MALLEE CATCHMENT
TECHNICAL BULLETIN

Technical Bulletin #23

Climate variability and land management practices

Above. Wheat crop in the Mallee region. Photo: Mallee CMA.

This technical bulletin summarises the findings of a study undertaken to help explain the extent to which climate variability influences short term land management change in the Victorian Mallee. It is important to note that this project was not looking at long-term changes due to predicted climate change.

This project aimed to investigate the impact of climate variability on land management practices at a sub-regional and whole of region scale. More specifically, this project focussed on practices that may impact on the extent of soil erosion arising from extensive agriculture in the dryland Mallee.

The main data sources for this study were the results of the Mallee Soil Erosion and Land Management Survey and climate data accessible through the Bureau of Meteorology (BoM). There has been no primary data collection or social research conducted with farmers as part of this study.

Method

Land Management

A review of data sources from Mallee Catchment Management Authority (CMA) funded projects on land management practices in the Mallee concluded that the primary data set most relevant to this study was the Mallee Soil Erosion and Land Management Survey. A social research project on dryland cropping practices in the Mallee also provided evidence of recent and rapid practice change (RMCG 2008).

Initially, the Soil Erosion and Land Management Survey was conducted twice yearly (spring and summer) over approximately 1000 paddocks along road transects located throughout the Mallee region. The survey method was modified in 2007-08 to use a closer in-paddock assessment of fewer sites (less than 160) and is conducted during late summer (March), post cropping (June) and in spring (October). These sites are considered to be reference sites and do not provide a statistical representation of the Mallee or its subregions. The Department Primary Industries (DPI) in partnership with the

At a glance

- Climate variability has played some role in influencing decisions made by farmers to increase cropping intensity, reduce tillage intensity and on some farms, adopt no-till.
- Attributing changes in land management practices to climate variability is difficult because farmers do not change uniformly and they change for a variety of reasons.

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mallee catchment management authority

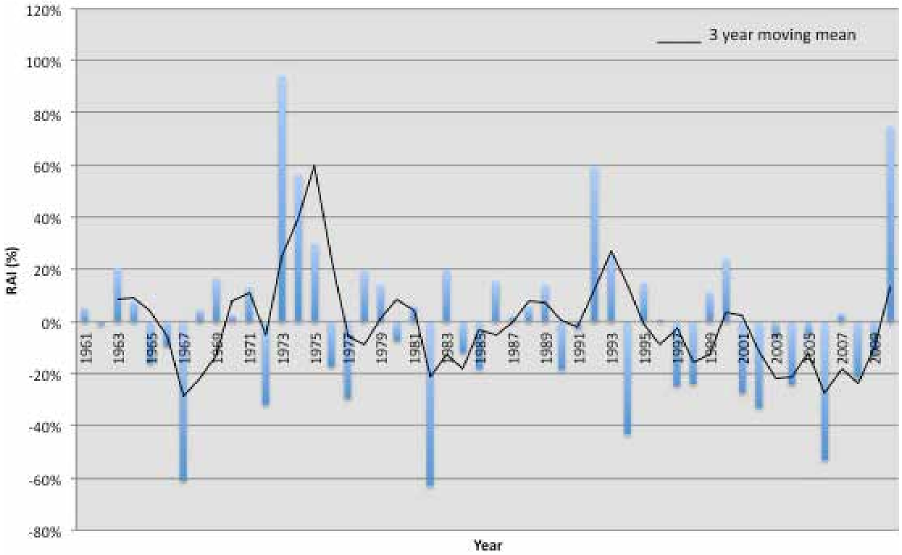

Figure 1. Mallee rainfall anomaly index 1961-2010.

Mallee CMA conducts the survey (DPI 2010).

Climate variability

The project investigated climate variability in relation to rainfall, temperature, heat shock and frost trends. Climate data was accessed from the BoM for three weather stations located in Mildura (northern region), Ouyen (central region) and Birchip (southern region) for two distinct time periods:

- Representative average (1961-1990) – this 30-year time frame is recognised by BoM as a reliable representation of the 'average' climate, and creates a base case scenario from which to assess the current climate;
- Current variability (2000-2010) – this 10-year time frame was used to create a current climate variability scenario to compare with the representative average. This time frame adequately captures variability as it includes the prolonged drought and wet 2010.

Available data on land management practices was assessed against trends in rainfall and temperature over the survey collection period.

