

# Bioengineering?????

- integrated technique use engineering in conjugation with ecological principles to construct **vegetative living system** to prevent erosion
- combines principles of ecology, hydrology, geology & physics.
- involves use of living plant material to build structures(**living fence**) that reduce erosion.
- more effective over conventional structures.
- are aesthetically pleasing , self maintaining , less expensive & streamside habitat for wildlife & fish.

- restores overall **condition of the stream.**

## Application of Bioengineering

- ❖ Steep slopes
- ❖ Cut and fill slopes along roadways
- ❖ Landfill covers
- ❖ Spoil banks
- ❖ Stream banks

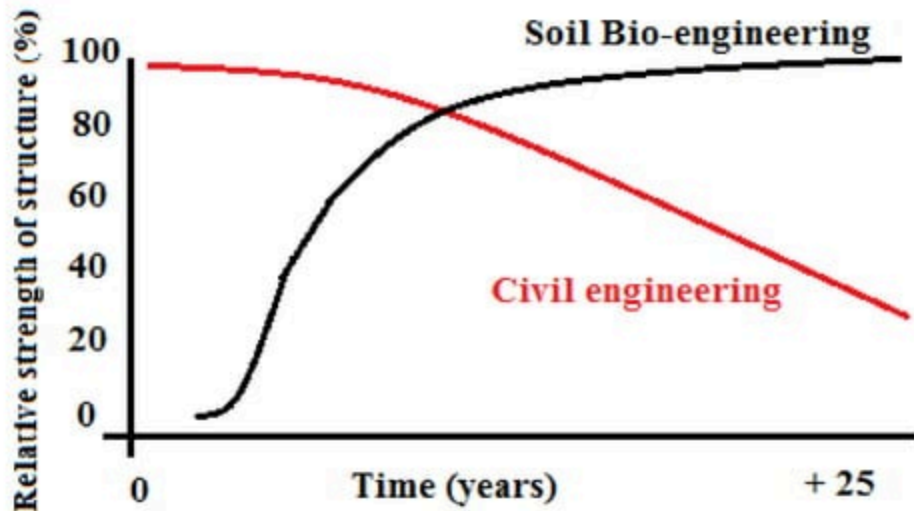
## Examples Practiced In Nepal:

- soil bioengineering @ krishnaveer
- Bio-terracing along all hill roadsides
- bioengineering measures @ Dipayal-Mellekh road.

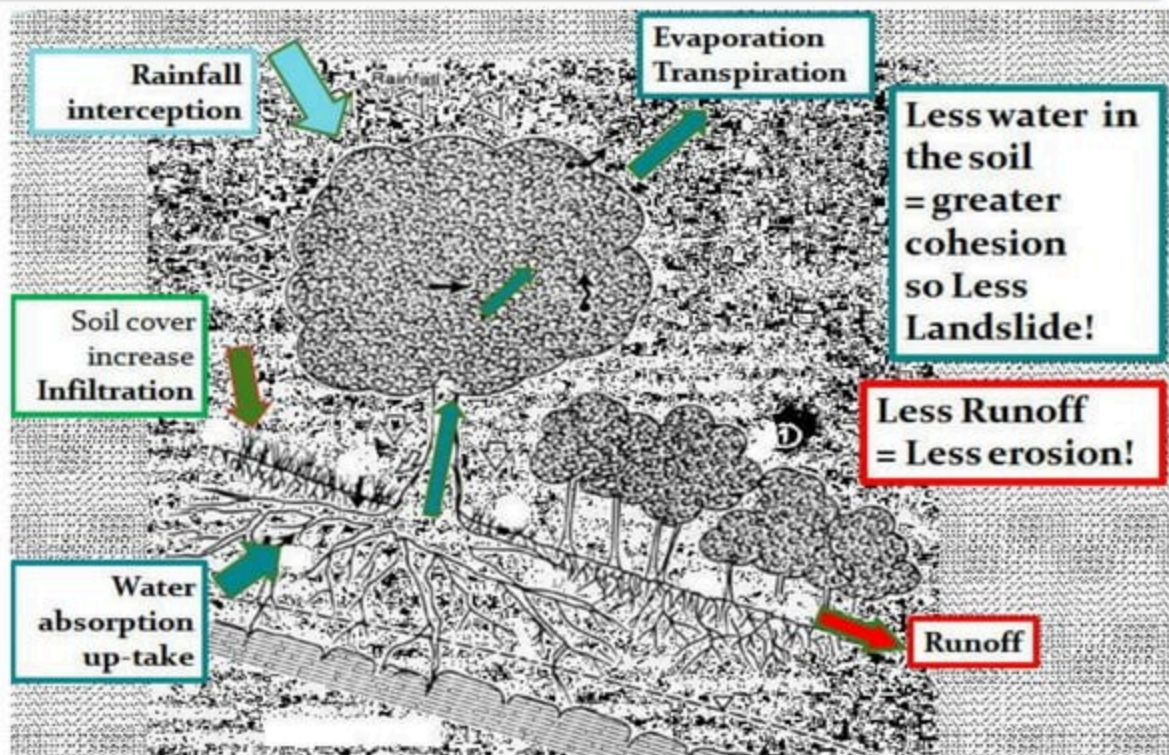
## Plant used for bioengineering:

Bamboo, Utis, katus, Eucalyptus, chilaune, kutmiro, kafal tree, Amriso, Napier, stylo, molasses, Babiyo, kans.

