

## Soil Erosion: Types and Their Mechanism

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### Abstract

Soil erosion is a universal phenomenon. Out of the 328.7 m ha of India's geographical area about 175 m ha (53.3%) is subjected to soil erosion and some kind of land degradation. Soil erosion is one form of soil degradation along with soil compaction, low organic matter, and loss of soil structure, poor internal drainage, salinization, and soil acidity problems. This other forms of soil degradation, serious in them; usually contribute to accelerated soil erosion. There are several factors responsible for soil erosion. Soil conservation is an essential practice for getting good crop production from all regions especially from arid and semi-arid areas. In arid and semi-arid regions these two factors are major indicators of soil quality. Low soil moisture leads to erosion by wind and excess water leads to leaching of nutrients. So, soil erosion is the major threat to dry regions of the country. This article reviews the various types of soil erosion and mechanisms behind. This information is essential for adopting suitable soil conservation strategy.

### Keywords:

### 1. Introduction

The problem of soil erosion exists all over the country. Out of the 328.7 m ha of India's geographical area about 175 m ha (53.3%) is subjected to soil erosion and some kind of land degradation (Brady, 2010). Soil erosion is one form of soil degradation along with soil compaction, low organic matter, and loss of soil structure, poor internal drainage, salinization, and soil acidity problems. This other forms of soil degradation, serious in them; usually contribute to accelerated soil erosion. Soil erosion is a naturally occurring process on all land. The agents of soil erosion are water and wind, each contributing a significant amount of soil loss each year. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil. The loss of soil from farmland may be reflected in reduced crop production potential, lower surface water quality and damaged drainage networks.

Detachment and transportation of top soil particles by wind and/or water is known as soil erosion (Shi, 2012).

The process of soil erosion is made up of three parts:

- **Detachment:** This is when the topsoil is actually "detached" from the rest of the ground.
- **Movement:** This is when the topsoil is relocated to another area.

- **Deposition:** Where the topsoil ends up after this process.

### 2. Natural or Geological or Normal Soil Erosion

When the top soils are gradually removed under normal conditions of physical, biotic and hydrological equilibrium it is called normal erosion. Sometimes, it is also called geological erosion it take place steadily but long time slowly which developed the present topographic feature like valley, plains, stream, channel etc. It is very slow process in which complete equilibrium is maintained between soil removing and soil forming processes. The normal erosion tends to produce wavy or undulating land surface with alternating ridges and depressions. This is accomplished chiefly by means of slow migration of soil particles from soil surface in successive rains. In arid region, wind during the long dry season is an important factor for normal erosion. Nature requires, on an average, about 1000 years building up 2.5cm of top soil, but wrong farming methods may be take place only a few years to erode it from lands of average slope (Weil et al., 2016).

### 3. Accelerated Soil Erosion

It occurs due to disturbance in natural equilibrium by the activity of men and animal through land mismanagement, destruction of forests, over grazing etc. When the removal of soil does not keep harmony with the soil formation and it is



much faster than the latter, it is called accelerated soil erosion.

#### Agencies or mechanism of soil erosion

- Water erosion
- Wind erosion
- Biotic erosion

##### 1.1. Water erosion

Soil erosion caused by rainfall is the application of energy from two distinct sources namely (i) the falling rain drops and (ii) the surface flow. The energy of falling raindrop is applied vertically from above, whereas that of surface flow is applied more or less horizontally along the surface of the ground. The chief role of the falling of rain drop on ground is to detach soil particle, whereas that of the surface flow is to transport the soil. The falling of raindrop also makes a major contribution to the movement of the soil on unprotected sloping lands during the period of heavy impact storms, by splashing large quantities down slope.

Soil erosion caused by water can be distinguished in different forms, viz (1) splash erosion, (2) sheet erosion, (3) rill erosion, (4) gully erosion, (5) ravine erosion, (6) landslides, and (7) stream-bank erosion.

##### 1.1.1. Splash erosion

Remove of soil particles due t rain drops is called splash erosion.

##### 1.1.2. Sheet erosion

Sheet erosion means removes a thin uniform covering of top productive/surface soil from large areas, often from field, more or less, during every rain which produces a run-off. This type of erosion is very insidious, since it keeps the cultivator almost ignorant of its ill-effect. It is also known as death of farmers.

##### 1.1.3. Rill erosion

When runoff starts, channelization begins and erosion is no longer uniform. Raindrop impact does not directly detach any particles below flow line in rills but increases the detachment and transportation capacity of the flow. Rills are small channels, which can be removed by timely normal tillage operations.

##### 1.1.4. Gully erosion

It is more prominent type of erosion in which heavy rainfall, rapidly running water and transporting water may result in deeper cavities or grooves called gullies. Gullies may be 'V' shaped or 'U' shaped. Gullies cut the large fields into small fragments and, in course of time, make them unfit for cultivation uncultivable. Continuous flow of water through gullies further deepens the grooves and may ultimately result in ravines. Ravines are 15 to 30 cm in deep and with steep vertical sides.

