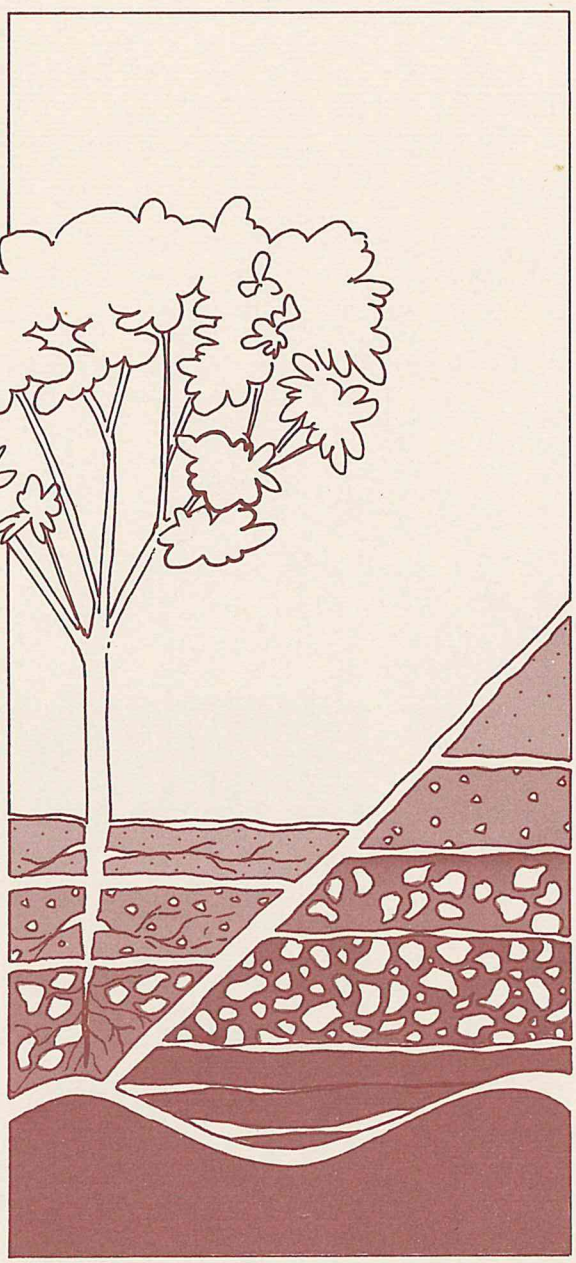
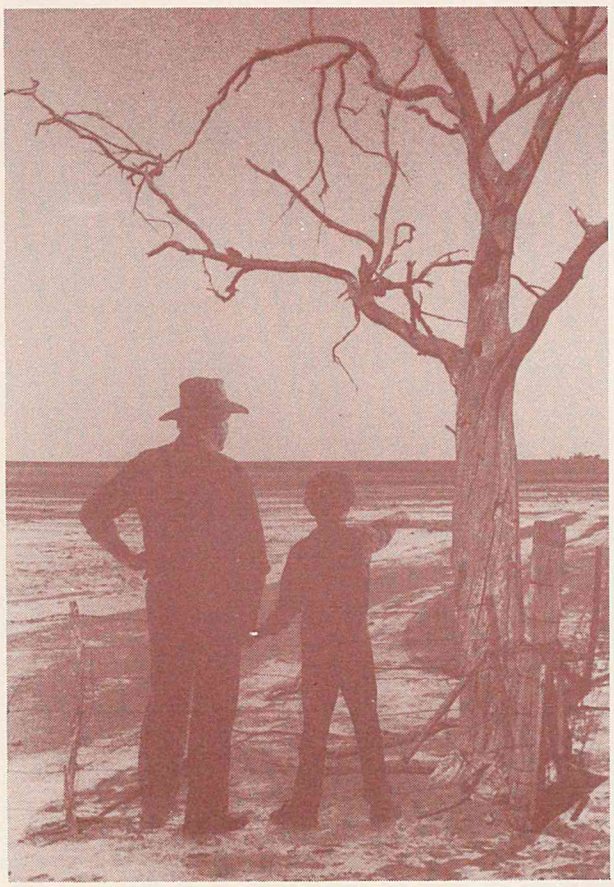
Save our Soils





World Environment Day Theme

Plenty of trees were retained on this farm to protect soil and stock.

A World Crisis

The world depends on soil to produce most of what we eat. Each year there are more people needing food and less soil to grow it.

