Adapting to climate change in Australian farming systems: A network for applied R&D.

Peter Hayman

SARDI Climate Applications, GPO Box 397, Adelaide SA 5001 www.sardi.gov.au Email Peter.Hayman@sa.gov.au

Abstract

A new national network has been formed (the Primary Industries Adaptation Research Network -PIARN) to deal with growing interest amongst some farmers, agronomists, funding agencies and policy makers in adapting to a variable and changing climate. After describing the context of the network and referencing key websites and resources, issues on adaptation of farming systems are raised.

Farming systems in the Australian grains belt are adapted to rainfall that is low and erratic, with unreliable planting rains and springs that start warm and often finish hot. On one hand this makes the grains belt sensitive and exposed to a warming and drying trend, on the other hand there is a high degree of adaptive capacity at the plant, paddock and farm enterprise level. We discuss why the distinctions between managing a variable climate and managing a variable and changing climate are subtle but important and conclude with a view as to how the agronomist profession can contribute to the network and the issue.

Key words

Climate change, adaptation

Introduction

Climate change research is often organised under the three broad headings of 1) climate science, 2) impacts and adaptation and 3) mitigation. This is consistent with the three working groups of the Intergovernmental Panel on Climate Change (IPCC) and a consensus that it is not a case of reducing greenhouse gasses *or* adapting to climate change, we need to do both. Stern (2007) noted that adaptation was not an alternative to mitigation but that in most cases, it provided local benefits without long lag times. He also maintained that due to the complexity of adaptation, governments had a role in providing information. Although there may be immediate benefits to adaptation it could be much easier to write a '10 point plan' and set policy targets for an industry to reduce greenhouse gas emissions than it is to plan adaptation strategies for worrying but uncertain climate change.

The National Climate Change Adaptation Research Facility (NCCARF), hosted by Griffith University has the role of "leading the research community in a national interdisciplinary effort to generate the information needed by decision-makers to manage the risks of climate change impacts". NCCARF has established eight adaptation research networks, one of these networks addresses Primary Industries. It is hosted by the University of Melbourne with Professor Snow Barlow as convenor. The expected participants in the network include agronomists as they are likely to have a key role in adapting farming systems to climate change. Other networks include climate change and health, marine ecosystems, terrestrial biodiversity (see www.NCCARF.edu.au for full list, host universities and how to join the Primary Industries network).

NCCARF also is charged with developing national adaptation research plans in each of the 8 themes. The National Climate Change Adaptation Research Plan for Primary Industries identifies research that generates knowledge and tools that address the following: how and why primary industry systems or parts of systems are vulnerable to climate change, levels of adaptive capacity, how adaptive capacity can be increased, how a stakeholder can move from adaptive capacity to adaptation actions and the adaptation technologies, options and understanding that are needed to implement these actions.

Although the emphasis of this paper is on adaptation, it is naive to ignore the point that there is a range of opinions in the farming (and agronomy) community about the science of human-induced climate change. Agronomists are trusted by many farmers as a filter on information from government, media and the scientific establishment. Hence it is not surprising that agronomists are asked whether they believe in climate change. This question is probably better worded as "Are you convinced of the evidence of human induced climate change"? Andergregg et al. (2010) used the terms convinced and unconvinced rather than more pejorative terms such as 'deniers' and 'alarmists', 'sceptics' and 'believers', 'contrarian' and 'conventional'. Although it is obviously best to read primary sources, the IPCC summary for policy makers, the frequently asked questions section of the Department of Climate Change (http://www.climatechange.gov.au/en/climate-change.aspx) and the August 2010 report from the Australian Academy of Sciences are useful places to start for busy agronomists (http://www.science.org.au/policy/climatechange2010/index.html)

The Australian Academy of Science document deals with the issue of confidence and uncertainty. It states a high degree of confidence that humans are changing the composition of the atmosphere and that this is warming the atmosphere. The report also recognises that the exact amount of warming for a given trajectory of greenhouse gasses is hard to identify and acknowledges the difficulty of assessing how climate change will affect individual regions, particularly future changes in rainfall patterns. It is wise for agronomists to remain sceptical when told an exact amount of drying to expect by 2030 or that a specific drought or heatwave is due to climate change. It is more helpful to frame this in terms of increased risk of heat events or frequency and severity of drought (Hennessy et al. 2008). Although the main driver of drought in SE Australia is natural variability, evidence is mounting for some human influence (Timbal et al. 2010).

