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8th ASIAN REGIONAL CONFERENCE
May 2-4, 2018, Kathmandu, Nepal

Government of Nepal
Ministry of Irrigation
Department of Irrigation

Sustaining spring sources through evidence based interventions to augment irrigation in Nepal middle hills

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Friday, 4 May 2018

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Context

Voices from Banlek, West Seti

- Springs in the hills and mountains are drying
- Livelihoods are threatened
- A scientific understanding of mountain springs is missing
- Science-based interventions is needed to increase reliability and water availability in springs.

BCRWME project

- **BCRWME:** Building Climate Resilience of Watersheds in Mountain Eco-Regions
- Increase reliability of water resources for domestic use and irrigation in Far-West
- Implement interventions to increase water availability in drying springs.

CLEAN WATER FOR ALL

Trace natural spring water near your community

Improve the condition of the spring water and collect it into intake

Pipe it towards a water tap for everyone in your community

A SAFE COMMUNITY

Treat natural gullies and landslides eroding your hillsides

Brush layering is one technique preventing erosion and landslides

Feel safe together with your family and your community

A BETTER LIVING

Trace natural water resources to build irrigation ponds

Irrigate your land to grow fruits and vegetables

Increase your family income with your profitable yields

Source: BCRWME

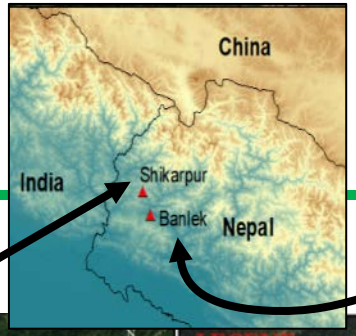
Objectives

- Understand the land and water processes in springsheds
- Recommend improved watershed intervention/management plans

Project Tasks

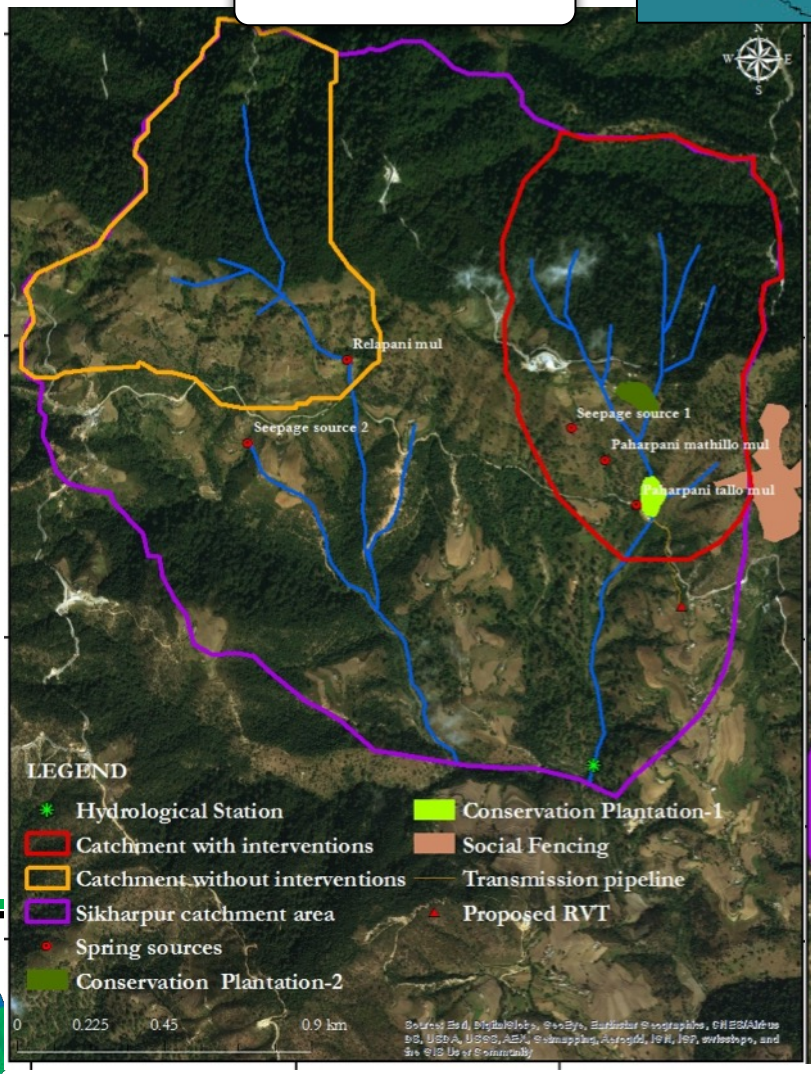
- Monitor climate & spring+streams
- Develop land-use land cover maps
- **Use isotope tracers**
- Model hydrological and land management processes
- Model and monitor watershed interventions

