COMMONWEALTH OF AUSTRALIA

Official Committee Hansard

HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION

Reference: Long-term meteorological forecasting

WEDNESDAY, 3 JUNE 2009

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HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION

Wednesday, 3 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, Mr Cheeseman, Mr Johnson, 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

Committee met at 10.04 am

FINDLAY, Dr James, General Manager, Climate Change and Water Science Branch, Bureau of Rural Sciences

CHAIR (Ms Vamvakinou)—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, the federal Minister for Innovation, Industry, Science and Research. Written submissions were called for and 33 have been received to date. The committee is now conducting a program of public hearings and inspections. This hearing is the second for the inquiry.

I welcome the representative of the Department of Agriculture, Fisheries and Forestry. 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. We thank you for your submission and now invite you to make a brief opening statement before we proceed to questions.

Dr Findlay—Thank you. To give you some background, the Bureau of Rural Sciences is a professionally independent group within the Department of Agriculture, Fisheries and Forestry. We aim to provide better outcomes for rural and regional Australia through the delivery of science and decision support tools on issues affecting particularly agriculture, fisheries and forestry. We and the department more broadly certainly support efforts to improve our seasonal forecasting capability. I will use the term 'seasonal forecasting' if that is okay, being largely synonymous with 'long-term meteorological forecasting' and just a bit easier to say. We support those efforts because we do think they will provide farmers with a better capacity to improve productivity and adapt to changing climate or climate variability, as the case may be, depending on your current belief.

Farmers are the single largest user group of these long-term forecasts. Some evidence we have before us suggests that about three-quarters of them refer to them but only about half of them rely on them, which suggests that if we could get better predicted capacity and accuracy from the forecasts we could see better decision making by farmers and certainly improvements in productivity.

At this stage our understanding is that the only group with the capability to undertake these sorts of improvements is the Bureau of Meteorology and CSIRO collaboration known as CAWCR. They do need additional resources to do this work; it is not something they can currently build into their work plan. It is a substantial piece of additional work and there is some uncertainty about its ability to deliver improved accuracy, but we think it is well worth the effort. Certainly, the BRS and our sister bureau, the Australian Bureau of Agricultural and Resource Economics, and the department more broadly are well placed to assist BOM and CSIRO to make sure they have the information they need from farmers at the start of this process, but also to make sure that the farmers get at the back end of this what they need out of it in terms of usable

tools and information they can make sensible decisions with, rather than complex science with a lot of uncertainty around it.

CHAIR—I will start by going to the comments that you made at the end about the CSIRO and the Bureau of Meteorology and the work they are doing on improving seasonal forecasts. We have heard from both of those bureaus. Is it simply a question on additional computing and people resources in terms of improvement or is there something broader that we need to come to grips with to improve long-term forecasts?

Dr Findlay—We do need to put more effort in. We do need additional expertise. We certainly do need extra computing power. That is an impediment at the moment. We are dependent on international resources for a lot of the information that feeds into our climate system scenario, if it is going on elsewhere overseas, to try to improve these sorts of systems. The Southern Hemisphere is somewhat unique and a lot of efforts in the Northern Hemisphere are not going to address the sorts of questions we want addressed and certainly not at the scale that farmers need this sort of very localised up-to-date information. That is not going to be available through overseas efforts. We are dependent on the remote sensing capability from overseas facilities and that needs to be maintained.

I did mention there is some uncertainty out of this. There is no reason to believe that throwing a heap of money at this and finding some good people will necessarily improve our ability to forecast. The POAMA, the Predictive Ocean Atmosphere Model for Australia, has its roots about 25 years ago. As a scientist, I am reasonably optimistic that effort here would be worth while and certainly could improve our accuracy, but we do not know how well we can do that yet.

