Tracking climate adaptation of growers in the Victorian Wimmera through varying seasonal conditions

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Abstract
Dry seasonal conditions from 1996-2008 prompted the Victorian Department of Primary Industries to commence a project in the Wimmera utilising a Participatory action research, development and extension (PARD&E) methodology to investigate and demonstrate cropping practices that improve water use efficiency (WUE) and adaptation to climate variability. During the project, surveys have been conducted with the two participating farmer groups comparing farm practices in 1995, 2008 and 2011 to investigate climate adaptation during both wet and dry seasonal conditions. This paper focuses on the findings of the 2011 survey contrasting them with practices from 1995 and 2008 and presenting key findings from the PARD&E process. Survey results indicated that from 2008 to 2011 area sown to cereal, pulse and oilseed crops all increased often at the expense of long fallow and pasture potentially in response to wetter seasonal conditions. They also indicated steady uptake of GPS guidance and increased sowing of crops into standing stubbles since 1995. This data provides a snapshot of farming practices over time for two Wimmera districts highlighting the importance of flexible farming systems, enabling adaptation to both wet and dry seasonal conditions as well as the range of complicating factors that often make influencing practice change at farming systems level challenging.

Key Words
Climate adaptation, PARD&E, crop rotation, stubble management, nitrogen, phosphorus

Introduction
From 1996 to 2008, cropping farmers in the Victorian Wimmera experienced the driest seasonal conditions in recorded history. Annual rainfall at Longerenong averaged 341 mm compared to a long term average of 402 mm (BOM 2012). In response, the Victorian Department of Primary Industries commenced a project to fast-track the adoption of management practices that maximise crop water use efficiency (WUE) as a means of adapting to both current and future climate scenarios. This project utilised a participatory action research development and extension (PARD&E) methodology in order to empower farmer participants to influence research and accelerate practice change focussing on two small farmer groups in the Wimmera, one at Sheep Hills and the other at Horsham East. At the beginning of the project a survey of participating farmers was carried out to identify the adaptation strategies that farmers had undertaken between 1995 and 2008. Results indicated that farmers had rapidly taken up stubble retention, technologies such as GPS guidance and more risk-averse fertiliser strategies as outlined by Nuttall 2010.

Anecdotal evidence since 2008 suggests that with annual rainfall averaging 542 mm between 2009 and 2011 (BOM 2012) farmers in the Wimmera have returned to many of the practices which predominated previous to the dry period of 1996-2008. This paper focuses on findings from the final project survey which sought to measure practice change from 2008 to 2011. It will primarily focus on examining whether participants have returned previous practices or whether technological advances and a change in attitude to risk has seen growers continue to employ practices implemented during drier years.

Methods
A follow up survey was conducted using a multiple choice questionnaire presented to the two farmer groups (Sheep Hills and Horsham East, Victoria) at the completion of the on-farm trial and communications phase of the 'Fast tracking climate adaptation' project. The original benchmarking survey carried out in 2008 sought to track changes in agronomic and business practices by comparing 1995 to 2008. The follow up survey totalled 17 questions asking many of the same questions in order to compare agronomic practices in 2008 and 2011. A total of 14 farmers from the Sheep Hills group and 10 farmers from the Horsham East group were surveyed.

Results and Discussion

Survey results indicated a consistent increase in the proportion of paddocks sown to cereal, pulse and oilseed crops between 2008 and 2011. Seventy-one percent of respondents indicated that they had increased the proportion of their farming area sown to cereals and pulses and 58% indicated that they had increased their area sown to oilseeds (Figure 1). At Sheep Hills these increases were predominantly at the expense of long fallow (57% of respondents) and pasture (43% of respondents) despite livestock prices often being strong during this period. At Horsham East increases were at the expense of a variety of crops, fallow and pasture (individual group data not shown). This increase in cropping intensity and a trend towards growing 'risky' crops (pulses and oilseeds) aligns with anecdotal evidence and state wide industry estimates; the area of canola sown across Victoria grew from 251,000 ha in 2008/09 to 340,995 ha in 2011/12 (DPI 2012). It is hypothesised that these changes could be in part due to decile 8 and 7 growing seasons in 2009 and 2010 (DPI 2010, DPI 2011) followed by a very wet summer and significant stored soil moisture leading into season 2011. While this project and the industry more broadly is often focussed on adapting to dry seasonal conditions these rotational changes are an indication of farmers implementing flexible farming systems able to cope with and take advantage of more favourable seasons.