An emerging issue for agricultural R&D

The issue of climate change has been developing over several decades. The Australian Academy of Sciences commissioned a report on climate change in 1970s and the Greenhouse 1988 conference and related workshops had significant input from agronomists. Perhaps due to a long history with climate variability and the managing climate variability program, agriculture has been one of the leaders in terms of impacts and adaptation work. For example, at the recent international adaptation conference at the Gold Coast in June 2010, the primary industries sessions were by far the most heavily oversubscribed and only a fraction of the submitted work could be included in oral presentations. Nevertheless for most of us, climate change is a relatively recent issue. The 1998 agronomy conference had no index entries for climate change or global warming. In his closing address titled "The Future Challenge – Search for System" Ray Ison did not mention climate change. As a visiting expatriate he asked past colleagues what the emerging issues were for agronomy, and although climate variability was raised as an issue, there was no discussion of climate change. A scan of the contents of more recent conferences show no entry for 2001 (Hobart) a plenary by Peter Gregory in 2003 (Geelong), a plenary and a number of contributed papers at the International Crop Science Congress (2004) and then a steady increase over the 2006 (Perth) and 2008 (Adelaide) conferences. Perhaps due to the rapid growth in R&D in climate change relevant to agriculture there is a perception from R&D funding providers and user of the information at the policy, industry and farm level that the effort could be better coordinated. Figure 1 provides an overview of the main coordinating bodies and research agencies addressing mitigation and adaptation.

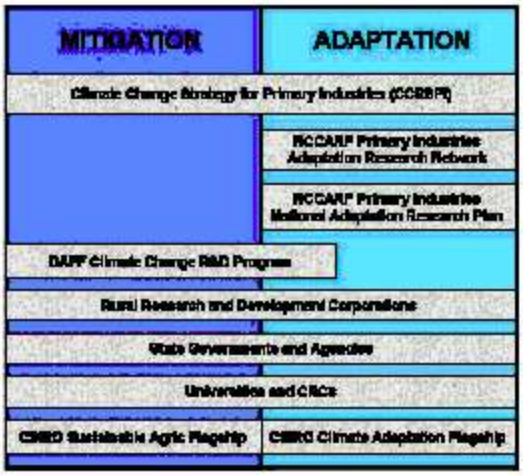

Figure 1. Relationship between key coordinating activities, networks, funding agencies and R&D providers on climate change. Diagram and explanatory text from draft PI National Adaptation Research Plan.

Some of the key components of Figure 1 are as follows: The Climate Change Research Strategy for Primary Industries (CCRSPI) is a cross sectoral R&D strategy developed under the mandate of the R&D subcommittee of the Commonwealth Standing Committee for Primary Industries in 2008. This research strategy was established to guide research into adaptation to climate change and greenhouse gas mitigation including issues of emissions accounting and trading. CCRSPI commissioned CSIRO to provide a comprehensive review of adaptation in Australian Agriculture (Stokes and Howden 2010). The Commonwealth Department of Agriculture Forests and Fisheries (DAFF) Australia's Farming Future is a four year initiative (2008-2012) established to help primary producers adapt to and manage the impacts of climate change. Key components are a Climate Change Research Program (CCRP), a more extension orientated program FarmReady and a Climate Change adjustment program which addresses the issue of ongoing rural adjustment.

The main providers of funds for R&D relevant to climate adaptation are the Rural Research and Development Corporations, who have had a high degree of input into CCRSPI. CSIRO is a major R&D provider through the Climate Adaptation Flagship and the Sustainable Agriculture Flagship as are university departments. State and territory government climate-related research programs have invested significantly in developing and communicating research and information about adaptation to climate variability and change.

The Primary Industry Adaptation Research Network was formally contracted in February 2010 and is an open network. The Convenor is Professor Snow Barlow (University of Melbourne). Co-coveners are Richard Eckard, Peter Grace, Peter Hayman Mark Howden and Ross Kingwell. Alison Turnbull is PIARN coordinator and Lauren Ricards is a part time research fellow. There are 7 themes:

- Plant Adaptation to Climate Change - Prof David Ellsworth (UWS), Dr Mark Hovenden (UTas)
- Animal Health, Production and Biosecurity- Dr Gary Muscatello (University of Sydney)
- Farming Systems – Prof Deirdre Lemerle (CSU/NSW DPI) / Dr Peter Hayman (SARDI)/UA
- Soil management – Professor Peter Grace (QUT)
- Water management – Professor Steve Tyerman (UA/Waite) / Professor Wayne Meyer (UA)
- Regional Social and Economic Adaptation and Assessment - Dr Paul Dargusch (UQ)
- Forestry – Professor Richard Harper – (Murdoch University)

The Farming Systems theme of PIARN

The focus of the farming systems theme is on adaptation at the paddock and farm level. This sits between adaptation studies on crop and animal physiology at a lower level (plant adaptation and animal health themes in PIARN) and the regional social and economic adaptation theme at a higher level. Figure 2 can be used to distinguish between adjustment changes, system changes and transformational changes. Much of the RD&E at a paddock level on agronomy and pasture management will be involved in adjusting current systems and this will be hard to distinguish from best practice in a variable climate. Identifying appropriate adjustment adaptations and the limits to these adaptations under warming and drying will be a valuable contribution from agronomists in the coming decades. At the farm level there are questions of how climate change can be factored into whole farm modelling and frameworks to consider climate risk in farm management and appropriate system changes. Farming systems thinking has been useful to classify types of farms in agroecological zones. The notion of these zones shifting raises questions of how farming systems will change and how farming systems in an adjacent warmer and drier zone might offer spatial analogues. Farming system thinking also highlights multiple factors such as commodity prices, costs, policy changes, emerging pests and disease that interact with climate risk and can lead to system changes.

