Erosion

→ **Detachment**, **Transportation** and **Deposition** of particles by Action of wind, water and Gravity

G-A = 328 m-ha

→ erosion affected = 856 m ha / 85.67
- wind = 12.40
- water = 73.27

→ Net cultivated = 185.8 m ha → erosion affected (56.7) m ha

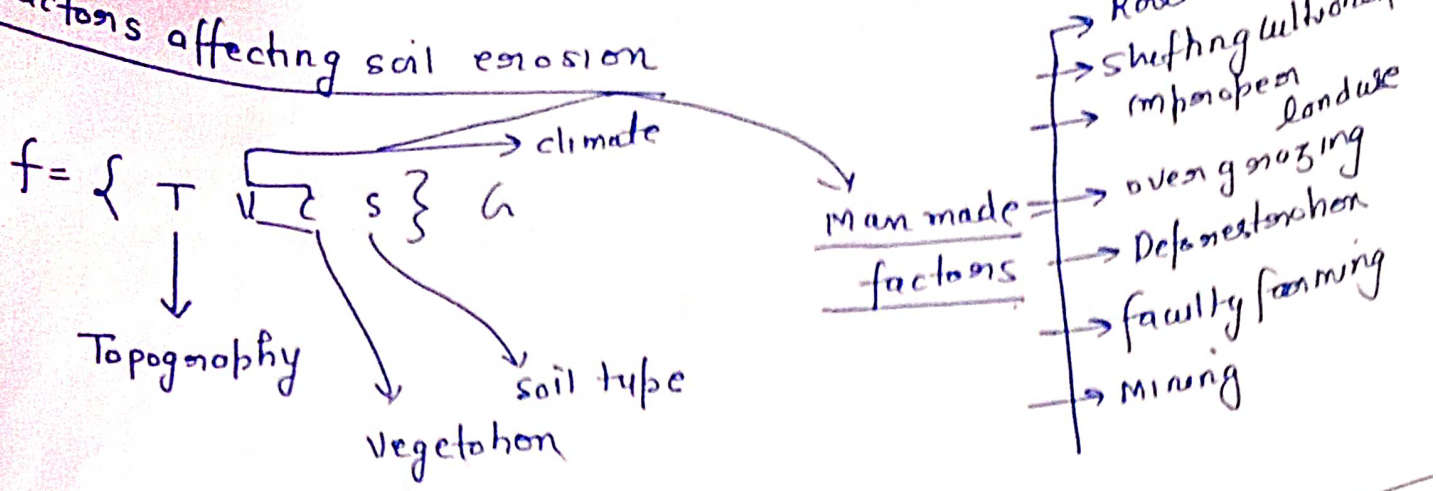
Erosion

- Geological [Natural / Normal erosion] — stream / Rivers
- Accelerated [Man made factors] — Deforestation / Road construction
  - wind
  - water
    - splash
    - sheet
    - Rill
    - Gulley
    - stream Bank

weathering → Breakdown of Rocks on earth surface. / soils

- physical
- chemical
- Biological

Factors affecting soil erosion



Topography	slope length, steepness, roughness, gradient (slope length)
soil type	soil texture, OM, soil structure, silt (most prone), water holding, to erosion, Compressive strength
climate →	Rainfall (Intensity, Humidity, Radiation, frequency, Temp, wind velocity)
Geography	
Vegetation →	Ground cover
	Root system

Effects of erosion

erosion problems

- Land degradation [critical stage = 6 g m ha]
- loss of Nutrient
- water logging / Accumulation [critical area = 8.5 m ha]
- soil texture [affected]
- soil salinity [5.5 m ha area] destroy crop growing capacity
- sea cost Damage
- floods problem
- Disease (water borne)
- improper irrigation and Drainage
- silting of Rivers / streams and irrigation channel
- Crop yield ↓
- Economy.