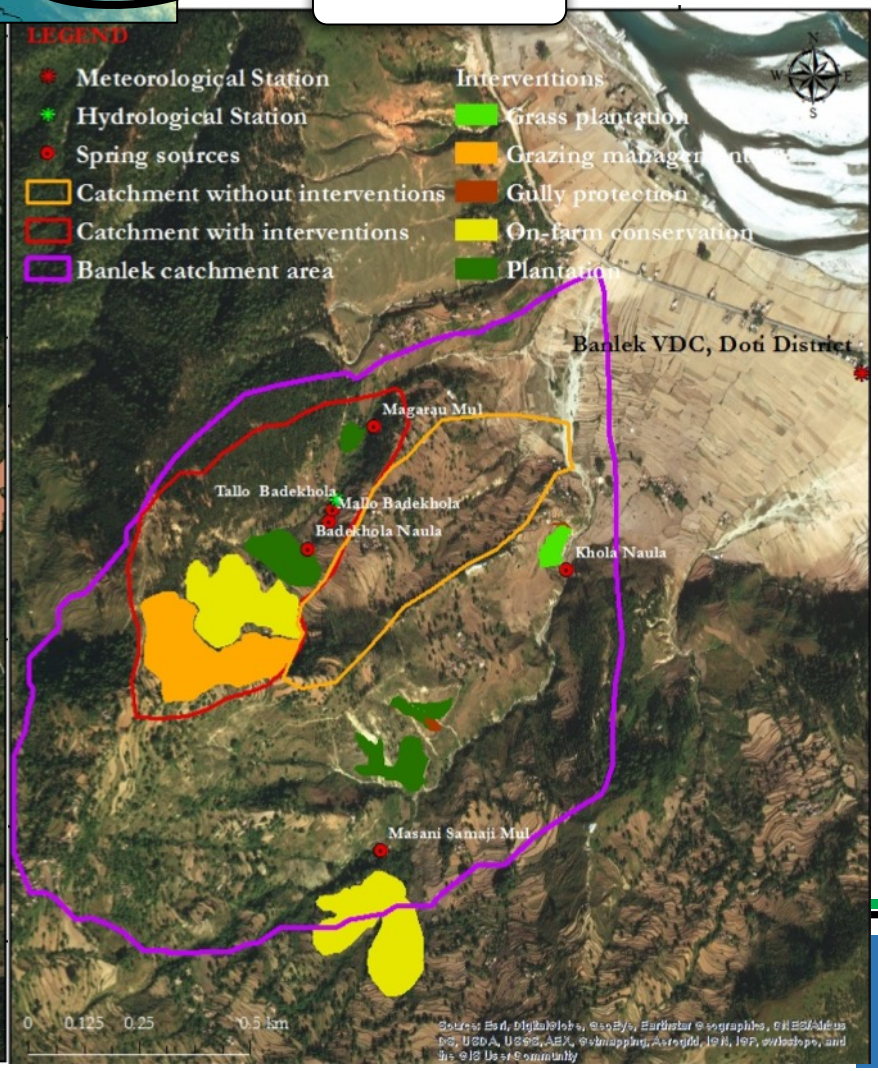
Study Sites



SHIKARPUR

BANLEK





Study Sites

	Shikharpur	Banlek
Catchment Area (km^2)	3.74	1.43
No. of Springs	3 out of 5 studied	4
Elevation range (m)	1812 - 2470	770 to 1215
Slope (degrees)	0.8 to 63	5.8 to 48.4
Intervention types	Conservation plantation and social fencing	**Recharge pond**, grass plantation, grazing management, on-farm conservation, gabion check dams
Spring water usage	Drinking, micro hydropower, agriculture	Drinking, cattle

Methods: Hydrogeological Survey and Process Model

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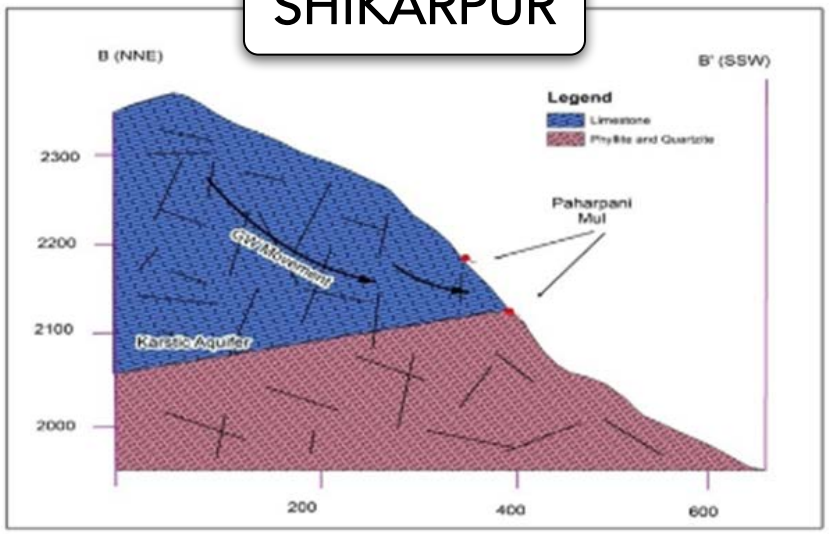

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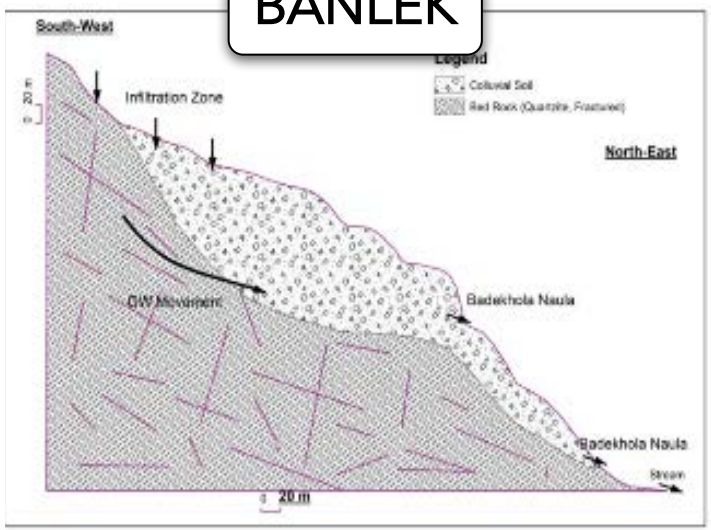

