



sustainable grazing
on saline land

LandWater & Wool

Shaping the future



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another ^{australian wool} innovation
limited

productive solutions for salinity management

There are great opportunities for managing saline lands for livestock producers. Two of these are:

- Make productive use of saline land in the discharge areas; and
- Make better use of the water in the recharge areas – those areas where water enters the profile.



photo courtesy of Robyn Dynes

Case Study:



Salt bush delivers 300% increase in gross margin

Michael and Margaret Lloyd, from Lake Grace in Western Australia, have become advocates for the productive utilisation of saline land.

The effects of salinity began to be noticed on their property 'Bundilla' in the mid 1970s. Within 15 years the arable area on their property had been reduced from 1800 ha to 1000 ha. Michael and Margaret realised that if they were going to continue farming, something had to be done with the saltland. Now some 12 years later, nearly 600 ha have been planted to saltbush at a cost of \$24/ha (excluding labour).

The stock cost \$6 per head to run and cut six kilograms of wool per head. In the analysis this wool has been conservatively valued at \$3/kg. Fertiliser at \$20/ha has been applied to the treated areas but not to the untreated areas. The annual benefit from treating the saline areas has been an extra \$52/ha – easily covering the cost of establishing the salt bush.

Saline land will remain a part of the landscape. "We've got to find more productive and sustainable ways to use saltland," says Michael.

"We've quadrupled our stocking rate to more than eight dry sheep equivalents (DSE) per hectare without additional clovers.

Michael Lloyd

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	Costs	Returns	Gross Margin
Untreated Saline Land	\$12/ha	\$36/ha	\$24/ha
Treated Saline Land	\$68/ha	\$144/ha	\$76/ha

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SALINITY



Know-how
to tackle salinity



Dryland salinity

Dryland salinity is recognised as one of the major threats to farming in the high to medium rainfall zones of Australia. Many of the areas used for wool production will come under increasing risk. Dryland salinity is also a major issue for the wellbeing of many rural communities. Rising saline water tables destroy road foundations, cause bricks to disintegrate, reduce quality of water supplies and destroy vegetation along watercourses and in discharge areas.

Currently, over 4,500,000 hectares are considered at risk from shallow water tables (within two metres of the surface) or from salinity. It is estimated that about 67,000 km of roads will be affected by 2050.

In 1999 the annual cost of salinity in Australia was estimated to be;

- \$130 million in lost agricultural production,
- \$100 million in damage to roads, buildings, etc; and
- \$40 million in loss of valuable environmental assets.

The costs of repairing the damage will need to be borne by the Australian community as a whole. Wool growers can obtain significant financial advantage and have an impact on this major environmental issue by sowing unproductive saline land to salt-tolerant grazing plants and by establishing high water use pastures in recharge areas.

Areas in green are forecast to contain land of high hazard or risk of dryland salinity by 2050

Source: National Land & Water Resources Audit, Environment Australia



photo courtesy of John Powell

REALITY CHECK

If left unchecked, areas at risk of rising water tables expected are to increase by 13,500,000 ha – an area almost equivalent to the freehold land in Victoria – by 2050

Source: National Land & Water Resources Audit, Environment Australia



GETTING ON TOP

A growing number of livestock producers are turning liabilities into assets by establishing salt-tolerant species on saline seeps. Through careful management, these once waste areas have now become valuable productive areas of the farm.

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Dealing with salinity

The basic mechanisms behind the development of dryland salinity are well known:

- Excess water enters the soil profile because trees and other deep-rooted species have been cleared from our farming and urban lands. This process is called **recharge**.
- As the water table rises to the surface because of this recharge it brings with it salts dissolved from the soil, creating a **discharge** zone

The results of salinity that are seen today are the end result of actions undertaken many years ago – even as far back as the 19th century. It is unlikely that current farming practices will control salinity in many areas of the country. Even if all the best agricultural practices were put in place, it will take about as much time to correct the problems as it took to create them. Because salinity will get worse before it gets better, it is critical to slow the spread of salinity and minimise the impact of saline areas on land and waterways. Opportunities exist in most wool production systems to reduce the impact of salinity and its rate of spread while gaining economic benefits.

