



SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution Coimbatore – 35

Accredited by NBA – AICTE and Accredited by NACC – UGC with 'A++ Grade Approved by AICTE , New Delhi
and Affiliated to Anna University , Chennai.

DEPARTMENT OF AGRICULTURAL ENGINEERING

19AGE308

WATERSHED PLANNING AND MANAGEMENT





What is soil erosion??

- ▶ Soil erosion is the washing or blowing away (by water or wind) of the top layer of the soil.
- ▶ Erosion whether it is by water , wind or tillage, involve three distinct action– **soil detachment, movement & deposition.**





INTRODUCTION

Save slide

Soil erosion: Soil erosion is the detachment, transport and deposition of soil particles on land surface. Also termed as Loss of soil.

❑ Measured as Mass/unit area





2.1 Causes of Soil Erosion

No single unique cause can be held responsible for soil erosion or assumed as the main cause for this problem. There are many underlying factors responsible for this process, some induced by nature and others by human being. The main causes of soil erosion can be enumerated as:

(1) Destruction of Natural Protective Cover by

- (i) indiscriminate cutting of trees,
- (ii) overgrazing of the vegetative cover and
- (iii) forest fires.

(2) Improper Use of the Land

- (i) keeping the land barren subjecting it to the action of rain and wind,
- (ii) growing of crops that accelerate soil erosion,
- (iii) removal of organic matter and plant nutrients by injudicious cropping patterns,
- (iv) cultivation along the land slope, and
- (v) faulty methos of irrigation.

