Report

# Report on the Condition of Agricultural Land in South Australia

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# Executive Summary

There are 10.2 million hectares of land used for farming in South Australia. This land has been cleared of its native vegetation and almost all of it has suffered some form of degradation as a result of farming systems that are inadequately aligned with sustainability requirements of its natural resources. Loss of productive capacity of agricultural soils results in adverse environmental, economic and social impacts, many of which are effectively irreversible.

This is a report on a range of indicators of the condition and management of agricultural land in South Australia. The report is based on data collected and collated by the Land Condition Monitoring Program (LCM) of the Department of Water, Land and Biodiversity Conservation. Data sources include field surveys, the Australian Bureau of Statistics, Bureau of Meteorology and surveys of land manager practices, knowledge and attitudes. The LCM Program has been collecting original data for only 4 years, so for some issues where changes occur over very long time periods, this report presents only a baseline assessment.

## WATER EROSION

About 781,000 hectares of South Australian agricultural land have a moderate to high inherent susceptibility to water erosion by virtue of soil type and land slope. Conventional farming practices are not adequate for preventing unsustainable levels of soil loss on this land. The greatest proportion of this highly susceptible land is in the Northern and Yorke Region and the Mt Lofty Ranges. A further 2.4 million hectares of land is inherently susceptible to significant water erosion if inappropriate land management practices are used.

| Soil Erosion Indicators | Current Range (Whole State) | Desirable Short term | Desirable Long term |
|---|---|---|---|
| Water Erosion Risk Index | 55–86 days | < 35 days | < 15 days |
| Wind Erosion Risk Index | 72–171 days | < 35 days | < 15 days |

The LCM Program does not measure or estimate actual quantities of soil lost during any given period, because such direct measurement over the whole State would be technically difficult and require large resources. Instead it uses a risk assessment approach. The method is based on a combination of inherent susceptibility (slope and soil type) and key management practices (mainly tillage and surface cover) in major cropping districts of the State. It is assumed that, in the longer term, any change in erosion risk would be reflected as proportionate change in actual soil loss.

The primary indicator developed in the LCM Program for monitoring water erosion risk is the **Water Erosion Risk Index (Water ERI)**. It is effectively an estimate of the average period for which cropped land is exposed to water erosion risk during the year. Over the 4 years of monitoring to date, the annual state-wide Water ERI has ranged from 55 to 86 days. In the Northern and Yorke Region, with the largest area of susceptible land, the annual index has ranged from 52 to 99 days.

As yet, the period of data collection is too short to determine meaningful trends. Land that is managed with best available tillage and stubble management practice should have a Water ERI of less than 15 days, so there is scope to reduce water erosion risk significantly in most areas.

The main opportunities for improvement are in the elimination of all pre-sowing cultivations through large-scale adoption of direct-drill and no-till systems. Farmer surveys show that around 20% of cropping land is prepared using no-till, with a total of 30% (including no-till) of cropping land prepared by direct drill technologies.

## WIND EROSION

About 2.4 million hectares of agricultural land in South Australia have a high inherent susceptibility to wind erosion, due mainly to having sandy soils. Most of this highly susceptible land occurs in Eyre Peninsula, Murraylands and South East Regions. A further 3.5 million hectares have a lower inherent susceptibility, but can lose significant amounts of soil if the surface is left in a fine, loose state due to inappropriate tillage or grazing practices.

The methodology developed in the LCM Program to monitor wind erosion uses a similar risk assessment process to that used for water erosion. The process is based on assessing a combination of inherent susceptibility (soil type) and key management practices (mainly tillage and surface cover) in the main cropping districts of the State. It is similarly assumed that, in the longer term, levels of change in actual soil loss should be reflected by proportionate changes in erosion risk.

The primary indicator developed in the LCM Program for monitoring wind erosion risk is the **Wind Erosion Risk Index (Wind ERI)**. It is effectively an estimate of the average period for which cropping land is exposed to wind erosion risk during the year. Over the 4 years of monitoring to date, the annual state-wide Wind ERI has ranged from 72 to 171 days. The greatest overall period of risk occurred on Eyre Peninsula with 212 days in 1999-2000 when drought severely affected western parts of the region, and was 203 days in Murraylands region in 2002-2003.

The state-wide drought in 2002 was most severe in Murraylands and, because many crops and pastures failed to establish, significant areas were exposed to erosion through the following summer and autumn. The period of data collection to date is insufficient for determining trends in wind erosion risk, but there is clearly scope for a very large reduction.