Soil Conservation (Advantages)

- sustainable production.
- To reduce soil loss
- To increase moisture holding capacity
- Protection of water bodies against pollution
- increase roughness
- filteration capacity
- to reduce the velocity of impact of Rainfall. and minimize flood
- ground water recharge ↑

Reason for erosion

Causes for soil erosion → Man made

- Road construction
- Shifting cultivation
- Improper land use
- Over grazing
- Deforestation
- Fault Farming techniques
- Mining

Physical factors

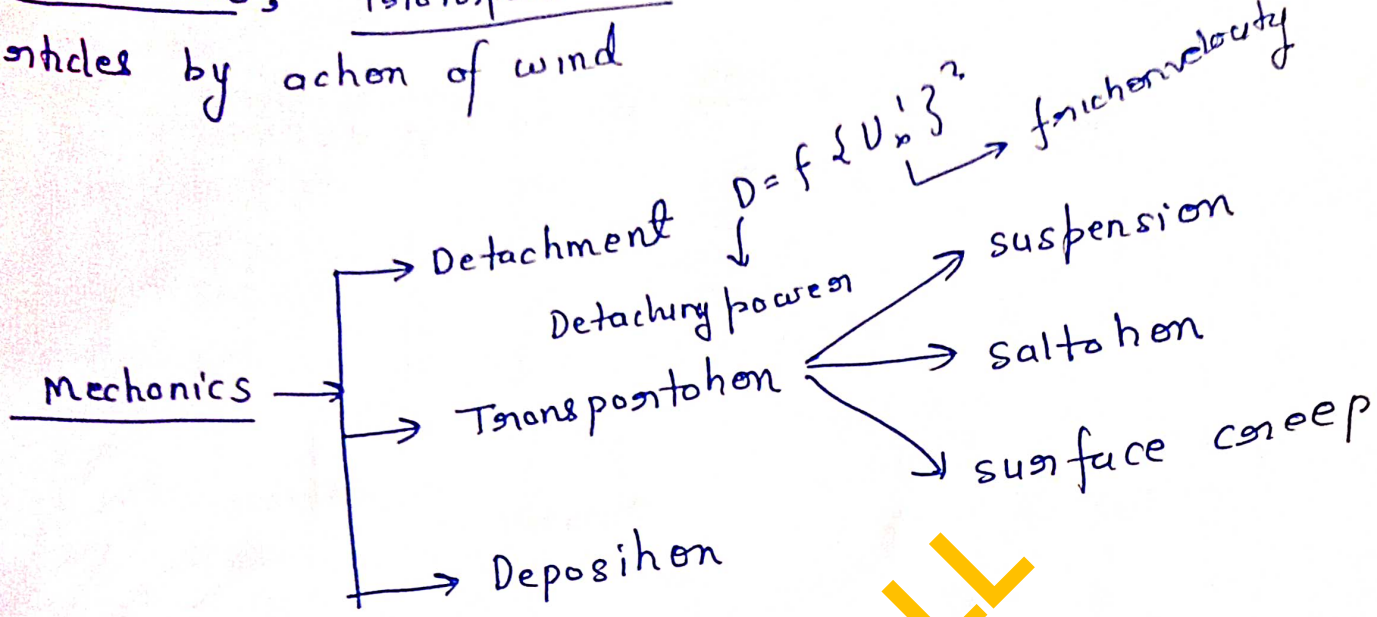
- Topography
- soil type
- Vegetation.

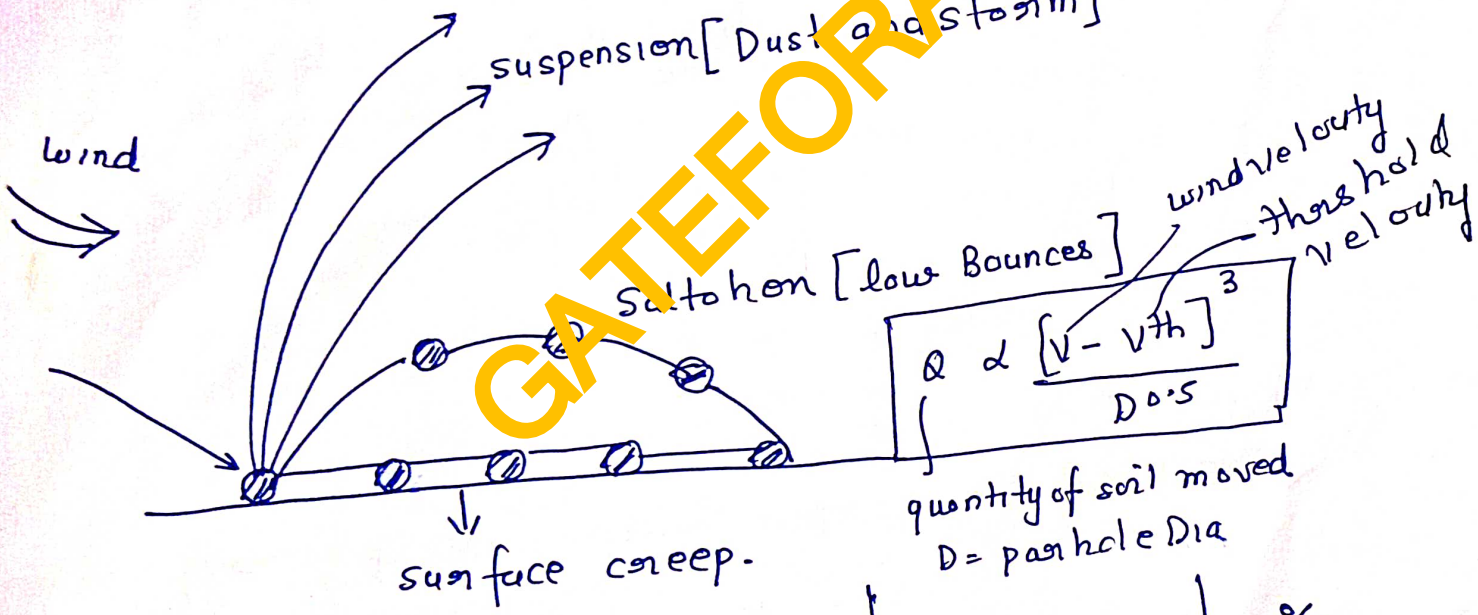
soil conservation Programme → NWDRA [National watershed development project for Rainfed area

