5

Climate modelling and weather forecasting

5.1 A frequent theme in submissions received and evidence heard by the Committee was the need for reliable climate modelling and weather forecasting on a regional level. Farmers need more information in greater detail at their regional levels in order to make better decisions about how best to adapt to variations in climate and prepare for extreme weather events.

5.2 There are a number of ways to explain the difference between climate and weather. One simple and effective explanation comes from the Bureau of Meteorology:

> Climate is what you expect, weather is what you get.[1]

Current climate modelling and weather forecasting systems

5.3 In evidence to the Committee, Mr Bruce Stewart, of the Bureau of Meteorology, stressed the need for accurate data and information as the basis for climate modelling:

> Any adaptation strategy must be underpinned by sound, high-quality climate data and information collected in a consistent manner from a monitoring network that is operated to agreed international standards. Climate data is fundamental to defining historical and recent climate trends and understanding the envelope of climate variability and change faced by agriculture.

1 http://www.bom.gov.au/lam/, viewed 30 October 2009.

> The bureau is a strong believer in the benefits to be obtained from getting its information, products and services out to the user community. In this regard, we have established many partnerships with agencies that work directly with farmers and natural resource managers in making that climate information more relevant, including through extension efforts that help relate information directly to farming needs.[2]

5.4 Mr Stewart went on to inform the Committee about present capabilities and acknowledged some current limitations in seasonal forecasting:

> In terms of seasonal forecasting, at the moment the period that we can best make predictions for is the next three months in advance. The current methodology we use is a statistical approach based on sea surface temperature anomalies in the Pacific and the Indian oceans. That is the predictable period. There is a considerable amount of research being undertaken within CSIRO and the Centre for Australian Weather and Climate Research— CAWCR. That is a bureau-CSIRO joint venture to improve that level of forecasting capability. There is a modelling approach being developed that is more dynamical, so it is a modelling of the sea surface temperatures and the relationship with future temperature and precipitation. The modelling at the moment is better in terms of its capability to forecast temperature variations in the next three-month period, and less good in terms of rainfall. The capability varies throughout the year, so it is not a consistent, 'We can always do it well everywhere'. And the capability varies across the country because the different elements of the system influence rainfall in different areas and different temperatures.[3]

5.5 In its submission, the Bureau of Meteorology informed the Committee about the Australian Community Climate and Earth Systems Simulator (ACCESS):

> Improvements in longer term climate projections in Australia will depend on the success of combined CSIRO and Bureau of Meteorology efforts in developing the Australian Community Climate and Earth Systems Simulator (ACCESS), a complex high performance climate and climate change model.[4]

2 Mr Bruce Stewart, Assistant Director, Climate and Oceans, Bureau of Meteorology, *Transcript of Evidence*, 16 September 2009, p.13

3 Mr Bruce Stewart, Assistant Director, Climate and Oceans, Bureau of Meteorology, *Transcript of Evidence*, 16 September 2009, p. 18.

4 The Bureau of Meteorology, Submission no. 65, p. 1-2.

> Further research is needed to improve the confidence in the projections of climate change. The ACCESS project is central to the Bureau's plans for modelling of future climate variability and change. ACCESS will ultimately provide stakeholders with data and information to drive their own agriculture, water management, and natural resource management models.[5]
>
> It is intended that the climate projections for Australia from the ACCESS model be included in an online database. Such a database would in addition provide information from the climate models developed in several other major research institutes around the world, enabling better assessments of likely future climate than can be derived from using one model alone. Such a future climate database will be critical to adaptation planning for the longer term by all primary industry and natural resource managers. An equivalent detailed database has already been developed for the United States.[6]

5.6 Mr Barry Hanstrum, also of the Bureau of Meteorology, gave evidence to the Committee outlining planned future capabilities for shorter range weather forecasting for farmers:

