The Parliament of the Commonwealth of Australia

Farming the Future

The role of government in assisting Australian farmers to adapt to the impacts of climate change

House of Representatives
Standing Committee on Primary Industries and Resources

March 2010
Canberra

ISBN 978-0-642-79291-4 (Printed version)

ISBN 978-0-642-79292-1 (HTML version)

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"Where grows? – where grows it not?

If vain our toil – we ought to blame

The culture – not the soil"

Alexander Pope in Epistle IV, Essay on Man 1824

Among Committee members on this inquiry, there exists a broad and divergent range of views on climate change itself; this should not detract from a bipartisan recognition of the need to change farming practices for so many reasons, and recognising that a 'one size fits all' approach is not the most effective appropriate response. So there is a need for research into different farming techniques and processes.

Change in the rural sector has always been difficult; generational change was, up until recently, badly dealt with. Dad handing over at seventy to son, 50, who is sitting with the cheque book at the kitchen table, while 27 year old son waits in the wings impatiently arguing for change. How does he win against this generational culture?

I look at this way. I have lived in this country all my life and I have watched the seasons come and go. I have seen changes in the elements over the last 50 years or so. I guess it has been about 50 years since I started taking notice of climate and changes in the weather.

Growing up in the country, of course, the weather was always a subject of conversation. I have also noted that climate conditions have become more unsettled in the latter part of my time on earth. I do not know enough about the science to say that global warming is occurring, but I do feel that the climate is changing on an irregular basis and there are many reasons for it to do so. There

are some natural reasons for climate change and there are the activities of man and the animals with whom we share the earth.

Man has been able to influence and change some of the natural influences of climate through being able to harness some of our natural resources to make living in our world easier.

In order to have these basics of life, to be able to provide everyone with these commodities and to have a surplus for trade, we have manipulated their production.

If you have, as most people do, a basic understanding of chemistry, then you understand that when you add elements to the atmosphere there will be changes, some of them good and some of them not altogether desirable. With any sort of mass production there is a waste stream—emissions, if you like. That waste stream also has to be dealt with, whether by recycling it, by reusing it in some way or by disposing of it safely. We do those things a lot better than we used to, when we started mass production.

Whatever we do, and however we do it, there is an element of cost. There will always be an element of cost. If, therefore, we are trying to minimise man's effect on the earth, then there is an expense attached to it. We have been aware of that for some time.

There is the cost of dealing with waste. When people live together in high-density environments, the land cannot deal with the waste naturally. We have to intervene—to take it away, to pump it out or do something else to deal with it. This is the same with whatever product or activity we are coping with, whether it is the waste from a cheese factory or the waste from a chicken coop. We have learnt to take some of the waste from our production and turn that into a plus for us as well. This can help mitigate the costs involved with waste disposal and we can even gain from it.

Science has helped in many ways to deal with waste, whether it be by recycling it, reusing it, rendering it inert or carefully destroying it—but, whatever you do, or how careful you are, there is always a bit left over. But it does not mean that it is useless.

So in this report, we have attempted to identify all the positive things that are happening in the rural sector, to hear how people are using waste material (such as carbon) of one industry to enhance another, to work out processes for generational change and to look at government processes and how it can further assist. We looked at what new research needs to be done and how to get that information out to all those who want to improve their practices.

We are also very aware that with change comes casualties and we need to ensure that those who have just had enough can be assisted to move out and allow the younger generations to pick up the old ploughshare and turn it into a more modern tool to move this oldest of industries into the future. So we don't have to blame the culture or the soil.

My colleagues and I would like to thank the many individuals and organisations who contributed to the inquiry, particularly those whose properties we visited and who shared their ideas and aspirations. It has given us great hope for the future.

I would like to thank my Deputy Chair Alby Schultz and the rest of the Committee for their dedication and support on this inquiry, it has been a pleasure to work with them.

Finally the Committee Members and I would also like to thank the Committee Secretariat, Julia Morris, Dr Bill Pender and Dr Deborah King and their administrative support, Kane and Tarran, for their hard work especially over the Christmas period, to produce this report.

The Hon Dick Adams MP
Chair

Membership of the Committee

Chair The Hon Dick Adams MP

Deputy Chair Mr Alby Schultz MP

Members

Mr James Bidgood MP
Mr Nick Champion MP
Mr John Forrest MP
Mr Barry Haase MP
Ms Kirsten Livermore MP
Mr Graham Perrett MP
Mr Sid Sidebottom MP
Mr Tony Windsor MP

Committee Secretariat

Secretary	Ms Julia Morris
Inquiry Secretary	Dr Bill Pender
Research Officer	Dr Deborah King
Administrative Officers	Ms Kane Moir
	Ms Tarran Snape

Terms of reference

The Committee to inquire into and report upon:

- 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.

List of abbreviations

Acronyms

ACCESS	Australian Community Climate and Earth Systems Simulator
AFF	Australia's Farming Future
AIAST	Australian Institute of Agricultural Science and Technology
AMOS	Australian Meteorological and Oceanographic Society
ANU	Australian National University
APL	Australian Pork Limited
AWI	Australian Wool Innovation
BoM	Bureau of Meteorology
CAAANZ	Conservation Agriculture Alliance of Australia and New Zealand
CAWCR	Centre for Australian Weather and Climate Research
CCRSPI	Climate Change Research Strategy of Primary Industries
CMA	Catchment Management Authority
CORS	Continuously operating reference station
CPRS	Carbon Pollution Reduction Scheme
CRC	Cooperative Research Centre

CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTF	Controlled Traffic Farming
DAFF	Department of Agriculture, Fisheries and Forestry
DCC	Department of Climate Change
DERM	Queensland Department of Environment and Resource Management
EC	Exceptional circumstance
FFI CRC	Future Farm Industries Cooperative Research Centre
GPS	Global positioning satellite
GRDC	Grains Research & Development Corporation
HM	Holistic Management
IPCC	Intergovernmental Panel on Climate Change
MLA	Meat & Livestock Australia
MFS	Monaro Farming Systems
MSF	Mallee Sustainable Farming
NAFI	National Association of Forest Industries
NARP	National Adaptation Research Plans
NCCAR	National Climate Change Adaptation Research
NCCARF	National Climate Change Adaptation Framework
NFF	National Farmers Federation
NRP	National Research Priorities
OAN	Otway Agroforestry Network
PIARN	Primary Industries Adaptation Research Network
PIMC	Primary Industries Ministerial Council

PIRSA	Department of Primary Industries and Resources South Australia
PISC	Primary Industries Standing Committee
POAMA	Predictive Ocean Atmosphere Model for Australia
QCCCE	Queensland Climate Change Centre of Excellence
RDCs	Research and development corporations
RFA	Regional Forest Agreement
RIRDC	Rural Industries Research and Development Corporation
RTK	Real Time Kinematic
SARDI	South Australian Research and Development Institute
SCF	Seasonal Climate Forecasts
SOI	Southern Oscillation Index
SWCCF	South West Climate Change Forum
TCFA	Tasmanian Community Forestry Agreement
TIAR	Tasmanian Institute of Agricultural Research
VFF	Victorian Farmers Federation

Glossary

bio-alcohol	Methanol, ethanol
biochar	Charcoal created by pyrolysis of biomass.
bioenergy	Bioenergy is renewable energy made available from materials derived from biological sources.
biofuel	Fuel made from plant matter rather than fossil fuels.
biomass	Renewable organic matter such as agricultural crops and residue, wood and wood waste, animal waste, aquatic plants and organic components of municipal and industrial wastes.
bio-oil	A liquid fuel produced by the pyrolysis of biomass.
broadacre	An Australian term used to describe land suitable for farms practicing large-scale agricultural operations.
CO_2	Carbon dioxide. A gas present in the atmosphere which plays an important role in the greenhouse effect.[1]
climate	The atmospheric conditions for a long period of time, and generally refers to the normal or mean course of the weather. Includes the future expectation of long term weather, in the order of weeks, months or years ahead.[2]
controlled traffic farming	A farming practice where all machinery used in crop production is restricted to permanently located wheel tracks.
el Niño southern oscillation (ENSO)	'El Niño' used here refers to the warming of the oceans in the equatorial eastern and central Pacific; Southern Oscillation is the changes in atmospheric pressure (and climate systems) associated with this warming (hence 'Southern Oscillation Index' to measure these changes). 'ENSO' is used colloquially to describe the whole suite of changes associated with an 'El Niño' event - to rainfall, oceans, atmospheric pressure etc.[3]

1 http://www.bom.gov.au/lam/glossary/
2 http://www.bom.gov.au/lam/glossary/
3 http://www.bom.gov.au/lam/glossary/

feedstock (bioenergy)	The raw material that is processed to create bioenergy, biochar and other bio products.
greenhouse gases	Components of the atmosphere that contribute to the greenhouse effect. The gasses of particular interest to agriculture include carbon dioxide, methane and nitrous oxide.
holistic management	A framework for on-farm decision making that explicitly considers a set of goals, and a set of tools to achieve these goals. Goals might relate to farm profits, but also to other aspects that enhance the quality of human life. 'Holistic' decision making involves the careful and systematic assessment of the various goals deemed important by a given farmer.
lignite	A form of coal between the development of peat and black coal, brownish-black and woody in appearance with a high moisture content.
lignocellulose	The combination of lignin and cellulose in the structural cells of woody plants.
minimum tillage (min till)	Minimum tillage cropping is a conservation farming system, which may encompass reduced tillage, direct drilling and zero tillage. It minimises soil disturbance and retains crop residues when sowing.[4]
mycorrhizae	The symbiotic association of beneficial fungi with the small roots of some plants. Mycorrhizae may improve the water and nutrient uptake of trees, especially of immobile nutrients such as phosphorus.
nitrous oxide	One of the greenhouse gases. Substantial emissions stem from agriculture and fossil fuel combustion.
no till	One pass seeding with points creating less than 20% soil disturbance.[5]
perennial	A plant which continues to grow year to year.
pyrolysis	The decomposition of organic matter by heating without oxygen.

4 http://www.vicnotill.com.au/notilldefinition.htm

5 http://www.vicnotill.com.au/notilldefinition.htm

soil carbon	The generic name for carbon held within the soil.
southern oscillation index	The Southern Oscillation Index (SOI) is calculated from the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin.
weather	A description of conditions over a short period of time - a 'snap shot' of the atmosphere at a particular time.[6]
zero till	One pass sowing system using discs for minimal soil disturbance.[7]

6 http://www.bom.gov.au/lam/glossary/

7 http://www.vicnotill.com.au/notilldefinition.htm

List of recommendations

2 Making Decisions On-farm

Recommendation 1

The Committee recommends that the Australian Government support rural counselling and support groups, such as Rural Alive and Well, and place funding for such groups on a permanent and regular basis.

Recommendation 2

The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, take more effective account of the needs and decision making processes of farmers and ensure that the delivery of adaptation programs is flexible and responsive to the needs of farmers and rural communities.

3 Current and Prospective Adaptations

Recommendation 3

The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, invest research funding in the following high priority areas:

- Soil carbon sequestration;
- Soil stabilisation and pasture improvements using methods such as perennial pastures, pasture cropping, rotational grazing, biodynamic farming, minimum/no till cultivation and controlled traffic farming;
- Soil water retention strategies and water use efficiency;
- Landscape planning and natural resource management; and
- Risk management.

Recommendation 4

The Committee recommends that the Australian Government, in conjunction with State and Territory Governments, establish a national Continuously Operating Reference Station network across Australia and regulate for signal compatibility between different GPS systems.

Recommendation 5

The Committee recommends that the Australian Government support further research efforts into the mitigation of greenhouse gas emissions from agriculture.

4 Energy on farms

Recommendation 6

The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, increase its investment and support for research into energy efficiency in the agriculture sector and the development of alternative energy and alternative fuels on-farm, particularly in regard to:

- Biofuels;
- Biomass from agricultural waste; and
- Biochar.

5 Climate modelling and weather forecasting

Recommendation 7

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

Recommendation 8

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

6 Research and extension

Recommendation 9

The Committee recommends that the Australian Government maintain its commitment to climate change research pertaining to Australia's agricultural industries, ensuring that the funding is committed, sustained and pays due attention to regional as well as national needs and priorities. Climate change research must reflect the changes affecting different regions, soils and topography—as all have an impact on changes in farming practices to deal with them.

Recommendation 10

The Committee recommends that the Australian Government, as part of its ongoing strategy development to issues affecting agriculture and climate change, develop a strategy to capture, evaluate and disseminate the range of farmer driven innovations that have a significant capacity to increase the resilience and productivity of farm enterprises.

Recommendation 11

The Committee recommends that the Australian Government ensures that there is an overall body to receive and analyse research and co-ordinate research across the nation in relation to climate change adaptation in agriculture, and that said body is given the necessary resources of staff and funds to carry out its role.

Recommendation 12

The Committee recommends that the Australian Government give greater consideration to better integration of local and regional organisations into its overall response to the issues affecting agriculture and climate change, and provide additional funding to support the management role of these local and regional organisations.

7 Role of Government

Recommendation 13

The Committee recommends that the Australian Government give further consideration to the analysis of government policy and outcomes in the submission to the current inquiry made by the Future Farm Industries CRC, with a view to ensuring the better coordination of research and extension efforts and the delivery of effective policy outcomes.

Recommendation 14

The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, explore further opportunities to facilitate adaptation to climate variability and climate change through the use of targeted, industry and issue specific, incentives.

Recommendation 15

The Committee recommends that the Australian Government place funding for local and community organisations engaged in the work of supporting farmers in adapting to climate variability and climate change upon a permanent and regular basis.

1

Introduction

1.1 In February 2009, the House of Representatives Standing Committee on Primary Industries and Resources commenced its inquiry into Australian farmers and climate change.

1.2 The focus of the inquiry has always been on the practical actions and outcomes that farmers, communities and governments can undertake to deal with the actual and potential challenges of climate variability and climate change.

1.3 A recurring theme of the evidence presented to the Committee has been the adaptability of farmers in the face of Australia's extremes of climate variability. Many of the adaptations to meet the challenge of climate variability will also assist the adaptation to climate change.

1.4 The report has been structured to illustrate the principal issues brought to the attention of the Committee. Debate on the incidence and impact of climate change has attracted a great deal of attention in the Parliament, the government, and the media during the course of the inquiry. It is a contentious and potentially divisive issue in many minds. Even amongst evidence received by the Committee, there was no single definition offered, and in significant ways the debate on climate change science detracts from the very real challenges farmers are facing.

1.5 The Committee found that issues farmers are managing on a daily basis are dealt with in countless different ways, and that any discussion of farmers' methods of adapting to climate variability inevitably hinges on different attitudes and decision making processes. Therefore, before consideration of specific aspects of on-farm responses to climate variability, the Committee examines those social impacts of managing **any kind** of change. Chapter 2 therefore examines the recognition that response to climate change must start with people and communities, not just practices and technology.

1.6 Chapter 3 gives an overview of the many practical adaptations to climate variability and climate change that have been brought to the attention of the Committee.

1.7 Chapter 4 looks at the issue of energy consumption and production on-farm, the capacity to reduce agricultural greenhouse gas emissions and the capacity of the sector to contribute to the overall mitigation effort.

1.8 Chapter 5 examines the need for better weather and climate forecasting, and the potential to deliver same.

1.9 Chapter 6 looks at the research and extension effort, especially the need to ensure ongoing investment into research that assists farmers to meet the challenges of climate variability and climate change, extension services that give effect to this research, and a high level of coordination of the research effort.

1.10 Chapter 7 examines the overall role of government in supporting adaptation.

2

Making decisions on-farm

'*We know we need to change…*'[1]

2.1 The evidence received by the Committee during the course of its inquiry into farmers and climate change incontrovertibly demonstrated that climate variability and climate change have the potential to have significant impacts on farming communities from a social and psychological point of view, and that adaptation is a psychological and social process as much as a physical and economic process. The need to understand the potential social and psychological impacts—and mitigate those impacts—and to understand the thought processes, social pressures and attitudes that both hinder and promote adaptation, are essential parts of the response to climate variability and climate change for industry and government alike.

Managing social impacts

2.2 The Committee has received evidence highlighting the potential impacts of climate change upon farming families and rural communities. The economic and environmental impacts of climate change will create significant social and psychological stresses which need to be anticipated and effectively managed.

2.3 In its submission to the inquiry, Mallee Sustainable Farming stated:

> The impacts of climate change will have significant impact on farming and farming communities in the low rainfall cropping

1 Dr Christine Jones, *Transcript of Evidence*, 24 June 2009, p. 20.

> areas of Australia. Small changes in climate can lead to large impacts on the environment and our industry and the need for rapid adaptation to change will be paramount to maintain social sustainability.[2]

2.4 Likewise, in its submission, the Victorian Farmers Federation (VFF) noted that:

> It is likely that existing problems such as depression and isolation will be exacerbated by the impacts of a changed climate, especially increased drought and disaster events such as floods [and] fire.[3]

2.5 The VFF further noted that these stresses were likely to be exacerbated by the impact of the current drought on rural communities, stating that:

> The resilience of rural communities has been worn down over the recent years of drought, and their capacity to adapt to further stress is greatly reduced.[4]

2.6 In evidence before the Committee, Mr Graeme Ford highlighted the impact that drought was already having in terms of creating a sense of social and personal isolation in rural communities:

> We have noticed from some of the responses in the 12 years of drought that farmers and farm families in very difficult circumstances actually stop talking to people; they retreat behind the farm gate, rather than reaching out. These are the areas that we need to start to reach to. We need to get behind the farm gate to the people who have withdrawn into their own business and not looking at where they need to be. That is a difficult challenge.[5]

2.7 Dr Rowan O'Hagan, of Australian Women in Agriculture, also emphasised that the adjustments already faced by farmers and rural communities were placing many under unprecedented strain:

> I would say that, probably up until a couple of years ago, people thought about adapting by making these incremental changes: different varieties, different stocking rates and working on water conservation techniques. But it is at the point now where there has been a huge jump in where we have to adapt. People have gone from irrigation, with huge infrastructure and capital investment, to dry-land agriculture overnight, basically. That is a huge shift.

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2 Mallee Sustainable Farming Inc, Submission no. 31, p. 1.

3 Victorian Farmers Federation, Submission no. 33, p. 7.

4 Victorian Farmers Federation, Submission no. 33, p. 7.

5 Mr Graeme Ford, Victorian Farmers Federation, *Transcript of Evidence*, 3 September 2009, p. 5.

> You cannot just say, 'Well, I'm going to grow a slightly different variety of wheat,' for example; you have to make a complete change or get out. That is all very well, but then we must look also at the social impact of that on those regions.
>
> I think the reality has only just started to hit home in the last couple of years and the percentage of people who are deciding, 'Well, this is climate change,' is actually increasing now; so it has tipped over. We are dealing with a lot of pain also in terms of the psychological fallout of massive change across the board—not only in your livelihood but in your community and the broader community. So the whole of Australia is dealing with water scarcity and the whole of the world is dealing with climate change. It is a lot to take on in a short period of time.[6]

2.8 Mr Ford highlighted the need for making production more efficient and to develop and diversify the economies of rural communities as part of managing the impacts of climate change:

> We generally perceive the impact [of] climate change as being an impact on production. Obviously you will see a decline if what we fear is true for the weather systems, which means there will be less economic activity in rural areas and less money, which makes it difficult to sustain a population. Therefore, to sustain the population you would need to either compensate for the changes in climate by being able to make more efficient production systems or you have to find some other way of diversifying the economies in rural areas. We probably think it is a mix of both, so we would like to see a very strong focus on regional development and to start to see some efforts put into diversifying those rural economies. That will be difficult.[7]

2.9 He also highlighted the role of government in developing community capacity providing support services to individuals and communities as part of the process of adjustment:

> The other side of risk management is having a capacity in the community to deal with these variations... It is not a simple decision for a farmer to leave the land; it is perhaps much more complex than someone choosing to leave a milk bar in a capital

6 Dr Rowan O'Hagan, Australian Women in Agriculture Ltd, *Transcript of Evidence*, 3 September 2009, pp. 85-6.

7 Mr Graeme Ford, Victoria Farmers Federation, *Transcript of Evidence*, 3 September 2009, pp. 4–5.

> city. It has often been their family home for generations and their whole identity is tied up in it. They believe that they have probably got very few skills to do something else. It is not just about selling a business; it is actually selling their whole life and moving to a different life. I think we see that farm families in general do attempt to hang on to businesses that perhaps they would be better served being out of. How we facilitate that is the real crux. How do we assist people to make those decisions? We cannot force people to sell their assets and we would not want to see that at all, but obviously bringing people to those decision points is a task that the government services like counselling services and outreach workers could assist with.[8]

2.10 Dr Nigel Wilhelm, representing the Australian Institute of Agricultural Science and Technology (AAIAST), made a similar point in evidence to the Committee:

> … that is one of the almost unique features of the agriculture industry, where the home and the business are so closely linked and are in fact often the same entity. That of course makes business adjustment much more difficult and the emotional stakes far higher. I guess that is about the adjustment schemes and support schemes. It is hard to separate the business operation from the social side of things. That is the dislocate we need to make. The businesses will adjust; it is softening the social impact, and the government has the best role.[9]

2.11 The importance of rural counselling services to the process of adjustment and adaptation was emphasised by Ms Elaine Paton, past president of Australian Women in Agriculture, who told the Committee:

> There are things like rural counsellors—we are talking about financial and emotional stress—and knowing that the financial counselling service is ongoing is really essential to the security of families who need that service to help them and work with them to come to the decision they need to make.[10]

2.12 In her evidence, Ms Karlie Tucker, senior consultant with the RM Consulting Group, highlighted the importance of peer support and peer-to-peer interaction. She stated:

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8 Mr Graeme Ford, Victorian Farmers Federation, *Transcript of Evidence*, 3 September 2009, p. 5.

9 Dr Nigel Wilhelm, AIAST, *Transcript of Evidence*, 18 November 2009, pp. 3-4.

10 Ms Elaine Paton, Australian Women in Agriculture Ltd, *Transcript of Evidence*, 3 September 2009, p. 87.

> That is where I think the peer-to-peer stuff is really important, because of the similar experiences going on. Helping each other with how you manage through it has been really important. There have been some fantastic examples of getting farmers together just to talk about what is going on and how they are managing through it and, if they are not managing through it, then actually getting in there and intervening. Peers are often a stronger help because of the social way that farmers are, more so than perhaps a rural counselling service.[11]

Committee members meeting with representatives of Rural Alive and Well, Melton Mowbray, Tasmania

2.13 The importance of rural counselling services and support networks was brought home to the Committee during inspections in both Tasmania and Western Australia.

2.14 In Tasmania, the Committee met with members of Rural Alive and Well, a support and counselling service based at Melton Mowbray. They explained to the Committee the importance of reaching out to vulnerable members of the rural community and providing support. A key role of the

11 Ms Karlie Tucker, RM Consulting Group, *Transcript of Evidence*, 3 September 2009, p. 63.

service was to make connections with the support services provided by government, and help people access those services. One problem the service faced was the silo mentality of governments and bureaucracies; another was the lack of secure funding for the service they provided. The essential ingredient of the service they provided was intervention and building personal connections, giving people a sense that they were not facing the trials and tribulations of life alone.

2.15 The consequences of such an approach were highlighted at a meeting with departmental officials and farmer representatives at Geraldton in Western Australia. The creation of strong social support networks in the region, involving strong peer support and a pre-emptive strategy, had allowed the farming community to get through a period of severe drought in 2006–07 without one instance of suicide.

2.16 In its submission, the Climate Change Research Strategy of Primary Industries network (CCRSPI) noted the likelihood of significant social impacts on rural communities and the need for government intervention to assist rural communities to adapt. Its submission stated:

> Significant social pressures will accompany the economic and biophysical impacts of climate change on primary industry—especially when the changes in primary production flow onto labour-intensive primary processing and service industries. Government has a clear role in assisting individuals and communities to adapt to the socio-economic impacts of climate change.[12]

2.17 This would require social research and analysis, and decision making process which went beyond simple cost/benefit analyses:

> Social analysis is required to consider the impacts of climate change on rural communities and to better target government's social spending in these communities (Drought Policy Review Expert Social Panel 2008).
>
> Decision analysis, which extends beyond simplistic cost benefit analysis, is required to assist government in considering the economic, environmental and social trade offs associated with policy choices and the community strategies and tactics to adapt to climate change.[13]

12 CCRSPI, Submission no. 10, p. 4.

13 CCRSPI, Submission no. 10, p. 13.

2.18 In its submission, Dairy Australia also pointed to the need to create resilient local communities, with strong social and knowledge networks, to manage the impacts of, and adaptation to, climate change:

> Resilient farms support local communities, but equally, resilient local communities make it easier for farmers to adjust. To support local action we need a better understanding of the factors operating at a community and social level that enhance resilience. We can develop resilient systems but these systems will break down if the social and knowledge networks supporting them break down. Implementing activities that support local action and local knowledge networks are more likely to deliver sustainable improvements/sustainable adaptation to climate change than generic industry activities.[14]

Committee conclusions

2.19 It is the Committee's view that strong local networks—supporting farmers and their families, providing access to services and information, and providing connections that allow problems to be identified and addressed before they become unmanageable—are a vital part of the response to climate change in rural Australia. The evidence taken by the Committee in Western Australia and Tasmania demonstrates the value of intervention services. The Committee is very much of the view that such services should continue and be supported by Government. In particular, the Committee was impressed with the work of Rural Alive and Well in Tasmania, and believes this organisation, and others like it, should receive long term support.

Recommendation 1

2.20 **The Committee recommends that the Australian Government support rural counselling and support groups, such as Rural Alive and Well, and place funding for such groups on a permanent and regular basis.**

14 Dairy Australia, Submission no. 12, p. 7.

Managing social change

2.21 Managing social impacts is one aspect of the adaptation equation; another is managing social change—identifying social and attitudinal barriers to climate change adaptation and the most effective ways of encouraging a positive response.

