Submission No. 15

Submission to the Inquiry into long-term meteorological forecasting in Australia

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Brief background on PIRSA and SARDI

The PIRSA Agriculture, Food and Wine Division (AFW), working in partnership with primary industries, stakeholders and other national and state government departments has a key focus on the economic development of agriculture, food and wine value chains from farm to markets with environmentally sustainable and socially responsible strategies. The division's sustainable systems unit provides focus on social and environmental issues including the impacts of adverse climate variability e.g. drought and floods, while the emergency management team is responsible for agency preparedness for emergency response and recovery strategies.

South Australian Research and Development Institute (SARDI) is the research and development division of PIRSA. SARDI has been involved in working on the interface between climate science and farmers since the early 1990s. Over the last 15 years SARDI has developed a series of accredited workshops for farmers on application of climate science to farm management. Once farmers attend a workshop they are given access to free, ongoing newsletters that interpret seasonal rainfall, temperature, and pasture outlooks for the South Australian context.

The SARDI Climate Applications Unit is not involved in the development of climate modelling and seasonal forecasts. Rather it aims to inform users of climate science from the Bureau of Meteorology and CSIRO and keeps a watching brief on developments from other Australian forecast providers and international groups such as ECMWF (European Centre for Medium range Weather Forecasts) and the International Research Institute for climate prediction based in Columbia University, New York.

First term of reference: The efficacy of current climate modelling methods and techniques and long-term meteorological prediction systems;

PIRSA and SARDI works closely with the Bureau of Meteorology in Adelaide in the following areas including:

- Emergency response where farms and livestock are involved,
- Policy and program development on climate variability including drought and climate change.
- The interaction is assisted via biannual meetings between PIRSA and the Bureau.

SARDI also works closely with the National Climate Centre of the Bureau of Meteorology and the Centre for Australian Weather and Climate.

These organisations are responsive to requests for information and Australia is served well by the hard working scientists in the Bureau of Meteorology and CSIRO.

1.1 The important role of the Managing Climate Variability Program (MCVP)

The work on climate applications in SARDI has benefited from our involvement in the MCVP and the former Climate Variability and Agriculture Program. These programs, managed by Land and Water Australia have contributed to the improvement of climate science in Australia, but more importantly have focussed climate science onto end user needs. SARDI strongly endorses the science plan of MCVP as highlighting the current strengths of the meteorological forecasting in Australia and directions for future research.

1.2 The need to move beyond statistical relationships

Most current forecast systems are based on statistical relationships between historical climate at a location in Australia given a similar set of certain indicators as sea surface temperatures or atmospheric indices such as the Southern Oscillation Index. These systems continue to offer guidance, however the move to more reliance on dynamic modelling of the climate system is necessary for a number of reasons:

a) There is increasing evidence for the role of the Indian Ocean Dipole and the Southern Annular Mode as well as the tropical pacific (El Nino Southern Oscillation - ENSO). Clearly there are not enough years of recorded climate history to incorporate these factors into a statistical model, their interaction can only be captured in a dynamic model.
b) Climate change means that there are changes in both the predictors (e.g. Sea Surface Temperature) and predicants (Rainfall).
c) Due to the power of computers and the availability of data, it is likely that if there were strong statistical relationships that they would have already been identified and

d) Finally, due in part to the enormous effort in climate change science, dynamic models are likely to become more available.

Although dynamic climate models are likely to become more available, special effort should be focused on their application to the issue of seasonal climate forecasts. There are challenges of how to incorporate the output of dynamic climate models into crop simulation models.

1.3 A useful summary from Academy of Science Workshop in August 2006

A representative of SARDI was on the organising committee of Australian Academy of Science workshop on the Science of Seasonal Climate Forecasts (Manton et al 2006). The proceedings are available at http://www.science.org.au/events/seasonal/index.htm. No doubt there were aspects of climate science in Australia not covered by this document and there have been developments since this document, nevertheless it represents a useful summary.

1.4 The most common concern is accuracy of the Seasonal Climate Forecasts (SCF) and current forecast systems

Although there is a high degree of awareness of SCF by farmers and about half indicate in surveys that they use SCF in their farm management decision making, most farmers and advisers indicate they would like to place greater weight on SCF than they currently do. This is due primarily to their perceived low accuracy.

Stated reason	Portion stating	Source[1]
Forecasting is not reliable	76%	AFFA 2002 (n =1500)
Weather is not a priority/essential for the farm's operation	12%	
Weather patterns are impossible to predict	9%	
Climate is more consistent / reliable in my area	8%	
Not accurate	73%	BoM 2003 (n=660)
Not relevant to my industry	20%	
Didn't know they existed	4%	
Not detailed enough	3%	

The fact that accuracy is so often raised by farmers and advisers in any discussion of SCF, suggests that a probability forecast is most often converted into a categorical forecast and the probability is used as a guide to confidence.

[1] Survey data from Bureau of Meteorology and AFFA summarised in Hayman, PT Crean J Parton, KA, and Mullen, J.M (2007) How do seasonal climate forecasts compare to other innovations that farmers are encouraged to adopt ?. Australian Journal of Agricultural Research 58, 975-984. PDF of reference available from Hayman.peter@saugov.sa.gov.au.

