Green Roads: Experience from Nepal

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Presenter: Saroj Yakami – Country Coordinator/Program Manager at MetaMeta Nepal

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GREEN ROADS FOR WATER

META META

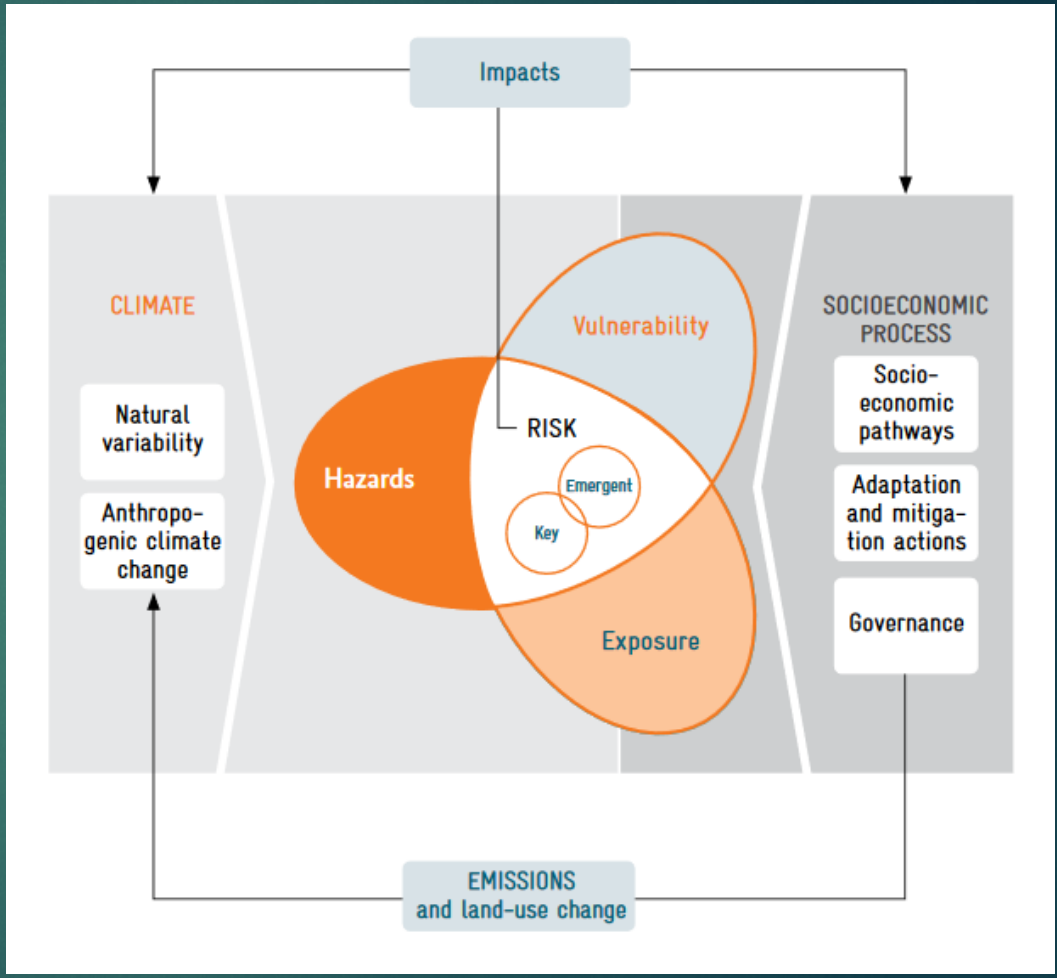
IRF GLOBAL

Green Future Farming

GLOBAL RESILIENCE PARTNERSHIP

Flood-Based Livelihoods Network Foundation

Risk is a result of the interaction of **hazard**, **exposure** and **vulnerability**. (IPCC AR5)



Mountain Roads and Climate Risk: the special connection:

- Roads feature prominently:
- 1. roads increase **exposure**;
- 2. as **vulnerability factor**: roads can be a lifeline that can be broken;
- 3. in terms of **risks: roads** accelerate **climate impacts**:
  - **erosion**
  - **flooding**
  - **microclimate**
- 4. but green roads can also be a major **adaptive measures!**

They change the hydrology

New road water crossings

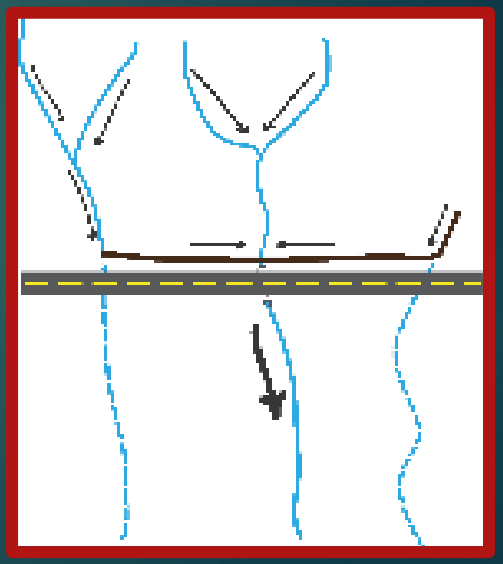
- Streams and torrents – create shutes and crossings

