



COMMONWEALTH OF AUSTRALIA

Official Committee Hansard

**HOUSE OF  
REPRESENTATIVES**

STANDING COMMITTEE ON INDUSTRY, SCIENCE AND  
INNOVATION

**Reference: Long-term meteorological forecasting**

WEDNESDAY, 24 JUNE 2009

CANBERRA

BY AUTHORITY OF THE HOUSE OF REPRESENTATIVES



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**HOUSE OF REPRESENTATIVES**  
**STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION**

**Wednesday, 24 June 2009**

**Members:** Ms Vamvakinou (*Chair*), Fran Bailey (*Deputy Chair*), Mr Bidgood, Mr Champion, Mr Cheeseman, Dr Jensen, Mr Johnson, Mr Ramsey, Ms Rishworth and Mr Symon

**Members in attendance:** Fran Bailey, Mr Bidgood, Dr Jensen, Mr Ramsey, Mr Symon and Ms Vamvakinou

**Terms of reference for the inquiry:**

To inquire into and report on:

Long-term meteorological forecasting with particular reference to:

- The efficacy of current climate modelling methods and techniques and long-term meteorological prediction systems;
- Innovation in long-term meteorological forecasting methods and technology;
- The impact of accurate measurement of inter-seasonal climate variability on decision-making processes for agricultural production and other sectors such as tourism;
- Potential benefits and applications for emergency response to natural disasters, such as bushfire, flood, cyclone, hail, and tsunami, in Australia and in neighbouring countries; and
- Strategies, systems and research overseas that could contribute to Australia's innovation in this area.

**WITNESSES**

**BLUMENTHAL, Dr Martin, Manager, Agronomy, Soil and Environment, Grains Research & Development Corporation..... 1**

**CREIGHTON, Mr Colin, Coordinator, Managing Climate Variability, Land & Water Australia ..... 1**

**ROBINSON, Dr Michael, Executive Director, Land & Water Australia..... 1**



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**Committee met at 10.09 am**

**BLUMENTHAL, Dr Martin, Manager, Agronomy, Soil and Environment, Grains Research & Development Corporation**

**CREIGHTON, Mr Colin, Coordinator, Managing Climate Variability, Land & Water Australia**

**ROBINSON, Dr Michael, Executive Director, Land & Water Australia**

**CHAIR**—I declare open this public hearing for the inquiry into long-term meteorological forecasting in Australia being conducted by the House of Representatives Standing Committee on Industry, Science and Innovation. The inquiry arises from a request to this committee by Senator the Hon. Kim Carr, federal Minister for Innovation, Industry, Science and Research. Written submissions were called for and 33 have been received to date.

I welcome witnesses. Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. I invite you to make brief opening statements.

**Dr Robinson**—Land & Water Australia is the managing agent for the Managing Climate Variability program. As one of the rural and research development corporations, Land & Water Australia has been leading climate related research development and extension for about 15 years. In that time, the Managing Climate Variability program and its various predecessors have been our flagship in this regard. More recently, we have led the National Climate Change Research Strategy for Primary Industries and, indeed, the consultation through the process of developing that research strategy highlighted the importance of seasonal forecasts and climate variability for agriculture and natural resource management. It is our quite significant experience in that area that, for agriculture and natural resource management, understanding climate variability and improving our forecasting skill in the period of a two weeks to six months time frame is one of the most important improvements that climate modelling needs to undertake for the agricultural sector.

Hence, it is critical that the climate variability program continues and we are delighted to say that, with Land & Water Australia's abolition, Grains Research & Development Corporation will pick up the management of the Managing Climate Variability program. They have been a long-time partner, investor in and supporter of this work.

We also highly recommend to the committee that significant further investment in climate variability and seasonal forecasting work continues, particularly through the Managing Climate Variability program. I will ask Martin to follow on from there.

**Dr Blumenthal**—Grains Research & Development Corporation is a partner in the Managing Climate Variability program. As Michael indicated, GRDC have volunteered, with the support of all the other partners of MCV, to manage the program. From 1 July we will be the managing agents. Certainly all the partners are committed to the program continuing. The current contract

period is to 30 June 2010 but there is a lot of interest amongst the parties for the program to continue. Improved seasonal forecasts are seen as being critical to the profitability and sustainability of rural industries.

Looking at forecasts and the use of them, we all look at the weather daily—certainly farmers look at the weather daily. About half the farmers look at the seasonal forecast two to six months out and factor that into their management. We would like to increase that level of adoption. With climate change, we see seasonal forecasts and adapting to seasonal changes as one of the best ways that our farmers can adapt to climate change. They make their decisions as seasons play out. They obviously do not make management decisions that are going to have an impact in 2030 or 2070; they make decisions that are going to have an impact this year, next year or for the next five years. So it is very much about seasonal forecasting, and that is where we see the emphasis. Even though the management is changing, the commitment is still there from rural industries to invest in improved forecasts. Colin has comments to make.

**Mr Creighton**—I will summarise very quickly the document I have before me. The first page covers some elements about the program. The next page follows the terms of reference. I will quickly go through that for you.

