MALLEE CATCHMENT
TECHNICAL BULLETIN

Technical Bulletin #27

Potential impacts of predicted climate change on Mallee dryland farming systems and land management practices

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

Left: Mallee Sustainable Farming field day. Photo: Mallee CMA.

Potential climate change and climate variability have been identified as critical issues facing the Mallee region in the coming years. This technical bulletin describes some of the activities the Mallee Catchment Management Authority (CMA) has undertaken to understand the impact predicted climate change may have on current farming systems and to identify future research needs.

The anticipated effects of predicted climate change on the region include increased temperatures, lower soil moisture and increased summer rainfall.

A summary of how the climate in the Mallee is expected to change based on climate change projections is available at **www.climatechange.vic.gov.au.**

The Mallee CMA supports on-ground research and demonstrations to identify and promote improved farming systems and land management practices within the dryland cropping areas of the region. Previous projects have evaluated the impact of different management practices on soil erosion, soil health, crop water use and farm productivity. A summary of current and previous projects is available on the Mallee CMA website **www.malleecma.vic.gov.au.**

At a glance

- Four projects were undertaken to understand how predicted climate change may impact farming practices.
- Mild climate change was predicted to exacerbate the summer weed problem; however, anticipated improvements in crop production by 2030 may compensate for that.
- Crops grown on soils with subsoil limitations such as high electrical conductivity, were more vulnerable to climate change prediction, showing greater yield decline than sites with lower electrical conductivity.

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To further improve the knowledge of the impacts of climate change in the region, the Mallee CMA commissioned four projects to re-visit some of these past research and demonstration activities and model the impacts predicted climate change may have on the outcomes.

The project began with a workshop in February 2012 with climate change and modelling experts and project stakeholders. The workshop developed guidelines to ensure consistent methods were applied across the projects. The Mallee CMA, Mallee Sustainable Farming (MSF), BCG, Dodgshun Medlin Agricultural Management and the Department of Primary Industries were represented at the workshop. The workshop was conducted with input and guidance from experts involved in the application of climate change information and simulation modelling of crops and farming systems from the South Australian Research and Development Institute (SARDI) and CSIRO.

The outcomes of this workshop are documented in 'Applying climate change scenarios to the Mallee CMA research and demonstration projects – Workshop report' MSF (2012a) available at **www.malleecma.vic.gov.au**

A set of climate parameters were also agreed to for applying climate change projections to Mallee CMA farming system projects (Table 1). The parameters were based on the 2030 medium emissions growth scenarios outlined in the Victorian Government's Climate Change in the Mallee Report (DSE 2008).

Above: Caltrop. Photo: Mallee CMA.

Table 1. Climate change scenarios and climate parameters used for analysing climate impacts on Mallee dryland farming systems projects.

	Mild	Moderate	High
Change in Temperature	+1°C	+1°C	+1°C
Change in rainfall (annual)	-5%	-10%	-20%
CO_2 concentrations (parts per million – ppm)	420 ppm	420 ppm	420 ppm

Documented below are summaries of each project.

1. Applying predicted climate change scenarios to summer weed control strategies and related impact on soil health - Dodgshun Medlin Agricultural Management.

This project extrapolated the results from the Summer Weed Control Strategies project (Dodgshun Medlin Agricultural Management, 2010) into the predicted climate scenarios for 2030. This project explored correlations between herbicide application timing and frequency, the extent of summer weed control and the impact on crop production. This helps to evaluate if currently successful farming practices will be robust enough to withstand predicted climate change and what the implications may be for continued agricultural viability and natural resource management.

The findings indicated that under mild climate change, the summer weed problem would be exacerbated; however, anticipated improvements in crop production by 2030 may compensate for that. The benefits of summer weed control were emphasised in the moderate climate change scenario where the difference in crop production under good weed control and no weed control are double those under the mild scenarios. The outcomes of the modelling for the high scenario indicated that crop production will be reduced from current levels even under good weed control and may be less viable if summer weeds are not controlled (Dodgshun Medlin Agricultural Management, 2012).

The outcomes of this project are documented in Dodgshun Medlin Agricultural Management (2012), 'Applying climate change scenarios to summer weed control strategies and related impact on soil health', available on the Mallee CMA website **www.malleecma.vic.gov.au.**

2. How predicted climate change may impact the productivity of cereal and broad-leaved crops used for fodder and grain – Mallee Sustainable Farming.

The aim of this project was to see what impact predicted climate change may have on the outcomes of previous research into the productivity of cereal and broad leaved crops in the Mallee. The results of the original project showed that broad-leaved break crops such as field pea, vetch and canola have the potential to be used as productive grain crops or to improve the quantity and quality of feed supply to livestock enterprise. Furthermore, these crops can improve soil health by increasing soil nitrogen levels relative to cereals and changing disease levels in soils.