Changing surface run-off

- Surface run-off interrupted
- Road surface accelerates/ concentrates run-off

Changing sub-surface flows

- Moisture flow interrupted
- Springs disturbed



Effects:

Disturbed flows

Erosion

Damage to road surface

They change the micro-climate

- Hydrology disturbed (see above), less capacity to retain water
- Soil exposed to sun-light in road cuts – drying up
- Moisture bleeding from cuts (gully effect)
- Less canopy - more exposure to sunlight
- Roads as wind tunnels

Effect:

- Drying of forested slopes

They change the sedimentation

- Erosion during/ just after road construction
- Erosion from less stable slopes
- Sedimentation from road surface
- Erosion in road drains

Effect:

- More sediment in streams and water bodies
- More sediment washed in fields (the more so in early years)

Many things we can do

Good road building practice

Careful choosing the alignment

Special measures

General good road building practice

Gradual road slope – avoids roads developing into drains

Gradual outward slope of road - no run-off accumulation

Adequate road drainage

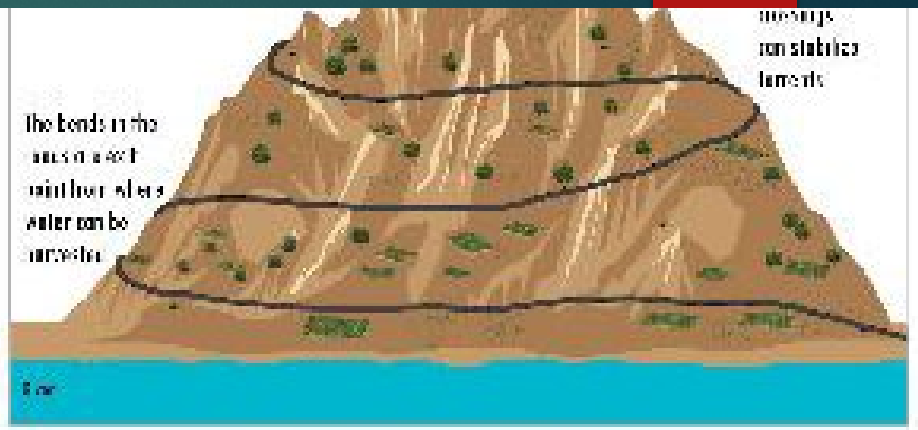
Multi-year approach - road consolidation over years

Labor based approach – attention for detail. care for springs, careful use of spoils