> The bureau is to unroll over the next few years an exciting project around the nation called 'The next generation weather forecasting and warning system'… It will realise a massive increase in productivity in the bureau's products and services. Those changes will be mostly reflected in rural communities. It will start in New South Wales soon, and we hope to have the system in place by about this time next year. We will be able to offer most of the smaller communities in rural New South Wales a seven-day forecast equivalent to the one we are currently providing only to capital cities. It will be underpinned by a new weather forecasting model, which the bureau has imported. It is essentially the United Kingdom weather forecasting model which has a much higher skill overall than the previous model that we were using to underpin our forecasts. The combination of the increased accuracy of the model we are using for the next week combined with this new system—which is a different way of preparing forecasts, and greatly increases our productivity in the number of places we can provide for and the length of time we can provide those forecasts for, so instead of one day it will be out to seven days—and a suite

5 The Bureau of Meteorology, Submission no. 65, p. 3.

6 The Bureau of Meteorology, Submission no. 65, p. 4.

> of graphical products, which the farming community have been calling for for a number of years, will mean that the look and feel of our weather service for the next week for the whole country, but particularly for the rural parts of Australia, as a result of this project will change very significantly in the next year in New South Wales and throughout the country over the next four years.[7]

5.7 In its submission to the Committee, the Queensland Department of Employment, Economic Development and Innovation listed programs that the Queensland Government currently provides to assist producers identify seasonal climate risk:

- Development of the Southern Oscillation Index (SOI) phase system which has wide international adoption. This information provides three month seasonal forecasts and is disseminated through the LongPaddock website, rural press and ABC weather reports on radio and television.
- The Queensland Climate Change Centre of Excellence (QCCCE) is also undertaking further climate forecasting research such as developing the Seasonal Pacific Ocean Temperature Analysis-1 (SPOTA -1) which is intended to forecast summer rainfall by the end of the preceding wet season (nine to twelve month forecasts), an outcome very important for the beef industry.
- Seasonal Crop Outlooks for wheat and grain sorghum. These reports are also integrated into the National Agricultural Monitoring System (NAMS) and provide input into ABARE's Crop Report.[8]

The need to improve forecasting skill

5.8 In its submission to the Committee, Land and Water Australia cite improved climate forecasts as one of the key challenges to adaptation under the Climate Change Research Strategy for Primary Industries (CCRSPI):

> For many in Australian agriculture seeking to move to a higher level of adaptation, it is sufficient to meet the challenge of improving the skill in our climate forecasts - multi-week through to seasonal.

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7 Mr Barry Hanstrum, Regional Director, New South Wales, Bureau of Meteorology, *Transcript of Evidence*, 16 September 2009, p. 20.

8 Queensland Department of Employment, Economic Development and Innovation, Submission no. 69, p. 5.

> For forecasts to be useful for farmers' risk management, planning and decision making they need to be translated into predictive assessments eg - soil moisture, irrigation water availability, fertiliser needs, pasture growth and the risk profile of extreme events - eg frost, heat stress, flood and prolonged drought. Tools that apply forecasts to identify adaptation strategies within a cropping or pasture cycle will be of increasing importance as climate variability increases under climate change.[9]

5.9 The submission to the Committee from the Australian Academy of Science painted a rather dismal picture of current Australian systems for observing and modelling climate change:

> [T]he scientific knowledge underlying climate change is not complete and the Academy note[s] that there remains considerable uncertainty in the mechanisms of climate change and how it will be manifested at regional and smaller scales at which adaptation measures are required.[10]
>
> The Australian systems for observing, monitoring and modelling climate systems, principally through the facilities of the Bureau of Meteorology (BoM) and the CSIRO, require significant upgrading and expansion. Many of the present observing systems were originally set up for different purposes. With increasing demands for improved data resolution and quality, and with new technologies becoming available, a creaking system needs major upgrades.[11]

5.10 In evidence to the Committee, Growcom reiterated the importance of better forecasting for growers:

> … absolutely fundamental to our capacity to adapt is better forecasting at a seasonal and regional level. That comes out every single time we speak with growers.[12]

5.11 Numerous submissions to the 2009 House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia also clearly enunciated why farmers need better weather forecasting and climate modelling to help them adapt to climatic variations. The submission from the Department of Agriculture, Fisheries

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9 Managing Climate Variability Program, Land and Water Australia, Submission no. 11, p. 2.