CHAIR—I am not a scientistic and I am trying to understand this highly scientific area. One of the things that strikes me is that it is obviously clear that traditional methods of weather forecasting do not seem to be able to be as effective or as reliable, so we cannot rely on them as we did and have for such a long time. I am trying to understand whether improvements in technology, understanding and capacity to actually read all the variables in the weather and understand it is the reason why the traditional method of statistical based forecasting is being seen to be perhaps obsolete or not as effective. In other words, are we understanding the weather in a way that we did not understand it before or are we responding to the fact that the weather is changing in such a way—not because technology is telling us, but because things are happening that were not around beforehand—that it now warrants a different type of forecasting? Of course, I am referring to the dynamic modelling. I do not know whether it is the cart before the horse or the chicken before the egg or whatever. Can you shed some light on that?

Dr Findlay—I do not think it is an either/or. I think both of those things are occurring at the moment. It is certainly the case that our weather is more variable at the moment, which is certainly backed up by the evidence. That means that the ability for forecasters and experts in the Bureau of Meteorology to use past information to predict the future is declining. Secondly, beyond the weather forecasts, people in this room with an agricultural background would know that there is a lot more than the Bureau of Meteorology that you rely on in making decisions. We have a Masters of Climate series where we have been talking to farmers about the sort of information they need. Even those groups, who are people very interested in this sort of technological end of the world, are saying their basic understandings, what their families believed and what their networks believed about very localised phenomena are not reliable at the

moment in terms of predicting what they should do within season and between seasons. We are seeing that experience, but also statistical information is becoming less reliable for predicting the future. That is happening quite quickly.

Combined with that, we are certainly getting better. POAMA has been around for a long time, and we heavily dependent on the El Nino Southern Oscillation as a predictor. We are getting much better information now about these other types of phenomena—the Indian Ocean Dipole, the Madden-Julian Oscillation, the Southern Annular Mode—and how they influence Australia's weather, especially on the western side of the Great Divide. I think a lot of our weather systems are very good at predicting for the east coast, for that strip 100 kilometres in, but after that you need to understand a lot more about what is going on. I note that you have previously received evidence about aerosol events. The answer is that both of those things are happening and the time is right.

CHAIR—Ms Bailey.

FRAN BAILEY—I am particularly interested in the use of supercomputers. Given that Europe, in particular, and the UK have been using the dynamic method with forecasting for some time, is there evidence to suggest that this is of greater benefit to farmers? Secondly, are you familiar with the German technology known as Firewatch, which came out of the Mars mapping program, which scans for humidity, air pressure and so on?

Dr Findlay—Is the committee familiar with the difference between dynamic and statistical models out of the previous evidence?

FRAN BAILEY—Yes.

Dr Findlay—I do not need to go on to explain that. There is certainly some evidence to suggest they are doing better in Europe, certainly with three-, five- and seven-day forecasts, not necessarily going beyond that at this stage, but even that is a fairly big step. They are doing better. They are reducing uncertainty. Coming back to the Australian context, it is hard to know whether that is necessarily transportable to our experience and how quickly well developed.

FRAN BAILEY—In terms of when to plant and what types of crops to plant, given that we have changing weather conditions in southern and northern Australia—

Dr Findlay—Again, we do not know the limits of our current system. This is very early days for the dynamic system. They are better in Europe now and that is where people are moving quite quickly away from statistical models to dynamic models. There is no reason to believe that Australia would not follow a similar path, but how quickly we would move along that path relative to the risk-return on this sort of investment, which is quite substantial, is unknown and I cannot shed much light on that. It is a research question and the nature of research questions is: if you knew the answer you would not be doing research.

On your second question, I am broadly aware of that. I used to work on forestry issues and looking at the fire risk in Australia. The Bushfire CRC and other groups would be able to give you better evidence on that.

FRAN BAILEY—It has wider applications for agriculture as well.

Dr Findlay—It does. All of those tools are using a back end of important parameters. It is important that agriculture designs the parameters they need out of the back end of these tools. It is actually the same model at the front end. It is just tuning your output for a specific need and that is what Firewatch is doing, so it is certainly better. It is a nice model. There are some opportunities. We have not talked about extreme events yet. Obviously farmers face hail, frost and other events, including flood. We have seen three one-in-100-year floods in northern New South Wales this year. If you knew that was coming or if you knew there was a heightened risk of that this year you might have made some different decisions. These sorts of tools are the only way to get at those things. We have seen rare events apparently not being rare anymore. Drought is also another example.

