

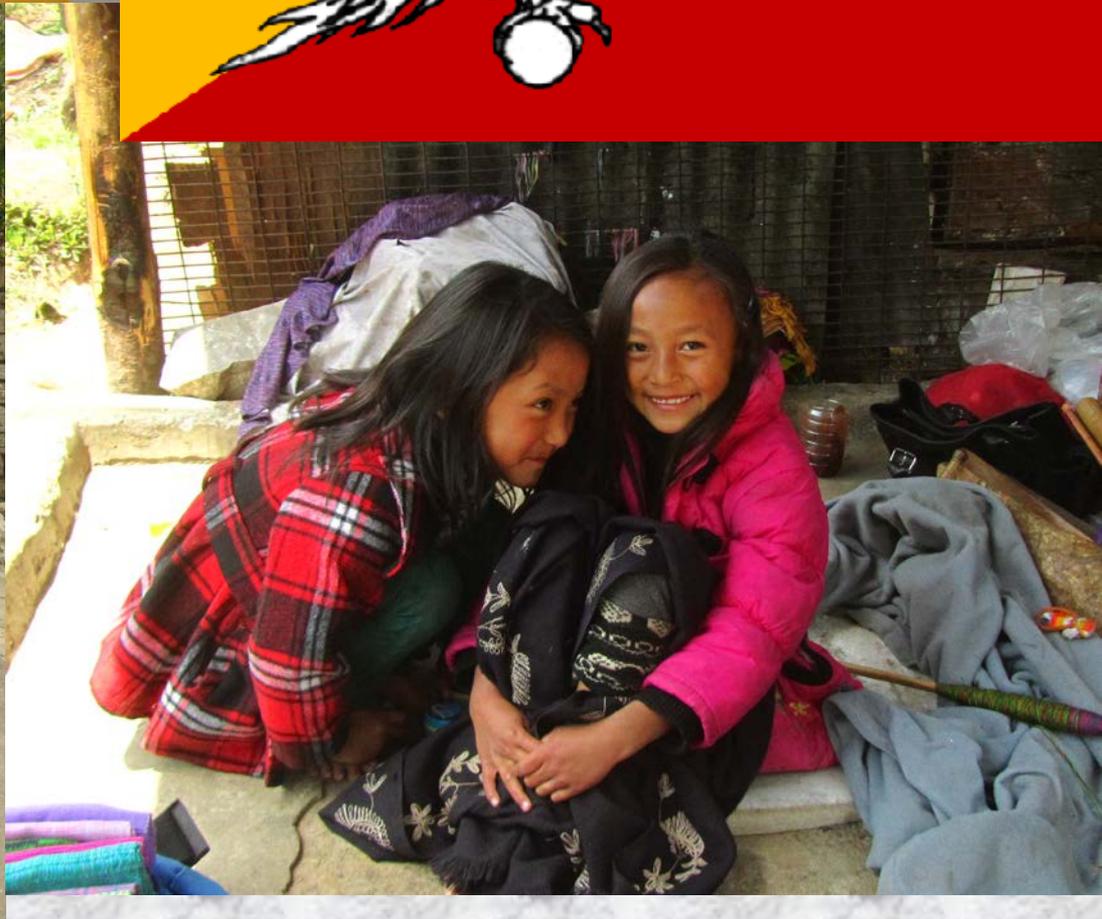
Challenges to Sustaining Agriculture Production in Bhutan and Nepal