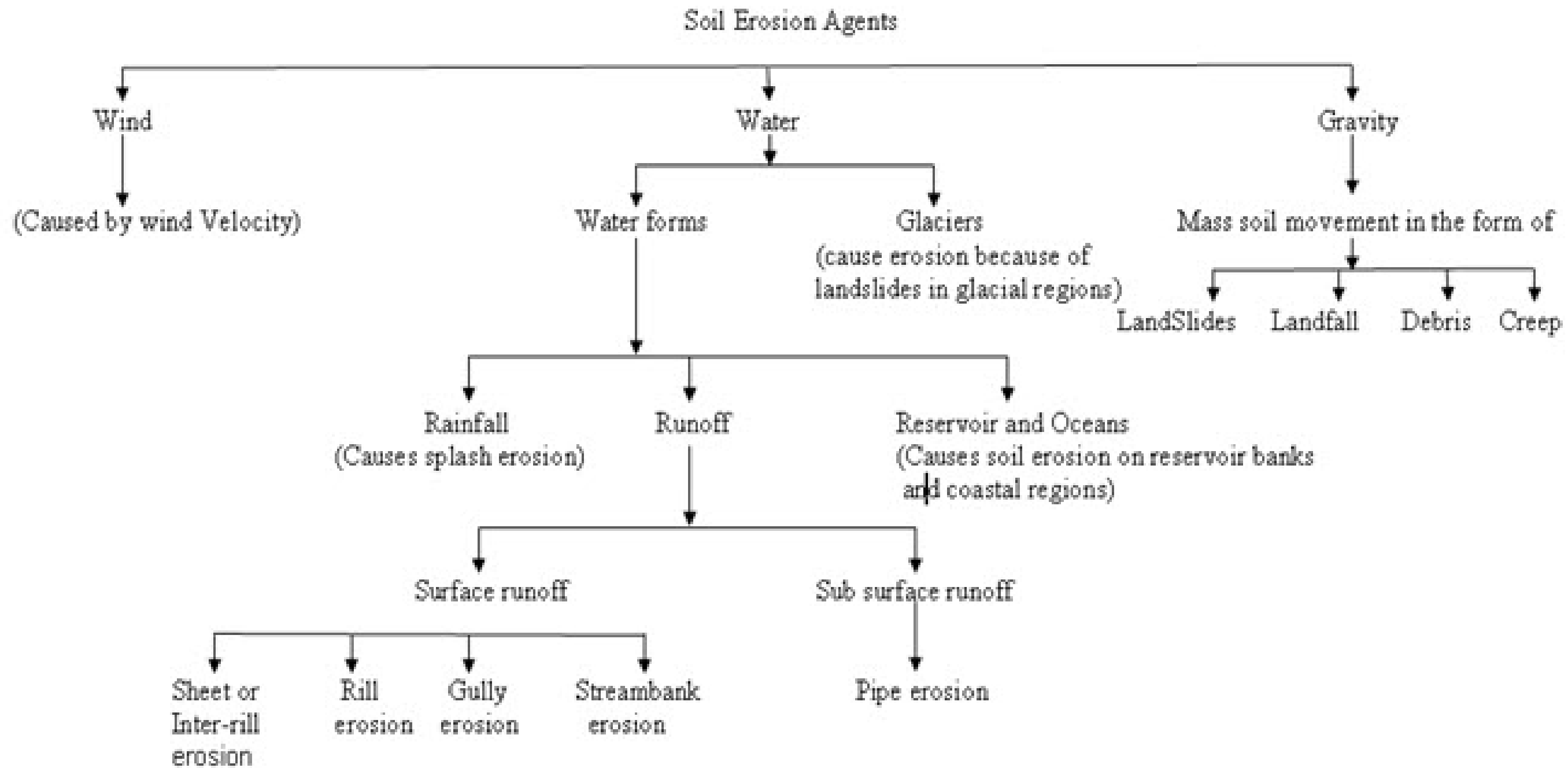


Fig. 2.1. Soil erosion agents, processes and effects. (Sources: Das, 2000)



2.5.1 Mechanics of Water Erosion

There are three steps for accelerated erosion by water:

- i) Detachment or loosening of soil particles caused by flowing water, freezing and thawing of the top soil, and/or the impact of falling raindrops,
- ii) Transportation of soil particles by floating, rolling, dragging, and/or splashing and
- iii) Deposition of transported particles at some places of lower elevation.

Rain enhances the translocation of soil through the process of splashing as shown in Fig.2.2. Individual raindrops detach soil aggregates and redeposit them as particles. The dispersed particles may then plug soil pores, reducing water intake (infiltration). Once the soil dries, these particles develop into a crust at the soil surface and runoff is further increased.



2.5 Mechanics of Soil Erosion

Soil erosion is initiated by detachment of soil particles due to action of rain. The detached particles are transported by erosion agents from one place to another and finally get settled at some place leading to soil erosion process. Different soil erosion processes are shown in Fig. 2.2.

