Wind erosion

Wind erosion is a common cause of land degradation in the arid and semi arid grazing lands of inland Queensland. It is one of the processes leading to desertification. Significant wind erosion occurs when strong winds blow over light-textured soils that have been heavily grazed during periods of drought.

Wind erosion is also a natural process. The large parallel sand dunes in south-west Queensland, including the Simpson Desert National Park, are the result of wind erosion and deposition over thousands of years. These dunes are constantly moving and roads and tracks can be covered by drifting sands in only a few hours.

Understanding wind erosion is important as it provides a foundation for developing appropriate and effective land management and erosion control processes. To control wind erosion, DERM encourages the adoption of sustainable management practices in the grazing and cropping industries.

Areas affected by wind erosion

The lighter textured soils (sands and loams) in the low rainfall lands of Queensland's south-west are the most susceptible to wind erosion. Average annual rainfall in this area is between 150 and 500 millimetres (mm).

Wind erosion is generally not a serious issue in the two per cent of Queensland that is used for cropping. This area is located in higher rainfall areas and most of the soils are well-structured clays. The relatively large aggregates formed by clays are too coarse to become airborne. However cultivated sandy and red loamy soils are susceptible to wind erosion when they have no cover and are in a dry, finely worked condition.

The effects of wind erosion

Wind erosion may have the following impacts:

- Soil fertility is reduced because of the loss of the plant nutrients that are concentrated on fine soil particles and organic matter in the topsoil. This reduces the soils capacity to support productive pastures and sustain biodiversity.
- Erosion at the base of bushes and plants can result in the plant being isolated and ground cover being thinned out.
- The erosion of light-textured topsoil can expose dense clay subsoils. These smooth and bare areas, called claypans or scalds can cover hundreds or even thousands of hectares. They are difficult to revegetate due to the lack of topsoil, low permeability and their often saline nature.
- The build up of soil particles against obstacles may bury fences and roads.
- Sand grains transported by strong winds can damage vegetation in their path by sandblasting.
- Air pollution caused by fine particles in suspension can affect people's health and cause other problems.

Contributing factors

Overgrazing by livestock is a prime cause of wind erosion. Grazing pressure can also occur from kangaroos and wallabies, as well as feral animals such as rabbits, goats and camels.

Periods of drought associated with a negative Southern Oscillation Index (SOI) provide the highest levels of wind erosion activity. The hotter and drier conditions predicted under climate change scenarios would exacerbate the problem.

The breakdown of the biological soil crust, which is a characteristic of many arid zone soils, makes soils susceptible to wind erosion. This living crust incorporates algae, lichens, mosses and liverworts and protects the soil from all forms of soil erosion. Crust cover can take many years to recover once damaged.

The wind speed required for erosion depends on the size, weight and wetness of the soil particles. Movement of small, disturbed particles begins with light gusts of wind, however wind speeds of 20 to 30 kilometres per hour are required for significant erosion to occur.

Major dust storm events in Queensland are usually associated with the easterly passage of frontal systems across the continent, hot pre-frontal northerly winds, post-frontal southerlies or frontal westerlies. These weather systems are most prevalent in Queensland during spring and early summer.

Sources of air borne materials

Soils are made up of particles of sand, silt and clay. Individual soil particles generally need to be less than one mm in order to be moved by wind. Individual clay particles have an average diameter of only 0.001 mm but they usually clump together in aggregates that are too heavy to be moved by wind. Non-aggregated particles of sand, silt, clay and organic matter are most susceptible to removal by wind erosion.

Some dust originates from sediments carried by floods in rivers in the Lake Eyre catchment. Sediments deposited in alluvial areas can be protected by the abundant pasture growth that occurs after the flood. However where sediments reach saline areas, there will be

minimal vegetation growth. After the floodwaters soak in or evaporate, the fine sediments left on the smooth bare surfaces are susceptible to removal by wind.

Wind erosion processes

The three processes of wind erosion are surface creep, saltation and suspension. Characteristics of each are outlined below.

