COMMONWEALTH OF AUSTRALIA

Official Committee Hansard

HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON PRIMARY INDUSTRIES AND RESOURCES

Reference: Assisting Australian farmers to adapt to climate change

WEDNESDAY, 21 OCTOBER 2009

CANBERRA

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HOUSE OF REPRESENTATIVES

STANDING COMMITTEE ON PRIMARY INDUSTRIES AND RESOURCES

Wednesday, 21 October 2009

Members: Mr Adams *(Chair)*, Mr Schultz *(Deputy Chair)*, Mr Bidgood, Mr Champion, Mr Forrest, Mr Haase, Ms Livermore, Mr Perrett, Mr Sidebottom and Mr Windsor

Members in attendance: Mr Adams, Mr Bidgood, Mr Forrest, Mr Haase, Ms Livermore, Mr Perrett, Mr Shultz, Mr Sidebottom and Mr Windsor

Terms of reference for the inquiry:

To inquire into and report on:

- Current and prospective adaptations to the impacts of climate change on agriculture and the potential impacts on downstream processing.
- The role of government in:

  - augmenting the shift towards farming practices which promote resilience in the farm sector in the face of climate change;

  - promoting research, extension and training which assists the farm sector to better adapt to climate change.
- The role of rural research and development in assisting farmers to adapt to the impacts of climate change.

WITNESSES

Committee met at 5.08 pm

ASH, Dr Andrew John, Director, Climate Adaptation Flagship, Commonwealth Scientific and Industrial Research Organisation

HOWDEN, Dr Stuart Mark, Chief Research Scientist, Theme Leader, Climate Adaptation Flagship, Commonwealth Scientific and Industrial Research Organisation

KEATING, Dr Brian Anthony, Director, Sustainable Agriculture Flagship, Commonwealth Scientific and Industrial Research Organisation

CHAIR (Mr Adams)—Welcome, gentlemen. You have all been here before and know the processes. Do you have any comments to make on the capacity in which you appear?

Dr Howden—I am the theme leader in the Climate Adaptation Flagship.

CHAIR—Thank you. We have the CSIRO submission No. 19 which you are appearing before us on. Do you wish to make a brief statement in relation to your submission and then we will have some questions?

Dr Ash—Just a very brief statement. The submission which you have obviously got, which was put in in March, covers three broad areas: dealing with some conceptual aspects of adaptation of primary industries, talking about some specific adaptation options for different sectors of the ag industry and then about the role of government and how it might assist adaptation, and then the role of research and extension, which broadly address the terms of reference which focus on adaptation.

In that submission we have not touched on any areas dealing with mitigation. That is part of the reason why Brian Keating is with us today. His area of work is looking after the mitigation aspects of agriculture and climate change.

CHAIR—Thank you for that and thank you for the submission. I guess others will deal with opportunities and risks and things, but I would like to ask you about a model for conducting research and funding research for climate change. What do you think about that? What are your feelings about the sort of model? Some of those things are starting to emerge. We have had evidence from different witnesses about that and I would be interested in whether we need a national body to oversee and to coordinate. There are a lot of things happening with a lot of different bodies in Australia. Do we need a coordinating structure nationally to work collaboratively with states and universities and other research areas in the private sector?

Dr Ash—I will respond to that initially and there might be some other responses after that. In the context of climate change, we do need some coordinating work. We have a number of entities that take on research in this space, from the rural research and development corporations through to universities, through to state agencies and CSIRO. Some of the aspects of climate change are generic enough that it does not make sense for each of those groups to be doing their own bit, typically the RDCs. So some coordinated efforts—whether it be around some of the climate change projections which would touch on a number of industries; issues of some of the impacts of those climate change projections on industries—can be done more generically. That is

a good reason for having a coordinated body, and just for economies of scale. We do not have a huge number of researchers in Australia and in the ag sector generally and it makes more sense to get more bang for your buck by having that coordinated approach.

There are a number of mechanisms for achieving that coordination. We have had in place, up until now—it is somewhat in abeyance—the Climate Change Research Strategy for Primary Industries that was under the management of Land and Water Australia. That was one mechanism, particularly for bringing some coordination to RDCs, universities, CSIRO and state departments. Then we have, for example, the Climate Adaptation, our own flagship program, and we do try and work fairly closely with the RDCs and state governments and the Commonwealth through DAFF and the Department of Climate Change and also collaborate with universities and do participatory work with farmer groups and the ag industry. That is the second mechanism.

The third mechanism is the National Climate Change Adaptation Research Facility which has been established by the Department of Climate Change and a consortium run by Griffith University. That has as part of it a primary industries network which particularly brings a network of researchers from universities and CSIRO into that. Associated with that NCCAR Facility, they are developing a national adaptation research plan for agriculture. They are the three mechanisms that we have had in place for coordinating activity, at least in the adaptation space. I do not know, Brian, whether you have any comments more broadly in the mitigation area.

Dr Keating—Some of those mechanisms also touch on mitigation. I endorse your comments, Andrew. I would perhaps add that, in terms of mechanisms, we can think about structures and about process. Structures do not necessarily lead to better coordination. Sometimes they can lead to additional fragmentation and additional barriers. Good process can also be a very important element. One example I would like to give in the mitigation area is a program that the CSIRO is coordinating for the Department of Agriculture, Fisheries and Forestry around soil carbon. There is a national soil carbon program. It involves universities and departments in every state and territory and is certainly rolling out a coherent new national program on soil carbon research. That has been a fairly low transaction cost, low structural response, that hopefully will deliver some good coordinated outcomes.

CHAIR—Is that based in Adelaide?