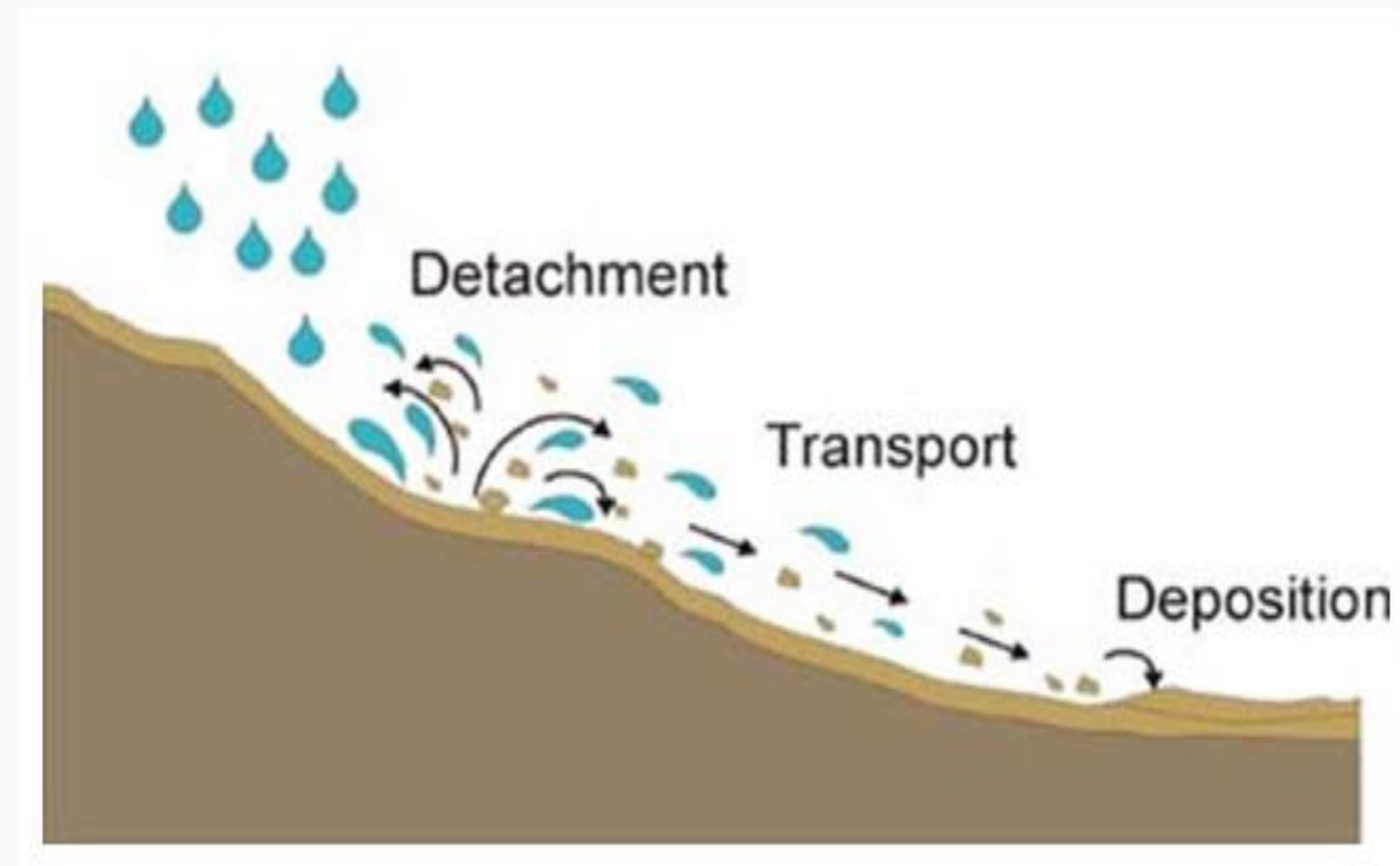


Fig. 2.2. Process of water erosion by the impact of raindrops.



1.2.3 Water Erosion

The soil erosion caused by water as an agent is called water erosion. In water erosion, the water acts as an agent to dislodge and transport the eroded soil particle from one location to another (Fig. 1.2).