This year alone—

- 20 billion tonnes of soil will be eroded from the world's land surfaces by wind and water.
- 25 million hectares of soil will be degraded through flooding, salinity, alkalinity, compaction or other such processes.

The World Conservation Strategy, produced in 1980 to help ensure the survival of people on this planet, warned that if current rates of land degradation continued, close to one third of the world's arable land would have been destroyed by the end of the century. It also said that within that same 20-year time span the world's population would increase from 4,000 million to 6,000 million.

The key words were "if current rates of land degradation continue". That is the challenge to all people of the world.

The Cover Up

Soil is being lost in various ways. Some because we build homes, factories and roads on it for an exploding world population. Japan, for instance, farms its land more intensively than most countries. But between 1960 and 1971 it lost 7 per cent of its agricultural land to urban spread.

In the same period, European agricultural land newly covered by urban development ranged from 1.5 per cent in Norway to 4.5 per cent in the Netherlands.

Canada is one of the world's great grain producers. Between 1961 and 1971 about 8,000 square kilometres of prime farmland were covered over — or about 320 hectares for each 1,000 increase in population.

In the United States more than 12,000 square kilometres of agricultural land is covered by concrete and tarmac each year.

Farming Land

Only about 10 per cent of the world's land area is suitable for farming. The rest has some drawback or other. It is too wet or too dry. In some places the soil is too thin or doesn't have the right nutrients. In others it is toxic to plant life or permanently frozen. The best land is distributed unevenly. Europe (36 per cent) has the biggest proportion. Central America (25 per cent) and North America (22 per cent) are also in the top bracket. Countries at the lower end of the scale include Asia (10 per cent), South America (15 per cent) and Australia (15 per cent).

Soil Erosion

Bad farming practice is also degrading vast areas. Nature takes 100 to 400 years to create 10 millimetres of topsoil. It can be blown or washed away overnight. Soil erosion is a natural and continuous process. If a sufficiently dense cover of vegetation remains, the soil usually regenerates at about the same rate as it is lost. If the vegetation is destroyed or scanty, erosion is accelerated. The problem is worst in the tropics because of the hilly terrain, high rainfall and nature of the soils. More than half of India, for example, suffers some sort of soil degradation. About 1.4 million square kilometres are subject to erosion. A further 27,000 square kilometres are being affected by floods, salinity and alkilinity.

From one area covering 800,000 square kilometres about 6,000 million tonnes of soil are lost each year. This includes more than 6 million tonnes of nutrients, which is more than the amount of fertiliser applied.

The United States has the largest soil conservation service in the world. Yet about 12 000 square kilometres of American soil are being degraded by erosion each year. This is roughly equivalent to the area being lost to urban development in that country.

Growing Deserts

Permanent pastures, whether cultivated or wild, cover 30 million square kilometres, or 23 per cent, of the earth's land surface. They support most of the world's 3,000 million head of domesticated grazing animals and hence most of the world's production of meat and milk.

Soils and vegetation are taking such a beating from hooves and human implements that almost 38 million square kilometres — a quarter of the earth's land surface — is in danger of becoming desert.

The precious soil is either stripped from the land — to fertilise the ocean or silt up reservoirs — or sterilised by salt or alkali.

The drylands, where rainfall is low and evaporation and transpiration high, are the most vulnerable. Unless used with care and skill they are likely to become desert. They cover a third of the earth's land surface and represent the most extensive ecological problem on earth.

Conserving Australia

Australia is one of the oldest continents in the world. Its soils are usually deficient in nutrients, particularly phosphorous and nitrogen. Native plants have adapted to cope with these soils. But generally they will not grow introduced agricultural plant species — without added fertiliser.

Only about 10 per cent of Australia has the climate, terrain, soils and water suitable for a high level of agricultural production. In many areas soil salinity also reduces output.