Dr Keating—That is correct. The CSIRO's project leader in that area is based in Adelaide. That is Dr Jeff Baldock. But, as I said, about 25 per cent to 30 per cent of all the activity in that program CSIRO is doing itself and the other 70 per cent is being done by other agencies but using some consistent national methods, and the data are going into consistent national databases and so on.

Mr SCHULTZ—How closely are you working with state agencies and private individuals on that issue? The reason I ask is that we have seen some excellent work in that area on an interstate basis.

Dr Keating—The state agencies that are formally involved in that program, to the best of my understanding, are the University of Tasmania which is TIAR, which is a joint university-state

agency; the New South Wales Department of Primary Industries; the Queensland department of natural resources; the University of Western Australia; Department of Primary Industries, Victoria. All those agencies and state departments are involved. In terms of private individuals, we are aware that there is a lot of interest in the private sector in the farming sector generally around issues like soil carbon. We are doing our best to reach out to that level of interest, offering opportunities for soil sampling and soil analysis of privately run trials to be connected into that national network. It is early days, but we are certainly keen to try and facilitate and tap into the energy and enthusiasm that is out there in the farming community.

Mr SCHULTZ—Is any of that being done in the sandy regions of Western Australia?

Dr Keating—Yes. The University of Western Australia project is focusing on the sandy soils of Western Australia, which are substantially different, of course—and the carbon story. We believe there are some differences there.

Dr Howden—In terms of the adaptation side of that, the Department of Agriculture, Fisheries and Forestry Farming Futures program on climate change also has coordination across different sectors as part of that adaptation strand and, similarly, CSIRO has a strong role in many of those projects. We are working with state agencies and farmer groups right across the nation on that, both north and south in terms of grazing, right across the nation in terms of cropping, and there is a forestry call as well. There are various mechanisms for coordination which happen at different levels.

One of the critical things there is that, regardless of at which level that coordination occurs, it is really important to connect that information with users, particularly greenhouse climate change adaptation which happens at an enterprise level and consequently there has to be that linkage to those enterprise decision makers. So there is a conflict there between higher level coordination and lower level delivery and that is what we are trying to work towards, both in the flagship and as part of some of those activities like the primary industries network.

CHAIR—It is certainly an issue that we have had a lot of—

Mr SCHULTZ—Given the urgency of this issue in the public arena now and certainly in terms of the high interest about it in agriculture, do you have access to sufficient funding and resources to be able to handle the demand?

Dr Howden—Within CSIRO, no, and that is part of the reason why we have strong partnerships with state agencies and other actors in this space, because they have capability that we are working with to deliver to those demands. Even then, we are increasingly having to say no to new opportunities.

Mr SCHULTZ—Is the fact that you do not have sufficient resources restricting you in any way, shape or form?

Dr Howden—It is fundamentally about priorities. If they are a significant priority in terms of the science and the delivery to users, then that will happen. It is not a fundamental barrier.

Mr SCHULTZ—I am not trying to place you in a position or, indeed, my parliamentary colleague in a position. I am just trying to get a picture of the urgency of what we are trying to achieve here through this inquiry, what you are trying to do as a government funded body and whether we have the right resources in the right place in the way of funding and resources to be able to cope with the demands that are out there, given the worldwide interest in this area.

CHAIR—Can you use more money?

Mr SCHULTZ—I did not want to ask that question direct. I did not want a bloody bureaucratic answer.

Dr Ash—Certainly you asked a bureaucratic question.

CHAIR—Yes or no?

Dr Ash—The answer is always yes, I guess. The challenge there is being able to deliver on some of the time scales that are needed, somewhat, in adaptation, because some of the adaptation needs are here and now, but also in the sorghum/biosequestration space where we need robust analytical and measurement methods to support the measurement of carbon and to be able to ramp up quickly. It is not just a funding issue; it is also being able to get all the bodies in place to be able to do the work.

CHAIR—Yes, and the time to get the research done.

Dr Ash—Yes.

Dr Keating—There is a particular pressure point at the moment around both our opportunities to restrict greenhouse gas emissions for agriculture and our opportunities to store carbon in soils or forests. There is a lot of pressure from the community—and from government interests, of course, in science—to inform how Australia handles those things and CSIRO is ramping up its activities as fast as it can and drawing people off other jobs and onto those jobs. Our new flagship has that as one of its two big key goals. I do not think you have ever had a scientist say they cannot use more money, but it is true—

Mr SCHULTZ—One did today at lunchtime.

Dr Keating—Yes. I was going to qualify that.

Mr SCHULTZ—We do not mind giving money to productive scientists. We do not like giving money to inactive and unproductive scientists.

Dr Keating—Yes. There is a real capacity constraint here as well.

CHAIR—I think we understand, yes.

Mr SCHULTZ—Just a final question?

CHAIR—One.

Mr SCHULTZ—What about private enterprise? Does it contribute, in financial terms or other terms, to helping you guys do the excellent work that you are doing?

Dr Ash—Yes, through two mechanisms: (1) through the levies that are provided through the RDC system, which are matched by government, and (2) some private, particularly commercial, farming operations are contributing directly to research that is in their particular interest.

CHAIR—Graham, you might come into that, with opportunities.

Mr PERRETT—Thank you, Chair. The scientist I referred to was at a lunch today of climate change scientists. He was basically saying that they are well funded in terms of investigating climate change. The science is there; the facts are there. It seemed to me that the summary of it was that the south-east and the south-west are going to get drier and the north is going to get wetter. The focus of the CSIRO over the last 50 years has seemed to be more on partnerships with profit-making ventures. Because most of the profit-making ventures are in the south-east and the south-west, would it be fair to say that there is not a lot of incentive to get people to the north, because all the capital, all the people, are in the south-east and the sliver of the south-west? Would that be a fair summary of events?