The main opportunities for improvement are in the management of soil surface cover for both cropping and grazing on sandy soils. Direct drill and no-till methods are important technologies for maintaining surface cover in cropping systems. Surveys show that around 21% of farmers still use cultivated long fallow in their cropping systems. The figure is as high as 50% of farmers in the highest risk, low rainfall areas. One of the keys to reducing the period of erosion risk is to minimise the cultivation and exposure of land to erosion before sowing. However, in highly susceptible areas, as many as 62% of farmers currently prefer to start their cultivation program by March, resulting in extended exposure of the land. With best cropping and grazing practices, the annual Wind ERI should be less than 15 days.

## SOIL ACIDITY

Most agricultural systems accelerate the rate of soil acidification. As soil pH falls below about $pH_{CaCl}$ 5, productivity and water use by crops and pastures declines markedly. At least 1.9 million hectares of agricultural land in South Australia is either already in a degraded state due to acidity, or is on the brink of damage due to acidification. The only practical and effective method for managing soil acidification is through the application of lime.

The primary indicator of soil acidification used in the LCM Program is the balance between estimated acidification rates for agricultural land, and the amount of lime used.

Lime use increased by more than 100% during the 1990's, but at current levels of about 200,000 tonnes per annum, it is still only about 85% of the theoretical amount required just to balance annual acidification on high-risk soils. An estimated 879,000 ha of agricultural soils are already so acidic that productivity and long-term fertility has been significantly reduced. These soils would require a further 1.2 million tonnes of lime to bring their pH up to a level that is not production limiting.

Surveys have shown that the incidence and level of acidification are generally under-estimated by farmers. In the Mt Lofty Ranges and Kangaroo Island, where soil acidity should be of universal concern, only 60% of farmers considered they had acidic soils on their property and only 51% of them were able to identify correctly the critical pH below which production is likely to decline. In the surveys, while 92% of Mt Lofty Ranges and Kangaroo Island farmers with acid soils knew that lime application was the main treatment for soil acidity, only 64% had applied lime in the previous 3 years.

In practical terms, an increase in lime use on susceptible soils to about 350,000 tonnes per annum would be required to be confident that South Australian agricultural soils have a net positive trend with respect to acidification.

| Acidification Indicators | Current | Desirable |
|---|---|---|
| Estimated application to: | | |
| – Balance Acidification | 200,000 tonnes/yr | 230,000 tonnes/yr |
| – Raise pH of Low pH soils (10 yrs) | – | 120,000 tonnes/yr |

## DRYLAND SALINITY

The area of land directly affected by water-table induced secondary salinity in the agricultural and remnant native vegetation areas of the state is estimated to be around 398,000 ha.

This is predicted to increase to about 593,000 ha in the next 20-50 years, with most of the increase on the coastal plain of the Mid and Upper South East.

Monitoring has shown the watertable rising up to 10 cm annually in places in this region (Barnett 2001) depending on seasonal rainfall. The Upper South East Dryland Salinity and Flood Management Plan, incorporating extensive drain construction, has been implemented to address the situation.

To date, the Land Condition Monitoring Program has not implemented a routine system to collect data on the areal extent and spread of dryland salinity. However, many of the other soil degradation issues addressed in this report contribute to accelerated groundwater recharge rates as a result of reduced productivity and water use by crops and pastures. There are opportunities for significantly increasing the water use of these annual plants and for a much wider use of perennial plants in the landscape.

## PHYSICAL CONDITION – COMPACTION, STRUCTURE DECLINE, SEALING, CRUSTING

Almost 1.7 million hectares of agricultural land in South Australia have soils with physical properties that make them inherently susceptible to soil surface structure breakdown. More than half of the susceptible soils occur in the Northern and Yorke Region. These soils readily form surface crusts and seals under raindrop impact, which in turn reduces water infiltration rates, increases runoff and risk of water erosion. Almost all agricultural soils suffer some level of compaction and pan development below the depth of cultivation. Depending somewhat on soil type, the impact of compaction can range from relatively minor to severe loss of productivity.

The main opportunities for reducing adverse soil physical conditions are to significantly reduce tillage and maintain surface cover. Surveys indicate that South Australian farmers currently average 2.3 tillage passes, including sowing, to prepare land for crop. Anecdotally, this represents a large reduction in tillage, even in the last decade or so, but is still substantially more than the ultimate goal of only a single pass at sowing. The surveys also show that an average of 12% of farmers usually burn residues and another 49% occasionally do so.

| Soil physical Condition Indicators | Current | Desirable |
|---|---|---|
| Average tillage passes for crop preparation | 2.3 passes | 1 pass |
| Proportion of managers usually burning stubble | 12% | 0 |

This practice not only leaves the soil surface open to degradation by erosion, but also reduces the organic matter available for soil biological activity. There is still considerable scope for reduced cultivation and burning as a means of improving soil physical condition across the cropping districts of South Australia.