FRAN BAILEY—It is my understanding that this scanning-mapping technology, because it measures humidity and air pressure, in particular gives people indices to say what can happen when all of this comes together.

Dr Findlay—Yes. The good thing about dynamic models is they can take inputs from a whole range of sources and they are not constrained to the past. They are based on a systems understanding, and because of that systems understanding you can build in information, including real-time information about humidity and fuel load in a forest, for example, and combine that into an output that is actually meaningful for management.

FRAN BAILEY—Don't get me started on that!

CHAIR—Mr Symon.

Mr SYMON—You mentioned before that forecasting further inland is not as good as it is closer to the coast. What research is being done in that area to improve that? Obviously there are things happening that have not been understood so far that are causing that variability.

Dr Findlay—Yes. This has been quite an area of research—for example, the Indian Ocean Dipole. There are various descriptions now referring to the 'dog with four heads'—it was three heads, and it was one head originally—in terms of trying to understand Australia's climate systems. You may have had this reported already. That is certainly where this research is going. Through that research people are beginning to be far more aware of the sorts of opportunities dynamic models present as a way of combining that sort of information together to produce a whole-of-continent, fine-scale output, usable form, up-to-date information source for what the future outlook is going to be. It is certainly an area of active research, but they are only in the early stages of trying to combine that. These are big complex models and actually trying to combine them into a systems based model, a dynamic model, is where they are at right now. That is certainly an active area of research, but not in a combination sense.

Mr SYMON—Who is the driver of the research? Does it come through your department, CSIRO or through the bureau?

Dr Findlay—It does not come through us. The Bureau of Meteorology is the main driver of that research and CSIRO are increasingly playing in that space. This is a very complex system.

That is where CSIRO is playing a more active role day to day—that is, in the research outlook. Groups such as CSIRO are very well placed to tackle those sorts of big, nasty questions.

Mr SYMON—Do they feed in information provided from your department? You might say that farmers in this area need to know a particular type or series of events when they occur. Are they reacting to that from you or are they just operating in their own sphere?

Dr Findlay—No, they are doing both. I should say that both the Bureau of Meteorology and CSIRO have been reasonably active in this space. Their ability to go out and talk to farmers is necessarily limited by resources. It is not their main task. One of the benefits that we have as a department, and certainly the two bureaus, is that we have active funded engagement with farmers talking about these sorts of needs. We can feed in that information. We have been working with CAWCR and with the Bureau of Meteorology and CSIRO on this question to make sure that farmers' needs are dealt with.

I should not lead you to believe that BOM and CSIRO are not doing that. They are. I am quite impressed by the fact that there are people within the Bureau of Meteorology who are very willing to go out and talk to farmers to get that information, and that has certainly been encouraging.

Mr SYMON—The other question that I had goes back to computers, which seems to be quite popular this morning. We had a hearing in Melbourne not long ago, visited the bureau and saw their brand-new supercomputer, which obviously cost quite a bit of money. But, as was explained to us, the bigger the computer the more problems you can shove into it the more you know but then the more you want to know. Is it a question of dollars in that they could have something better than what they have at the moment to help out what we are discussing now or is it just having to wait as that technology becomes available?

Dr Findlay—In terms of the supercomputing question, there is a reasonable amount of supercomputing capacity in Australia. It is getting the funding to task that computing power to deal with this question. In terms of the research questions, one of the good things about dynamic models is they can tell you about your key uncertainties, what are the important things you need to know a lot about, a bit about or are not that relevant. At the moment you are flying a little bit blind in that space and therefore a lot of the research tends to be paradigm driven: I am an XYZ scientist so I am going to look at things through my XYZ goggles.

One of the good things about these models is you start to say, 'What would make a big difference to our understanding?' You can start to play that game. It is a bit like a flight simulator. What does the pilot need to know better to make better decisions in the future, so how can we train him without having to put him in a plane and discover that he does not know what he needs to know at all the wrong times? That is one of the benefits of these sorts of simulation type, dynamic model processes. You can say: 'What happens if? How would this piece of information improve our understanding of this system?' That is where you can start to target your investment rather than, at the moment, a bit more of a scattered approach. It is easy to generalise. People are not making blind guesses, but you can certainly refine your uncertainty space through these sorts of models.