Dr Ash—I would not entirely agree with that. The nature of agriculture is different, obviously, between the south and the north. There are a lot more agricultural farming opportunities in the south compared with the north which is more dominated by extensive grazing lands and a thinner strip of agriculture around the—

Mr PERRETT—Currently.

Dr Ash—This is all currently, yes.

Mr PERRETT—But it is a simple science: if you do not have the rain, you do not grow.

CHAIR—Order! We will get an answer.

Dr Ash—Just by virtue of the environmental and climatic constraints, there has not been as much activity in the north. As you know—and perhaps you might want to comment on the northern study shortly—there has been a history of development attempts in the north over 100 years or so which have not always been successful, but that does not mean we should not be exploring them again and continue to explore them, because we have new technologies and we have new understanding of the systems and the constraints under which that farming can be conducted. I think there are opportunities in the north. You might be right about attracting people to not just invest in the north but to go up and live in the north and actually be part of those agricultural enterprises.

Mr PERRETT—Could I tease it out a bit further, Chair?

CHAIR—One more.

Mr PERRETT—Yes. The notion I have is that the CSIRO and scientists and your innovation certainly let us be ahead of the curve in terms of mitigation but, for devoting capital, at the

moment we are relying on the market, as in, 'It's as dry as buggery down here, so we're going to have to go somewhere else,' whereas Australia might have an opportunity to be ahead of the curve in terms of moving capital. We are not communist China and we do not get to move people in large masses, but in terms of being ahead of the curve and luring people to the north, if indeed the opportunities are there—I mean, as I said, my basic science is: no water, no growth; no fodder, no animals.

CHAIR—It is more of an economic development issue that you are dealing with, and climate change may drive it, but it will be private capital and where that goes and how we get it there if it goes to the north.

Mr PERRETT—It is a bit outside your bailiwick, I know.

Dr Ash—I will not make a comment on the economic capital side of things but, on the R&D to support that, the CSIRO has a rich history of working in the north, understanding the constraints to agriculture and exploring the opportunities, and so we do have a pretty good knowledge base from that long history of activity in the north.

CHAIR—And somebody from the north: Barry Haase.

Mr HAASE—Hardly the north! I am all of the west. I want to give you a plug. I hope I have not got it wrong, but the Frank Wise Institute in Kununurra was part of CSIRO.

Dr Ash—Yes.

Mr HAASE—It did brilliant work and, since some of the heady but disastrous days of the past on the Ord, there has been a great deal of redemption. The latest product is chia—and what a breakthrough that is going to create for growers in the Ord, especially with stage 2 coming on. I would love you to place on the record the wonderful opportunities you see for Murray-Darling horticulturists that would move to the Ord and create a new life for themselves and for their future. However, more specifically, I would like to know about what research CSIRO is doing in relation to the integration of high-temperature growth in perennial pastures and cold winter growth of cereal crops so you have got a cereal crop and a grazing pasture in the one area. We have heard a lot of theory from various witnesses and we have witnessed some sandplain country in Western Australia where they are almost there, but no-one could give us practical proof of successfully having the summer pasture and the winter-grown cereal crop.

Dr Ash—I think what you are talking about there is pasture cropping. Mark, you might want to make some specific comments on that. That is your space.

Dr Howden—I have worked with farmers on this system, including up in the Gulgong area, so they are some of the lead farmers who started the whole pasture cropping idea of—

Mr HAASE—Just name the area?

Dr Howden—Gulgong.

Mr HAASE—Gulgong in—

Dr Howden—New South Wales. It is the Central Tablelands area. In some circumstances that system has significant benefits, because it uses both the summer and winter rainfall. The challenge is in places where there is a lack of summer rainfall, in having effective persistent perennial grass in that system, and so we are challenged by having a grass that will grow adequately in very dry conditions and be grazed at the same time. So there are some issues there in just getting that system to work outside of the core areas in central New South Wales where it was initiated, but in those places where we have both adequate summer and adequate winter rainfall it is a system that makes a lot of sense.

Dr Keating—I am not aware of all the details, but I believe there are some related systems of interest in WA, where people are looking at summer-active grasses for those seasons—and it is not every year, but a small number of years—where there is sufficient summer rainfall. People are looking at how those summer-active C4 grasses in WA can be fitted into the winter cereal system. I suspect the focus for that work is through the CRC, the farm futures cooperative research centre.

Mr HAASE—Is there—excuse me, Chair, won't you.

CHAIR—One more, yes.

Mr HAASE—I am concerned. It struck me and, I believe, most members of the committee that visited and heard the evidence here from the New South Wales group—I hope they are New South Wales—that this was pretty much a radical breakthrough, something that commonsense said you cannot do. The question specifically is: is CSIRO leading or following this practical research?

Dr Ash—I will probably handball that one on shortly. But the notion of trying to get farming systems where you have rotations coming in—and you can do this in cropping systems where you have different crops coming in—

Mr HAASE—Of course. This is far more radical.

Dr Ash—Yes. There has been a lot of research on that for a long time. We have had the lead in that in the dry tropics for a long time.

CHAIR—Some of this has been done by ground cover. It holds the country together.

Dr Ash—Yes.