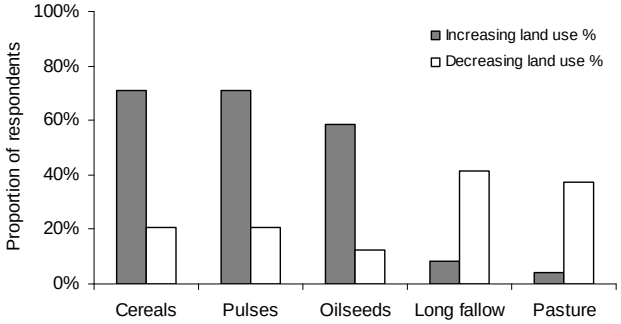

Figure 1. Proportion of respondents (Horsham East and Sheep Hills) who indicted that they had increased or decreased the proportion of their farm area under various land uses from 2008-2011. Total responses = 24

Previous results showed a shift towards maintaining standing stubbles, particularly at Sheep Hills from 1995 to 2008 (Nuttall *et al* 2010). Anecdotal evidence since 2008 indicates an increase in stubble burning, slashing and cultivation in the Wimmera. Survey results however did not agree, with 79% of respondents indicating that they had increased the proportion of their farm sown into standing stubbles during this time at Sheep Hills. Results were mixed about which practices were in decline (Figure 2). GPS guidance is a key tool that has contributed to stubble retention in modern cropping systems and 82% of those who increased standing stubble at Sheep Hills also utilised GPS guidance. Overall, use of guidance at Sheep Hills was 86% in 2011 having grown steadily since 1995 (Figure 3). At Horsham East 50% of respondents made no change to their stubble management practices from 2008-2011, 40% of respondents increased the proportion of stubbles left standing and 30% increased burning while practices in decline were once again more evenly spread (Figure 2). Uptake of GPS guidance at Horsham East reached 60% in 2011 progressing more slowly than at Sheep Hills (Figure 3) and this may be related to smaller farm sizes in this area. The 2008 survey indicated an average farm size of 904 ha at Horsham East and 1,868 ha at Sheep Hills (Nuttall *et al* 2010).

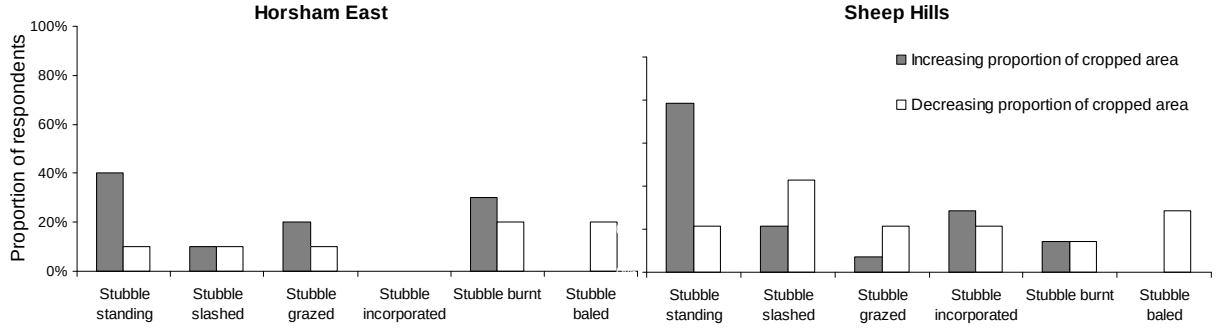

Figure 2. Proportion of respondents at Horsham East and Sheep Hills who indicted that they had increased or decreased the use of various stubble management practices 2008 to 2011. Total responses = 14 (Sheep Hills) and 10 (Horsham East).

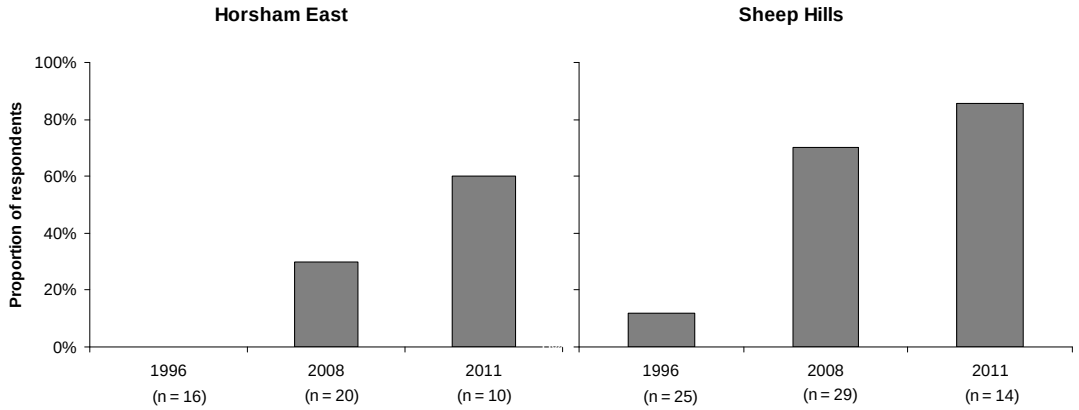

Figure 3. Proportion of respondents at Horsham East and Sheep Hills who utilised GPS guidance in 1995, 2008 and 2011. 'n' denotes total responses.

