A.7 Land Deterioration

Many forms of land deterioration are evident throughout the study area, especially on cleared land, although deterioration initiated by gold-mining activity of the last century also occurs in areas which retain native vegetation.

A distinction is made in this report between observed land deterioration-i.e, deterioration seen during the period of field work (1985/1986)-and susceptibility to land deterioration, which is and indication of the maximum degree of deterioration likely to occur under unsuitable management conditions.

Some forms of land deterioration-for example, sheet erosion and soil creep are the result of natural processes, and changes since settlement have accelerated rather than created these processes. In some instances the rated may have been reduced as a result of land management practices.

Land deterioration is usually the result of inappropriate land management, and out ability to restrict deterioration to within tolerable limits is fundamental to our aim of sustainable land use.

Forms of deterioration

Sheet erosion

Sheet erosion takes place when the forces due to rainfall, flowing water and gravity overcome the cohesion and weight of the soil particles or aggregates.

Susceptibility

The potential for sheet erosion exists on any sloping land. Potentially erosive overland flow results when rainfall or run-on exceeds the infiltration capacity of the soil. Erosion susceptibility is greatest in the steeper areas that have soils of low infiltration capacity.

In the study area with duplex souls and/or those with sealing or hard-setting surfaces are most likely to cause overload flow and have the potential to sheet or rill eroded. These areas include the steeper slopes on sedimentary rocks, especially the metamorphic aureole ridges, and less commonly the granitic slopes. Especially sensitive are the northern areas with lower rainfall. There, the vegetation cover is at a minimum during late summer-early autumn and high intensity thunderstorms, which are common at this time, can cause severe erosion.

Incidence

Sheet erosion is widespread on the sharp, and generally cleared, metamorphic aureole peaks and ridges. Other notable instances occur on the Tertiary gravel cappings, on sedimentary rises with mallee vegetation and on cleared sedimentary hills. In most case land disturbance, such as clearing, overgrazing and cropping, vegetation harvesting or soil extraction, has increased overland water flow and exposed the soil to erosion. Erosion on granitic slopes is less common due to the high infiltration capacity of the topsoils. However, many of the granitic souls have relatively impermeable clay subsoils, and when rainfall exceeds the storage capacity of the surface souls, overland flow and sheet erosion occur. Rill and track erosion are specialised forms of sheet erosion, and frequently occur in conjunction with sheet erosion.

Minor examples of sheet erosion occur on the colluvial slopes surrounding the metamorphosed ridges.

Effect and management

Sheet erosion reduces on-site productivity-largely through loss of the topsoil and its nutrients, and the exposure of hard-setting or inhospitable subsoil horizons. Off-site effects include increased flash flooding and sedimentation.

Management practices which reduce sheet erosion include-in steeper areas fencing to preclude grazing and allow natural revegetation, and the control of rabbits-and in gentler pasture renovation and the construction of contour banks.

Gully erosion

Gully erosion endues when the forces due to rainfall, flowing water or gravity overcome the cohesion and weight of the soul particles/aggregates.

Susceptibility

Gullies develop where run-off and seepage waters accumulate, most commonly in valley alluvium. The areas at greatest risk are the lower slopes and valleys on or adjacent to the steeper hills and ridges. The retention of native vegetation usually prevents erosion, with the roots of plants providing mechanical resistance to soil detachment as well as keeping the souls relatively dry. In the central and northern areas duplex soils with hard setting surfaces are common. These topsoils readily shed water increasing overland flow and leading to erosion. The clayey subsoils, as well as providing a choke to rainfall infiltration which in turn increases overland flow, tend to have high slaking and dispersion characteristics, encouraging soil detachment. The hazard also increases in the drier northern areas where plant growth on agricultural land is relatively weak.

Incidence

Gully erosion, often initiated by salting, is common throughout the study area, especially on sedimentary and granitic terrain. Notable sites include: the Lexton area, where severe gully erosion and salting occur together; the undulating to hilly sedimentary terrain in the centre; the weathered granitic areas-for example around Mount Korong and near Murphys Creek; and the lower colluvial slopes off the metamorphic aureole ridges. Gully erosion by gold-mining during last century is still evident in areas now covered by native vegetation. Minor gully erosion occurs in alluvial terraces and colluvial fans in the north.

Effect and management

Although the amount of land lost to production is small, gullies restrict the movement of livestock and machinery, and reduce the vigour of the adjacent vegetation. Gully head development may threaten roads and other services, while the general off-site effects include increased sedimentation and frequency of flooding.

Reducing the overland flow into the gullies is an essential first step in preventing gully erosion or controlling an existing problem. In general, land management should be directed towards increasing water use by planting deep-rooted species such as trees or perennial pastures. Contour banking or deep ripping may be appropriate in some situations.

When gully erosion is advanced, common control measures include the construction of fences to keep out stock, of gully head structures and of diversion banks. Other measures include gully infilling, planting trees, shrubs and densely rooted grasses, eradicating rabbits and excluding cultivation from the management program.

Gully and streambank erosion are common on cleared sloping terrain in the central and northern areas.