Dr Keating—We were working on those issues at Katherine in the 1980s—some legume based forages, direct drilling maize into those things. We are certainly very aware of the really innovative farming practices that have been going on in New South Wales and I know, Mark, you have had colleagues working in collaboration with those farmers. I myself about 10 years ago was involved in some analyses of the climatic suitability of those innovations—where they might work; the balance between the cropping potential and the grazing potential. I think the answer to your question is that we lead sometimes and we follow sometimes. We are happy to follow the lead of innovative farmers and at times add value perhaps to extend their results into other regions.

Mr HAASE—Not involved to the point of knowing of any negativity about the research or about the outcome?

Dr Ash—Not negativity in the sense of where it is practised; it is just caution about the extent to which you can extrapolate the activities to other regions.

Dr Howden—And the economics have to work.

Dr Keating—Those economics are very particular to the business economics of the individual enterprises—so if you are into a grazing business versus if you are heavily into a cropping business and the balance between the two.

CHAIR—Which is what we heard in your electorate.

Mr HAASE—Yes, it confirms that.

Mr WINDSOR—To follow on from what Mr Haase was saying, are you looking at pasture cropping as more of an opportunity arrangement or is there, as some people are suggesting, because of the existing pasture standard, something that we have not really put our finger on happening in the soil—some claims in relation to soil moisture movement from depth? Is the CSIRO doing any work on that, or is it purely taking advantage of a dormant pasture phase to utilise moisture through no-till techniques?

Dr Keating—The standard scientific interpretation of what is going on would be more that operational aspect of having plants able to grow at different times of the year, make use of water when it falls, and mixing the pastures with the crops. I am aware of some theories that farmers have about plants drawing extra water out of the atmosphere, for instance, if that is what you are referring to. Some of that, I think, is more speculative.

Mr WINDSOR—Or from depth?

Dr Keating—That is very much traditional—from depth.

CHAIR—Holes in the ground being dug for us to look at.

Dr Keating—Yes. Obviously a perennial pasture tends to be more deeply rooted than an annual crop, so you will get, potentially, more efficient use of water that falls. That falls below the root zone of the annual crop and the perennial pasture can make use of that. That is quite solid—

Mr WINDSOR—CSIRO does not see any sorts of breakthroughs occurring in the root zone in terms of the general health of the plant and generation of carbon?

Dr Howden—What we found, at least in the central New South Wales work, was that you could explain what was going on simply in terms of the water dynamics, the nitrogen dynamics. In a similar way, those pasture systems use nitrogen much more efficiently. You do not have spare nitrogen floating around to get leached into the profile or to get lost as a gas. It also means that you have more effective use of light, which means you grow more biomass. If you have

more biomass you can both have more cover and put more carbon into the soil and, if you have deeper rooting grasses there, some of that carbon goes down deeper than it would otherwise do. Between all of those things, you could explain what was going on in those systems quite adequately without having to draw on other processes which we did not understand.

Dr Keating—Mark, I would support that, but also add that there will be situations where there are soil health issues, soil disease issues, where incorporation of the rotation or the incorporation of another species will definitely be beneficial to the soil microbial balance. That is well established in, say, annual wheat cropping, build-up of soil diseases, rotating with other crops—canola or perennial pastures. It certainly has benefits in terms of the beneficial and pathogenic nature of soil organisms.

Dr Ash—It is worth saying, though, that our understanding of soil biology is behind some of our other agronomic understanding of above-ground processes. That probably does limit our ability to fully interpret all the findings that people are getting, both in practice and in research.

CHAIR—That has come through to us a bit in evidence.

Mr WINDSOR—In some of the presentations the impact of climate change on water availability has been talked about. There has been mention that in the cotton industry, for instance, there may be a change in land use to better adapt to water availability and those sorts of things. Have you done any work or is there any modelling in relation to any land use shifts if we impose an emissions trading scheme over agriculture and highlight the negatives of agriculture—the nitrous oxide, carbon footprints, moving stuff about—as compared to the carbon economy and the fuel economy, bearing in mind that land may well be able to shift out of food or into carbon or into fuel or biofuels? The CPRS that is currently before the parliament actually has an encouragement towards the carbon economy through the planting of trees for carbon purposes. Has CSIRO done any work in terms of modelling the impacts of land use based on a range of prices in those three markets?

Dr Keating—Yes. We have done one detailed piece of work in very recent times. That is just starting to appear. There is one publication out now in the public domain. It is a piece of work that was commissioned by one of the South Australian departments and it was looking at the potential economic competitiveness of agriculture with carbon forestry—if we can call it that—in a region of South Australia and, as well, the potential implications on water balance and biodiversity. So on those four issues—agricultural competitiveness with carbon forestry and potential water and biodiversity—there is one piece of work that is now available.

Mr WINDSOR—Has that got a carbon target superimposed on it?

Dr Keating—No, not a carbon target, but it assumes different carbon prices. It takes the current economic analysis or the profitability of the current agricultural activities in that region and says, 'This is the profitability of a hectare of wheat-sheep farming,' and then says what sort of carbon price would, all other things being equal, give a higher return in an economic sense, compared to what the historical agricultural returns would be.

Mr WINDSOR—Can you give us some indication of what that means for that particular example?

Dr Keating—It suggests that, with a very narrow, strict economic comparison, a gross margin, X dollars per hectare for wheat farming, Y dollars per hectare for carbon forests—so a $20, $30 price for carbon—once carbon prices are up much above $20, then you start to get a potentially economically attractive proposition to move some fraction of the farmland from cropping to carbon forestry. So it does suggest that there are some fairly large shifts that, from a narrow economic point of view, could raise the economic returns from farming in that region, but they would reduce the wheat production—and they do have implications for water, of course, as well.