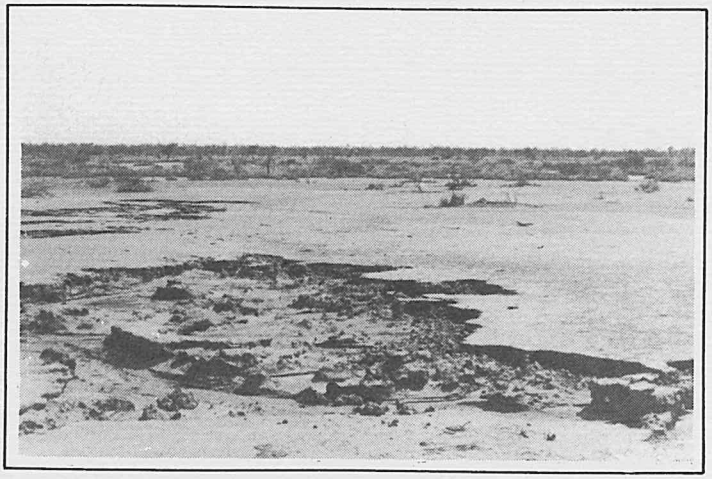
In the mid-1970's land-use specialists studied the nature and extent of Australia's land degradation problems. They concluded that more than half the area now being used for agriculture or pastoral grazing needed treatment if productivity were to be maintained.

The degradation is almost entirely the result of human activity. It takes many forms, because of the wide variations in climate and topography and the many different ways land is used.

Water, wind and salt are the natural agents of soil degradation in Australia; after man has paved the way.

Pastoral Areas

In the dry parts of Australia sheep and cattle have been grazed on stations for many years. In some areas native vegetation has been damaged to such an extent that herbage, shrubs and even trees have disappeared completely. Bare, "scalded" areas sometimes cover thousands of hectares. In such cases the top soil has usually been stripped away by wind and water and gullies have formed—some so deep that they make access to the area difficult. Sometimes grazing animals cause the degradation by selecting only the palatable plants, ultimately eliminating valuable species and leaving a plant cover that provides little or no grazing.



A bare, eroded plain on a Kimberley station.

Farming Areas

Australia's major agricultural products, such as grains, wool and meat, come mostly from dry land agricultural areas (non-irrigated farms) which account for 1.8 million square kilometres of our land surface.

Land degradation on some of these farms is evident in sand drift in paddocks and dust storms in the dry season which carry away the most fertile fractions of the soil.

On sloping land gully erosion has become a feature on some farms. Rains, carrying away tonnes of valuable soil, have left gullies behind that obstruct machinery and make paddocks difficult to crop. Waterlogging is another factor. So much deep-rooted vegetation has been cleared in some areas that the remainder cannot take up a significant amount of the water travelling down through the soils. Watertables build up underground bringing up salt leached from the soil. Evaporation and capillary action bring the moisture and its salt to the surface. Little vegetation can tolerate high salt concentrations. Areas become bare and often glisten with white salt crystals in the summer.

Australia has large areas of irrigated farmland where orchards, pastures, vineyards and crops are watered during summer. Salinity is becoming a serious problem in some of these areas; in some cases because watertables are rising, and in others, because the streams feeding irrigation dams are becoming saline because of the salt washed from farm paddocks upstream.

Tackling the Problem

Land degradation is a national problem. Commonwealth and State Government authorities are working together to assess the problem and prepare a basis for an Australian soil conservation policy.

Programmes are being undertaken to prevent further land degradation and to repair damage already done. Each State has a soil conservation authority of some kind. Some have been in existence many years and have had some success in helping land users with soil conservation programmes.

Skilled officers are in close contact with farmers and other land users. New legislation involves them closely in important conservation projects.

Good farm practices, such as contour cultivation, careful stocking and pasture and crop rotations, should be adequate to treat about 54 per cent of Australia's degraded farmland. This is being done in many places already. The remaining 46 per cent needs more extensive treatment such as gully control dams, drainage and contour banks.

The task ahead for Australia is formidable. But already there is an increased awareness and interest in soil conservation by the farming community, Governments and the community generally. The next 10 years should produce valuable results.

A healthy crop, watered from the Ord River Dam.

The State of W.A.

Western Australia covers almost a third of the Australian content but less than 8 per cent of it is being farmed. Another 38 per cent is "station country", pastoral land carrying sheep and cattle. More than half the state is too dry — or the rainfall too unreliable — for either farming or grazing.

Some examples of farming land degradation in W.A. include:

- About 2 per cent of farming land now too saline to grow crops.
- Many kilometres of fresh erosion gullies in paddocks after each winter and after every unusually heavy downpour.
- The baring of 64,000 hectares of farm land in the south coastal region in 1981.
- Less obvious forms of land degradation such as sub-surface compaction of millions of hectares of heavier wheatbelt soils and development of acidity in some sandier soil types.

Pastoral Areas

Pastoral holdings carry relatively few stock on native vegetation. Grazing is difficult to control because of the costs involved in managing vast areas.