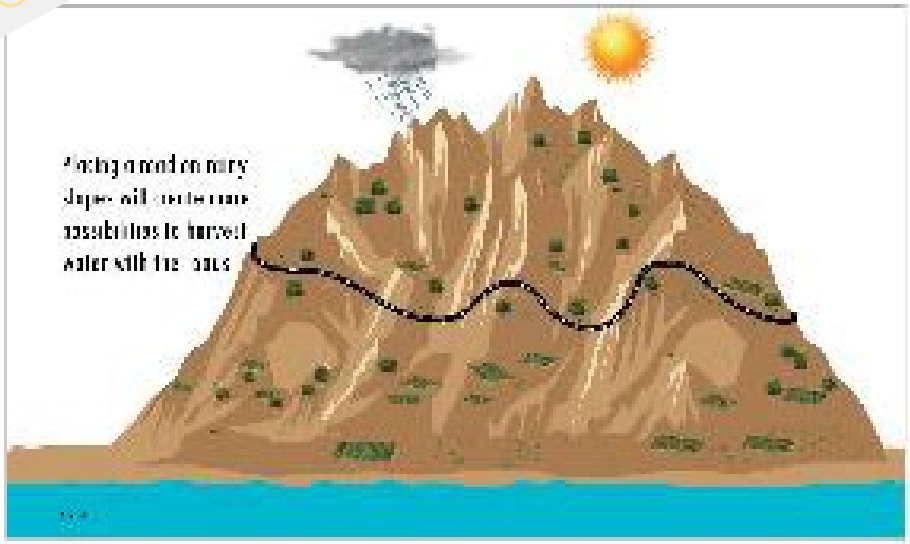
Reuse of spoils

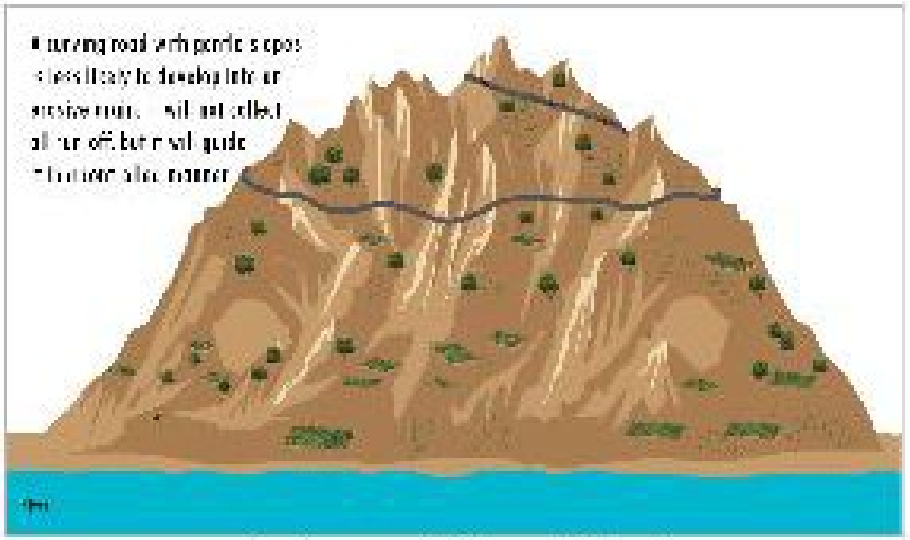
Use of bio-engineering

(1) Placing the Road High, Mid or Low Hil



(2) Choosing Road Alignment





Special measures

1. Management of springs and seeps
2. Controlled road water crossing
3. Water harvesting
4. Adequate and productive road drainage
5. Stabilization and water storage with road causeways
6. Slope protection and water retention using the spoils
7. Trap road sediment

1. Management of roadside springs and seeps

In mountain areas of Nepal springs and seeps major source of drinking water and agricultural water

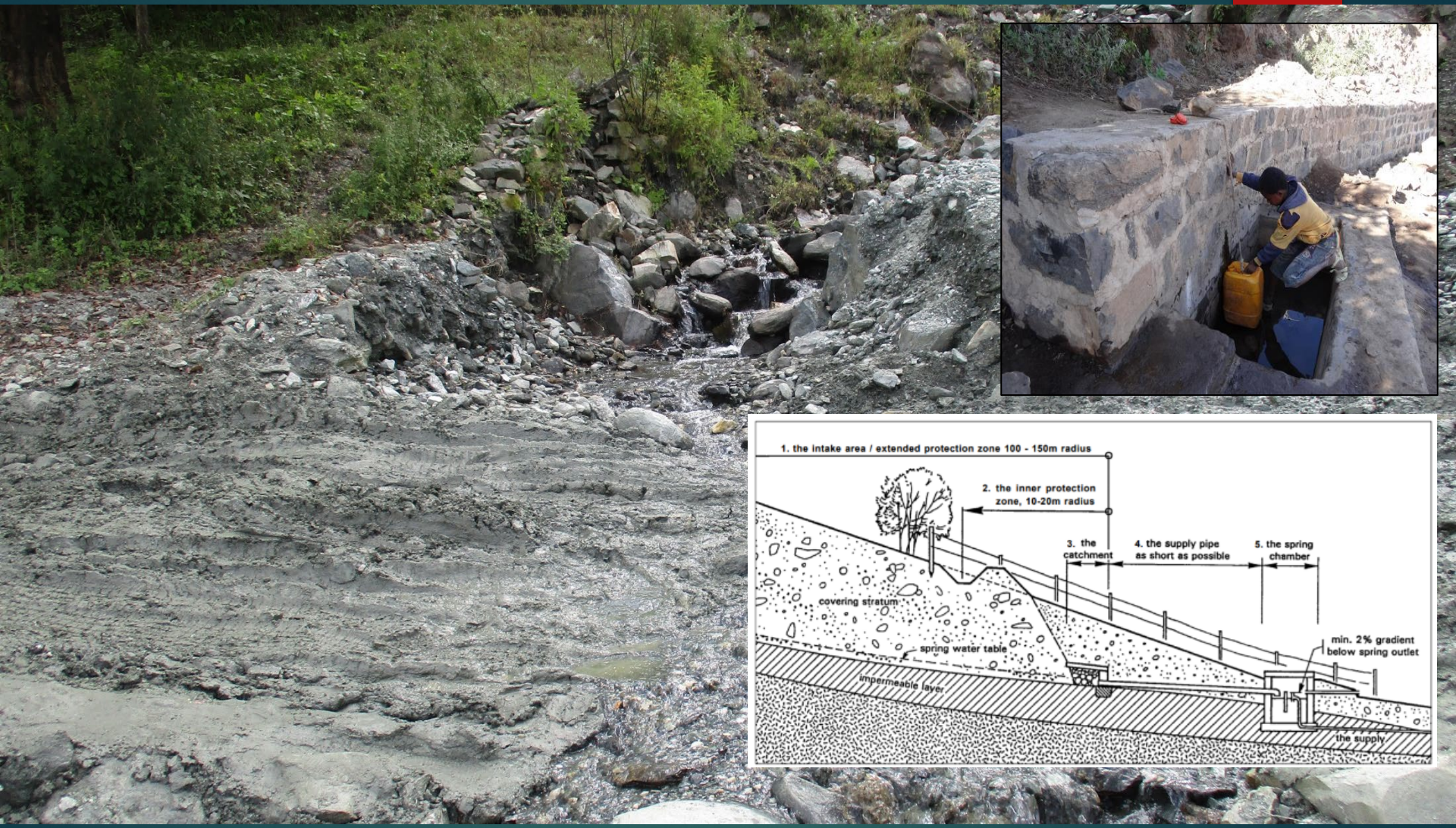
Often opened up or disturbed by road development

