Land Notes
Natural Resource Management

SOIL STABILITY AND EROSION

Erosion is a natural process, but it can be accelerated through changes in land use, vegetative cover and drainage patterns. The major agents of soil erosion are water, wind and gravity; with water being the most significant agent. Erosion caused by water can be defined as splash, sheet, rill, gully, riverbank and tunnel erosion. The best protection against increases in these processes is through maintenance of surface cover. Vegetation and ground cover also protects the soil from wind erosion.

WATER EROSION

Splash (raindrop) erosion

Raindrops falling on bare soil break individual soil particles loose (see Figure 1), allowing them to be picked up and carried by runoff. These particles block air and water pathways into the soil, decreasing infiltration and increasing runoff.

The size and velocity of raindrops determine their ability to dislodge the soil. The higher the intensity of the storm, then the greater the erosive capacity of the raindrops. Vegetative cover and surface litter absorb energy from raindrops, reducing the amount of soil splash (see Figure 2). In addition, the cover reduces the amount of direct contact between the drops and the soil. Increasing roughness of a soil surface also tends to reduce the impact of splash.

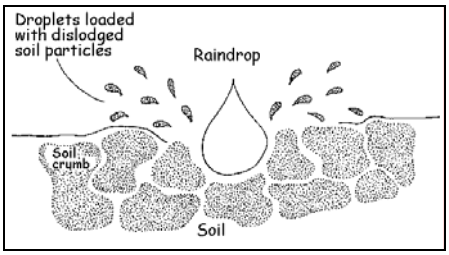

Figure 1 The effect of raindrop splash on bare soil

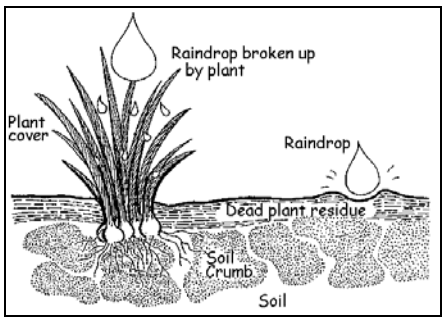

Figure 2 The effect of vegetative cover

Sheet erosion

Sheet erosion occurs when loose or detached soil is transported in a uniform layer, with no channelled flow. Small particles are carried in suspension, while larger, heavier particles are "bounced" along (saltation).

Long, steep slopes also increase the effects of sheet erosion due to the higher velocity of runoff. The retention of vegetative cover and surface litter protects the soil surface, reduces contact between the soil and water, and slows the velocity of runoff. This, in turn, allows more water to infiltrate, and greatly impedes the process of sheet erosion.

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Rill erosion

If runoff is travelling over uneven soil, or if it is moving quickly enough, shallow channels may form. These are known as rills, and are usually no more than 30cm deep. They can, however, be quite long and widespread over any given area.

Water flows quickly in a rill because it is concentrated, leading to increased detachment and transportation of soil particles. The faster water travels, the greater its scouring and cutting force. This can (but not always) lead to the formation of gullies.

As with sheet erosion, slope and vegetation play an important role in determining the severity of rill erosion. On long slopes, water can accumulate quickly in channels and form rills. This is particularly the case where vegetation is scarce. Vegetation and ground cover spreads the flow over a wider area, reducing its velocity. At lower velocities, the runoff cannot carry as much loose soil, and the excess is deposited as sediment.

Plate 1 Rill erosion

Gully erosion

Gullies are formed when rills become deeper channels. While rills will disappear temporarily with cultivation, gullies cannot be stabilised through cultivation, due to their depth and size. Gullies flow intermittently, during and/or shortly after rainfall.

Gully formation begins with scouring of the topsoil within a channel. The gully head then usually moves upslope due to incision by concentrated runoff, or slumping by subsoil dispersion. This causes the channel to become longer and wider. A waterfall may form at the gully head, which can lead to undercutting and further slumping of material into the gully floor, also contributing to gully head advancement.

Factors affecting the rate of gully erosion include the slope of the channel (the steeper the slope, then the higher the erosive power of the flow), the size and shape of the gully and the direction of the channel. Other factors are the size and nature of the catchment, soil type and vegetation.

Tunnel erosion

This is a minor form of erosion in the Northern Territory, and occurs mostly in sodium rich clay subsoils. When water penetrates the subsoil, this soil becomes non-cohesive and is easily dispersed.