- RVR and FPR [River Valley Project and Flood Prone River]
- WDPSCA [watershed development project for shifting cultivation area]
- watershed develope programme [WDP]
- Drought Prone area [DPAP]
- Integrated watershed development Project [IWDP]

Wind Erosion

Detachment, Transportation and deposition of particles by action of wind





		size	%
Suspension	Finer particles (Dust → Aer)	d < 0.1 mm	3 - 38
Saltation	Large particles (low Bonce) for shorter distance	0.05 - 0.5 mm 0.1 - 0.5 mm	55 - 72 %
surface creep	Large (very) particles along surface	[0.5 - 1/2] mm 0.5 - 1 mm 0.5 - 2 mm	7 - 25 %

Factors Affecting wind erosion

→ TVCS G

wind erosion control measures

- → sand dunes
- Vegetotive Measures
  - Temperary
  - Purmonent
- Tillage Prachle [multch, and cropping] strip tillage, crop residue
- Mechonical structures (sometimes vegetotive)
  - → wind break
  - → shelter break

$D = 17\,H\,\frac{V_m}{[illegible]}\cos\theta$

wind break	shelter break
short barrier.	Longer barrier [more than 2 rows]
→ Any barrier [Mechanical/vegetation] for protecting buildings	made of shrubs and trees
→ 90° to the direction of prevailing wind	90° to the direction of prevailing wind.

wind erosion problems

→ Arid and semi-arid regions.

→ high velocity, mayor → sandy soil, Vulnerable = organic soil

→ Desert area = 11.796 m ha / 16.3 lakh ha.

Coastal areas	sea (high wind) total area = 1.47 mha sea cost
Desert area	Rajasthan (9.692 mha) → sand dunes ~~Himachal~~ Haryana (1.4 mha) → sand dunes Gujrat (0.704 mha) → sand dunes
Semi arid areas	Rajasthan Haryana Gujrat Pnjab MP AP
Inland River	Ganga and Chambal river

particles in wind erosion

> 1 mm dia → non erodible

0.5 - 1 mm dia → erodible by strong velocity

< 0.5 mm → highly erodible

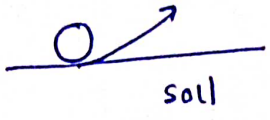
suspension	d < 0.1 mm	3-38 %
saltation	0.1 - 0.5 mm	55-72 %
surface creep	0.05 - 2 mm	7-25 %

water erosion.

Removal of top layer of soil by rainwater.

Mechanics of water erosion

① Hydraulic Action.



② Abrasion.

water + soil = Mixing

Abrasive power (water ↑)

③ Attrition

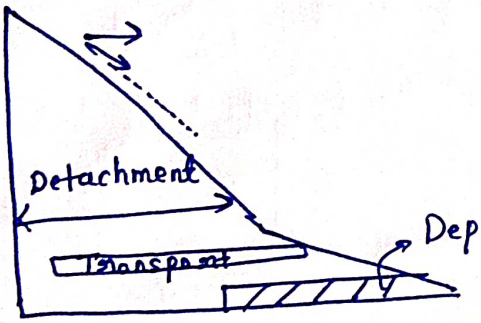
Collision of particles

④ solution

chemical paste b/w water and soil

Detachment

⑤ Transportation.