10 Australian Academy of Science, Submission 48.a, p. 1.

11 Australian Academy of Science, Submission 48.a, p. 3.

12 Growcom, *Transcript of Evidence*, 14 July 2009, p. 16.

and Forestry concurred with submissions from the SA Farmers Federation and the WA Farmers Federation, and provided a broader context:

> Better information about Australia's potential future climate is central to decision making for individual enterprises and for policy planning. Understanding climate variability at seasonal timescales and having relevant long term meteorological forecasting tools will greatly assist risk management strategies at an enterprise level. There is also an increasing recognition that climate change intensifies some of the risks associated with climate variability and perhaps presents new risks.
>
> Although the sensitivity to climate varies across Australian agricultural sectors, there are some general features of climate to which most sectors are sensitive. High rates of change and abrupt shifts in climate may exceed agricultural producers adaptive capacity. Improving farmers capacity to adapt to climatic changes both within-season and in the long-term will be crucial in determining how well they will cope with climate change.
>
> The type of climate information required to support decision making in agricultural industries depends on whether within-growing season or multiyear decisions are being considered. For example, within-season decisions might include crop selection and seeding, fertiliser application, stocking and destocking of livestock, and control of pests, weeds and diseases. Longer term decisions may involve infrastructure investments (such as grain handling facilities or dams), perennial crop species, irrigation systems and farm purchases.[13]

5.12 In her submission to the Committee, grazier Ms Rosemary Hook raised the problems of how inaccuracies in weather forecasting and climate modelling hinder farm planning and understanding of potential mitigation options, and confidence in future meteorological forecasts:

> My understanding is that global climate modelling only indicates likely directions of change, for example, less rainfall, higher temperatures and more extreme events. I understand that it is not possible to model regional or local weather patterns that would include factors such as rainfall intensities and duration, wind speeds, coincidence of extreme heat and wind days, and the like. I

13 Department of Agriculture, Fisheries and Forestry, Submission (no. 27) to the House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia, p. 6.

> also gather that in order to try and understand future conditions for agriculture, modelling is being used to predict regional changes to growing seasons and soil water profiles. However, as it is not possible to model future weather patterns as inputs to the regional models, assumptions are made as to how rainfall will be distributed, temperatures reached, the duration of hot or cold periods, and so on. From what I know of some assumptions being made, I think the past summer has indicated that many could well be wrong - while those who carry out such modelling and prediction would probably be the first to admit this, the problem is that outputs generated tend to become accepted as "what will happen". As planning becomes more widespread, one can see that the assumptions and non-definitive nature of the predictions will be forgotten.
>
> The notion of adaptation should be used carefully, and we need improved capability to predict future weather patterns to underpin our understanding of realistic options.[14]

5.13 The CCRSPI Network submission to the Committee suggested a higher level of confidence in current meteorological products, while still noting issues of concern:

> Decision support tools that translate climate data into commodity-specific information are required to improve productivity and profitability… Already the overwhelming majority of Australia's farmers and agricultural advisors use regional weather forecasts to help inform on-farm decisions. Those who do not use forecasts cite the unreliability of forecasts or their lack of local application.[15]

5.14 The 2009 House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia also received submissions about the skill and accuracy of forecasting. The submission from Primary Industries and Resources (SA) stated that 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.