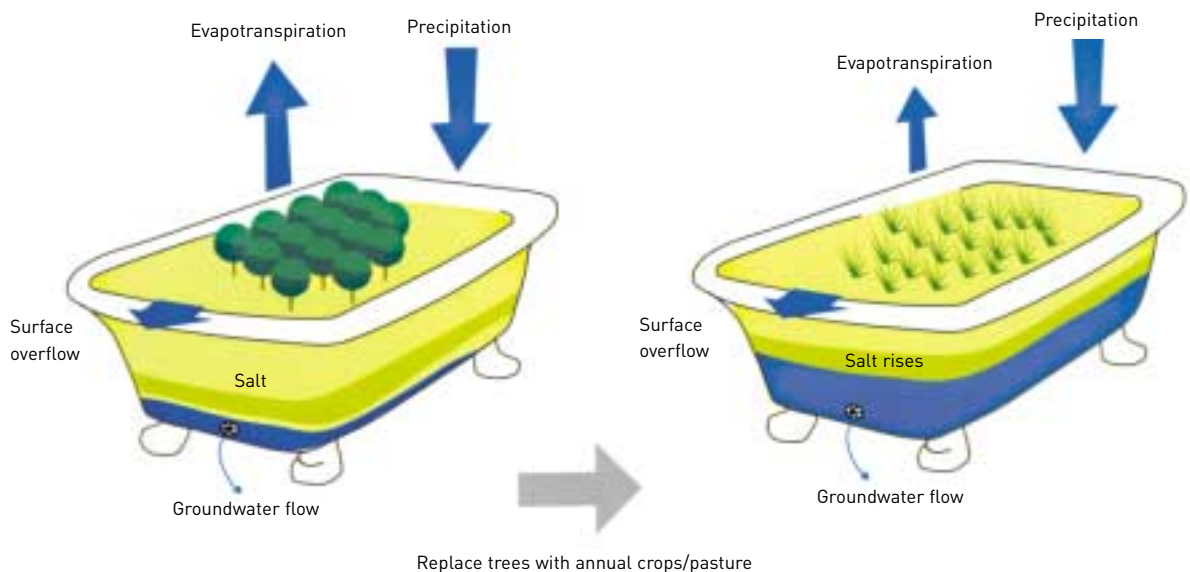


Diagram 1: Increased recharge resulting from the removal of trees and their replacement with annual species causes water tables to rise.

Source: *Trees, water and salt* - Joint venture Agroforestry Program, RIRDC.



Early saltbush planting
photo courtesy of John Powell

Indicators of salinity

Early detection of increasing soil salinity is critical in preventing soil loss and capturing benefits from the establishment of tolerant species. As salinity levels increase, the productivity of non-tolerant pasture and crop species falls and the non-tolerant species are gradually replaced by tolerant species. In the worst areas the soil will be bare and have a crust of white salt crystals on the surface. Stock selectively graze saline areas, creating conditions for soil erosion. *Table 1* shows some of the indicators of salinity with some of the plant species seen at various salinity levels.



Saltbush has been proven to be a robust source of feed and is known to reduce groundwater recharge.
photo courtesy of John Powell

Salinity Rating	Indicator species	Other Indicators
Low	No limitation to desirable species.	Even growth of pasture.
Moderate	Wimmera ryegrass (<i>Lolium rigidum</i>) Water buttons (<i>Cotula coronopifolia</i>) Windmill grass (<i>Chloris truncata</i>) Wallaby grass (<i>Danthonia eriantha</i>) Spiny rush (<i>Juncus acutus</i>) Sea barley grass (<i>Hordeum marinum</i>) Couch grass (<i>Cynodon dactylon</i>)	Reduced growth in areas. Clovers, capeweed disappear. Grasses are pale from low nitrogen due to from lack of clovers and salt effects. Generally no bare areas.
High	Sea barley grass, Couch grass Windmill grass, Spiny rush Creeping brookweed (<i>Samolus repens</i>) Ice plant (<i>Mesembryanthemum crystallinum</i>) Australian salt grass (<i>Distichlis distichophylla</i>) Annual beard grass (<i>Polypogon monspeliensis</i>)	White crystals may appear on the bare soil when the soil is dry. Animals graze and lick salty areas. Water in dams and drains may become very clear. Water table shallow (less than 1.0m). Clay soils may have the appearance of being well structured.
Extreme	Samphire (<i>Halosarcia pergranulata</i>) Sea blite (<i>Suaeda australis</i>)	Areas of bare ground. Sheet and gully erosion. Trees will be dying. Water table at, or close to the soil surface.