## SOIL NUTRIENT DECLINE

Agricultural crops and pastures take up large quantities of nutrients from the soil, and considerable amounts are exported in produce. Nutrient decline is not itself a permanent degradation state, as it can generally be remedied with some form of fertiliser application. However, low or unbalanced soil nutrition can cause very large reductions in productivity and water use and consequent increased risk of erosion and salinity.

The majority of South Australian soils have very low natural phosphorus levels, and often have trace element deficiencies. Without very large inputs of key nutrients, agricultural productivity would be very low. Around 30% of soil samples submitted to the South Australian Soil and Plant Analysis Service over the last decade were low in soil available P. This might suggest either poor nutrition management, or that cropping is expanding onto soils of lower nutritional status.

The nutritional status of agricultural soils needs to be managed so that it does not limit production and thereby increase the risk of other degradation. An important part of achieving this is the use of better technology to support nutrition decision-making by land managers. Surveys have shown that soil testing is used regularly by 71% of farmers across the State, but only 54% of those in low rainfall areas do so. Farmers in low rainfall areas also tend to rely more on their own knowledge than to seek outside expertise to assist them.

## WATER REPELLENT SOILS

Water repellence is a problem mainly of siliceous sandy soils, where it can cause poor establishment of sown crops and pastures, resulting in low productivity and water use. Poor plant growth and cover on sandy soils exposes them to risk of wind erosion. There are about 2.48 million hectares of agricultural land in South Australia that are moderately to severely affected by water repellence.

Clay spreading is a relatively new practice, requiring large capital investment, which has widespread application for reducing the effects of water repellence and increasing fertility and productivity of sandy soils. It has been successfully used in the upper South East, where surveys indicate that 27% of farmers with repellent soils on their property have undertaken some clay spreading. The practice is increasingly being taken up in other regions, but is in the relatively early stages of adoption and the results have been mixed. While there are some tillage management practices that can improve performance of sown crops and pastures on water repellent soils, their adoption is relatively low.

The land manager surveys show that an average of only 44% of farmers with water repellent soils on their properties have tried one or more of the available management options, including clay spreading. There is still considerable scope for improved production and water use on very large areas of sandy agricultural soils.

## WATER USE EFFICIENCY

The Land Condition Monitoring Program uses changes and trends in crop water use efficiency (as measured by the proportion of wheat and barley potential yield achieved) as a general, integrative indicator of the productive capacity and health of SA cropping lands. Of primary concern would be any declining trend in WUE, since this would suggest some form of degradation of the natural resources upon which agriculture is dependent.

Water use efficiency for wheat and barley, the major cereal crops grown in South Australia, rose from 34% to 52% of their combined potential yield, between the decades of 1965-1974 to 1991-2000. While this is a significant improvement there remains considerable scope to increase water use efficiency in annual cropping and grazing systems in most districts.

| Soil Fertility Indicators | Current | Desirable |
|---|---|---|
| Proportion of soil samples<br>Available phosphorus < 20 mg/kg (SASPAS) | 30% | < 10% |
| Proportion of managers using soil testing | 71% | > 90% |

| Water Repellence Indicator | Current | Desirable |
|---|---|---|
| On Water Repellent properties:<br>– Proportion where clay spreading used | 27% | > 60% |

| Water Use Efficiency Indicators | Current | Desirable |
|---|---|---|
| Wheat and barley grain yield:<br>Proportion of potential yield achieved | 52% | > 75% |

## REVEGETATION

Revegetation, particularly with native perennial plants, can provide a range of environmental, economic and amenity services. Initial surveys of NHT planting records indicated an annual rate of revegetation, by tubestock and direct seeding, of 6,000 ha in 1997 and 1998. Over a subsequent 4-year survey period, the rate of planting of native indigenous species for non-commercial purposes was consistently around 4,000 ha per annum, with a further 400-1000 ha of Australian native plants that are not local species.

Commercial planting of Eucalypts for the pulp and paper industry varied from 3,000 ha to 21,000 ha per annum. Overall, an estimated 74,000 ha of revegetation (including hardwood plantations but not including commercial pine forest plantings) were undertaken between 1999 and 2002, with most in the South East and Mt Lofty/Kangaroo Island regions.

It will take many decades of revegetation at this rate to have a significant impact on major NRM issues like dryland salinity, soil erosion or native habitat restoration.

| Revegetation Indicators | Current (Ha/yr) | Desirable (Ha/yr) |
|---|---|---|
| Plantings of: | | |
| – Native species | 5 – 6,000 ha/yr | 20,000 – 50,000 ha/yr |