Some of these areas are fragile. When heavily grazed they are sometimes finally denuded of all plants and become vulnerable to wind and water erosion.

Once the top soil is gone a crusted surface develops that will not harbour seeds for natural revegetation. Man must repair the damage stock have caused. Sloping land must be furrowed or ridged along its contours. Seeds suitable for the conditions must be planted.

A classic example of such reclamation was carried out by the Department of Agriculture in the eroded catchment area of the Ord River. Before work began 20 million tonnes of soil a year were being scoured into the river, threatening to silt up the Ord River Dam.

Hundreds of thousands of hectares of bare plain were treated and today are covered with dense grass and shrubs.

In other areas which are degraded, but not bared and eroded, better grazing management is helping on a number of sheep and cattle stations.

Today about 10 per cent of pastoral country is considered stable. But about 46,000 square kilometres are eroded to some extent.

Farming Areas

Although much smaller in size, our farms overshadow our pastoral properties in terms of total productivity.

More than 16 million hectares have been cleared for farming in the State's south west corner, much of it in the past 25 years.

Soil types range from sand to clay loams; rainfall from more than 1400 mm to less than 300 mm a year; topography from hilly, to undulating, to almost flat.

About one-third of cleared farmland in Western Australia is stable under today's management systems. The rest needs special care and better land management practices.

Water Degradation

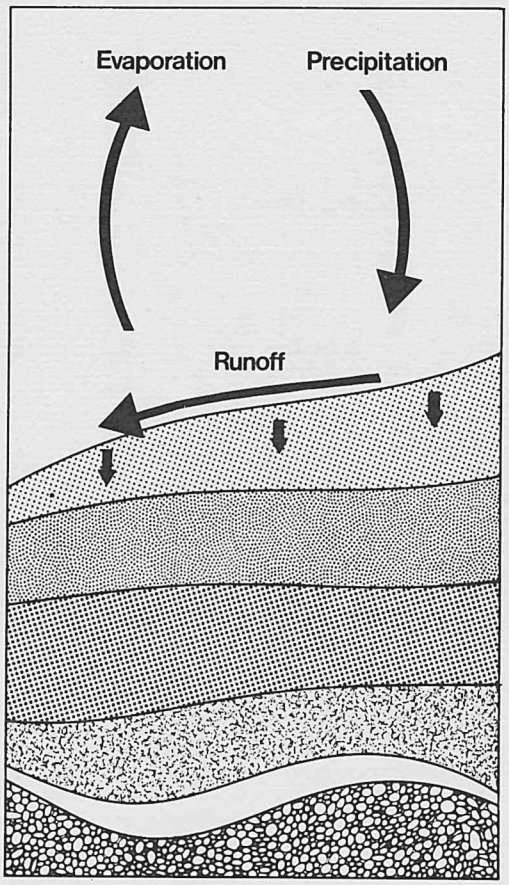
Our agricultural areas depend on a reasonably reliable rainfall. Yet rainfall, can also cause significant economic loss by erosion, waterlogging and flooding if surface runoff is not controlled. When rain hits the soil surface, it either remains in the soil, evaporates into the atmosphere, runs off the surface or drains down through the soil to the watertable. Plant growth depends on the proportion which enters the soil and stays in the root zone.

Research workers estimate that every millimetre of rain received by a crop during its growing season represents a potential yield of 10 kg of grain per hectare. Water running off the surface of a paddock represents a significant potential crop loss.

Runoff can also cause water erosion. Soil fertility is reduced because the richer top layer is carried away. W.A. research indicates that each millimetre of cultivated soil lost means a loss of 10 kg of nitrogen and 2 kg of phosphorus per hectare. Both are vital plant nutrients.

In addition gullies created by erosion obstruct the working of paddocks. Unwanted silt can be deposited in dams, on roads and against fences.

Water erosion starts when rainfall that cannot soak into the ground flows away as runoff. On bare soils it can carry soil particles dislodged by the impact of raindrops or by the water flow itself.



Researchers say that the rate of rainfall infiltration through the surface of many W.A. farming soils has fallen markedly since the original vegetation was cleared. This applies particularly where a surface crust has developed.

This crust often results from such farming practices as cultivating too fast, cultivating too frequently, or cultivating at the wrong soil moisture level. The less clayey and loamy soils are cultivated the easier it is for rainfall to penetrate.