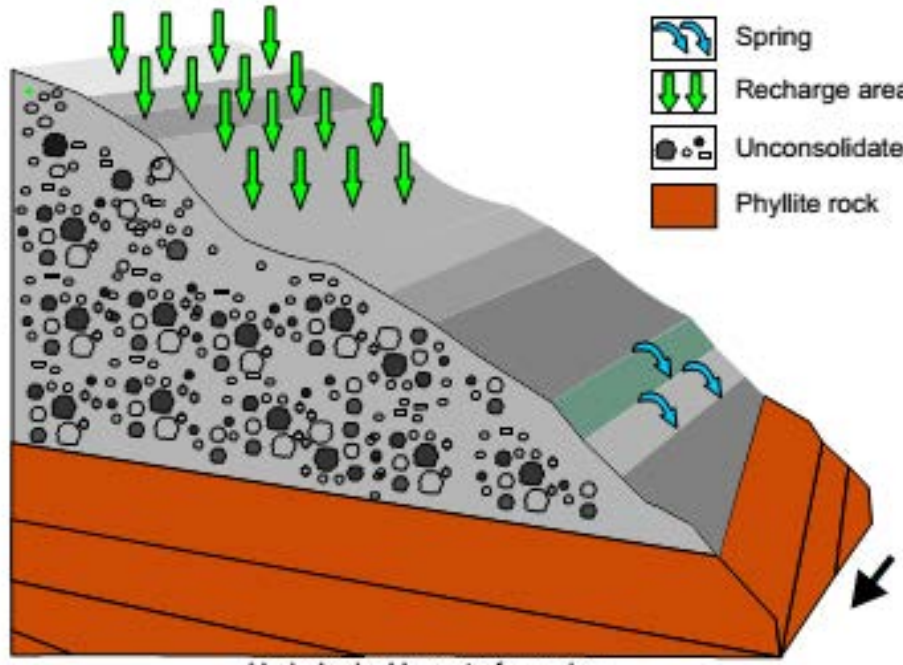

Hydrological layout of a spring

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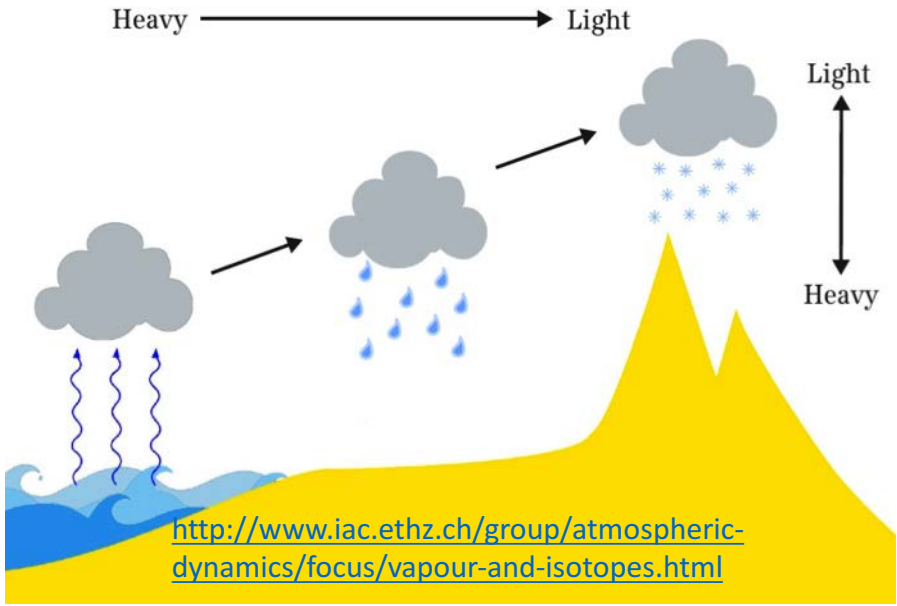
Methods: Isotope Analysis

- Water consists of isotopes of oxygen (^{16}O, ^{18}O) and hydrogen (^{1}H, ^{2}H)
- Isotopic composition of water changes in the water cycle from various processes (evaporation, condensation, altitude effect…)
- Isotope composition of water