14 Ms Rosemary Hook, Submission no. 47, p. 2.

15 Climate Change Research Strategy of Primary Industries Network, Submission 10, p. 16.

> 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.
>
> 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.[16]

5.15 The difficulties of balancing expectations for emphatic forecasts with the more realistic probabilistic forecasts present particular challenges. In evidence to the House Standing Committee on Industry, Science and Innovation, the Australian Meteorological and Oceanographic Society (AMOS) explained the challenge:

> … how do you get the information that we have across to, on the one hand, the general public, the media and people who have broad interest in whether there is going to be a drought next season or not, and to an individual user who is worried about the farm gate, his or her particular farm and what decisions he or she might be making now. We have really struggled with this. It is a really complex problem and it is easy to get confused. Because of the chaotic nature of the atmosphere … these forecasts are all probabilistic.[17]

5.16 For the Grains Research & Development Corporation (GRDC), one of the key investment areas is improving seasonal forecasting to allow growers

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16 Department of Primary Industries and Resources (SA), Submission (no. 15) to the House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia, pp. 3-4.

17 Australian Meteorological and Oceanographic Society Inc, *Transcript of Evidence*, House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia, 29 June 2009, p. 10.

to be able to pre-empt seasons.[18] In their submission to the Committee, while maintaining that climate forecasting was a powerful management tool, GRDC also issued a caveat on the reliance on forecasting as a major tool:

> Managing variability within the season remains the most powerful method for growers to adapt to climate change. One half of Australian grain growers take into account seasonal climate forecasts in farm management. Increasingly growers are delaying large investments in fertiliser as they wait to see how seasons progress. Managing in the context of the season is in effect a practical adaptation to climate change.
>
> Despite being the most valuable tool, current levels of understanding of within season variability are of marginal value for individual growers in making decisions for their farm businesses due to a lack of predictive power. The El Nino Southern Oscillation (ENSO) /Southern Oscillation Index (SOI) models have the greatest power with 58% of seasonal variability explained by these models. When these tools are used by a skilled operator, a benefit of $8/ha can be gained in some areas of Australia.
>
> There is however still debate over the usefulness of improving forecasts. It can be argued that a reliance on seasonal forecasting leads to farmers investing less into risk management strategies making their businesses vulnerable when the forecasts are wrong.
>
> To avoid a shift away from on-farm risk management in favour of better seasonal forecasting, emphasis on improving our understanding of the drivers of climate change have been focused on.[19]

Appropriate meteorological products for farmers

5.17 One of the recurring issues in submissions to this inquiry was the need to have meteorological services and products that are appropriate and useful for agriculture. Two important aspects of this issue are the need for more regional and industry-specific meteorological information and getting the information out to farmers in a useful form.

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18 Grains Research and Development Corporation, *Transcript of Evidence*, 27 May 2009, p. 3.

19 Grains Research and Development Corporation, Submission no. 53, p.p. 5-6.

Regional and industry specific forecasting

5.18 In evidence to the Committee, Mr Colin Creighton of the Managing Climate Variability program, enunciated the kind of services they would like to offer farmers in regional forecasting:

> The bottom line for us is: more skill and value in our forecasting. The whole role of Managing Climate Variability is to listen to farmers' needs and to provide forecasts at the time they want them. It is no good telling a wheat farmer in WA if it is going to rain in December; he has already harvested. He wants to know about this time of the year: does he turn the tractor on or not? Our job in Managing Climate Variability is to make that happen. So our job is to work out what the farmers need and then, through things like the water and the land site on the Bureau of Meteorology, produce the products that they then use. If you have not been on the water and the land site, I recommend it. There were something like 70 000 hits last month and there are roughly 140 000 farmers in Australia. I am not saying that half the farmers in Australia hit that site, but it is very, very popular; that is because it is starting to produce the products about climate variability that farmers want.[20]

5.19 A pressing need for agriculture is to have accurate meteorological information available on a regional scale. In evidence to the Committee, Dr Jason Evans pointed out that the current climate projections are based on global climate models:

> On the global scale, which is controlled by very large-scale atmospheric circulations and radiative effects of the atmosphere and so forth, these models produce quite good projections, quite reasonable agreement with each other. But of course that scale is not particularly useful for a farmer or a catchment manager. The Victorian Murray does not look the same as the Lachlan River basin, but in these models they are the same. What we are really talking about is how you down-scale from these very broad scales that we have reasonable confidence in to scales that are meaningful to these people.[21]

5.20 Scaled down meteorological projections, combined with knowledge of land surface interactions at a regional level begin to produce information

20 Mr Colin Creighton, Program Coordinator, Managing Climate Variability, Managing Climate Variability Program, *Transcript of Evidence*, 3 June 2009, pp. 6-7.