2.22 One aspect of the role of government in promoting adaptation to climate change which was raised regularly throughout the inquiry was the need to get a clear and consistent message through to farmers and industries about climate change. In its submission, the South Australian Farmers Federation stressed the need for a consistent message on climate change:

> Government has a role in the provision of consistent messages around climate change. Presently there are very mixed messages about climate change and its potential impacts for Australia from a range of sources—within Governments and outside of Government. This makes it very difficult for industry and individual farmers to interpret and develop strategies to reduce or address the impacts of climate change.[15]

2.23 In its submission, Australian Women in Agriculture also highlighted the need for a clear and consistent message on climate change:

> The accumulating scientific data indicates that significant action is required on climate change, on an accelerated basis, for both adaptation and mitigation. The major social change this will require demands unequivocal leadership and a clear consistent message from government at all levels. Any gaps between government response to climate change and the need for action on climate change leads to uncertainty for the community and business, with consequent higher future costs, lost opportunities and frustration.[16]

2.24 Dr Rowan O'Hagan, representing Australian Women in Agriculture, extended this to a clear and consistent articulation of Government responses to climate change, particularly the Carbon Pollution Reduction Scheme:

> The first thing I want to raise is about looking at the bigger picture or, as I tend to think of it, the macro picture, which is how farmers will operate under the regulatory system that will pertain under

15 South Australian Farmers Federation, Submission no. 21, p. 4.

16 Australian Women in Agriculture, Submission no. 56, p. 1.

> the CPRS. Under the CPRS, as well as being constrained by production types of activities, farmers will be working in a slightly different environment. One of the issues with that, which is very important, is that the community be given clear and consistent messages about climate change and the need for the CPRS and how it will affect agriculture. At the moment it is very confusing and inconsistent. When you are trying to win the battle for the hearts and minds of people in relation to adapting to climate change and managing under that different environment, it is very important that misinformation or confusing information is not out there.[17]

2.25 Mrs Aysha Fleming, a social researcher with the Tasmanian Institute of Agricultural Research (TIAR), also told the Committee that:

> I think that because it is an area that there is quite a widespread range of emotions about it is quite important that the government has a really clear message about where they stand so that people can respond to that and everyone is on the same page, so to speak, about where the government are. On top of that, it is really important that there is appropriate funding and that it is quite clearly available so that people know how they can begin to act and where the support is.[18]

Understanding decision making processes

2.26 The key to managing climate change adaptation is identifying the social, psychological, institutional and financial barriers to adaptation.

2.27 In their submission to the inquiry, social researchers Professor Frank Vanclay and Mrs Aysha Fleming identified a number of the social and attitudinal barriers to climate change adaptation:

> Resistance to change is not just about individual reactions, it is a broader social issue. This means that resistance does not occur within an individual's head, or because of an individual's personal characteristics—education level, personal motivations or situation, skills or beliefs. Resistance is created by common perceptions, norms and values held in society. In our society currently, resistance is being created because climate change is perceived as being:

17 Dr Rowan O'Hagan, Australian Women in Agriculture, *Transcript of Evidence*, 3 September 2009, p. 82.

18 Mrs Aysha Fleming, TIAR, *Transcript of Evidence*, 21 September 2009, p. 10.

- 'just' another environmental or global threat,
- too big to influence,
- an unmanageable and inequitable financial burden, and;
- too uncertain to warrant major action.

If climate change is seen as yet another environmental or global threat like pollution or the hole in the ozone layer, it is common to place blame elsewhere, for example on other industries (e.g. energy, transport) or other countries (e.g. China, India). It is also common to wait for a technological solution that will have relatively little personal effect (e.g. banning CFCs). Climate change is not currently perceived by farmers as something sufficiently urgent to warrant drastic changes in their lifestyle or farm practices.

If climate change is perceived as being too big to influence, because climate is something intangible, invisible and seemingly out of human control, it can lead to rejection. Climate change is dismissed outright, and can lead to feeling overwhelmed or hopeless.

Mitigation of climate change is seen by many farmers as a financial burden, rather than an opportunity. This can create anger and stress, because profit margins are further reduced and farmers risk viability. As a result, cost-cutting measures that are even more harmful to the environment may be utilised. There are potential financial benefits in acting now in response to climate change, but these are not widely recognised.[19]

2.28 In evidence before the Committee, Mrs Fleming emphasised the importance of government understanding the range of pressures faced by farmers in response to climate change, and that government needed to respond to those pressures:

> I would like to summarise the key findings of my research and then emphasise three points for your consideration. As part of my PhD I interviewed 63 farmers from the dairy and apple industries in Tasmania about their thoughts on climate change. I ask them number of open questions and found that there is a wide range of understandings of climate change, a great deal of confusion about how to act, and a fair amount of distrust about climate information and programs such as the Carbon Pollution Reduction Scheme.

19 Professor Frank Vanclay and Mrs Aysha Fleming, TIAR, Submission no. 2, p. 3.

> The first point from my research that I wish to emphasise for the committee to consider is that understandings of climate change are not related to factors of age, education, level of income, farming industry or so on, but rather values, beliefs and ideas about farming. This means that climate change is understood by farmers in a range of ways based on their own personal world views. This needs to be both acknowledged and encouraged.
>
> The second point I wish to emphasise is that need for government to work with farmers to develop a local level social understanding of climate change—that is, involving farmers in the creation of their own information about climate change is more useful than with providing them with external, expert information. Finding appropriate extension and planning infrastructure, for example, is important. The Climate Futures for Tasmania project—and I have some information about that here, which I can provide to you—is an example of local level information about climate projections. This local level information could be useful in a process of working together with farmers to develop strategies of adaptation.
>
> Thirdly, it is important that farmers are supported by the government in the process of adapting to climate change. However, everyone in the wider community will also need to act, so it is necessary that farmers see their involvement as part of a wider social program. Otherwise they may feel unfairly targeted or burdened. [20]

2.29 Professor Vanclay also reminded the Committee that the diversity within the farming community, the individual nature of responses to climate change, required a diversity of solutions—that there is no single universal response to climate change:

> I think something that is a little bit understated is that there is not just one type of farmer. We need to consciously remind ourselves of the diversity of farmers and the different ways in which farmers pitch their business strategies, the different values they have around what they are trying to achieve on their farms and the different ways that they engage with information... What that means for promoting change in relation to any issue, whether it is climate change or anything else, is that there is no one solution that will work for everyone. We need to be aware of the diversity that exists and to tailor the message about the change we are

20 Mrs Aysha Fleming, TIAR, *Transcript of Evidence*, 21 September 2009, pp. 9–10.

> trying to achieve in terms of the different discourses. In fact, one of the unstated things in Aysha's presentation is that she is using a discourse methodology to study her farmers, and her conclusion in her PhD is that, by identifying the different discourses that farmers operate in and targeting extension along those different discourses, more change will be able to be effected.[21]

2.30 In its submission, the RM Consulting Group highlighted research into the decision making processes undertaken by farmers in response to climate change, and the need for policy makers and advisors to take this into account:

> The complexity of decision making in mixed farming systems … means that rational approaches such as cost-benefit analyses need to be complemented with 'non rational' tools such as gut feel or intuition. A farmer's decision may be in response to a mix of financial, management and social reasons that cannot easily be captured in a tool, making it less useful to and less used by farmers. This is reflected in the range of responses from farmers interviewed as part of the 'Grain and Graze' project which can be summarised as:
>
> - The tools to make decisions are either not well understood or are not adequate to make complex mixed farming decisions.
> - Because the decisions are complex and have many unknown variables and risks, a detailed assessment of the costs and returns is considered of little value.
>
> Rather, this research suggested mixed farmers decisions are driven by four main factors:
>
> - hassle reduction—the desire to keep a system simple and avoid complexity
> - labour—the desire to use labour more efficiently and the ability to find it when required
> - recreation—the desire to find time for recreation
> - personal preference—the desire for a system that (predominantly) consists of the enterprises a farmer enjoys.
>
> Additionally, research suggests that farmers draw on many sources of advice and guidance from both the public, private and community sectors. There particularly seems to be a trend amongst 'leading' farmers to operate their businesses in a 'CEO' mode, with them outsourcing the multiple areas of specialised advice they do not have the time or ability to become expert in

21 Professor Frank Vanclay, TIAR, *Transcript of Evidence*, 21 September 2009, p. 15.

> (McGuckian 2007). 'Teams' of experts are needed to support such farmers in making decisions in the complex environment they operate within.[22]

2.31 Ms Karlie Tucker expanded on the decision making process and its implications in evidence before the Committee:

> There is the idea that there are five or six different levels on which farmers are making decisions. The first one is the farm production level and then there is the non-production elements of the farm business, the non-farm elements of the family business, non-business elements of farming, and then the wider rural community. A decision that they make in the production elements is influenced by all of these. An example that we have used in the past is the decision, especially amongst mixed farm[s], to run more or less stock. That has a whole lot of production implications on farm. It also has implications for whether that farming family can go on holidays at certain times of the year. If they run more stock, they cannot. It also has implications for their involvement in the wider community…
>
> A decision on farm will be influenced by all of these factors. The social factor has a couple of aspects. There is what is available as far as services in rural communities. If schools are closing down it is less likely that the farming family is going to want to stay there, and it makes it harder to maintain a business if they do not want to be there. There are also those decisions about how it influences their ability to take holidays and other things. Also, there is the desire within farming families to return to the farm and to continue farming. There are great impacts on whether they want to stay there and be involved.[23]

2.32 A similar view of risk and decision making was revealed in a study conducted by the School of Earth and Environmental Sciences at the University of Wollongong. The major findings of the study suggested that:

> 1) risk management varies widely amongst farmers which impacts how they deal with climate risk;
>
> 2) individual risk management strategies, while conscious of global processes, are embedded in the everyday lives of farmers; and,

22 RM Consulting Group, Submission no. 29, p. 4.

23 Ms Karlie Tucker, RM Consulting Group, *Transcript of Evidence*, 3 September 2009, p. 58.

> 3) regardless of individual belief in climate change, climate risks are managed within an array, not separate to other risks.[24]

2.33 Dr Alison Gates, a research fellow with the School of Earth and Environmental Sciences at the University of Wollongong, expanded on the findings of the study:

> In terms of looking at what we can really learn from the study that we have done, climate is one—albeit an important one—of a series of risks that farmers deal with on-farm. That is the way it has emerged in the conversations that we have had with farmers—that it is a risk. We have been really interested in gauging the range of responses to that risk. Our results talk about a group of very reactive farmers, who react to the risk, are relatively unprepared and do not have high levels of resilience, and the group of traits that go with that set of more reactive farmers. And then our results talk about the strategic farmers, who have a much more strategic approach to dealing with that risk and see that as part of their business.[25]

2.34 Dr Gates highlighted two aspects of the study. Firstly, that the farmer was the relevant unit of viability in the study, which shifts the emphasis from commodities, industries or issues to farmers, their families and their communities. She stated:

> So, rather than saying: 'In terms of climate change we are going to go out and study wheat' or 'In terms of climate change we are going to go out and study commodity prices or soil type, these small elements of the many dimensions of farming', we say that the relevant unit of viability for our study is the farmer and the farming family. That then incorporates all of those scientific understandings that the farmer has about soil and water and the elements of the farm but also about the social dimensions of the farmer and his or her lifestyle, family, and social and cultural connections to the place where they are farming.[26]

2.35 The second point highlighted by Dr Gates was the highly individualistic nature of decision making amongst farmers:

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24 School of Earth and Environmental Sciences, University of Wollongong, Submission no. 24, p. 2.

25 Dr Alison Gates, School of Earth and Environmental Sciences, University of Wollongong, *Transcript of Evidence*, 1 July 2009, p. 42.

26 Dr Alison Gates, School of Earth and Environmental Sciences, University of Wollongong, *Transcript of Evidence*, 1 July 2009, p. 43.

> There is a lot of room for personality in farming… If you give two people the same scenario—their neighbours, microclimate and soil are almost exactly the same—those two different people with different make-ups will do two entirely different things. Both might be successful at what they do or one might not. I think that the approach that each individual takes is based a lot on personality and personal preference. Even if we could come to an agreement about a standard method for forecasting, for example, I am not sure that necessarily both or either of those farmers would take it on because they have their own way of looking at the sky and understanding the place where they work. One of the things I have taken from the study is just how much intrinsic environmental knowledge these farmers have of the places where they farm. They know their country better than anybody else. There is as much to be learnt from them about how to predict and manage and look at those landscapes as there is to learn from outside and to bring to them.[27]

2.36 In their submission, Professor Vanclay and Mrs Fleming drew clear implications for policy development from the results of their study:

> Our research suggests that although the majority of farmers believe that climate change is occurring, there is widespread confusion about its causes, and they are not necessarily convinced by the suggested need for urgent adaptation and mitigation. As a result, we believe that:
>
> 1. there is an on-going need for clear statements that the science is decided and the government will act on climate change;
>
> 2. there is a need for more research into the beneficial actions agricultural industries can take, and active extension of this information to farmers. However, more than just information is necessary. Support for farmers to implement actions and to work together is needed. This needs to include financial incentives, opportunities for building social networks, collaborations, recognition and rewards;
>
> 3. finally, the social value farmers hold and exercise as 'stewards of the land' needs to be recognised and encouraged.[28]

27 Dr Alison Gates, School of Earth and Environmental Sciences, University of Wollongong, *Transcript of Evidence*, 1 July 2009, p. 48.

28 Professor Frank Vanclay and Mrs Aysha Fleming, TIAR, Submission no. 2, p. 4.

2.37 Ms Tucker, in evidence before the Committee, emphasised the importance of providing information and market signals as a way of managing change, but also letting farmers make decisions about what is right for them:

> I think farmers are amazingly market based. They respond very well to market signals and to information. I think the biggest thing with farmers is always information. They will make the best decisions possible for themselves. As we said, the decision-making environment they are in is very complex. I do not think anyone other than them can say what the right decision is. They need to have the suite of information and then be able to make that decision for themselves.[29]

2.38 In its submission to the inquiry, CSIRO pointed to the complex array of factors that will influence responses to climate change on a global scale with which governments and producers would have to contend:

> Climate change will therefore impact Australian agriculture against a backdrop of constant economic and social change, and these impacts will occur at multiple scales. Most fundamentally, climate change will affect the relative productivity of alternative land uses, as changes in rainfall and temperature differentially impact different types of crop and livestock. The viability and vulnerability of alternative agricultural land uses will also depend on the effect of climate change on world prices, as climate changes affects the relative productivity of Australia's trading partners and competitors. All of these changes will take place against a changing institutional context, including changes in greenhouse mitigation policy such as carbon trading schemes.[30]

2.39 CSIRO also highlighted the complex array of factors which will influence adaptation domestically and the approaches that will be required to overcome them:

> There is clearly a strong case for investing in adaptation responses. However, there is often an assumption that governments, industries and individual landholders have the capacity to implement adaptation options where in reality there are attitudinal, social, behavioural, institutional or environmental barriers to adopting adaptation measures. Howden et al. (2007) has suggested a number of approaches to overcome these barriers

29 Ms Karlie Tucker, RM Consulting Group, *Transcript of Evidence*, 3 September 2009, p. 64.

30 CSIRO, Submission no. 19, p. 8.

to build adaptive capacity and to change the decision environment. These include:

1. Acceptance that climate change is real and will amplify over the coming decades. Effective communication and unambiguous detection and attribution of climate change will facilitate acceptance of climate change.

2. Confidence that the projected changes will significantly impact on farming enterprises. This requires systems research with industry participation and effective communication strategies that can demonstrate clearly the impacts of climate change even though climate projections may have uncertainties.

3. Technical and other management options available and targeted to specific regions and industries (e.g., improved crop, forage, livestock, forest germplasm, nutritional management).

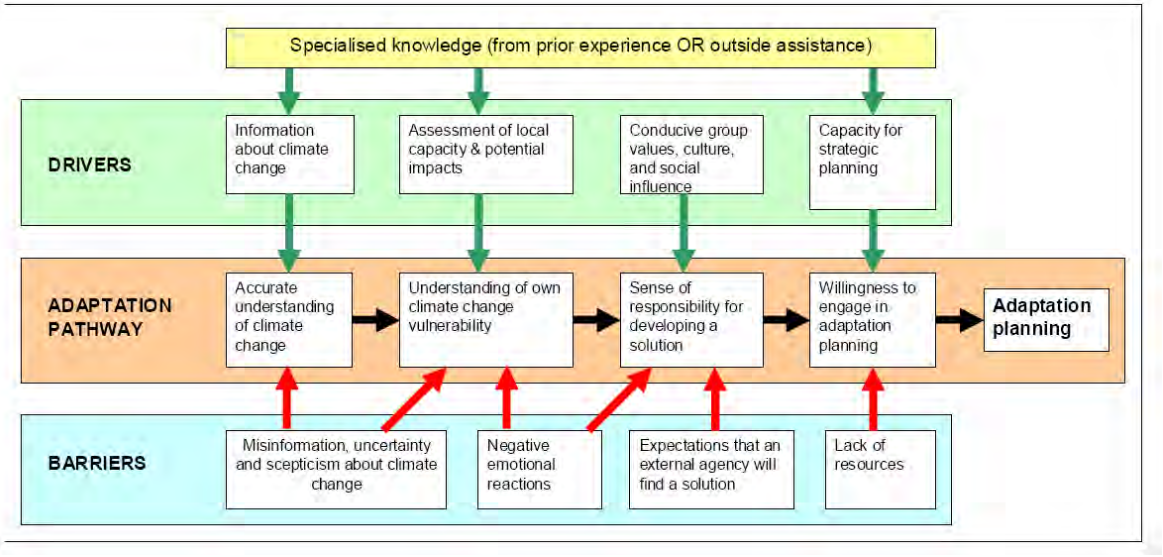
4. Early warning of likely major land use changes resulting from climate change that allows early policy intervention in supporting transitions and structural adjustment. Options include direct financial support, alternative livelihoods not so dependent on agriculture, building social capital and community resilience, infrastructure development, new land use and land tenure arrangements.

5. Adaptive management and governance in policy, institutions and industries that support agriculture. Regular monitoring of adaptation approaches to assess their costs, benefits and effects with efficient feedbacks to policy and management to facilitate continuing adjustments and improvements in adaptation.

A generic conceptual model of adaptation engagement has been developed by CSIRO (Figure 2) to help overcome barriers to adaptation that would assist in implementing the five steps outlined above. The model is presented as a pathway of stages, with different drivers and barriers relevant at different stages along the pathway. It is envisaged that the model will help to guide engagement efforts with stakeholder groups at different stages on the pathway.[31]

31 CSIRO, Submission no. 19, p. 17.

Figure 2.1 A pathway for adaptation engagement with associated drivers and barriers.



Source *CSIRO Submission no. 19, p. 18.*

> Government can play a key role in building adaptive capacity in rural industries and communities through supporting appropriate education and training and through facilitating more streamlined approaches to adaptive management and governance. Climate change will pose a whole new range of challenges that may require changes to policies and legislation that government will need to consider.[32]

2.40 As the National Farmers' Federation notes in its submission, adaptation is about understanding the social processes in change and managing those processes effectively:

> Adaptation will not simply flow from more field demonstrations. Change in the primary industries will also flow from social and community responses. Social research to complement policy development on how to support communities through these changes will be critical. Industries will also need research and development to assist primary producers to recognise when and how they should transition from one industry to another whilst retaining profitability and sustainability—as well as for the investigation of new primary industries for the future.[33]

32 CSIRO, Submission no. 19, p. 18.

33 National Farmers' Federation, Submission no. 17, p. 13.

2.41 The process of adaptation, according to Mr Jean-Francois Rochecouste, of the Conservation Agriculture Alliance of Australia and New Zealand (CAAANZ), will also take time:

> Social change does not come very quickly. It is not a two-year or a three-year project; it is a five-year, persistent type process with a small amount of money. It requires not necessarily a huge bucket of funding but just a small amount of money over the longer term.[34]

Creating change

2.42 That change is possible has been highlighted in much of the evidence received by the Committee. Chapter 3 highlights the innovations in farming practice brought before the Committee. In other evidence, Mr Jim Maynard, the Chairman of Mallee Sustainable Farming Inc. and an experienced farmer, pointed to the experience with no-till farming in his district:

> We find that a percentage of farmers are always ready to adapt to change. That will go on whether we exist or not. They are very forward thinking, progressive farmers. Also, on the other end of the scale, there is probably a percentage of farmers that will never change, will drop out of the system when either the bank manager will drop them out or they will sell out or retire, because they have had enough of it. In the middle there are a lot of people standing there. A lot of farmers will be there. They only need a bit of a catalyst and a bit of help for the first year or two, then change will take off. The real example of that in the Mallee is that a few years ago there were a few people doing direct drilling. In the last four or five years it is now up to about a 70 per cent uptake in direct drilling. That occurred wholly and solely because there was a drought and they could see the advantage of those odd farmers that were doing it better. It took off like anything.[35]

2.43 In a similar vein, soil scientist Dr Christine Jones highlighted the readiness of many farmers to embrace change under the right circumstances:

> I would see the key factor is to support the landholders who are making these changes because they are highly respected or more believable—to put it that way—to fellow landholders and if it

34 Mr Jean-Francois Rochecouste, CAAANZ, *Transcript of Evidence*, 14 July 2009, p. 31.

35 Mr Jim Maynard, Mallee Sustainable Farming Inc., *Transcript of Evidence*, 3 September 2009, p. 72.

> comes from within farming communities the change will be supported and they already have established social networks. We are finding that it is the most innovative, leading-edge farmers who are making these changes because they have been doing it another way for 30 or 50 years and they realise that it is just not working because their costs are increasing and their soils are declining. Intuitively landholders know that what they are doing is not the right thing. They do want to change. I cannot tell you how many people at recent workshops and things we have had have almost been in tears saying: 'We know we need to change. We just desperately need the information.' They are ripe for change.[36]

2.44 Dr O'Hagan, in evidence before the Committee noted the need to emphasise the benefits of climate change adaptation:

> …farmers are members also of the wider community and I think they also have a great opportunity to contribute to carbon pollution reduction. A lot of farmers see that as being of benefit to them because they will not only reduce energy costs but also improve their soils and their biodiversity. So a lot of very positive benefits come from shifting some of our farming practices.[37]

2.45 A similar point was made by Dr Kate Sherren, of the Fenner School of Environment and Society at the ANU, with regard to the social benefits of Holistic Management (HM) grazing:

> On the quality-of-life side of things, I can only really speak from an anecdotal point because we are still in the middle of the social research and the research was not designed to test whether or not holistic management was better, but these are the things that we see in the literature and that I hear from some of my respondents. One of them is that there is more family time. I have noticed that those who are doing holistic management tend to be in partnerships between husband and wife, with a lot less need for the wife to go and get work off farm to supplement the farm income, because, I guess, the women can move stock just as easily as the men can. There is actually less labour there. And, because the women are not working off the farm, there is actually more time from the family standpoint. That is what it seems to be.

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36 Dr Christine Jones, *Transcript of Evidence*, 24 June 2009, p. 20.

37 Dr Rowan O'Hagan, Australian Women in Agriculture Ltd, *Transcript of Evidence*, 3 September 2009, pp. 86-7.

> And then there is the benefit of improved mental health, which has also been in the media quite a lot. There is less risk year to year because of that lack of boom and bust that we see. And it has to be said that there is a huge pride and satisfaction amongst the landholders doing this kind of work from the stewardship role that they are taking on by focusing on the land base as opposed to focusing on the livestock and assuming that everything else will go all right.[38]

2.46 In its submission, the Fenner School of Environment and Society at the ANU, noted that:

> Farmers practicing HM grazing in the USA have reported an enhanced quality of life, due to more time for their family. The emphasis on holistic goal setting thus could also have important benefits for the mental health of members of the rural community, which is an important aspect of adaptive capacity at a social level.[39]

2.47 The submission continued:

> The HM system also extends beyond production-based solutions by supporting social and structural aspects of agricultural systems. Social and structural aspects of HM agricultural systems focus on stewardship and extended duty-of-care, social networks for sharing of experiences and information. Change at this level will be essential for the agricultural sector to have the capability to implement complex adaptive management strategies required to adapt to climate-change conditions.[40]

Committee conclusions

2.48 Communicating a clear and consistent message on climate change is a prerequisite to successful adaptation. Governments at all levels need to undertake to deliver this message, and in a manner relevant to the experience of farmers, for whom managing climate variability is a long term and everyday experience. Part of this is in understanding the decision making processes of farmers. Another part is the creation of positive messages—how adaptation can improve business resilience,

38 Dr Kate Sherren, Fenner School of Environment and Society, ANU, *Transcript of Evidence*, 17 June 2009, p. 3.

39 Fenner School of Environment and Society, ANU, Submission no. 4, p. 5.

40 Fenner School of Environment and Society, ANU, Submission no. 4, p. 6. Emphasis in orginial.

maintain or increase productivity, and promote personal and social welfare.

2.49 The Committee has been greatly impressed with the work of those social researchers who presented their work in evidence before the Committee. This body of work gives us a deeper appreciation of how farmers adapt to change, the pressures and influences they are subject to, the complicated nature of the decision making processes they undertake as a matter of course, and the need to understand these processes as part of the policy development process. To effectively support farmers adapt to climate change, government policy must in turn adapt itself to the needs and decision making process of farmers. The delivery of adaptation programs needs to be flexible and responsive to the needs of farmers and rural communities.

2.50 The Committee has also been impressed with the range of adaptations already available, adaptations which can increase resilience, improve productivity, and promote personal and social welfare. These will be dealt with in more detail in Chapter 3.

Recommendation 2

2.51 **The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, take more effective account of the needs and decision making processes of farmers and ensure that the delivery of adaptation programs is flexible and responsive to the needs of farmers and rural communities.**

3

Current and prospective adaptations

'…there's no drought at my place'[1]

3.1 During the course of the inquiry, the Committee took evidence and saw at first hand a range of current and prospective adaptations to the impacts of climate variability and climate change on agriculture. Farming practices examined in this chapter have a strong emphasis on improving soil health, water use efficiency and diversification of operations to improve overall productivity, and mitigation strategies to reduce greenhouse gas emissions in agriculture.

3.2 One of the common themes that emerged from the submissions and evidence presented to the Committee during the course of this inquiry was the capacity of Australian farmers to adapt to climate variability. There is certainly a culture of innovation within the farming community. The Committee saw plenty of reasons to believe that with sufficient support and careful management, many of the challenges of climate variability and climate change could be overcome, and by using techniques and technology already available.

Soil carbon

3.3 The Committee heard evidence that one of the most important adaptations to promote resilience against changes in weather patterns is improving the quality of the soil. The importance of soil carbon in improving soil health and in mitigating greenhouse gas emissions was a recurring theme during

1 Carbon Coalition Against Global Warming, Submission no. 50, p. 9.

the inquiry. Evidence presented to the Committee throughout the course of this inquiry reveals that improving soil carbon offers a way to establish greater resilience in the face of weather variability.