Vegetation of any kind will reduce the impact of raindrops and help reduce runoff. The only way to protect Western Australian paddocks during the early part of the winter growing season is to leave dry pasture or stubble (the dried straw of the previous crop) on the surface. Modern minimum cultivation techniques, such as direct drilling, are used to sow into this dry plant material.

By working on the contour across a sloping paddock, small furrows left by a seeding machine can help reduce runoff by trapping water.

On a bigger scale, contour banks can be used. They are particularly valuable on hilly paddocks with erosion-prone soils.

Most erosion gullies in many parts of the wheatbelt were formed long ago, in the early stages of farm development and in the "fallowing era". Fallowing meant ploughing paddocks in springtime for cropping the following year.

But gully erosion is continuing where paddock layout prevents contour cultivation and where firebreaks, stockpads and farm tracks encourage water courses. Even badly-placed gateways or watering points can lead to animal and vehicle tracks and potential water erosion.

Contour farming, pasture improvement, realignment of fences, roads and firebreaks, and careful grazing management can help prevent gullies forming. Old gullies can be filled in by machines.

More farmers are now developing whole-farm conservation plans to prevent land degradation. Farmers developing newly-released land are now required to prepare conservation plans before they start clearing the native vegetation.

Waterlogging

Soil becomes waterlogged when it is completely saturated by heavy rainfall, by an accumulation of runoff, or by seepage just below the soil surface. It is mostly a problem on relatively flat land.

A paddock may remain waterlogged for months because of slow water movement through the soil and slow evaporation in cold winter months. Drainage systems, using special contour banks and deep open drains, can help.

Flooding, as distinct from waterlogging, can result from particularly heavy rainstorms, often during summer, and from continual rain. There is substantial evidence that flooding is more frequent in W.A. since clearing for agriculture.

Some farmers use levee banks to protect flood-prone cropping land. Though often quite effective they can have unforseen effects on farms, roads and even towns further downstream. Soil conservation authorities favour a whole-catchment approach to water erosion, waterlogging and flooding to overcome these problems without inconveniencing others.

A flooded paddock in the wheatbelt.

Wind Degradation

Wind is one of the most widespread causes of erosion in Western Australia. Nearly all farmland that is cropped or grazed by sheep can be affected.

The most obvious evidence of wind erosion is sand drift in coastal and some farming areas.

But it is the dust, even from minor dust storms, that concerns soil conservation research workers the most.

Contour working reduces erosion and retains moisture where it is needed.

Wind erosion has damaged these sandy, unprotected paddocks.

Wind erosion causes serious damage to soils by separating particles with different weights and sizes. Dust particles, containing most of the soil's fertility, are the first to be carried away.

Many farmers believe that soil blown away by winds lands next door. But fine clay and organic matter may be lifted thousands of metres and transported hundreds of kilometres. Only the heavier, less fertile fractions might land within a few kilometres.

Research workers have found that five hours of wind storm averaging 35 km/h removed the dust fraction from the top two millimetres of an exposed sandy paddock. This was the equivalent of 2.7 tonnes of fertile dust per hectare.

If such dust loss continued down to a centimetre in depth the yield from the following cereal crop could be reduced by up to 19 per cent. The effects of lost productivity could still be evident three to five years later.

On a typical summer-grazed , sandy paddock sheep can loosen the equivalent of 40 tonnes of soil per hectare. A late summer wind storm removed more than five tonnes of dust fraction per hectare from such a paddock. In another case, a badly mismanaged sandy grazing paddock lost 200 tonnes of soil, including 30 tonnes of dust, per hectare during a wind storm.

Many of the practices used to combat water erosion also help with wind erosion. Soil is more resistant to wind erosion when it is:

- cropped less often,
- cultivated fewer times when cropped,
- cultivated more slowly,
- cultivated when moist,
- direct drilled without previous cultivation.

Another positive strategy is to leave a cover of stubble from the previous year's crop. This reduces wind velocity at the soil surface, thus helping to prevent the dust fraction being carried away as well as preventing sand grains blasting crops.

Tree windbreaks can help protect the soil surface if they are sited across the line of the most damaging winds. Effectiveness depends on height and density.

About one-quarter of all W.A.'s cleared land needs special attention to prevent wind erosion.

Soil Salinity

Since agricultural development started in Western Australia, about 2 per cent of arable land has been taken out of production by the build up of salinity. If salinity continues to increase at the rate it has in recent years 1,750,000 hectares will have been lost by the year 2,000.