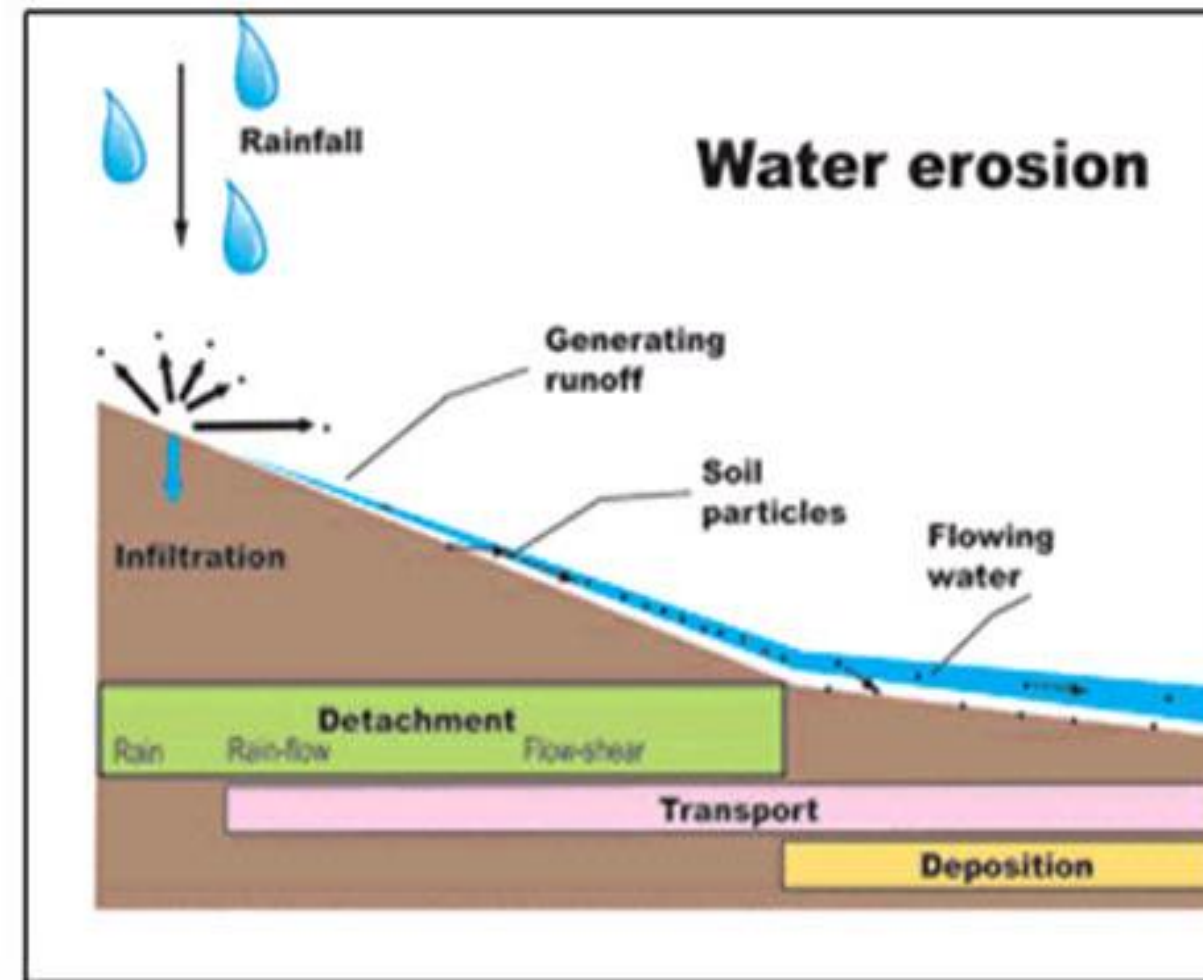


Fig. 1.2. Process of water erosion.



Types of soil erosion...

- ▶ 1. Geological Erosion
- ▶ 2. Accelerated Erosion
 - ▶ A) Wind erosion
 - ▶ B) Water Erosion
 - ▶ a) rain drop Erosion
 - ▶ b) rill erosion
 - ▶ c) gully erosion
 - ▶ d) bank erosion
 - ▶ e) Sheet erosion
 - ▶ f) landslide erosion
 - ▶ C) land slide erosion



Geologic Erosion

It is a normal process, representing erosion of land in natural environment. It is caused by effect of

- Rainfall
- Run-off
- Wind
- Topography
- Atmospheric temperature



Accelerated Erosion

Accelerated erosion is due to man made activities, which have brought about changes in natural cover and soil condition. The activities includes

- Land Preparation for raising crops,
- Land use patterns for building houses, infrastructures, industries, hill cutting, deforestation, lack of soil conservation and watershed management.