21 Dr Jason Evans, UNSW Climate Change Research Centre, *Transcript of Evidence*, 1 July 2009, p. 50.

of sufficient accuracy to become a useful decision-making tool. Dr Evans continued:

> I do a lot of this in a dynamical sense—how you try and down-scale these global projections to the scales that are useful, taking into account all the dynamics of the atmosphere and the land surface interactions.
>
> [The local knowledge that we already have] comes into how you talk about the land surface. I am still talking in a modelling framework. How you talk about the land surface in these models very much is determined by what we know locally. You can find the idea that you do not just have ground cover determined by a satellite picture that tells you how green it is, but you can actually be aware of the exact type of vegetation that is there. If it is an agricultural area, you can be aware of…the soils, the dominant practice, so you can know something about growing and harvest times, and all these things impact on the local and regional climate.[22]

5.21 The Climate Change Research Strategy of Primary Industries (CCRSPI) Network provided the Committee with a comprehensive submission that drew attention to the need for more and better information about specific regions in association with local hydrology:

> Farmers cannot rationally respond to climate change and adapt to its likely impacts without basic information about what changes may occur in their climates and the implications of this for their agricultural practices.
>
> - Climate change and landscape interactions: further development of global circulation models is required to better understand the drivers of Australia's climate and increase the accuracy of rain forecasts. These models must be "down-scaled" to catchments and agricultural regions to provide more reliable seasonal forecasts and longer term climate predictions for specific regions.
> - Climate predictions need to be fed into models of landscape hydrology to better understand the implications of climate change for irrigated agriculture and river health. Current efforts will require regular updating as the science of climate change and catchment modelling improves.

22 Dr Jason Evans, UNSW Climate Change Research Centre, *Transcript of Evidence*, 1 July 2009, p. 50.

- Interaction between climate and primary production: down-scaled climate models in combination with hydrological models will hopefully enable improved predictions of seasonal soil moisture, frost, heat stress, and irrigation water availability - both seasonally and under expected climate change scenarios. This information is essential to enable farmers to make informed decisions around the viability of future agricultural enterprise, and for government to formulate rational policy.[23]

5.22 In its submission to the Committee, the UNSW Climate Change Research Centre advocates the inclusion of regional variables to provide the much sought after regional climate modelling:

> The Australian government plays a major role in promoting research into climate change impacts and assessment of adaptation strategies for Australian farmers. For this research to be effective, it needs to produce accurate projections of climate change at spatial scales of relevance to farmers, and include direct and indirect impacts on vegetation and crop production of increasing concentrations of atmospheric CO_2. While changes in temperatures and precipitation are very important when investigating the climate change impacts on vegetation, they are not the only factors that may influence crop production. Many studies have shown that changes in the physical characteristics of the land surface can have an impact on the climate. These changes can arise directly from land use activities but may also result from responses of crops to seasonal, inter-annual or longer changes in the atmospheric state. That is, there is a feedback loop between the land and the atmosphere, with each impacting the other. Vegetation (crops, pasture etc) also responds directly to changes in CO_2 which can change the speed at which crops progress through the various growth stages as well as the total production. Irrigated crops often produce relatively strong coupling between the land and atmosphere and are impacted both by changes in runoff caused by climate change as well as changes in evaporative demand. Currently Australia does not have the capacity to produce climate change impact projections that account for these processes. Developing such a capability should be a priority for government backed research in the near future.[24]