Dr Ash—I am not criticising that at all, but what is missing, particularly when you are talking about these land use changes and going into carbon products, which are going to be there for 60 to 100 years, is the impact climate change itself will have on the potential for those carbon stores to be secure in the long term. As the immediate economic attractiveness may push towards, say, vegetation planning for carbon, we need to do that analysis of what it might mean in the long term for the security of that carbon under climate change itself.

CHAIR—We are really on the edge there at the moment—and also getting a price on carbon to do economics in that area.

Dr Keating—Yes. Chair, I should have added that, as I said, it is a very narrow economic analysis and there is the social dimension of whether you as a farmer would be prepared to lock your land up for 100 years, so there are some very big social questions there.

Mr WINDSOR—What about the third economy? With the carbon costs being imposed on the food sector and some of those costs being ameliorated in a positive sense by going into lignocellulosic ethanol, for instance, have you done a similar analysis to the land use shift there, where you do not have those carbon footprints?

Dr Keating—We have got a lot of questions there. So, how lignocellulosic biofuel technology development might come into this and be a player in these alternative land uses?

Mr WINDSOR—A competitive land use.

CHAIR—From food?

Mr WINDSOR—Yes.

Dr Keating—We are on the edges of doing that type of work at the moment. I am not sure we have anything that is at a stage as advanced as the example I have already given. In fact, to be honest, Andrew, this is the thing we have just been talking about doing.

CHAIR—Yes. It is work that is conceptual, can we say? Conceptually you would be looking at that?

Dr Ash—More than conceptual. We know conceptually what needs to be done and we actually just need to allocate some resources and move on and do it.

Dr Howden—And there is a process to do that, yes.

Mr FORREST—Reading the CSIRO stuff on this subject is always a bit overwhelming. Your submission talks about what the challenges are. It mentions knowledge gaps and there was one particular sentence that leapt off the page for me about rice. It says:

> Potential new methods of rice production (aerobic culture) may allow expansion of rice growing to new areas ...

There is a similar theme for cotton and grain, and I was hoping you could give us some positive examples—'And we've had an area of research here and we've developed some knowledge that can flow through to' the people I represent, or we all represent, in the Murray-Darling. It is terrible out there. Economically there is no hope at all.

Can you give me some positives: 'Yes, and here's a good example of where we've invested in research and we've got an answer'—something? That last response was the sort of thing I was after, but can you give me a bit more for the other commodities? My fear is that we are just going to be the carbon sink for the world, growing trees, and my communities will all change, we will close the schools—all the social adjustment that is going to be involved with that.

Dr Ash—There are some practical adaptation options that allow farming to continue in a food production sense without economically going down the current farming track. Mark, have you got anything specifically from the report that we have done there, or do you want to provide that on notice?

Dr Howden—The response I would give is that we have done a fairly wide range of what we call desktop studies. That is, essentially, scientists exploring adaptation options in view of potential climate changes and we have done that perhaps for a decade. In terms of working closely with farmers and having significant resources to take it from those desktop studies to a much more practical demonstration, it has only happened in the last couple of years, so we are still fairly early on in the process of working with farmers or catchment authorities to deliver the sorts of things that you are asking about. Having said that, I think we have had significant impact on farming practices in different places through improved climate risk management and that is part of what the Climate Adaptation Flagship is, so it is looking at managing El Nino and similar causes of variability. I think we have had significant impacts on using our resources, such as water, much more efficiently than we used to. As a consequence, we have got much better water use efficiency and better yields. And we have had a range of more informed discussions by some industries about their options in terms of climate change.

One example of that is the Peanut Company of Australia, which is in the process of moving part of their business to the north, to Katherine. That is as a result not necessarily of CSIRO's activity but of that company having a particular interest in that, but that is a positive in the sense that they are looking at these climate changes and seeing how they can take advantage of them. There are a number of other examples particularly driven by farmers who have a particular perspective on climate and climate risks, where they are already starting to take action, and that is based on opportunities rather than risk.

Dr Ash—They are longer term. They are not at delivery stage yet, but we are starting to invest fairly heavily in the area of climate-ready crops, so we are starting to put more emphasis on our breeding programs around issues of higher temperatures, adapting cereal crops to deal with higher temperatures for example, dealing with a higher carbon dioxide environment, and we can

take advantage of that in a positive way. There has been ongoing work over a number of years around drought tolerance and being able to get better adapted varieties around that particular climate risk. That work is continuing.

So we are investing a fair bit in some of those technologies. One of which is not quite at the farmer-ready stage yet but is at an advanced stage of researching, for example, is polymer films. Putting those over crops at the time of planting gives you wider planting window opportunities, improves the microenvironment under that polymer film in the early stages—the first 30 days or so—of growth so that you have better water use efficiency, you have in fact got an enhancer until you get better growth. So that is a real, practical technology which we think will add some benefit in dealing with some of these climate risks.

Mr HAASE—How will you assign your research priority from here on? You are concentrating on getting this all ready. How will you assign the priority after that? Will you just chase where the money is, or will you think ahead?

Dr Ash—We have gone through a process of working out what we think are the vulnerabilities in the different sectors and in the different regions and what might be potentially the most suitable adaptation options and investing effort in those. That goes from at the individual farm level, around some technologies, through to the farming system practices—and they will be done in different regions for different crops—right up to then thinking about what might be some of the transformational options that are needed more in land use change, where it is not possible perhaps in the longer term to cope with some of the bigger climate challenges that might be presented.

CHAIR—Yes—north-west coast, Tasmania: spuds, carrots.

Mr SIDEBOTTOM—Yes. We will be the food bowl.

CHAIR—South as well as north.