The first page, effectively, is: what type of research program should you be thinking about? We are user-funded by levies, and I think that being user-funded is very important. Obviously it is about listening to the users' needs and refining and defining them and designing the program. Then it is very much about legacy issues at the end so that we can make sure the products can continue beyond the research program. Any research program, we believe, should do that. Our particular program has a benefit-cost ratio of 4.6 to one, which for any research program is very, very high.

Moving on to reference 1—as I move onto the next page—this is the program that has actually funded Australia's dynamic model. You have probably heard a lot already about the need to meet the dynamic models. There is only one research program in Australia that has been funding that and it is Managing Climate Variability. There are some issues there about where we are going with dynamic models and whether we should be doing more. Whether you put the resources into this program or into something else is your business, but the reality is that we have been the ones that got us to where we are now in terms of skill. I am quite proud about that even though it was before my time. The program itself is very important in pushing the whole issue of dynamic models.

So in terms of reference 1, you have already heard that statistical approaches are past their use-by date. I have just told you about dynamic models and what POAMA is starting to do. The little picture in the middle there concerns some work we did to try to understand better the drivers of Australia's climate. We are a system. There is the Indian Ocean, the Pacific Ocean and the Southern Ocean and there are tropical systems, and you have probably all heard they affect our climate. Unless our models or our forecasting in any form picks up and interrogates that whole system, we are not going to come out with accurate forecasts. My skill is in system science—a whole range of different systems from engineering onwards—so really my role in this is pushing hard the systems approach.

Then there are some recommendations. Obviously, more investment is needed. We really do not have enough money for what we need to do. Whether it is for emergency services or agriculture or whether it is urban water authorities, it does not matter, everyone is looking for better forecasts with more certainty and longer lead times.

Obviously, we need international collaboration. We cannot do it alone. While I talk about an Australian system, we are really talking about a global system. There is some good work going on in Europe and India and so on. We must recognise that this is long-term research. You do not get the results in three years—it might take five years. Last but not least, as you will probably hear from others, we need a new supercomputer every five or 10 years. That is the reality of where we are going in much of this science. So there are some key points in terms of reference 1 and some recommendations.

Turning over the page, terms of reference 2 is about impact and benefits. The key point for agriculture is that there is a substantial benefit already. Many people are already using forecasts. Some of the programs are part-funded—some get 70,000 hits a month. Seventy thousand people are going on one site every month and one of the reasons is that we have got the products that people are saying they want. So the user is driving the research, if you like.

I put an example in the middle there of some work being done for us in south-western Western Australia. In very short summary, if you are somewhere like Katanning and you blindly followed the last 27 years of forecasts—and no-one would advocate that you blindly follow anything—your profitability would increase somewhere around \$34 per hectare and, if you were further east, up to \$100 per hectare. Now on a grain crop that is quite a considerable part of the profit. That is just an example of where forecasting is already starting to have impact, and I guess that Martin has already talked to you about how GRDC is very keen for this work to continue. So the recommendations there are really about being user-driven. Let us make sure that when we do the research we have thought about the end-user and the products coming out at the end.

Terms of reference 3 are about the potential benefits. They are multiple. When I was with USGS for a while in Washington, they made much of the information free and all of a sudden they found all these uses of information they did not know existed. As we get better forecasts there will be a whole range of uses, whether it be white water rafting or whatever that we have not even thought about now. So the more we can do, the better our skill, and the more uses there will be. There will be uses we will not think about at the time such as tourist operators—whatever. I put an example there about Australia's variability. Have a look at the bottom three rivers, the Darling, the Hunter and the Murray. For the Darling, the ratio of high-flow to low-flow is 47,000. So between the highest flow and the lowest flow there is a difference of 47,000, 47 hundred times. Now you compare that with European rivers or many other places in the world where the ratio is 10, 17, or something like that. Australia's variability is like this.

**Dr JENSEN**—Is that predominantly due to inflows and therefore water allocation? I assume it is more due to that than rainfall. Would these ratios have been the same, say, a century ago?

**Mr Creighton**—Yes. This is the catchment hydrology, the runoff in the catchment in a natural condition. It is not about water allocation.

**Dr JENSEN**—But the water allocation will relate to the amount of water that actually reaches the river.

**Mr Creighton**—I used to be involved in CSIRO Flagship Water. The reason Australia has the highest density of dams in any country is because we have the most variable run-off and the most variable climate. Our response was to build lots of dams. It was a good response because that is about moderating this variability. That is the natural variability within the Darling. Imagine, for example, that we can predict better run-off to catchments and storages. Think about irrigation and certainty of allocation or environmental flows. We know we are going to get a wet year. Australia's ecology is boom and bust. When we get a wet year, we push it harder, we get better floods and we do more for the environment, or we do more for irrigation—or whatever the issue is.

The reality is that, with our ecology and with our variable climate, the better we can predict it, the more we will end up with great responses for Australian agriculture, for Australian sustainability and for urban water supply. Urban water supplies are now systems. Part of the work we did in the Flagship was to say that it is about demand management, it is about desalination, it is about dams, it is about re-use et cetera. Every urban environment is now pulling multiple levers. If we can give them a forecast lever as well then they can manage that storage, or turn on or off that desalination plant—whatever it is. So really the forecasts are very, very important. We have not done the numbers for urban water authorities, but I would guarantee that, if we did, they would be very big numbers in terms of profitability.