Big areas of land were affected by salinity, of course, before agricultural development. In some parts of the outer wheatbelt, dry salt lakes made up 10 per cent of the landscape.

But a big proportion of wheatbelt soils which seemed unaffected when cleared, contained large quantities of salt within the soil profile.

Some wheatbelt soils carry more than 600 tonnes of salt per hectare between the surface and the bedrock. Most is stored in the sub-soil.

Before clearing, relatively deep-rooted native plants used up most of the rainfall as it penetrated the soil. This kept the watertable down.

With clearing, native vegetation was replaced with shallow-rooted crop plants which used a much smaller proportion of the rainfall. The unused water penetrated deep into the sub-soil, collecting salt as it went, until it reached the ground water.

As the ground water built up close to the surface, salt was carried up through the soil profile.

Rising salt has also affected most of the previously fresh swamps, lakes and streams in the agricultural areas. Many of the ground water supplies for stock in parts of the wheatbelt are also saline.

The loss of arable land and farm water supplies is now costing W.A. agriculture between $10 million and $20 million a year. This does not include the costs of measures farmers are taking themselves. Many have built specially designed banks on the contour across sloping paddocks to stop surface and sub-surface seepage from reaching valley floors. There are now thousands of kilometres of such interceptor banks.

Soil salinity is the subject of intensive research around the world. In W.A. the Department of Agriculture has identified most of the causes and is researching measures to make use of land already salted. Drainage systems are being investigated and salt tolerant plants palatable to stock are being tested on various saltland areas. Whichever way the problem is approached, reclamation of salt affected land will be a long, slow process.

Soil Acidity

Without chemical or electrical conductivity tests, it is difficult to tell whether a soil has an acidic, alkaline or neutral reaction, so slight is the effect on human taste. Yet plants are very sensitive to such slight reactions.

Many W.A. soils react on the slightly acid side of neutral, a result of the nature of their formation. But in recent years a different soil acidity problem has developed.

On such soils acidity appears to increase as the nitrogen content is built up either by the use of fertilisers or by legumes such as subterranean clover, which "fix" atmospheric nitrogen.

This acidity has not yet caused any spectacular falls in crop yields but it is considered serious enough to warrant increased research in this field.

Soil Structure

Western Australian pioneers looked for relatively heavy-textured soils containing clay and loam. Most of these soils have given excellent results, but today's farmers often find that they are becoming more difficult to cultivate and that they lose "workability" very quickly. This indicates the soil's structure is breaking down.

Structure refers to the aggregates, or "crumbs" in soil, formed when sand, silt and clay are bound together by natural cementing agents such as plant material.

The size, shape and arrangement of these crumbs determine the size of the air spaces within the soil. Generally good soil has a good crumb structure.

Sometimes a hard pan is formed below the surface of some of the heavy textured soils when it is compacted by heavy tractors and cultivation equipment. This makes it difficult for plants to send roots down through the soil profile.

Soil structure improves when it is left under pasture, without cultivation. There have also been promising results with the use of gypsum (calcium sulphate) which helps break the soil into crumbs again.

Minimum tillage techniques, in which the farmer controls weeds with herbicides and reduces the number of times he has to cultivate his paddocks before sowing, are reducing the rate of structure breakdown. Deep ripping is being used in some areas to break up the hard pan formed by soil compaction.

Salt encroachment has damaged about two per cent of Western Australia's farm land.

Deep gully erosion on a Western Australian wheat farm.

A combination of erosion and salinity took this farmland out of production.

Saving Our Soil

As we have seen, big areas of Western Australia have been degraded by water and wind erosion, salinity, acidity and structure breakdown.

However we know how to repair the damage already done and conservation programmes are under way to develop land use systems that will allow primary producers to maintain productivity without damaging the source of that productivity — the soil.

The Soil Conservation Act has been updated. A Soil Conservation Advisory Committee has been established to identify land conservation problems and to develop effective policies to combat them.

Under the Act, areas with particular land degradation problems can be declared "Soil Conservation Districts" so special efforts can be applied to overcoming the problems of a whole area. If need be, farmers and other users can be told to change their land management.

Today's land degradation trends in Western Australia cannot be reversed quickly or easily. But the main problems have been identified and future generations can expect to see the valuable effects of the campaign to "Save Our Soils".

Edited and designed by the Information Branch ,
Department of Agriculture , in conjunction with the Department of Conservation and the Environment.