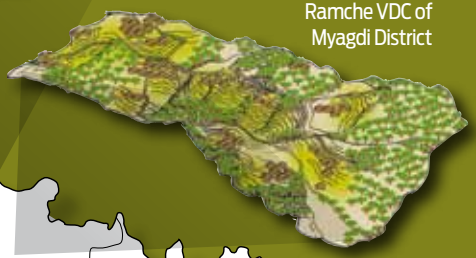


Groundwater resilience Nepal: A case study in the Middle Hills

March 2015, Kathmandu

Madanpokhara VDC of Palpa District



Ramche VDC of Myagdi District

Background

Groundwater resources in the Middle Hills of Nepal play a crucial role in supplying domestic and irrigation water along with providing base-flow for rivers. However there has been very little systematic study of groundwater, making it difficult to evaluate how water supplies and river flows may change in response to changing climate and land-use. To begin to establish an evidence base, two catchments in Nepal's Middle Hills: Ramche Village Development Committee (VDC), at an elevation of 2,000–3,000 masl, with terraced farming and forested slopes, and Madanpokhara VDC which is largely below 1,000 masl with expanding commercial agriculture were investigated. The study aimed to characterize the hydrogeology of the catchments, assess water supplies and water usage and evaluate how resilient groundwater is to change.

Study Approach

Scientists from the ISET-Nepal, British Geological Survey and ISET–International carried out the study. The study involved groundwater sampling during the post-monsoon season of 2013 and pre-monsoon season of 2014. Sampling included detailed investigation of thirty-one sites across the two catchments using a combination of water supply surveys, spring flow and temperature measurements, sampling for inorganic chemistry and groundwater residence time indicators. In addition 12 months of weekly hydrological monitoring at seven springs and monthly water usage surveys were undertaken in the two catchments.

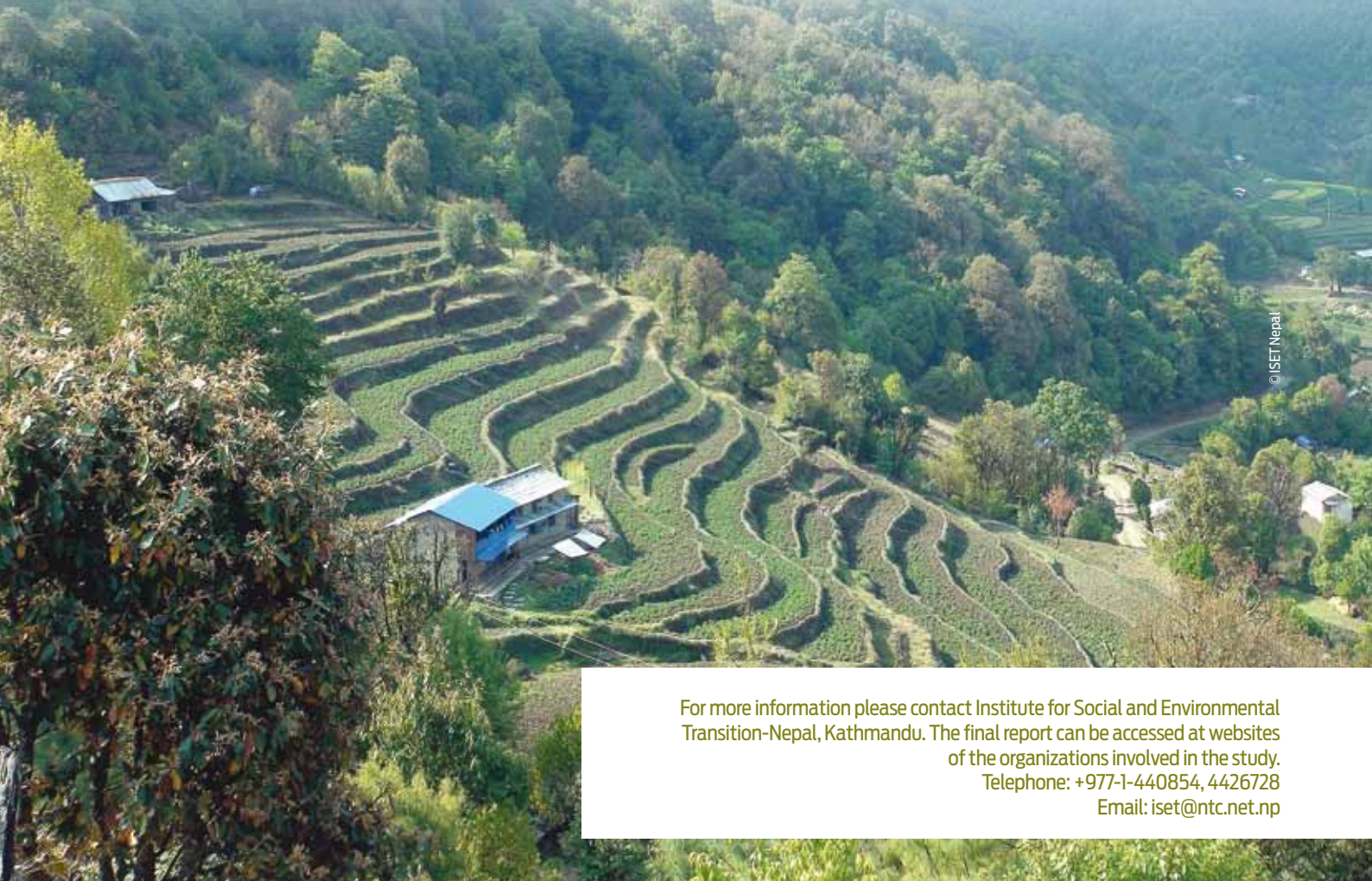
Stream level data recorder installed at Nangi, Myagdi