3.4 The need to increase soil carbon in agricultural soils was a recurring theme in the range of submissions received by the Committee. Mr David Matthews, a farmer in Kilcoy, Queensland, described the importance of soil carbon:

> As we know soil organic carbon is the building block for all vegetation. It is obtained by green growing plants when they convert the sun's energy and atmospheric carbon dioxide into liquid carbon compounds which relocate to the plant roots. These plant nutrients feed the plant (approx 30% of nutrients produced) and the remainder feeds soil fungi and bacteria which are living in symbiotic relationship with the plant. By harvesting the plant (grazing or mowing) the plant sheds a similar amount of its root base and humification of the shed material occurs and soil carbon levels may increase. This organic carbon now in the form of humus is also the water storage unit in the soil. A hectare of soil to a depth of 30 cm with an organic carbon content of 1 % can hold 170 000 litres of water.
>
> A 25 mm rainfall event drops 250 000 litres of water on a hectare of ground surface. Thus when soil carbon is only 1% about one third of the water cannot be stored in the soil and runoff occurs. This runoff has the potential to become soil erosion events.
>
> Thus by reducing our soil carbon content we have effectively reduced the ability of the landscape to hold water for plant growth in dry times as well as reduced recharge for our rivers and streams. We really have encouraged the rainfall we are now getting to run out to sea because it is just not possible to store the water in the soil.[2]

3.5 In evidence heard by the Committee, soil biologist Dr Christine Jones said that to increase soil carbon, farming practices need to change:

> In our never-ending quest for technological quick fixes we frequently overlook the obvious, the simplest and the most effective solutions. Without doubt, increasing the level of carbon in agricultural soils is the most obvious, simple and effective

2 David Matthews, Biodynamic Agriculture Australia, attachment to Submission no. 49.

solution to climate change. But we cannot increase soil carbon unless we change farming methods.[3]

Figure 3.1 The plant-animal relationship

Grass plants grow on a sigmoid basis. If left ungrazed, at some stage in their growth the above-ground or leaf and stem portions of the plant begin to change their cell structure. The cells in the above ground parts of the plant begin to lignify or become 'woody'. If left ungrazed the plant begins to suffer and will eventually die of 'over-rest'.

On the other hand, plants can also be grazed too early. When a plant is grazed, the natural balance between above ground and below ground structures is disturbed. Just as it is not possible to sustain a large leaf mass upon a small root system, neither is it possible, postgrazing, to sustain a large root system below ground when there remains a smaller post-grazing leaf mass above ground.

Immediately following the act of grazing the plant begins to slough off some of its roots, trying to restore balance to its structure. This material is 58% carbon by weight, the building block of soil carbon. Given time, as post-grazing leaf growth recommences the plant will begin to build new roots to replace those it sloughed off. It does this in order to maintain balance as it recovers from the grazing that was so necessary to sustain its life.

During this period of post-grazing recovery though, the plant is at risk of 'over-grazing'. If the plant is bitten again before it has fully rebuilt its root system there is a net damage to the plant. If frequent biting is allowed to continue for too long, the plant will die from root destruction directly arising from too frequent grazing. The left-hand pot in the photo to the right shows a balanced but very unhealthy plant that is close to death, having been 'grazed' too frequently.

Source: Dr John White, Submission no. 60.1, p. 26.

3.6 Dr Jones oversees 12 carbon measuring sites in Western Australia on properties that have changed farming practices. During evidence heard by the Committee, Dr Jones showed photographs of one of the test sites and explained:

> There was not any rain until two or three weeks ago, so they have had their longest number of consecutive days with no rain and yet these perennial grasses have survived. If they were not there, that would be bare sand. These grasses have been planted with the

3 Dr Christine Jones, *Transcript of Evidence*, 24 June 2009, p. 11.

> specific purpose of increasing soil carbon and also to form the base for annual cropping. So there will be a grain crop in winter time sown into these summer active grasses. So there will be something green all summer and then something green all winter. We are talking about yearlong green, because the only way to get carbon into soil is with a green plant. If you have the bare sand, you are going to be losing carbon, losing soil water holding capacity and losing nutrient status.[4]

3.7 The Wentworth Group of Concerned Scientists, in their report *Optimising carbon in the Australian landscape*, also advocate a shift in farming practices to increase soil carbon. With the increase in soil carbon, increases in agricultural production are expected and opportunities arise for biosequestration:

> Agricultural practices over the past century have mined Australian soils of their carbon stores. Nearly 40% of carbon stocks have been lost from Australia's cropping soils. The loss of soil carbon is a primary cause of land and water degradation, acidification and the destruction of soil structure. This reveals the great co-benefit of improving soil carbon. Soil carbon sequesters carbon from the atmosphere which also improves soil health and as a consequence, agricultural production. CSIRO have identified the significant biosequestration potential of the Australian landscape to absorb carbon. The paradox in their analysis is that whilst nearly 50% of terrestrial carbon in the Australian landscape occurs in grasslands and croplands, less than 20% of the estimated potential of the Australian landscape to store carbon occurs in these landscapes. This is because without changes to existing agricultural practices, any increase in carbon will come at the cost of agricultural production.
>
> Experts believe that it is technically feasible for Australian agricultural landscapes to increase soil carbon levels by 2% per year. This would result in the storage of an additional 900Mt of CO_2e per anum.[5]

3.8 In his submission to the Committee, Dr White of Ignite Energy, summarised the benefits of improved soil carbon for farmers:

- Better plant resistance to pests and diseases

4 Dr Christine Jones, *Transcript of Evidence*, 24 June 2009, p. 12.

5 *Optimising Carbon in the Australian Landscape*, Wentworth Group of Concerned Scientists, p. 8.

- Increased ability of soils to transfer nutrients to plants, for greater productivity which can improve farmers' incomes
- Increased soil water-holding capacity, holding the water until it can be used by the plants rather than letting it run off into waterways, ie, increased drought resistance
- Increased soil stability which means greater resistance to erosion, which in turn means cleaner waterways
- Unlocking of nutrient overload from synthetic chemical fertilisers
- Reduced recharge to groundwater and reduction or elimination of salination
- Improved biodiversity: soil organic matter contributes to the health of soil microbial 'wildlife' and micro-flora which are the very start of the food chain
- Healthier, climate-change compliant products that should avoid trade restrictions and attract premium prices.[6]

3.9 The Carbon Coalition Against Global Warming made the same points in its submission to the Committee about the benefits of improved soil carbon for farmers. The submission also made particular note of the micro-climate effect that can be achieved with the consistent green vegetation that becomes possible when 'carbon farming':

> [T]here is another way that Australian farmers can influence the climate: by creating a micro- climate around their property. A micro-climate will affect wind, rainfall, sunshine, and air temperature. It is a technique normally used by croppers. They use slope and row placement and alignment to determine a 'solar budget'. They use alley-cropping and shelter belts and mulches…
>
> Often a land manager will say, in the depth of a drought, 'there's no drought at my place'. By that they mean that they have managed their vegetation such that they have retained moisture in the landscape. When you protect your groundcover and don't overgraze or strip the earth bare by poisoning weeds or ploughing, you build or moisture reserves. Then water starts to cycle on your property. Some managers report receiving 1 mm a day in dew from fogs and mists.[7]

6 Dr John White, Ignite Energy, Submission No. 60, p. 6.

7 Carbon Coalition Against Global Warming, Submission no. 50, p. 9.

Perennial pastures

3.10 Perennial grasses are being used by an increasing number of farmers for ground cover, grazing, improved moisture retention and the improvement of soil carbon. The root systems of perennial grasses are longer than annual grasses offering greater resilience in dry times.

3.11 The benefits of using of perennial grasses are multiple. In evidence to the Committee, Mr Kevin Goss, of Future Farm Industries CRC, stated:

> Perennial plants are plants that have the ability to use rainfall whenever it occurs and to make the most of soil moisture whenever rainfall is not occurring. They are proving to be incredibly robust in both grazing and cropping systems.[8]

3.12 In evidence before the Committee, Dr Brian Keating, Director of the Sustainable Agriculture Flagship, CSIRO, further stated that:

> 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.[9]

3.13 In its submission to the Committee, the Southern Midlands Council Landcare unit stated:

> Healthy perennial pastures can produce some of the most carbon rich soils and may contain up to 350 tonnes of organic carbon per hectare.[10]

3.14 In her submission to the Committee, Dr Christine Jones pointed to additional benefits of perennial grasses:

> Perennial groundcover has multiple agricultural, ecosystem and landscape benefits in addition to restoring soil health. For example, weeds cost the Australian economy $8 billion annually when the value of lost production and reduced biodiversity are added to money spent directly on weed control. If land is left 'empty' it creates a space for weeds to colonise.[11]

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8 Mr Kevin Goss, Chief Executive Officer and Executive Director, Future Farm Industries CRC Ltd, *Transcript of Evidence*, 9 September 2009, p. 2.

9 Dr Brian Keating, *Transcript of Evidence*, Canberra 21 October 2009, p. 8.

10 Southern Midlands Council Landcare Unit, Submission no. 9, p. 2.

11 Dr Christine Jones, Submission no. 52, p. 3.

3.15 In a 2003 Land and Water Australia publication, the authors point to yet other benefits of perennial pastures:

> The farmers using native perennials have all reduced their fertiliser inputs and claim the use of native perennials is beginning to address the issue of nutrient balance. [12]

3.16 The reduction of fertiliser inputs associated with the use of perennial grasses is made possible through biological processes that occur in the root zone of the grasses. In her submission to the Committee Dr Christine Jones explained some of biological processes:

> Soil benefits in many ways from the presence of living plants year-round, due to reduced erosion, buffered temperatures, enhanced infiltration and markedly improved habitat for soil biota. Significantly, it is not 'biomass' per se which is the driver for soil carbon sequestration, but the soil life that the biomass supports, via photosynthetic capacity.
>
> Mycorrhizal fungi differ quite significantly from decomposer type microbes in that they acquire their energy in a liquid form, as soluble carbon directly from actively growing plant roofs. By this process they are actively drawing down atmospheric carbon and turning it into humus, often quite deep in the soil profile, where it is protected from oxidation.
>
> Where mycorrhizae are functioning efficiently, 40-80% of the carbon fixed in green leaves can be channelled directly into soil as soluble carbon, where it is rapidly polymerised with minerals and nitrogen and converted to stable humic compounds in the soil food-web. The humates formed by soil biota are high molecular weight gel-like substances that hold between four and twenty times their own weight in water. Humic substances significantly improve soil structure, porosity, cation exchange capacity and plant growth.
>
> Mycorrhizal fungi access and transport nutrients such as phosphorus, zinc and nitrogen in exchange for carbon from their living host. Plant growth is usually higher in the presence of mycorrhizal fungi than in their absence. In perennial grasslands, mycorrhizal fungi form extended networks that take several years to develop. They have mechanisms that enable them to survive

12 *Review of farmer initiated innovative farming systems*, Land & Water Australia, Australian Government, p.18.

> while host plants are dormant but **cannot survive** if host plants are completely removed from the ecosystem.
>
> Under appropriately managed perennial groundcover, soil water balance is improved by hydraulic lift and hydraulic redistribution in seasonally dry environments. These processes bring moisture to the root-zone that would not be available to an annual crop or pasture.[13]

3.17 Species of perennial grasses for pasture vary from region to region. Western Australia, for example, has no native perennial grasses and relies largely on Mediterranean species.

3.18 Certain species of perennial pasture grasses are favoured over others by different farmers according to region, soil types, or personal preference.

3.19 Perennial pastures are also used as part of pasture cropping and some managed grazing systems.

Pasture cropping

3.20 The submission made by the Southern Midlands Council Landcare Unit outlines the method, process and benefits of pasture cropping, also known as perennial cover cropping:

> Pasture cropping is a land management method where cropping and grazing are combined into a single technique with each enterprise enhancing each other economically and environmentally. The process of pasture cropping involves direct-drilling an annual grain crop without herbicide into dormant perennial groundcover. The practice enhances plant-microbial associations, vastly improves rates of biological nitrogen fixation, stimulates nutrient cycling, facilitates sequestration of highly stable, humified soil carbon and promotes formation of new topsoil.
>
> Perennial cover cropping (pasture cropping) is becoming more widely adopted in Australia and has been implemented in most states with outstanding success. On the mainland a grain crop is largely sown in winter while the perennial grasses are dormant. Additionally, there were good results in Victoria and New South Wales by sowing summer forage crops into winter dominant

13 Dr Christine Jones, Submission no. 52, p. 11.

> native perennial pastures. This is likely to be the most effective technique for adoption in Tasmania.
>
> Cropping into dormant perennial groundcover is a one-pass operation that markedly reduces fuel costs and largely eliminates the need for fossil-fuel based herbicides, fungicides and pesticides. Perennial cover cropping has many similarities to annual cover cropping but brings with it the ecosystem benefits of perennial groundcover.[14]

3.21 In her submission to the Committee, Dr Christine Jones also discussed the benefits of pasture cropping and provided the example of NSW central west farmer Nigel Kerin:

> Nigel Kerin was NSW Farmer of the Year in 2008. The first photo shows Mr Kerin in his newly sown crop (no bare ground) and in the second Mr Kerin is admiring his bounty closer to harvest (perennial croplands look like any other farmland once they approach maturity). This 'yearlong green' land management technique produces high quality, nourishing food simultaneously with restoring landscape function and providing ecosystem services such as oxygen-rich air and clean water.[15]

3.22 This successful example of pasture cropping notwithstanding, Dr Jones also pointed to the need for further research:

> Broadacre cropping could benefit enormously from widely spaced rows or clumps of long-lived perennial grasses and fodder shrubs. As yet we do not know the required critical mass to restore soil ecosystem function, but it might only need to be 5-10% perennial cover. The benefit of permanent mycelial networks in terms of aggregate stability, porosity, improved soil water holding capacity, reduced erosivity and enhanced nutrient availability would be immense.[16]

3.23 In his evidence to the Committee, Dr Mark Howden, Chief Research Scientist of CSIRO's Climate Adaptation Flagship, while also noting the benefits of pasture cropping, was not convinced of its universal application:

> In some circumstances that system has significant benefits, because it uses both the summer and winter rainfall. The challenge

14 Southern Midlands Council Landcare Unit, Submission no. 9, p. 2.

15 Dr Christine Jones, Submission no. 52, p. 4.

16 Dr Christine Jones, Submission no. 52, p. 11.

> 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.[17]

Rotational grazing

3.24 The Committee heard evidence and took submissions about different kinds of managed grazing systems. Some managed grazing systems are used in conjunction with perennial grasses and pasture cropping.

Holistic management

3.25 In its submission to the Committee, the Fenner School of Environment and Society outlined holistic management (HM):

> Unlike many other adaptive strategies to climate change, HM grazing is a proactive, low-tech solution that has at its core a different way of thinking about grazing systems, combined with the smarter application of known management techniques. Adoption of HM grazing signals a change in farming mentality from trying to gain control over the land to working with natural variability and embracing an ethic of land stewardship. Farmers using HM grazing have reported a wide range of benefits, including reduced soil erosion, increased water efficiency, improved pasture species cover and composition, improved quality of life, and more stable financial returns. Public good benefits include increased carbon sequestration, more biodiversity, and reduced nutrient loads off-farm.[18]

3.26 The submission went on to explain some of the distinguishing features of HM grazing:

> HM grazing is a particular way of running a livestock grazing enterprise that is used by a moderate but rapidly growing number

17 Dr Mark Howden, Chief Research Scientist, Theme Leader, Climate Adaptation Flagship, CSIRO, *Transcript of Evidence*, 21 October 2009, p. 7.

18 The Fenner School of Environment and Society, Submission no. 4, p. 1.

> of farmers. It increases the resilience of individual farm enterprises to changes or uncertainties in climate. HM grazing can be distinguished from other ways of managing a grazing enterprise at levels: a fundamental level, and a technical level:
>
> - Fundamentally, HM grazing is based on an explicit decision framework; explicit goal-setting; monitoring practices and adaptive management; and the principle that the health of the land is a fundamentally important basis for profitable farming.
> - Technically, HM grazing is based on high-intensity short-duration grazing (an extreme version of rotational grazing) rather than continuous grazing; and the keeping of 'grazing charts' that provide a means of anticipating feed availability and periods of drought.[19]

3.27 The submission notes that the use of grazing charts is one of the key tools of HM grazing:

> One fundamentally important aspect of holistic resource management is the emphasis it places on the natural resource base as the ultimate source of income and quality of life…Farmers employing HM grazing use a number of practical tools to help them manage their livestock rotation schedule. The most important of these tools is a 'grazing chart', which maps out how much feed is available in any given paddock at any point in time. These are easily created with graph paper and a pencil, and are updated after each rain. Using these charts, an HM manager will know at any given point in time how many 'days of feed' he has ahead of himself, if it does not rain. If the number of 'days of feed ahead' becomes too small, the farmers can make strategic decisions such as de-stocking before a drought actually hits, before expensive supplementary feeding becomes necessary, and before the health of the land is compromised.[20]

3.28 The Committee also heard evidence from Dr Fischer that HM grazing has additional benefits over time:

> One of the interesting things about rotational grazing is that, when you bring a mob onto a patch, they no longer feed in a selective way. If livestock are on the same patch of land for a long time, they basically eat their favourite species of grass over and over, and that leads to overgrazing. With rotational grazing you bring in a big mob and they nibble whatever they can get their mouths on.

19 The Fenner School of Environment and Society, Submission no. 4, p. 2.

20 The Fenner School of Environment and Society, Submission no. 4, p. 3.

> So some of the things that the livestock do not typically go for will get grazed as well. There are case studies of people who have employed this for a long time and can demonstrate that they have less weed cover than they used to have and instead have more perennial grasses than they used to have. Even though they have not used any chemicals in the process, through time the nutrient balance in the soil changes in such a way that it is no longer favourable to those weeds and becomes more favourable towards the things that are favourable from an economic perspective. So it is not as instant as spraying, but over time, if you give it 10 years or so, you will get changes in the system that are basically self-perpetuating.[21]

3.29 As part of the inquiry, the Committee visited the property of Mr David Marsh, north of Boorowa in New South Wales, who uses HM grazing techniques. There the Committee also met with Mr Bruce Ward, a leading exponent of HM grazing. HM grazing is a both a production technique and a decision making process that matches landscape, production and lifestyle. The rapid rotation of stock through feeding paddocks ensured the recovery of grasses after feeding. There is also the additional benefit of weed control, as stock tend feed less selectively under rapid rotation. Use of a mixture of species of perennial grasses ensured soil cover, soil health, soil moisture and over-competition of weed species. Flexible stocking rates ensured that the system was never put under unsustainable pressure. While overall productivity was lower than in high input systems, HM grazing was more sustainable, reliable and had much lower input costs, which also made it more flexible. On the day of its visit, the Committee was impressed by the evident health of the pasture and the animals on farm.

Biodynamic farming

3.30 Biodynamic farming uses a series of natural preparations to improve soil biology and soil structure. In their submission to the Committee, the Carbon Coalition Against Global Warming describe the broad approach:

> Biodynamics adopts a homeopathic approach to preparing natural fertiliser and times activities to align with cycles of the moon and

21 Dr Joern Fischer, Research Fellow, Fenner School of Environment and Society, Australian National University, *Transcript of Evidence*, 17 June 2009, p. 9.

> the stars. Many ordinary, sober farmers report great results with biodynamic preparations.[22]

3.31 In their submission to the Committee, Biodynamic Agriculture Australia explained the extent of uptake and some of the benefits of biodynamic farming:

> Biodynamic practitioners can be found throughout Australia, in every state and territory, across a wide range of agricultural production - grazing, cropping, horticulture, viticulture and dairy.
>
> Biodynamic practitioners have anecdotally reported significant drought tolerance over the past 10 years; they experience better production and returns than would be expected from previous drought situations. In times of flood soils with better soil structure also do not erode or bog as badly as low organic matter soils.[23]

3.32 In evidence to the Committee, Ms Cheryl Tillett of Biodynamic Agriculture Australia expanded further on the benefits of biodynamic agriculture:

> Various studies have been conducted over the years and, in general, it can be concluded that biodynamic farming practices have many benefits. The total energy for fuel production of mineral fertilisers and pesticides et cetera to produce a dry matter unit of crop was 20 per cent to 56 per cent lower. Biodynamically grown fruit had significantly higher brix levels. This is due to the use of horn silica (501). With regard to soil aggregate stability, soil pH, humus formation, soil calcium, microbial biomass and faunal biomass, the biodynamic system was improved.[24]

3.33 Ms Tillett went on to enumerate some of whole-of-farm benefits that promote greater resilience through the improvement of soil:

> By using the biodynamic system you are looking at the whole farm organism. You are building up the health of the farm organism and building up the humus content and the structure of the soil so that there are better water retention capabilities. As well as the water retention capabilities, there is a reduction in the amount of irrigation. For instance, if the farm is in an area where they need to irrigate, people who are using biodynamics tend not to have to use

22 Carbon Coalition Against Global Warming, Submission no. 50, p.8.

23 Biodynamic Agriculture Australia Submission no. 49, p. 1.

24 Ms Cheryl Tillett, Acting Business Manager, Biodynamic Agriculture Australia, *Transcript of Evidence*, 14 July 2009, p. 53.

> the same quantity of water for the same outcome as a conventional farmer might have to do. So there is the building of the carbon in the soil through the build-up of humus, the sequestering of the carbon from the atmosphere into the soil and then the water retention as a bonus so that the whole farm becomes more resilient to changes that might be happening.[25]

3.34 In their submission to the Committee, Ms Julia Weston and Mr Frank Giles of Seaview Farm provided an overview of how the use of biological farming methods and practices has increased production and provided resilience during drought on their Tasmanian property. They do not name the biological farming practices they use, but show by example what farmers can do to adapt to changes in climate:

> We like the story of two farmers in North East Tasmania (not us!) One follows a similar philosophy and practice as ours. His paddocks are rich and green, his stock healthy. Just across the fence another farmer has poor pastures and has to resort to pesticides and herbicides just to keep control of the place. It is necessary to give his cattle bullets of mineral supplements whereas the other farmer does not. And yet, the farmer with the poor paddocks with simply a fence separating the two never asks "What are you doing that I am not?"
>
> It doesn't matter what you call it: biological, biodynamic, organic or a mixture of all three, if it works use it! And if we are looking at the effects of climate change and how to promote resilience then there is an urgent need to change current farming practices which largely dominate the thinking in agricultural circles today.
>
> …It is an approach that is gaining ground even in mainstream farming communities simply because it makes good sense, it does work, and in the long term is cost effective.[26]

Tillage practices

3.35 Numerous submissions to the Committee referred to the benefits of conservation tillage practices, often as part of a broader farming system.

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25 Ms Cheryl Tillett, Acting Business Manager, Biodynamic Agriculture Australia, *Transcript of Evidence*, 14 July 2009, p. 54.

26 Ms Julia Weston, Submission no. 23, p. 5.

The most commonly cited benefits were improved soil health and fertility, greater water efficiency, and energy saving.

3.36 In conservation tillage, crops are grown with minimal cultivation of the soil. When the amount of tillage is reduced, the stubble or plant residues are not completely incorporated, and most or all remain on top of the soil rather than being ploughed or disked into the soil. The new crop is planted into this stubble. The tillage practices are commonly referred to in the submissions as zero-till, no-till, and min-till and are differentiated from traditional tillage methods mainly in the degree to which the soil is disturbed prior to planting.

3.37 The tillage-based conventional approach did produce reliable crop yields for some years. However a realisation began to emerge that the system was inherently unstable in that soil structure was degraded, soil erosion was accentuated, organic matter was reduced and energy inputs were high. The effects of this system on soil erosion could be dramatic, with massive erosion events occurring in southern areas of Australia, for example in the mallee soils of Victoria and South Australia. This realisation was based on the impact such an aggressive system had on soil structure, with structural decline being widely found following repeated tillage operations.[27]

3.38 In its submission to the Committee, the Conservation Agriculture Alliance of Australia and New Zealand (CAAANZ) articulated the benefits of no-till:

> The current farming practice of No Tillage, including full stubble retention, has the ability to adapt to variable climate conditions (and is doing so now) due to its seeding date flexibility, water harvesting capacity and improved water use efficiency that leads to massive yield benefits over conventional farming systems during periods of below average rainfall. The system also improves soil health leading to long term sustainability of the farm sector in Australia. To quote one of our farmer members "The No tillage farming system is climate change ready".[28]

3.39 A research paper published by the Grains Council of Australia, while enunciating the same benefits of conservation tillage practices as CAAANZ, also noted that these practices protect soil from erosion, play

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27 Alan Umbers, "Farming Practices in Australian Grain Growing – the means for both Productive and Environmental Sustainability," Grains Council of Australia Limited, p.4.

28 The Conservation Agriculture Alliance of Australia and New Zealand, Submission 54, pp. 1-2.

an important role for increasing soil carbon, and increase soil biomass, all leading to increased productivity.[29]

3.40 The Grains Council paper and a Landcare Australia booklet both note that conservation tillage practices also use substantially less fuel. The Landcare Australia booklet, aimed at farmers, makes clear observations about the relationship between tillage and carbon dioxide:

> Excessive soil disturbance can expose soil carbon compounds to oxidation and lead to their loss as carbon dioxide. The combustion of fossil fuels to produce the energy used in soil tillage also results in emissions of carbon dioxide.[30]

3.41 The Committee heard evidence from Mr Dale Park, of the Western Australian Farmers Federation, indicating the uptake of conservation tillage practices in Western Australia:

> I would say that at least 90 per cent, and probably 95 per cent, of cultivation these days is min till or no till. It is virtually not done anymore. I know a couple of farmers up in the north-east do still use ploughs in some of their country but they also do not put in crops every now and again because they have not got enough rain. The vast majority are min till.[31]

Controlled traffic farming

3.42 In its submission to the Committee, the Tasmanian Institute of Agricultural Research, described Controlled Traffic Farming (CTF):

> In CTF systems, all machinery used in crop production is restricted to permanently located wheel tracks. A paddock farmed using controlled traffic can be thought of as a series of uncompacted "root beds" that are ideally suited to crop growth, separated by compacted "road beds" that are ideally suited to traffic. CTF can directly address soil erosion, soil structure decline and organic matter decline caused by conventional tillage and traffic practices. CTF can also improve water use efficiency and

29 *Farming Practices in Australian Grain Growing – the means for both Productive and Environmental Sustainability*, Alan Umbers, Grains Council of Australia Limited, 2006.