depends on its source

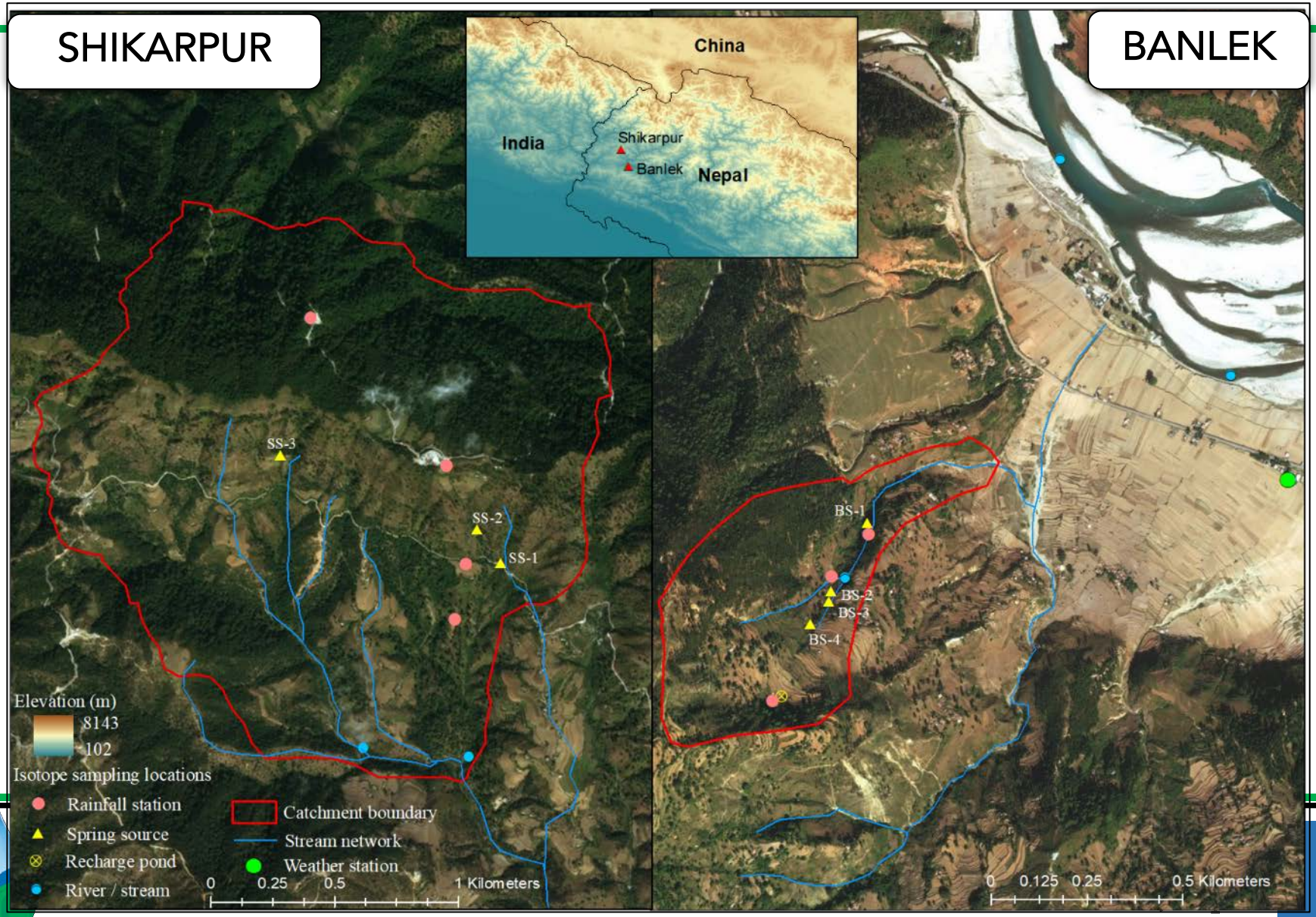


http://www.iac.ethz.ch/group/atmospheric-dynamics/focus/vapour-and-isotopes.html

Methods: Isotope Sampling

- Over 422 samples collected in 2 years
- Rainfall:
  - Every rain event (>5mm) at different elevations for both study catchments
  - Snow sample for all snow events in winter months
- Springs and streams:
  - Weekly samples from springs during monsoon and fortnightly during dry season
  - Weekly and fortnightly samples from streams and river

Methods: Isotope sampling sites



Results: Isotopic Composition of Rain Samples

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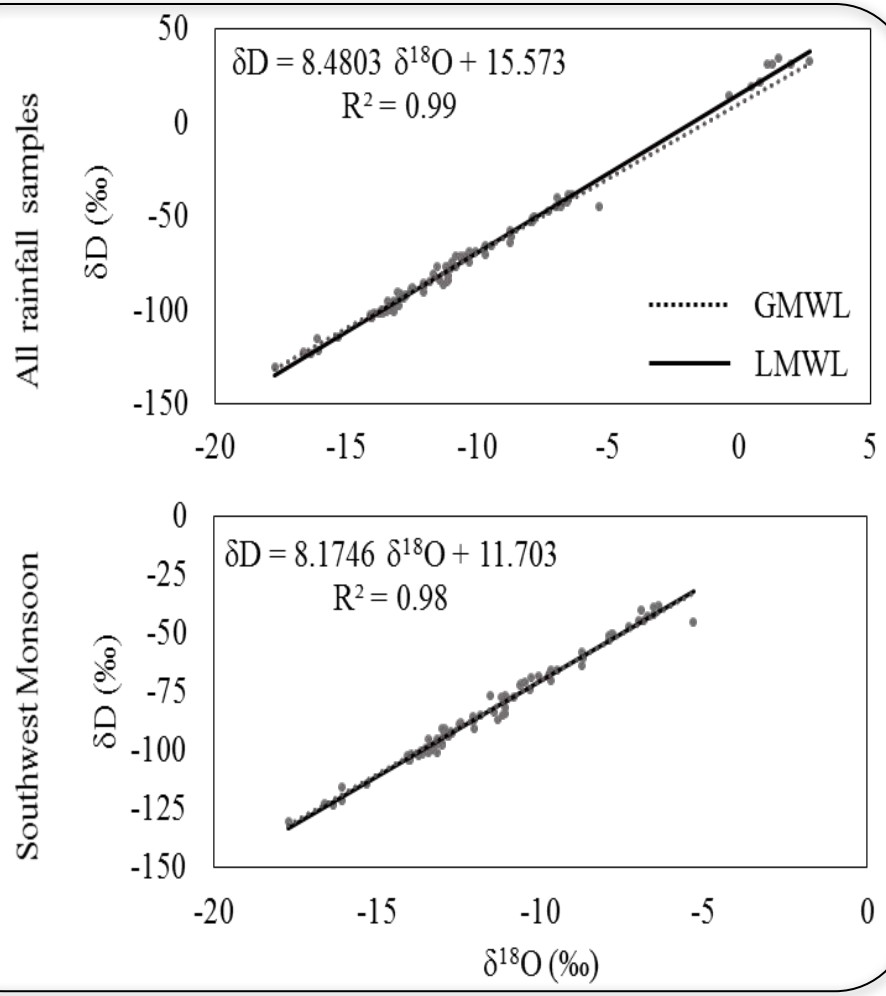