##### 1.1.5. Ravines erosion

It is prolonged and advance stage of gully erosion leads to

ravines found in deep alluvial soils. It is nothing but deep and wide gullies.

##### 1.1.6. Landslides or slip erosion

This type of soil erosion is caused by heavy rainfall and it occurs in sloppy lands, such as mountains and hilly areas with slope is >20%. In this type of erosion when the running water percolates through the crevices of rocks great masses of soils and loose rocks lying on the steep slopes slip downward. The immediate cause of a slide may be an earthquake, or a heavy rainfall, which unduly saturates the ground or part of road.

##### 1.1.7. Stream bank erosion

On the banks of swollen rivers it is most active. During the rainy season when fast running water streams take turn in some other directions, they cut the soil and make caves in the banks. As a result of this, quite often large masses of soils become detached and washed away from the banks and are deposited at places in course of streams.

##### 1.2. Wind erosion

Wind erosion takes place normally in arid and semi arid areas devoid of vegetation, where the wind velocity is high. The soil particles on the land surface are lifted and blown off as dust storms. When the velocity of the dust bearing wind is retarded, coarser soil particles are deposited in the form of dunes and thus fertile lands are rendered unfit for cultivation. In other place, fertile soil is blown away by winds and the subsoil is exposed, as a result the productive capacity of the soil is considerably reduced. Lifting and abrasive action of wind results in detachment of tiny soil particles from the granules or clods. The impact of these rapidly moving particles dislodge other particles from clods and aggregates. These dislodged particles are ready for movement. Movement of soil particles in wind erosion is initiated when the pressure by the wind against the surface soil grains overcomes the force of gravity on the grains.

Wind is responsible for three types of soil movement in the process of wind erosion. They are known as (i) saltation (ii) suspension and (iii) surface creep.

##### 1.2.1. Saltation

The major portion of soil carried by the win is moved in a series of short bounces called "saltation". The soil carried in a saltation consists of fine particles ranging from 0.1 to 0.5 mm in diameter. About 50-75% of soil erosion by wind carried out by saltation. Saltation is caused by the direct pressure of wind on soil particles and their collision with other particles. After being pushed along the ground surface by the wind, the particles leap almost vertically in the first stages of saltation.

##### 1.2.2. Suspension

Movement of fine dust particles smaller than 0.1 mm diameter by floating in the air is known as suspension. Soil particles carried in suspension are deposited when the sedimentation force is greater than the force holding the



particles in suspension. This occurs with decrease in wind velocity. Suspension usually may not account for more than 15% of total movement.

### 1.2.3. Surface creep

Soil particles, larger than about 0.5 mm in diameter but smaller than 3.0 mm, are too heavy to be moved in saltation but rolled and sliding along the surface by the pressure of wind and hitting during saltation. About 5-25 % of soil erosion carried out by surface creep. About 90% of the total soil movement in wind erosion is below the height of 30 cm and about 50% of it is within 5 cm of the ground level.

### 1.3. Biotic agencies causing soil erosion

1. Excessive grazing, deforestation, undesirable forest biota, and mechanical practices by man are important factors which cause soil erosion. Deforestation is the commonest factor which is responsible for soil erosion.

2. Grazing is yet another destructive biological factor for the soil erosion. Cattle and sheep during the summer graze the forest vegetation and make the soil bare.

3. Shifting cultivations. Shifting cultivations are usually noted in the mountains which are geographically young and degraded into soil easily and the whole of the land is covered with a thick mantle of tropical forest vegetation. The removal of the forest or bush cover by felling and burning for shifting cultivation and the resulting exposure of the bare soil to rams and sun, cause enormous soil losses especially on hill slopes. Both surface layer of the soil and large quantity of plant nutrients are washed away under the influence of intense rainfall. Shifting cultivation is a major problem in the hilly areas of Assam, Manipur, Tripura, Arunachal Pradesh, Nagaland and Orissa. Fields on steep slopes are cultivated and top soil is

washed away by rains. The loss of soil is too much and the fields become uncultivable.

4. Forest fires are responsible for burning down forest trees on huge scale.

5. Faulty agricultural methods—Sometimes farmers do not care towards leveling and terracing of their upland fields. Rainfall washes away the top soil and results in erosion.

6. Over-grazing by cattle causes removal of vegetation cover of the soil.

### 3. Conclusion

Soil and water are two most important factors which governs all physical and chemical process of soils. Soil conservation is an essential practice for getting good crop production from all regions especially from arid and semi-arid areas. In arid and semi-arid regions these two factors are major indicators of soil quality. Low soil moisture leads to erosion by wind and excess water leads to leaching of nutrients. So, soil erosion is the major threat to dry regions of the country.

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