National Cooperative Soil Survey Conference
Annapolis, MD

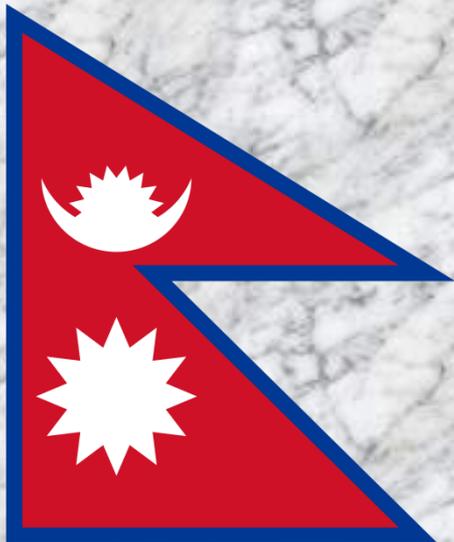
Dr. John M. Galbraith

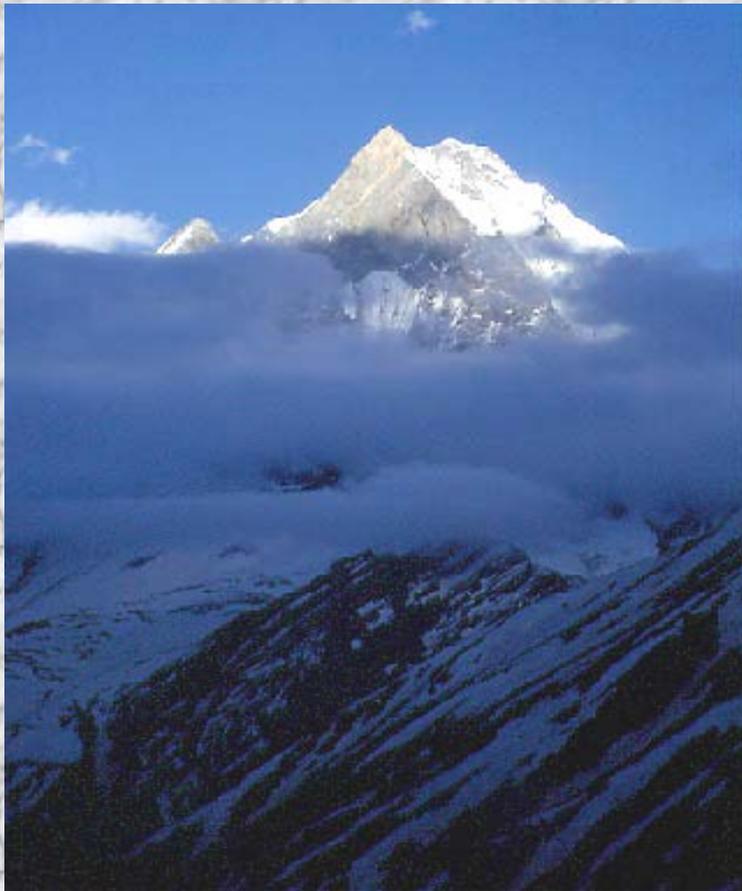
20 June, 2013





This is why
we care

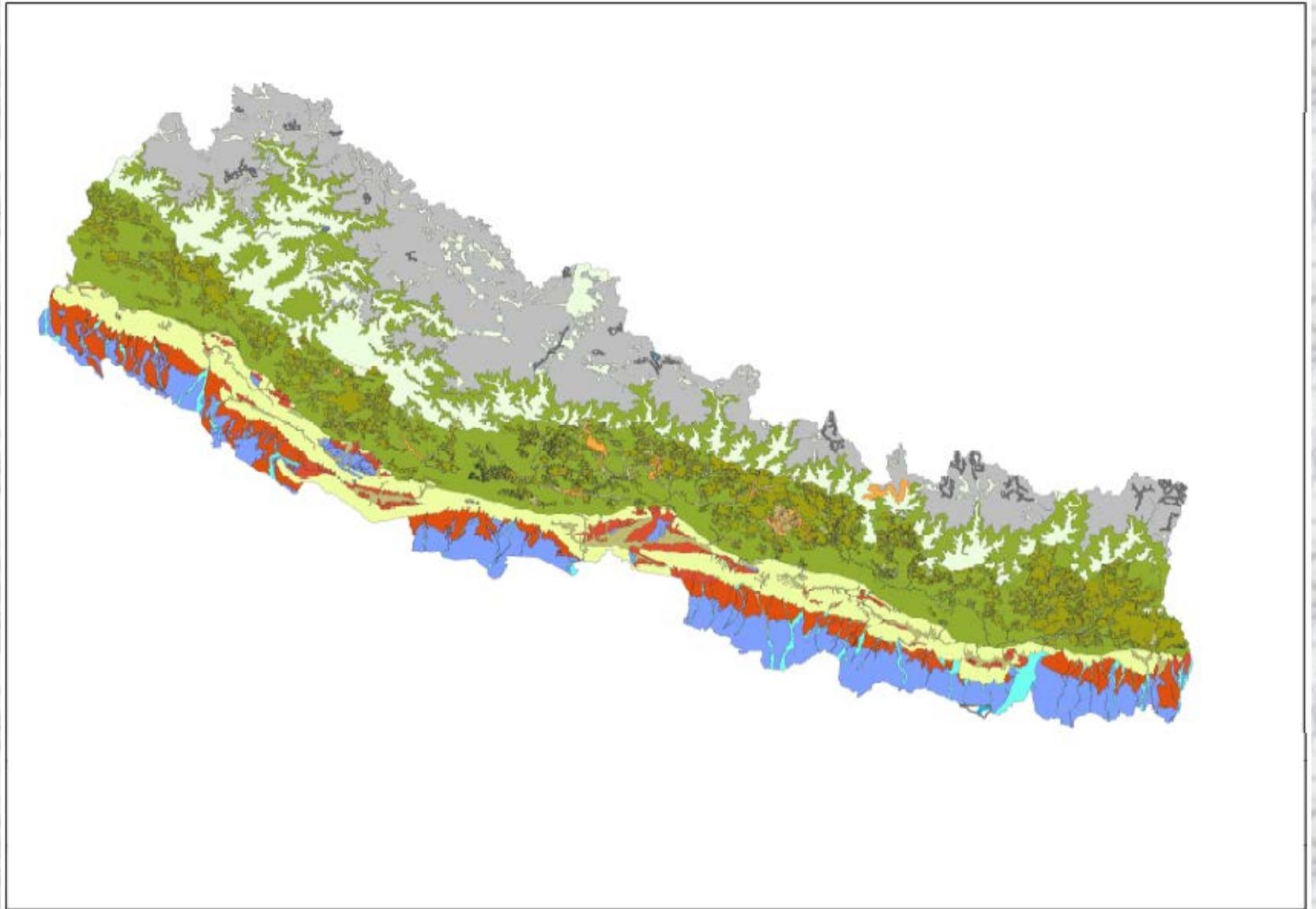




Geology and Soils



Soils in Nepal – ISRIC (SOTER database)



Soils and Misc. Land Types

Table 4: Dominant soils derived from the SOTER database for Nepal

Dominant soils according to FAO- Unesco Revised Legend ¹	FAO codes	Phase	Area (km ²)	Percentage
Humic Cambisols	CMu		22039	15
Rock outcrop	RK		20228	14
Eutric Regosols	RGe	LI	12984	9
Dystric Regosols	RGd	LI	11409	8
Gelic Leptosols	LPi		9392	6
Eutric Gleysols	GLe		9262	6
Eutric Cambisols	CMe		9165	6
Glaciers	GG		9051	6

Luvisols = 3% of the country have soils with argillic horizons (clay accum. subsoils)

River Floodplain Dominated by Entisols



Regosols = Entisols

- No diagnostic subsoils
- Psammments or Fluvents in Soil Taxonomy



Leptosols = Entisols

- Very shallow soil
- Orthents in Soil Taxonomy



Cambisols

- Eutric Dystrudepts in Soil Taxonomy



Cambisols in Colluvium



Luvisols = Ultisols



- Clay accumulation in subsoils.
- Udufts in Soil Taxonomy.