→ suspension

→ Traction [Large Bounce]

→ saltation [small bounces]

⑥ Deposition

$Q \propto V^6$

Volume of particles carried

$Detachment \propto V^2$

$Transportation \propto V^2$

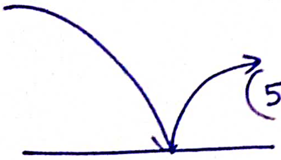
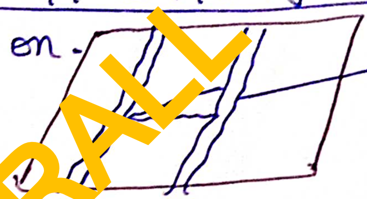
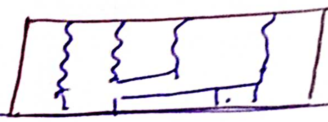
$V \propto \sqrt{S} \propto \sqrt{2gh}$

$A \propto \sqrt{S}$

$KE \propto V^2$

slope → four time / V → 2 times / KE → 4 times

water

splash $KE = \frac{1}{2}mv^2$ impact Raindrop size, shape Terminal velocity	 → due to impact of Rainfall → $v \propto \sqrt{s} \propto \sqrt{2gh}$ (50-75) cm metric tones / ha-cm → $KE \propto v^2$ $KE = 210.3 + 89 \log_{10} I$ (cm/hr)
sheet [colour, coarse particles] TVCS	Removal of water in form of thin layer Detachment $\propto V^2$ Transportation $\propto V^5$] → show with example. ↓ blacksoil 17-43 t/ha/year
Rill erosion	Micro channel erosion.  Rills
Gulley erosion	Advance stage of Rill Last stage of water. w > 50 cm (size Large) 

Controlling Measure of water erosion.

Agronomi

splash erosion	impact, Raindrop size, terminal velocity, Dropsize distribution	
sheet	TVCS Rainfall intensity, energy duration	more Dominant

effect of slope on erosion
water erosion

$$S = \frac{DH}{L}$$

$$V \propto \sqrt{2g(DH)}$$

slope 4 times, velocity twice, KE → 4 times

$$KE = \frac{1}{2} m V^2$$

Sheet-erosion [Detaching Power $\propto V^2$ [4 times]
Transportation $\propto V^2$ [4 times]
Volume of particles $\propto V^6$ [64 times]
flowing runoff]

Hussek $E = f\{S^{1.4}\}$

Neal $E = f\{S^{0.8}\}$

Zingg $E = f\{S^{1.4}\}$

Smith and Wischemeier $A = 0.43 + 0.30S + 0.043S^2$

(soil loss $\left[\frac{m^3}{ha}\right]$) Y.

$$A = RKLSCP$$

$$LS = \frac{\sqrt{L}}{100}\left[0.76 + 0.53S + 0.076S^2\right]$$

S = % slope
L = feet.

LS_1 =

symptoms of water erosion

- Appearance of rills / small Gulleys
- pebbles / stones on surface
- Gulley formation
- Reservion silting
- Coloured circles on rock
- sedimentation
- heaps of debris
- Deposition of sand on bed slope.
- Seeing state of Rock.
- Natural plant [change]

Controlling Measure of water erosion

- Safe disposal of Runoff
- Reducing Velocity
- Vegetative / Agronomical / Biological
- Engineering Measures

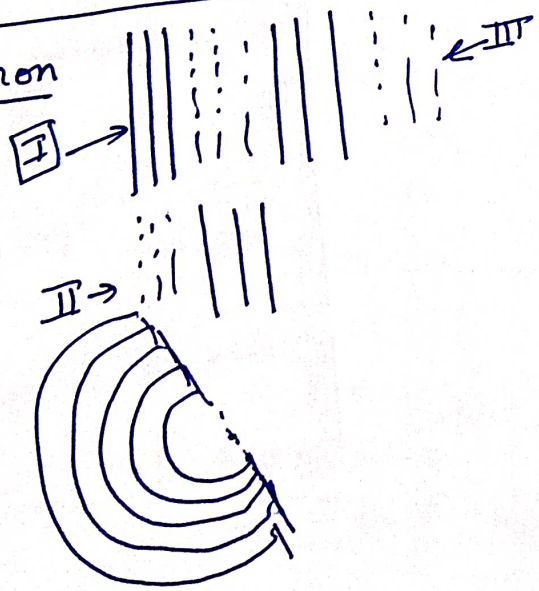
Vegetative / Agronomical / Biological

- Crop Rotation
- strip cropping
  - field
  - Buffer
  - Contour
- Contouring
- Mulching
- Biological
- Agroforestry
- Reforestration
- Mixed Cropping [Inter cropping]
- Cover cropping