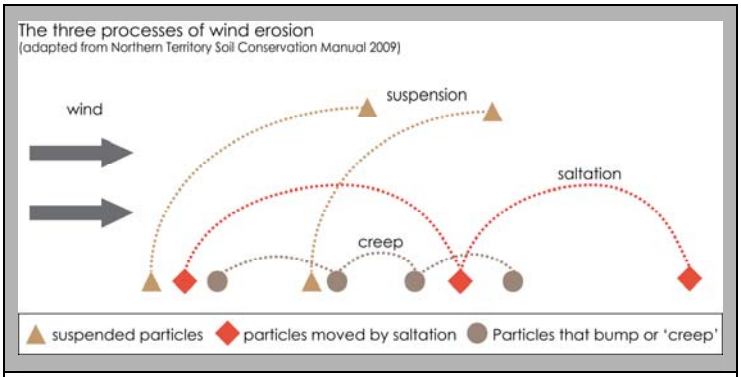

Figure 1 The three processes of soil erosion

Surface creep—in a wind erosion event, large particles ranging from 0.5 mm to 2 mm in diameter, are rolled across the soil surface. This causes them to collide with, and dislodge, other particles. Surface creep wind erosion results in these larger particles moving only a few metres.

Saltation—occurs among middle-sized soil particles that range from 0.05 mm to 0.5 mm in diameter. Such particles are light enough to be lifted off the surface, but are too large to become suspended. These particles move through a series of low bounces over the surface, causing abrasion on the soil surface and attrition (the breaking of particles into smaller particles).

Suspension—tiny particles less than 0.1 mm in diameter can be moved into the air by saltation, forming dust storms when taken further upwards by turbulence. These particles include very fine grains of sand, clay particles and organic matter. However, not all dust ejected from the surface is carried in the air indefinitely. Larger dust particles (0.05 to 0.1 mm) may be dropped within a couple of kilometres of the erosion site. Particles of the order of 0.01 mm may travel hundreds of kilometres and 0.001 mm sized particles may travel thousands of kilometres. Through this process, Australian soil has been carried to New Zealand and beyond. Fine dust may remain in suspension in the air until it is washed out by rainfall.

Control measures

The most effective method of controlling erosion by both wind and water is to maintain adequate levels of cover on the soil surface. To achieve this on grazing lands, stock numbers need to be managed to match the current and expected seasonal conditions. Graziers have to make regular decisions about how many animals they should run on a piece of land taking into account the added impact of native herbivores and feral animals.

Trees and shrubs help to reduce wind velocities and so provide protection from wind erosion. Large areas of grazing lands in Queensland are tree-covered or subject to woodland thickening. While thickening has a negative impact on pasture growth and may contribute to water erosion, it provides protection from wind erosion.

Shelter belts or tree corridors contribute to biodiversity, provide shelter for livestock and reduce the drying effects of winds. However, it is not practical to plant belts of trees in the vast, arid inland areas where wind erosion is most prevalent. Hence well-managed pastures are the key to providing erosion protection in these areas.

While cultivated areas in Queensland are at serous risk from erosion by water, most are not at significant risk from wind erosion. However some clay soils, that also contain sand, can be eroded by wind after heavy rainfall. This phenomenon has been observed in the Brigalow Belt. Raindrop impact may 'flatten' a bare soil and leave sand particles on the soil surface. When the soil dries out, the sand particles on the smooth surface can be removed by the strong westerly winds that often follow rainfall events. Roughening the surface by cultivation will reduce the immediate threat. However the best solution is to maintain stubble cover using practices such as zero tillage or reduced tillage. Stubble protects the soil from both water and wind erosion.

Dustwatch

Dustwatch (www.dustwatch.edu.au) is a community research project, monitoring the extent and severity of wind erosion across Australia. Through Dustwatch, a nationwide network of volunteers combine local observations of dust activity with data from monitoring equipment, meteorological records and satellite imagery to provide an understanding of dust transport processes in Australia.

Other sources of information

For more information regarding wind erosion refer to DERM's website <www.derm.qld.gov.au>. The following DERM fact sheets may assist:

- Fact sheet L91 Erosion control in grazing lands
- Fact sheet L90 Managing for drought in grazing lands

The State of the Environment reports, available on DERM's website, include information provided by researchers from Griffith University who are involved in the DustWatch program.

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