If not taken care of will damage the roads

Spring management for road protection, drinking water and agriculture

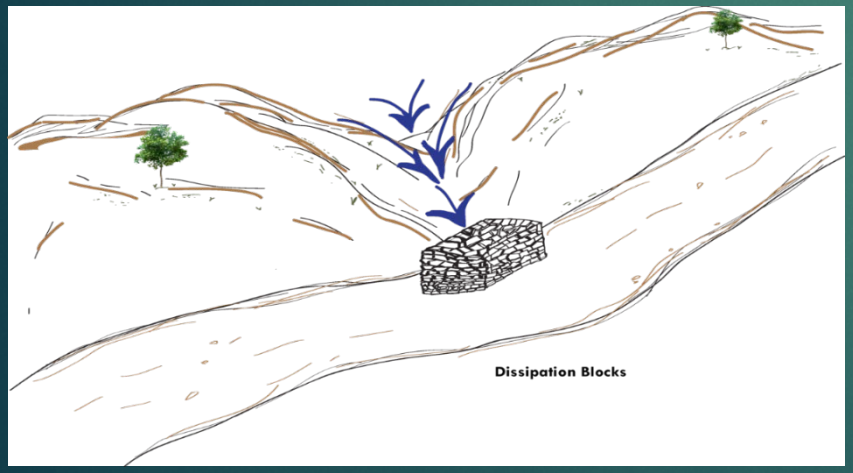
- Collection
- Protection (spring box)
- Road crossing
  - French mattresses
  - Pipes

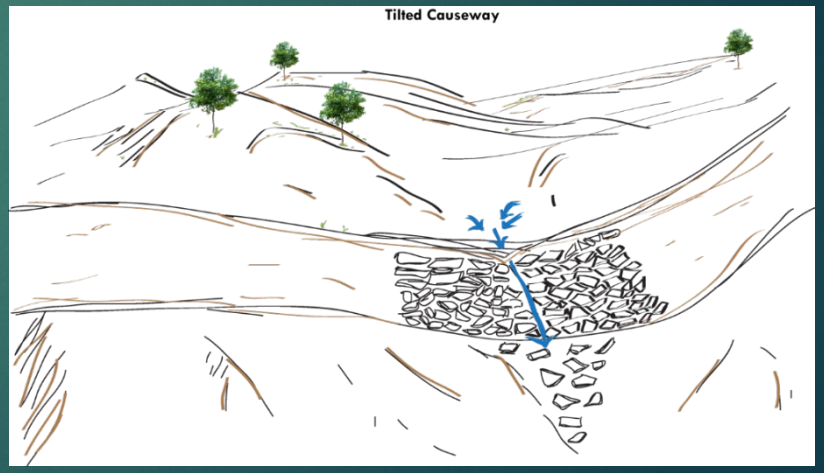
Spring Type	Description	Spring management
Spring with concentrated discharge	Not used	Retaining wall with weep holes or with longitudinal drain to collect excess water and traverse drains (French mattresses) underneath the road
	Used for agriculture	Retaining wall with longitudinal drain to collect excess 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


1. the intake area / extended protection zone 100 - 150m radius
2. the inner protection zone, 10-20m radius
3. the catchment
4. the supply pipe as short as possible
5. the spring chamber
covering stratum
spring water table
impermeable layer
min. 2% gradient below spring outlet
the supply

2. Controlled road water crossings

- On regular streams and torrents
- Break water speeds with baffle heaps
- Coarse stone causeways





