Springs and seepage are naturally occurring discharge features of groundwater flow systems through faults, fractures, joints and permeable layers under gravity (Valdiya and Bartarya, 1989).
Importance of hydro-geology

At any one instant in time, ground water is the largest single supply of fresh water available for use by human, in terms of storage (http://pubs.usgs.gov/gip/gw/gwgip.pdf).

As the geological formation changes so does the movement of water in springs, wells and its potential availability in an area.

- geology (type, distribution and permeability characteristics of geologic units),
- topography (landforms and relief), and
- climate (timing and amount of precipitation).

Influences the amount of water that occurs as surface flow versus the amount that infiltrates into the ground as recharge to groundwater (Kreye et. al 1996)

Mountain springs

Mountain springs emanate from unconfined aquifers (Negi and Joshi, 2004; Tambe et al., 2012a).

are fed by groundwater that accumulates in unconfined aquifers during the monsoon, turning the hills into water towers (Sharma et al., 2016).

As long as there is balance between recharge and outflow the water tower is sustainable (Sharma et al., 2016).
A Generalized water Tower and Ground water Dynamics in the middle mountains

Contd..

Mountains are among the most fragile environments on Earth (Sharma et al., 2009) as they are Urbanizing rapidly. The flow from many springs has lessened, permanent springs have become seasonal, and seasonal springs have dried up completely (Sharma et al., 2016).

**Major Threats**
- watershed degradation (Tambe et al., 2012b; Sada et al., 2013).
  - deforestation,
  - Population growth,
  - construction of roads,
  - Change in land use pattern,
  - encroachment of nearby spring sources
- Climate change (Tambe et al., 2012b).
Nepal-Country background

Nepal is a mountainous country formed by the collision of Indian tectonic plate with Asian plate. Nepal has young geological variations

About 2.27% of the world water resource

Extensive groundwater resources in Nepal

Increasing shortage of water after 1980s

Source: Hussain and Giordano, 2004

80% of rain falls during Monsoon (June-September)

Spring resource in Nepal

A major domestic supply in mid-hills of Nepal (Merz et al 2003; Bricker et al., 2014)

Dug well for community use
Problems!!

Much less attention is given to address the disappearance of spring resources. Springs are poorly understood and insufficiently mapped.

The precise relationship between precipitation and recharge, and actual extraction rates is hardly known in Nepal. (Sharma et al 2016)

Rapidly urbanization in mid-hills with an extension in their peri-urban area. (Agriculture urbanized)
The springs are drying up in mid-hills of Nepal because:

- diversion of water for irrigation because the cultivation pattern has changed requiring more than 60 % water (Pradhan et al., 2015)

- springs are localized which may or may not have direct hydrological links with river flows (Pradhan et al., 2015; Sharma et al., 2016).

- urbanization that increases demands for water for domestic, residential, industrial, recreation and dumping of wastes stressing peri-urban residents access to water in terms of both quality and quantity (Katul et al., 2012; Narain et al., 2013).

To fulfill their demand people are opting for alternatives water resources wells and deep boring especially in peri-urban area.
Recent findings in Nepal

Around 29% of the springs in Dapcha and 14% of the springs in Tinpiple of Kavreplanchowk district had dried indicating underground storage is decreasing (Sharma et al 2016).

Monsoon discharge of the springs is declining exacerbating the water security during the dry months (winter and pre-monsoon season) of the year with discharge less than 1 l/s from the study in Ramche and Nangi of Myagdi district and Madanpokhara VDC of Palpa District from western region (Bricker et al., 2014)

Reported decline of springs in Lubhu, Lalitpur district along with the decline in yield in the existing ones (Sada et al 2013).

In Jhaukel, showed that the discharge has declined in stone sprout and a spring in Nabala area and the average annual groundwater drawdown is 3.38 feet because of unauthorized sand mining, scraping out of the top soil by brick factories and over extraction of groundwater for commercial purpose (Shrestha et al., 2013) .
Findings from India

Mountain Springs are declining in India

Valdiya and Bhartarya (1989) found springs are drying up and recorded a decline in river discharge of Gaula River of Kumaun Himalaya from 25-75% due to deforestation.

Negi and Joshi (2002) used an approach of spring sanctuary to replenish the springs resources. The annual discharge rose to 12.5% in 1999-2000 from 7% in 1994-1995.

Spring discharge doubled during the dry season, from 1055 L/d in 1995 to 2153 L/d in 2000.

Negi and Joshi (2004) used an approach of rainfall and spring discharge relationship to understand behaviour of springs in Dugar Gad & Srikot Gad in Uttranchal.

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Tambe and others (2012a) showed that the spring discharge followed an annual, periodic rhythm with a spring discharge peaked during post autumn (September–November) at 51 L/min which declined to 37 L/min during winter (December–February) and to 8 L/min during spring (March–May), followed by a spike to 42 L/min (June–August) during the monsoons.
Conclusion

The spring discharge in a mountain watershed is controlled by rainfall, land use, hydrology and vegetation, and the geomorphology of the recharge zone hence, *geo-hydrological* approach is required for the identification of recharge areas for springs resource management (Negi and Joshi, 1996; Tambe et al., 2012a).