Water Erosion

- ▶ The impact of rain drops causes splash erosion
- ▶ Run-off water causes scouring, scraping and transport of soil particles, leading to sheet, rill and gully erosion.
- ▶ Flood water causes erosion of River Banks
- ▶ Water waves cause erosion of bank and sides of reservoir, lakes and oceans.
- ▶ Subsurface seepage water causes soil boiling, erosion and removal by piping.
- ▶ Glacial erosion causes heavy landslide



1.2.3.2.1 Splash Erosion

This type of soil erosion is because of the action of raindrop. The kinetic energy of falling raindrop dislodges the soil particle and the resultant runoff transports soil particles. Splash erosion (Fig. 1.3) is the first stage of soil erosion by water. It occurs when raindrops hit bare soil. The explosive impact breaks up soil aggregates so that individual soil particles are 'splashed' onto the soil surface. The splashed particles can rise as high 0.60 meter above the ground and move up to 1.5 meter from the point of impact. The particles block the spaces between soil aggregates, so that the soil forms a crust that reduces infiltration and increases runoff.

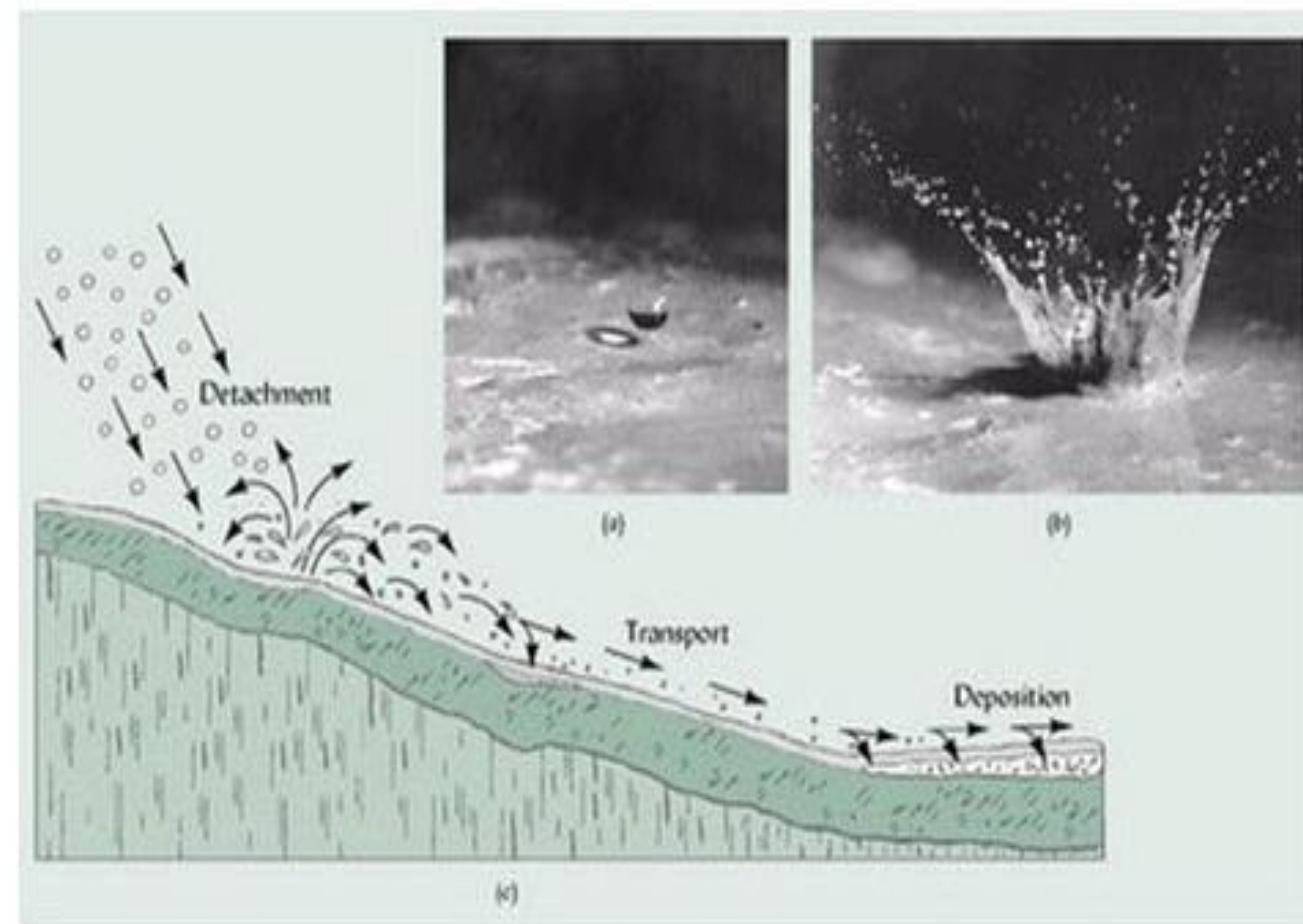


Fig. 1.3. Picture describing splash erosion of the soil.





Wind Erosion

It is primary responsible for creation and maintenance of desert areas

- ❑ Finer soil particles from top soil along with organic matter and nutrients are easily detachable and removed by wind velocity.



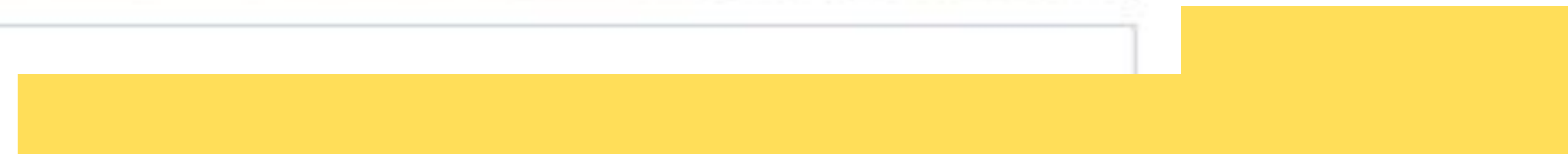


Erosion due to surface run-off





Bank Erosion





Sheet Erosion