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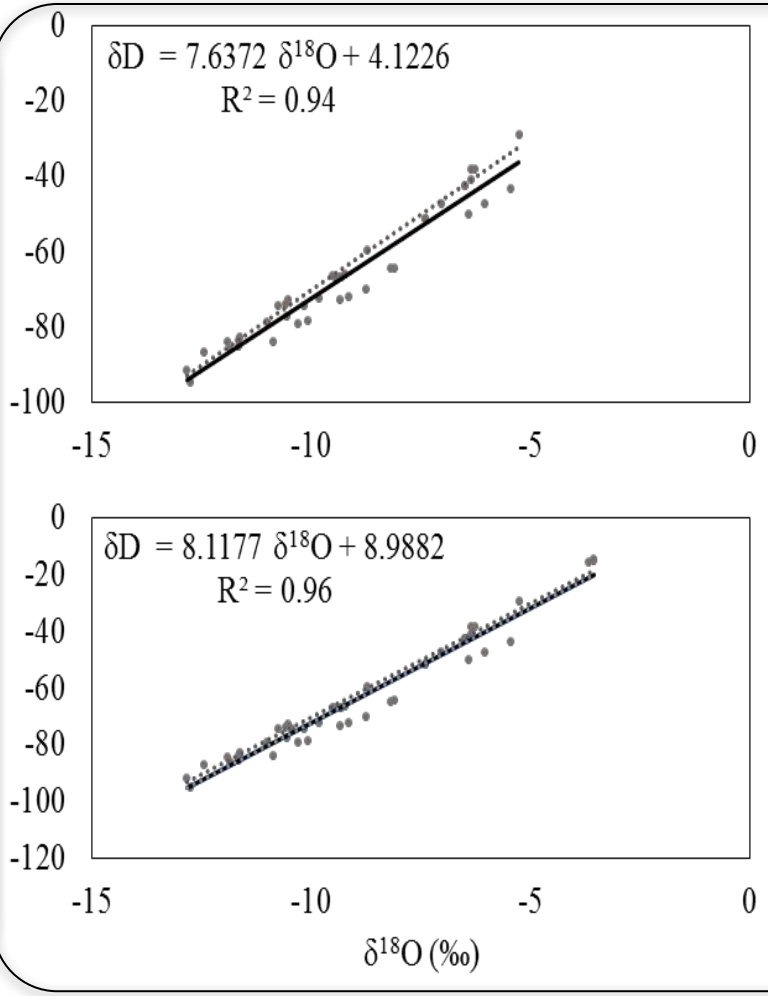
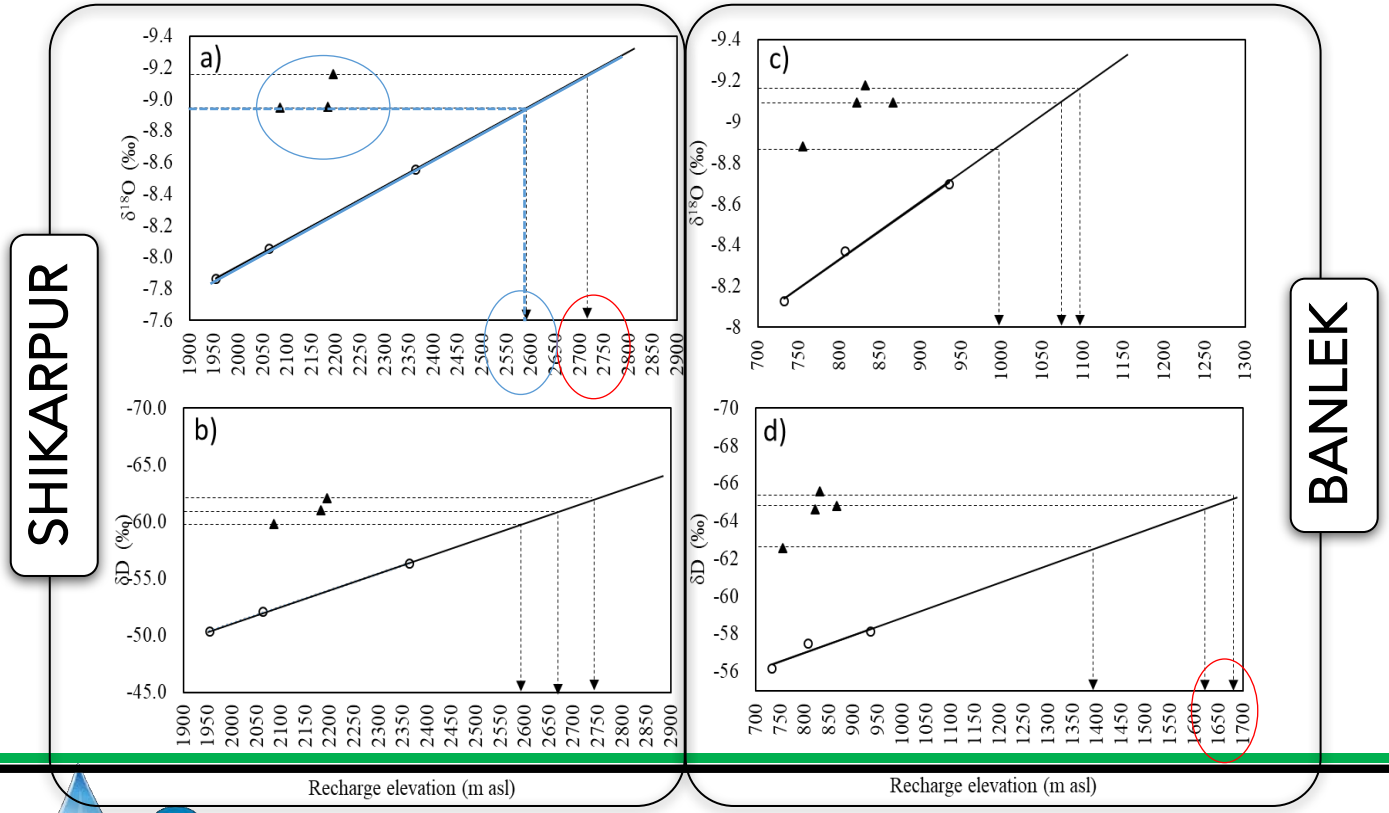


Results: Recharge Zones

- Recharge elevations identified from:
  - Altitudinal gradients for $\delta^{18}O$ and δD in precipitation
  - Average isotopic composition of spring water samples