3. Water harvesting from roads

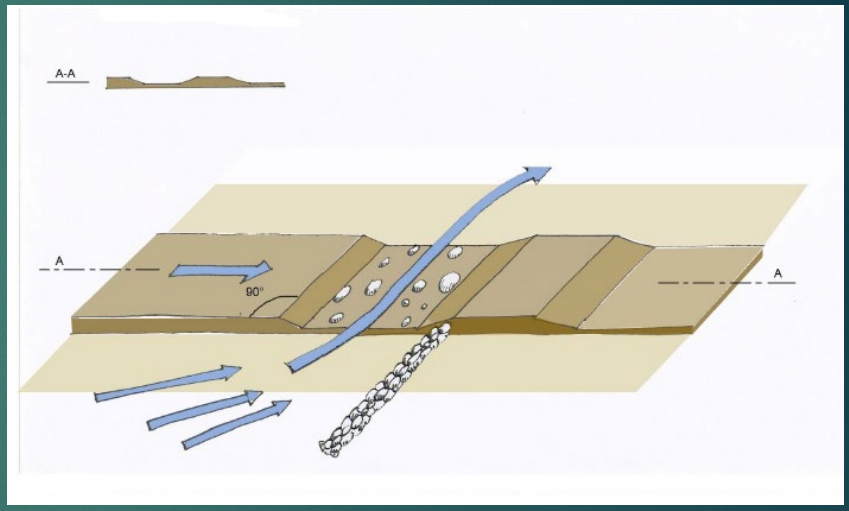
- Road side (lined) storage (concrete, geo-textile, clay) contribute to horticulture or stock water

- Guide spring water or road water to areas of use

Better routing of road run-off for water harvesting

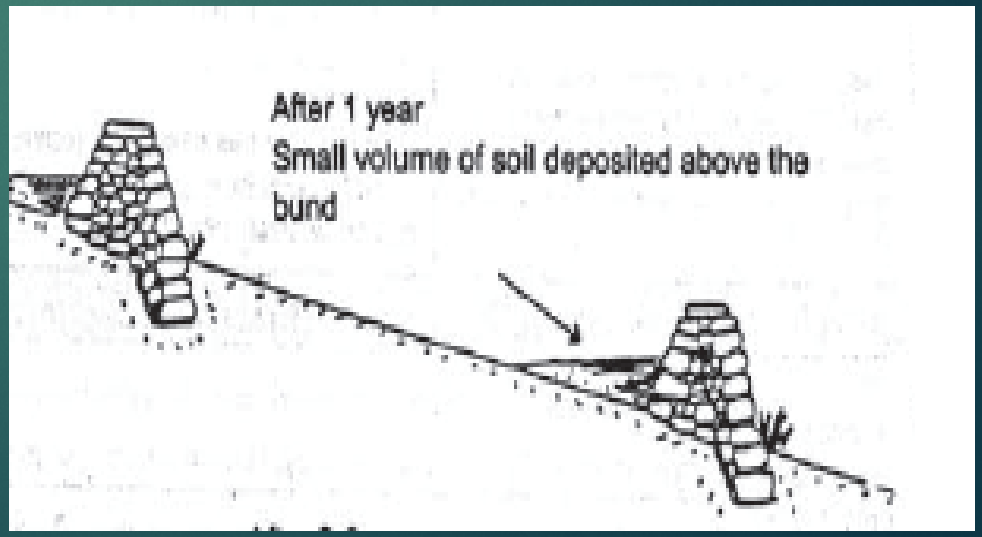
4. Adequate and productive road drainage

