

Rangeland Soil Quality

Water Erosion



What Is Water Erosion?

Water erosion is the detachment and removal of soil material by water. The process may be natural or accelerated by human activity. The rate of erosion may be very slow to very rapid, depending on the soil, the local landscape, and weather conditions.

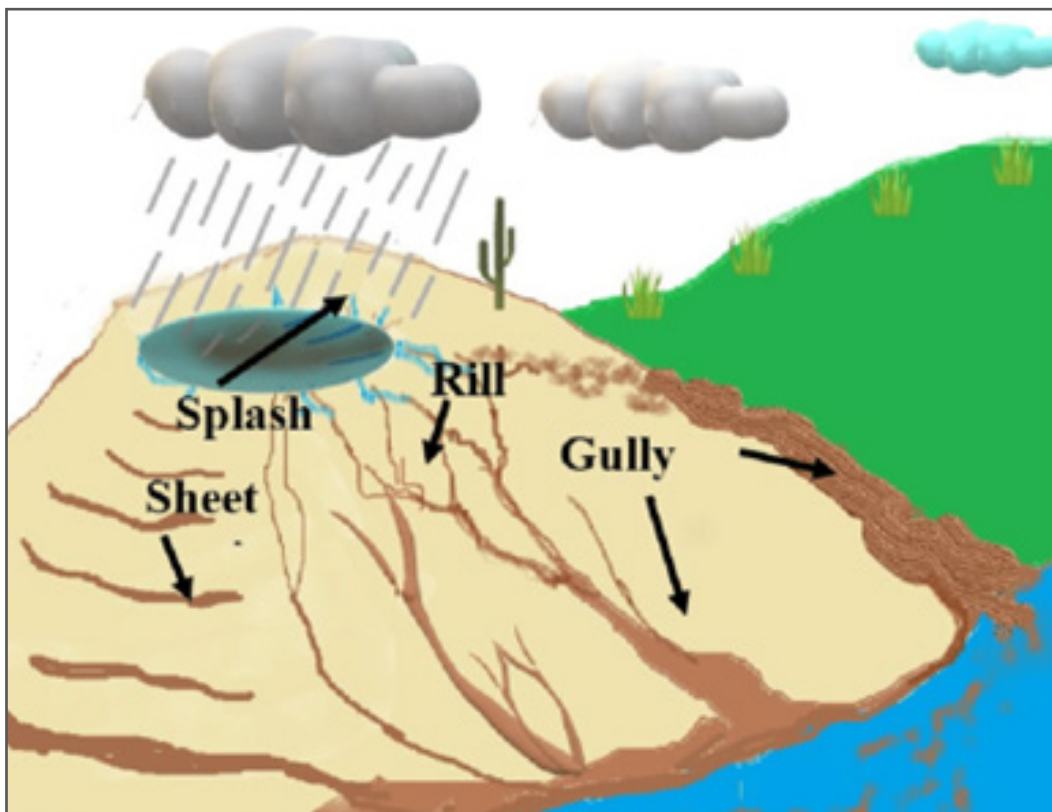
As shown in figure 1, water erosion wears away the earth's surface. Sheet erosion is the more-or-less uniform removal of soil from the surface. Rill and gully erosion occurs when concentrated runoff cuts conspicuous channels into the soil. Deposition of the sediment removed by erosion is likely in any area where the velocity of running water

is reduced behind plants, litter, and rocks; in places where slope is reduced; or in streams, lakes, and reservoirs.

Why Is Erosion a Concern?

Soil erosion by wind and water is already a serious threat to US rangelands and may be accelerated by future climate change (Edwards et al. 2019). Loss of topsoil reduces the capacity of the soil to function and restricts its ability to sustain future uses. More widespread erosion will only increase the exposure and sensitivity of rangelands to climate

Figure 1 - Schematic showing types of water erosion (Senanayake, 2020)



References

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impacts, reducing resilience to climatic stressors and pushing some rangelands past restoration and conservation thresholds (Edwards et al. 2019).