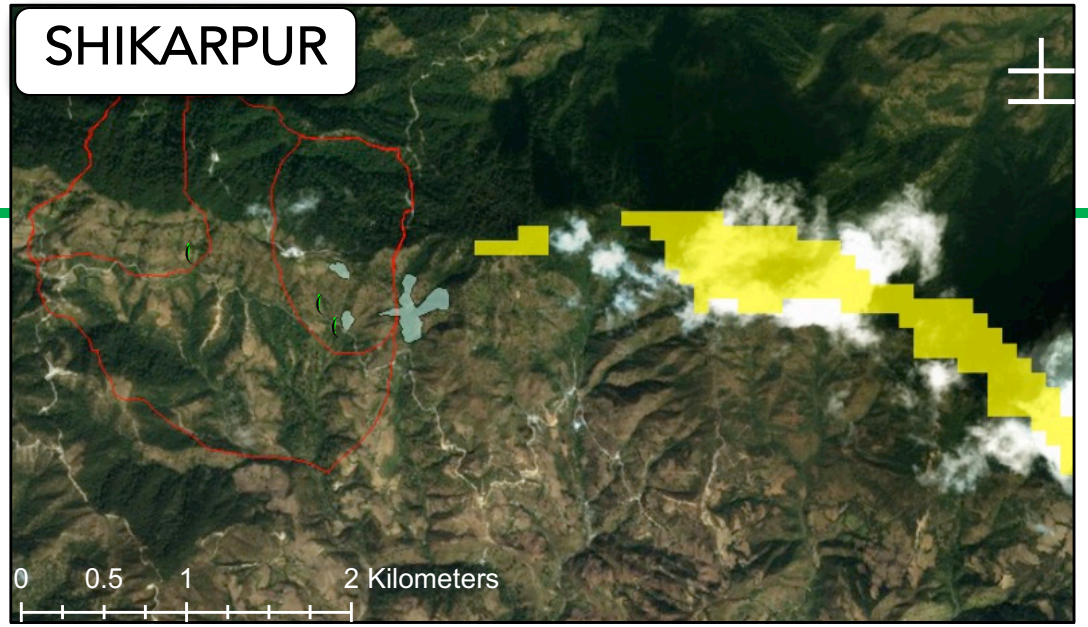


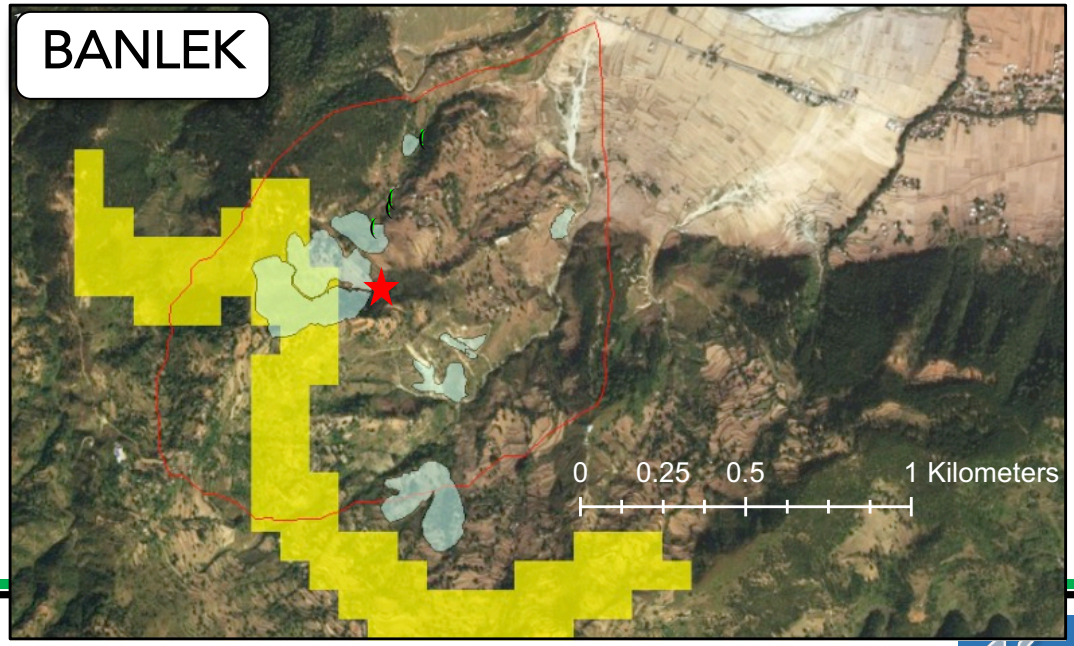
Shikharpur:
2600 – 2700 masl
Banlek:
1000 – 1100 masl

Unrealistic results for 3 springs:!!

Science-based Interventions

- Interventions in BCRWME:
  - *Afforestation, Recharge Ponds, Small Storage Tanks, Bioengineering for Gully Protection, Social Fencing, Source Water Protection etc.*
- Recharge pond is only viable in Banlek
- Location of existing recharge pond is not optimal





Spring sources
Catchment boundary
Planned interventions (BCRWME)
Recharge zones

Conclusions

- Isotope analysis successfully used to understand spring recharge and rainfall
  - Composition of rain samples show seasonality
  - Some springs show strong domination by rainfall
  - Feasibility of recharge pond demonstrated
- The estimated recharge elevation ranges for 2 springs each in Shikharpur and Banlek
- Remaining 3 springs are likely dominated by unconfined aquifer, with limited rain influence in the short run
- Spring catchment is different than surface water catchment
  - Look at landscape level; valley to valley approach

Forging Ahead

- Further validate isotope based recharge zones:
  - Model surface water-groundwater
  - Gather additional geophysical data
- Use isotopes to explore linkage with downstream groundwater activities
- Set up long term monitoring program to evaluate recharge efficiency
- Test method in additional sites to improve reliability

Acknowledgement

- This research study was initiated as part of the project - GRANT: 0358-NEP-**Building Climate Resilience of Watersheds in Mountain Eco-regions (BCRWME)** - Package 2: Watershed Hydrology Impact Monitoring Research project.
- All isotope lab analysis were conducted at the National Institute of Hydrology, Roorkee, Uttarakhand, India.