Mr SYMON—Thank you.

CHAIR—Mr Cheeseman.

Mr CHEESEMAN—I am curious to know what sort of investment has been made by either you or some of the other government agencies in mapping ocean temperature, using that information, modelling it and monitoring it? It occurs to me that the temperature of the ocean, currents and so on do drive our climate. I am curious to know whether, from your perspective, there has been adequate investment put into that task to enable us to build strong climate models.

Dr Findlay—That is certainly not something my department deals with directly. In my past life as a fisheries researcher I paid fairly close attention to the information that had been collected about ocean systems and particularly ocean temperatures. It is a key area of focus and also international focus. It is not something Australia does alone. There is a whole range of shared infrastructure or shared information. Yes, there is a large investment.

One of the things that you should be aware of is, as soon as you start dealing with the oceans, it becomes incredibly expensive. These sorts of remote sensing activities on the ocean, especially using anything other than the surface that you cannot do by satellite, become very expensive. I want people to understand it is a significant investment. It is a very large area of focus for the CSIRO Marine Atmospheric Research Group. They certainly lead the way on behalf of Australia in that area. Again, as to the Bureau of Meteorology, a lot of the models are currently based on information from those systems and so there is a lot of data collection going on, but researchers will always tell you they need more. You are right; that is one of the main drivers and you need to understand those systems very well to understand Australia's climate, especially rainfall.

Mr CHEESEMAN—In broad terms, Australia is not too dissimilar in land mass to continental Europe. How much more money is Europe investing in their weather systems on a similar land mass to Australia? Is it tenfold?

Dr Findlay—I would have to take that on notice. It would certainly be much larger. To be fair, they are dealing with far more complex systems than we are, by the nature of the geography. I would not know those numbers. That is not an area that I focus for DAF.

CHAIR—Mr Bidgood.

Mr BIDGOOD—I have two very different questions. The whole science of long-term forecasting is obviously a very difficult thing. Firstly, the impact of the universe and solar activity on global climate is totally unpredictable and totally external, but it happens. For example, a meteorite coming into the atmosphere or a volcano even on Earth exploding and throwing dust into the atmosphere changes the dynamics of the atmosphere, hence the amount of UV coming through and so on, and also the temperature. How do you allow for this? Obviously they are an external and an internal. How do you equate those sorts of things?

Dr Findlay—Rare events with large impacts are difficult to deal with in a modelling context. At some point you need to draw a line—it is a meta rules process—and say, 'I am going to try to have a system that deals with the most likely scenario. Ninety-nine per cent of the time I'll get this right and if you follow the information I'm providing you here then you're making sensible decisions.' Dealing with the one per cent events that have big impacts, meteor strikes, large dust—

Mr BIDGOOD—Solar flares.

Dr Findlay—Some people are debating now whether solar flares are unpredictable. If you can start to resolve that question then, of course, you can start to build that into your models as well. Again, that is probably beyond the scope for Australia at the moment in terms of investment or potential.

As to dealing with those events, yes, you just need to know that they are there and you need to be willing to put your rules aside and say, 'If this happens, then this probably isn't the best approach.' You need to put that aside for the moment and you are going to have a different weather system for the next little while. There is a limit to what you can predict.

Mr BIDGOOD—Thank you for that. I was particularly interested in your comments about sunspot activity, or solar flares, because there are people out there who say they can do forecasting due to the predictability of that, but we will leave that for another time. My second question is totally different. Can you give me an example of a change of behaviour of a nation and its agricultural determination due to forecast information of extreme weather events? Is there any case in America, Europe or anywhere else where they have said, 'We've been told by the scientists that we're going to have possibly floods or drought. Therefore, we're not going to plant this crop or, therefore, we are going to plant this crop'? Is there any example where there has been a direct change of behaviour due to the scientific information of long-term forecasting?