Mr SIDEBOTTOM—That is right. Thanks, Dick. On page 16 of your report here on food processing and manufacture, which is important to a lot of people in this room, you mention:

> Little attention has yet been given to the impacts of climate change on the whole value chain of food from production, to processing …

et cetera, which is a pretty fundamental process. What research has been undertaken to investigate the implications of climate change for downstream processors and the local economies? It strikes me that this is pretty much at the heart of the consequences of climate change on food processing and manufacturing and, of course, the growing of food itself.

Dr Ash—Yes. The answer is that relatively little has been done by us in that space. There is some effort going into looking at some of the issues around food quality as a result of, particularly, higher temperatures—what that might mean for the protein quality in cereals and for quality in other foodstuffs—and starting to at least work with other parts of CSIRO on issues in the food side of things; so Food Science Australia and our people in that space in CSIRO around the processing issues. But it is still pretty early stages.

Dr Howden—There are perhaps two examples there. One is with the sugar industry. Because it is such a tightly integrated industry, you have to deal right across the chain from the growers to the industry side of it. We have done some work on that in terms of climate change. The other is where we are working with Mars Foods to look at climate change adaptation across the value chain, but that is still in the discussion phase rather than implementation.

Mr SIDEBOTTOM—If I may just take the example of sugar—it does not affect my area but it certainly affects others here—exactly what are you doing? What have you been researching and investigating in terms of sugar in the whole food chain and the effects of climate change?

Dr Howden—In particular, that study looked at what the climate change scenarios were, what the implications were for the production side and flowing through to the transport and processing side; understanding how some adaptations such as increased irrigation might ameliorate some of the negative things and what some of the positive management actions to increase yields under high-yielding scenarios were, and starting to liaise with the industry about what were the conditions under which they might feel threatened, because if a mill closes then all of the growers in that region are significantly affected and they will have to look for alternative crops. So there are thresholds in those industries and we were trying to understand what those thresholds were and whether climate change would likely help or cause those thresholds to be crossed.

Dr Ash—On another area with sugar, it is not climate change, it is more around climate variability. There is quite a bit of work going on there in being able to use seasonal climate predictions to help not just the on-farm part of the industry but the processing end of things, around scheduling of processing and storage of sugar and transport of sugar, particularly around the forward booking of the transport of sugar by ships and things. Some of that work has been going on which goes through that value chain. Sugar is a fairly simple value chain, in that we are just processing and exporting a large quantity. When you are talking about food that makes it all the way through to the retail sector—perishable food and other types of processed foods—there is still a lot of work to be done on that.

Mr PERRETT—This is a question on behalf of Kirsten in a way. She looks after the beef capital of Australia. Your submission makes comment about some general framework around ruminants, but do you have any good news to do with ruminants or some innovations or anything that is happening out there? It seems to be a very small part of your submission.

Dr Ash—Yes, there are two. Part of the reason that it was a small part of the submission is that we were focusing on some of the adaptation options. There is a slight positive in all that: as carbon dioxide concentrations increase, plants use water more efficiently and some of the work that we have done in the north around some of the tropical pasture grasses shows that that does provide some potential advantage when we get droughts, in that they can use the water somewhat more efficiently. They also grow more effectively under high CO2, but that comes at the cost of protein quality being lower, so you have to think of some of the nutritional issues there. That is probably one of the few positives that you might get out of that. If you are talking about some of the other issues around ruminants and the emissions side of things, such as methane—which might be where you are coming from—

Mr PERRETT—Either way—coping with or mitigating the emissions.

CHAIR—Different breeds, genetics in beef cattle: I think in that industry the breeders are looking for, 'What do we do? How do we adapt? Give us some direction.'

Dr Ash—On that subject, we have already done some fantastic work in the last 50 years in tropically adapted cattle through Brahmans and Brahman crosses.

CHAIR—What are they like? Why don't they bring them out there now?

Dr Ash—In higher temperatures, yes. In other areas, particularly in dairy cattle—sorry, this is getting away from beef, but ruminants are livestock.

Mr PERRETT—That is fine, yes.

Dr Ash—With dairy cattle, there are some issues that can be addressed by shading and sprinkler systems that can be put in place to lower the temperatures, because there is a fairly direct effect of temperature on reducing milk yields. You can deal with some of that, at least with modest increases in temperature, through some technologies. So there are opportunities, but some of the risks are also significant.

Dr Keating—Around emissions mitigation, I can add the methane emissions side. We do have an active program of work on tropical beef and the emissions story in Ms Livermore's electorate in Rockhampton. We are looking at a couple of things and I will make three comments. Firstly, we are looking at the fundamental relationships between animal diet and emissions. There are some early suggestions—and I hasten to add that this is not yet peer-reviewed literature—that the emissions levels in our current accounts, which do have an extra factor in them for tropical beef, may be slightly overestimating the emissions of those tropical beef. So there is a small potential gain. I do hasten to add that these emissions and the protocols have to be internationally peer reviewed, but CSIRO is very active in making sure that we have the best data going into that, so one would hope in the near future that that material will be published and go into the peer review.

Secondly, there are some suggestions that some feed mixes may actually be reducing the methane per unit intake. There are some suggestions that leucaena as part of the diet might be having that effect. These are really early days.

CHAIR—Up or down?

Dr Keating—Down.

Dr Ash—It is a legume tree.

Dr Keating—It is a tropical leguminous shrub that is grown in Central Queensland and other regions. That is just one example. We are looking for those sorts of feed additives that may have some positives. It is very early days. Thirdly, one of the big mitigation opportunities with the northern beef herd is to raise productivity. If we can feed animals better, get offtake in a year earlier, we can have a significant impact on the methane load per unit production. So that is back into our traditional productivity research. We are very keen to ramp up that activity because of the extra benefit we would get from the methane side of it.