Water may enter the subsoil through old stump holes, burrows or other depressions. In severe cases, enough subsoil may be washed away to form a tunnel. If the overlying topsoil collapses, a gully is formed.

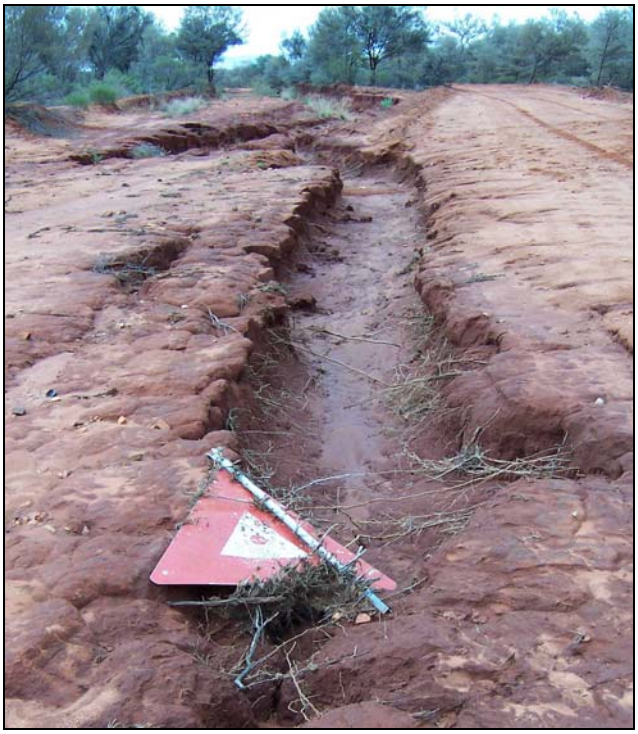

Plate 2 Gully erosion

Riverbank erosion

Rivers are naturally dynamic systems that transport and deposit sediment throughout their course. Generally the outer edges of bends in the system (where the water flows faster) are undercut and eroded, with the resultant sediment being deposited on the inside edges. This process produces and extends meanders. Any change in the amount and frequency of flow will have an effect on these processes.

If channel flow increases, the water is able to carry more and larger particles. This can lead to bank erosion, and in severe cases whole sections of riverbank can fall into the river and be transported downstream as sediment.

Anything that increases runoff within a catchment can result in increased channel flow. Obviously, an increase in runoff allows more water to enter the river/stream system. This situation is worsened if the vegetative cover along the banks of waterways is reduced or destroyed

Soil moved by saltation or surface creep usually remains in the immediate area, while soil carried in suspension may travel hundreds of kilometres before being deposited.

The susceptibility of an area to wind erosion depends primarily on climate, soil texture and vegetation cover. Unlike erosion by water, wind erosion is not as heavily influenced by topography, or slope.

Vegetation and ground cover reduce the effects of wind erosion by protecting the soil surface and reducing soil contact with surface winds. Plant roots also bind soil particles together, and make them more resilient to being detached. In addition, the presence of vegetation lowers the wind velocity at the surface, and so decreases the capacity of the wind to dislodge and transport soil particles. Vegetation will also trap and hold wind borne soil particles.

WIND EROSION

Wind erosion occurs on relatively dry soils, so is more of a problem during dry seasons and drought. Air turbulence created by vehicles driving along unsealed roads and tracks acts on the road surface in the same way as natural wind, and can lead to the loss of significant amounts of fine-grained material from the road surface.

Plate 3 Wind erosion

Wind transports soil in three ways - saltation, suspension and surface creep. Saltation occurs through direct pressure of the wind on the soil, where particles are detached by the wind and bounced along the surface. Airborne particles hitting the ground may dislodge other particles, which in turn are carried forward.

Some of the detached particles will be small and light, and so will be carried in suspension and blown away as dust. Larger particles that are too heavy to be bounced or suspended are rolled along the ground, either directly by the wind or by the impact of other particles. This is known as surface creep.

MASS MOVEMENT (GRAVITY)

Mass movement is the process where a mass of land slides down slope. The activating force is gravity, but movement usually occurs when the weight of the soil has been increased. This is often caused by excessive groundwater entering the area, usually through the removal of vegetative cover. Deep rooting plants will not only remove water through transpiration, but also stabilise the soil with their root systems.

The removal of support at the toe of a slope is also a major cause of mass movement. This is not a major form of erosion in the NT. It may occur at road cuttings where excavation has been too steep, on riverbanks or on construction sites.