Dr Findlay—There certainly is, but not in terms of the scale that you are probably talking about here where there is a change en mass due to a change in the evidence. The evidence does not tend to change that quickly. People tend to integrate long-term forecast information with their current beliefs, other systems, the past information, their current production system and reality. The rapid adapters, the people who are very actively pursuing this sort of information, tend to be the people who are quite responsive on their farms. They, firstly, have a diverse strategy and, secondly, tend to be quite rapid at adapting to changed circumstances. We have seen that with things like our Masters of Climate series. We have also been talking to people about climate variability. A lot of information that people access is about averages. When you ask people to unpack that, they tend to be overly optimistic about what their average conditions are like. When they start to understand some of the variability that they are dealing with—while spring might be a great time in three out of 10 years, for the other seven it is actually catastrophic—they see that they might be better off on balance going to an autumn lambing in some areas, for example. We have seen that change in behaviour going on and people improving their productivity quite markedly through that.

So, no, not sudden shifts/massive change; it tends to be a more gradual change than that with the adapters and then the followers coming behind that group, but they integrate information across a range of sources. There is a whole range of other factors helping them make decisions about how to make money out of their business beyond just long-term forecasting. We know that farmers are the major user of long-term forecasts.

Mr BIDGOOD—That is the premise of this inquiry: once we do establish the benefits of long-term forecasting, to benefit the agricultural industry of $47 billion. That is quite a key foundation premise of the inquiry. Thank you for that.

CHAIR—Mr Johnson.

Mr JOHNSON—I will come down from the universe back to earth. I have a generic question. I have the University of Queensland in my electorate. I suspect it takes pretty smart people, like yourself, to be doing what you are doing.

Dr Findlay—That is where I came through.

Mr JOHNSON—UQ?

FRAN BAILEY—You did not know that, did you?

Mr JOHNSON—No. I will have to go and make a note of that. I am assuming you have family in my electorate.

Dr Findlay—Possibly, yes.

Mr JOHNSON—How much interaction is there between yourself and maybe your peers or colleagues with relevant organisations or departments and specialists both in the academic world and in the professional organisations that exist around the country?

Dr Findlay—I have been remiss in not mentioning the universities. I probably should have. Places such as the BRS work on weeks to months-type timeframes in terms of the advice that we provide. We are dealing with issues on a fairly rapid turnover rate. The CSIRO, the research parts of the Bureau of Meteorology and universities deal with these longer time horizon issues. Some of these really big hairy questions are very well dealt with by universities. They are things that take a lot of thinking and a lot of work. Nevertheless, even though we are all working across different spectrums of time, we are all working towards the same end. That is actually quite an active network. For example, we do a lot of work with the University of Southern Queensland, UQ and a whole range of the universities. More agriculturally based universities are actively engaged in this space. Likewise, they are engaged with CSIRO and the Bureau of Meteorology in those types of activities. I think the network is pretty good. That is one of the good things about scientists, they are driven by interest.

Mr JOHNSON—Is the collaboration proactive or is it incidental? For example, if Professor X or PhD student X comes up with an idea, will he share it with people like yourself or is it only if you happen to have links already?

Dr Findlay—No. The nature of science is that the network works very well through the scientific literature process. It never happened if it was not published. That is the bottom line. All of these very good professional scientists keep a very close eye on what is coming out. They know about it before it comes out in the literature. The networks are very strong.

Mr JOHNSON—That is excellent.

Dr Findlay—We had the World Meteorological Organisation meeting in Australia last month in Toowoomba. What was very evident from that process was that, while Australian researchers are very well linked, we probably do not have the links to the agricultural community that some

of the other countries have. I hate to use the term, but agrometeorological outputs are certainly a bigger focus in a lot of other parts of the world. Again, I think that is an area for us to improve on.

Mr JOHNSON—That is a subpart of my question. Are links to those state borders—

Dr Findlay—It is not as good as it could be. That is where we have an important role to play. The collective group from universities, CSIRO and BOM through ourselves to the agricultural community can certainly make that link a lot stronger.

Mr JOHNSON—Why is that link a bit tenuous? Is it because of time, funding or finite resources to concentrate on those links or is it one of those things that you just have not got around to?