CHAIR—Thank you, Brian.

Mr HAASE—It is interesting that the questions that have come from my colleagues preceding this are all about the same thing. I attended a client science luncheon today and scientists, more concerned with flora and fauna in the environment and changing weather and the impact, talked about increased carbon dioxide levels and the belief that we will achieve faster growth in all plants as a result. But you made the point that the protein content is less easily fixed in a plant that is grown in a high carbon dioxide environment, due to its ability to better utilise water, and suggested that the digestive process—well, I believe this is what she suggested—

CHAIR—Photosynthesis.

Mr HAASE—was going to create a greater level of emissions as a result.

CHAIR—Something to do with more nitrogen.

Mr HAASE—I would love you to either affirm or deny it.

CHAIR—Have you got the question?

Dr Ash—Yes, I think I can respond to that one.

CHAIR—Thank you, Andrew.

Dr Ash—The issue there is—less nutritional value.

CHAIR—Order!

Dr Ash—Yes. In fact, I very briefly made that point before, from some experimental work that we did outside Townsville, where we looked at the effects of elevated CO2—carbon dioxide—levels at 460 and 550 parts per million, so the higher levels that we might expect in the future. Certainly the issue you are talking about there is that the total amount of nitrogen or protein that is taken up by the plants is still about the same but, because the plants have grown more, it is just diluted out, so the overall protein content drops quite significantly.

Mr HAASE—Per kilo of—

Dr Ash—Of forage available. That does provide then some issues for digestibility of that feed when it goes through particularly ruminants, which is mostly how that pasture resource is used.

Mr HAASE—So the veracity of that statement gets a tick from you?

Dr Ash—Yes. And particularly once you get into that environment—it is a slightly different issue—a lot of that Northern Australian country is open savanna, with a lot of intact woodland still in place, so grass and trees. One of the clear effects to emerge from that work, though, was a more significant growth response in the tree seedling compared with the grassy layer, which would suggest that we might expect trees to start dominating grasses with time. It does provide

some evidence to support what we have been observing in the last 30 or 40 years, which is vegetation thickening to a wide extent across Northern Australia.

Dr Howden—Just expanding on that slightly, I think that is right. What Andrew said is that we will get a positive response from carbon dioxide, but that response will occur mainly where there is adequate nutrition—adequate phosphorus and nitrogen—in the system. So if you are in a very nitrogen limited system, such as many sandy soils for example, you will not get that growth response.

Mr HAASE—Truly?

Dr Howden—That is right. The other element to this is that that is true in terms of animal production in the north of Australia, but in the southern parts of Australia, particularly in the more productive parts, the animals are not nitrogen limited, they are actually energy limited. So if you have higher carbon dioxide—which grows more biomass, so you grow more plant—you will actually get a production benefit from that because you are not nitrogen limited, so it is not protein limited. In those circumstances, as long as you have enough water, you will get the benefits from the carbon dioxide.

Mr HAASE—You can grow more animals, yes.

Mr WINDSOR—About seven years ago this committee had about four hours with CSIRO in Melbourne—Brian, you may have been there—and we were told that there was a requirement for $65 billion to fix the dryland salinity issue in the Murray-Darling system. We have heard nothing about that particular issue in your submission as part of climate change and productivity and agriculture and whatever. Has that issue gone away because of climate change, or has CSIRO got a different view on what that climate catastrophe for that region is going to be at the time? What has happened?

Dr Ash—Mark has done quite a bit of work there. It is a complex issue because, yes, it does relate to a drying climate and, again, elevated carbon dioxide becoming an influence over time, with salinity, which—

CHAIR—Adds to the complexity.

Dr Ash—Anyway, I will let Mark respond to that.

Dr Howden—I think the short answer, because there is a whole stack of complexities, is that where we get lower rainfall in southern Australia, particularly lower winter rainfall, we will have a decrease in the amount of water that goes below the root zone of crops or other plants and that will reduce in the long term the salinity hazard.

Mr WINDSOR—And we did not know about that seven years ago?

Dr Howden—We did, because I published a paper in 2002-03 on that, but there has not been a lot of work done on the interaction of climate change and dryland salinity apart from a few just pointing out that, if we get much lower rainfall, that risk of dryland salinity will decrease over most of Australia.

Mr WINDSOR—So CSIRO has a different view now than it did seven years ago on that dryland salinity issue in the Murray-Darling?

Dr Howden—Not in aggregate. What it is saying is that if there are significant reductions in rainfall the risk will reduce. It does not say it will go away. It just means that the processes which are driving dryland salinity will back off a bit on the accelerator. It does not make a comment on whether that will solve the problem or not.

CHAIR—There is not enough water to bring the salt up.

Mr WINDSOR—That is quite different to what CSIRO were saying seven years ago.

Dr Howden—Because climate change had not been factored into those analyses at the time.

CHAIR—He's got a memory like an elephant!

Mr FORREST—If I might just drop a little bit of information, I have been working with the Irish on that dire stuff and they have really got some advances, to the point where the minister for agriculture is thinking about some taxation incentives to help primary producers move towards that. A literary search will show up any research over there.

My question was to go beyond that to the whole issue of measurement for agriculture. It is part of the dilemma of whether agriculture is included in a trading scheme or excluded and it is a problem around the world. Are there any advances on resolving the difficulty of getting a hand on the measurement rather than just guesstimates, but towards some real research?