- ▶ Sheet erosion is the movement of soil from rain drops splash and runoff water.
- ▶ It typically occurs evenly over a uniform slope and goes unnoticed until most of the productive topsoil has been lost.



TYPES OF SOIL EROSION

(1) **Sheet erosion-** Sheet erosion is the removal of the thin layer of topsoil by raindrop splash or water run-off.





Sheet Erosion





Rill Erosion

- ▶ In general the sheet flow is carried out by very small definable channels called interrill.
- ▶ When the process of soil erosion and deposition through interrill is prolonged, the interrills are widened, leading to formation of small channels called rills.



(3) Rill erosion

If sheet erosion occurs with full force, the run off water moves rapidly over the soil surface. It cuts well-defined finger-shaped groove like structures, It appears as thin channels or streams. It is known as Rill erosion.





1.2.3.2.3 Rill Erosion

Rills formation is the intermittent process of transforming to gully erosion. The advance form of the rill is initial stage of gully formation. The rills are shallow drainage lines less than 30cm deep and 50 cm wide. They develop when surface water concentrates in depressions or low points through paddocks and erodes the soil. Rill erosion is common in bare agricultural land, particularly overgrazed land, and in freshly tilled soil where the soil structure has been loosened. The rills can usually be removed with farm machinery. Rill erosion is mostly occurs in alluvial soil and is quite frequent in Chambal river valley in India. The typical rill formation is presented in Fig. 1.5.