Luvisols in Paddys

These are Aquults in Soil Taxonomy



Luvisol on Ancient Alluvium

Hapludults in
Soil Taxonomy



Dark Ancient Lakebottom Soil

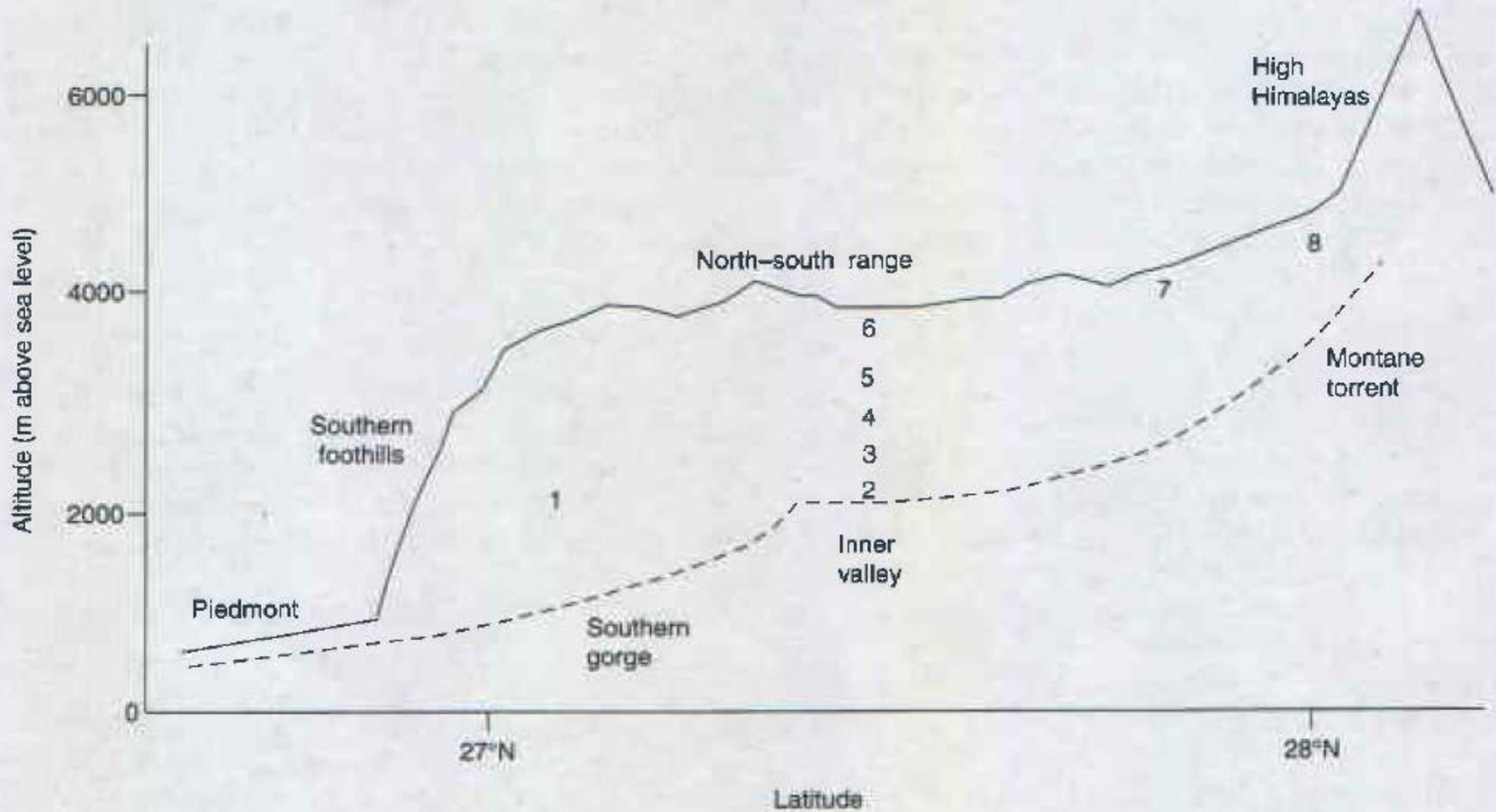


Kathmandu

Low OC soils



Bhutan







Sustaining Ag Production

Provide

- Extension
- Education



Sustaining Ag Production

Maintain

- soil fertility
- soil health (carbon, aggregate stability, microbes)
- pest management (crop rotations)
- irrigation water

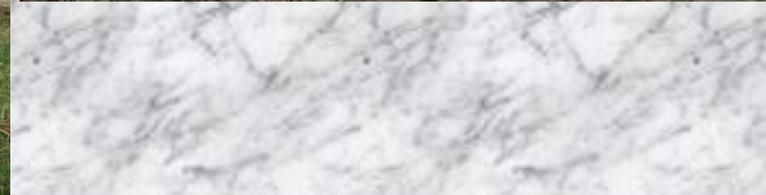
Reduce

- erosion
- landslides
- zoning/land use conflicts

Soil Fertility 1