Preliminary Findings

- There is a heavy reliance on springs for water supply in the Middle Hills, particularly at higher altitudes. The springs are typically perennial but with significantly reduced flows during the winter and pre-monsoon season. The springs have bicarbonate groundwater chemistry and generally low overall mineralization.
- Two principle types of springs have been identified i) diffused springs which emanate from higher slopes and discharges to form headwaters of incised mountain streams, and ii) discrete springs which appear at topographical lows at lower elevations.
- Diffuse springs issuing from the higher slopes are reliant on recent monsoon rainfall and snow to sustain higher flows, but base-flows are sustained by groundwater storage within the weathered aquifer and will therefore have some inter-annual storage. Discrete springs issuing from the base of lower slopes are most likely to be fed from groundwater storage within the fractured aquifer network.
- The relatively weak coupling of spring flow and recent rainfall implies some inter-annual storage. Groundwater residence time indicators (CFC and SF6) indicate a mean residence time of 10-20 years for baseflow, suggesting some in-built resilience. However the general low storage of the groundwater environment suggests that none of the springs would be resilient to a long term if precipitation were to reduce.
- Stable isotope results for the diffuse springs in the higher slopes suggest that a reduction in precipitation or changes in the seasonality of rainfall would result in a more restricted groundwater capture zone for the springs and a lower year round flow. Stable isotope results for the lower discrete springs suggest a more localised but seasonally consistent groundwater capture zone. These springs may therefore be less vulnerable to changes in seasonal rainfall but may be susceptible to changes in the spatial rainfall patterns.
- Spring flows and water quality are highly vulnerable to changes in land use.
- In the lower catchment of Madanpokhara where floodplain and outwash deposits are present a proliferation of manually drilled shallow tube-wells have been installed in the last 5-10 years. Groundwater abstracted from these tube-wells is largely used for irrigation of agricultural land, use of the groundwater for domestic purposes is more-limited. However, it is unclear whether recharge to the floodplain aquifer balances groundwater abstracted from it. These shallow tube-wells have increased the resilience of the local communities but are potentially vulnerable to over-exploitation as a result of population increase and economic growth as well as being sensitive to polluting activities.
- Systematic long-term monitoring of the groundwater system such as springs flows, groundwater levels and chemistry would give a much better understanding of emerging trends and the resilience of groundwater to change.

Way Forward

To strengthen the evidence base the on-going flow and temperature monitoring of the springs sources is being undertaken by ISET-Nepal. There is urgent need for strategic monitoring and reassessment of the springs to identify long-term trends in mid-hills of Nepal.



For more information please contact Institute for Social and Environmental Transition-Nepal, Kathmandu. The final report can be accessed at websites of the organizations involved in the study.
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