5. Stabilization and water storage with low causeways and platforms

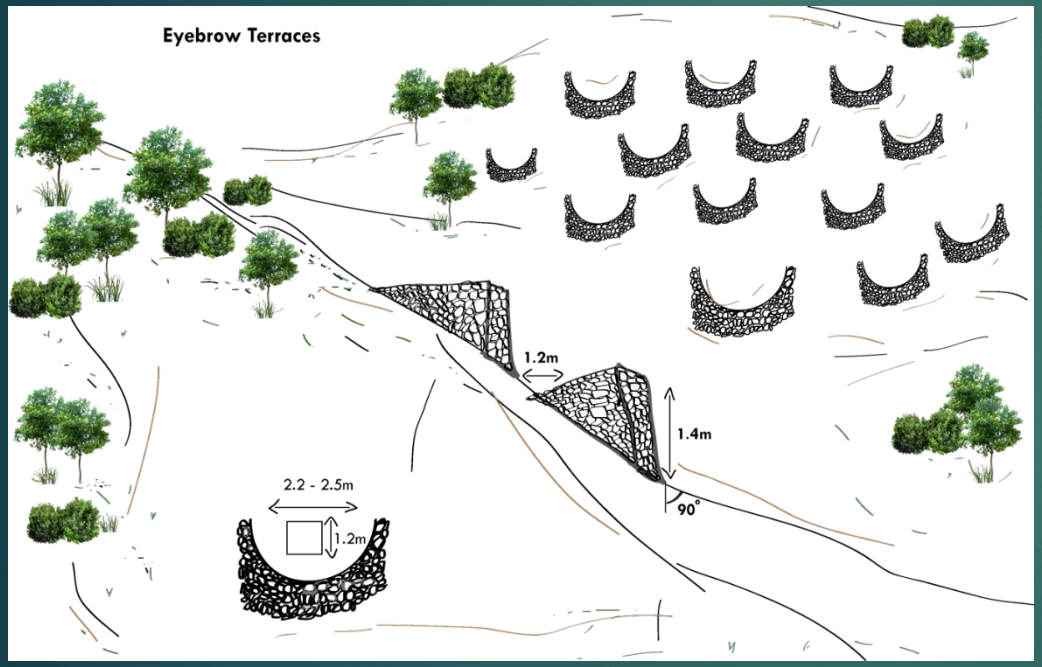


6. Slope protection and water retention using spoils (microclimate change)

- Reduce risk of erosion, degradation of forest hill slopes, re-greening
- Several useful techniques
- Use of eyebrows/ half moons] terraces
  - Semi-circular walls, open in run-off directions
  - Use abundant spoil material
  - Reinforced at back side
  - Infiltration pit
  - High density of eyebrows
  - Capture soil for regreening
- Use of stone bunds

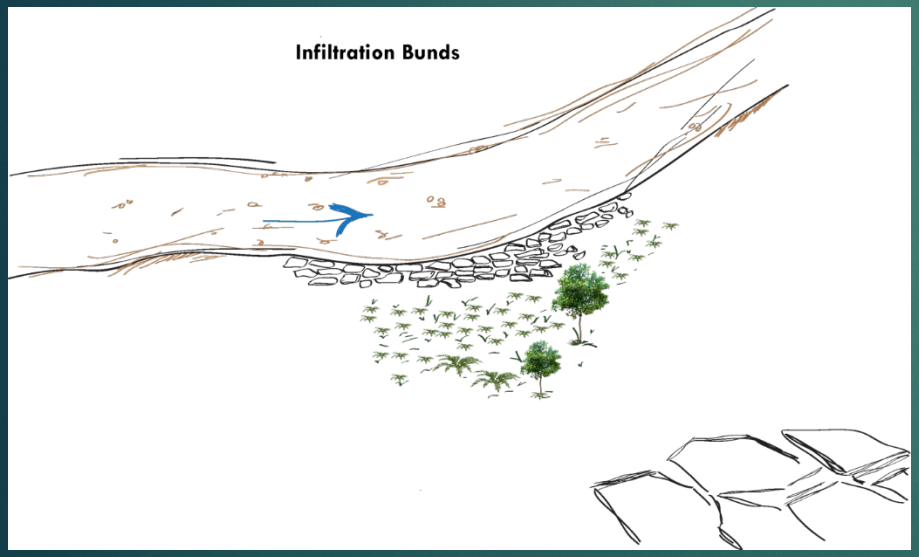


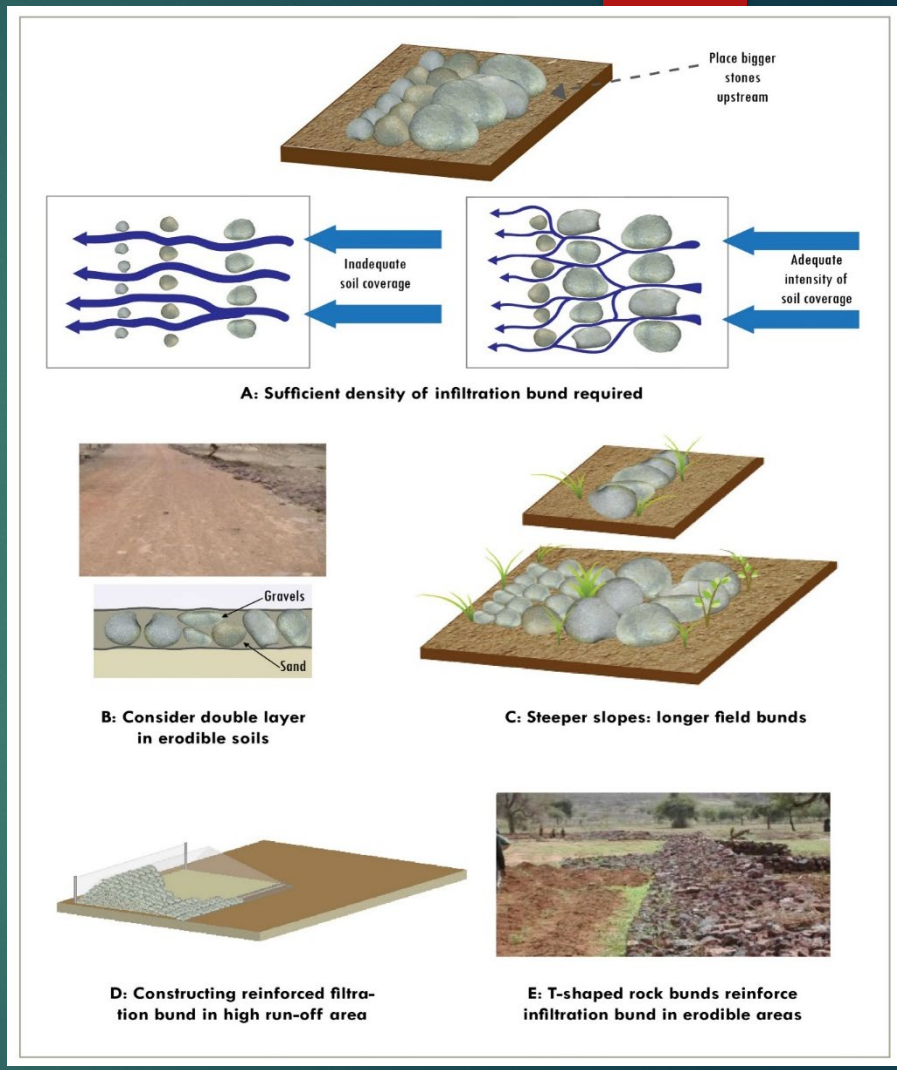
6. Slope protection and water retention using spoils - halfmoons on steep slopes



