**Green Roads for Climate Resilience and Water Management**

Tailor Made Training

Dhulikhel, Nepal

# Road-side spring management during road construction and maintenance in mountainous and hilly areas

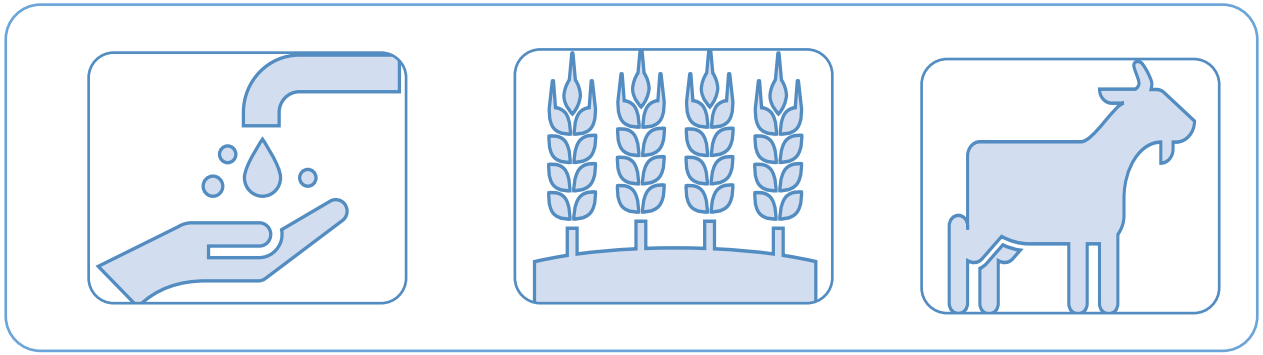

GREEN ROADS FOR WATER

META META

# Springs are important sources of water

## especially during the dry season

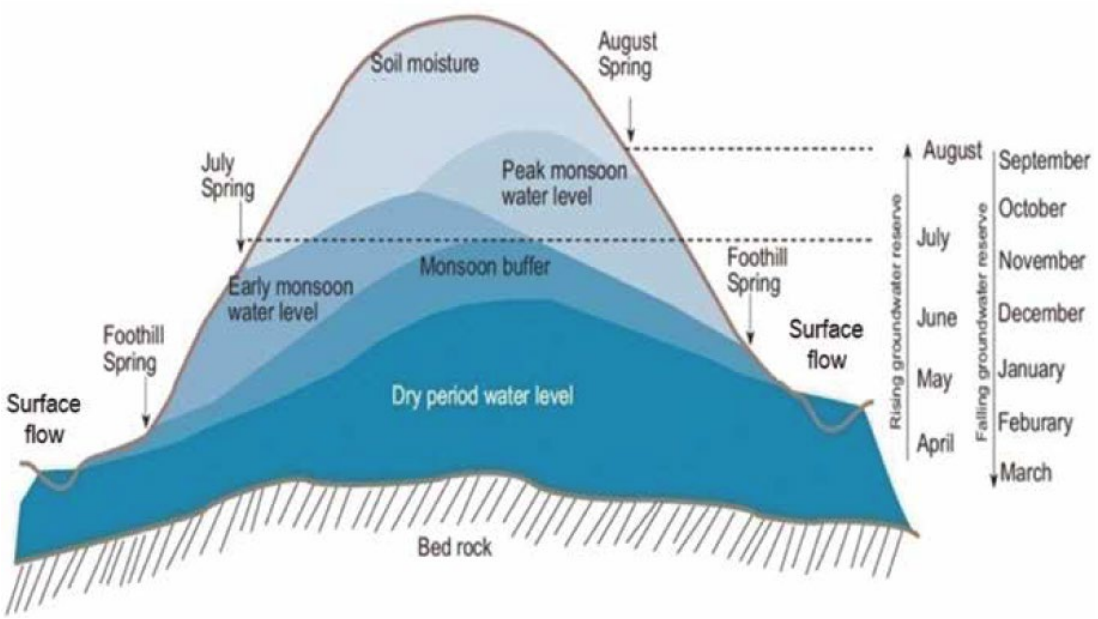
80% of the 13 million people who live in the hills and mountains of Nepal depend on spring water as their primary source of water



| Water for domestic purposes | Water for small scale irrigation | Water for livestock drinking water |
|---|---|---|

# How are springs created in the hills and mountains of Nepal?

- The source of the springs is rainwater, which infiltrates the soil and seeps through cracks and fissures in the rocks before accumulating underground above impervious rock layers.
- Water is stored both in the soil and in the rock fissures, effectively creating a 'water tower'.
- The water emerges where impermeable material blocks the groundwater flow and intersects the sloping ground, or where groundwater flows along a rock fracture and the fracture intersects the hill slope.



# Types of springs in the hills and mountains of Nepal

- **Dharo (or dhara):** Dharo' are free-flowing springs that emerge directly from the ground
- ***Kuwa:*** A 'kuwa' is a shallow pit dug to collect water that doesn't flow freely but seeps slowly out of the ground
- ***Inar or well***: When the volume of water in a kuwa goes down, people tend first to widen the pond and then to dig a deeper well called an 'inar', which they line with concrete rings
- ***Tyanki***: In some places, tanks ('tyanki' in Nepali) are built instead of wells to serve a similar purpose to an inar
- ***Polythene pipes***: This is more a method of conveyance than an actual spring.