30 *Landcare Australia: Meeting the Greenhouse Challenge*, Australian Greenhouse Office, Department of the Environment and Heritage, 2005, p. 19.

31 Mr Dale Park, Land Management and Climate Change Executive Portfolio Holder, Western Australian Farmers Federation Inc., *Transcript of Evidence*, 24 September 2009, p. 4.

> crop productivity, while reducing energy and fertiliser related greenhouse gas emissions. The essence of CTF is as simple as - "Plants grow better in soft soil, wheels run better on roads".[32]

3.43 The TIAR submission also draws attention to CTF as a system that leverages the advantages of a range of existing practices, such as zero-till.[33]

3.44 Dr Tullberg, of the Australian Controlled Traffic Farming (ACTF) Association, gave evidence to the Committee about the benefits of CTF in reducing on-farm emissions:

> It is well known that, by reducing tillage, you reduce the amount of fuel you use, so you reduce the amount of carbon dioxide that gets produced as a result of burning diesel fuel…If you are going on permanent wheel tracks which are hard you use a lot less fuel - about half the fuel. Those are the emissions related to diesel fuel use.
>
> People often do not consider the energy that goes into producing herbicides, which is one of the issues of zero tillage… But the big one in terms of energy going into modern cropping systems, as I am sure you know, is nitrogen fertiliser. There is very little difference between conventional mulch tillage and zero till. There is a significant improvement in controlled traffic again because of course you do not put fertiliser on permanent wheel tracks and because you do not get the inefficient fertiliser use associated with compacted soil.
>
> The final one to be concerned with is emissions from the soil, primarily nitrous oxide. Nitrous oxide is produced when you have soil at a particular levels of water filled porosity. That occurs much more often when you have a compacted layer further down the profile. You avoid this in controlled traffic farming. Zero tillage alone actually increases emissions because you will get more soil compaction, particularly in heavy soils…CTF can reduce emissions by approximately 45 per cent.[34]

3.45 The Committee also heard from Dr Tullberg that using CTF would increase soil carbon:

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32 Tasmanian Institute of Agricultural Research, Submission no. 15, pp. 3-4.

33 Tasmanian Institute of Agricultural Research, Submission no. 15, p. 4.

34 Dr Tullberg, Australian Controlled Traffic Farming Association, *Transcript of Evidence,* 14 July 2009, p.45.

> The other thing that should be mentioned is that because you are producing more crops, more biomass, you are also going to provide the maximum chance of increasing soil carbon because you have absolute minimal soil disturbance; you do not need to disturb beneath seeding depth. If you are in non-compacted soil, it maximises the chance of carbon sequestration.[35]

3.46 One of the issues hindering the broader adoption of CTF is the reliance on global satellite positioning technology and the required base stations. Mr John McPhee, an employee of the TIAR appearing in a private capacity, told the Committee:

> You would not bother trying to do controlled traffic farming without satellite guidance. As you would be aware, most growers around the country who have moved in that direction have bought their own base stations.[36]

3.47 In its submission to the Committee, the TIAR explains further:

> Regardless of the industry, successful adoption of CTF is dependent on access to high quality Global Navigation Satellite System (GNSS) signals and data for machine guidance. The uptake of GNSS guidance for tractors and harvesters in Australia has been rapid. Almost without exception, growers have maintained their independence and bought individual guidance systems to suit their needs. Victoria has taken a lead in the establishment of a Continuously Operating Reference Station (CORS) network that will ultimately cover the state, and render the use of individually owned base stations obsolete.[37]

3.48 CTF Solutions, in its submission to the Committee, expressed frustrations similar to those of the TIAR and the ACTF Association with the individual systems of different machinery manufacturers:

> Australian farmers have bought about 4000 RTK GPS base stations[38], for about $100 million. This is more than is required to cover the whole of Australia with the same quality signal but only gives coverage to about 20% of Australia's cropping country. This

35 Dr Tullberg, Australian Controlled Traffic Farming Association, *Transcript of Evidence,* 14 July 2009, p.45.

36 Mr John Mc Phee, *Transcript of Evidence*, 21 September 2009, p. 4.

37 Tasmanian institute of Agricultural Research, Submission no. 15, p.9.

38 RTK, Real Time Kinematic, satellite navigation is a technique used in land survey and in hydrographic survey where a single base station provides the real-time corrections to a very high level of accuracy.

> is because the GPS suppliers to agriculture decided to provide only proprietary signals, i.e. differentiated by each company. These same companies supply the same service to surveying applications with non-proprietary signals. This is a rip-off, constrains CTF uptake since the GPS equipment is not compatible with different makes of tractors and harvesters (the general norm on Australian farms), and contractors cannot use the layouts of the farm owner. This enormous cost to Australian agriculture is all unnecessary.[39]

3.49 The TIAR, in its submission to the Committee, recognised an opportunity for government to augment a shift to farming practices that promote greater resilience in the face of climate variability:

> There is an ideal opportunity for government to show leadership, and in conjunction with the private sector, facilitate the establishment of CORS networks nation-wide, at least in the major cropping areas. Such infrastructure would be invaluable in the expansion of CTF and would lead to significant efficiencies in farming operations, not to mention a range of other emergency services, infrastructure and environmental benefits.[40]

Surface irrigation

3.50 The submission to the Committee from the Murray Irrigators Support Group describes methods to promote greater resilience in the face of climate variability by saving irrigation water and using it more efficiently. Some key points include:

- The Padman Stop, an invention by John Padman, [is] a 100% water tight control structure used in conjunction with the Fast Watering System also called low energy irrigation developed by John Padman.
- Trials of over 500 farms have shown that the faster the water is applied to the bay, the less water is used.
- Further to this it has been demonstrated at the Padman Stops trial research site that it is possible to control water application fairly accurately on to the bay, and to achieve the highest efficiency possible, more research needs to be done on application rates and frequency of irrigation.

39 CTF Solutions, Submission no. 45, p. 9.

40 The Tasmanian Institute of Agricultural Research, Submission no. 15, p. 9.

- Higher flows can easily be achieved by using the channels as storage.
- This form of irrigation is carbon positive because it uses less energy and produces more crops, which in turn will increase carbon sequestration.[41]

3.51 In evidence to the Committee, Mr Padman, a member of the Murray Irrigators Supporters Group, talked about the Fast Watering system he developed:

> We are about water savings productivity, sustainability and carbon reductions. That all sounds good, but we have demonstrated that we can achieve all of these things. By way of background, 80 per cent of Australia's water is used in irrigation, 70 per cent of which is flood irrigation, which we now refer to as surface irrigation. 'Flood' is a sort of bad word. This irrigation has long been recognised as a low efficiency industry. After doing a bit of research ourselves, we found that efficiency to be around 60 per cent. It was clear to me when I started this project in about 2004 that we had to do something about it…I guess for years we had plenty of water and all of a sudden our water just disappeared and things just happened in a hurry.
>
> At that time I did trials on what we called fast watering technology. To prove this we built a pump with a meter on it and started doing real farm trials. The results were magnificent. We started getting results of between 30 per cent and 50 per cent water savings. For the first three farms we submitted the results to the National Save Water Awards, and about this time last year we won those awards.
>
> Traditionally in surface irrigation it might take eight to 10 hours for the water to pass over the field. Fast watering permits watering many times faster than farmers normally would. The key to fast watering is to irrigate faster than the water can soak below the root zone. All of a sudden you start to get a very efficient irrigation without water logging. Quite common with the trials was a 30 per cent water saving. We found that, if you extenuate that and start to add a few of the other things we put in our submission, such as soil moisture monitoring, automation and event documentation, you can get up to 50 per cent water savings.[42]

41 Murray Irrigators Support Group, Submission no. 8, p. 2.

42 Mr John Padman, *Transcript of Evidence*, 3 September 2009, p. 41.

3.52 Mr Bryant, another member of the Murray Irrigators Support Group, gave evidence to the Committee about his personal experience:

> [M]y son bought the home farm from us three years ago… and I thought I had the place all A's and done pretty well—he put in the Padman Stops. We used to use 22 mega litres to water this particular area. When he put in the Padman Stops—nothing else changed—it went down to 12 mega litres. That shows you the savings that are there. I suspect that he grew a fair bit more tonnage, too, because the plant was never waterlogged. Because you are not putting as much water on you are not getting waterlogging.[43]

Property inspections

3.53 During the course of the inquiry, the Committee visited several properties engaged in practices which assist in the adaptation to climate change. It is interesting to note that many of the farmers the Committee spoke to during these inspections, while aware of the climate change benefits of the practices they were undertaking, were often motivated by the need to improve productivity or manage environmental degradation. There was also a strong sense that these innovations are being adopted in isolation, outside of any policy framework, and without the benefit of government research support or verification.

3.54 The Committee visited several properties in the Geraldton area which are working with Dr Christine Jones in the use of perennial grasses to maintain ground cover and build up soil carbon, thereby improving fertility and moisture retention. The Committee was impressed by the obvious health of the plants and soil and the apparent increase in carrying capacity of the pasture. Moreover, the farmers involved are heavily engaged in the work of testing individual solutions to their particular situations. Different mixes of grasses and shrubs are being tried by each farmer to suit their individual needs. Different grazing regimes are being utilised to suit the various plants. The Committee also visited a test site for pasture cropping, where winter crops are planted directly into dormant summer pasture. This has great potential to increase productivity and diversity of income, a significant factor in improving the reliance of farm enterprises.

43 Mr Dudley Bryant, Murray Irrigators Support Group, *Transcript of Evidence*, 3 September 2009, p. 43.

Members of the Committee inspecting a property in the Geraldton area with Dr Christine Jones.

3.55 Mr Cam McKellar, a farmer near Spring Ridge on the Liverpool Plains of New South Wales, is undertaking the restoration of soil carbon on his property. He noted that the naturally carbon rich soils of the area were badly depleted over decades of intensive cultivation using conventional tillage and artificial fertilizers. Using carbon rich humus as the principle fertilizer he has raised soil carbon on his property to 3% (from 0.5%). He has reduced pesticide use, increased soil biology and is maintaining yields despite limited use of nitrogen fertilisers. Improving soil health is also improving the nutritional value of the food produced.

3.56 Mr Andrew Pursehouse, of Breeza Station on the Liverpool Plains, has been using no-till farming methods since 1992. Breeza Station produces a range of summer and winter crops. Mr Pursehouse indicated that no-till methods are quite successful on his property and that he sees no reason to move away from them.

3.57 Mr David Wallis is a biological farmer at Quirindi, and processor of fodder for horse silage. He is passionate about value adding, noting that the horse silage business was drawing produce from a dozen farms around the district. He converted to biological farming methods, which has improved soil carbon levels and retention of moisture in the soil. He finds that better soil also made plants more pest resistant. He advises, however, that the switch from conventional farming methods is something

that takes time and money to produce results. He urges more research into biological farming methods to test and demonstrate the results he and others are getting.

3.58 Mr Neal Johansen, a farmer at Dululu, in the Rockhampton district of Queensland, is using controlled traffic farming methods to produce a rotation of wheat and legume crops. Improved moisture retention means that he is able to sow opportunistically with a lower risk of crop failure. The principal concern with controlled traffic farming is the need to have standardised machinery and access to GPS technology (which also needs to be standardised).

3.59 On their property near Rockhampton, Anne and Gordon Stunzner run cattle. They find that pasture improvement is the key to maintaining fertility and productivity amongst the animals and improving moisture retention in the soil. Perhaps somewhat against conventional wisdom, they use ripping to mitigate soil compaction by the cattle. They also manage and harvest native vegetation for commercial use and value adding on site using portable milling equipment to produce sawn timber. They note that unmanaged regrowth is of little environmental or commercial value.

3.60 The Groves family grow fruit at a property near Rockhampton. They irrigate with their own bores and dams and have a comprehensive strategy to deal with climate variability, including extremes of drought, storms, fire, flood and pests. They noted that moisture monitoring is expensive to install but ultimately pays for itself, and that use of drip irrigation has reduced water use by two-thirds. They uses extensive ground cover and mulching for moisture retention, and ground cover to prevent erosion. They use native trees as windbreaks and to bring in birds and bats to control insects. Slashing and grazing are used to reduce fire risks.

3.61 The Committee also visited the property of Arcturus Downs, near Emerald in Queensland. Arcturus Downs had 15 000 ha of dryland farming, 1000 ha of irrigated farming and ran 5000 head of cattle. On-site dams allow flood harvesting for irrigation. Minimum tillage is used across the property; however, controlled traffic techniques are restricted to the graded irrigated land. Some tillage is regarded as essential for weed control, especially with the appearance of herbicide resistant weeds. A mixture of drip and flood irrigation is used. There was some discussion of the relative merits of each. Drip irrigation is more water efficient and produces better yields. It is also far more expensive than flood irrigation, and maintenance intensive. There is a belief that current and prospective

adaptations will allow Arcturus Downs to meet the future challenge of climate variability.

3.62 The Committee visited several properties in the Hamilton district of Victoria. Jigsaw Farms, owned and run by Mr Mark Wootton, runs a mixture of lambs, wool, beef and timber. Some 24% of the property is under timber, meaning the enterprise was covering its own emissions about twice over. The timber provides environmental services and commercial return. There is extensive use of ephemeral wetlands which are good for biodiversity and provide environmental services. The system is otherwise high input to maximise production.

3.63 At 'North Skene', the Committee met with David Robertson and Graeme Moyle, two farmers who moved out of the traditional mixed farming of the Hamilton region into pure cropping. The cropping system they use is controlled traffic farming on raised beds (for drainage) with stubble retention for moisture and soil carbon. David and Graeme are members of Southern Farming Systems, a farmer/subscriber based research organisation which focuses on cropping in high rainfall areas.

Committee conclusions

3.64 The evidence presented to the Committee during the course of its inquiry has highlighted the importance of soil carbon in Australian agriculture. It is clear to the Committee that improving soil carbon is one way to develop resilience in the face of climate variability and climate change. The Committee applauds the work being undertaken by individuals to improve soil carbon in agricultural soils, and supports the recommendation of the Standing Committee on Rural and Regional Affairs and Transport recommendation that:

> The Government should significantly increase the research effort in relation to the potential of soil carbon as a climate mitigation measure, as a means of reducing the capital input costs to agriculture as a means of increasing resilience in agricultural systems.[44]

3.65 There are a significant range of potential adaptations that could increase the resilience of Australian farmers in the face of climate variability and climate change. Many have win-win-win potential, in that they improve productivity, environmental sustainability and reduce or mitigate

44 Standing Committee on Rural and Regional Affairs and Transport, *Climate change and the Australian agricultural sector*, 2008, p. 47-48.

emissions. They will also confer social benefits as improved productivity and sustainability increase personal and community resilience.

3.66 The Committee is concerned, however, that many of these adaptations are not being identified, tested and disseminated in any organised way. Much of the research into these adaptations is being undertaken by farmers in isolation or with limited support. Given the potential consequences of climate change, and the potential benefits of many of these adaptations, it would seem that a better coordinated research and extension effort is required. The Committee is aware of recent initiatives being undertaken by the Australian Government. It will deal more closely with this issue in Chapters 6 and 7.

3.67 Given the increasing importance of GPS technology to farming, the Committee is also concerned about the lack of GPS signal compatibility between different makes of farming equipment. This situation, whereby different machinery on the same farm cannot have GPS compatibility, or where contractors cannot integrate their equipment with that of farmers, requires adjustment. The Committee believes that action should be taken to establish a national CORS network across Australia and that signal compatibility between different GPS systems should be required by law.

Recommendation 3

3.68 **The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, invest research funding in the following high priority areas:**

- **Soil carbon sequestration;**
- **Soil stabilisation and pasture improvements using methods such as perennial pastures, pasture cropping, rotational grazing, biodynamic farming, minimum/no till cultivation and controlled traffic farming;**
- **Soil water retention strategies and water use efficiency;**
- **Landscape planning and natural resource management; and**
- **Risk management.**

Recommendation 4

3.69 **The Committee recommends that the Australian Government, in conjunction with State and Territory Governments, establish a national Continuously Operating Reference Station network across Australia and regulate for signal compatibility between different GPS systems.**

Biochar

3.70 Biochar is being investigated by a number of bodies as a soil conditioner, alternative fuel source, and for its carbon sequestration potential. Biochar is a form of fine-grain charcoal which is created by converting organic matter (such as wood, leaves, food wastes and manure), though heating in a low or zero oxygen environment.

3.71 The biochar production process begins with biomass being fed into a pyrolysis kiln—a furnace that burns with little or no oxygen. At the end of this, two main products come out of the kiln. The first is biochar, usually representing about 50 per cent of the carbon content of the biomass. The other is biofuel.[45] (See Chapter 4).

3.72 Biochar production can be customised to suit the end purpose of the product:

> The pyrolysis conditions can be optimised for bioenergy or biochar production. Biochar qualities can also be tailored for desired properties (e.g. high stability, high adsorptive capacity, increased cation exchange capacity, high nutrient content) through selection of feedstock and processing conditions.[46]

3.73 In evidence presented to the Committee, the Grains Research and Development Corporation flagged some potential for the use of biochar in grain production:

> We are interested because there are indications that it can improve cation exchange capacity and improve crop nutrition and have some benefits to crop production. That is the focus of our two projects. We are looking at about 12 different source materials for

45 *The basics of biochar*, Background Note, Parliamentary Library, 10 September 2009, http://www.aph.gov.au/library/pubs/bn/sci/Biochar.htm.

46 *An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use*, CSIRO, 2009, p. 143.

> chars—making them through a number of processes and looking at their functionality and their benefits to crop production through a series of trials, both for glasshouse and in the field, and seeing if there is real benefit for crop production.[47]

3.74 A 2009 CSIRO report enumerates the benefits of biochar for plant production when used as a soil amendment:

- reduce soil acidity,
- increase or retain plant productivity with a lower amount of fertiliser use, and
- more efficiently retain nutrients and avoid leaching from the soil profile.

> Furthermore, biochar may enable soil and vegetation to adapt to climate change by increasing water holding capacity of soils, and by increasing soil pliability and water infiltration.[48]

3.75 In its submission to the Committee, the National Association of Forest Industries points to the multiple applications of biochar:

> Biochar can be incorporated in biofuel production as well as provide an additional carbon sink with potential for increasing the quality and fertility of agricultural soils. Further evaluation of these types of new technologies is warranted.[49]

3.76 Under the Climate Change Research Program, the Australian Government has provided funding for a research project into biochar, which will target gaps in our understanding of this emerging technology and address uncertainties about its use:

> This project will draw together leading researchers in Australia in the areas of biochar, bioenergy, soil science, emissions management and life-cycle assessment into a national effort, aimed to address key aspects of biochar generation and application in Australian agriculture.[50]
>
> Key activities under the project will include:

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47 Dr Martin Blumenthal, Program Manager, Agronomy, Soils and Environment, Grains Research and Development Corporation, *Transcript of Evidence*, 27 May 2009, p. 10.

48 *An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use*, CSIRO, 2009, p. 143.

49 National Association of Forest Industries, Submission no. 51, p. 9.

50 http://www.daff.gov.au/about/obligations/grants_reporting_requirements/november_2009 accessed 14 December 2009.

- a life cycle assessment of biochar from feedstock source to production to sink, including costs, risks, benefits and implications for farmers
- categorisation of biochars according to their properties and suggested usage
- economic assessment of biochar for both net greenhouse gas emissions and potential profitability to land owners
- analysis of risk factors in terms of rates of applications as well as the potential production of toxic by-products during pyrolysis.[51]

Lignite

3.77 The Committee heard evidence from Dr John White about a lignite-based fertilisation system. The system complements and is used in conjunction with other farming methodologies and improves soil biology. Lignite occurs in most states.

> It is a system. It is not just a product and it is not just one company's product. There are many suppliers of this, although at small scale still; they need expanding. It means that you want to keep grass coverage; you do not want bare paddocks. You do not want deep ploughing; you want low tillage. You want seed drilling. You do not want to burn stubble; you want to use folia sprays with biology to digest the stubble and add to the soil and not burn it and kill more. You want to use biological organic based fertilisers. You want to keep grass cover. It is a system, but it does not require technology or knowledge that does not already exist and almost every farmer can convert to it.[52]

> Traditional farming in a range of ways has killed most biology in most soils. You do not find an earth worm in many farm paddocks any more; you do not find the fungi and bacteria mix that you need for healthy plant, grass, crop, and tree growth. The main point of this fertilisation system and other biological farming systems is to use modern technology and better products to rebuild that biology and carbon mix to get healthy, fertile soils and plant growth— and the worms reappear within a year or so.[53]

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51 http://www.daff.gov.au/climatechange/australias-farming-future/climate-change-and-productivity-research/emissions_reduction2?SQ_DESIGN_NAME=spaced&SQ_ACTION=set_design_name, accessed 14 December 2009.

52 Dr John White, Ignite Energy Resources, *Transcript of Evidence*, 3 September 2009, p. 95.

53 Dr John White, Ignite Energy Resources, *Transcript of Evidence*, 3 September 2009, p. 94.

3.78 Dr White noted:

> My confidence is based on the fact that a company we are in joint venture with… has been developing and building this biological farming system over 15 to 20 years. Its founder and managing director is a fifth-generation wheat farmer, so he knows. He now has three factories that are manufacturing a range of biological carbon based fertiliser products—liquid powder and high compressive strength granules—to be used in the same farm machinery that they use for spraying and MAP and DAP.[54] He is now fertilising over 300 farms, spreading from the WA wheat belt right across South Australia… into western and south-western Victoria and heading to Gippsland. He is fertilising regularly every year over 300 000 hectares. This is not R&D. This is not speculative. The soil carbon and biology increase and crop yield—the productivity and profitability—on these farms are measured, proven and known. It is spreading across the farm fence because farmers look over and see their neighbour doing better at less cost, regrowing biology and worms.[55]

3.79 Dr White described the fertiliser production process using lignite:

> …which is brown coal. Certain patches of the lignite are very young and just past being peat. Much of our brown coal is as good as or better than peat… It is so young; it is pure, clean organic material. There is nothing dirty about brown coal. It is two thirds water. It is low sulphur, low ash and low heavy metals. It is pristine, beautiful organic material. Of course, if you burn wet brown coal, you consume an enormous amount of heat to evaporate the water and you make a lot of CO_2.[56]
>
> We blend [the lignite] with the required nutrients, such as soft rock phosphate; with the trace elements, such as calcium, magnesium and zinc, that you need for the soil; and particularly with a mix of bacteria, fungi and enzymes that the soils need in a proper balance in order to be fertile. We mix that with the brown coal and other nutrients.[57]

3.80 Dr White went to describe how the fertiliser is used:

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54 Monoammonium phosphate (MAP), and Diammonium phosphate (DAP).

55 Dr John White, Ignite Energy Resources, *Transcript of Evidence*, 3 September 2009, p. 94-95.

56 Dr John White, Ignite Energy Resources, *Transcript of Evidence*, 3 September 2009, p. 98.

57 Dr John White, Ignite Energy Resources, *Transcript of Evidence*, 3 September 2009, p. 99.

> It has an inoculant of biology to restart the biological activity in the otherwise chemically killed, fungicide killed soil. It is not surprising that, when you spray fungicides, you kill the essential fungi in the soil that is needed for healthy plant growth. We make it in three types. We make a liquid extract of high-concentrate humic-fulvic, which can be sprayed. For example, you would spray it on stubble with a bacteria mix to biologically digest the stubble within six months rather than have to burn it for the next sowing season. We make a powder blend, which can be put out through a circular spreader. Alternatively, we make a high compressive strength granule, which can be seed drilled in the same way as MAP and DAP granules are. So it is a range of products used in a range of different ways. But it is quite inexpensive to make.[58]

Committee conclusions

3.81 The Committee believes that biochar and similar products have significant potential to play a part in Australian farming systems, both as a soil additive and a form of carbon sequestration. It welcomes the Australian Government's investment in biochar research.

Farm Forestry

3.82 A number of submissions to the Committee suggested that another way for Australian agriculture to adapt to changes in climate and weather is to diversify on-farm income. Growing trees on farms as part of an integrated farm plan has potential to diversify farm income and provide other benefits such as shelter for stock, enhanced biodiversity and carbon sequestration. Several submissions outlined different ways of incorporating trees on farms, each with a different emphasis on the numerous benefits that growing trees on farms can bring.

3.83 In evidence before the Committee, Mr Allan Hansard, CEO of the National Association of Forest Industries stated:

> Forestry can also complement a range of agricultural activities which may be at greater risk from the effects of climate change. Trees used strategically in the landscape can enhance pasture and plant production and provide direct livestock production and

58 Dr John White, Ignite Energy Resources, *Transcript of Evidence*, 3 September 2009, p. 99.

> calving benefits through provision of shade and shelter, particularly during periods of climatic stress. As a long-term perennial, trees are generally not as susceptible to seasonal and climatic variations as some other types of crop. Trees can be planted as woodlots and plantations or used in specific configurations to provide shelter functions for some crops and pastures. This is not about forestry competing against Australia's food basket; it is about coexistence resulting in a potentially larger, healthier and sustainable food basket.
>
> Consequently, the forestry sector's role as a complementary land use can help reduce farm reliance on drought assistance and provide alternative income sources in dealing with the longer term impacts of climate change—in the same way the full recognition of wood biomass provides farmers with a viable, alternative source of income. As part of a sustainable system, farmers could provide wood biomass to regional based generation facilities, reducing the reliance on fossil fuel energy and creating greater long-term energy security for regional Australia.[59]

3.84 Mr Hansard also pointed out the particular benefits of farm forestry for farms within proximity of commercial plantations:

> What we have noticed over the development of the commercial plantation industry over the last 40 or 50 years in Australia is that farm forestry and agroforestry can benefit through proximity to commercial plantations. Where you have farmers that grow trees that are close to existing plantations, they can often piggy-back on a lot of the infrastructure and there are often economies of scale that come with a commercial-size plantation. Often, we have seen the development of commercial plantations in parallel with the development of farm forestry.[60]

Trees on farms

3.85 Forestry Tasmania has developed a program which integrates forestry in the farm landscape called Trees on Farms. In evidence to the Committee, Dr Hans Drielsma of Forestry Tasmania explained:

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59 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Transcript of Evidence*, 24 June 2009, pp. 2-3.