Table 1: Indicators of various levels of salinity



The saline and water-logged land performs a very important role in maintaining weaner growth in a dry autumn.



Lachlan Campbell,
Wellington, NSW

Waterlogging

Indicator species are also influenced by the level of waterlogging. *Diagram 2* shows the relative tolerance of some indicator species to salinity and waterlogging. Note that the classifications of salinity and waterlogging are approximate and do not directly correlate to the categories in *Table 1*.



Natural regeneration on saltland – samphire on highly salinised areas, bluebush on well-drained heavier soils, with a good understory of salt tolerant grasses.
photo courtesy of John Powell

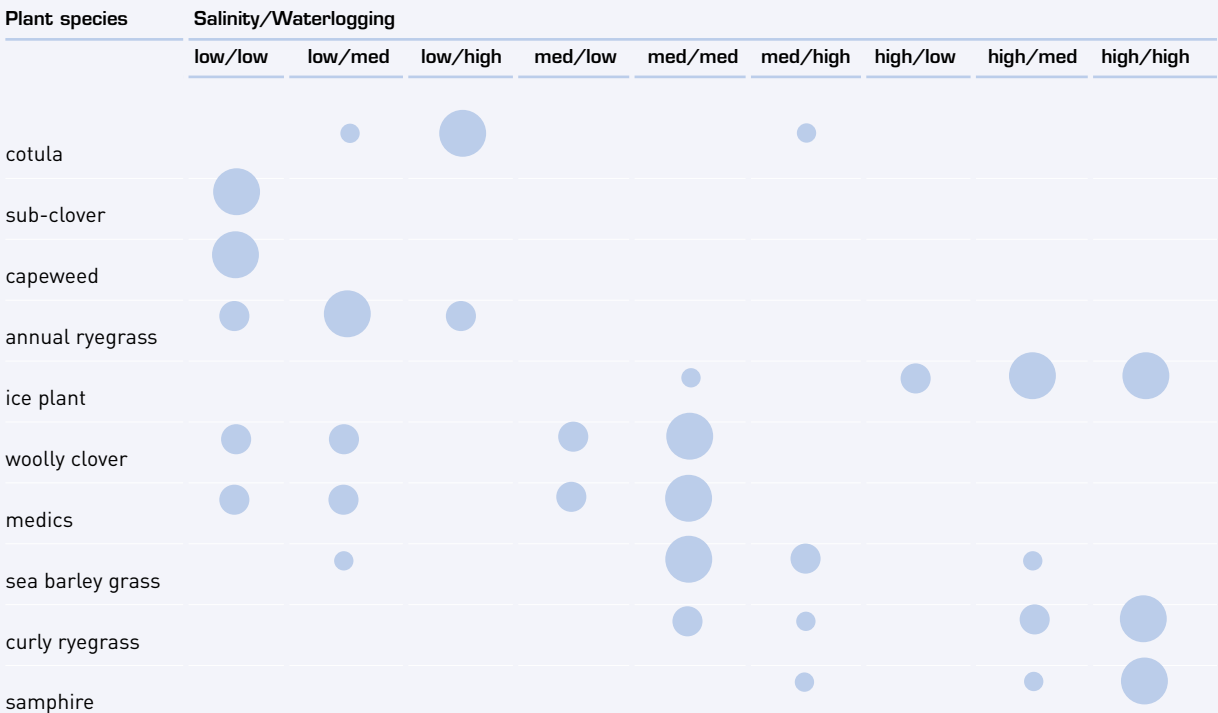


Diagram 2: Indicator species at various levels of waterlogging and salinity

Source: Barrett-Lennard & Malcolm 2003

Managing saline areas

Saline areas on farms will be a continuing part of our farming systems, but they can be made productive through careful management and the use of deep rooted, salt-tolerant species. The greatest benefit from planting these more desirable salt-tolerant species occurs when the saline areas are integrated into the farming system. Because saline areas can remain moist longer than surrounding non-saline areas, they can complement dryland pastures by providing valuable 'out-of-season' feed.