Erosion removes or redistributes topsoil, the layer of soil with the greatest concentration of organic matter, biological activity, and nutrients. The ability of a plant community to recover after topsoil is lost is restricted. Erosion breaks down soil structure, exposing organic matter within soil aggregates to decomposition and loss. Degraded soil structure reduces the rate of water infiltration. Erosion of nutrient-rich topsoil can cause or accelerate a shift to less desirable plants, such as grass to shrub species. In this process, soil organic matter and nutrients eroded from one area contribute to resource accumulation in another, such as areas around shrubs. Soil erosion can bury plants and roads, accumulate in streams, rivers, and reservoirs, and degrade water quality.

What Causes Water Erosion?

Erosion is due to the impact of raindrops on bare soil and the power of flowing water over the soil surface. Natural erosion rates depend on

inherent soil properties, slope, and climate, which together determine the ability of the site to support vegetation. Accelerated erosion occurs when the plant cover is depleted, spaces between plants become larger, and soil structure is degraded due to excessive disturbance or reduced inputs of organic matter. Compaction increases runoff and the risk of accelerated erosion. Runoff concentrated by poorly designed or maintained roads or trails can cause accelerated erosion on the adjacent slopes and roadbeds.

Many vegetation and soil properties affect the risk of erosion. Each specific soil has its natural hazard of erosion. A sandy or clayey texture generally is less erodible than loam or silt loam. However, sandy soils formed in material weathered from decomposed granitic rock are highly erodible. Soils with rock fragments or biological crusts on the surface are protected from the impact of raindrops. Stable soil aggregates bound together by organic matter resist erosion and enhance infiltration, thereby reducing runoff. The amount of runoff and the power of water to erode and transport soil is greater on long, steep slopes. Bare soil between plants is most susceptible to erosion.

What Are Some Indicators of Erosion?

Erosion and the risk of erosion are difficult to measure directly. Other soil properties that can be measured that affect erosion and can change with management include soil surface stability, aggregate stability, infiltration, compaction, and organic matter content. Measuring these properties can shed light on the susceptibility of a site to erosion. Comparing visual observations along with quantitative measurements to the conditions indicated in the ecological site description or a reference area helps to provide information about soil surface stability, sedimentation, and soil loss.

The visual indicators used to identify past erosion include:

- ◆ bare soil,
- ◆ base of plants discolored by soil movement from raindrop splash or overland flow,
- ◆ pedestaled plants or rocks,
- ◆ exposed roots,





- ◆ terracettes (benches of soil deposited behind obstacles),
- ◆ an increase in the number and connectivity of waterflow patterns between plants,
- ◆ soil deposition at slope changes,
- ◆ changes in thickness of topsoil,
- ◆ exposure of subsoil at the surface,
- ◆ rills, headcutting, and/or downcutting gullies,
- ◆ sediment in streams, lakes, and reservoirs, and
- ◆ reduced plant growth.

When measured every few years, the following indicators can be used to predict where accelerated erosion is likely to occur in the future:

- ◆ an increase in the amount of bare ground or in the size or connectivity of bare patches,
- ◆ reduced soil aggregate and surface stability, and
- ◆ reduced water infiltration.

Management Strategies That Minimize Water Erosion

A management plan should consider erosion risk and the potential for recovery. The risk of erosion is increased by fire frequency or intensity that is either greater or less than expected for a site, disturbances such as heavy grazing, and the establishment of weeds. Areas with fertile topsoil are most likely to recover after a disturbance. In areas where much of the topsoil is lost, the site may no longer be able to support historic vegetation. Management strategies include:

- ◆ Maintain or increase the cover of plants or litter on the soil through the application of good rangeland management practices.
- ◆ Reduce soil surface disturbances, especially in arid areas.

- ◆ Increase the rate of water infiltration and improve soil aggregate stability by improving or maintaining the quality of the plant community.
- ◆ Minimize grazing and traffic when the soil is wet and thus prevent the reduced infiltration caused by compaction and physical crusting.
- ◆ Build water bars and direct waterflow from roads, trails, or vehicle tracks across the slope or into existing drainageways.
- ◆ Maintain road surfaces and drainageways.