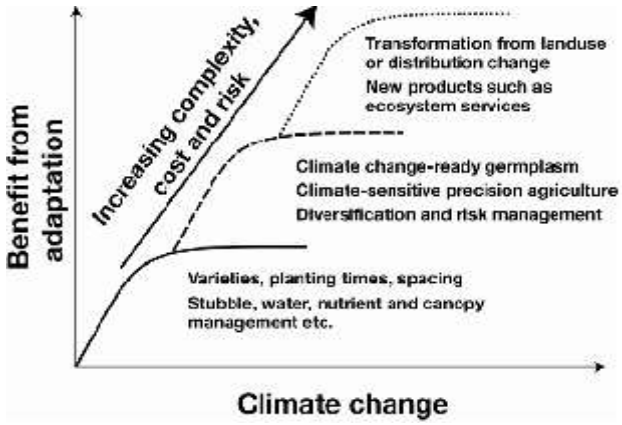

Figure 2. Hypothetical relationship between incremental and more transformational adaptations – from Howden et al. (2010). This framework has been used in the National Adaptation Research Plan.

Challenges for adaptation RD&E – over attribution and additionality

Earlier in this paper reference was made to three working groups of IPCC. A key concept in Working Group 1 (climate science) is that detection and attribution are separate processes. Just as detecting a trend in rainfall or temperature does not imply attribution to a specific cause, we must be careful of a form of climate determinism that interprets changes in farming systems as a response to changes in climate rather than complex interactions of climate, developments in technology, markets, land prices and other forces. Just as climate science loses credibility if it is seen to over-attribute every weather event to climate change, there can be a risk of over-attribution of past and future actions by farmers as determined by climate. This identifies the need for careful analysis of the role of climate in determining past land use and practice change and the need for future climate adaptation to be viewed in a broader context of change.

Additionality is a concept from IPCC Working Group 3 (mitigation). This is the notion that an action that might sequester carbon on a farm needs to be shown as being additional to what was already being done. Liverman (2010) has raised the question of whether additionality was relevant to adaptation R&D. On one hand the best way to prepare for future climate change is to manage current variability with sound agronomy, however this leads to the question of what is additional under climate change adaptation R&D. Pannell (2010) and others have posed this question in the Australian context. In terms of Figure 2, additionality for R&D will be hardest to show in the bottom left hand corner. However R&D for climate variability is unlikely to be a full substitute for R&D for climate change. For example, accepting climate change requires abandoning the notion that climate fluctuates or even runs in cycles that are bounded by

the envelope of past variability. Milly et al. (2008) argued that climate changes required a rethink of the way risk management in the water industry was taught and practiced. Although agronomy is often dealing with a shorter planning horizon than the water industry, notions of variability and cycles of poor seasons and good seasons are strongly held. Farmers and advisers are sometimes surprised how relatively small percent changes in mean rainfall and increases in temperature can have a large impact in the ratio of good seasons to bad seasons and warm seasons to cool seasons (Hayman and Alexander 2010).

Concluding Remarks

Agronomy is an applied science where the key question is "what do we do about the situation?" rather than the basic science question of "why is it so?" In many ways agronomists are more akin to engineers who use science to solve problems and build bridges rather than physicists. In his Donald oration Brian Hearn (1996) noted Passioura's distinction between science and engineering and stated that he wore his engineer's badge with pride. Agronomists play a vital role in the applied science questions such as "what are the likely impacts of climate change?", "what are the adaptation options?" and "at what level of change do these adaptation options fail"? To be successful, a network on adaptation and climate change requires practising agronomists to address these challenging questions.

Acknowledgements

Mark Howden, Snow Barlow, Lauren Rickard and Deirdre Lemerle and two referees provided useful advice on an earlier draft.

References

Anderegg WRL et al. (2010). Expert credibility in climate change. Proceedings of the National Academy of Sciences 1003187107.

Australian Academy of Sciences (2010). The Science of Climate Change - Questions and Answers.

Hayman PT and Alexander BM (2010). Greenhouse 2009 Conference. pp.113-122, Perth. (CSIRO)

Hennessy K et al. (2008). An assessment of the impact of climate change on the nature and frequency of exceptional climate events. Bureau of Meteorology and CSIRO.

Hearn AB (1996). An Agronomist's Odyssey. 7th Australian Agronomy Conference, Toowoomba.

Howden SM, Crimp S, Nelson R (2010). Greenhouse 2009 Conference. pp. 101-112, Perth. (CSIRO)

Liverman D (2010). Bridging the science-policy interface: America's Climate Choices and the role of science in climate governance. http://www.nccarf.edu.au/conference2010/archives/1001.

Milly PCD et al. (2008) Stationarity Is Dead: Whither Water Management? Science 319, 573-574.

Pannell DJ (2010). Policy for climate change adaptation in agriculture. http://cyllene.uwa.edu.au/~dpannell/dp1003.htm. Accessed September 2010.

Stern NH (2007). The economics of climate change. Cambridge University Press, Cambridge.

Stokes C and Howden M. (2010). Adapting Agriculture to Climate Change. CSIRO, Melbourne.

Timbal B et al. (2010). CAWCR Technical Report No 026, July 2010.