7. Trap road sediment for farmland

Infiltrating bunds on downside road shoulder, using road spoils (flat stones)





NEPAL: CHALLENGES IN ROAD CONSTRUCTION - TERAI

River embankment and sedimentation leaving little space for water to flow.
Problems of flooding, washed away bridge apron and blocked culverts.

1. Roads and floods

Major rivers, heavy monsoon

High silt loads, tendency to shift

Regular flooding

What can we do:

- give enough space to the river

- do not choke the river with bridges

- avoid uncontrolled breaches by low height roads with controlled overflow

- make sure roads do not cause waterlogging by blocking drainage paths

- use roads for evacuation and temporary relief


2. Groundwater management

2. Roads and groundwater management

Groundwater tables are high and reliable – much recharge and relatively porous soils

It is the ‘treasure’ of the Terai

Monsoon paddy needs reliable groundwater tables:

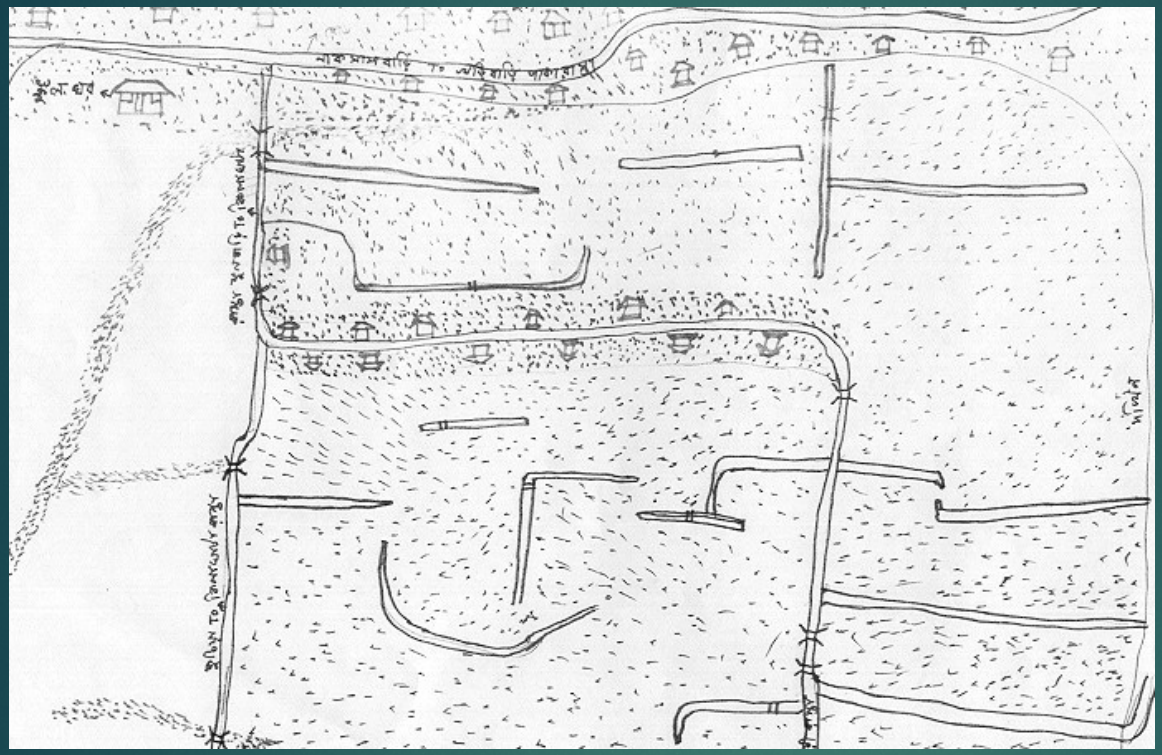
- avoid gullies and promote gentle recharge

