SOIL EROSION

1. Soil erosion
2. Soil erosion - three phase phenomena

   * Detachment

   * Transportation By wind, H_2O and gravity

   * Deposition
3. Action of wind and water
4. Two forms of energy

   Potential energy PE = mgh (head)

   Force N = kgm / sec^2 Nm/sec = watt = kg m^2

   $mgh = sec^2$

   2. Kinetic energy

   ½ mv^2
5. **Factors affecting soil erosion**

   * Rainfall * Runoff * Wind * Soil * Slope * Plant cover * Temperature
6. **Two broad classification**

   1. Geologic / natural / normal erosion

   Formation and loss simultaneously which maintain the balance between formation and losses.

   2. Acceleration

   Deterioration by mankind by wind, water, gravity & glaciers

Water erosion

- Rain drop erosion
- Sheet erosion
- Rill erosion
- Gully erosion

- Stream bank erosion

Mechanics of water erosion

i) Hydraulic action

The force exerted by the air in the voids

ii) Abrasion

Shear force of water to scour the soil

iii) Attrition

Mechanical breakdown of loads.

iv) Solution

Chemical action between soil and H_2O

v) Transportation

Depends on velocity / type of load

vi) Deposition

Whenever the velocity is lower than the carrying capacity, then the loads will be deposited on the bed of the water course.

GULLY EROSION

- ❖ It is an advanced stage of rill erosion in which the size of the rill is so enlarged which cannot be rectified by ordinary tillage implemnts.
- ❖ Process of gully formation follows sheet and rill erosion
- ❖ It also occurs when runoff volume from a sloppy land increases sufficiently or increase in flow velocity to cut deep inversions or when concentration of runoff water is long enough in the same channel

1. It can be formed by unchecked rills.
2. It can be formed on natural depressions where runoff water accumulates.
3. It can be formed on the track formed by vehicle movements.

Gully Developing process

Stage 1 : Initiation stage

During this stage the channel erosion and deepening of gully bed takes place. This stage normally process slowly where the top soil is resistant to erosion.

Stage 2 : Development stage

In this stage, both depth and width of the gully are getting increased due to waterfall action of the flowing velocity. So the loose soil materials will be washed away. Lot of soil erosion takes place in this stage.

Stage 3. Healing stage

After the developmental stage the further degradation slowly comes to halt. Then the healing stage takes place. In this stage the vegetations are slowly coming up in the bed as well as in the side slopes of the gully.

Stage 4 : Stabilization stage

Almost in this stage, gully, stabilization takes place. Here the healing process is fully completed and the channel obtained a stable bed gradient and side slopes. Vegetation will grow abundantly to cover the soil surface and develop new top soil.

Classification of gully

I. Based on shape

i) 'U' shaped gully

This type is formed in alluvial plains where surface and subsurface soils are easily erodable. The runoff flow undermines and then the gully banks are collapsed which results in the formation of vertical side walls and in this way the 'U' shaped gullys are formed.

ii) 'V' shaped gully

I is developed where the sub soils are tough to resist the rapid cutting of soil by runoff flow. As resistance to erosion increases with depth, the width of cut decreases and so 'V' shaped gullys are formed.

In hilly regions the 'V' shaped gullys are quite common because of this high flow velocity in steep slope and also the flow volume is common.

II. Based on state of the gully

1. Active gully

Whole dimensions are enlarged with time. The size enlargement is based on the soil characteristics land use and volume of runoff passing through the gully. The guly's found in plain areas are active in nature.

2. Inactive gully

Whose dimensions are constant with time. The gullys found in rocky areas are inactive, because rocks are very tough to erosion by the runoff flow.

III. Based on the dimension of the gully

1. Small gully

These are these, that can be easily crossed by farm implements and removed by ploughing and smoothing operations and by stabilizing the vegetation.

2. Medium gully

Are those that cannot be easily crossed by farm implements. They can be controlled by terracing or ploughing operations. The sides are stabilized by creating vegetative growth on them.

3. Large gully

Those which went beyond their reclaimable stage and for stabilization tree planting may be done as an effective method.

Gully control

The following methods are to be followed to control the gullys

a) Treatment of catchment area

b) Division of gully

c) Stabilization of gully head

d) Stabilization of gullys

i) Biological measures

ii) mechanical measures

a) Treatment of catchment area

Catchement area can be treated as per the requirements.

1 - 3% slope	-	Contour bunds, vegetative bunds
4-10% slope	-	Graded bund, graded trench
11-15% slope	-	Bench terraces, inward sloped bench terraces, outward sloped bench terraces
16-33% slope	-	Countour stone wall, staggered stone wall, staggered stone wall
> 33%	-	Afforestation ie. planting of trees

b) Diversion of gully

The gully can be directed for a small distance inorder to stabilize the head of the gully. The head of the gully can be stabilized by stone pitching, masonry construction, sodding of grasses inorder to control further scouring.

The diverted water course can join the main gut after some time.

d) Stabilization of gully

i) Biological measures

If the vegetation is increased on the gully bed then the velocity of flow could be reduced thereby the transformed matter could be deposited on the head of the gully so thick vegetation would start coming up on the side bed. If biological measures, are not effective, then we can go for mechanical measures.

ii) Mechanical measures

It consists of masonry structure across the gully as well as along the side slope of the gully.

Check dams

Check dams can be constructed across the gully the check dam consists of body wall and side walls apron may be provided in d/s side to preventing scouring of water.

Retaining walls

Retaining walls can be constructed invulnerable places along the side walls of the gullys. Retaining walls can be plastered or even without plastered. In the case of without plastered, it is called 'dry stone pitching'

Different types of check dams

i. Brush wood dam

ii. Loose rock dam or rock fill dam Temporary structures

iii. Gabion or netting dam

Causes : Gully erosion

There are several causes to activate the gully formation. Some examples are given below.

1. Creating the land surface without vegetation

2. Adoption of faulty tillage practice
3. Overglazing and other forms of biotic pressure on the vegetative cover existing on the land surface.
4. Absence of the vegetative cover
5. Not smoothening of rills, channels or depressions present on the ground surface.
6. Improper construction of water channels, roads, rain line, cattle trails etc.

Main theory of gully control structures are

1. Velocity is reduced, so carrying capacity of soil is reduced.
2. The slope is being cut in to small flat terrain
3. The water will stagnate and has the opportunity to percolate inside the ground water resources.

Stream bank erosion

It is a kind of water erosion in which soil is removed either by the runoff flowing over the sides of the stream, coming into the stream from U/S areas or by scouring and undercutting of soil below the water surface.

Land slide

Movement of soil mass from upper portion of the mountain to the lower portion is called land slide. To prevent land slide vegetative cover has to be increased in the land slide prone areas. To arrest land slide completely is a very difficult task. Retaining walls could arrest land slide to some extent.

Erosivity

It is defined as the potential ability of rainfall to cause erosion. It is rainfall factor it depends upon the physical characteristics of rainfall which include raindrop size, drop size distribution, kinetic energy, terminal velocity etc.

Erodibility

It is defined as the vulnerability or susceptibility of the soil to be eroded. It is the function of physical characteristics of the soil. It is a soil factor. The physical character includes the texture, structure, organic matter content.