Saltbush with large amounts of seed ready for harvest

photo courtesy of John Powell

Steps

1. **Identify** the area affected by salinity. Changes in the species present or in the appearance of the area can be a good guide (see *Table 1* and *Diagram 2*). Early detection of saline areas is important. The earlier these areas are identified and treated, the greater the chance of those areas remaining productive. Early treatment will also preserve topsoil.
2. **Soil test** to determine the salt level of the soil. To get the worst case scenario, sample suspected saline areas in late summer. Dry conditions cause the salt to accumulate at the soil surface. Take 20-30 cores to a depth of 10 cm and send to a recognised laboratory for analysis. The salt level will provide a guide to productive species that will be suitable for the area. The major financial benefits from improving saline land come from treating moderately saline land.
3. **Estimate** the rate of spread of the salt patch using past observations of changes in pasture composition, etc. The rate of spread may be gradual, or may be rapid following years of above average rainfall. Monitoring the depth to the water table in bores or with piezometers (tubes inserted in the ground to measure the depth to the water table) over a number of years will indicate if there is a rising table. A rising water table suggests that existing saline patches will expand with time or that new salt patches will develop.
4. **Fence off** the saline areas to control stock access. Stock that have free access to saline areas will overgraze them. (Often significant improvements in plant cover can be achieved just through the exclusion of stock). Locate the fences where they will be unaffected by any increase in the area of salinity, or use an electric fence that can be moved if necessary.
5. **Divert** surface water to prevent it from running on to the saline area.
6. **Establish** deep rooted, salt-tolerant species. The selection of suitable species depends on the region, the level of salinity, the soil type and how long the site remains waterlogged during the year. *Diagram 3* shows the relative tolerance to salinity and waterlogging of some of the commonly sown salt-tolerant species

On low-moderately salinised land with moderate waterlogging, options include tall wheat grass, tall fescue, and balansa clover. As waterlogging increases in severity, puccinellia and salt water couch are more adapted.



photo courtesy of the Land

The 'out of season' food from saltland is more valuable than conventional supplementary feeding.

Les Payne,
Victoria Valley Vic.

The saltbush paddocks now provide good feed during autumn when it is scarce.

Ian and Joan Walsh,
Cranbrook WA.



Newly sown puccinellia pasture
photo courtesy of Bruce Munday

It is important to go wide to encompass the saline area and allow for some spread. Keeping out of the salt also maximises the life of the fence.

Les Payne,
Victoria Valley Vic.

Saltbush and bluebush have similar salinity ratings, but saltbush is more tolerant of waterlogging.

The selection of suitable species depends on the rainfall of the area, the level of salinity and the degree of waterlogging that occurs at the site. If available, local knowledge is invaluable in determining the best options. Establishment methods also vary between sites and local experience should be sought. Good agronomic practices need to be followed: good weed control, properly prepared seedbed, adequate fertiliser and good pest control.

7. **Allow** plants to fully establish before grazing and control grazing pressure to prevent the area from being bared-off from overgrazing. High intensity short duration grazing, that leaves a good level of residual ground cover, is preferred. Small areas that are not expanding can be difficult to manage productively and may be better revegetated and left ungrazed.
8. **Test** stock water for salinity and ensure that water of good quality is provided for stock - particularly where high salt content pastures will be grazed (e.g. saltbush). The higher the salt content of the pasture, the better the water quality needs to be.



Diagram 3: Relative tolerance of productive species to salinity and waterlogging.

Source: Barrett-Lennard & Malcolm 2003

“Not only do saltland pastures provide production and income, saltland looks immeasurably better when covered with pastures compared to bare and eroding areas.”