Engineering Measures

- Bunding
- Terracing
- Vegatative Grassed water ways
- Control structes for Gulley.

Crop rotation

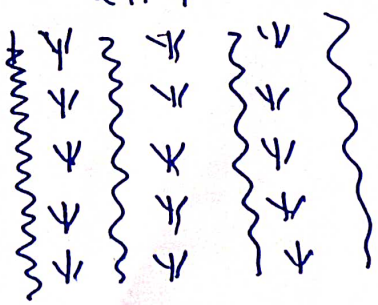


Contouring

Mixed cropping

Pigeno pea and sorghum

साथ



strip cropping

- strip cropping
  - Field
  - Buffer
  - wind strip cropping
  - Contour

strip cropping → Alternate crop's in narrow strip across the slope.

→ Reduce Runoff

→ Increase filteration

→ crop rotation.

Close growing crops (wheat)	row crops (Corn / soyabean) [Erosion Resistant]

Contour Strip cropping	(90° to slope) ½ percent on Contour		level land.
feld strip cropping	Direction of wind, strips	Not on Contour	irregular to topography
Buffer strip cropping	Buffer, Contour	legumes / Grasses	critical slope (protection)
wind strip cropping	uniform width	Right angle to wind	wind erosion.

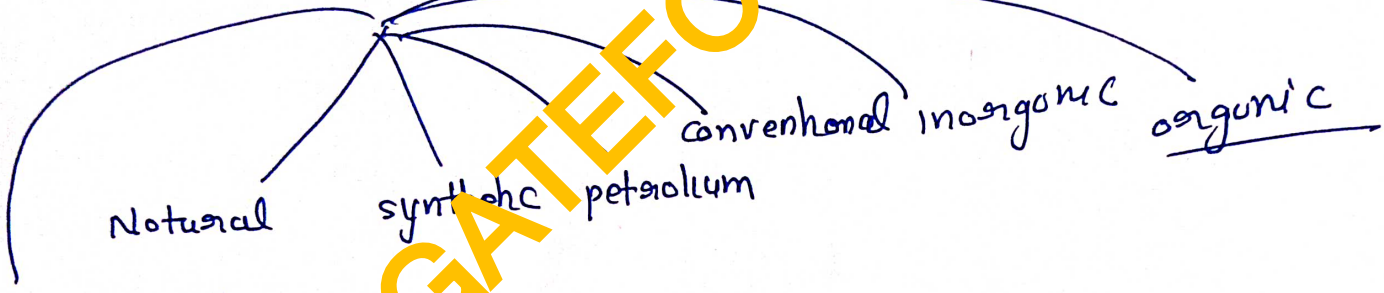
Stubble Mulch Method →

→ f↑ (filteration rate)

→ Q↓ (Runoff decrease)

→ Conserving moisture.