5.23 In its submission to the Committee, Growcom, the representative body for the Queensland production horticulture industry, expressed concern for

23 Climate Change Research Strategy of Primary Industries Network, Submission 10, pp. 12-13.

24 Climate Change Research Centre, University of NSW, Submission no. 18, p. 1.

the limited availability of information about climate change as it relates to the horticulture industry:

> A major barrier to the identification of likely climate changes and the development of industry and government responses is a lack of information, research, modelling and analysis specifically focused on the implications of climate change on the horticulture industry, especially on a regional scale. Analysis of climate-related economic, industry, and environmental issues specific to the horticulture industry is essential to underpin government's development of appropriate and well designed policies and instruments. This information and analysis will also form the basis for industry adaptation and mitigation strategies.[25]

5.24 The submission to the Committee from the Horticulture Australia Council and Horticulture Australia Limited expressed similar concerns to Growcom and pointed to the specific needs of horticulture in Australia, compared to agriculture, in improving seasonal forecasting tools:

> … Currently the limitation on the use of tools (climate applications for managing climate variability) in horticultural industries, is the lack of information - at the micro-climate/regional level – that addresses the lead-time and season requirements of the horticultural industry. The combination of long season (3 months) and short lead-time (zero), which are appropriate for other agricultural industries, is a significant constraint to the use of forecasting tools in horticulture, where a much shorter season length (several weeks to one month in some cases), and a much longer lead-time (3 to 4 months), would be much more useful. Given a sound forecast system that meets the requirements of the industry the appropriate tools can be produced. There are no forecast systems based on the SOI and SST's which have been extensively tested for longer lead-times and shorter seasons.[26]

Making forecasting appropriate and accessible

5.25 The need for improved forecasting also extends to how farmers obtain and understand the information in a context relevant to their situation.

5.26 The 2009 House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia received

25 Growcom, Submission 55, p. 6.

26 Horticulture Australia Council and Horticulture Australia Limited, Submission no. 62, p. 28.

submissions and heard evidence identifying lack of understanding of meteorological data as a root problem. The Queensland Department of Environment and Resource Management (DERM) submission to the inquiry also noted:

> Not only is there a need to tailor or customise forecasts to meet the needs of decision makers and other stakeholders (e.g. a forecast targeting a particular season at a certain lead-time), it is also important to translate seasonal forecast information into terms that can be readily be incorporated into management and decision-making. This may involve systems analysis and the use of models to translate climate information into more relevant information for decision makers (e.g. pasture or crop production rather than rainfall). However, an approach based solely on output from a centralised agency is unlikely to gain trust with stakeholders, therefore reducing the uptake of this information into management systems and decision making.[27]

5.27 The House Standing Committee on Industry, Science and Innovation also heard evidence from the Australian Meteorological and Oceanographic Society (AMOS). AMOS highlighted the potential for consumers to be overwhelmed by the amount of information available, which rendered them unable to use it for important decision-making. While one solution is to tailor forecasts for individual needs, this too presents problems:

> This is feasible but it is very person intensive... It is very demanding to have people sit down with farmers or groups of farmers and say: 'You're really interested in this decision. This is the sort of information that the science can provide that will be useful,' but we aren't going to put that on a website or publish it in the Australian or a weekly rural magazine because it is too much information for most people and we find that most people overreact to it or underreact to it.[28]

5.28 AMOS added that, that rather than improving decision-making, supplying more information via the Bureau of Meteorology web site had the potential to lead to rash or unwise decisions.

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27 Queensland Department of Environment and Resource Management, Submission (no. 33) to the House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia, p.18.

28 Australian Meteorological and Oceanographic Society Inc, *Transcript of Evidence*, House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia, 29 June 2009, p. 10.