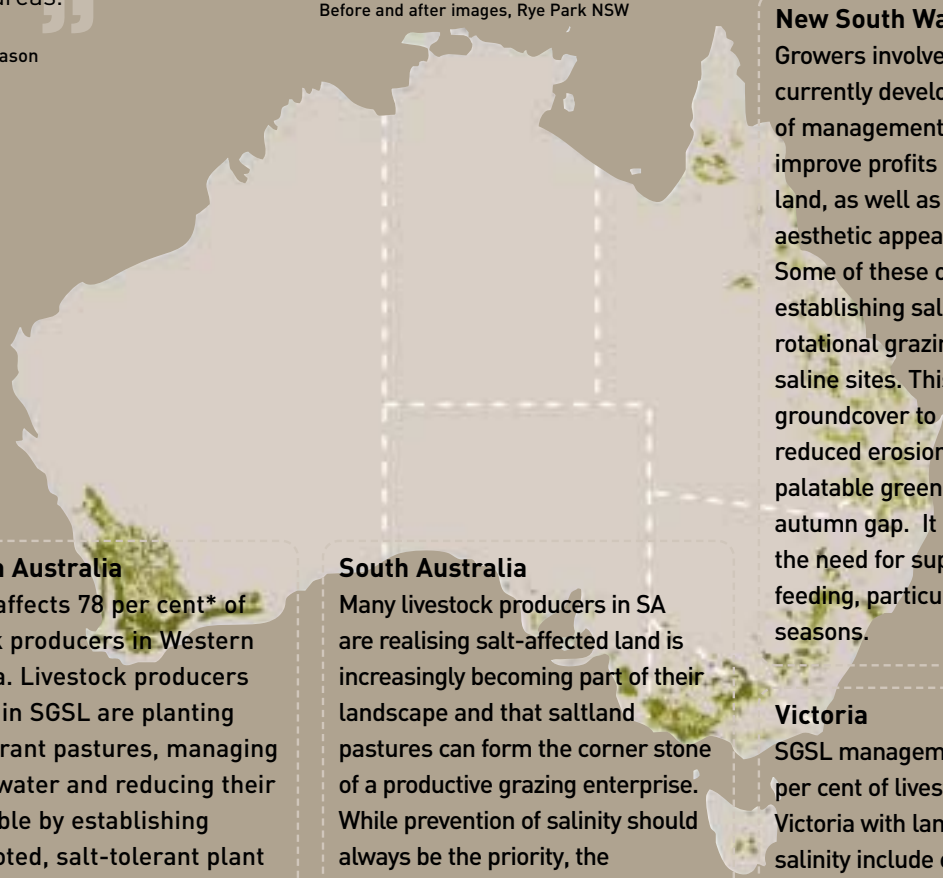
Dr. Warren Mason



Before and after images, Rye Park NSW



photos courtesy of John Powell



Western Australia

Salinity affects 78 per cent* of livestock producers in Western Australia. Livestock producers involved in SGSL are planting salt-tolerant pastures, managing surface water and reducing their water table by establishing deep-rooted, salt-tolerant plant species including saltbush and wattles as well as strategically fencing off areas affected by dryland salinity and managing this land appropriately, and as part of the total grazing system.

South Australia

Many livestock producers in SA are realising salt-affected land is increasingly becoming part of their landscape and that saltland pastures can form the corner stone of a productive grazing enterprise. While prevention of salinity should always be the priority, the introduction of pasture species such as *Puccinellia* is making a huge contribution to paddock productivity. New research currently supported by SGSL aims to find new, low-cost management systems and plant species to further improve the pasture mix, particularly in the high rainfall zone.

New South Wales

Growers involved in SGSL are currently developing a combination of management options to help improve profits from their saline land, as well as improve the aesthetic appeal of these areas. Some of these options include establishing saltland pastures, rotational grazing and fencing off saline sites. This has enabled groundcover to establish and has reduced erosion and provided palatable green feed to reduce the autumn gap. It has also reduced the need for supplementary feeding, particularly during dry seasons.

