Expectations for the future

Monitoring trends in wind and water erosion in South Australia

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Introduction

A wide range of government-funded programs exist to help progress farming systems towards sustainability, and there is a need to simultaneously monitor their effectiveness. Reducing land degradation is fundamental to achieving progress and recently the Department of Water, Land and Biodiversity Conservation (DWLBC) in South Australia has established a program to begin to monitor key indicators of land condition.

Wind and water erosion have historically been the most important degradation issues in the agricultural districts of South Australia. A reduction in soil loss is essential to sustain economic development and lessen the effects that the erosion can directly have on state infrastructure and both natural and agricultural ecosystems.

Directly monitoring soil loss is technically impractical because of the temporal and spatial variability of soil erosion events. The approach adopted focuses on assessing the trend in exposure of land to provide quantitative indicators of changes in wind and water erosion risk rather than a direct estimate of the amount of soil lost. Over time, any change in the risk of erosion is assumed to result in a change in the quantity of soil lost from agricultural landscapes.

A significant part of reducing erosion lies in more widespread on-farm use of No-Till technology across the agricultural districts of the state, particularly in the cropping areas. An increasing use of No-Till farming will result in a reduction of exposure and erosion risk, and a rapid field survey methodology has been developed to collect key data to monitor trends in a number of indicators. The simulated data presented in this paper is designed to demonstrate both the expected changes in the key erosion risk indicators and the potential for reducing erosion risk by using alternative methods of sowing crops compared to the conventional tillage systems that are currently most prevalent.

Discussion

Erosion Risk Profile Changes

Figure 1 shows the cyclic risk profile of land exposure to wind erosion risk that has occurred in the Murraylands region of South Australia since October 1999, with peak exposure at sowing time, usually during June in most years to date. Normally with conventional tillage systems, the risk begins in the spring, nine months or so preceding the crop, as long fallows are initially cultivated. Subsequently, the risk increases through summer and autumn as additional cultivation is stimulated by rainfall and declines rapidly to zero in the month following sowing as crops establish and cover the ground. Occasionally, as happened in the 2002 state-wide drought, severe climatic conditions can affect crop and pasture establishment. In that year, some crops and pastures failed to establish and a proportion of bare land continued through the rest of the year and into 2003. Further crop sowing established cover on most of these exposed areas but, in parts of the district, small areas even continued to erode through until the 2004 crop established.

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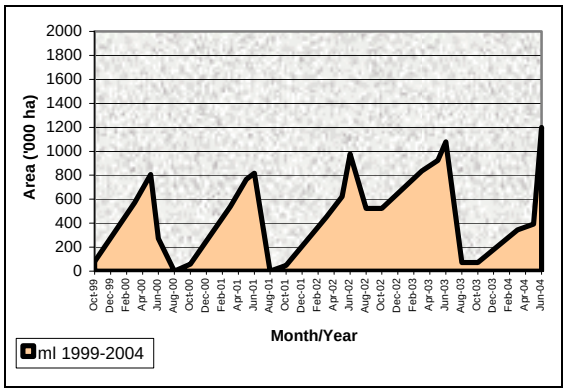

Figure 1: Estimated area of land ('000 ha) at risk of wind erosion in the Murraylands in South Australia
— October 1999 – March 2004

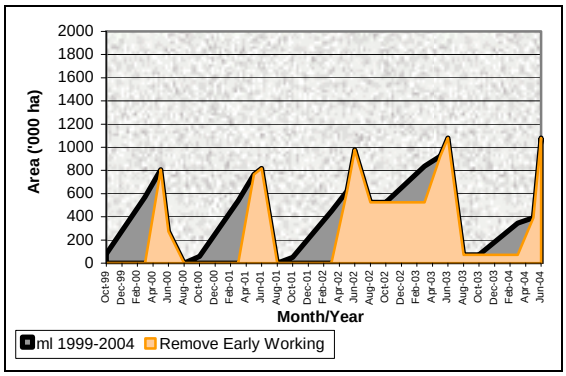

Figure 2: Estimated area of land ('000 ha) at risk of wind erosion in the Murraylands in South Australia
— remove October and March working

Figure 2 highlights the potential reduction (dark areas) in exposure of the land if long fallow and summer or early autumn cultivation had been eliminated from the tillage system during the monitoring period. If no tillage had occurred before sowing (Figure 3), as for a full cut direct drill sowing system, the exposure and risk would have been significantly less. With those scenarios, the wind erosion risk could have been less than 60% and 30%, respectively, of the actual risk experienced during the monitoring period. It is likely the soil loss that occurred during the period in the region, and particularly as a result of the 2002 drought, could have been less had these reduced tillage systems been in place, although significant erosion problems were still probable because of the bareness of the land following sowing with these systems.