This survey sought to quantify use of various tools and practices associated with nutrient decision making contrasting those used for phosphorus (P) and nitrogen (N) decisions. With P the use of tools such as nutrient budgeting, seasonal outlooks and soil testing increased from 1995 to 2008 but decreased by 2011 at both sites (Figure 4). The survey asked respondents whether they used a standard rate of P across all paddocks for a given crop or whether they applied no P. Results indicated that applying a standard rate was a diminishing practice over all three years while applying no P was an infrequent practice that peaked in 2008 corresponding with the final year of dry seasonal conditions and high fertiliser prices. Use of various tools for N decisions followed a similar trend to P, peaking in 2008 before declining. This decline is thought to be related to improved seasonal conditions and reduced fertiliser prices. Seasonal outlook information in particular was used more commonly than most others for N decisions reflecting the more tactical nature of N decisions with the move towards supplying N during the growing season rather than at sowing (Figure 5). As with P decisions the practice of applying a standard rate of N has been in sharp decline since1995 while the practice of supplying no N was highest in 1995 and 2008 before falling in 2011. These changes corresponded with growth in cropping intensity between 1995 and 2011, increasing the requirement for N inputs and dry seasonal conditions in 2008 limiting the need for N inputs.

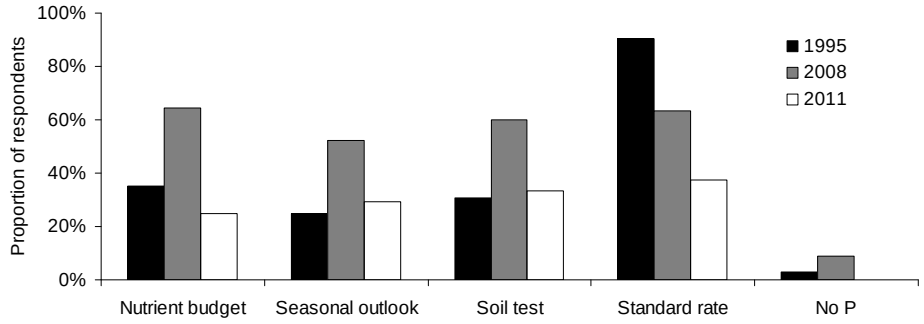

Figure 4. Mean proportion of respondents who employ various tools and strategies when making decisions relating to P application 1995 (n = 35), 2008 (n = 45) and 2011 (n = 24). 'n' denotes total responses.

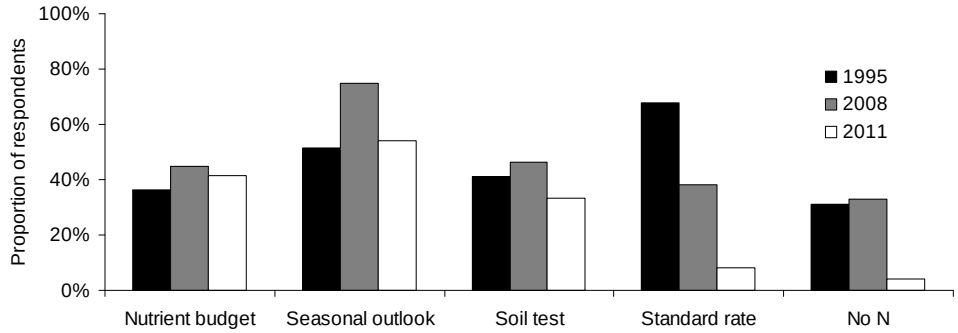

Figure 5. Mean proportion of respondents who employ various tools and strategies when making decisions relating to N application 1995 (n = 34), 2008 (n = 42) and 2011 (n = 24). 'n' denotes total responses.

The aim of this project was to use a PARD&E methodology to identify and demonstrate practices that improve WUE in order to adapt to dry seasonal conditions. In some cases the change in practices observed since 2008 aligns with such adaptation, in other cases they seem to be adapting to more favourable seasons (not without good reason) which raises the question of whether this project has achieved its goals. As was reported by Wallace *et al* (2010) this project has been able to consistently generate positive engagement with the farmer groups involved. Evaluation indicated that when asked if this project had increased knowledge of the topics trialled average response was 3.7/5 and when asked whether participants found engaging with researchers useful responses averaged 3.9/5. One of the key findings has been that achieving practice change at the farming systems level is difficult within the average project life span. Such changes are made based on a complex mix of seasonal conditions, technology changes, financial constraints, knowledge and individual values. It is proposed that by improving farmer's knowledge of the agronomic and environmental ramifications of system change they can then make a more informed decision when tackling seasonal conditions. Using this as a metric for evaluation suggests that this project has been successful in improving farmers' ability to make informed decisions and implement flexible farming systems. It is hypothesised that this move towards more flexible systems represents a more robust climate adaptation for the long term.

Conclusion

The results of the two surveys conducted as part of the fast tracking climate adaptation project provide a snapshot of changes in farm practices since 1995 for two dryland cropping districts in Victoria. They have shown that following a series of wetter than average years there has been an increase in area sown to cereals, pulses and oilseeds often at the expense of long fallow and pasture from 2008-2011. They have also shown a steady increase in stubble retention and uptake of GPS guidance since 1995 and move towards more adaptive nutrition management. This has shown that while climate adaptation often focuses on adapting to dry seasonal conditions, farmers are implementing flexible systems able to tackle both wet and dry conditions and this may be the best form of climate adaptation. Evaluation of the project has also highlighted that using a PARD&E methodology can achieve strong engagement with the target audience and increase knowledge of the effects of system level changes, enabling more informed decision making.

Acknowledgements

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