Erosion and Climate Change

It is likely that erosion risk and erosion events will be affected by climate change as a consequence of changes in rainfall patterns; increase in temperature affecting plant water use and soil water balance; increased windiness and incidence of drought; an increase in frequency of extreme storm rainfalls; and in some areas, sea-level rise and storm surge events. Increased erosion will have considerable impact on infrastructure, productivity and sustainability, at the farm, region and national level.

Erosion types and features

The most significant effect of climate change on erosion is likely to be on rates of shallow landsliding, but effects on earthflows, gully, stream bank, sheet and wind erosion are also likely. For most erosion processes incidence of storm rainfalls will be critical. Although for some, increased temperatures and lower rainfalls in the north and east will tend to counteract the effect of increased storm rainfalls by lowering pre-storm soil moisture conditions. Increasing incidences of drought and projected increase in windiness will increase wind erosion risk.

Areas most susceptible to increased erosion (landsliding, earthflows, gully and sheet erosion) are the soft rock hill country of Taranaki, southern Waikato, Manawatu-Wanganui west of the Ruahine Range, Otago, South Canterbury and inland Marlborough. As rainfall and river flows increase, bank erosion could become increasingly severe in many parts of the country, except the east and north of the North Island.

The intensive cropping area around Ohakune is susceptible to increased sheet erosion.

Increasing incidence of drought in the east of the country is likely to have a greater influence on wind erosion than will changes in wind erosivity. Many areas in the east of both islands with highest potential for erosion (landslides, gully erosion and earthflows) are projected to have a decrease in mean annual rainfall. So the impact of climate change will depend on changes to extreme rainfall and extra-tropical cyclone activity.

Coastal erosion

There is increased potential for destructive coastal erosion due to a combination of sea level rise, storm events and storm surges, changing onshore wind and wave patterns (see sea level rise factsheet). Sea-level rise is occurring already with impacts on farmland and rural infrastructure such as roads and sea walls.

Higher sea level increases the likelihood of hazardous flooding and erosion events (storm surges and waves on top of sea-level rise) and planning is needed as these events can cause damage and are expected to become more common. Farm land in low-lying coastal and flood-prone areas can expect to be affected by larger and more frequent flooding and deposition of debris from erosion events further upstream.

Wind erosion

Large areas of New Zealand are susceptible to wind erosion – e.g. coastal sand dunes, the Volcanic Plateau, and large areas of the plains and steeplands of the eastern South Island. Wind erosivity and soil moisture content are key controls on wind erosion rates and these may change with climate change, along with increased drought frequency.

Susceptibility to soil erosion is important in cropping regions, but also on farms where soil cultivation and disturbance occurs with pasture renewal and forage crops production.

Issues with soil erosion will depend on soil type, soil moisture level and wind direction and speed. Areas such as Canterbury and Hawke's Bay have had problems in the past with damaging wind erosion.

For the farmer, adaptation practices align well with objectives to protect soils and reduce evaporative moisture loss:

- Conservation farming practices to minimise soil disturbance (direct drilling and stubble retention);
- Strategies to improve water use efficiency (maximising the use of available water) including soil fallow practice, use of more persistent and perennial plants such as lucerne, and fodder trees;
- Consideration of soil and land types in management; and
- Adopting principles of erosion protection (shelter to slow the velocity of wind or and contour management to slow water run-off).

Hill Country Erosion

Our hill land can experience a mixture of erosion processes, often occurring simultaneously across different parts of the landscape.

Shallow rapid landslides are usually triggered by a rainfall event (intense storm or long period of wet weather), and they are likely to change in frequency with climate change, depending on changes to storm and annual rainfall, rainfall variability, extra-tropical cyclone frequency, temperature, and wind.

Earthflow erosion is most extensive on crushed mudstone and soft rock hill country. There are complex links between earthflow movement and climate related to soil moisture and storm rainfall. Changes in rainfall and temperature (through its effect on evapotranspiration) may influence rates of earthflow movement.

Gully erosion is most common in the North Island east coast soft rock hill country, mountain lands of both islands, Northland, and the Volcanic Plateau. Any increase in rainfall with climate change, either of annual totals or storm events, can be expected to increase gully erosion.

Sheet erosion will potentially be increased by any change in runoff, as a result of increased rainfall intensity or duration with climate change.

Eastern regions of New Zealand with the highest potential for landslip, gully and earthflow erosion, are projected to have a decrease in rainfall with climate change. This is likely to have implications for the use and effectiveness of the limited range of tree species used currently for land stabilisation.

The establishment of spaced-planted *Populus* and *Salix* species is most difficult on eroded slopes in summer dry environments. New systems to reduce pole mortality need to be developed to increase survival in an environment that is expected to become drier. Better information on the resilience of the different poplar and willow clones to water stress is needed so that the clones most suited to the expected future regional climates are planted. Appropriate clones should also be bred to suit these dry environments.

Stream bank erosion

Bank erosion is common along rivers and streams, but is not well understood. Rates of bank erosion are influenced by flow velocity and stream power, implying any increase in runoff and flood flows associated with increased rainfall and high magnitude storms will result in an increase in bank erosion rates.

Consequential impacts

The impact of sediment loss resulting from land and stream bank erosion on downstream land use, infrastructure and activity can be substantial. Siltation of pasture and crop land; deposition of gravel, rock and remnants of vegetation; and formation of debris dams that cause damage to infrastructure typically involve substantial remediation and disruption to activity and services.

Over the longer term, if incremental changes to farming systems do not keep up with climate change, it is possible that more transformational change will be needed. More complex decisions to adopt significantly different land use or land management practices are likely to be made over a number of years, perhaps over generational timeframes.

Further information

The full report on which this summary is based is *Impacts of climate change on erosion and erosion control methods – A critical review. MPI Technical Paper No: 2012/45.* This can be downloaded from www.climatecloud.co.nz/CloudLibrary/2012-45-Climate_Change_and_Erosion-Final_Report.pdf

There have been many resources developed to assist in managing erosion-prone areas and these can be accessed at http://www.mpi.govt.nz/forestry/funding-programmes/slm-hill-country-erosion-programme