Streambank erosion

Streambank erosion results when forces due to water movement along a stream channel are sufficient to detach and remove soil material from the banks.

Susceptibility and incidence

The potential for this form or erosion exists along the banks of all streams in the catchment. The presence of native vegetation, mostly Eucalyptus camaldulensis, usually prevents significant erosion, although undercutting of the banks of the incised Loddon River and its tributaries does occur to a minor extent during flood periods.

Effect and management

Significant streambank erosion can lead to sedimentation of stream channels and may damage structures such as roads and bridges.

Along the stream itself, bank erosion can be reduced by establishing a dense cover of vegetation and by excluding stock, or at least by providing stock with stabilised access to the water. In severe cases, physical protection of the banks, for example by logs or rocks, may be necessary.

Gully erosion is not only unsightly. It lowers agricultural production, restricts access to properties, threatens roads and other structures and provides a source of sediment to clog streams and dams.

Wind erosion

Wind erosion occurs when the forces due to wind are sufficient to overcome the cohesion and weight of the soil particles and allow their movement.

Susceptibility

The susceptibility of soils to wind erosion depends on a number of factors, including surface texture, position in landscape and the probability of strong winds when the soil is in a dry and exposed condition. Surface soils high in organic matter, or with sandy loam, silty or sandy textures, are most susceptible. In the study area the granitic soils on exposed crests and upper slopes are at greatest risk.

Incidence

In most years, including the period of this survey (1985), the area suffers only minor wind erosion. During the drought of 1982-1983, however, significant wind erosion took place throughout most of it, especially in the north. At this time soil loss of up to 50 mm of topsoil, equivalent to approximately 700 tonnes/ha, was observed on northern granitic slopes and alluvial plains.

Effect and management

The main effects of wind erosion are loss of productivity through loss of vegetation cover, surface nutrients and topsoil, and the blanketing of man0made structures such as roads and fences by drift material. To reduce the hazard the topsoil must be protected, especially during dry and windy periods. In cropping rotations stubble should be retained as long as possible and the length of fallow periods minimised, and when cultivated the ground left in a ridged cloddy condition. In grazed areas a good pasture cover should be maintained. Fertilizer application, resowing, rabbit control and conservative stocking rates may be necessary.

Soil compaction

Compaction is the increase in soil bulk density and the related decrease in macroporosity that develops when the physical pressure on the soil exceeds its ability to resist deformation and/or when organic matter is oxidised.

Susceptibility

Susceptibility to compaction depends largely on soul organic matter and moisture content, texture and structure. Moist soils are most vulnerable due to reduced friction between the soul aggregates. Soil texture influences the maximum amount of packaging that can occur and medium textures, such as loams and clay loams, are most susceptible. Organic matter promotes the formation of aggregates that resist deformation and compaction.

Incidence

Some degree of compaction occurs throughout most souls. It is most noticeable in soils that are regularly cultivated, or are subjected to continuous trafficking such as may occur near farm gates.

Effect and management

Soil compaction, since it affects most soil types, is a significant but often unnoticed form of soil deterioration. It can hinder seed germination, decrease seedling emergence and reduce plant vigour. Other effects include increased run-off, leading to sheet erosion on-site and increased flash flooding and sedimentation off-site. Management practices such as minimum tillage, spray seeding or long pasture phases in a cropping rotation tend to reduce compaction by maintaining organic matter an by reducing mechanical disturbance.

Slope failure

Slope failure occurs when the shear forces exceed soil/regolith strength. This generally occurs when soil/regolith strength is reduced by an increasing in eater content. A slope failure may range from minor slumping on hillside to a major landslide where large columns of soil and/or rock slide down a hillslope.

Susceptibility

The susceptibility is greatest on the steeper slopes of the basaltic scarps, the metamorphic aureole ridges and the granitic and sedimentary hills. Soils with high infiltration rates allow the soil/regolith to become rapidly wetted, and therefore have a higher susceptibility. Similarly if an impermeable layer underlies the soil/regolith, the overlying zones become saturated and unstable. Clearing the perennial native vegetation extends the period when the soil is wet, and removes the anchoring effect of tree roots. Undercutting of slopes by road construction may contribute to slopes failure. Risk of slope failure is highest when periods of prolonged soil saturation on steeper terrain coincide with seismic activity.

Incidence

Since the most of the study area does not have high rainfall, and may of the steeper areas remain forested, the actual incidence of slope failures is low. Minor movement occurs on the basaltic cones and scarps, especially where the basaltic soils overlie weathered sedimentary parent materials, and on the steeper granitic and sedimentary slopes.

Effect and management

Slope failures limit productivity by exposing inhospitable subsoils, and may cause damage to structures such as fences, buildings and roads. Stabilisation of hazardous areas may sometimes be achieved by deep rooted plants, especially trees, which help to anchor the soul and decrease the soil/regolith moisture content.