- Stabilize ground water tables

What can be done:

- control groundwater tables with bridge sills

- spreading of rain run-off with bunds and smaller roads



Connect run off spreading bunds to local roads to slow down run off and increase infiltration

3. Agricultural water management

3. Roads and agricultural water management (rice)

Paddy is main crop – controlled water level is very important – separating high and low land

Productivity improves with better drainage and storage

Especially new monsoon rice varieties in South Asia need water management i.e. retention and removal of water – local roads are fit for this

What can be done

- Making local roads on the contour line separating high and lowland
- Use borrow pits for drainage and storage
- Use small roads and gated culvert to control water in the fields
- Use roads to divert water

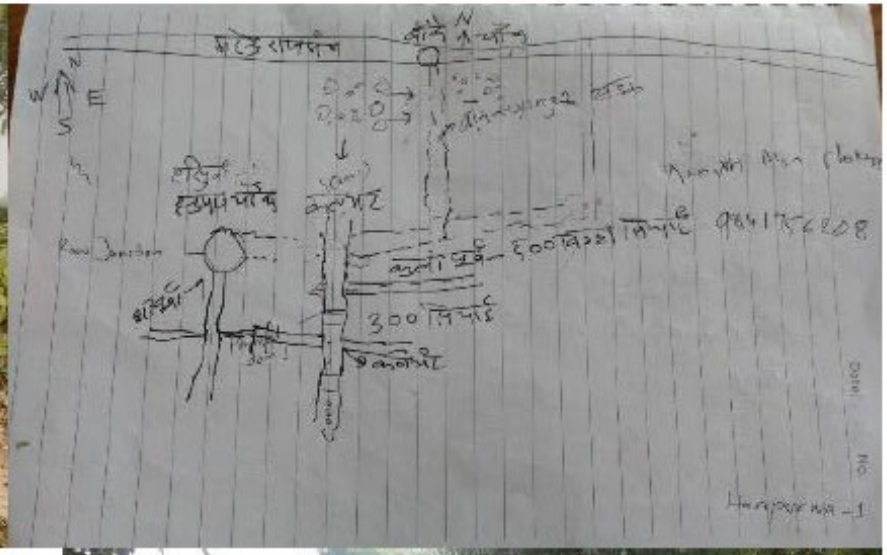
NEPAL: OPPORTUNITIES IN ROAD CONSTRUCTION - TERAI

Cross-culvert and side drains used to harvest water for farming

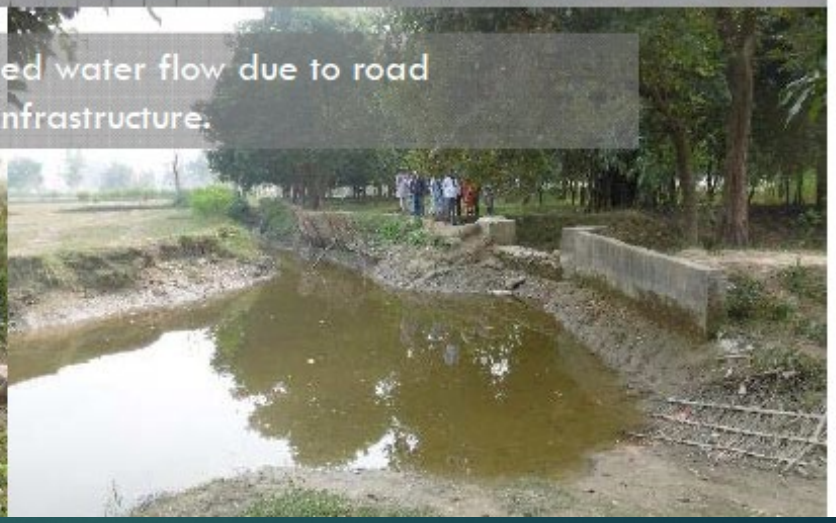
Water stored in succeeding ponds

Gated culverts for water management

NEPAL: OPPORTUNITIES IN ROAD CONSTRUCTION - TERAI



Farmers have tapped into increased water flow due to road construction. Making use of road infrastructure.



Thank you!

For more information contact :
www.roadsforwater.org
fvansteenbergen@metameta.nl
adeligianni@metameta.nl
syakami@metameta.nl

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