Polythene pipe conducting water from a dhara

A covered inar

Water conveyed from a distant spring by polythene pipe

# Drying of springs

- ✓ **50% of perennial springs in the Himalaya have dried up or become seasonal**
- ✓ **Spring discharges have also significantly declined**

**Possible causes for the disappearance of springs:**

- Anthropogenic
  - Demographic changes
  - Increased water consumption
  - Changes in land-use (e.g., deforestation, grazing)
  - Neglect of traditional ponds that recharge groundwater
  - Infrastructure development
- Climate Change (changes in rainfall patterns)

# Road development affects the occurrence and flow of springs

**Road development causes springs' drying**

- The intensive and uncontrolled road construction of roads in mountain areas is opening mountain aquifers, causing a 'a drying by thousand of cuts'
- The uncontrolled development of wild springs and seeps during road construction could empty small aquifer systems
- Road development affects the sustainability of the existing fragile water supply systems


*Bleeding mountains, drying springs*

# Impact of road development on different types of springs

| Spring type | Description | Effect of road development |
|---|---|---|
| **Springs with concentrated discharge (through one or more orifices)** | | |
| **Fracture spring** | Faults, fractures, and cleavage in semipermeable and permeable formations connected with a water source (seepage, flow,, shallow or deep aquifer) | Road development may expose the spring; rock cutting may change the location of the orifices, either blocking old or creating new ones. |
| **Contact spring** | Permeable layer overlays an impermeable layer, forcing water to come out, often in a line of springs | Road may distort the outflow of the spring, causing orifices to be blocked or new ones to be created; highly dependent on geological faulting. |
| **Fault spring** | As a result of geotectonic movement, a permeable layer is moved on top of an impermeable layer | Road may distort the outflow of the spring, causing orifices to be blocked or new ones to be created; highly dependent on geological faulting. |
| **Depression spring** | The groundwater table reaches the surface in topographical low point | Road may create new depression springs where the roads are made in cut, or dry existing springs by lowering the groundwater table. |
| **Karst spring** | Relatively large flow from large openings, typically in karst areas where water erodes the calcium formation | Roads may expose new springs and expose new cavities. |
| **Springs with diffuse discharge** | | |
| **Seep** | Diffuse direct discharge of water, usually from soils or unconsolidated sediments (sand or gravel) | Road development may create many seeps, especially where roads are developed in areas with deep soil profiles. |
| **Secondary springs** | Water issued from a primary spring that is typically covered by debris or rock fall | Road development may expose springs or change the outlet, particularly where unconsolidated material is removed. |

# and vice versa: The development of springs during road construction damages the roads

**Spring development during road construction causes also road damage**

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by destabilizing or by creating depressions on the roads that grow during the monsoon and cause uncontrolled and erosive run-off from road bodies


**Therefore, the management of roadside mountain springs is a double must:**

- Safeguarding the quality of roads
- Ensuring water supply in the hilly and mountain areas

# A systematic connection between road development and spring management is needed

By working together with local communities on mapping the existing springs and seeps

By capturing the springs and seeps and guiding them with proper systems including underneath road drainage systems and finally converting them into productive water sources


By using the manual labor method (than mechanized method) in order to preserve the springs when building roads in sensitive areas

# Recommended good practices for roadside spring management

| Spring Type | Description | Spring management |
|---|---|---|
| **Spring with concentrated discharge** | Not used | Retaining wall with weep holes or with longitudinal drain to collect excess water and traverse drains (French mattresses) underneath the road |
| | Used for agriculture | Retaining wall with longitudinal drain to collect excess water and traverse drains (French mattresses) underneath the road |
| | Used for domestic water supply | Spring box (captage) and conveyance to benefit community, or tap fitted on protected spring |
| | Used for domestic water supply and storage | Spring box (captage) and conveyance to benefit community. Include possibility of spring closure (tap) to store water inside the mountain aquifer (especially in karst areas) |
| **Spring/ seep with diffuse discharge** | Not used | Develop road drainage in up-road section to collect seepage and convey to safe place |
| | Used for agriculture | Use gravel section in road to convey water to agricultural land |

# Step-by-step methodology for springshed management

1. Comprehensive mapping of springs and spring sheds
2. Data monitoring system: setting up of rainguage station at springsheds
3. Understanding governance aspects for spring and springshed management: Local community will be key to this. Focus on community spring management approach for long term sustainability of springs and springshed management
4. Hydrogeological mapping
5. Classifying spring types, identifying mountain aquifer and recharge areas: Delineating recharge area
6. Developing springshed management protocols: Developing institutional mechanism for operation and maintenance and conservation of intervention related to recharge, springsheds and springs. This will help the institution for operation and maintenance of springs and springsheds
7. Continuous monitoring and see the impact

# Successful examples

Roadside Spring Management in Northern Ethiopia had benefited the rural communities but also have improved the road quality and reduced the road maintenance costs

https://www.youtube.com/watch?v=8JjTxOFezpc&feature=emb_logo&ab_channel=GlobalResiliencePartnership

# Successful examples

*Roadside spring opened after road construction in Tigray, Mulegat (Ethiopia)*

*Roadside spring opened after road construction in Tigray, Mulegat (Ethiopia)*

# Thank you!

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