Dr Findlay—No. I think it is largely a resourcing question. Australia has a very dispersed farmer network. We have a lot more land covered by far fewer farmers, which means when you are dealing with these things at this sort of scale it is actually quite difficult to get to everyone that you need to talk to. That is one of the essential parts out of this sort of process, if this committee is going to make recommendations. The investment, time and effort in that space is essential right at the start, and not waiting until the back end of this.

CHAIR—I would like to follow on from that, because I have my finger on a question as to whether we have suitably trained agricultural scientists and extension officers. I want to preface this by saying, in layman's terms, that obviously we are at an interesting juncture, at the moment, in terms of weather forecasting. Brisbane is having the biosecurity conference next year. We understand that the world's population is growing. Food shortages are afoot. This country has an agricultural industry that wanes and thrives. Clearly there are ways where we can take advantage of those opportunities. I just wanted your assessment in terms of our research and development into agriculture and how we can become leaders in filling that projected food shortages to 2050. Are we equipped to do that? Where are the shortages in terms of our researchers, scientists and linkage people? Is it working? Is it coordinated? On the basis of what Mr Johnson was saying, there seems to be a tenuous coordination. Where can we make improvements? I am asking the question in terms of the sorts of recommendations this committee can make. You have already alluded to one. Where are we at and where should we go?

Dr Findlay—I should probably clarify this. The link is not bad, but I think it could be better. There is no doubt that things such as long-term forecasting are one of the major drivers for helping people improve productivity in Australia and meet some of those shortages that you are referring to. We really have a very strong farming community in Australia. They are very adaptable. They have proven themselves to be very competitive against a difficult world stage. They already are certainly in the top 10 per cent. Probably the top 80 or 90 per cent are very active users of this sort of information. Improving it can only help.

We have quite a good network of extension officers through the catchment management authorities and other processes. There is no lack of will. The surveys that we have done of attitudes towards groups such as the Bureau of Meteorology is that within government the Bureau of Meteorology is probably the single group that farmers believe the most. They use them a lot and they trust their information quite a lot. The one that they question, though, is

long-term forecasting. As a group they do not believe it is accurate enough to meet their needs, and so that is certainly a big area for us. There is no doubt that if you can make better tactical decisions—sorry to use the jargon—within season and between seasons you are going to make better decisions about improving the productivity of your farm and make your farm business more resilient. At a collective level, within an industry sector you can certainly make better decisions about how you use your infrastructure or how you invest in infrastructure. Across the entire agricultural network there are certainly good opportunities to make better decisions based on what we need to do to adapt and what we need to do to be a more resilient and productive agricultural sector. We are certainly well down that way, but investment in long-term forecasting is a great idea to help productivity.

CHAIR—Mr Cheeseman.

Mr CHEESEMAN—I just wanted to follow on from Mr Johnson's question and the chair's question. It occurs to me that it is pointless in investing in long-term forecasting if you actually have limited capacity to get that information out to the farm sector. I think you have mentioned that there is some capacity through natural resource management groups, catchment management authorities and the like. What suggestion would you make to us as to how we might give greater capacity to get that information out?

Dr Findlay—We have looked at this question at some length. Obviously we have a whole range of needs to get information out to farmers. As I said earlier, they see the Bureau of Meteorology as a respected and trusted source of information and they often access information. Most farmers are accessing information these days through the internet and they are very active users of the information, despite broadband and other challenges. The feedback we receive is that the information is not packaged in a way that is useful for farmers, especially in dealing with events that involve a lot of uncertainty. Dealing with that is quite difficult. We are keen to look at some of the tools we already have. We already have the National Agricultural Monitoring System, which takes climate information and production information and turns that into outputs. This was originally designed for government to use to make better decisions about drought support. Major users of that tool now are farmers, but it is done as an up-to-date and up-to-now. There is no forecasting capacity in there at the moment. We have been talking to the Bureau of Meteorology and CSIRO through the CAWCR process looking at ways we might use tools like that. We already have a large user base. We are getting about 1,700 farmers using that tool a month, to do exactly what we are doing now, but not looking forward. We could to take that sort of output from CAWCR and turn that into a predictive system. The tools are there.