This project modelled that under predicted climate change scenarios, a decline in biomass production under field pea, vetch and canola would be experienced. The project also modelled that crops would flower earlier under predicted climate change conditions, and therefore lose feed quality and value at a more rapid rate. The decline in biomass production was also expected to decrease the nitrogen fixation.

The outcomes of this project are documented in MSF (2012b), 'How climate change may impact the productivity of cereal and broad-leaved crops used for fodder and grain', available on the Mallee CMA website **www.malleecma.vic.gov.au**

3. The long term (2005>) relationship between farming systems and climate with soil properties and production – BCG.

This project used the Agricultural Productions Systems Simulator (APSIM) to assess the impact of the predicted mild, moderate and high climate change scenarios on crop yield. The farming systems model simulates the effect of environmental variables and management decisions on crop yield (BCG 2012). BCG applied this model using data collected at Waitchie and Sea Lake long term monitoring sites.

Increased temperatures were predicted to accelerate plant growth and shorten developmental phases, while increased carbon dioxide stimulates crop growth and yield, transpiration efficiency and water use efficiency. However, increased CO_2 also lowers plant protein and reduces grain quality. The models predicted that increased carbon dioxide of 420 ppm stimulated plant growth and yields, however, it did not appear to be enough to compensate for the predicted 20% decline in rainfall under a high scenario.

BCG found that crops grown on soils with subsoil limitations such as high electrical conductivity, were more vulnerable to climate change, showing greater yield decline than sites with lower electrical conductivity.

The outcomes of this project are documented in BCG (2012), 'Applying climate change scenarios to farming systems research and demonstration projects', available on the the Mallee CMA website **www.malleecma.vic.gov.au.**

4. How climate change may affect sowing time and variety selection at Ouyen – Mallee Sustainable Farming.

The aim of this project was to see what impact climate change may have on wheat production in the Mallee and to assess if sowing time and variety selection will provide adaptation options for farmers seeking to mitigate the impact of predicted climate change on production (MSF 2012b).

Sowing time has a big impact on the yield potential achieved by wheat crops growing in the low rainfall Mallee. Maturity length is a key attribute of wheat and Mallee farmers commonly use varieties that have short to mid season maturities. A previous project undertaken by MSF (2010) showed that mid maturity varieties tended to have greater yield potential when sown early (start of May), however, as seeding was delayed (early and late June), switching to shorter maturity varieties improved yield outcomes in most seasons.

This project used the Agricultural Productions Systems Simulator (APSIM) to model wheat crop yields under predicted climate scenarios for 2030. The outcomes included:

- Wheat yield reductions of 10 percent or less are expected under mild and moderate climate change (rainfall decline of five to 10 percent) at Ouyen, while high climate change (rainfall decline 20 percent) could reduce yield by approximately 30 percent;
- Yield reductions under climate change will be most severe in the drier growing seasons, resulting in a greater proportion of seasons where yields are less than 1.5 t/ha;
- Using varieties with different maturity lengths based on sowing date is important under the current climate and will continue to be important under predicted climate change.

The outcomes of this project are documented in MSF (2012c), 'How climate change may affect sowing time and variety selection at Ouyen', available on the Mallee CMA website **www.malleecma.vic.gov.au.** The outcomes of MSF (2012d) 'How climate change may affect sowing time and variety selection at Mildura' can also be found on the Mallee CMA website.

Above and left: Wheat crops in the Mallee.
Photos: Mallee CMA.

Conclusion

These are the brief summaries of three projects undertaken by the Mallee CMA to investigate the impact of predicted changes to the Mallee climate on farming system practices.

All climate change predictions provided have been generated from the views and opinions of workshop participants and has not involved an extensive review of the literature. These projects have built numerous assumptions into the modelling and the limitations documented in each project report should be considered when interpreting the results.

Further Information

Further information, including copies of the project reports, is available on the Mallee CMA website **www.malleecma.vic.gov.au**

Acknowledgements

Mallee Sustainable Farming, BCG and Dodgshun Medlin Agricultural Management were engaged by the Mallee CMA to undertake these projects with funding provided by the Victorian State Government. The workshop would not have been possible without the participation of representatives from SARDI, CSIRO and regional stakeholders.

References

BCG (2012), Applying climate change scenarios to farming systems research and demonstration projects, unpublished report for the Mallee CMA, Mildura

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MSF (2012a), Applying climate change scenarios to the Mallee CMA research and demonstration projects – Workshop report, unpublished report for the Mallee CMA, Mildura.

MSF (2012b), 'How climate change may impact the productivity of cereal and broad-leaved crops used for fodder and grain', Mallee CMA, Mildura.

MSF (2012c), Technical Bulletin #25, How climate change may affect sowing time and variety selection at Ouyen, Mallee CMA, Mildura.

MSF (2012d), Technical Bulletin, How climate change may affect sowing time and variety selection at Mildura, Mallee CMA, Mildura.

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