The recommendation is around a whole-of-government approach. In our written submission we state how the research is somewhere between a nascent and developing phase with global circulation models. I strongly recommend that we need to think harder about a whole-of-government approach because there are so many beneficiaries to this work. We are putting much of our investment into the Dr Peter McIntosh and the Dr Oscar Alves that work in CSIRO and Bureau of Meteorology, because they are the core science group. We are also doing that also because of the legacy of the bureau; the work we do ends up in products that then become routine. But it is very much a whole-of-government approach that we are trying to push for all beneficiaries. I think that is very, very important.

The last term of reference was around strategies and systems. You have probably heard a lot about that from the science team; I do not need to repeat some of the things you have probably already heard. I just make the point that, if we talk to Australia's farmers about our investment—meagre as it might be, and reduced now of course with DAFF and Land & Water Australia no longer investing—they say, 'Just do more on forecasting.' They see that as the key priority for our program. I am sure that if you talk to other users they see the importance as well.

So our last recommendation is really about asking where we get these resources from. For agriculture, of course, we are going through a review of exceptional circumstances, and that really provides an opportunity to make Australian agriculture a lot more resilient and gives us the chance to position Australian agriculture internationally. We suggest that things like forecasting are part of positioning Australian agriculture and should be part of exceptional circumstances investment.

**CHAIR**—Thank you very much. That was very interesting. I want to ask a question in relation to the all-of-government approach. We have identified Australian systems and Australian climatic conditions, and we recognise that we need to partner with the international community and that everything seems to be rightfully integrated internationally. But the issue of water in this country is approached in such a parochial manner in terms of the states. If you live in the south as I do, you think that the water up north is being wasted. What do you think of the all-of-government approach in relation to that integrated system of capturing our water and maximising the best use of those resources while understanding and using accurate forecasting?

**Mr Creighton**—There is always more to do, but my first response is that we must stay in the high-level principled space. The Bureau was set up to provide information for Australia, so we keep resourcing places like the Bureau that are doing a great job. Yes, we do have a long way to go in water allocations and sharing and so on, but we still stay at the principled level. We stay up there and we seek, by staying up there, for others to emulate where we are going. So whether it is water or forecasting or many of the other national issues facing Australia, it is about establishing the quality principles and the likely outcomes and staying there.

**CHAIR**—Are we up to scratch in relation to understanding our climate and making the best possible use of our information?

**Mr Creighton**—No.

**CHAIR**—That is what I want to hear from you; it is what I am really asking. I want to know whether we are up to scratch and, if we are not, whether it is because there is not enough funding or whether it is because of the state system and the parochial nature of that.

**Mr Creighton**—The states have no role in forecasting.

**CHAIR**—No, they do not. This is true.

**Mr Creighton**—The work in forecasting is done in the Australian government largely through the Bureau, with the research largely done with people like CSIRO. In answer to the question of whether or not we are up to scratch, the POAMA, the dynamic model for Australia, is one of the eight best dynamic models in the world. All the dynamic models have improved in the last 10 to 15 years and they are continuing to improve. If I was to do a forecast tomorrow, I would use the Australian, European and US models, and I would probably have a little side look at what is happening in India and Japan. But the reality is that Australia is up there. It has world-class science and has some great scientists coming through—for example, Dr James Risbey and his crew—who are doing great stuff. It is really about giving them the operating space.

**Dr Robison**—I think, too, it is important that when we talk about a whole-of-government approach it is not only the states and the Commonwealth but also different agencies in the Commonwealth and the RDCs who are collectively funding and supporting what is needed to be quite a significant effort in this space. When you ask if we are up to scratch, I would answer that we do relatively very well but that we could do a hell of a lot better. In terms of the real applications that we have talked about for agriculture or some of these other industries, there is still a long way to go. We need significantly more funding to get us there sooner rather than later.

**FRAN BAILEY**—I do not disagree for one minute that we have exceptional scientists, but I really think I need a lot of convincing when you say that Australia is right up there. We have just recently visited Melbourne and seen the installation of the supercomputer there. Given that I am very aware that the WMO has already moved beyond the supercomputer and is in the process of installing what I think is called ‘The Blue’, a super supercomputer, and given that that now is linked in with their EUMETSAT program—which I am about to investigate next month—and that the farming organisations throughout Europe and the UK have the ability to download that via ordinary satellite dish to a PC, I am not aware that Australia is in this space at all.

**Dr Robinson**—I think the point is well made in that if we do not fund in this area we will get left behind quite quickly.

**FRAN BAILEY**—Aren’t we already left behind?

**Dr Robinson**—My feeling is that we are okay at the moment but we have got to be investing.

**FRAN BAILEY**—You tell me where there is an application of all of this technology in Australia today, because I am not aware of it. I am aware that within Europe, the UK and the US this application to industry already exists and has for some time. It is not just the application in industry but also for weather forecasting, fire weather forecasting, disaster management. It already exists. The Geofogo program in Portugal already exists; it is being rolled out. I am not aware of any of this or its application within Australia. So if you can point me in that direction I will be very grateful.

**Mr Creighton**—First off, I would refer you to the water and the land component on the website for some of the information that is coming out. I agree our technology would not be anywhere near Europe’s, but neither are our resources. There are other things like, for example, the text messages that go out to the whole dairy industry from the bureau. I know that is basic technology, but they are the sorts of things that are happening already.