On the other hand, Figure 4 demonstrates just how effective a No-Till sowing system is in reducing the risk. Not only could risk have been reduced by around 90%, but it could also have provided farmers with greater sowing flexibility. For example, in the 2002 drought, some conventionally prepared land was simply sown in an attempt to stabilise it rather than with any expectation of harvesting a crop. In the No-Till situation, land does not receive prior cultivation and needs only to be sown where there are prospects of a return. This means that, as well as being essentially erosion-safe, a No-Till system offers substantial labour and cost savings in adverse seasons.

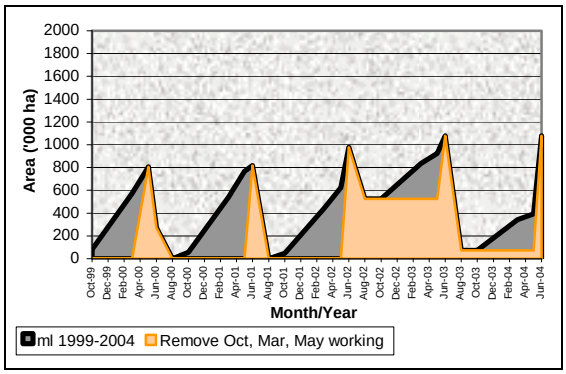

Figure 3: Estimated area of land ('000 ha) at risk of wind erosion in the Murraylands in South Australia
— Direct Drill

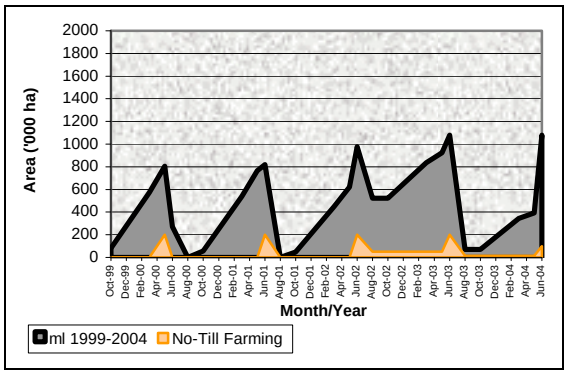

Figure 4: Estimated area of land ('000 ha) at risk of wind erosion in the Murraylands in South Australia
— No-Till farming

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Peak Risk

Recent land manager surveys have indicated that around 20% of crop is currently sown using No-Till systems, although field survey evidence suggests this varies widely from district to district. On the other hand, observations in 2004 indicate the area may be on the increase, as land managers explore the possibilities of averting the problems caused by the 2002 drought.

Figure 5 shows the estimated annual peak area of land at risk of wind erosion during the October 1999 to July 2004 period (red line). The peak has risen in the four years of monitoring because of a gradually increasing amount of cropping being undertaken in the Murraylands, largely using conventional sowing systems. The green line represents the scenario of a 10% increase per annum of No-Till farming over that period. Effectively, this could have achieved a net decline in the amount of land at risk of wind erosion in the Murraylands in the order of 150 000 ha and an overall reduction in the order of 400 000 ha, including the increase in cropping which occurred in that time.

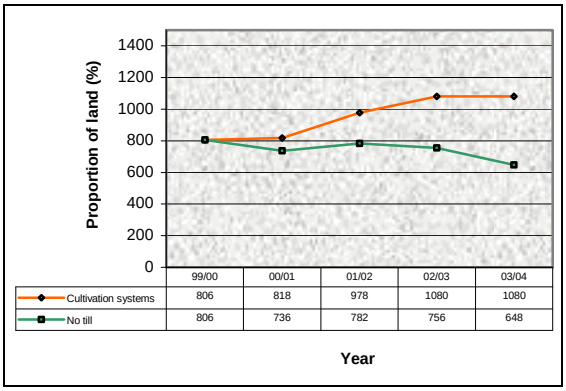

Figure 5: Peak (May–June) area ('000 ha) area of land at risk of wind erosion in the Murraylands of South Australia simulated for No-Till farming for the period October 1999 – July 2004.