Soil acidification

Soil acidification is associated with improved pastures in higher rainfall and irrigation areas. The addition of nitrogen from either fertiliser or legumes results in acidification of the soil as the nitrogen is converted to nitrate, which in turn combines with base cations available from the soil storage or clay mineral exchange sites. When nitrates are taken up by plants or leached from the system soil acidity increase. The build up of organic matter associated with improved pasture results in increased cation exchange capacities and this appears to be an important factor in soul acidification.

Susceptibility
The susceptibility of soils to acidification is influenced by climatic factors, such a annual rainfall, and soil parameter such as organic matter content, clay content and mineralogy, texture, permeability and water-holding capacity. Light textured soils of low initial organic matter content are most susceptible.

Incidence
Soil acidification is a potential, and probably widespread, problem in all cleared areas sown to improved pastures – especially legumes.

Effect and management

Soil acidification can result in aluminium and manganese toxicity, decreased availability of phosphorous, molybdenum, magnesium and calcium or decreased activity of soil microbes, including nodule bacteria. Regular dressings of lime may be required if toxicity problems severely limit plant production.

Salting, here indicated by spiny rush, is often related to the clearing of adjacent hills.

Salting

Salting develops when stored salts derived from the atmosphere and from rock weathering become concentrated in the root zone.

Susceptibility and incidence
Two main types of salting occur in the study area.

The first, and potentially the most difficult to control, is caused by deep lead discharge. This results when salty water contained in deep leads (buried sands and gravels of ancestral river channels) is forced to the surface. The amount of water in the deep leads is influenced by seasonal rainfall, and some evidence suggests that years of excessive rainfall lead to and increase in the discharge of the deep lead system. This was noticeable after the exceptionally wet years of 1973-74 when the hinge-line (the point where recharge changes to discharge) in the Loddon system moved up the valley approximately 20 km to near Serpentine as the result of increased ground water pressures (Macumber 1983)

A susceptibility to salting therefore exists in any part of the plain that overlies deep lead systems. Currently, discharge occurs in lower-lying areas north of Serpentine; notable examples include Bears Lagoon-Calivil area. Deep lead discharge also occurs further up the valley at Timor West and has the potential to expand further. Recharge to the deep leads takes place over vast areas and is extremely difficult to control.

The second main type is due to local or regional groundwater systems not related to deep lead systems. Recharge is often very close to the incidence of salting. Recharge typically occurs through sedimentary terrain on crests and slopes where permeable fractures rock strata lie near or at the surface. Stored salts in the soil and weathered rock are mobilised by infiltrating water, and salting usually results on lower slopes and in depressions where the salty water table near or reaches the surface.

Clearing the native vegetation from recharge sites allows increased water infiltration to the groundwater systems, and is largely responsible for the increase in salting since European settlement.

Notable occurrences of salting are, from north to south:

Fernihurst area – gentle slopes and plain near the metamorphosed sedimentary ridge

Bears Lagoon area – deep lead discharge into lower lying parts of the plain

Kamarooka – extensive areas at the base of the sedimentary slopes

Rheola area – numerous salted depressions on weathered granitic terrain south and east of Rheola

Leichardt-Marong – small salted areas adjacent to the sedimentary slopes

Ravenswood area – numerous small areas in the granitic terrain adjacent to metamorphosed sedimentary hills

Moolort plains – the basaltic plains around Moolort now exhibit a number of small salted patches, probably due to discharge from underlying sedimentary strata

Lexton area – common on lower slopes and in depressions

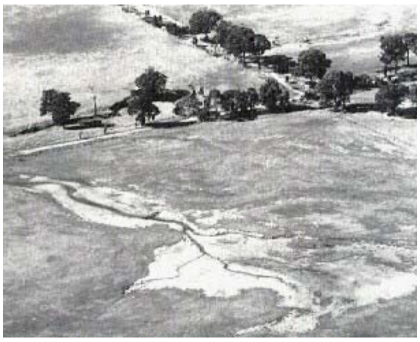
Numerous other minor instances of salting occur throughout the study area. Salting, at present, is absent in the higher-rainfall country to the south-east, possibly due to the lower quantities of stored salts in the leached soil and regolith profiles.

Effect management

When salt-bearing water tables reach within approximately 2 m of the surface, water rising by capillary evaporates and concentrates the salts at the surface, resulting in the eventual death of crops, pastures and trees. Farm water supplies may also be contaminated and in severe conditions where surface discharge affects the stream ecology. Vegetation growing at the salting site may actually concentrate the salts in the soul by continually removing the soil water by transpiration. Ironically their growth can result in salts concentrating to toxic levels.

To reverse the dramatic increase in salted areas, land use must incorporate species with higher water use, especially in areas of maximum groundwater recharge, such as on the shallow permeable soils on hills composed of Palaeozoic sediments. Replanting with trees and the use of seep-rooted species such as lucerne will encourage a balanced land use.

Unlike other forms of deterioration, the cause and effects of salting may operate on areas that are widely separated. Problems in extension and reclamation occur when the cause is inappropriate management further up the catchment. Effective treatment requires district, regional and State-wide efforts to revise land use and management practices.



Dryland salting of the lower slopes and drainage depressions has taken this land almost totally out of production.