**FRAN BAILEY**—But, with respect—

**Mr Creighton**—It is not in the same ballpark, I know.

**FRAN BAILEY**—It is just not in the same area at all, is it?

**Mr Creighton**—So, what do we do? Do we walk away from it and not get forecasts for Australia? No.

**FRAN BAILEY**—I am not suggesting that for one moment.

**Mr Creighton**—Do we massively increase the investment? I would be cautious about that too. We have not got the capacity yet.

**FRAN BAILEY**—What about the opportunity for strategic alliances and partnerships with a lot of these organisations?

**Mr Creighton**—The bureau has a partnership with the Hadley Centre, for example. I rang the head of the bureau, Greg Ayers, the other day. He was not there. He was over in Geneva. He has only been in the job a couple of weeks and he is already in WMO. That is part of his role.

**FRAN BAILEY**—Isn't that putting all the eggs in the one basket just by partnering with the Hadley Centre?

**Mr Creighton**—We are not just partnering with the Hadley Centre. If you look at where the forecasts are starting to come from, you see that they are coming from an understanding of all those models. What we have not yet migrated the bureau from is the old statistical forecasting to a full interrogation of all the dynamic models and some of the statistical forecasting to come up with the next generation of forecasts. We have a way to go, unquestionably.

**CHAIR**—We are aware that we are in a transition period. The bureau made that very clear to us at the beginning—they are in this zone at the moment. So we are trying to grasp where we are at, where we should be going and where the challenges are, which is why I guess Fran is being so persistent with some of the questions.

**Dr Blumenthal**—I just had another example of the application of climate forecasting in Australia, and that is the Yield Prophet program. Birchip Cropping Group, a large grower organisation in Victoria which does have impact right across Australia, have commercialised a program called Yield Prophet, which uses climate forecasting and links that to a growth model of crops and is able to provide a tool in management decisions for grain growers. There is actually a subscription service where a grower pays an amount for their available soil water to be measured on a paddock so they can get quite accurate measures to assist them in their decision making throughout the growing season—time of planting, whether to apply fertiliser, how much to apply, how the season is likely to play out. Largely that is driven by the ENSO model—the southern oscillation index. There is work by the Met Bureau with POAMA, which we have invested in, and clearly we are going to get improved forecasts over the next few years. It is already in the experimental phase. If you do know where to look on the Bureau of Meteorology website, you can find the POAMA model and anyone who is interested can use it, but they are hesitant to have it publicly available because it is experimental.

**FRAN BAILEY**—I guess the bottom line is that our farmers exist in a highly competitive environment and our competitors in other parts of the world have got ready access to much better and much more sophisticated science enabling them to make quicker and more informed decisions.

**Mr Creighton**—Unquestionably; and nor have they got the variable climate that we have got. We have got more work to do.

**CHAIR**—We are also larger and there is massive variability.

**Mr Creighton**—Yes.

**Mr RAMSEY**—I am very pleased with the highlights of some of the possibilities for, particularly, our agricultural sector in this area. It is the holy grail for much of Australian farmlands—being able to have some accurate idea of what the season is going to be doing over

the next three or four months. It comes back a little bit to our scientific capacity. You said that we have some very good scientists coming on. Are we, because of our limited nature in comparison with some of the leading nations at least, losing scientific capacity overseas? Do we have people training in the sciences and then going off to greener pastures or are we managing to hang on to those people that will drive us?

**Mr Creighton**—I really do not have numbers for you. All I can really say is that some of our leading scientists happen to be recent immigrants to Australia. Some of the people I am working with have come from other countries, and there are obviously some Australians as well. Whether there is net loss or net growth, I do not know. But the answer is not so much about holding things to ourselves; it is more about collaboration. As Fran was mentioning, this is an international activity. Every time we do a project there must be peer review papers, for example. So the more they can do in a disciplined way, linking with their international colleagues and fostering further science development, the better. That is all we can really do.

**Mr RAMSEY**—And thank you, Martin, for bringing up Yield Prophet because if you had not I would have asked about it for the benefit of the other members.

**Mr Creighton**—Again, that is funded by this program, of course.

**Mr RAMSEY**—Yes. And that is where I want to get back to—that is, managing climate variability and its being picked up by GRDC. What kind of impact is this going to have on the GRDC budget and its ability to sustain its other activities, as well as what it is doing at the moment? Is GRDC picking up all the increased costs that Land & Water Australia has dropped off, or is that being spread equally among the rest of the partners? How is it going to be managed?

**Dr Blumenthal**—The program does have an allocation for a coordinator and administrative support, so that allocation will come across. Essentially, the management agreement and the individual contracts are being novated to GRDC, so current contracts will not be impacted. We will lose the Land & Water Australia contribution, but as we are working towards renewing the program from the 2010-11 financial year we will be seeking other investment—both more investment from current partners and also new partners to join the program. So in this financial year there is no impact on GRDC's budget. The whole program is coming over to GRDC as a package. In the future we will need to work on current partners investing more, and also getting new partners into the program.