# bioengineering and civil engineering techniques



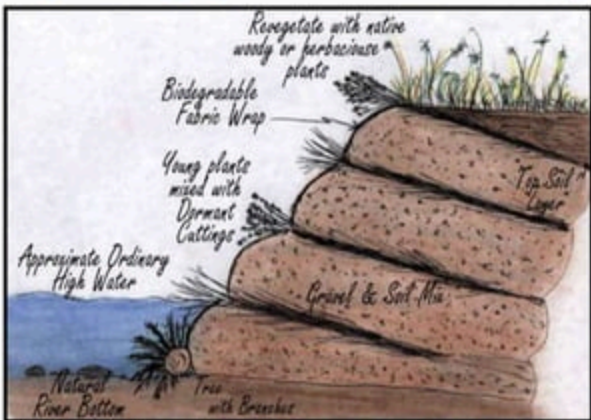
# Influence of Vegetation on Water balance



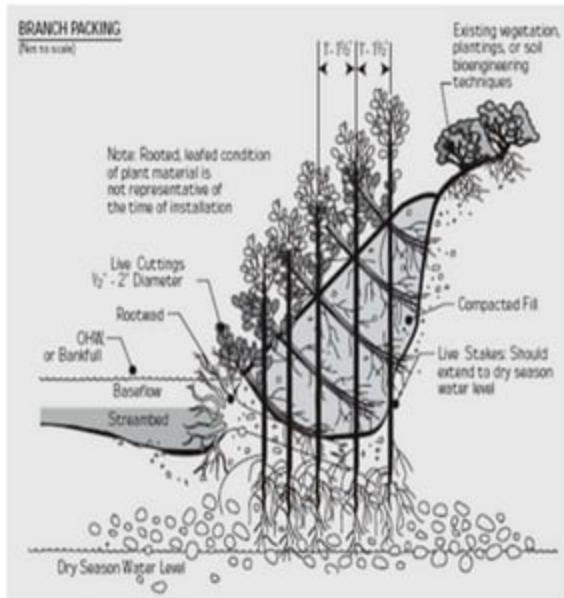


# Brush layering

- brush layer is a layer of plant material intercepted between layers of soil on cut slopes or fill slopes.
- made of live cuttings planted in line, on terraces across the slope, covered with soil.
- Re-vegetation technique, combines layers of dormant or rooted cuttings with soil.
- Brush layers act as live fences to capture debris moving down the slope.



- primary use- to minimize bank erosion & additional use - enhance aesthetics.
- works better on fill than cut slopes because of use of longer stems in fill.
- used to stabilize a slope against mass wasting & erosion protection.



# Brush layering

contd.....



Row of brush layer being planted



Brush layer established after 2 years of planting



# Hedgerow planting

- Establishment of dense vegetation in a linear design for natural resource conservation using woody plants or perennial grasses.

## **Purpose of Hedgerow Planting:**

- I. Fodder , cover and corridors for terrestrial wildlife, aquatic organisms.
- II. Living fences
- III. Boundary delineation
- IV. Contour guidelines
- V. Screens and barriers to noise, odours and dust.
- VI. Improvement of landscape appearance.

# Hedgerow planting contd.....

- improve water quality & provide wildlife habitat.
- a soil conservation measure but also generate fodder & income to marginal farmers.
- contribute to sustainable mountain development through erosion control.



<b>Strengths</b>	<b>Weakness</b>
<b>Effective control of soil erosion on sloping land</b>	<b>Difficult to establish in steep slopes</b>
<b>Increase soil fertility</b>	<b>Takes long time to establish</b>
<b>Produce fodder &amp; forage for livestock</b>	<b>High initial cost</b>
<b>Bio-terracing</b>	<b>Difficult to establish bio-terraces</b>
<b>Simple to implement using local resources</b>	<b>Threatened by free grazing animals</b>

# Palisade

- Palisade is a wall consisting of living uniform stakes driven into the ground close to each other.
- top ends of stakes are tied to a horizontal pole at both sides of the gully.
- used as defensive structure.



Palisades with double horizontal pole

- live materials sprouts & becomes major structural component; contribute to soil moisture depletion through transpiration.
- Trap material moving down the slope, form a strong barrier and reinforce slope.
- Quick & easily to built, immediately effective, usually grows well, cheap if material at site is available & Filter effect.

**limitation:-** availability of material restricted(long, straight poles).



# Grass planting

- Establishment of perennial conservation cover using seed, clump, rhizome, cuttings.
- common practice on marginal cropland to prevent wind, water erosion.
- quickest and easiest ways to add vegetation to a large area.

## Why permanent grass cover?????

- Enhances soil quality by reducing compaction & restoring depleted organic matter.
- Reduces soil erosion- dense root systems, form a **structural web** within the soil; the particles are trapped between roots.

## Grass planting contd..

- Improves the water infiltration capacity & improves water quality.
- Direct sowing of grass seeds (*Lasiurus sindicus*) creates barrier for sand movement.
- Sequesters carbon.
- Creates wildlife habitat, especially for grassland birds