- Traditional method of composting and manuring has been replaced
- There is subsidized fertilizer but no fertility testing
- Current subsidized inorganic fertilizer programs to be phased out in Nepal

Manure /straw
piles



Where is the Manure Now?

- Manure is now used for cooking and heat
- If manuring returns, it forces people to go into the forests to get firewood



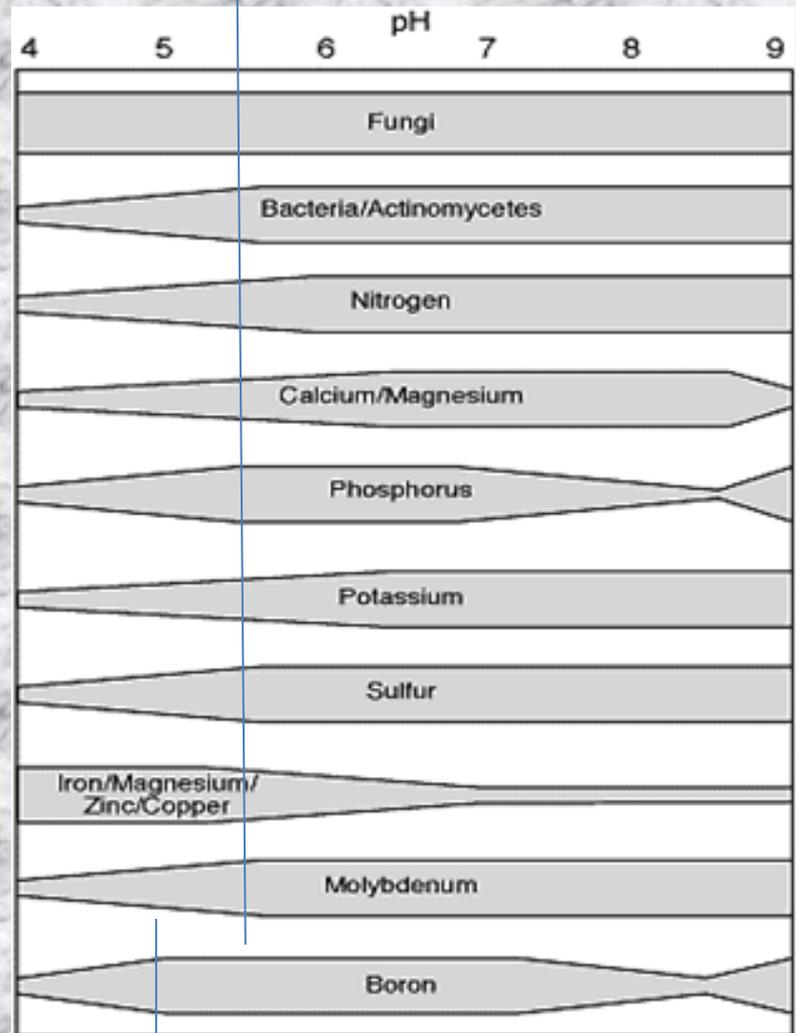


Soil Fertility 2

- Legumes/cover crops, azolla offer alternatives, however....
- 1-4 crops are grown on fields each year.
- Fallow period is used to restore moisture, not to grow cover crops or legumes.