**Mr RAMSEY**—What kind of hole are we seeing here as a percentage of your total budget for operating?

**Dr Blumenthal**—Land & Water Australia's contribution was \$400,000.

**Dr Robinson**—Our contribution next financial year, which we have actually been able to maintain, was \$400,000, so the budget is covered for next financial year, which basically is the end of this current phase of the program. But we cannot make any further contribution obviously as we do not exist beyond—

**Mr RAMSEY**—But the total budget is—

**Mr Creighton**—The year before that we had DAFF money of roughly half a million a year as well, which stopped. So, effectively, following next year we are down almost \$1 million a year on a spend of only a couple of million.

**Mr RAMSEY**—So there will be a serious impact unless we can find some new money somewhere to keep this program going. Presumably we will because all of the points you make are very valid and it just cannot afford to stop.

**Mr Creighton**—I am reducing my time, for example. We are having a hard look at the transaction costs. I am only going to be on the program for a day and a half a week from now on.

**Dr Robinson**—With the department having pulled its funding out previously, we had written the current strategic plan to expand the program. We still are in a process of looking for those other partners because we saw this shortfall coming—not the Land and Water Australia shortfall but the other shortfall—and the increasing need for this sort of work. So we are in a process of trying to expand the program anyway.

**FRAN BAILEY**—I think it is incredible that other countries are increasing their budget for all of this research and we are decreasing it.

**Mr Creighton**—We are trying.

**FRAN BAILEY**—It is a nonsense.

**Mr RAMSEY**—In a generic sense, where are you looking? I do not expect you to individually name companies, but are you looking at the private sector?

**Dr Robinson**—We have done one science plan for Northern Australia to try and foster some investment from the three states—Western Australia, the Northern Territory and Queensland. That science then articulates a couple of key forecasting projects and some applications. We have had discussions with senior staff in Queensland and ministers and senior staff in Western Australia but not yet in the Northern Territory. There is strong interest but their agricultural budgets and so on have problems as well.

**Mr Creighton**—If we go to the private sector, we know that—and I think we put this in our submission—things like the coal industry will benefit from this. But it is very difficult to get the private sector to invest in this long-term research. I come from North Queensland. I am on a Port of Airlie consultative committee. About October last year I said to them, ‘We are going to have a problem with this development with the wet season coming up.’ They did not have it in their construction schedule. All their earth-moving equipment and so on was on lease and doing nothing between November and the end of February. So there are huge benefits for the construction industry, but the chances of getting the construction industry to invest are very low.

**Dr Robinson**—On the chance of getting private and other public investment, it is actually pretty resource intensive to chase it up. We have been constantly balancing in the program money going to research investment that is so desperately needed versus spending quite a lot of resources chasing extra dollars. There is always a balance to find. That squeeze is on even more with the reality of the budget now. Colin’s time has to be reduced even more, which will make

the expansion of the program even more difficult. This is a national issue. We would love significant national level funding for this program. I think the MCV program is very good. Martin mentioned yield profit. We are very good at applying real tools that farmers can use, but we want to expand the program so we can generate similar sorts of tools for the mining industry, urban water utilities or tourism operators. That is a whole new suite of areas. That is not insignificant amounts of money we are talking about to do that sort of work and it is not short term either, unless the money comes in big buckets.

**Mr SYMON**—I would like to go back to what was in your submission in regard to increasing variability of climate. I note in there you have science capability to accurately predict changing rainfall due to a changing climate as low to almost nil. It then goes on to talk about the impact on our water systems that we will see in the short- to medium-term. What do we need to do from a government point of view to address that? What is the area that picks that up that we are not covering at the moment?

**Mr Creighton**—The first point is: if a dynamic model for 2070, or the climate change end, is not giving you a good answer in 2010 then why would you believe it in 2070? That is my first point. That implies a certain type of model development. The model development must fit the purpose now and then be able to project further out. That is what is required. It does not matter whether it is in Australia or for IPCC predictions.

The second point I would make is that there has been a distinction made between weather and climate where people talk about the chaos that is weather and how climate is a bit more predictable with averages and so on. That is a good question too. I am not sure that climate is more predictable. To suggest that the chaos that might be accompanying changing climate is predictable is, to my mind, a touch ambitious.

The third point is that, if we are talking to agricultural producers and possibly many other users, they very readily accept climate variability. They work with it. They can see the predictions for temperature in 2070 as a rationale for mitigation, but if you want a user to adapt give him better forecasts for now. To my mind, we have to think of those two policy agendas. There is mitigation, controlling carbon, sequestration, ETS and all the rest of it. We use the fact that the temperature is projected to increase. We cannot give you similar projections for rainfall. But if you want someone to adapt—whether it is about emergency services, urban water or agriculture—you give them forecasts, from multiweek forecasts through to seasonal, covering several months, possibly even a couple of years for water allocation. That is how we will respond to the pressures of a changing climate.

**Mr SYMON**—So where would investment be needed in terms of predicting rainfall? As we say, we have forward predictions for temperatures. Rainfall is not usually discussed in the same sentence.

**Mr Creighton**—The models simply are not good enough. The reality is that you invest in the POAMA type dynamic model approaches through the new version with access et cetera. You improve your forecasts now and then you roll them out in the longer term. A point I would also make there is that we have tested the POAMA model for multiweek forecasts—in other words, for between four days and 14 days. I know there are tactical decisions around things like chemical application on farms, bushfire management or whatever, but those tactical decisions

are also important. So what we are saying and what we have said in the submission is: let's think hard about weather all the way through to climate and, by investing in our models now, let's make sure we deliver that almost seamless component we are after.