60 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Transcript of Evidence*, 24 June 2009, p. 4.

> This innovative program will provide farmers with the opportunity to plant trees to reclaim weed infested land, secure a new revenue stream, capture carbon and provide long-term habitat for threatened species such as the swift parrot. This is a commercial solution to an environmental problem. Reclaiming land infested with weeds, particularly gorse, is an expensive problem for farmers, but we believe Trees on Farms converts that problem into an opportunity. In a nutshell, Trees on Farms will enable landowners to joint venture with Forestry Tasmania to established commercial wood lots on cleared land, particularly degraded land with low agricultural productivity. In the first instance we will work with individual farmers to identify suitable sites. Once these sites are identified we will then enter into a contract where we undertake to plant the trees at no cost to the farmer and the farmer undertakes to protect the growing trees from browsing animals and stock. After 15 to 20 years, when the wood lot is ready to be harvested for timber, Forestry Tasmania and the landowner will share in the revenue. If the parties agree, a new crop of trees can then be grown.[61]

3.86 The Committee visited Mt Vernon, the property of Mr Peter Downie, who is participating in the Trees on Farms program. His property contains plantations of both native and introduced species with a view to providing environmental services and commercial returns. Aside from demonstrating the value of farm forestry on his property, Mr Downie also displayed a keen knowledge of the impact of past agricultural practices upon the health of the soil and the hydrology of the landscape, and the way in which the productivity of the land had been undermined by land clearing and inappropriate production methods. It provided an insight into the intergenerational impacts of past actions and the fact that some acts of landscape restoration may require perspectives of 100 years or more.

61 Dr Johannes Drielsma, Executive General Manager, Forestry Tasmania, *Transcript of Evidence*, 21 September 2009, p. 28

Committee members talking to Peter Downie, Kempton, Tasmania

Agroforestry

3.87 The Otway Agroforestry Network (OAN) offers an extension service similar to that of Forestry Tasmania except the focus is on community development. OAN is a not-for-profit community organisation promoting the wider adoption of vegetation management as an integral component of productive and environmentally sustainable agriculture. The work of the Otway Agroforestry Network centres on trees as part of the farm infrastructure, providing aesthetic value, environmental services (habitat for birds as part of integrated pest management, stock shelter and revegetation of water courses) while also providing an income stream through the production of high quality saw logs. The key to success was giving each farmer the training and tools to manage the timber on their own properties, within the context of group leadership and peer support. Farmers undertook formal training through the Master Treegrowers course, and had access to expertise and support within the network. Network cooperation meant that relatively small stands of timber could be harvested at commercial rates. The result of the Network's operation was a significant increase in tree cover without loss of productivity, and an improvement in the commercial and environmental sustainability of individual enterprises.

3.88 In its submission to the Committee, OAN described its approach:

> We focus on facilitating and supporting farmer participation in R&D using social networking, peer support, education, product research, and market development. We help farmers design and manage forests that meet their own needs as well as providing environmental and commercial benefits for the wider community.[62]

3.89 The OAN submission went on to describe agroforestry and some of its benefits:

> Agroforestry is the strategic integration of multipurpose trees and shrubs into farming systems to enhance productivity and protect natural resources. Agroforestry offers a means of implementing multi-functional agriculture - something which is urgently needed across the nation. Improved water quality in our streams, protection of soils, crops and livestock, the conservation of our unique flora and fauna and the promise of alternative timber sources and other forest products, make well managed trees on farms a good story for rural communities and the nation as a whole.[63]

Engineered woodlands

3.90 The Engineered Woodlands Project run by Southern New England Landcare was a variation on the theme explored in the section above, with similar outcomes in mind. Trees provided carbon offsets and other environmental services such as windbreaks and stock shelters. They also provided a harvestable resource. Through careful design, it was possible to place a substantial proportion of a property under trees with no loss of carrying capacity or productivity.

3.91 In its submission, Southern New England Landcare stated:

> The Engineered Woodlands Project aims to demonstrate a profitable land use that integrates the growing of native trees and shrubs for biodiversity carbon and timber values within agricultural production systems. Engineered woodlands are paddock-wide tree crops where the trees are wide-spaced and allow normal agriculture to operate between them. In short, the plantings do not displace pastures and conventional crops but are integrated with them.

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62 Otway Agroforestry Network, Submission no. 71, p.1.

63 Otway Agroforestry Network, Submission no. 71, p.1.

Key benefits of an Engineered Woodland are:

- Shade and shelter for better livestock, crop and pasture production,
- Better habitat connectivity for biodiversity,
- Improved soil nutrient cycling and water use efficiency, and
- Income from timber and carbon credits.

Key features of an Engineered Woodland are:

- Designed to produce multiple products from traditional agriculture as well as the trees
- The use of the entire paddock for tree establishment minimises fencing costs, thus substantially reduces establishment costs
- Agricultural activity can continue between belts once trees are sufficiently established (within 1-3 yrs for most sites)
- Tree belts or copses are established at spacings to suit machinery, pasture and stock management and are aligned to maximise microclimate benefits.[64]

Members of the Committee, with representatives of Southern New England Landcare, inspecting an example of engineered woodland in the Tamworth region.

64 Southern New England Land Care Ltd, Submission no. 39, p. 3.

3.92 In evidence to the Committee, Mr David Thompson of Northern Inland Forestry Investment Group provided an example of productivity increases on one farm involved in the Engineered Woodlands project:

> For that particular farm [shown in the powerpoint presentation], the one with the contours, we estimated that 70 per cent of the benefit for that farm was going from stock shelter. On that particular farm, there was a 50 per cent reduction in sheep losses and a 10 per cent increase in lambing rates, with 11 per cent of the farm under trees. That translated to around about $20 000 per year of increased income.[65]

Committee conclusions

3.93 Farm forestry provides a real opportunity for farmers to diversify income while improving the environmental sustainability of their properties within the context of existing production mixes. It is not about the wholesale replacement of agriculture by forestry with all its attendant social, economic and environmental consequences. Farm forestry also provides for emissions offsets through the storage of carbon in trees, and, potentially, the creation of income through carbon credits.

3.94 During the course of the inquiry, the Committee had the opportunity to inspect sites related to all three of the above programs and was impressed by them all. They had in common a desire to see forestry incorporated into the existing farm enterprise rather than simply bolted on, and all showed sensitivity for the ecological impacts of forestry in the landscape. None was a case of simply changing land use for commercial return regardless of the environmental, economic or social consequences. The key difference between them was the level of ownership, responsibility and direct involvement in the forestry enterprise by the farmer. All three provide models for future action.

65 Mr David Thompson, Project Manager, Northern Inland Forestry Investment Group, *Transcript of Evidence,* 19 August 2009, p. 11.

Mitigation

Ruminant emissions

3.95 Australia's agricultural gas emissions are estimated to be sixteen percent of the net national total.[66] It is also estimated that 80 per cent of agriculture's emissions are generated by the digestive processes of ruminant animals. This process, enteric fermentation, produces methane. Methane emissions from ruminant livestock represent a loss of carbon during feed conversion, which has implications for both animal productivity and the environment because this gas is considered to be one of the more potent forms of greenhouses gases contributing to global warming. In his evidence to the Committee, Mr Robert Young, NSW Department of Primary Industries, informed the Committee of recent ruminant emissions research:

> We received $1.6 million … to undertake research on how we might reduce methane emissions from ruminant livestock. That research again is part of a national collaborative program, so different groups around Australia are doing different components of that. Meat and Livestock Australia are also integral to it. Our parts of the program are to look at the genetic capacity of both cattle and sheep, through breeding, to reduce methane emissions and to look at feeding strategies and ruminant manipulation as options to reduce methane emissions.
>
> To give you some examples, there is about a 20 per cent difference between high-emitting methane livestock and low-emitting methane livestock just because of their genetics. Methane is a net loss to the system, if you like. If you can stop that methane emission you could convert that into wool or meat or milk or whatever. It is a deadweight loss. If we can improve the adoption of the livestock that are predisposed to low-methane emissions—sheep, goats et cetera—there are significant gains.[67]

3.96 Another area of research to reduce methane emissions in livestock looks at different types of stock feed. Mr Young continued:

> In the area that you specifically mentioned, which was tannins in legumes, yes, we recognise there are a number of options—and

66 *Carbon Pollution Reduction Scheme Green Paper*, Department of Climate Change, July 2008, p. 14.

67 Mr Robert Young, Climate Change and Water Research, Department of Primary Industries, NSW, *Transcript of Evidence*, 1 July 2009, pp. 25-26.

> not just in legumes. There are a number of shrubs as well that have high tannins with the capacity to reduce methane emissions from livestock. We are also looking at a range of rumen additives and a number of other factors.[68]

3.97 In his evidence to the Committee Dr Keating of the CSIRO told the Committee of similar research being undertaken:

> We do have an active program of work on tropical beef and the emissions story 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… 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.[69]

68 Mr Robert Young, Climate Change and Water Research, Department of Primary Industries, NSW, *Transcript of Evidence*, 1 July 2009, pp. 25-26.

69 Dr Brian Keating, Director, Sustainable Agriculture Flagship, *Transcript of Evidence*, 21 October 2009, p. 11.

Committee conclusions

3.98 The Committee is conscious that emissions from agriculture form a significant part of overall greenhouse gas emissions and supports further research efforts into the mitigation of greenhouse gas emissions from agriculture.

Recommendation 5

3.99 **The Committee recommends that the Australian Government support further research efforts into the mitigation of greenhouse gas emissions from agriculture.**

4

Energy on farms

4.1 Energy in agriculture is becoming an increasingly important issue on farms for economic and environmental reasons. Savings in electricity and fuel costs are another incentive to improve energy efficiency. Improving the efficiency of energy use on farms can also help to reduce greenhouse gas emissions associated with burning fossil fuels. The uptake of farming practices that already promote resilience in the face of weather and climate variability, such as those in Chapter 3, may also offer the additional benefits of reducing energy usage.

4.2 The Rural Industries Research and Development Corporation (RIRDC), guided by the National and Rural Research Priorities of the Australian Government notes that:

> Demand for alternative feedstocks for fuels, electricity, chemicals and a range of commercial products has grown dramatically throughout the world in the early years of the 21st century…
>
> Australia faces a complex set of challenges and opportunities with respect to future energy supplies, policy and technology. An unprecedented interest in bioenergy in the international arena, as well as Federal and State governments who are keen to promote new industries, and investors and engineers keen to promote new biofuel and bioenergy technologies, means that bioenergy is becoming a tangible option for the future. A move to bioenergy will have major implications for farms and regions.
>
> High oil prices are already having an impact on agriculture as input costs increase, not just for fuel, but for other products reliant on oil such as fertiliser. Farming systems have been partly buffered from increasing oil prices due to changes in the way systems run (for example legumes reducing dependence on nitrogen-based fertilisers, minimum tillage etc) but are reaching

> limits and are increasingly 'energy exposed'. The challenge is to become more energy efficient and self-sufficient at farm and regional level.[1]

Energy efficiency

4.3 Energy is a significant portion of the running costs incurred in modern agriculture. If the cost of energy is to increase as predicted, savings in electricity and fuel costs are one incentive to improve energy efficiency. Many of the farming practices detailed in the Chapter 3 that promote the increase of soil carbon, also make credible claims to reduce energy usage and greenhouse gas emissions on-farm.

4.4 Controlled Traffic Farming (CTF) for example, uses less energy than conventional farming. In its submission to the Committee, the TIAR points to some of the broader environmental benefits of CTF:

> Reduced greenhouse gas emissions due to:
>
> - reduced on-farm energy consumption due to less tillage, lighter draft loads and more efficient use of tractor power, and
> - reduced carbon losses as a result of less tillage, reduced energy consumption in the manufacturing and transport sectors due to lighter equipment and less fertiliser manufactured and transported.[2]

4.5 In evidence to the Committee, Dr Jeff Tullberg of the ACTF Association demonstrated the many advantages of CTF, pointing to some of the less obvious energy saving benefits:

> It is well known that, by reducing tillage, you reduce the amount of fuel you use, so you reduce the amount of carbon dioxide that gets produced as a result of burning diesel fuel…When you are no longer tilling the soil, you are disturbing it very little, and most of your fuel is actually used to carry this weight around the paddock. If you are going on permanent wheel tracks which are hard you use a lot less fuel—about half the fuel. Those are the emissions related to diesel fuel use—and, as I say, that is commonly known.
>
> People often do not consider the energy that goes into producing herbicides, which is one of the issues of zero tillage. In controlled

1 http://www.rirdc.gov.au/programs/new-rural-industries/bioenergy- bioproducts-and-energy/program-overview/program-overview_home.cfm, accessed 12 January 2010.

2 Tasmanian Institute of Agricultural Research, Submission no. 15, p. 5.

> traffic, because you grow more crops and because you can get onto ground quicker, you can deal with weeds when they are smaller, you can use less active ingredients and you get reduced herbicide use. But the big one in terms of energy going into modern cropping systems … is nitrogen fertiliser. These figures are worked out on the basis of perhaps 50 kilograms of nitrogen per hectare, which might be a reasonable Australian broadacre situation. There is very little difference between conventional mulch tillage and zero till. This is a significant improvement in controlled traffic again because of course you do not put fertiliser on permanent wheel tracks and because you do not get the inefficient fertiliser use associated with compacted soil.[3]

4.6 The Murray Irrigators Support Group gave evidence to the Committee about the energy saving potential of Fast Watering technology used in conjunction with Padman Stops[4]:

> Gravity or surface irrigation, as we said, is 80 per cent of our irrigation and has little or no energy cost. There has been a bit of emphasis for irrigators to convert to a pressurised system, such as centre pivot, drip or spray, but what will happen is that their energy costs will increase, as will the amount of carbon they put out. One thing we are trying to do is retain our gravity irrigation system and make it efficient. We know that it can be just as efficient as the other systems, but the great thing is that there is not much cost there. Most of it is already there and it is low carbon.[5]
>
> That leaves us with the question of pumping water for irrigation. Pumping water has significant implications for carbon pollution, and I am sure that is of interest to this committee. The energy costs that come from putting water into a pipe, be it centre pivot, sprinkler system or drip, are significant. Work done by Guangnan Chen and Craig Baillie[6] shows that a pressurised irrigation farm can use three times the energy overall that a gravity fed farm might use. Currently a large amount of irrigation in Australia,

3 Dr Jeff Tullberg, Executive Committee Member, Australian Controlled Traffic Farming Association, *Transcript of Evidence*, 14 July 2009, p. 45.

4 A Padman Stop is a watertight rubber flap set in a concrete structure that makes it easy to automate gravity flow water, thus reducing the loss of water from leaking bay outlets.

5 Mr John Padman, Murray Irrigators Support Group, *Transcript of Evidence*, 3 September 2009, p. 42

6 National Centre for Engineering in Agriculture, University of Queensland.

> prior to Water for the Future, is under gravity fed systems or has a component that is fed by gravity.[7]

4.7 The 2005 document, *Landcare Australia: Meeting the Greenhouse Challenge* has some more general advice from farmers, to farmers, for improving on-farm energy efficiency:

> The type of fuel used in vehicles and machinery will influence the amount of greenhouse gases they emit when operating. Purchasing a new vehicle that uses an alternative fuel, such as liquid petroleum gas (LPG), or converting existing vehicles to make them compatible with alternative fuels, can reduce greenhouse gas emissions, improve air quality, and reduce running costs.
>
> Landcare Greenhouse Challenge participants identified the following ways to increase energy efficiency on their farms:
>
> - Select energy efficient machinery, appliances and vehicles when making purchases, and replace old, inefficient equipment.
> - Conduct regular maintenance on existing equipment to improve efficiency.
> - Adopt minimum till practices to reduce fuel consumption.
> - Use alternative fuels where possible (e.g. LPG).
> - Install renewable or alternative energy sources, such as solar panels, to supply electricity.[8]

4.8 There are also numerous smaller ways to reduce and conserve energy usage on farms. A Canadian study, 'Energy and the Canadian Food System,'[9] suggests that by taking a holistic approach, major savings in energy on farms may be made. Many of the examples in the study have a corresponding practice for which submissions were received by the Committee. For example:

- Tillage systems and physical manipulation of the soil
- Irrigation and soil moisture control
- Renewable energy production
- Plant species selection

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7 Mr John Padman, Murray Irrigators Support Group, *Transcript of Evidence*, 3 September 2009, p.45.

8 *Landcare Australia: Meeting the Greenhouse Challenge*, Department of the Environment and Heritage, 2005, p. 20.

9 *Energy and the Canadian Food System with particular reference to New Brunswick*, Stuart B. Hill & Jennifer A. Ramsey, McGill University, Quebec, 1977.

Other practices in the study may only be relevant in the context of Canadian agriculture or climate but remain as examples of what might be achieved through a focus on energy efficiency.

Energy efficiency in agricultural industries

4.9 A review prepared by the CSIRO in 2008 for Land & Water Australia offered advice for government on the location of agricultural industries for improved energy efficiency:

> Clustering of compatible industries with intensive livestock production, in order to tighten or close the resource loop, is another option. Agricultural industrial parks that co-locate industries involved in waste processing, energy generation, water capture and recycling, feedstock and foodstuff manufacture etc with livestock production have the option to reduce energy demand from fossil fuels and increase value in the value chain. The siting of these agricultural industrial parks should be determined after considering the potential for increased exposure of the site to climate change.[10]

4.10 The National Agriculture and Climate Change Action Plan 2006-2009 offers a series of strategies to reduce energy demand in agriculture as well as along the agricultural industry supply chain. While no real action is suggested, it is evidence that the issue has been acknowledged.[11]

Alternative energy

4.11 It is clear from the evidence presented to the Committee that there is significant interest in developing alternative energy sources for on-farm use and as a supplementary income stream. Initiatives within the bioenergy industry offer opportunities for creating energy from waste or by-products from agriculture and forestry.

4.12 In its submission to the Committee, the Grain Growers Association made a case for alternative energy sources on-farm as a supplementary income

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10 "An overview of climate change adaptation in the Australian agricultural sector – impacts, options and priorities." CSIRO, 2008, p. 262.

11 http://www.daff.gov.au/__data/assets/pdf_file/0006/33981/ nat_ag_ clim_ chang_action _plan2006.pdf, accessed 11 January 2010.

stream, and as an important contribution that farmers can make towards a low carbon economy:

> We should also look for other new revenue streams for farmers and regional Australia such as the harvesting of solar and wind energy and the production of renewable fuels. These new potential enterprises can be implemented on Australian farms right now if the correct incentives are put in place. New enterprise opportunities will assist to provide greater resilience to rural and regional communities, improved employment and investment opportunities and place Australia in a strong position for a changed climate and a low carbon economy.[12]

4.13 In particular, the submission from the Grain Growers Association called for:

- Continued development of, and support for, renewable fuel sources such as biofuels as part of a wider strategy of energy security. Australia should encourage the use of biofuels and if necessary continue to mandate these into the fuel system. Farmers should be encouraged to use biodiesel on farm, which can be locally produced as an alternative to petrochemical diesel from the oil industry. The government should reconsider its approach to fuel excise to facilitate such developments.
- Diffuse energy generation opportunities across Australia, should be encouraged, particularly on farms, including solar and wind power generation and small scale biofuels production. That is, as well as large scale investments, that individuals be encouraged to have household or small business generation sets to cover the immediate site power requirements and may be able to contribute back into the power grid. Such a strategy would relieve the need for new coal powered systems and make greater use of the natural resources of wind and sun available to Australia. [13]

4.14 In evidence to the Committee, Mr Hansard of the National Association of Forest Industries also identified alternative energy options as potential opportunity:

> Another key market signal is the full recognition of wood biomass for the generation of bioenergy. The current regulations under the National Renewable Energy Target Scheme only partially recognise wood biomass for the creation of renewable energy credits. The result is a significant lost opportunity to rural and

12 The Grain Growers Association, Submission no. 46, p. 3.

13 The Grain Growers Association, Submission no. 46, p. 9.

> regional Australia, in terms of jobs and investment, and a continued heavy reliance of Australia's economy on fossil-based energy.[14]

4.15 Another approach to optimising alternative energy opportunities is the conversion of diesel engines to run on alternative fuels. Bennett Clayton Pty Ltd is an engine technology company that specialises in converting diesel engines into alternative fuels including LPG, LNG and bio-alcohols (methanol and ethanol). In its submission to the Committee, Bennett Clayton outlined a current project and some of the benefits:

> Bennett Clayton is currently working with farmers in the Riverina to develop alternatives to diesel engines used by rice farmers to pump water from deep bores. Bennett Clayton has invested significant R&D in developing a conversion for a commonly used engine (John Deere 6068) from diesel to LPG.
>
> In the first instance LPG was chosen as a locally available fuel, and the technology has been structured for easy local manufacture. The converted engines are essentially ready to operate on renewable fuels (methanol or ethanol) that could in future be produced locally from local farm products (lignocellulose).[15]
>
> The converted engines have been very successful, reducing the cost of operating the pumps from $51 per megalitre of water pumped to $38 per megalitre of water pumped (on current fuel prices). The engines have also shown emissions reductions of up to 94% (particulates and NOx).[16]
>
> These changes can have a very significant impact in the farm irrigation sector, both by offering farmers greater efficiency, and by reducing emissions. As the engines are essentially ready for renewable bio-alcohols, farmers could transition to an on-farm produced bio-alcohol (e.g. methanol) fuel as soon as production technology, currently in development, becomes available…
>
> These alternative fuel engines have demonstrated reliability, having operated in the field for thousands of hours. They exhibit extremely low emissions, and reduced CO_2 production. They are more economical than diesels, both in fuel cost, and in maintenance…

14 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Transcript of Evidence*, 24 June 2009, p. 2.

15 Bennett Clayton Pty Ltd, Submission no. 72, p. 1.

16 Bennett Clayton Pty Ltd, Submission no. 72, p. 2.

> However, the take up of these engines in the market is hampered by the distortion created by the Commonwealth diesel fuel rebate. Farmers enjoy a Commonwealth Government rebate of about 38c per litre for diesel fuel used on the farm.[17]

Bioenergy on farms

4.16 Bioenergy is renewable energy made available from materials derived from biological sources. Bioenergy is also the term used to describe the many varied ways of utilising biomass to create fuel for energy.

4.17 The bioenergy industry in Australia is starting to offer viable alternatives for farmers to produce on-farm energy, sequester carbon, and profit from selling biomass. In its submission to the Committee, CSIRO categorise the different technological pathways for the production of bioenergy:

> There are many different technological pathways to producing biofuels, bioelectricity and other bioproducts. The various production pathways can be broadly grouped into:
>
> - First generation technology - which means that it is already used by commercial enterprises.
> - Second generation technology - this represents a step change in technology - it has been physically demonstrated but is not yet commercial due to scale-up issues, or it is not commercially viable due to very high conversion costs.
> - Third generation technology - this means that the process is at the conceptual planning stage, 'on drawing board' or at bench top demonstration stage, but has a long way to go before it can be deployed.
>
> Each of these different technologies has close links to the types of biomass that can be used to feed the process (known as biomass feedstocks). In addition to the types of technologies and feedstocks, assessments must be made in relation to the current production base for biomass (i.e. what is already being produced in Australia) as well as future production base (which may include new and novel plant species, or changes in land use to produce energy crops or forests etc).[18]

4.18 The submission continued:

> Different parts of the plant can be used with different technologies. For example with a cereal crop, ethanol is currently

17 Bennett Clayton Pty Ltd, Submission no. 72, p. 3.

18 CSIRO, Submission no. 19, p. 15.

produced only from grain using first generation technology. By moving production to use second generation technologies however, the fate of the stalks or stubble from the grain could be diverted away from the current system of being retained in a minimum tillage system (or in some areas being burnt), to being

- co-fired in the a coal fired power station to produce bioelectricity
- converted into ethanol via enzymatic technologies
- converted directly into syndiesel using thermochemical processes
- converted by pyrolysis into biochar and syngas (which could be used to produce syndiesel or run a turbine for bioelectricity)
- in future, being fed into a biorefinery to make a range of bioproducts (e.g. bioplastics, adhesives) as well as energy or fuel as a co-product.[19]

Working bioenergy plants

4.19 There are plants producing bioenergy in operation in a number of industries that use readily available biomass that would otherwise be a waste product. The Australian Pork Limited submission to the Committee described an early bioenergy project still in operation:

> …Australia's first on farm anaerobic digester in 1989 at Berrybank Piggery… is still generating heat and power for use on site and exporting electricity back into the grid. (Unfortunately, biogas capture and use is yet to be widely adopted across the industry due to the poor return on investment faced by pig producers, which has been exacerbated by low cost of coal fired electricity).[20]

4.20 Sugar mills in Australia have a readily available source of feedstock in the form of bagasse, the fibrous residue remaining after sugarcane is crushed to extract the juice:

> Australia's sugar industry is now using a "waste" by-product - bagasse - to co-generate over 1000 GWh of electricity per annum plus a similar amount of heat. The heat is used to crystallise the sugar, while most of the electricity is exported to the grid.[21]

19 CSIRO, Submission no. 19, p. 16.

20 Australian Pork Limited, Submission no. 16, p. 12.

21 CCRSPS Network, Submission no. 10, p. 9.

4.21 The Committee is also aware of a macadamia nut factory in southern Queensland that produces power from nut shells to run its operations (20%) and feeds the rest back into the grid (80%).[22]

4.22 Extensive research and development has been carried out in Western Australia, where Verve Energy operated a pilot Integrated Wood Processing (IWP) plant for several years, using advanced pyrolysis technology developed by the CSIRO to process oil mallee biomass:

> Combined with eucalyptus oil extraction, the IWP offers the potential to commercialise charcoaling, carbon activation technology and renewable electricity generation. The technology was developed in Australia by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), which Verve Energy adapted to electricity generation. Production from mallee tree feedstock of three marketable products - activated carbon, renewable electricity and eucalyptus oil - allows the mallee chain to be viable for farmers and developers alike.[23]

4.23 Up to 10 potential sites around the state were identified for future IWP plants to be built:

> Basically, wherever there are substantial plantings, and access to the Transmission System on to the grid, there is an opportunity to build an IWP plant.[24]

4.24 The Western Australian energy minister Francis Logan issued a media statement just prior to the end of plant operation discussing the improved commercial attractiveness of the technology:

> I have asked Verve Energy to seek expressions of interest from within the private sector about the commercial application of this technology. There is still a long way to go but I believe this technology represents a terrific opportunity for investment, at the cutting-edge of renewable energy production. With the right kind of investment, five to 10 mallee-tree generators could be built for the Wheatbelt and generate up to 50MW of electricity. Not only will this improve electricity reliability issues in the South-West,

22 http://www.agl.com.au/sustainability/Pages/energy-from-macadamia-nut-shells.aspx, accessed 14 December 2009.