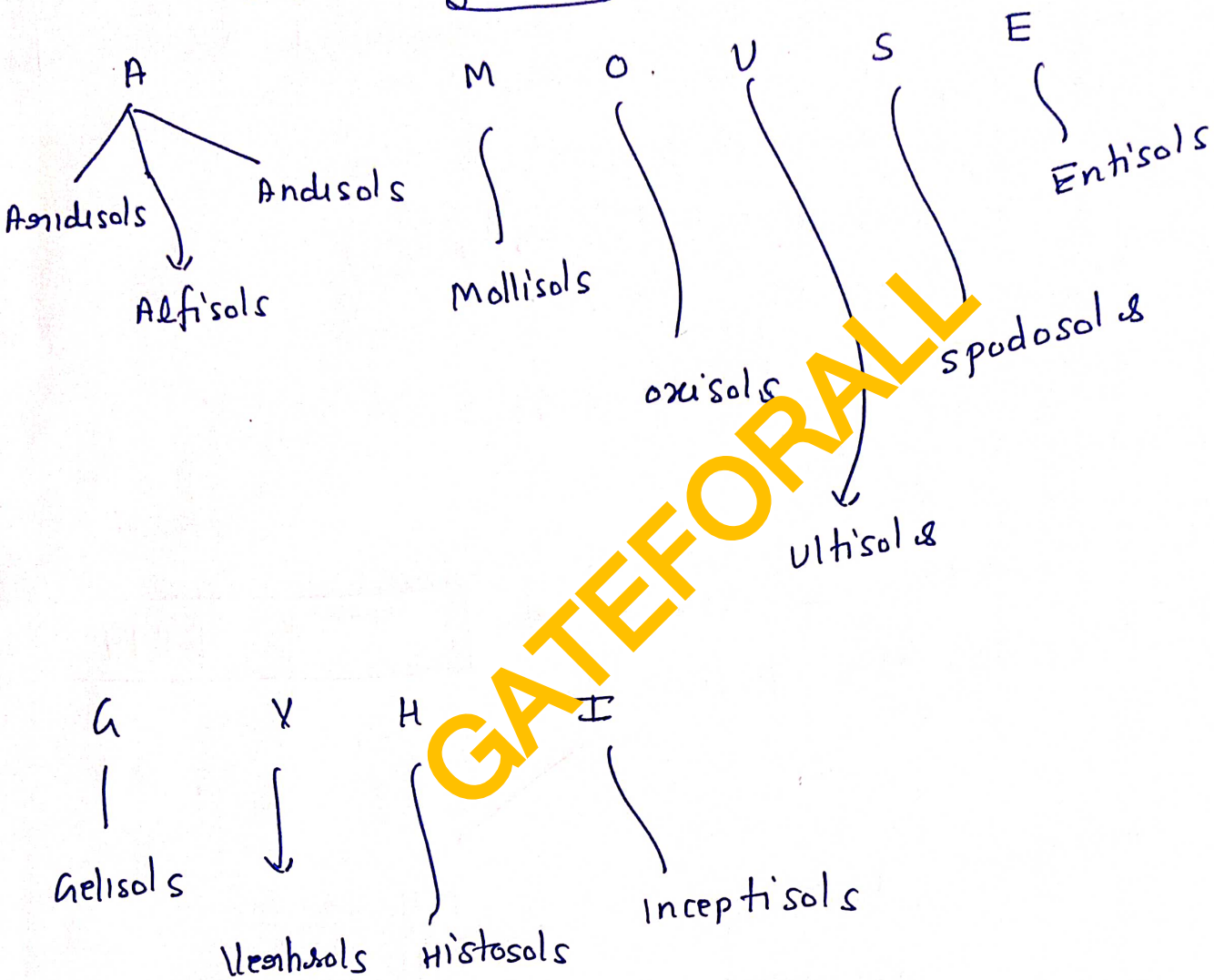
→ to reduce evaporation.



stone Mulching (stone)

USDA soil classification

12 (United states department of Agriculture).
based on **genesis** of soils.



Grass land Management

→ Use natural vegetation to achieve better productivity and better erosion control measure

→ to Maximize benefits.

Cropping system → order in which the crops are grown.

- parallel multiple cropping
  - Mixed cropping
  - Intercropping
  - Relay cropping
  - Alley cropping
- sequential multiple cropping
  - sequential double cropping

Benefits → productivity, crop yield, fertility, less Risk, weed protection, harvesting easy.

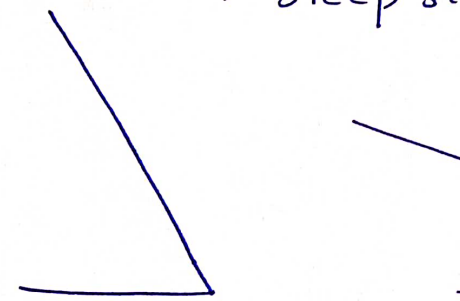
water erosion

critical slope length →

→ slope length at which the erosion begins.

→ function { critical inclination of land } [inverse relationship]

→ steep slope [tends to zero]



More critical inclination, less critical slope length

less critical inclination more critical slope.

cebbir Jula

$$L = \frac{Vk^2}{moi\sqrt{I}}$$

$$V = C\sqrt{RS}$$

$$R = \frac{A}{P} = \frac{b \times y}{b+2y} = y.$$

$$V = C\sqrt{yS}$$

$$C = m\sqrt{y}, \quad m = \frac{87}{\gamma}$$