Collaboration between:

CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

LED BY: IWMI International Water Management Institute

DSCWM - CONSERVE SOIL AND WATER, PROMOTE GREENERY

Funded by:

Nordic Development Fund

ADB

CIF CLIMATE INVESTMENT FUNDS

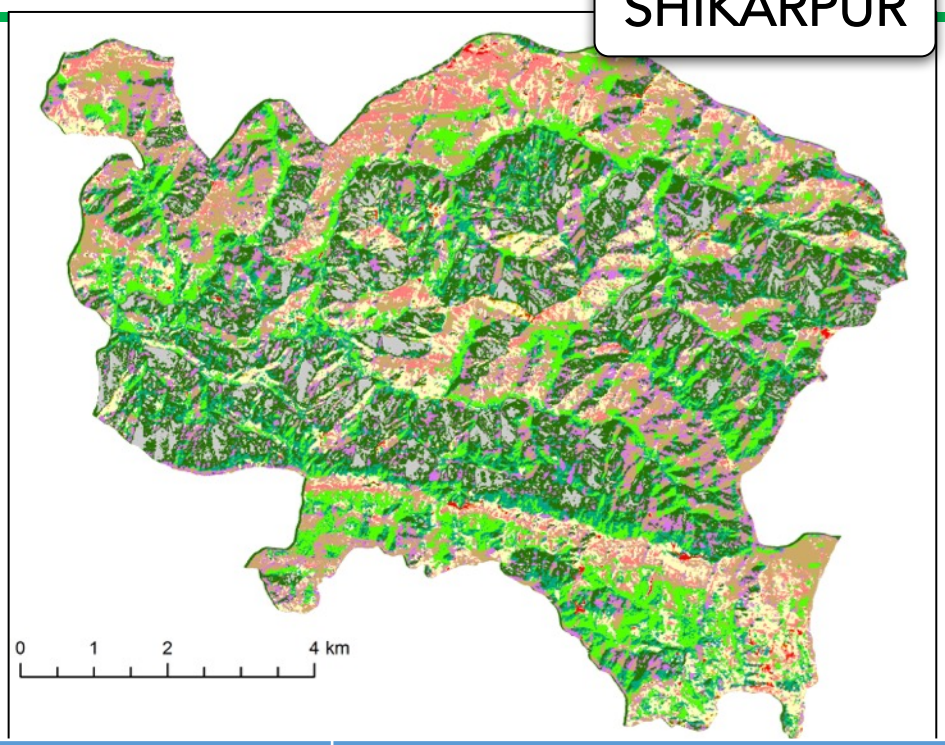

THANK YOU

Extra: Hydro-met Data Collection

- Two automatic meteorological and hydrological stations
- Manual monitoring of spring discharge

Extra: Land Use Land Cover Mapping

SHIKARPUR



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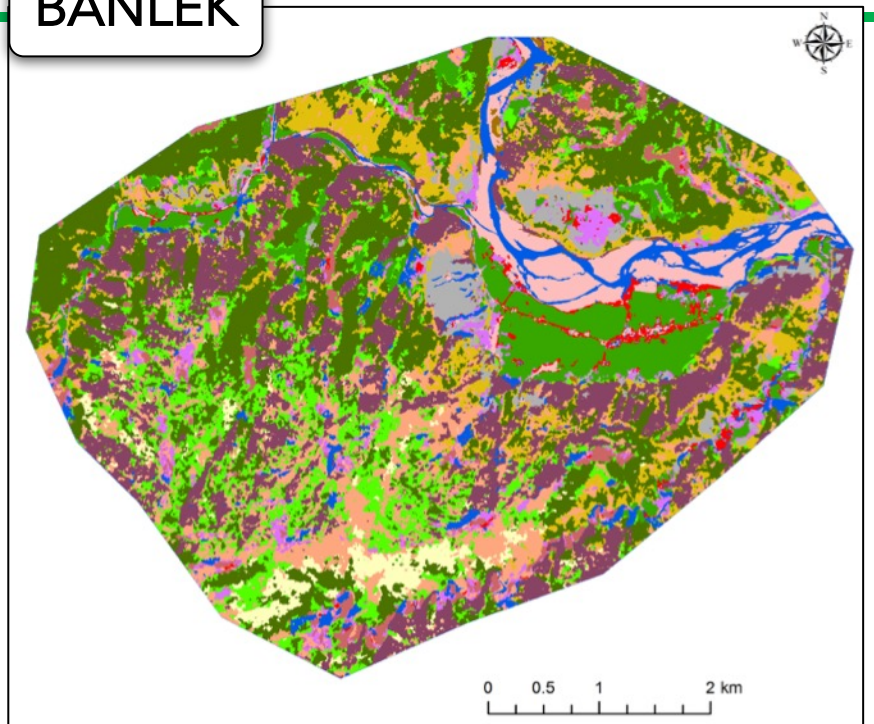
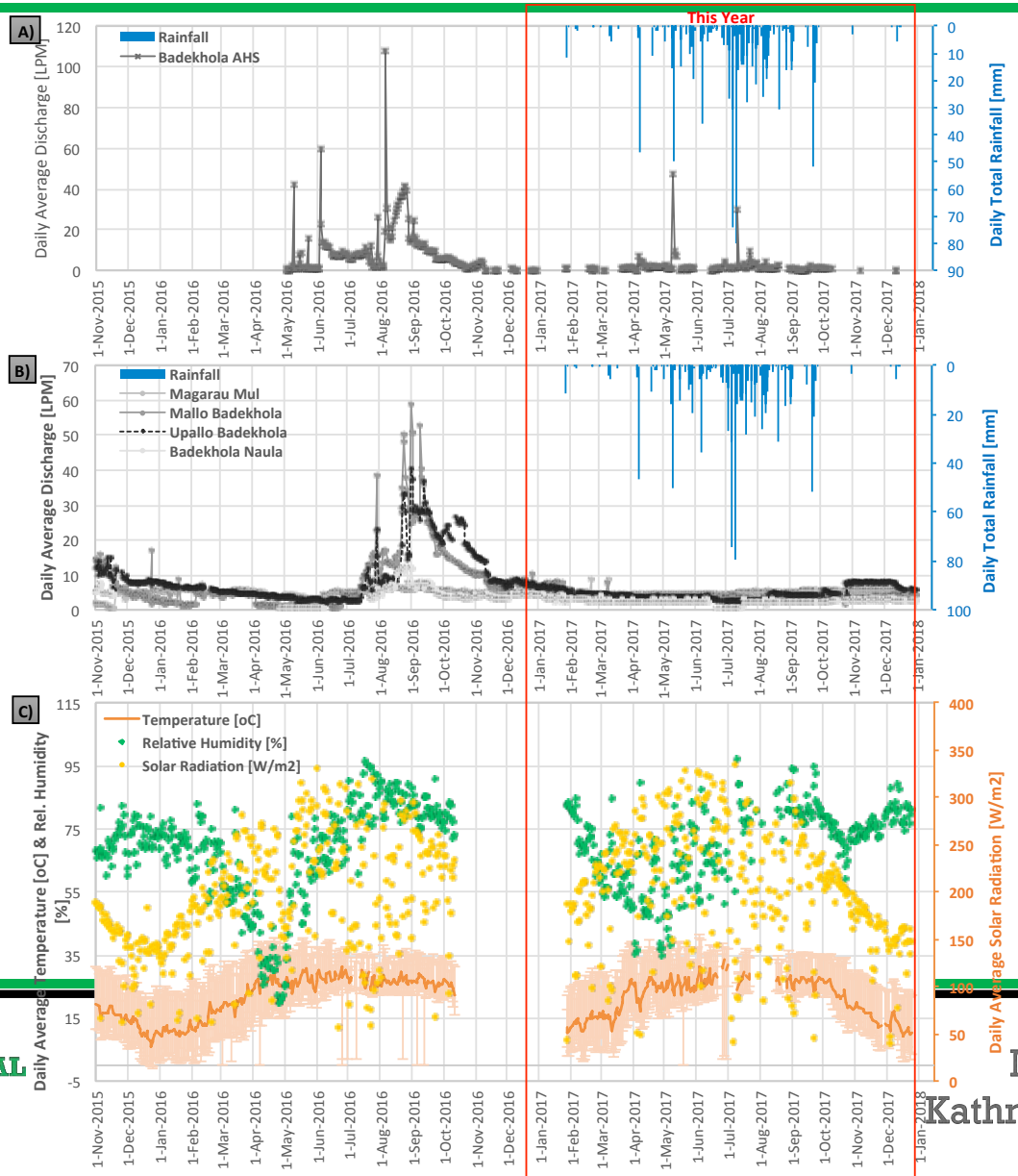