23 http://www.verveenergy.com.au/mainContent/sustainableEnergy/OurPortfolio/iwp.html, accessed 14 December 2009.

24 http://www.oilmallee.org.au/wood_processing.html, accessed 11 January 2010.

> but also provide farmers with an additional income source, particularly on land affected by salt.[25]

4.25 The plant received $20 million of funding from numerous government agencies. Despite the cited commercial potential the plant closed down in 2006 at the end of its demonstration period.

Biochar

4.26 Renewable energy is one of the by-products of biochar production (see Chapter 2). The biofuel produced in the biochar process is often syngas, which is a mixture of mainly hydrogen and carbon monoxide, with a little carbon dioxide. The proportions of the three gases vary according to the processes used to create the syngas. However, the important point is that syngas is combustible and so can be used as a fuel source. Depending on the process, the biofuel from the kiln could also be bio-oil, which can be used as a substitute for diesel in some engines.[26]

4.27 As discussed in Chapter 3 the biochar itself may be used as a soil conditioner. A 2009 CSIRO report explains the potential, and slightly competing, outcomes of different biochar processes:

> Biomass ('feedstock') for biochar production can comprise most urban, agricultural and forestry biomass such as wood chips, saw dust, tree bark, corn stover, rice or peanut hulls, paper mill sludge, animal manure and biosolids. Under controlled conditions (i.e. in a pyrolysis plant), about 50% of the carbon in biomass is converted to biochar while the remainder is used for the pyrolysis process and bioenergy (heat, stream, electricity) production, the exact ratios depending on the type of production (e.g. fast vs. slow pyrolysis), biomass source and set conditions of pyrolysis…
>
> Sustainable production of biochar occurs as part of bioenergy production from pyrolysis of sustainably-produced biomass, which may be in the form of thermal energy, synthesis gas ('syngas'; e.g. hydrogen, methane, carbon monoxide) or bio-oil. Yields of biochar are reduced when yield of energy obtained from the system is increased. However, as calculated by Gaunt and Lehmann (2008), while the energy gain decreases if biochar is added to soil instead of being burnt for further heat production

25 http://www.oilmallee.org.au/pdfs/Fran Logan_Milestones at Mallee Plant.pdf, accessed 11 January 2010.

26 *The basics of biochar*, Background Note, Parliamentary Library, 10 September 2009, http://www.aph.gov.au/library/pubs/bn/sci/Biochar.htm, accessed 14 December 2009.

> and energy gain, the emission reductions by adding biochar to soil are much greater than the fossil fuel offsets when using the biochar as energy. In other words, if energy maximisation is the key goal, then biochar should be used for further energy generation (mainly heat); however, if emission reductions and climate change mitigation through C sequestration is the aim, then biochar should be captured and added to soil. Additional analysis is required to assess the relative merit (in terms of CO_2-e benefit) of these two pathways and will be largely driven by the CO_2-e intensity of electricity production (i.e. coal versus green power production).[27]

4.28 In evidence to the Committee, Mr Dale Park of the Western Australian Farmers Federation suggested that the utilisation of a pyrolysis plant could be an alternative income stream for farmers and offer benefits to the local communities:

> Another avenue of agricultural income would be to produce biomass to burn one way or the other. I would prefer to put it into pyrolysis, and you generate energy with that as well. Giving farmers another option is quite important. Things like bioenergy mean that we will keep people in those rural areas, whereas forestry traditionally has taken people out of those areas and reduced our populations. Maybe some of these new green industries can help keep that population in those country areas.[28]

4.29 Mr David Thompson, of the Northern Inland Forestry Investment Group, in evidence to the Committee, saw a potential source of savings and income for farmers who had lots of trees on their farms. Forestry residues from thinning trees can be used to produce syngas for electricity and subsequently feeding into the grid:

> [The syngas produced] can be used to generate electricity. My understanding from the local expert on pyrolysis is that for that to fly the feed-in tariff for the electricity coming from the pyrolysis plant needs to be around 80 per cent of the current green energy retail price, which I think is 24c, so it needs to be around about 16c.[29]

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27 An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use, CSIRO, August 2009, p. 144.

28 Mr Dale Park, Land Management and Climate Change Executive Portfolio Holder, Western Australian Farmers Federation Inc., *Transcript of Evidence*, 24 September 2009, p.12.

29 Mr David Thompson, Project Manager, Northern Inland Forestry Investment Group, *Transcript of Evidence,* 19 August 2009, p. 5.

4.30 Under the Climate Change Research Program, the federal government has provided funding for a research project into biochar, which will target gaps in our understanding of this emerging technology and address uncertainties about its use:

> This project will draw together leading researchers in Australia in the areas of biochar, bioenergy, soil science, emissions management and life-cycle assessment into a national effort, aimed to address key aspects of biochar generation and application in Australian agriculture.[30]
>
> Key activities under the project will include:
>
> - a life cycle assessment of biochar from feedstock source to production to sink, including costs, risks, benefits and implications for farmers
> - categorisation of biochars according to their properties and suggested usage
> - economic assessment of biochar for both net greenhouse gas emissions and potential profitability to land owners
> - analysis of risk factors in terms of rates of applications as well as the potential production of toxic by-products during pyrolysis.[31]

Sources of biomass

4.31 Biomass is material derived from recently living organisms, which includes plants, animals and their by-products. Biomass is the raw material, or feedstock, that is processed to create bioenergy, biochar and other bio products.

4.32 One source of biomass for energy producers and one that could potentially provide supplementary farm income is mallee eucalypts. Oil mallees are already used in integrated cropping and grazing systems, and to assist in salinity control in some areas.[32] The submission to the Committee from Future Farm Industries CRC (FFI CRC) points to current research and future developments for the use of oil mallee as biomass:

> … FFI CRC is developing short rotation woody crops (starting with oil mallees) that will diversify farm income into bioenergy

30 http://www.daff.gov.au/about/obligations/grants_reporting_requirements/november_2009 accessed 14 December 2009.

31 http://www.daff.gov.au/climatechange/australias-farming-future/climate-change-and-productivity-research/emissions_reduction2?SQ_DESIGN_NAME=spaced&SQ_ACTION=set_design_name, accessed 14 December 2009.

32 Future Farm Industries CRC, Submission 67, Attachment B.

> and bio-sequestration enterprises, and add to the resilience of mixed crop-livestock farming and wheatbelt communities.[33]
>
> Specialist cropping, livestock or mixed farmers will have an additional, new enterprise based on woody crops located in harmony with the still dominant crop or grazing enterprises. The current constraint to a viable oil mallee industry - a cost efficient biomass harvester, is now being tackled by FFI CRC. With its commercialisation in 2010-11, farmers will be able to choose between harvesting biomass for energy related products and bio-sequestration of carbon, according to price and farm priorities.[34]

4.33 In evidence to the Committee Mr Hansard, of the National Association of Forest Industries, suggested the forestry industry as a reliable source of biomass:

> I would like the committee to note a complementary activity to the use of wood biomass for energy—that is, the use of wood biomass for the production of biochar. The forest industries welcome the recognition by both sides of parliament about the potential benefits of biochar in storing carbon and improving the productivity of our agricultural soils... The forest industry is the largest source of biomass for the potential production of biochar. The win-win in this is that, while producing biochar, you can also generate heat for energy generation. But, as previously mentioned, we need the correct market signals.[35]

4.34 The National Association of Forest Industries submission to the Committee made a more detailed case for the use of forest industry by-products for biomass:

> Wood waste for renewable energy - There is enough wood waste available from existing forest industry activities in Australia to produce 3 million megawatt hours of electricity per annum. The net benefit of using this wood waste would be a permanent reduction in Australia's greenhouse gas emissions of up to 3 million tonnes of CO_2e per year. Renewable energy from wood waste reduces CO_2e emissions by 95-99% for each MWh of

33 Future Farm Industries CRC, Submission 67, p. 2.

34 Future Farm Industries CRC, Submission 67, p. 3.

35 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Transcript of Evidence*, 24 June 2009, p 3.

> electricity generated when compared to coal-fired electricity generation.[36]

Potential negative impacts associated with bioenergy

4.35 A number of submissions brought to the attention of the Committee some of the potentially negative impacts of collection and transportation of biomass required to produce bioenergy. Evidence was also received by the Committee expressing concern about the potential pressures on food production in favour of fuel production.

4.36 The CSIRO submission to the Committee notes that one of the challenging issues with the use of biomass to create biochar or bioenergy is the sourcing of material, and costs of collection and transportation of the biomass to the processing plant:

> Climate change will present a new and developing opportunity for biofuels in Australia. The use of biofuels is one mitigation strategy that can reduce greenhouse gases. However, the production of biofuels may be affected by the impacts of climate change and careful thought needs to go into the location of feedstocks for biofuel production and its relationship with land used for food production. As biofuels is an emerging industry and is not yet locked in to particular locations, it is in a position to take advantage of early planning and to address climate change adaptation issues associated with its supply chain. For example, there is likely to be less reliance on moving production facilities if crop locations could be anticipated in advance…
>
> Production of biofuels is dependent on the quantity and geographic location of the biomass. As such, the production of biofuels will be affected by the adaptation undertaken by the suppliers of these crops to maintain crop quality and quantity.[37]

4.37 One Queensland firm has overcome collection and transportation issues of biomass by offering on-site biomass charcoal production with a fully mobile pyrolysis plant. Claims are also made that some of the off-gases from the processor are used to run the mobile plant.[38]

4.38 A number of submissions also concern expressed about the potential to divert grain or sugar away from human food and animal feed value chains

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36 National Association of Forest Industries, Submission no. 51, p. 4.

37 CSIRO, Submission no. 19, p. 15.

38 http://www.bigchar.com.au/index.htm, accessed 14 December 2009.

for the production of energy. This concern was shared by Australian Pork Limited. In its submission to the Committee, one of the key recommendations for government to maintain a sustainable pork industry was the removal of government assistance for biofuels:

> Mandating ethanol content in fuel and encouraging grain-based biofuel production diverts grain from human food production, creates a food versus fuel relationship and eventually increases food prices for consumers. Incentives must be redirected into second-generation biofuels that are economically viable.[39]

> [F]rom an intensive livestock industry perspective, additional demand for grain distorts local markets and artificially inflates feed grain prices. Coupled with this is the increasing demand for food and international policy support for biofuels, causing world grain prices to trend upward. [There] is a significant threat for the viability of highly grain dependant intensive livestock industries such as the Australian pork industry.[40]

4.39 The submission to the Committee from the Victorian Government also expressed concern about the impacts of grain production diverted away from food to fuel:

> Other policies may affect Victorian farming businesses through impacts on market prices and market access. For example, the decision of the US Government to promote biofuels is an example of a policy risk for Australian farm businesses originating in another country. The policy diverted grain production away from food to fuel leading to upward pressure on grain prices. This benefited Australian wheat growers, but adversely affected dairy farm businesses, feed lotters and piggeries that purchase grains to finish cattle for market.[41]

4.40 In its submission to the Committee the Australian Academy of Science pointed to a global trend of increasing pressure on food agriculture to supply biomass:

> A further pressure is now emerging with the world's attention turning to renewable sources of energy. Most countries are converting, to a greater or lesser extent, to ethanol and biodiesel to deliver part of their energy needs. It is a sobering thought that Australia does not have enough arable land to satisfy its current

39 Australian Pork Limited, Submission no. 16, p. 5.

40 Australian Pork Limited, Submission no. 16, p. 16.

41 State Government of Victoria, Submission no. 73, p. 8.

> fuel needs as biofuels, even if no food crops were grown. In the US for example, already there are concerns about impact on food supply as the total corn crop in some States has been redirected to the biofuels industry which is likely to consume up to 80% of the total US corn crop in the next few years. It is now clear that whilst arable land resources are static there will be competition for that land between the food industry and the biofuels industry. The demand for agricultural produce is likely to intensify.[42]

Research and development

4.41 Several submissions to the Committee called for increased government support for alternative energy options as well as research and development opportunities.

4.42 While significant research has already been undertaken by government bodies, industry, and individuals to improve and develop energy on farms, there is still much work to be done.

4.43 In evidence to the Committee, Mr Hansard, of the National Association of Forest Industries, stressed the emerging nature of bioenergy in Australia:

> …these opportunities for our industry and for agriculture are just evolving now. We do not have all the answers as to the commercial side of this, and this is where we really need help from the government in order to put some good research into this sort of thing and look at the economic viability of these sorts of systems. We know that it can be done, because it is done overseas. In relation to the recognition and use of wood biomass, we are behind a lot of the other Western countries. We know it can be done; what we need is some good research into how it fits in to Australia and how we can actually do it so that it is commercially viable.[43]

4.44 Ms Narelle Martin, in her submission to the Committee, raised the question of how prepared Australian farming may be for very high oil prices. She advocated accelerating the pace of research to assist farmers exploit the potential opportunities in bioenergy:

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42 The Australian Academy of Science, Submission no. 48b, p. 8.

43 Mr Allan Hansard, Chief Executive Officer, National Association of Forest Industries, *Transcript of Evidence*, 24 June 2009, p. 7.

> Not only is equipment used by farmers run on diesel fuel, but many fertilisers and pesticides are derived from oil based products. Climate change and the increasing costs of fuel pose a major challenge for farming and rural communities. A useful question to ask is what happens with farming when oil hits a price of US$300 a barrel? How will price rises in these farm inputs, an outcome of a confluence of costs that will arise from climate change and issues associated with Peak Oil, be managed and mitigated?
>
> There is an urgent need for research to be undertaken and accelerated on alternative fuel stocks, and adapting current technologies so that they can more easily use other fuel stocks. At the moment, we transform petroleum based energy into food and fibre, a situation that is unsustainable.
>
> There are also significant opportunities for farmers and farming communities to take advantage of climate change. Traditionally, farmers and farm lobby groups identify themselves as providing food and fibre for the world. There should be two more planks for the farming mantra: as generators of power, and harvesters of carbon. In both cases, there are significant potential opportunities for farmers to be able to increase the range of income streams…
>
> There is considerable potential for rural research and development to assist farmers to identify and adapt to such innovation. Identifying policy roadblocks and regulations that act as constraints on the development of innovative power generation is one area. Assisting in developing models so that ideas and applications can be trialled on a small pilot scale would be of considerable assistance.[44]

4.45 Australian Pork Limited (APL) funds research into on-site bioenergy and greenhouse gas mitigation. Pork production is heavily energy and fuel dependant and APL funds a number of projects for alternative energy production with pig waste and other initiatives that aim to save energy. The covered anaerobic pond and the anaerobic digester are two waste management systems that can be successfully used to collect methane for generating electricity. The submission to the Committee from Australian Pork Ltd., identified some of the research needs for bioenergy in the Australian pork industry:

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44 Ms Narelle Martin, Submission no. 14, pp. 1-2.

> … key information gaps remain around bioenergy including performance of lagoons as well as production systems in differing climates and the lack of experience among technology providers to build, commission and operate biogas capture systems.
>
> Significant progress has been made towards commercialisation of on-farm methane capture and use via the Federal Government's Methane to Markets in Agriculture Program, to which APL is the largest financial co-contributor. However, further R & D work is required to make these technologies truly commercial, for example: a wider demonstration of the technology, particularly of the proposed sludge management techniques, developing lower cost digesters for smaller sites, and technologies better able to digest deep-litter bedding. Additionally, a critical mass needs to be developed to reduce construction and operating costs. Equally important is the extension work to make information available to pork producers, their consultants and technology providers.[45]

4.46 Some of the current APL funded projects related to alternative fuels include:

- Using piggery waste to generate electricity
- Anaerobic digestion of livestock wastes
- Assessing the performance of lagoons and covered anaerobic lagoon digesters
- Since 2007 APL and pork industry partners have been the leading financial co-contributors to DAFF's *Methane to Market (M2M) in Agriculture* program, which has led to the following projects being jointly funded:
  - ⇒ Retro-fitting floating covers with biogas flaring at a 700 sow piggeries
  - ⇒ Use of biogas for shed heating.[46]

Committee conclusions

4.47 The Committee is of the view that promoting energy efficiency on farm and promoting the use of alternative fuel sources are an integral part of adaptation to climate variability and climate change. This is a complex issue, involving concerns about commercial viability and competing

45 Australian Pork Limited, Submission no. 16, p. 13.

46 Australian Pork Limited, Submission no. 16, p. 12.

demands for resources. Finding practical alternatives to current energy sources, and practical alternative uses for agricultural waste have clear benefits.

4.48 The Committee is encouraged by the range of practices already available for farmers that have the multiple benefits of reducing energy usage and increasing enterprise resilience. It is also encouraging to note that the potential impacts of increased energy costs on agricultural industries are being acknowledged. The Committee supports existing research into energy efficiency for agricultural industries.

4.49 The Committee believes that increased incentives for use of alternative energy on farms are needed. The potential benefits, both economic and environmental, mean that some priority should be given to such research as part of the overall research strategy for agriculture and climate change. The Committee concludes that there needs to be continued investment in research into bioenergy and its applications for agriculture and its associated industries. It is the Committee's view that the funding and support for research and development into alternative energy sources be continued and increased.

Recommendation 6

4.50 **The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, increase its investment and support for research into energy efficiency in the agriculture sector and the development of alternative energy and alternative fuels on-farm, particularly in regard to:**

- **Biofuels;**
- **Biomass from agricultural waste; and**
- **Biochar.**

5

Climate modelling and weather forecasting

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

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

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

Current climate modelling and weather forecasting systems

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The need to improve forecasting skill

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.14 The 2009 House Standing Committee on Industry, Science and Innovation Inquiry into long-term meteorological forecasting in Australia also received submissions about the skill and accuracy of forecasting. The submission from Primary Industries and Resources (SA) stated that the most common concern is accuracy of the Seasonal Climate Forecasts (SCF) and current forecast systems:

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

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

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

> The fact that accuracy is so often raised by farmers and advisers in any discussion of SCF, suggests that a probability forecast is most often converted into a categorical forecast and the probability is used as a guide to confidence.
>
> Linked to the notion of accuracy is the request for more emphatic forecasts. Farmers and advisers will commonly complain that forecasts are too often in the order of 55% or 60% chance of exceeding median rainfall; they would prefer a larger swing from climatology with a more definitive forecast (e.g. 70 or 80% chance) that they have greater confidence to use in their farm management planning decisions. There is a paradox whereby the request from farmers is for more emphatic forecasts, yet the greatest damage will be caused by forecasts that offer strong guidance that is wrong. In the absence of seasonal climate forecasts farmers are planning for a range of possible futures, strongly emphatic seasonal climate forecasts may cause farmers to plan for single future outcomes.[16]

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

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

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

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

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

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

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

Appropriate meteorological products for farmers

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

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

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

Regional and industry specific forecasting

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Making forecasting appropriate and accessible

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

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

25 Growcom, Submission 55, p. 6.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Committee conclusions

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

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

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

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

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

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

Recommendation 7

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

Recommendation 8

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

6

Research and extension

6.1 Research and extension are vital to Australia's farmers meeting the challenges of climate variability and climate change. It is important that effective adaptation and mitigation measures are identified, disseminated and effectively implemented to ensure the long term viability and productivity of our agricultural industries.

6.2 This is an area that the Committee has addressed in the recent past, in the report *Skills: Rural Australia's Need*.

The Role of government

The current policy framework

6.3 In their joint submission to the inquiry, the Department of Agriculture, Fisheries and Forestry and the Department of Climate Change outlined the current policy framework for climate change research for the agricultural sector at the Commonwealth level. The submission stated:

> It is critical for managing climate change that the sector's preparedness and decision-making be based on sound, world's best practice research and resultant adoption and uptake. Our farmers need to understand and build knowledge of the implications of climate change and greenhouse gas management in order to minimise risk, adequately manage threats, and maximise opportunities.[1]

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1 Department of Agriculture, Forestry and Fisheries, and Department of Climate Change (DAFF/DCC), Submission no. 70, p. 13.

6.4 The foundation of the policy framework is provided by the Primary Industries Ministerial Council and the Primary Industries Standing Committee:

> The current cross-jurisdictional policy environment for the rural sector, including that for rural R&D, is being led by the Primary Industries Ministerial Council (PIMC) and its sole subcommittee, the Primary Industries Standing Committee (PISC).
>
> A subcommittee of PISC on R&D has a role to develop a national approach for future rural R&D in Australia. Ensuring jurisdictions firmly place climate change at the top of their policy agenda is also a key priority currently for PISC.
>
> PIMC is working to develop and implement a National Primary Industries Research and Development & Extension Framework. The Framework will establish a stronger culture of collaboration and cooperation to address key cross sectoral and resource issues.[2]

6.5 Providing advice to the Minister of Agriculture, Fisheries and Forestry is the Rural Research and Development Council, consisting of people prominent in various sectors of Australia's rural industries:

> The Council will have a central role in facilitating more effective use of public resources to address priority issues of importance to Australia's primary industries and associated value-chains, enhance the speed of delivery of research outputs to Australia's primary producers and the uptake of R&D by them, and to enhance domestic and international cooperation and collaboration. The Council will work closely with the rural RDCs [research & development corporations], industry sectors, research providers, state and territory jurisdictions and relevant government agencies to strengthen rural R&D through improved collaboration, facilitation and prioritisation of investment, and performance measurement and reporting.[3]

6.6 In evidence before the Committee, Mr Allen Grant, executive manager of DAFF's Agricultural Productivity Division, expanded on the role of the Rural Research and Development Council:

> The minister has established the Rural R&D Council to provide advice to him on rural R&D investment and priorities across Australia. One of the tasks that they need to deliver on is a rural

2 DAFF/DCC, Submission no. 70, p. 13.

3 DAFF/DCC, Submission no. 70, p. 14.

> R&D investment plan. It is not an easy task and it is designed to look across the current R&D model. The government puts over $200 million each year into the rural research and development corporation model through matching levies but the task of the council is to look more broadly than that at how rural R&D is directed, at the needs of our rural constituents, at what further opportunities might there be to put funding into rural R&D either through public investment or private investment, at what other mechanisms exist in other sectors of the Australian economy that might be appropriate to adopt into the rural sector to increase the amount of funding into rural R&D and to provide broader advice on priorities for rural R&D funding. Climate change will be picked up in that advice but it is not a specific target for the advice that the minister is looking for from that council.[4]

6.7 Rural research and development funding is also guided by the Rural Research and Development Priorities, which provide a regularly updated list of priorities:

> It is important to have broad agreement on national priorities for innovation and rural R&D which public investors are prepared to support. As priorities change over time, government policy needs to keep pace to ensure issues of strategic concern like climate change are being addressed adequately through innovation and to ensure that resources are used effectively.
>
> Rural R&D is being guided by both the National Research Priorities (NRPs), established in 2002 and last updated in 2003, and the complementary Rural Research & Development Priorities (Rural R&D Priorities). Reflecting the fact the RDCs are jointly funded by government and industry, it has been a practice of successive agriculture Ministers since 1994 to issue statements of Rural R&D Priorities to ensure that the priorities of government, as well as industry, are incorporated into RDCs' investment decisions.
>
> The Rural R&D Priorities were updated in 2007, in consultation with industry, research funders and providers and state and territory governments, and represent a shared set of high-level objectives across sectors and jurisdictions.
>
> The review took place in order to refocus and refresh the national understanding of critical R&D investment needs to better target

4 Mr Allen Grant, DAFF, *Transcript of Evidence*, 28 October 2009, pp. 1–2.

agricultural industry R&D efforts and to reflect the changing external environment. As part of this review, *climate variability and climate change* was elevated to become an independent, stand alone priority.[5]

6.8 The aim of the Rural Research and Development Priorities is:

> …to foster rural innovation and guide rural R&D in the face of continuing economic, environmental and social change. As such, they include social, environmental and commercial issues, which are becoming increasingly interconnected as industries respond to community concerns in both their products and production methods.
>
> While the priorities fall within broad categories, within each category more detailed guidance is provided on the types of activities investors should be focussing on in the short to medium term environment. Rural R&D Priorities enable issues of common concern to be explored in a coordinated and cost effective way and they also complement the NRPs. Two 'supporting' priorities supplement the Rural R&D Priorities.[6]

6.9 The current Rural Research and Development Priorities are:

- *Productivity and Adding Value*:

Improve the productivity and profitability of existing industries and support the development of viable new industries.

- *Supply chain and markets*:

Better understand and respond to domestic and international market and consumer requirements and improve the flow of such information through the whole supply chain, including to consumers.

- *Natural resource management*:

Support effective management of Australia's natural resources to ensure primary industries are both economically and environmentally sustainable.

- *Climate variability and climate change*:

Build resilience to climate variability and adapt to and mitigate the effects of climate change.

- *Biosecurity*:

5 DAFF/DCC, Submission no. 70, p. 15.

6 DAFF/DCC, Submission no. 70, pp. 15–16.

> Protect Australia's community, primary industries and environment from biosecurity threats.
>
> These are accompanied by two 'supporting' Priorities:
>
> - *Innovation skills*:
>
> Improve the skills to undertake research and apply its findings.
>
> - *Technology*:
>
> Promote the development of new and existing technologies.[7]

6.10 Each of the 15 Rural RDCs use the Rural R&D Priorities and the National Research Priorities in their R&D investment strategies and plan, and report against both priorities annually in various Operational Plans and over the longer term in Strategic Research and Development Plans. 'The RDCs are one of the Australian Government's main vehicles to support and assist primary producers to adapt to the impacts of climate change through rural R&D.'[8]

6.11 The RDCs

> commission and manage targeted investment in research, innovation, and knowledge creation and transfer on behalf of their major stakeholders, their industries and the government. To guide RDCs' investment strategies, industry and stakeholders are consulted and their input helps to develop three to five year corporate plans that reflect Rural R&D Priorities.
>
> With the extensive industry networks the model provides, RDCs create a critical link between the science and producers. This enables research to be appropriately targeted and more effectively extended to end users. The RDC model has provided farmers greater options in adapting to climate change through recent R&D by, for example, developing cropping systems that are more adaptable to climate change, practices that minimise on-farm greenhouse gas emissions and plant varieties with improved water-use efficiency or drought tolerance.[9]

6.12 In evidence before the Committee, Mr Mark Gibbs, General Manager, Climate Change Policy Branch, Climate Change Division, DAFF, explained the Government's current priorities:

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7 DAFF/DCC, Submission no. 70, p. 16.