Victoria

SGSL management trials for the 39 per cent of livestock producers in Victoria with land affected by salinity include establishing salt-tolerant pastures by seeding saltbush and native grasses into raised mounds, rotational grazing and fencing salt-affected areas. This provides a range of benefits, including providing quality feed in summer with no autumn feed gap, reducing the need for supplementary feeding and being able to spell paddocks at the break.

Map indicates National Land & Water Resources Audit Land of high hazard or risk of dryland salinity by 2050

*LWW Best Practice Survey, 2003



photo courtesy of John Powell

“By the mid to late 1980s we had lost about 120 ha to salinity...this saltland now carries 11 DSE/ha/yr, on average!”

Andrew Southwell
Rye Park NSW.

Measuring salinity

Soil test and analyse for electrical conductivity (EC) to identify the level of salinity. The salinity ratings of soils measured by two methods are shown in *Table 2*.

Another method of measuring salinity is to use an EM 38 conductivity meter. These are portable instruments that can measure the soil salinity down to a depth of 1.5 m over large areas, in a short time. Soil salinity surveys using the EM 38 are becoming commercially available in Australia. Professional expertise is required to interpret EM 38 results.

EC_w- EC measured in a soil water solution
 - most common method
 - interpretation varies with soil type
 EC_e- EC of sufficient water to make a paste with the soil
 - less commercially available
 - results are independent of soil type

Salinity Rating	EC _e (dS/m)	EC _w (dS/m)			
		Sand	Sandy loam	Loam	Clay
Low	0-2	0-0.15	0-0.18	0-0.2	0-0.3
Moderate	2-6	0.15-0.46	0.18-0.55	0.2-0.60	0.3-0.86
High	6-15	0.46-1.15	0.55-1.36	0.6-1.5	0.86-2.14
Extreme	>15	>1.15	>1.36	>1.5	>2.14

Table 2: Interpretation of salinity levels in soils using EC_e and EC_w

Salinity levels in water

Salinity levels in water affect animal performance. *Diagram 4* shows the tolerance of various classes of stock (and humans) to levels of salinity in water. Note that the upper limits of salt tolerance will depend on the moisture content and salt content of the feed.

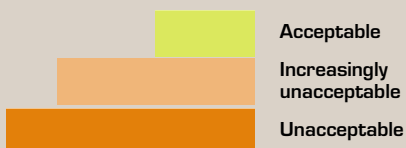
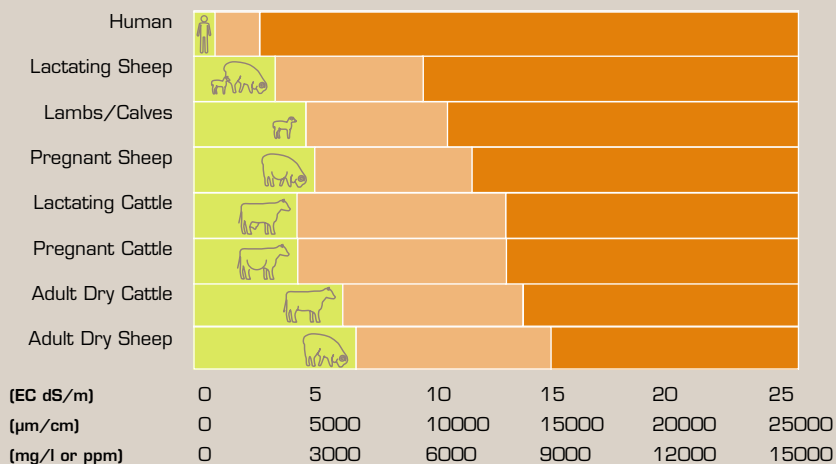


Diagram 4: Stock tolerance to salinity levels in water

'Leakiness' of grazing properties



photo courtesy of Georgina Wilson

Rain in agricultural areas either runs off or enters the soil. Of the rain that enters the soil, some evaporates, a small amount is used for plant growth and some is stored in the soil. Once the storage capacity of the soil is exceeded, water will move into deep drainage and add to the water table.