	Shikharpur	Banlek
Dominant Land Use Type	Forest area, cultivated land, earthen road, rock outcrop, barren land	Sal forest, Some mixed forest, cultivated land, barren land, earthen road, settlement
Land Based Intervention	Plantation and social fencing	grass plantation, grazing management, on-farm conservation

Extra: Hydro-meteorology in Banlek



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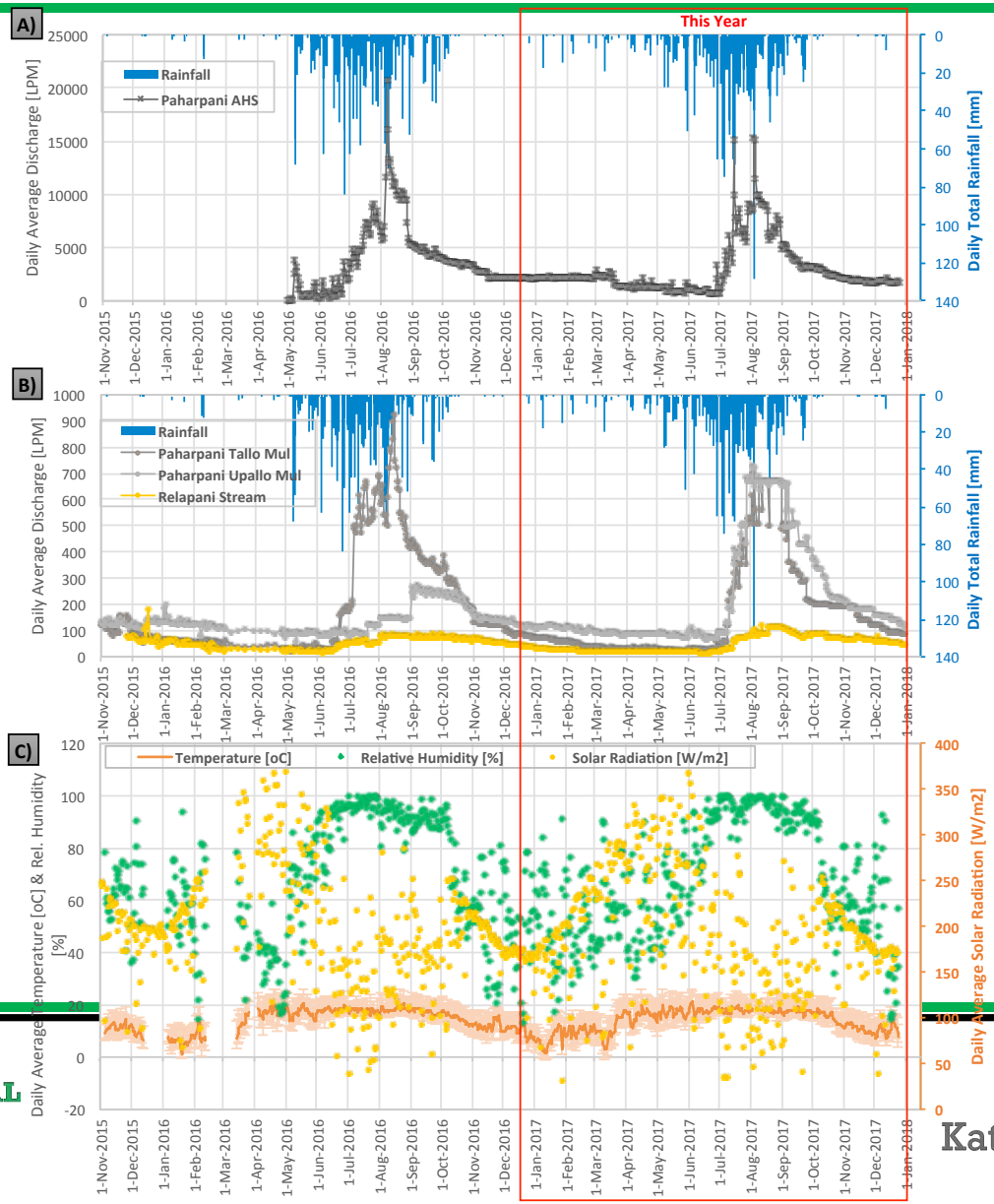

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