8 DAFF/DCC, Submission no. 70, p. 14.

9 DAFF/DCC, Submission no. 70, p. 16.

> In terms of Australia's Farming Future and the Climate Change Research Program, we have announced a number of projects this year which look at aspects of soil carbon. They look at how farmers can manage their nitrous oxide emissions. They also look at how they manage livestock emissions—which is mainly methane. There is also a large area of investment in how cropping systems and how managing beef herds and cattle herds in both northern and southern Australia will be impacted by climate change and how there are potential movements for some small industries around Australia. A lot of work has been commenced there and is underway. That work brings together scientists. It brings together the CSIRO and those organisations that are part of our RDC framework. For example, MLA is involved in that work. GRDC is involved in that work. Dairy Australia is also part of that work. They have quite good extension networks, which can extend the results down to farmers. Indeed, we are also using farming bodies such as the Birchip Cropping Group to discuss issues of adaptation in their particular region. More broadly, in Australia's Farming Future, there is also FarmReady.[10]

6.13 Mr Gibbs then expanded on the work being undertaken as part of the Climate Change Research Program:

> With soil carbon, there was a $10 million investment made under the soil carbon research program. By the time we had investment from the CSIRO and the state DPIs [Departments of Primary Industries], we had leverage up to about $20 million. That program of work is about soil sampling in a strategic and targeted way that looks at farm management practices. We also look at places where we are certain that a farm management practice has been going on for some time and compare them to fields where that practice has not been occurring. That is important from a science point of view so that we can start to make some scientific judgments about how soil carbon has increased over time with that practice. Across Australia we target cropping, vegetable growing in Tasmania and different types of farm practices. We have coverage across Australia except for the Northern Territory.
>
> … We are developing a standard methodology run by the CSIRO so we can compare different results under different practices across the country. There is a lot of debate about soil carbon at the moment and about how different practices can significantly

10 Mr Mark Gibbs, DAFF, *Transcript of Evidence*, 28 October 2009, p. 4.

> increase carbon. What we are trying to ascertain is how those levels of carbon can increase. It is not just factors such as what you might be deciding to grow at one point in time; there are also environmental factors, which are very important when it comes to soil carbon. Very significant natural disturbances such as droughts or bushfires, for example, can have an impact on soil carbon.

6.14 Mr Gibbs explained that there is a strong connection between the nitrous oxide program and the soil carbon program, because those two gases are related in terms of soil management. When speaking of nitrous oxide management, Mr Gibbs stated that:

> In the past we have tended to use a methodology which basically involved measuring from a bucket in the ground—I do not know if you have ever seen it. We have now replaced that with things called automatic chambers which allow for nitrous oxide emissions which vary based on night and day, so we can get much better calibration of what is happening out in the field and over time.

6.15 With regard to the management of the livestock program, Mr Gibbs explained:

> That is another coordination hub where we have a number of activities going on, both in the extensive area and in the intensive area. We are looking at different types of management practices ranging from feed supplements to looking at productive traits for different animals. How we actually measure methane is an issue; 'looking at the science of the gut' is my expert way of putting it. That is quite a complicated area.
>
> …Methane emissions are probably one of those areas where it is going to take some time to get answers, but the way we are coordinating the work involves using, again, universities and the extension networks that Meat and Livestock Australia has. We do not have results coming out of that program yet, because it has just started, but we aim to have some results in the near to longer term.[11]

11 Mr Mark Gibbs, DAFF, *Transcript of Evidence*, 28 October 2009, pp. 6–7.

Research needs

6.16 Through the policy framework outlined above, and through the Rural Research and Development Corporations, Cooperative Research Centres, the CSIRO and universities, the Commonwealth makes a significant contribution to the research and development needs of Australia's farm sector. The various State Governments also play a significant role in rural research and development, and extension, through their departments of primary industries and institutions such as the Tasmanian Institute for Agricultural Research. Nonetheless, the Committee received a considerable amount of evidence about the need to better fund and coordinate research into adaptation to climate change and climate variability, and to provide better communication between researchers and farmers.

Funding

6.17 The need to improve funding for research into climate change adaptation was highlighted in the evidence brought before the Committee. In its submission, Australian Pork Limited stated:

> To create world class innovation and maximise the resilience and adaptive capacity of agriculture, government funding to agriculture R & D needs to be significantly increased and should be proportionally in line with the support given to geosequestration from coal fired power stations. Geosequestration - R & D has recently received some $500 million in funding from the Federal Government. Agricultural emissions are equal to approximately 35 per cent of the emissions of the coal industry (National Greenhouse Gas Inventory 2006) and are potentially more easily remedied. A significant increase on top of the current available funding is required to address existing R & D gaps and identify areas of future work to successfully reduce the greenhouse gas emissions from Australian agriculture.[12]

6.18 In its submission, the National Farmers' Federation also called for increased research funding, emphasising that research on climate change adaptation should not be funded at the expense of research into productivity:

12 Australian Pork Limited, Submission no. 16, p. 5.

> R&D is vital in providing farmers with the appropriate signals to build capacity to respond to the challenge of climate change through adapting their farm systems. This same analysis can also inform infrastructure investment decisions and help inform international discussions on reducing greenhouse gas emissions. While industry can and will play a key role in developing this science, it is vital that Government also supports this process.
>
> The NFF recognises that farmers need access to the right tools to effectively manage the risks and capitalise on the opportunities arising from climate change and climate change policy. Failing to dedicate an appropriate level of resourcing to this need will expose the agricultural sectors and indeed the broader community to the potential for significant perverse outcomes from a CPRS implementation. The NFF therefore agrees with the CPRS Green Paper finding that *"Regardless of the policy approach, additional support for research and development into mitigation options for the agricultural sector may be required."*
>
> However, in an environment of increasing concerns over global food supplies and the need for Australian agriculture to continually improve productivity, it is important that the research priorities identified for Climate Change Research Program do not reduce or delay the delivery of research outcomes which are aimed at improving productivity and building resilient, sustainable, well managed agricultural businesses.[13]

6.19 Mr Ben Fargher, CEO of the NFF, highlighted concerns within the farm sector about shifting priorities and declining funding for research. He explained to the Committee:

> We have been concerned that over successive governments in this country we have seen pressure on our research and development in agriculture. And it is not just a Commonwealth government issue or a state government issue; it is across the board. If you measure agricultural research against ag GDP and call it research intensity, you will see that it is at levels that are particularly low. We are concerned about that. We recognise the government has spent some money on R&D, but we also recognise there have been some budget cuts to R&D as well, which we are less than enthused about. Our priority going forward is how we can invest and make sure the extension of the R&D system in the states, the

13 NFF, Submission no. 17, p. 6.

> Commonwealth, RDCs and CSIRO works and is focused on. It is the type of thing that is not necessarily sexy compared to the CPRS debate, but it is the type of thing where you wake up in 20 years time and realise you have lost something you once had and regret it deeply. So we are very focused on R&D.[14]

6.20 In its submission, the South Australian Farmers Federation also expressed concern about the current level of research funding:

> Research and development will be essential to enable primary industries to adapt to climate change. However it is concerning that Governments (both State and Commonwealth) are decreasing the amount of funding provided to research and development. This has the potential to severely impact on agriculture's ability to adapt to the changing climate whilst improving productivity.
>
> Government has a role in funding and assisting industry in the development of farming systems that are more able to withstand a highly variable climate. This could include a focus on new varieties (better adaptation to a dry climate, high temperatures and increased incidence of frosts), new technology eg opportunities to reduce inputs or maximise productivity through technology such as biochar or production of ethanol from animal effluent, and new farming systems including new types of crops and pastures.
>
> Research is also needed to identify the potential impacts of climate change within regions, including production and impacts on the natural resources, which would enable a greater understanding and the potential for rural communities and primary industries to develop strategies to address these impacts.[15]

Coordination

6.21 The need for a high level of coordination in research activities, to maximise efficiency and prevent duplication of effort, was also emphasised in the evidence presented to the Committee. In its submission, the NFF stated:

> The NFF has been supportive of a nationally coordinated approach to research, development and extension programs, which recognise the needs of specific industries. In addition, we

14 Mr Ben Fargher, CEO, NFF, *Transcript of Evidence*, 16 September 2009, pp. 1- 2.

15 South Australian Farmers Federation, Submission no. 21, p. 4.

> note that the science behind emissions management and adaptation is rapidly changing and emerging. A clear role exists for the synthesis of this information and continual updating of information through an information hub(s) to deliver it in a form that is useful and accessible to primary producers. There are also benefits that can come from facilitating transfer of information across industries and regions through such information hub(s).[16]

6.22 In its submission, CCRSPI noted that:

> Australia's relatively small rural RDE spending must be directed strategically and managed efficiently. A national collaborative approach to RDE is required to avoid duplication and poorly targeted efforts.[17]

6.23 In its submission, Australian Pork Limited stated:

> Considering the complexity of the issues and the short timeframe for the task, APL supports a nationally coordinated approach to climate change related research as suggested by NFF and CCRSPI. A concerted approach to climate change R & D is also one of the key recommendations that came out of the latest ABARE modelling exercise. This would facilitate knowledge transfer between different sectors, streamline the whole process and allocate Government and industry funds in the most efficient way.[18]

6.24 In the context of climate change, CSIRO's Dr Andrew Ash noted the benefits of research coordination and the three current mechanisms available to achieve this:

> 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

16 National Farmers' Federation, Submission no. 17, p. 15.

17 CCRSPI, Submission no. 10, p. 4.

18 Australian Pork Limited, Submission no. 16, p. 20.

> 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 [CCRSPI] 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.[19]

6.25 A particularly vital element of the research coordination effort for many stakeholders is CCRSPI, which was established under the auspices of PIMC. The Committee notes that it is the only body involving all major rural R&D, extension providers and funding bodies including all rural R&D corporations, State Government primary industries departments, CSIRO, and the Australian Government. In its submission, the Victorian Government stated:

> From Victoria's perspective, CCRSPI has already demonstrated its potential worth in a coordinating, facilitating and brokering role for rural R&D investment in the recent call for project proposals by DAFF for its Climate Change Research Program, funded under the Commonwealth's *Farming Future* initiative. CCRSPI has also provided a comprehensive summary of existing climate change

19 Dr Andrew Ash, CSIRO, *Transcript of Evidence*, 21 October 2009, pp. 1–2.

> research and development, and identified many gaps and major opportunities for new collaboration. The scale and nature of the climate change challenges for farming sectors means resources can ill afford to be wasted on duplication or for key projects to fail due to a lack of critical funding or coordination.[20]

6.26 In its submission to the inquiry, CSIRO, noted that CCRSPI strategy outlines six priorities:

- Understanding Future Climates
- Managing Emissions
- Preparing Industries
- Accessing Information
- Facilitating Change
- Linking Decision Makers

6.27 CSIRO further notes that CCRSPI is:

> … an important way for primary industries to come together, share knowledge and invest in new research to prepare and adapt to future climate scenarios. While each of the agricultural sectors will have its own specific issues to deal with in terms of climate adaptation, the CCRSPI initiative helps coordinate effort and avoid duplication, particularly for areas of information that are common across different sectors e.g. climate change projections.[21]

6.28 In their submission, Horticulture Australia Limited and the Horticulture Australia Council endorsed CCRSPI, noting that its three pillars are 'collaboration, coordination and communication of information, knowledge and research focused on climate change in primary industries...'[22]

6.29 HAL states that as a partner of CCRSPI, it has strongly supported the need for coordinated research and sharing of knowledge between primary industries. Their submission recommends:

> Action: a process for effective two-way flow of information/needs/actions between industry (via both the CCRSPI process and peak industry bodies) and Government is required.[23]

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20 Victorian Government, Submission no. 73, p. 28.

21 CSIRO, Submission no. 19, p. 22.

22 Horticulture Australia Ltd and Horticulture Australia Council, Submission no. 62, p. 19.

23 Horticulture Australia Ltd and Horticulture Australia Council, Submission no. 62, p. 30.

> Action: Government should support coordinated communication for primary industries through the CCRSPI process.[24]

6.30 Concerns were expressed to the Committee about the future of CCRSPI since the abolition of Land and Water Australia. Mr Robert Young, Director, Climate and Water Research, with the NSW Department of Primary Industries, advised the Committee:

> I guess we were a fan of the CCRSPI structure itself because it got all the players around the table—the state agencies, the CSIRO and all of the rural RDCs. A structure like that that brings most of the players to the table is useful. Now that Land and Water is gone, how we develop a strategy to move forward from that is where we are at at the moment. That might be finding another logical host for that structure, like RIRDC or a more generic RDC, if you like, rather than an industry specific one… I am quite comfortable in terms of who hosts it; the key thing is that people actually get to have a say in how it operates.[25]

6.31 Similarly, Mr Drew Wagner, Senior Policy Advisor with AgForce, raised questions about the future of CCRSPI and emphasised the need to continue the work that had been started under the auspices of Land and Water Australia:

> Without looking like we are sniping from the sidelines, the Land and Water Australia abolition took a lot of industry players very much by surprise. The work that they were doing using the climate change analogy under the CCRSPI program was a very specific and targeted primary industries research program, and the agendas that came out of that and the opportunities that even arose out of that process, while they might not have been able to be undertaken holistically because of the number of possibilities that would put forward, it at least would have allowed for a targeted regime to be worked through. It was getting to the point where a lot of that work was actually starting to get to the crux of what they were trying to achieve, but the flagship that was driving it has been removed. Now, we understand that functionality is still going to be there but, without the specific focus of organisations as executive agencies like that one was, often the agendas can get caught up in the minutiae of what is going on at departmental levels… The loss of that executive agency to drive that agenda has

24 Horticulture Australia Ltd and Horticulture Australia Council, Submission no. 62, p. 33.

25 Mr Robert Young, NSW DPI, *Transcript of Evidence*, 1 July 2010, p. 24.

> been seen as a massive loss and felt not only across the rest of the research and development corps but also across industry at the same time.[26]

6.32 In evidence before the Committee, officers from DAFF explained that CCRSPI had been transferred to the University of Melbourne.[27]

Time frames

6.33 The question of time frames for agricultural research, taking ideas from inception through to widespread adoption, was raised in evidence before the Committee. This is an issue the Committee also encountered in its previous rural skills inquiry. The evidence presented before the Committee in this inquiry highlighted the importance of matching programs and funding to the often long term requirements of agricultural research.

6.34 In evidence before the Committee, Mr Kevin Goss, CEO of the Future Farm Industries CRC, stated:

> …we are really saying that government assistance to farmers in this very important matter of adapting to climate change should take a longer term view than we see is being planned at the moment. If you think about the public and private investment in research that underpins collaborative arrangements that scan across the many entities that can really serve farmers very well, you see the science capacity behind it builds over time. This is a long run now, so having a long-term view about how it is to be done is clearly quite important.[28]

6.35 Expanding on this point, Mr Michael Poole, Director of the Future Farm Industries CRC, gave the example of the development of no-till farming in Western Australia:

> I was there for the whole of that journey of the development of zero till. It started off, really, with a dream: that we needed to move to tilling systems, which were much more efficient in their water use, which stopped the country blowing away, and which would take advantage of new technologies as they came in. Through a very strong partnership from the beginning … pulling all those in, it then took 30 to 40 years to bring that from an

26 Mr Drew Wagner, AgForce, *Transcript of Evidence*, 14 July 2009, p. 9.

27 Mr David Mortimer, DAFF, *Transcript of Evidence*, 28 October 2009, p. 9.

28 Mr Kevin Goss, FFICRC, *Transcript of Evidence*, 9 September 2009, p. 1.

> embryonic idea to now, when about 95 per cent of the country is using those techniques. I think that as we go forward in adaptation research and R&D for climate change we will see the same sorts of timescales. It is a long time-scale problem and we will need to bring that sort of effort to bear. It is about partnerships and research collaborations and it will need to bring in a whole range of technologies. A feature of bringing in the tillage was the partnership and collaboration, but there was also the aggression with which we attacked the problems. There were about a dozen step changes in that as we went forward—new pieces of technology coming in—so it was not a case of one thing being done and then adopted over 30 years. Problem after problem after problem had to be knocked over, and they are still being knocked over as new problems arise today in those systems. As climate change and climate variability impact on those systems, we are moving to new technologies to handle them. Our key message there is that, as Kevin alluded to, it has taken a long, hard grind of public and private money, public and private research and world-class technology to get there and that really is what we face with something as complex as climate change.[29]

6.36 Mr Wagner, of Agforce, also noted the often long time scales between inception and adoption, and the problems that could occur when programs or funding ceased too soon:

> The difficulty with R&D, though, is that—as anyone involved in research might tell you—you could find the answer tomorrow or you could find it in 10 years. The lead time on getting a lot of this stuff right and then commercialising it and extending the product out to the market can often be very long. There appears to be a reticence to commit to a lot of those longer time frames, which is understandable financially but perhaps, for market development and market accuracy, a somewhat too narrowly focused aperture to get that desired outcome in the end.
>
> There are often times … when R&D agendas have been removed because no outcome has been determined within a set time frame and a new priority has come up… But we need to take it to the nth degree to find out what that end outcome is, because otherwise we are going to keep throwing money at things we have not actually finished.[30]

29 Mr Michael Poole, FFICRC, *Transcript of Evidence*, 9 September 2009, p. 2.

30 Mr Drew Wagner, AgForce, *Transcript of Evidence*, 14 July 2009, p. 8.

6.37 Dr Don Yule, Director of Controlled Traffic Farming Solutions, pointed to the impacts of stop-start project funding on the development of Controlled Traffic Farming:

> The five years of the project just proved that it could happen, proved the content that was needed, that it would work and also demonstrated the process of the one-on-one interaction with the farmers… In terms of what government can do now there was no follow-up from Land and Water Australia.
>
> …What we needed at that stage was for them to say, 'This is really good stuff, we need to take it to the wider farming community and we also need to take it to the wider service sector.' What happened was that they said, 'We've done it, we'll move on to something else.' … GRDC was involved in that and they said, 'We're going to work on something else.' They also came back with a bit of a thing that we were supposedly so successful that everyone was doing it. It fell in a bit of a hole, I suppose.[31]

6.38 However, Mr Wagner, also emphasised the need to move quickly on research and development into climate change adaptation—the nature and complexity of the problem requires an urgent response:

> The thing that worries me and our organisation specifically though… is the sheer speed upon which we are going to have to see the deployment and commercialisation of these opportunities. We have talked about the ongoing very strong history of adaptation within this sector domestically in Australia since time began. But the difficulty here is that in the past we were talking about it taking generations to adapt and overcome issues. We are now going to be talking about multiple issues within generations. It appears that the impacts which we are trying to adapt to are ramping up almost exponentially. Perhaps the focus on the R&D side of things is not ramping up at the same rate.[32]

6.39 Mr Bill Williamson, an agricultural scientist who appeared before the Committee with the Murray Irrigators Support Group, noted that scientists were increasingly being asked to focus on simple issues with straightforward responses—often in response to policy demands—a fact which was undermining their capacity to work through complex issues like climate change adaptation:

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31 Dr Don Yule, CTF Solutions, *Transcript of Evidence*, 14 July 2009, p. 39.

32 Mr Drew Wagner, AgForce, *Transcript of Evidence*, 14 July 2009, p. 10.

> Science is good at dealing with difficult problems, and typically policy and politics likes to see simple problems. Simple problems are where there is a signal and you get a direct response. Difficult problems are situations where you have a signal and you might get one or two different answers. Complex problems are where you do not really see the signal; you just go out and do something and the farmer knows it is going to be right. That is a difficult space to work in. I think science more and more seems to be pushed into situations where science does not have the time to consider complex issues, and it is poorly prepared to deliver solutions for complex problems.[33]

Regional focus

6.40 Another important issue raised during the inquiry was the need for a regional focus for research initiatives. Regional variation in climatic, soil and production conditions made regionally relevant research outcomes vital.

6.41 In evidence before the Committee, Mr Dale Park, representing the Western Australian Farmers Federation, told the Committee:

> One of the real grizzles of almost all of Western Australian farmers is that for the amounts of levies that we pay into the RDCs, the research and development corporations, very little comes back to Western Australia. Certainly, we have heard the argument that comes back that the work done in the eastern states has application in Western Australia as well.
>
> Conversely, we also must recognise that the mechanisms for having lower carbon agriculture have not only a north-south divide but definitely an east-west divide, and that happens in the north and south too. Not a lot of what happens even in the Kimberleys can be compared with what happens in Queensland. We are reasonably close in our agriculture in the south-west land division to some of what happens in Victoria, but there is a hell of a lot of that is a lot different as well. One of the things that have definitely been lacking in quite a lot of research is the recognition that things are different in the west and the east.[34]

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33 Mr Bill Williamson, Murray Irrigators Support Group, *Transcript of Evidence*, 3 September 2009, p. 46.

34 Mr Dale Park, WA Farmers, *Transcript of Evidence*, 24 September 2009, p. 8.

6.42 Mr Park informed the Committee that the key to success in pursuing national research objectives was ensuring stakeholder representation from different parts of the country:

> I would support the idea of having regionally based research, but that can be national as well. Through some of the Australia's Farming Future funding for biochar there is a group that is the amalgamation of all our universities and the ag department, and CSIRO in Western Australia is participating in that through the national program.[35]

6.43 In his submission to the inquiry, the Minister for Agriculture, Food and Forestry, Western Australia, made a similar point:

> A key priority is to undertake research to identify the impacts climate change will have on the Western Australian agricultural industry. As noted, it is crucial that any such research takes into account Western Australia's unique conditions, and is not generalized from other regions. Thus, Western Australia supports the development of national research networks, but on the proviso that adequate funding is available to undertake Western Australian specific work.[36]

6.44 The Minister further noted that:

> Adaptation responses need to be determined at a local level. Each business will have a unique response depending on where they are in the farm family cycle. Each district will be affected in slightly different ways and experience different degrees of variability. It is predicted that WA will suffer the biggest effects from climate change and thus its rural communities may need to make significant adjustment. While there is some transferability of adaptation research across jurisdictions, in order to determine specific adaptation responses for Western Australian agriculture, specific work needs to be undertaken here in Western Australia. Consequently there is a role for both State and Commonwealth investment in researching adaptation responses for both agriculture and forestry.[37]

6.45 This is not an issue of relevance just for Western Australia. Mr Jim Maynard, Chairman of Mallee Sustainable Farming Inc., informed the

35 Mr Dale Park, WA Farmers, *Transcript of Evidence*, 24 September 2009, p. 8.

36 Minister for Agriculture, Food and Forestry, Western Australia, Submission no. 61, p. 3.

37 Minister for Agriculture, Food and Forestry, Western Australia, Submission no. 61, p. 1.

Committee of the need to take account of regional variations even within his area.[38]

Farmer led research

6.46 Farmer input into adaptation research was seen as a critical issue by many of those who spoke to the Committee, especially those farmers and researchers at the cutting edge of innovations that were receiving little or no institutional support. It was seen as critical to accelerating adaptation that farmers have input into research priorities and that scientific evaluation be made of farmer-led innovations.

6.47 In evidence before the Committee, Mr Maynard stated:

> MSF submits that direct farmer participation in problem solving and driving locally relevant research leads to a more rapid application of the practical on-farm solutions in the adaptation and adjustment to changing climate immediately and in the long term. By farmers owning that and having some say in it, it becomes more relevant to other farmers than just being told by a departmental person, 'This is what you should do.' It just seems to work a little bit better. It does not say that it works all the time, but in our opinion it does work better. In our area we have lived with a variable climate all our lives; I have seen it come and go. To survive you have to learn to adapt to whatever is happening at the time. We have had wet seasons and particularly dry seasons. We have learned to adapt as best as possible. However, in doing that, we have had to gain some research to make sure that what we find out is sustainable in the long term.[39]

6.48 Mr John Rochecouste, CEO of the Conservation Agriculture Alliance of Australia and New Zealand (CAAANZ), told the Committee:

> I think a lot of our researchers are not familiar with farm machinery and how it operates. So what we would like to see is a lot more on-farm research. We feel that, if you want to actually get information across to farmers, some of the best people with the capacity to do that are farmers who have done it themselves. They can go to their community and say, 'I can do it and I'll show you

38 Mr Jim Maynard, Mallee Sustainable Farming Inc., *Transcript of Evidence*, 3 September 2009, p. 68.

39 Mr Jim Maynard, Mallee Sustainable Farming Inc., *Transcript of Evidence*, 3 September 2009, p. 67.

> how I've done it.' We get a good crowd at most of the field days and events we have where farmers speak.[40]

6.49 He too highlighted the benefit of working directly with farmers to test and verify innovative practices:

> We have got the capacity to improve research enormously quickly by starting the research on the farm and then having yield monitors and a controlled traffic system collect that information, and we can have that distributed to the farmers within the season. We do not have to go through a three- or four-year research program. So, if researchers would just work with us, I am sure we could achieve results a lot faster.[41]

6.50 Mr Rochecouste concluded:

> We would like researchers to come and talk with us about what needs doing and not go off on their own and make a decision about what they think we need.[42]

Committee conclusions

6.51 The Committee believes that in general, the current policy framework for research and development of climate change adaptation is appropriate. The Australian Government has already committed significant funds towards climate change research and towards a range of potential and actual adaptation measures. The Committee is of the view that if this research effort is sustained good results will be effected.

6.52 The Committee has some significant concerns however that research needs to be effectively coordinated to avoid waste and duplication. The Committee heard evidence to the effect that CCRSPI was seen as an important agent for achieving coordination. The Committee is concerned that the work of CCRSPI may have been delayed by the demise of Land and Water Australia and the time taken to find CCRSPI a new home. The Committee is of the view that CCRSPI should be the principal agent for achieving research coordination in climate change adaptation, and that the Australian Government should provide the necessary resources of staff and funds for CCRSPI to continue its role.

6.53 The Committee also has some concerns about research funding. The current funding effort is the minimum required to achieve results and

40 Mr Jean-Francois Rochecouste, CAAANZ, *Transcript of Evidence*, 14 July 2009, p. 30.

41 Mr Jean-Francois Rochecouste, CAAANZ, *Transcript of Evidence*, 14 July 2009, p. 31

42 Mr Jean-Francois Rochecouste, CAAANZ, *Transcript of Evidence*, 14 July 2009, p. 33.

must be sustained if current and prospective research is to be converted into effective adaptation. Adaptation to climate variability and climate change is a long term project—it requires long term research funding.