**Dr JENSEN**—It is interesting you have got onto that, because I was going to ask a question about the funding. Are we spending too much on climate change, as in the long-range stuff, compared with the seasonal type forecasts, given that, as I think you have alluded to, effectively the same general circulation models are used for both seasonal variability and climate change? Getting it right now will actually assist with current strategies for improving economic performance, vis-a-vis forecasting weather into the future. You were saying that temperature was a little bit more robust than rainfall, but even the temperature predictions from climate modelling of global temperatures have not been particularly good, over this century at least. What sort of ratio do we have in terms of spending on climate change research in Australia compared with seasonal forecasting, for example, or indeed even weather forecasting in the day to 10 day time line?

**Mr Creighton**—I cannot give you a number, personally. I would comment that we are underresourced in the seasonal and the forecasting end—to pick up Fran's point earlier—compared to other countries.

**Dr Robinson**—I don't think we are overresourced at the climate change end.

**Mr Creighton**—But I would also say there are a series of policy agendas there. Don't forget there is a mitigation agenda, an agenda about energy and so on and there is an agenda about adaptation. Adaptation is for now; mitigation is for the much longer term. So I think we need to almost dissect those dollars in terms of those various policy agendas.

**CHAIR**—There are not enough resources going into the adaptation phase—is that right?

**Mr Creighton**—I don't believe there is, personally, no.

**Dr Robinson**—What we are saying particularly for agriculture and resource management is that the adaptation phase is very much now, but there are other sectors where the adaptation phase is perhaps more in the time frame of a year or several years, with a view to the longer term. Yes, farmers will still look at 2030, but the vast majority of their decisions are here and now.

There are other sectors, even policy sectors, that should be looking at 2030—perhaps around infrastructure support for whichever sector that you could class as adaptation. I do not think it is a black and white line. There are shades there that we need to think about, but there is no question that we are under-resourced in the short-term forecasting and adaptation—

**CHAIR**—It appears that there is improved systemic thought being given to that phase. Is that correct? I get the sense that you are doing things but they are not coming together. You are identifying areas that need to be improved upon but I get the sense that you feel there is no-one listening. Is that correct? It is very important. If you are going to look at an all-of-government approach and concepts you need to be able to network and bring them together. I get the sense from what you are saying that that is not happening. That is a problem in itself. Is that right?

**Dr Robinson**—It is a problem and it is certainly one thing that we have been trying to address in primary industries. I mentioned right up front in my submission the National Climate Change Research Strategy for Primary Industries, whose acronym CCRSPI is colloquially pronounced as ‘crispy’, where we have got basically every research agency inside the tent to coordinate their research activity in response to climate change. I do not know of any other sector that has done that, but we are at least having a go at that. So, we have got a fair idea now of basically what everybody is doing and where we are going, particularly with cross-sectoral issues like the ones that Grains have and that the beef industry also has. We know where we can collaborate and we are trying to lay the foundations long-term to have a coordinated research strategy across primary industries. I think we are making progress but there is still a long way to go. The foundations are there with respect to primary industries, but I think there are other linkages to other sectors that we need to be making, and making strongly, in the coordinated whole-of-government approach.

Primary industries are on our way. We would love to have more support for the CCRSPI initiative. I think more resources generally are going into it because the CCRSPI strategy has said that we are doing these things, but look at all the gaps! It identified the seasonal forecasting of climate variability as being incredibly important. But we are probably still not linked to the other sectors of the community as well as we would like to be.

**Dr Blumenthal**—It is probably worth saying too that the climate change R&D program led by the Department of Agriculture, Fisheries and Forestry does have an adaptation component, and there certainly is investment going into crop and animal industry adaptation, and also on farm business adaptation. There is also a farm-ready investment under DAFF that is dealing with a lot of the practical issues about communicating and training the rural sector in adapting to climate change. So there are some efforts going on and we are certainly collaborating in that space.

**Dr JENSEN**—Another thing that you were talking about was the increase of profitability if farmers et cetera had blindly followed the forecast. I take that point and I think that that is a good one to make. The question though, obviously, is that each individual farmer, say, has got a decision to make. It is a decision where if you smooth out the entire function, yes, it is increasing profitability, but when that farmer makes a specific decision for a specific year it might put him or her out of business. The question is: how do you go about addressing that and what are the costs associated with that—for instance, hedging or some other technique that might be used as insurance if the forecasts are wrong and the farmer, in following that forecast, has followed the wrong strategy? Have you thought about that and potentially how you would model it and what mechanisms could be used by the various industries given that the seasonal forecasts are not exact—they are statistical statements on probabilities of certain things occurring?

**Mr Creighton**—First off, we talk about climate risk management and get across to farmers that it is a probability. The second point is that it is part of your decision making. We would never, ever suggest that you blindly follow it—you know, getting the money for the kids to go to school, the labour issues on your farm, the forecast, the futures market or whatever it is. They are all part of the farmer’s decision, in total.