Findings

Cropping practices in the Mallee

The following inferences were made about farming in the Victorian Mallee from the literature:

- Farmers are growing more cereals on larger farms;
- There are fewer farmers in the Mallee;
- There has been recent and rapid adoption of no-till since the mid to late 2000s;
- Cropping intensity has increased and farmers are growing predominantly cereals and relatively fewer alternative crops, up until 2011 (when there was above average rainfall and farmers grew more canola);
- Climate variability (in particular dry seasons) has played some role in influencing decisions made by farmers to reduce tillage intensity and in some cases adopt no-till;
- There is a poor relationship between areas cropped and rainfall in any given year. However, it is unknown if farmers delay high cost input until later in the season when conditions are better known.

Climate variability

For the period 1961 to 1990 the whole of Mallee average annual rainfall was 332mm (287mm in Mildura, 343mm in Ouyen and 367mm in Birchip). Although 1961-1990 is representative of an 'average' climate (*Bureau of Meteorology 2011*), the total average annual rainfall varies considerably during this time period. The Rainfall Anomaly Index (RAI) allows the standardisation of the annual or seasonal rainfall against a long term average for an individual station. Figure 1 illustrates a series of fluctuating cycles of relatively wet and dry periods from 1961 with dry years tending to last between one and three years up until 2000. Between 2001 and 2009 rainfall was between 10% to 55% below average. This was a sustained dry period in comparison to the historic time frame of 1961-1990. Wet years bookend this decade, where rainfall was more than 20% above average in 2000 and 75% above average in 2010.

Temperature variability is less accentuated than rainfall; however there have been notable variations across the study time frame, as shown in Figure 2. These range no more than 6% above or below average. There is some correlation between the millennium drought (1997-2010) and above average temperatures. From 1999-2009 temperatures ranged between 0.7% and 5.7% above average. During the period from 1961 up until the last decade, temperatures tended to be around 2% below average (with the exception of a period in the early 1980s). Higher temperatures mean higher evaporation rates, which increase stress on crop growth.

The main climate events that could potentially influence land management practices have been identified as:

- Short lived extreme dry seasonal conditions (e.g. 1967, 1982 and 1994 droughts);
- Short lived extreme wet seasonal

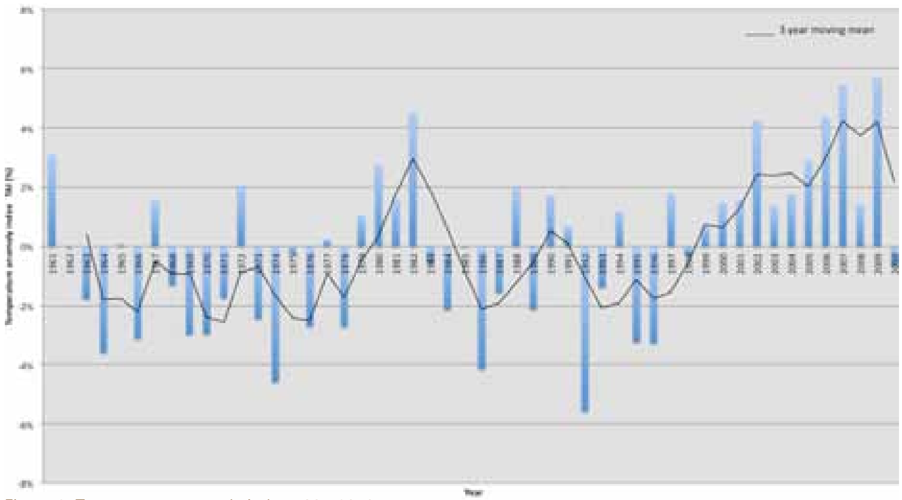

Figure 2. Temperature anomaly index 1961-2010.