pH Falling Below a Critical Point

Monsoon rains,
low clay soils
leads to extreme
leaching



Soil Health

- Related to soil carbon management



The soil is the same color as the rocks in the foreground.

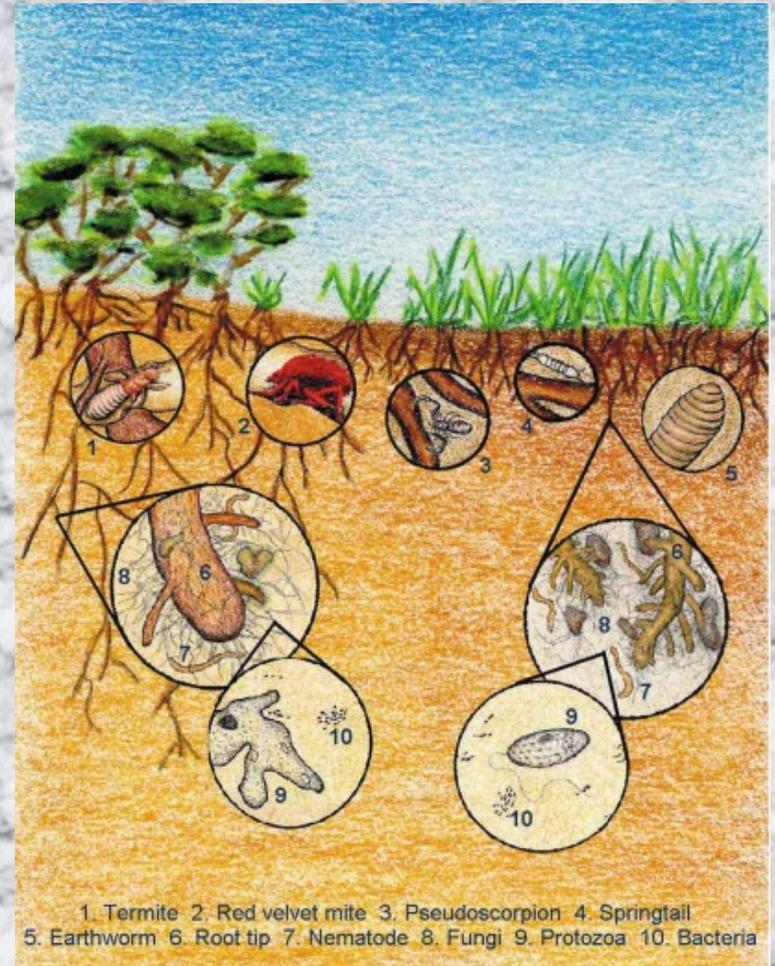
Crop Rotation/Agroforestry



Soil Biology

Little pesticide use:

- Good, because there are many microbes and macroinvertebrates
- Bad, because plant pests are prolific (nematodes)



Irrigation Water



No Irrigation Water



Abandoned Farmland

Labor drain for
farming



Reduce - Soil Degradation

Reduce Crusting



Mountain Erosion – Degradation from Excess Deforestation



kauleevnepal.org



Land Degradation

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Soil Loss from Fields - Exposed Subsoil



Invasive plants



Landslides







Landslides Caused by Road Construction



Zoning Challenges





Solution: Let's Work Together

The Yak Attack: Maybe This is a Good Time to Move on



I see you!