I guess the other point is that things like farm management deposits already exist. So there are ways to have a look at farmer income already, linked to the tax act and all the rest of it, to really

try to make sure that this variability of our climate, which also means variability of income, is to some degree moderated. So there are a range of policy initiatives within government already to help on those issues. But I would never, ever suggest that you should do everything based on one particular issue; it does not matter whether it is forecasts or the futures price for wheat or whatever.

**Dr JENSEN**—My concern—and this is not just related to this field; it is related to all sorts of fields in science, and I know that, having been a scientist in a past life—is that the benefits of something tend to be oversold. So, for instance, you will have this benefit-cost ratio of 4.6 to one. I am not going to discuss that in detail, because I do not know where that comes from; but in many cases it is idealising the benefits and minimising the costs associated.

**Mr Creighton**—We appreciate that. In the example I gave you for Catanning, we actually went to the farmers with that and we talked about optimising fertiliser. They said, ‘We never would do that.’ They always come back a bit because of risk management. So when they come back a bit from that optimum level of fertiliser application, that is where you get the numbers of 34 or \$100 from.

**Mr RAMSEY**—Can I just ask a question on that. I presume when you gave that figure that was our analysis looking back. It is not the information that was available to them through that period.

**Mr Creighton**—It is using what is called hindcasting. So it is using POAMA and saying, ‘If you had followed it blindly for the previous 27 years, these are the results.’ We factor in the commodity price, the fertiliser price and so on. And then we factor back.

**Mr RAMSEY**—Yes, that is what I understood. I just wanted to clarify it.

**Mr Creighton**—It is two to one. You are putting in \$1 of fertiliser and you are expecting to get \$3 back.

**Mr RAMSEY**—If not fabulously rich we would at least be living.

**Dr JENSEN**—I have one final question and it gets back to the issue of flow variability. Playing the devil’s advocate with that—and I know that our climate is very variable and that does lead to additional variability—looking at that data, I would say that it is almost an exponential function with the volume of the river concerned and that, with a small stream, that ratio could very well be infinity because you would have some years where the stream is completely dry. For instance, obviously the Amazon is the biggest river, then there is the Rhine, the Yangtze, the White Nile, the Potomac, the Orange—I know the Orange River is probably around the same volume as the Murray. When you look at that it seems to be that the larger the volume of the river, the less the variability.

**Mr Creighton**—I have not done the numbers. They are figures from about 1998 when I was doing the land and water resources audit. I was surprised at the numbers for Australia in areas such as the Hunter. I did not think it was anywhere near as variable as that. In a moderately sized catchment, I think there was a variation of 45 times. I am not sure. I would have to check that, but I do not think that is the case.

**Dr Robinson**—I can understand where you are coming from for very small rivers; they are likely to dry out at some point and you get that issue. But I am not sure that would hold for large rivers.

**Dr JENSEN**—I am just looking. It is not quite but almost a monotonic function of volume of river. You look at the Amazon, the biggest river, and you see that the variability is only 1.3. For the Rhine, which is smaller but is still a very large river, it is 1.9 et cetera.

**Dr Robinson**—I would suspect the Rhine and the Murray are probably the same area. I can go away and do some calcs if you like.

**Dr JENSEN**—I am talking about volumes rather than the area of the catchment. Thanks.

**ACTING CHAIR (Fran Bailey)**—The chair is unwell and has had to leave. Are there any more questions?

**Mr BIDGOOD**—My apologies for not being here for your presentation; I had to speak on the obesity report in the Main Committee. Can you elaborate on the Managing Climate Viability Program and how it has increased Australia's capacity to manage risks related to climate variability? I am sorry if anyone has alluded to that in their question previously, but, for my own information, how do you feel we are going?

**Mr Creighton**—As we have already said, it is this program that has funded Australia's dynamic model to get us somewhere towards, as Fran was mentioning, where the Europeans and the US and so on are. This is a program that has also funded things like Yield Prophet, which is a tool to help farmers make decisions about matching fertiliser—which, of course, is quite costly—with plant needs. And this is the program that is taking an integrated look at what agriculture, in particular, needs in terms of products—such as how much rain, when and so on. It has led to roughly 70,000 hits a month on the land and water component of the website in the Bureau of Meteorology, which we take as an indication that by designing products to meet farmers' needs through a reference group of farmers we are starting to hit the mark in terms of their needs. So they are probably the three key points I could make.

**Dr Robinson**—If I could add to that, I think that over 15 years there have been very significant achievements. It is in the last three or four years that we have shifted our focus away from statistical forecasting. We had made real advances in the statistical area but this is one of the programs that recognised very early that we needed to go to dynamical models for our seasonal forecasts. We know it is a long-term investment. There was certainly a lot of good work done that went into tools earlier in the piece too.

**Dr Blumenthal**—Certainly a lot of our understanding of the La Nina and El Nino events were as a result of investment in the predecessor of this program, the Climate Variability in Agriculture R&D Program. This and its predecessor have been going for 15 years. So there has been a very big focus on understanding the ENSO events.

**ACTING CHAIR**—Given Australia's geographic position, are you aware of any particular area of research that we are doing and leading in that we could perhaps use as leverage with the

WMO to get access to collaboration with some of the very advanced work that they are doing which would benefit agricultural industries?