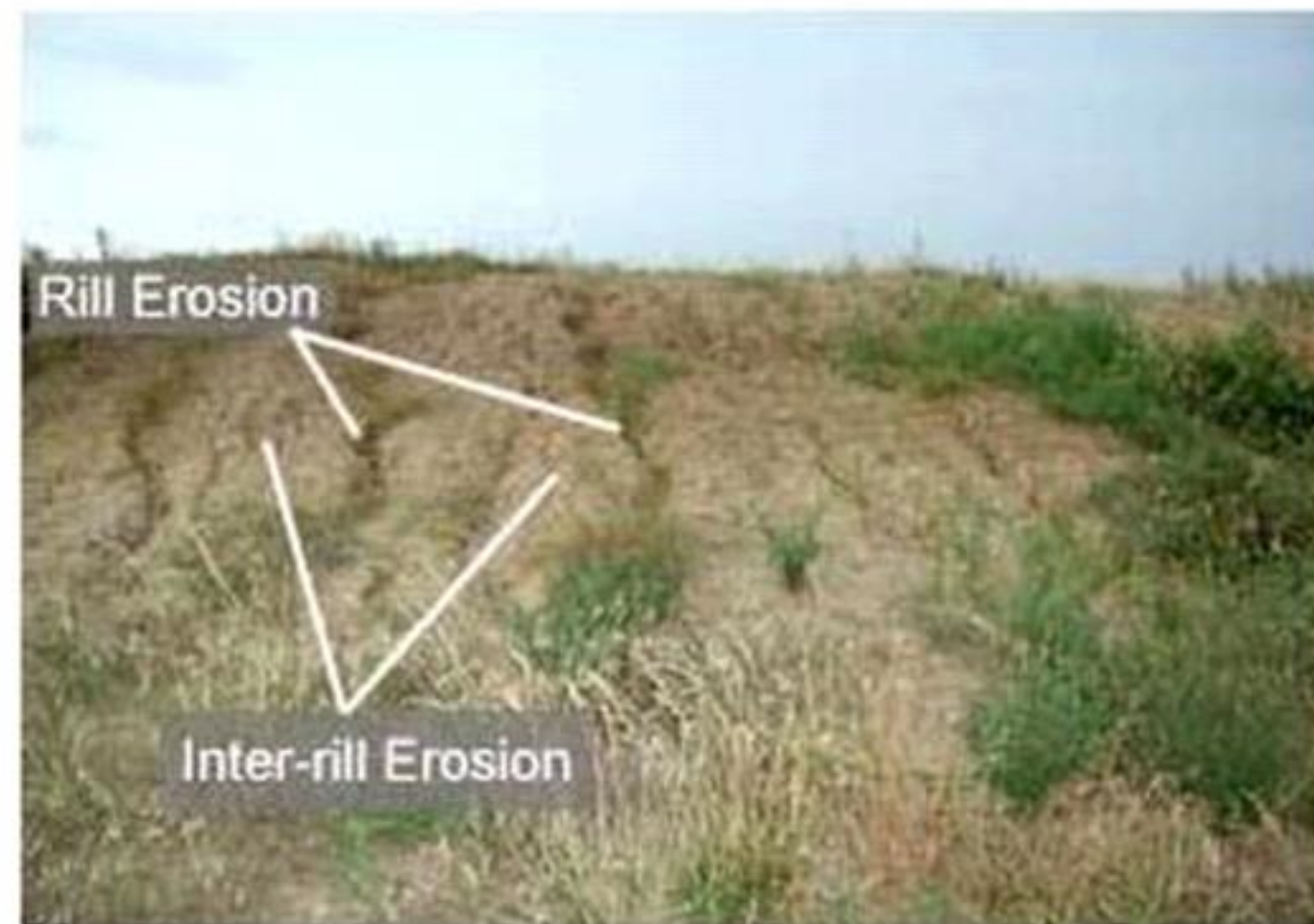
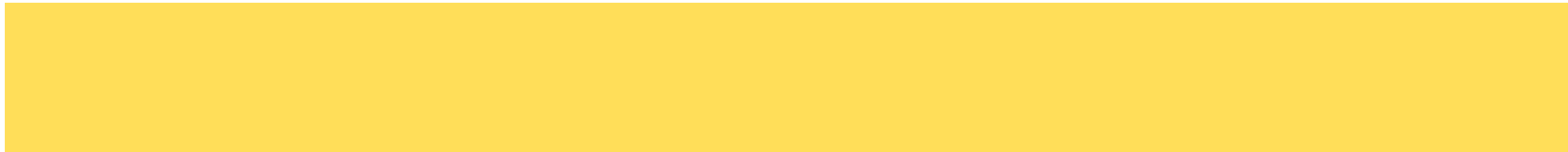


Fig.1.5. Rill formation following the sheet erosion.