Essentially, a declining trend in the peak area at risk can occur either through a reduction in cropping or an increase in the overall proportion of No-Till sowing. No other sowing systems are likely to have a significant effect on this statistic. The simulation demonstrates how the peak area at risk is an effective indicator, but longer term monitoring is necessary to show a trend in the real data.

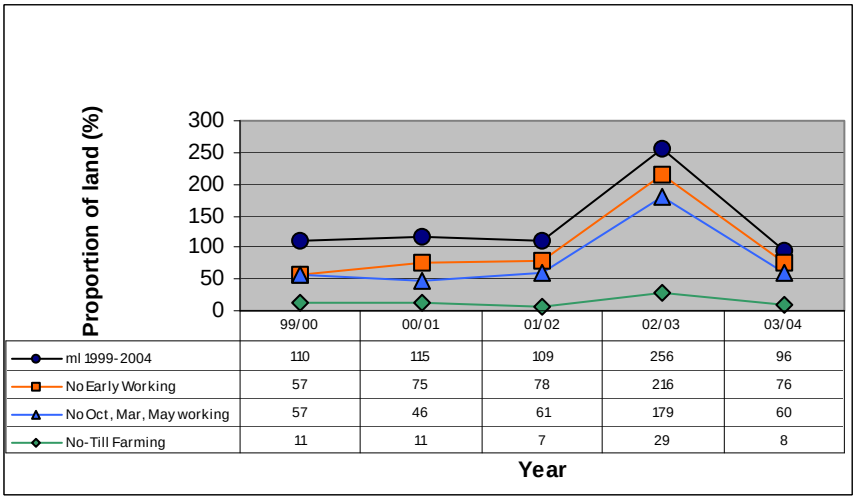

Figure 6: Wind ERI (relative to June susceptible crop) in the Murraylands of South Australia simulated for various tillage systems for the period October 1999 – July 2004.

Wind Erosion Risk Index

Figure 6 compares the actual Wind Erosion Risk Index (ERI) for the years from October 1999 to July 2004 to the estimated indices for various tillage systems over the same period. Where October and March tillage was eliminated, the estimated index value reduced by between 17 and 46% depending on the seasonal conditions experienced over the five-year period. If May cultivation was also eliminated, the value reduced by 28% to 46%. There was still a significant erosion threat because of the exposure of land at sowing with full cultivation machinery, even with direct drilling. As a result of the 2002 drought, the carry over exposure through to sowing in 2003 contributed substantially to the risk in all these systems.

On the other hand, while some exposure was assumed to create a hazard because of the difficulty in maintaining good ground cover in the drought, the overall estimated Wind ERI for No-Till sowing of all crop reduced by over 90% in all years. This highlights the potential for erosion reduction using No-Till sowing systems.

Summary

The data illustrate the very large amount of land that is placed at risk annually by current land management practices. Increasing use of new tillage technology should see a downward trend in all the indicators. However, it will be the uptake of No-Till technology that will have the greatest influence. The erosion risk profile, the peak annual risk and the cumulative period of risk, as demonstrated by the Wind ERI, are currently relatively less influenced by seasonal differences because most land managers still strive to prepare normal amounts of land even in adverse seasons. The peak risk area therefore usually follows the crop area trend. Even achieving a potential reduction of up to 50% in the period of erosion risk using direct drill sowing would still mean that a considerable risk existed.

While extreme seasons can cause extended exposure in all full cultivation sowing systems, No-Till technology means that land essentially remains undisturbed until sowing. Even then, only partial disturbance occurs as the seed and fertiliser are placed into the soil in narrow slots. Land can be safely sprayed for weeds and sown as soon as the season breaks in winter, even if the rain is relatively late. More importantly, land can be left unsown when rainfall is insufficient and it remains covered and soil conservation safe. In contrast, conventionally prepared land is cultivated bare in preparation for sowing crops and thereafter remains exposed and at risk of erosion until crops establish to protect the ground. Erratic or low rainfall can delay sowing, prevent sowing or cause poor crop establishment, all of which increase the risk of erosion because the surface is exposed.