**Mr Creighton**—Under the auspices of WMO, we recently held work on tools—decision support for agriculture. Australia is recognised as leading the world in applications of forecasting to support decision making. That is probably well recognised. I have been working internationally in natural resources management, as well as agriculture, for some time and I have always been pleasantly pleased at the status of Australia's science in relation to international science. So I would say that natural resources management and things like tools for interpreting forecasting to applications would be the two areas. And we are collaborating deliberately on those areas.

**ACTING CHAIR**—Do you think that we are using that international respect that we have, and the advantage that that gives us, as leverage to gain access to some of these other works that they are doing?

**Mr Creighton**—I am not sure we can lever. It is more a case of collaboration and interaction. For example, in the WMO workshop we had on tools there were people there from the Pacific Islands, Europe, the US and so on. It is more about sharing experiences and flicking contacts and models across at no cost. It is about sharing and collaboration. There is a mutual benefit activity. It is not leverage in terms of resources.

**ACTING CHAIR**—Are there any points that we have not covered that you would like to make to the committee in terms of this inquiry?

**Mr Creighton**—I would like to say thank you very much for having the inquiry. This sort of examination is the sort of thing we need.

**Mr RAMSEY**—With the Managing Climate Variability project we know we are looking at some funding issues, but given a lot more money do you have programs that you could extend it into? Exercise your imagination here a bit and say: 'Well, if we had resources this is what we could be doing. This is the type of service we could be rolling out.'

**Dr Blumenthal**—From a grower's perspective the message we are getting is that we want improved forecasts—better forecasts. So I think if there was additional investment we would put it towards improved forecasts. If you look at the map in Colin's handout, with the climate drivers and synoptic features, you will see that our understanding is strong about some of those drivers, and I think if we did have more investment we would invest in more understanding of the drivers themselves and the interrelationships between those drivers.

**Mr Creighton**—If you go to the other map there, the map of WA, you will remember that we talked about the profit. We are not doing very well on skill in, say, Geraldton, and the north-east agricultural region, because it is Indian Ocean driven and it is monsoon driven, and POAMA does not accurately pick up Indian Ocean or monsoon issues at the moment. So there is two areas: first, better engagement in the model of the Indian Ocean; and second, monsoons, tropical systems, the breaks in the monsoon—which are very important for grazing—and cyclones and all the rest of it. The third area would be research into the east coast lows—things like the recent

floods we had on the New South Wales coast and so on. They are not well covered in the model. So there are three regional areas where we know we can seek improvement.

The next thing I would be pointing to would be multi-week forecasting and getting that ramped up quicker so that we can get it out—because tactical decisions will help farmers and others think through the role of longer-term forecasting, as well. They start to trust something beyond four days or start to think harder about longer-term forecasting. And then beyond that it would be driving hard on international collaboration to make sure that POAMA/ACCESS plus the European model plus NOAA et cetera becomes part of routine Bureau of Meteorology forecasts.

**Dr Robinson**—If I can build on that, there are a couple of other issues, like understanding the drivers better and developing the tools. With significant additional investment you would look at the other end users and, when you have the understanding of those other drivers, turning it into tools for other industries and other sectors would be very useful. The second point I make is about the long-term investment needed. This is not something you put in for one or two years and expect to get something. This has to be a long-term investment, and that also includes the need for long-term capacity building and those collaborations and relationships. You cannot just come in and out of this field—drop it for a few years and pick it up again. There are careers here that need to be built. The third point I make is about the resources required in terms of adoption of research outputs and the tools. You do not just put them on a shelf or put them on a website. You actually have to run around and have good interaction between your scientists and your end users. That takes a lot of time and effort.

**Mr RAMSEY**—Yes, it does.

**Dr Robinson**—It is time that scientists—we have mentioned several here, such as Peter McIntosh—who are out of the office doing their climate modelling work and who are actually communicating. And they are communicating for good reason: to get that adoption and improve the understanding of the end users, in our case farmers. We have run Masters of Climate workshops around the country, which have been very well received. It is integral to successful programs that you resource that activity quite significantly. That again goes to long-term capacity building.

**Mr RAMSEY**—It is a great conundrum for scientists, isn't it: I go out to sell my project and to see that we get uptake and some use out of it but it actually takes me away from doing the science.

**Mr Creighton**—But it feeds back to the science as well.

**Mr RAMSEY**—Yes, it is important. It has to be done but you are always—

**Dr Robinson**—It is a balancing act. The scientific community has responsibility here to recognise the amount of time and effort that needs to go into these adoption type activities and to budget and account for it.

**ACTING CHAIR**—The research and the application of that research go hand and hand.

**Dr Robinson**—Absolutely. We think that has been one of our strengths in LWA and the climate variability program. As I said, we have run various Masters of Climate workshops and whatnot, and we have done a lot of work in promoting the tools that we have made. But that is essential for our thinking, long-term, to get that uptake.

**ACTING CHAIR**—Thank you very much. That was an excellent presentation and we really appreciate it.

**Mr BIDGOOD**—I move that we accept into evidence the hand-out on managing climate variability.

**Mr RAMSEY**—I second that.

Resolved (on motion by **Mr Ramsey**, seconded by **Mr Bidgood**):

That this committee authorises publication of the evidence given before it at public hearing this day.

**Committee adjourned at 11.10 am**