Gully Erosion

- ▶ Rills are smaller in size and depth, they can be destroyed by tillage operation.
- ▶ If their occurrence is prolonged, rills become larger in size and can not be destroyed by tillage operation, and they become Gullies.



(2) Gully erosion- In Gully erosion, the surface run-off is very high.

Gullies resemble large ditches or small valleys; are metres to 10 metres in depth and width.







Table 1.4. Classification of Gully

Particulars	Description of symbols of Gully			
	G1	G2	G3	G4
Depth in meter	Upto 1.0	1.0-3.0	3.0-9.0	>9.0
Width in meter	<18.0	<18.0	18.0	>18.0
Side slope (%)	<6.0	<6.0	6.0-12.0	>12.0



(4) Stream bank erosion

The rivers during floods splash their water against the banks. In this way the water cuts through them. Particularly at curves, water strikes with great speed and the bank caves in alongside. This type of erosion is also known as **Riparian erosion**.





1.2.3.2.6 Stream Bank Erosion

Stream bank erosion (Fig. 1.8) occurs where streams begin cutting deeper and wider channels as a consequence of increased peak flows or the removal of local protective vegetation. Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. This is quite prevalent in alluvial river and streams. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.



(a)



❖ Other Types-

- ✓ Wind Erosion-Soil erosion by wind is common in dry (arid) regions. Two characteristics of such region are:
 - (a) The soil is mainly sandy
 - (b) The vegetation is very poor or even absent

- ✓ Landslides or slip erosion-The hydraulic pressure which is caused by heavy rains increases the weight of the rocks at cliffs. As a result they come under the gravitational force and finally slip or fall off.



Land slide Erosion





Fig. - Landslides or slip erosion



1.3 Effects of Soil Erosion

The soil erosion adversely affects the livelihood of the people in one way or other. The major losses and problem occurs due to the soil erosion from various agents are listed below.

- Siltation of rivers.
- Siltation of irrigation channels and reservoirs.
- Problems in crop irrigation and consequent need of conserving the water.
- Damage to sea coast and formation of sand dunes.
- Disease and public health hazards.
- Soils eroded by water get deposited on river beds, thus increasing their level and causing floods. These floods sometime have various extreme effects, such as killing human and animals and damaging various buildings.
- Soil erosion decreases the moisture supply by soil to the plants for their growth. It also affects the activity of soil micro-organisms thus deteriorating the crop yield.
- Top layer of soil contains most of the organic matter and nutrients, loss of this soil reducing soil fertility and affecting its structure badly.
- Wind erosion is very selective, carrying the finest particles - particularly organic matter, clay and loam for many kilometres. There the wind erosion causes losses of fertile soils from highly productive farming areas.
- The most spectacular forms are dunes - mounds of more or less sterile sand - which move as the wind takes them, even burying oases and ancient cities.
- Sheets of sand travelling close to the ground (30 to 50 metres) can degrade crops.
- Wind erosion reduces the capacity of the soil to store nutrients and water, thus making the environment drier.



Problems of Erosion

- ▶ Loss in agricultural production
- ▶ Loss of nutrients
- ▶ Reduction of infiltration rates
- ▶ Increased cost in tillage operation
- ▶ Flood may occur in Rivers
- ▶ Decreases in useful life of reservoir
- ▶ Survival of wild life
- ▶ Land degradation
- ▶ Cost of removal of sedimentation
- ▶ Desertification.