Dr Keating—I will have a go at that one, but Mark has got expertise here as well. I think you are probably referring to things like measurement of methane from livestock and nitrous oxide from soils and fertilisers. They are the problematic ones. They are not so problematic when we take them as a national inventory, because the methods are averaging across, but they become problematic when you try to bring them down to an individual producer.

The formal response is that this is a very active area of current analysis led by the Department of Climate Change. CSIRO science is inputting to that process. I guess the other formal response is that the reason agriculture was delayed from any decision about a CPRS or not—and I know this is all up in the air—was because of this very issue. It was recognised that there were real difficulties in getting measurements at the individual farm level and responses that could be useful in terms of greenhouse mitigation.

I have not answered your question, I know. I am just saying that this is a very active area right now. There are advances going on all the time in the scientific measurement, but it is still not, I think, within sight of bringing that down to the practical producer level in those two areas. Mark, do you want to add anything?

CHAIR—I have read that there is a laser that you can use across—

Dr Keating—Yes, that is one of the science methods, to integrate across the paddock. Yes, definitely. But the feasibility of 100,000 Australian farmers, all with their laser guns? That is not

going to be the way to go. I think the dialogue that is happening under the carriage of the Department of Climate Change at the moment, with industry input, with science agency input, is looking across all the options, including: are there some simpler options?

Mr WINDSOR—What about the potential offset of measuring soil carbon?

Dr Keating—CSIRO is actively working on improving the cost-effectiveness and the confidence in soil carbon measurement. We are making some progress in this area. We are getting good support from the Department of Agriculture, Fisheries and Forestry under that national soil carbon program I mentioned earlier. One of the elements of the progress—and it is not the whole story but it is one important element—is using a technique called mid-infrared. So this is still a laboratory technique where we scan a soil and we get a fingerprint of that soil which can be used to characterise the nature and level of the soil organic matter, the soil carbon in that soil. The benefit of that technique is twofold. First, it not only gets us a handle on the total carbon but it tells us something about the nature of that carbon: whether it is really resistant and not going to change for a very long time or whether it is very fresh and labile and is turning over very actively. That is important information when thinking about the directions of change in that soil's carbon as it might respond to management. So that is one of the recent advances which is being built on right now in the new DAFF program.

Second, the costs of that are about one-tenth of the costs of formal laboratory analysis. It is not the complete answer to opening the door to widespread soil carbon analysis but it is a very important step. It is a fundamental building block. We need to build on that in a few other areas but, certainly, with the new flagship, it is a very high priority for us.

Mr WINDSOR—What about nitrous oxide under various management practices?

Dr Keating—The measurement of nitrous oxide in a research sense can be done and has been done in a limited number of cases. Every time it is done we learn something more, of course, but we are still in the business there. The sorts of methods that are available tend to be so many per cent of fertiliser. So if you put fertiliser on a wheat crop—what is the number, Mark? I think the current national average assumption is that 0.25 per cent is the fraction lost on a dryland wheat crop. Those sorts of summaries are consistent with the limited data that we have, but they are not particularly targeted at individual farm management and they are not responsive to the sorts of management decisions that you really might want to be targeting.

Dr Howden—Just to expand on that, part of the DAFF program dealt with not only soil carbon and adaptation but also with emissions. That was particularly in methane and nitrous oxide and there were several million dollars from DAFF which went into partnering with research organisations across Australia to look at nitrous oxide and methane emissions. So there is significant investment now coming from DAFF into that and we will see the fruits of that coming out in the next few years.

One of the problems, as Dr Keating just mentioned, is that nitrous oxide is incredibly variable over time—it can vary from hour to hour and over space—so you can have a spot here which has many times more greenhouse nitrous oxide emissions than a spot here, a metre away. So it is a very difficult thing to deal with in any sort of rigorous sense. If you were trying to have a

paddock based or a farm based budget of this, you would almost have to monitor every part of your paddock.

CHAIR—And what soil is there, too.

Dr Howden—It is simply not feasible. So you have to summarise that into general relationships which say that it depends on the amount of fertiliser or the type of fertiliser, the placement of fertiliser under the soil, or how wet your soil was, or how much organic matter there was as well and, using those general relationships, we can come up with some average number for what those emissions might be.

Dr Ash—The same issues of spatial variability apply then in soil carbon too and, when you go out into extensive pastoral enterprises that in some cases are many hundreds of thousands of hectares in size, just how to sample. I think eventually we will be looking to some remote sensoring.

Dr Keating—Exactly. So as I said before, the new MIR advance is one building block. What we call the time series—remote sensoring of what the vegetation is doing over large areas over time—is another fundamental building block that we have to start building in as well.

CHAIR—And that is satellite imagery.

Dr Keating—Satellite based imagery and combining that with targeted soil sampling.

CHAIR—Global positioning—

Mr PERRETT—Is it infrared satellite as well?

Dr Keating—No. Unfortunately, with soil carbon, we do not think you can do it from a satellite. You have to get into the soil, unfortunately. It would be good if we could.

Mr PERRETT—So an aeroplane survey or—

Dr Keating—No. I think you have to get your hands dirty!

CHAIR—This is a very interesting area that is going to give us some work. Soils have hit the deck. It seems we do not know as much as maybe we thought we did. Thanks very much. We really appreciate your time and your frankness with us. We will send you a copy of the transcript when we have had it done.

Tony, would you talk to Alby about the report on the Wentworth Group of scientists that were talking about carbon stuff. Would you move that we investigate that?

Mr WINDSOR—I so move.

CHAIR—Thank you.

Resolved (on motion by **Mr Sidebottom**):

That this committee authorises publication, including publication on the parliamentary database, of the transcript of the evidence given before it at public hearing this day.

Committee adjourned at 6.16 pm