Linked to the notion of accuracy is the request for more emphatic forecasts. Farmers and advisers will commonly complain that forecasts are too often in the order of 55% or 60% chance of exceeding median rainfall; they would prefer a larger swing from climatology with a more definitive forecast (e.g. 70 or 80% chance) that they have greater confidence to use in their farm management planning decisions. There is a paradox whereby the request from farmers is for more emphatic forecasts, yet the greatest damage will be caused by forecasts that offer strong guidance that is wrong. In the absence of seasonal climate forecasts farmers are planning for a range of possible futures, strongly emphatic seasonal climate forecasts may cause farmers to plan for single future outcomes.

1.5 A second issue commonly raised by users is the timing of the forecast

In a Mediterranean environment such as South Australia decisions such as crop area and choice are made in autumn, a common complaint is that the forecast information is not available early enough. There is a trade-off between accuracy and lead time, but in many cases there is considerable value in early warning.

Second term of reference: Innovation in long-term meteorological forecasting methods and technology;

As outlined in the brief introduction, SARDI and PIRSA do not see a role in the basic climate science. It would be good to see universities working in this area, but the preference would be for the work to be combined with CSIRO and the Bureau of Meteorology. There is considerable confusion in the user community when 'breakthrough' claims are made by a University without adequate testing.

Third term of reference: The impact of accurate measurement of inter-seasonal climate variability on decision-making processes for agricultural production and other sectors such as tourism;

3.1 The challenge of decision making in a variable climate

In Hayman *et al* (2007)[1] Australian Journal of Agricultural Research 58: 975-984 we argued the following:

> "Although droughts and floods are noticeable aspects of a variable climate, climate is a constant source of uncertainty for farmers. Because most farm inputs are allocated well before yields and product prices are known, farmers must allocate resources each season on the basis of their expectations about yields and prices. Climate variability erodes the accuracy of these expectations which in turn reduces resource use efficiency and farm incomes."

Demonstrating the relative advantage of a probabilistic Seasonal Climate Forecast (SCF) is difficult because it is an "information based" public good, relatively complex, difficult to trial and only partially compatible with existing

practices. In their favour, SCF are relatively low cost and the information can be applied across different paddocks and different enterprises, in other words a forecast of whether the coming season will be hotter, cooler, wetter or drier has economies of *scale* (same information can be used on many farms at no extra cost) and economies of *scope* (same information can be used for many different decisions and enterprises).

It follows that there are likely to be considerable economic returns from more accurate seasonal climate forecasts because the one innovation can be used in many different enterprises. It is also the case that considerable effort is required in applied research and development work on the application of seasonal forecasts to decision making.

3.2 The importance of managing year to year climate variability in a changing climate.

PIRSA and SARDI agree with the Climate Change Research Strategy for Primary Industries (CCRISPI) which outlines the need for managing climate variability as one of the most important strategies for managing climate change.

In the South Australian context the main climate related risks are:

- Droughts (including low runoff into farm dams and water flow in the Murray Darling Basin),
- Poor or late starts to the season,
- Dry springs often associated with frosts and heat events at the most vulnerable stage of crop development and
- Strong winds at times when landscapes are most vulnerable to erosion.

The frequency and severity of all these factors is likely to become different as climate changes. However an important aspect of managing these events is to manage the year to year variability and seasonal climate forecasts are an important part of this management.

Fourth term of reference: Potential benefits and applications for emergency response to natural disasters, such as bushfire, flood, cyclone, hail, and tsunami, in Australia and in neighbouring countries;

4.1 PIRSA role in the South Australian Emergency Management

PIRSA has responsibility under the State Emergency Management Plan as a Control Agency and Hazard Leader for agriculture and animal services. The Bureau of Meteorology is nominated as a participating agency to assist PIRSA in the responsibilities associated with responding to emergency incidents from animal and plant diseases or pests. The Bureau is a member of the State Mitigation Advisory Group, which reports to the State Emergency Management Committee.

4.2 Impacts of better long term meteorological forecasts in emergency management and opportunities for improvements.

PIRSA has developed a close association with the Bureau regarding its emergency management arrangements. There are opportunities for PIRSA to enhance these arrangements from more robust climate seasonal forecasting research and development aimed to increase the reliability of season forecasting.

At the beginning of each bushfire season PIRSA provides a briefing to not only PIRSA staff but other agencies with a biosecurity role (eg Local Government, DWLBC and DEH). This annual briefing is significantly reliant on accurate seasonal climate forecasting provided by the Bureau.

Seasonal growing conditions affect bushfire fuel loads and continuity of fuel availability. Fire breaks and fire suppression is less effective in good growing seasons. The ability of the Bureau to provide accurate seasonal climate forecasts would improve PIRSA's estimation of the likely cropping season outcomes and the associated bushfire risk. This information could assist in early preparation to mitigate the risk of bushfires.

Fifth term of reference: Strategies, systems and research overseas that could contribute to Australia's innovation in this area.

The International Research Institute for Climate and Society at Columbia University, New York has a mission of "Assessing and developing seasonal-to-interannual climate forecasts, while fostering the application of such forecasts to the explicit benefit of society." The literature from this organisation, especially Dr J Hansen is some of the more thoughtful on the topic of applying seasonal climate forecasts.

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