We have very good farmer networks. What we are seeing from farmers is that there tend to be leaders and followers in communities. If you can get to those leaders and educate them, the information spreads very quickly. The social networks that support that are very active. Through a combination of technology and their existing support networks the information will get out there, but it has to be in the right form. You cannot produce big, complex models with nasty graphs and big uncertainty bounds in currencies that do not mean anything to farmers. That is the risk with these sorts of outputs; it needs to be built in right up front. Farmers are the major user. Talk to them now and not at the back end about what product they want. Build it in right at the front.

Mr CHEESEMAN—I agree you have to be able to put the information into a useable format, but I think it is useful not only to have the information available for people to access via the internet, but also to set up some processes by which district-by-district or at least catchment-by-catchment there is an opportunity for farmers to come together and be properly, adequately and thoroughly briefed, in the lead-up to decisions having to be made about whether I put a crop in this year or I do not.

Dr Findlay—I entirely agree and it is very similar to the process we have run with our Masters of Climate series, looking at climate, though, rather than long-term weather forecasts. That is certainly our experience there. If you can get people down, talk to them in a room, go through the concepts together and get feedback from them, that is the way it works really well. It is a combination of tools. There is no silver bullet here about getting information out there. You are all looking to get elected; you know that.

Mr CHEESEMAN—Is there further investment needed to have a more detailed strategy?

Dr Findlay—Absolutely. The extension and implementation of this is a vital component, and to move ahead without that would be silly. You would be pursuing a science question and not a needs-driven question if you do that. That is where we often fail in terms of researchers. You get caught up in the research question, failing at the end of the day to remember that there is a need-driven outcome that you are looking towards here, and that is making farmers better informed.

Mr CHEESEMAN—Have you looked at the cost of having that structure?

Dr Findlay—We have started to have a look around in that sort of space. There is nothing that I would want to put on the table in terms of a definitive costing. It is not an insignificant investment. That is one of the failings that people often make; you put a large investment up front in some technological or research solution, but really under invest in that post-fact reporting to people. We, as a department, are certainly very keen to make sure that is not forgotten. We need to get the information out there quickly, because things are changing quickly and we need to get it out there soon.

FRAN BAILEY—How do you extend the links to land management authorities, the water catchment authorities and the emergency services organisations in terms of the importance of the application of the research? I understand that it would be difficult to involve, for example, some of these state based authorities in some of the formal links like those with the universities, but it is more in the application of the research. Can you suggest ways to widen the net to make sure that these organisations are better informed?

Dr Findlay—I am using 'farm' as a shorthand here to encapsulate a lot of those related businesses and a lot of processes. I mentioned earlier these sectoral groups, the irrigation authorities and the irrigation management groups are an incredibly important stakeholder in this sort of process. Just like on-the-ground farmers need to be involved, those people need to be involved at the outset. When I say 'farms' I am including the related business and the related infrastructure processes that support farms and not just the person sitting on a farm.

The emergency services are the other big users of this sort of information. If we are looking at better ways to predict the likelihood of these big impact events, and of course being better

prepared for that, again it is better to build in that information right up front. Building their needs into the process is essential.

At the moment we have user forums for these sorts of things, like our NAMS users forums. We went around the country and talked to a whole bunch of different groups—farmers themselves, these related groups and also some of these other people. In my view that is how you go about that sort of process. You go out and have focused forums where you invite all of those groups into a room. You visit them, you do not expect them to come to Canberra, and you go through that process. That is a very similar process that we run now and they are very effective.

FRAN BAILEY—Do you have any formal links with the CRC on bushfire research?

Dr Findlay—Not me as an individual, but certainly our forestry group does in feeding information back and forth. We monitor the health of forests and look at the impacts on soil erosion and other bits and pieces out of the back end of bushfires. It is not so much on the predictive capacity and emergency response; that is not our game.

FRAN BAILEY—That could be a way of extending that.

Dr Findlay—Yes.

CHAIR—Dr Findlay, thank you very much. We are in the early process of our hearings, but certainly the messages that we are getting are consistent. I think we are gaining an understanding as we go along of what is a very interesting and intricate scientific methodology, but one that has incredible application at a practical level.

Resolved (on motion by **Mr Cheeseman**, seconded by **Mr Johnson**):

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

Committee adjourned at 10.42 am