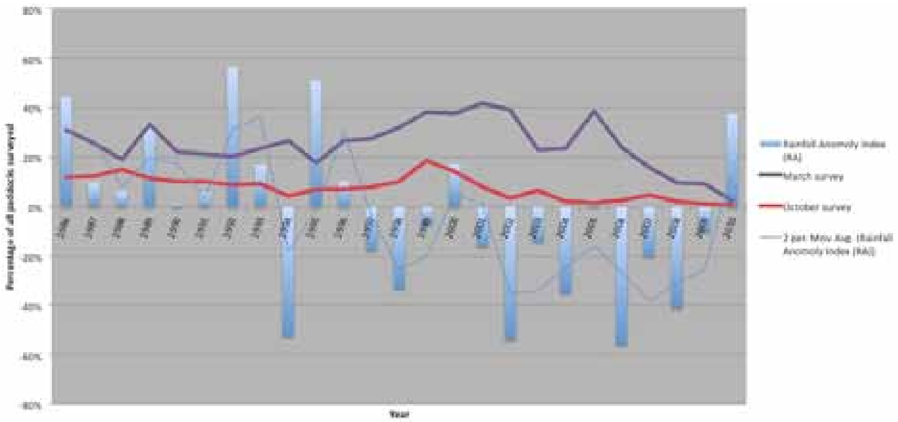

Figure 3. Trends in conventional fallow by season and growing season rainfall: Mallee region survey sites. Note: The soils erosion and land mangement survey monitoring methodology was modified in 2007, this may influence the results.

conditions (e.g. 2010 and summer of 2011);

- Longer term dry seasonal conditions (e.g. 1895-1902 (federation drought), 1937-1945 (World War II drought) and 1997-2010 (millennium drought));
- Longer term good seasonal conditions (e.g. mid 1950s to mid 1960s, 1970s);
- Increased number of hot days and frost events, which can impact crops during flowering and grain set.

Influence of climate variability on land management decisions

A range of data has been collated to help explain the extent that climate variability could have influenced farmers' decisions about practices:

- Trends in fallowing methods: trash retained/chemical/conventional or multiple tillage (1986 – 2010);
- Land use trends: in crop (cereal/non cereal), pasture and stubble, or fallow (1985 – 2010);
- Rainfall Anomaly Index and moving average: 1985 - 2010.

summer and spring survey periods in relation to rainfall variability during the growing season are shown in Figure 3. The occurrence of conventional or mechanically initiated fallows stayed in the range of 20% to 40% of paddocks surveyed from 1984 and peaked in 2001. A sustained decline in conventional fallow has occurred since then, which coincides with the prolonged dry period experienced up until the end of 2009.

Figure 4 shows the trends in land use of cropping land across survey sites (between 1985 and 2010) in relation to growing season rainfall variability. An increase in cropping intensity is relatively consistent across all regions. This increase in cropping intensity coincide with the prolonged dry conditions since 2002, increasing from 50% to 74% of paddocks surveyed under crop in 2010. This generally concurs with the findings of the social research farmer interviews conducted in March 2008 (*RMCG 2008*). The majority of farmers reported that they had increased their cropping intensity over the past five years, averaging 77% for the 2007 growing season (RMCG 2008).

The farmer response during the most recent extended dry seasonal conditions was:

- An overall reduction in tillage intensity since 2002 (i.e. mechanical fallows initiated later and reduced number of workings);
- Rapid adoption of no-till since 2007 (which meant high capital equipment purchases and the use of new technologies);
- More intensive cropping, but staying with lower risk crops (all cereals/ predominantly wheat);
- Cutting crops for hay when seasons finished early meeting the high demand for hay due to low irrigation water supplies;
- Varying livestock numbers (previous studies have found wide ranging views on compatibility of livestock with a no-till farming system and strong cultural preferences toward and away from sheep. Anecdotally, livestock numbers are increasing again in some parts of the Mallee).

The farmer response during the most recent wet period (2010 to Autumn 2011) has been:

- More stubble burning by necessity to reduce stubble loads to allow for seeding;
- Delayed cultivation due to paddocks being too wet to allow access to heavy machinery;
- Sowing more non cereals (mainly canola) to capitalise on unusually high soil moisture levels.

Discussion

Both cropping intensity and fallowing practices have changed since 2002. According to the Soil Erosion and Land Management Survey results (DPI 2010), an increase in cropping intensity and a sustained decline in conventional fallow has coincided with dry conditions since 2002. A dramatic reduction in the price of glyphosate also occurred during this period alongside increasing or sustained diesel prices. It became cheaper to chemically rather than mechanically fallow.