> The Bureau can quite easily provide more information about those details than you see on their website, but we do not think it is useful in a broad sense. What we would like people to do is not make decisions based on a one-inch headline on the front of the Herald Sun.
>
> We think it is really important to get that message across. For instance, we are concerned at the moment we are slipping into a new El Nino which may increase the chances of drier than normal conditions over much of eastern Australia over the next few months. … It is great to have a one-inch headline in the Herald Sun, but we do not want farmers to go out and sell the whole kit and caboodle and bet their last shirt that there is going to be a drought. It just depends on what sorts of decisions you are making, how much you should value that forecast.[29]

5.29 Part of the solution to the problem of interpreting meteorological data for use as a management and decision-making tool may lie in extension services for farmers. The SW Climate Change Forum operates as a network to supply farmers in one region with credible information about climate change and managing climate variation. The Forum is a regional body delivering climate change information that is context specific to the south western region of Victoria and context specific to industry. In evidence to the Committee Mr Mike Weise outlined what he sees as the main ingredients in the successful delivery of the program to the farming community:

> I think it is having information go in through doorways they are used to. For example, the dairy industry has a newsletter that it distributes to every farmer in the region, and information carried in there has been tailored particularly for that readership. The seafood people have management groups or committees from which they distribute the information through to that group. That is their context and typical way of doing it.
>
> It is about getting the majority of the population onside with this and helping them to separate out that alphabet soup... Quite a bit of the effort goes into helping build that framework in a primary

29 Australian Meteorological and Oceanographic Society Inc, *Transcript of Evidence*, House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia, 29 June 2009, p. 10-11.

> producer's mind before the information comes in about biochar, carbon trading, CPRS and so on.[30]

5.30 The Queensland Department of Employment, Economic Development and Innovation is also undertaking work to assist farmers to better understand projected variability in climate on a regional basis. The department's submission to the Committee outlined work being undertaken:

> In addition to the statistical forecasts (eg: SOI phase and Spota-1[31]), the Bureau of Meteorology/CSIRO's dynamic climate model Predictive Ocean Atmosphere Model for Australia (POAMA) is useful for producers, providing seasonal and interannual forecasts. It is under continual development, so producers are accessing the best available science. Access to both dynamic models such as POAMA and statistical models such as SOI phase system provides a broader understanding of the uncertainties in the forecasts and allows producers to best judge the differences between these tools and how they may be applied to their business. Having a better understanding of the strengths and weaknesses of statistical and dynamic models enables them to better understand the uncertainties around the future climate risks. The QCCCE is finalising regional climate change projections based on the CSIRO and BoM climate change projections for Australia. This information will assist producers to understand the projected changes in climate for their region.[32]

Committee conclusions

5.31 In the course of this inquiry the Committee has heard from many farmers about the importance of accurate weather forecasting and climate modelling. The lack of regional scale climate modelling is of great concern to the Committee.

5.32 The Committee recognises that farmers may be assisted further with some form of extension service that focuses on, or includes, interpretation of meteorological data for agriculture.

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30 Mr Mike Weise, Executive Officer, WestVic Dairy Inc & SW Climate Change Forum, *Transcript of Evidence*, 3 September 2009, p. 35.

31 Seasonal Pacific Ocean temperature analysis version 1 (SPOTA-1), is an experimental system that builds on the information used to create the Southern Oscillation Index SOI. Both are long-range weather forecasting tools.

32 Queensland Department of Employment, Economic Development and Innovation, Submission no. 69, pp. 5-6.

5.33 The Committee supports the recommendations made to the government by the House of Representatives Standing Committee on Industry, Science and Innovation inquiry into long-term meteorological forecasting in Australia. The uptake of these recommendations by the government will improve meteorological services for farmers in Australia.

Recommendation 7

5.34 **The Committee recommends that the Australian Government increase funding for research into improving the consistency and accuracy of weather and climate forecasting, especially at a seasonal and regional level.**

Recommendation 8

5.35 **The Committee recommends that the Australian Government develop an education and training scheme for farmers in the understanding and use of weather and climate information.**