Table 3 shows the amount of water (mm) that soils under different vegetation systems can absorb before drainage occurs.

Well structured soils can hold more water than poorly structured soils before there is loss to deep drainage. As the percentage of perennial plants grown increases, water use is increased within each soil type. This is because the longer a plant grows, the longer it can use water within a season and the deeper its root system, the greater the volume of soil from which water can be extracted.

Vegetation Type	Well structured soils	Red cropping soils	Duplex soils (soils with clay subsoils)	Sands
Annual pastures	140mm	100mm	80mm	60mm
Perennial pastures	180mm	140mm	120mm	100mm
Lucerne	280mm	200mm	160mm	120mm
Remnant Vegetation	350mm	350mm	300mm	200mm

Table 3: Storage capacity of different soils under various vegetation systems

For example, in a well-structured soil, lucerne will be able to extract 140 mm more moisture from the profile than will an annual pasture. This means that the soil under lucerne has a 140 mm rainfall buffer before drainage occurs. In a sandy soil the advantage to lucerne is reduced to 60 mm of rainfall because sandy soils have a poorer ability to hold moisture.

A revegetated saltland landscape provides both production and environmental benefits, as well as enhancing the value of the property.

Glossary

Recharge areas: Areas in the landscape where water moves through the soil and enters the water table.

Discharge areas: Areas in the landscape where the water table reaches the surface.

Electrical Conductivity: Indirect measurement of salinity levels. Measured by the amount of electrical current that passes through water or wet soil. The higher the salinity, the higher the conductivity.

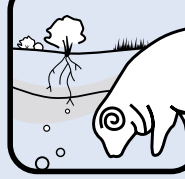


IN IT FOR THE LONG RUN

Even if all the best agricultural practices were put in place, it will take about as much time to correct the problems as it took to create them.

CONCERNED ABOUT WATER QUALITY OR NATIVE VEGETATION ON YOUR FARM?

Order a copy of the River Management and Water Quality or Native Vegetation and Biodiversity Guides. For details refer to page 12 of this guide.



Reducing recharge by using more water

Long term correction of dryland salinity requires the restoration of suitable vegetation types that will create a water balance similar to that which existed prior to European settlement. In many cases correction will be impractical and, if undertaken, many years will be needed before the balance is restored to pre-European settings.

While large scale replanting of catchments to trees is unlikely to be undertaken, water use by pastures can be increased and water table recharge rates reduced by using pasture plants which can grow longer into the season and explore a greater volume of soil (deeper root systems). Providing the right soil conditions for growth can also improve water use efficiency but this effect is of minor importance compared to changing species.

The establishment of perennial based pastures can be expensive. Good fertiliser and pest, weed and grazing management of these pastures is essential to ensure their persistence, high productivity and profitability.



Establishment of a perennial pasture species on recharge areas reduces addition to the water table and delivers production benefits.

photo courtesy of MS&A

KEY POINTS

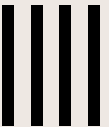
- **There is no quick fix for dryland salinity**
- **Planting deep-rooted perennial pasture species will reduce recharge, improve productivity and may slow the risk of dryland salinity.**
- **Saline discharge areas can be made more productive by planting salt-tolerant species, which may also have a range of benefits such as reducing soil degradation and reducing the movement of salt and soil to streams.**

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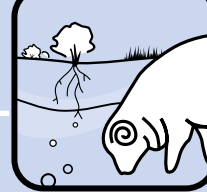
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sustainable grazing on saline land



Sustainable Grazing on Saline Land (SGSL) aims to support the 41 per cent of wool growers nationally who have land already affected by dryland salinity. It is the largest of the seven sub-programs in Land, Water & Wool¹ (LWW), the only national initiative that addresses the productive management of land and water specifically for wool growers.

SGSL was established to achieve:

- improved production and profit from grazing saline land;
- better environmental outcomes from saline land; and
- more pride for producers who have saline land on their properties and are being proactive about applying new management systems.

SGSL is achieving this through a combination of activities that will help livestock producers better understand and manage their saline land.

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We want to hear from you! If you have an idea for cutting-edge wool management options and production systems, please contact us.

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