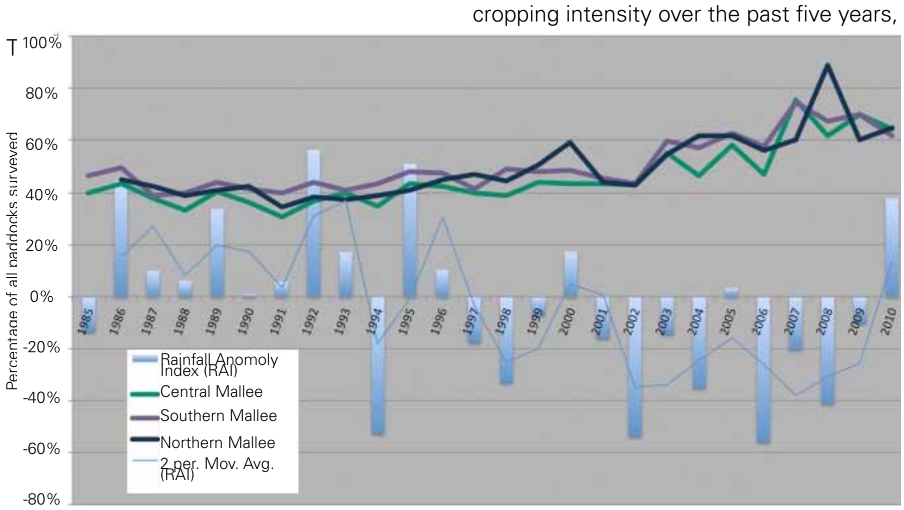

Figure 2. Trends in cropping intensity: cereal crops by region (1985 – 2010). Note: The soils erosion and land mangement survey monitoring methodology was modified in 2007, this may influence the results.

Furthermore, the increased cropping area correlates with larger farms that have necessitated larger paddocks and machinery using GPS guidance to speed up cropping operations. Spraying rather than cultivation also fits with this system. Larger paddocks can bring higher erosion risk because they are likely to encompass different soil classes and provide less control over grazing pressure. To mitigate against increased erosion risk farmers have reconsidered stocking rates or chosen to contain stock depending on seasonal conditions and groundcover.

Practices within a farming system also change due to more immediate seasonal conditions. For example, burning stubble where there are heavy residues (this year 2011); containing livestock to maintain groundcover where crop residues are small; early sowing or timing of chemical fallowing in response to summer rains; and cutting crops for hay when there's a dry or early finish to the season. While it is known what seasonal conditions trigger these decisions, changes in adoption rates of these types of practices have not been identified during this study due to a lack of data on the timing and extent of uptake.

The millennium drought (1997-2010) coincided with a period of rapid adoption of new technology and the influencing factors are varied. Farm consolidation has led to more crop area per farm and higher demands on increasingly scarce labour resources. These pressures have been made easier by larger machinery and new technologies. The use of consultants has helped no-till become more accessible for more people and there has been a preference away from sheep (especially amongst the younger generation of farmers). There is also a widespread belief among Mallee farmers that no-till better protects soil from wind erosion and farmers want to exercise their duty of care on this issue.

Conclusions

Climate variability (in particular dry seasons) has played some role in influencing decisions made by farmers to increase cropping intensity, reduce tillage intensity and on some farms, adopt no-till. The extent of the role of climate compared to other influencing factors is difficult to identify. During the extended drought farmers reduced tillage intensity for a combination of reasons. They wanted to protect their soil and at the same time they needed to improve their level of agronomic control (e.g. through sowing timeliness and more strategic nutrition inputs) to optimise production from limited soil moisture. A no-till system enabled them to better achieve this, especially on the lighter sandy soils in the central and northern Mallee.

Farmers are mostly focused on managing immediate risks (related to current seasonal conditions such as heavy stubble residues, weeds, mice) rather than longer-term climate considerations. Soil moisture and nutrient testing, prior to sowing and during the growing season, gives farmers greater understanding of the factors that affect crop performance and an opportunity to act accordingly. They can vary inputs, for example, and improve their overall performance. A better understanding of seasonal forecasts will also assist with decision making as the season unfolds.

Limitations

The main limitations of this study are:

- The primary data source was the Mallee Erosion and Land Management Survey. This survey has had a number of methodology modifications over the years, including major changes in 2007. This has led to some inconsistencies in the results.
- The links between climate variability and land management cannot be precisely identified given that farmers change practices for a variety of reasons. A better understanding of the range of influences on farmer decision making could be gained through conducting a more in-depth social research approach to data collection with farmers.
- The study has identified climate events or characteristics over the past 30 years that could have influenced land management at a regional and sub-regional scale. Shorter term or seasonal conditions can also trigger land management changes; however there was no data available on the timing and extent of uptake of these more immediate land management responses (which can also impact on erosion risk).

Acknowledgements

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Further information

The information for this bulletin has been taken from "*Climate variability and land management practices*". A copy of this report can be obtained from the Mallee CMA website:
www.malleecma.vic.gov.au

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Project Partners

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