6.54 The Committee agrees that there is a strong need for region specific research. The impacts of climate variability and climate change can be highly industry and location specific. It stands to reason, therefore, that developing local and regional responses to climate variability and climate change is essential.

6.55 The Committee was impressed with the potential range of responses to climate variability and climate change already being undertaken by farmers—some of it outlined in Chapter 3 of this report. A significant part of the adaptation response is already taking place outside the realm of government policy and formal research networks. An effort needs to be undertaken to capture, evaluate and disseminate these responses. Doing so will accelerate the adaptation response to climate variability and climate change.

Recommendation 9

6.56 **The Committee recommends that the Australian Government maintain its commitment to climate change research pertaining to Australia's agricultural industries, ensuring that the funding is committed, sustained and pays due attention to regional as well as national needs and priorities. Climate change research must reflect the changes affecting different regions, soils and topography—as all have an impact on changes in farming practices to deal with them.**

Recommendation 10

6.57 **The Committee recommends that the Australian Government, as part of its ongoing strategy development to issues affecting agriculture and climate change, develop a strategy to capture, evaluate and disseminate the range of farmer driven innovations that have a significant capacity to increase the resilience and productivity of farm enterprises.**

Recommendation 11

6.58 **The Committee recommends that the Australian Government ensures that there is an overall body to receive and analyse research and co-ordinate research across the nation in relation to climate change adaptation in agriculture, and that said body is given the necessary resources of staff and funds to carry out its role.**

Extension

6.59 During the course of the inquiry there was much discussion about the current state and availability of extension services. There was widespread agreement that government extension services had declined. There was less agreement on whether or not this was a problem. Some thought the decline in state government extension services reduced the availability of independent advice; others highlighted the increase of private extension services.

6.60 In its submission to the inquiry, CCRSPI noted the loss of government services and the need to increase overall funding for extension:

> Over the past decades successive governments, both state and federal, have reduced funding to rural extension networks and shut rural research stations. This has greatly reduced the capacity of governments to assist farmers to adopt new R&D and to be able to demonstrate and commercialise new technologies and practices in the field.
>
> Private agronomists and consultants have partly filled the extension gap, though their focus tends to be limited by commercial considerations…
>
> Much more investment is required in extension, training, commercialisation and demonstration if Australia's primary industries are to adapt to the impacts of climate change and continue to contribute to Australia's wealth and wellbeing.[43]

6.61 Mr Dale Park, of the Western Australian Farmers Federation, made a similar point. He told the Committee:

43 CCRSPI, Submission no. 10, pp. 16–17.

> The real difficulty for an on-the-ground farmer like me is being able to work out what is relevant, what is not relevant, and who you should be talking to. And with the demise of information coming from the ag department, which was always seen as an independent arbiter almost, we have to get our information from either consultants or proprietary firms and it just makes life a lot more difficult for us in trying to work.[44]

6.62 Mr Michael Poole, Director of the Future Farm Industries CRC, on the other hand, saw the shift from public to private extension services principally as a challenge to the public sector to integrate with the new reality:

> Twenty years ago it would have been almost totally a case of public agronomists working in departments of agriculture out there in the countryside. We have seen a steady shift. There has been some erosion of those services by the various governments and a steady rise in private agronomists. For example, our partner company, Landmark, now employs hundreds of agronomists and we have training programs for them. There are now consultants out there in the countryside. So a lot of delivery now is through the private sector, and the challenge then is for the public research sector and R&D sector to then interface with that army of people out there in the countryside to make sure that the technologies get through.[45]

6.63 Mr Kevin Goss, CEO of the Future Farm Industries CRC, reinforced the point:

> … there is a changing distribution of how advice works and how farmers are supported … the relative contribution of state agency personnel in applied research in this area is declining and the contribution of the private sector is increasing while the others are remaining about where they are. So what is really important, and it is really the central thing of what we are saying, is that if you are the Australian government and you are investing in R&D to assist farmers to adapt to climate change, then you need to think about how that connects with how farmers come to be part of that: it is the rising private sector, it is still the important role of the public sector and how you bring them together.[46]

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44 Mr Dale Park, WA Farmers, *Transcript of Evidence*, 24 September 2009, p. 9.

45 Mr Michael Poole, FFICRC, *Transcript of Evidence*, 9 September 2009, p. 12.

46 Mr Kevin Goss, FFICRC, *Transcript of Evidence*, 9 September 2009, pp. 12–13.

6.64 In evidence before the Committee, Mr Allen Grant from DAFF highlighted the widespread availability of extension services, arguing that farmers had to take some responsibility for accessing the available services:

> I think the capacity is there, but whether farmers choose to take it up is really up to them. It is there in programs like FarmReady, it is there in the extension services that are still provided mainly by the state governments and it is also there in the increasing number of economists and other business services that are provided by the business sector. Companies like Landmark and those sorts of people are really extending their abilities and skills and availability to take farmers through some of those key issues. So I think the capacity is there, but, in the end, farms have to choose to access it.[47]

6.65 Mr John Rochecouste, CEO of CAAANZ, argued that the critical point was to resource the best from of extension—from the point of view of CAAANZ a direct farmer-to-farmer format:

> The thing we feel is important is that farmers are often excluded from the extension process or are at the end of the pipe and we would like to see them a lot more involved in developing the information for themselves … A lot of our communication is done working with farmers in paddocks, and that capacity has been severely eroded in the last 10 to 20 years. A lot of departments of agriculture have pulled back from their on-the-ground extension. That has been picked up by farmer groups. All our members pay to become members and they do that because they get a benefit out of it. We would like to see extension that actually involves farmers a lot more in doing things on the ground, working with them in their area.[48]

6.66 Mr Mark Moore, Policy Analyst with the NSW Irrigators' Council, noted the success of an extension program run by the NSW Irrigators' Council:

> We went to six different locations throughout New South Wales. The feedback that came from the farmers who were attending them was on the ability to listen to individuals who were actually trialling things on their farm or had successfully completed trials and had supporting data. Farmers were being advised of this information not in the sense of 'this is what you should be doing' but in the sense of 'this is what I have been doing and it has

47 Mr Allen Grant, DAFF, *Transcript of Evidence*, 28 October 2009, p. 5.

48 Mr Jean-Francois Rochecouste, CAAANZ, *Transcript of Evidence*, 14 July 2009, p. 26.

> worked so you might be able to take away some ideas and new innovative ways of looking at things that might assist you when you look at your operation'. There was 100 per cent positive feedback from it…we have actually expanded it to nearly all of Australia. We are going to be going to Tasmania, Western Australia, South Australia, Victoria and Queensland.[49]

6.67 Several points were highlighted by various submissions and witnesses. The first was the need for governments to manage the flow of information, helping farmers sort out what material was relevant to them.

6.68 In evidence before the Committee, Ms Alison Turnbull, representing Horticulture Australia Limited, stated:

> There is both overload and need for information, so there are those two gaps that are happening. But the industry also is getting quite frustrated because climate change can be happening obviously at all different levels and the issue that we have is that we are getting global information that is driving the media and government to act, but the tailored, relevant information for them to actually make a change on farm is not there for them yet. The issue is the gap between what they are perceiving and being told by the media all the way down to 'What can I do to my farm and what does it mean to me?' Unfortunately we do not have an answer for everybody at the moment.[50]

6.69 A similar view was expressed by Ms Karlie Tucker, from RM Consulting Group:

> There is an information glut in that there is a lot of information around, but whether that information is useful is the first question for me. It is really difficult to find very good regional data on how rainfall will change over a year and between years for our region. … One example that I really like that has been used in the Department of Primary Industries is saying that there are different climate impacts, such as the southern annular mode, the Indian Ocean dipole, the El Nino and ENSO. It is about helping farmers understand those, when they are in positive or negative, how they affect rainfall or they are likely to affect spring rainfall, spring breaks and things like that. That helps management throughout the year for farmers. A really positive way that government can be involved is in helping train up people on the different indicators. I

49 Mr Mark Moore, NSW Irrigators' Council, *Transcript of Evidence*, 1 July 2009, p. 5.

50 Ms Alison Turnbull, Horticulture Australia Limited, *Transcript of Evidence*, 1 July 2009, p. 14.

> think there needs to be much more regional specific data, and also that information has to be presented in a way that farmers can use it for immediate decision making.[51]

6.70 Mr Chris Phillips, General Manager, Trade and Strategy, with Dairy Australia, told the Committee that the number of people who are able to pass on knowledge by having meaningful discussions with farmers is diminishing:

> One of the key challenges for us at present is that it is not the traditional thing about putting more fertiliser here or changing herd genetics there a bit. With respect to the greenhouse debate, it is about which types of herd genetics and feed systems will result in an answer for that policy. That may send a quite different commercial signal to the farmer as to whether he is making money out of those exercises. We are struggling at the moment to understand the many dimensions and how it crosses over in the different parts of the farm systems. In particular, some of the smaller dairying regions need support to work out how the skill bases can translate over.
>
> Yesterday I was talking to someone about a situation in Yarram, in Gippsland. Because of some of the changes in temperature for some of the farm systems down there they are finding they are not working very well with perennial ryegrass anymore. They are asking, 'How do we find out about other farm systems in Australia where they are not reliant on perennial ryegrass to the same extent, such as in South Australia and Western Australia?' But how do you get that extension knowledge that is localised in those regions over to someone in Gippsland? The local extension people know their regional systems, but we have to work out how we can translate some of that knowledge across regions.[52]

6.71 In keeping with the evidence presented in Chapter 2, it was noted in the submission of the RM Consulting Group that to be effective, extension had to be provided in a range of formats to meet different needs and situations:

> One-on-one advice is useful, but RMCG's investigation of best practice extension indicates there is huge value in discussion groups when farmers are under stress. At these times, the peer-to-peer learning and social interaction such groups provide is highly

51 Ms Karlie Tucker, RM Consulting Group, *Transcript of Evidence*, 3 September 2009, p. 61.

52 Mr Chris Phillips, Dairy Australia, *Transcript of Evidence*, 3 September 2009, p. 17.

> beneficial to maintenance of farmer well-being and their ability to make decisions. They can also provide relaxed environments for farmers to explore scenarios and to meet potential advisors.[53]

6.72 Moreover, in evidence before the Committee, Dr Alison Gates noted the importance of using established and trusted pathways to transmit information to farmers (a factor which will be further explored below):

> My initial reaction is that farmers tend to have quite established pathways where they get their information from and that maybe setting up a new approach might be counterproductive. I think it is important to make sure that the information gets down through the pathways that they are using. For a lot of people that is even simple things like the Land newspaper. Making sure that good information goes down existing pathways would be the place where I would be inclined to think that you start.[54]

Local coordination

6.73 Achieving accessibility and local relevance of research and extension was the key role of a number of local groups which provided models for local action.

6.74 In its submission, Mallee Sustainable Farming Inc. highlighted the success of its model in providing regionally focused research, development and extension. Since its formation in 1997, MSF has utilised research expertise from state, federal and local agencies, as well as skills from the private and university sectors, to make the organisation relevant to needs of local farmers. They have also developed 'a number of successful extension activities to communicate new and timely information to landholders.'[55]

6.75 In evidence before the Committee, Mr Jim Maynard, Chairman of Mallee Sustainable Farming Inc., stated:

> The model brings farmers and scientists working together to answer the challenges through a wide range of mechanisms, driven by farmer questions, including our state based reference committees. Each state in our area has its committee that feeds information from their farmers towards us to decide. We have regional forums, field days and demonstration sites. Last year we

53 RM Consulting Group, Submission no. 29, p. 8.

54 Dr Alison Gates, School of Earth and Environmental Sciences, University of Wollongong, *Transcript of Evidence*, 1 July 2009, pp. 47-48.

55 Mallee Sustainable Farming Inc., Submission no. 31, p. 2.

> trialled a system—that was funded from DAFF—in respect to when you need change. If we have four or five farmers in close proximity together that want to change their system, we employ an agronomist to help them to understand what the change implies. It worked very well, to such a degree that I know that there were four farms and two of them are now paying an agronomist to carry on the work. That is a very quick way to bring change on. It is the quickest way of the lot. It is a bit more expensive than field days and forums, but you really grab the issue. When you get four farms changing in close proximity and the neighbours start seeing results, it is often the case that eight or 10 farms that will take it on. That is a very quick way to implement change if you want it. It does come at a cost, but from what I saw of it, it is well worth it, but it was only a short-term project.[56]

6.76 In its submission, Mallee Sustainable Farming concluded that:

> MSF strongly believes that the farmer based Research, Development and Extension service delivery model is well placed to assist the farming and rural communities to be responsive and adapt to the impacts of climate change. It is critical that governments at all levels provide appropriate levels of support to farmer based organisations to enable them to achieve their core functions and respond to challenges as they arise.[57]

6.77 The South West Climate Change Forum, formed in August 2007 and based in South West Victoria to help primary producers adapt and prepare for changes in climate and climate variability, is another example of local action. Mr Mike Weise, representing the Forum, noted its development in response to 'the ambiguous and many sources of information that were coming to 1,700 or so dairy farmers in our region at that time.'[58] Its membership consists of local catchment management authorities, state and local government agencies, as well as industry representatives. It is supported by local, state and federal government organisations, as well as research and academic institutions.

6.78 In its submission, the Forum outlines its task to

> collect, collate, analyse and disseminate consistent and credible messages on climate change, thereby ensuring the primary

56 Mr Jim Maynard, Mallee Sustainable Farming Inc., *Transcript of Evidence*, 3 September 2009, p. 72.

57 Mallee Sustainable Farming Inc., Submission no. 31, p. 4.

58 Mr Mike Weise, SW Climate Change Forum, *Transcript of Evidence*, 3 September 2009, p. 31.

> production sector has access to the most up to date and relevant data for their specific operation.[59]

6.79 The Committee notes the Forum's conclusion that the 'ground up approach works well in delivering information about climate change and managing climate variation', and their observation that 'industry based groups and networks can deliver climate change messages more efficiently and effectively' because of their close contact with farmers, and their reputation as a reliable information source.[60] The Forum's submission states:

- There are already networks and industry groups in existence, with proven track records in engaging primary producers which need further government funding and continued support from government agencies to be effective in aiding the industry to deal with the physical, policy and peripheral effects that climate change and variability will bring.
- SWCCF provides a network model that can be replicated on the basis that many primary industries have similar issues regards water, soils, mitigation etc. With many farmer based groups only having a small staffing base, a regional representative group with staff devoted to working on climate change across a range of industries is very effective and supports a regional response and collaboration.
- A regional approach aids the coordination of activities and messages both across the region and between industries.[61]

6.80 Mr Weise highlighted the experience of the forum as a farmer-led organisation working for farmers, providing channels of communication trusted by farmers:

> Over the last six or seven years we worked with the catchment management authorities in western Victoria and we had an extension product that allowed farmers to determine which learning they chose to do. It is self-directed by farmers, which is a good extension methodology. CMA has found it really difficult to invest in that because it did not have a specific outcome. It was not metres of fencing or whatever. It took us probably five years to help them understand that this was a really good doorway to go through to have natural resource management change, because it was the farmer's own doorway. I would encourage this inquiry to look at going in through normal doorways to primary producers

59 South West Climate Change Forum, Submission no. 6, pp. 1–2.

60 South West Climate Change Forum, Submission no. 6, p. 3.

61 South West Climate Change Forum, Submission no. 6, p. 3.

> to help that change take place and not necessarily develop something new.[62]

6.81 The importance of local action was also highlighted in the evidence of Southern New England Landcare Ltd, a network of local producers. In its submission, Southern New England Landcare stated:

> That government can augment the shift towards farming practices which promote resilience in the farm sector in the face of climate change; and promote research, extension and training to assist the farm sector to better adapt to climate change by:
>
> - Utilising Community Organisations (such as Landcare Networks) that possess knowledge, social and intellectual capital that have been developed over the past two decades, to rapidly implement climate change programs
> - Providing adequate and sustained resourcing to these community organisations to allow them to carry out this role
> - Encouraging onground innovation by assisting local communities to build partnerships with agencies and research bodies to trial and develop technologies and practices that build resilience in the face of climate change
> - Facilitating adoption of these and other innovative practices by landholders by funding local organisations to run projects that deliver extension and incentive programs.
>
> For landholders to take ownership and responsibility for changed practices they must drive the direction of the change. Under current funding arrangements 20 years worth of experience and goodwill in landholder engagement stands to be lost, and along with it the opportunity landholder driven innovation and rapid adoption of management for climate change resilience.[63]

6.82 In evidence before the Committee, Mrs Sonia Williams, the executive officer of Southern New England Landcare Ltd, noted that:

> It is beyond the capacity of many of our farmers to fathom a way forward with things such as carbon pollution reduction schemes and climate change. We provide a mechanism where they can come to us and we can link them to the economists, researchers or programs. They see us as the one-stop shop. They are us—we are owned by them. They pay membership. We are a locally owned community organisation. They look to us to help them along the path of sustainability and profitability. … We have, over 17 years,

62 Mr Mike Weise, SW Climate Change Forum, *Transcript of Evidence*, 3 September 2009, p. 32.

63 Southern New England Landcare Ltd, Submission no. 39, p. 1.

> been working with farmers to mitigate the effect that activities had on climate change on their farms. So we have a strong relationship and an established network and system to bring all parties to the table to develop something that they are comfortable implementing.[64]

6.83 However, Mrs Williams also noted the disjunction between bottom-up leadership, essential to successful adaptation, and top-down prioritisation and funding:

> We have found that having the multistakeholder steering committees—we also have farmers on the steering committees—means that the relationship and communication is built up so that department of agriculture does not go out in isolation and dream up a great scheme that farmers have not got any intention of or ability to deliver on. I do not believe that we are as integrated as we should be. We are outside the funding loop of most of that and most of the programs that are developed are developed first and are then taken to the community. It is not the model we take, which is to bring all the partners together to develop the program.[65]

6.84 Changes in funding and priorities were potentially devastating for local groups dependent on outside funding:

> Our main funding came through the National Landcare Program and then the Natural Heritage Trust, and now it comes through Caring for our Country. I have been involved for 17 years. When the National Landcare Program first rolled out, local people identified issues that were important at the local level and bodies like ours brought all partners to the table to develop a way through. So there was ownership, and people could move forward on issues. With the Natural Heritage Trust, we started to move to regional priorities. Instead of the priorities of the local people driving it, it was a more top-down approach. People would say: 'This is what's important for our region. What might be needed at this level to start people off is tree planting. That might get them to where they are going.' They would be told, 'No, that is not a priority so you can't start there.' People were not allowed to start where they were comfortable with and capable of starting.

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64 Mrs Sonia Williams, SNELC, *Transcript of Evidence*, 19 August 2009, p. 7.

65 Mrs Sonia Williams, SNELC, *Transcript of Evidence*, 19 August 2009, p. 6.

> With the move to Caring for our Country, it went from regional priorities to national priorities and a very targeted business plan. So, unless your community is in one of the areas for which a high-priority target has been identified, the chances for funding are minimal. Even with creativity they are minimal. What we found on the tablelands was that loss of vegetation is not considered a priority issue under the Caring for our Country business plan. Anybody who has been onto the Northern Tablelands, with the huge dieback problems, will know that that is just not the case. So we struggle. We spend a significant part of our time trying to find resources so that we can go about doing a job. That is not a complaint; it is a fact. It would be far more productive to have some steady source of funding support for organisations with track records to get in there and link those processes in. Then we would not have to spend half our year just trying to keep the door open.[66]

6.85 Loss of funding means loss of staff; loss of staff means loss of capacity and local knowledge. Mrs Williams continued:

> Coordinators are the key to keeping a local network happening. They are the key to bringing in the partners. They are the key to actually identifying what it is in the local area that is important. I worked as a coordinator 17 years ago. I am now the executive officer of Southern New England Landcare. We have three to four part-time coordinators. They get to know their community. The community can talk to them. If the funding is not there for the coordinator, it becomes impossible. It is somebody's job to line all these things up—to bring the people to the table; to take the minutes; to organise this and that and to do the follow-up. That is what a true Landcare coordinator does.[67]

6.86 In discussing an engineered woodland project, Mr Shane Andrews, Project Officer with Southern New England Landcare, emphasised the need for continuity:

> The continuity of coordinators is critical for various innovations. I used to work for Greening Australia and we used to run various farm forestry projects. Typically, they would last for a year or two. The plantings would be done, the people got excited … the coordinator would leave and within five years they would have

66 Mrs Sonia Williams, SNELC, *Transcript of Evidence*, 19 August 2009, p. 7.

67 Mrs Sonia Williams, SNELC, *Transcript of Evidence*, 19 August 2009, p. 10.

> been forgotten about. With this engineered woodlands project, we have a longer term commitment through the Forestry Investment Group where we are monitoring the sites, having back up field days and getting media articles about there to keep the land use in front of the farmers of the region. Without that sort of coordinating role and its continuity, any new innovation can be dropped—the ball can be dropped.[68]

6.87 Similar issues were faced by other organisations. Mr Maynard from Mallee Sustainable Farming, told the Committee of his group's experience with uncertain funding:

> As a farming group we are severely challenged. A lot of energy goes into how we are going to fund next year. That is the biggest problem. We would spend about a third or half of our manager's time and probably a third of our wage structure in running it. It is only a small operation. We only have a manager and 4½ staff, with two of them part time. It is not a big organisation. We have an office and all your associated equipment to run it. We are finding that there is a significant amount of energy to keep that core office job running so that you apply for projects. Projects are good. A project usually wants results. You have got your dot point or key indicators that you need to report on. I have no hassle in reporting it, but there is not very much for the administration. With the closure of some of the research stations—we have one in our district with the state department pulling out of that research and extension—we are becoming more and more relevant in providing this service for government. We are finding it so hard.
>
> We have gone down a membership path and we are getting some money from members, but you cannot really keep putting that up in the middle of a drought or hard economic times. We get some money out of our membership, but it costs a bit to run a membership type thing. We are looking for sponsors, with some success, and some not successful. However, it is not enough to run the organisation. We are putting a lot of effort into trying to keep that going, and it gets pretty hard. We have a new manager here. I do not want to frighten him off or he might be gone next week. He has only been here eight days now.
>
> The point is that in going through appointing people you more or less cannot promise them a future unless you have got the money

68 Mr Shane Andrews, SNELC, *Transcript of Evidence*, 19 August 2009, p. 10.

> in the bank. You just cannot do that. It is hard to attract the right person if you say, 'I can only employ you until next year. I can't guarantee you any more.' It is an ongoing problem. I know what I am asking for is public money to run an office, but I feel that part of this is for the public good.[69]

Committee conclusions

6.88 The Committee is of the view that the provision of effective extension services is a vital part of assisting farmers to respond to the challenges of climate change and climate variability. The Committee notes that whether these services are better provided by government or the private sector is a matter of some contention within the farming community. Government certainly does have a role in the provision of extension services, at least insofar as ensuring that such services exist, are accessible, and effective. In many areas, State Government extension officers still play an important and effective role as coordinators and providers of information. The Committee believes that this role should continue. On the other hand, private sector extension services are undoubtedly also making a significant contribution to the development of farming enterprises. The ability to access both public and private services is undoubtedly an asset to the farming community.

6.89 Regardless of who provides extension services, the evidence presented to the Committee indicates that such services need to be flexible and responsive to the needs of a range of farmers in a variety of situations—there is no 'one-size-fits-all' approach to extension.

6.90 The Committee notes that another important factor in the provision of extension is local knowledge and local leadership. The Committee took evidence about and witnessed at first hand the work of a number of groups providing extension services at a local and regional level. These groups provide an essential service to farmers in terms of climate change adaptation. Integrating them into the response to climate change and ensuring that they have the resources to continue their activities is vital. Putting resources into a bottom-up approach to climate change, which focuses on local and regional priorities, should be seen as complementary to approaches based on broader national priorities.

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69 Mr Jim Maynard, Mallee Sustainable Farming Inc., *Transcript of Evidence*, 3 September 2009, pp. 73–4.

Recommendation 12

6.91 **The Committee recommends that the Australian Government give greater consideration to better integration of local and regional organisations into its overall response to the issues affecting agriculture and climate change, and provide additional funding to support the management role of these local and regional organisations.**

7

Role of Government

7.1 In their joint submission to the inquiry, the Department of Agriculture, Fisheries and Forestry and the Department of Climate Change outlined the Australian Government's response to climate change:

> Many farmers are testing and using different farming practices so their businesses are better able to withstand drought and other extreme events. However, this will not be sufficient to manage the future impacts of climate change, and farmers will need support and guidance to do this.
>
> Coordinated national effort by governments, agriculture industries, regions and individual producers will be required to put in place sound climate change strategies to ensure that agriculture is able to effectively manage the risks associated with climate change.
>
> The Australian Government's response to climate change adaptation in agriculture is therefore to focus on providing fundamental information and knowledge, and the decision support tools that will allow farmers and rural industries to manage the risks of climate change.
>
> This reflects the government's preference for markets to operate with minimal intervention, concentrating its role on situations where there is market failure, where there is a clear need to intervene to protect or maintain a public good, or where there is a high risk to assets of national significance.[1]

7.2 The submission further noted:

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1 DAFF/DCC, Submission no. 70, p. 2.

> Industry is best placed to respond to market drivers. Governments' responsibility is to ensure consistency in policies, regulation and incentives to facilitate adaptation, particularly so that these do not inhibit market signals or encourage maladaption.[2]

7.3 This emphasis on providing a broad policy framework, creating a regulatory environment in which market driven responses can flourish, and intervening to correct market failure was also reflected in the submissions of various State Governments.

7.4 In its submission, the Tasmanian Government stated:

> In summary, governments' role is to provide policy settings that assist businesses, communities and individuals to adapt to the impacts of climate change, and to take account of these impacts when making decisions about the provision of public goods and management of public assets.
>
> It is crucial that policies reflect the 'triple bottom line'— economic, social and environmental—in order to sustain the agricultural sector.[3]

7.5 In his submission, the Minister for Agriculture, Food and Forestry, Western Australia, noted:

> Government has a role in researching and communicating the implications of climate change. It needs to devise response strategies for the short term and long term. It needs to support industries and farming communities with information to enable informed decision making, as well as to develop risk mitigation strategies for extreme events.[4]

7.6 The submission continued:

> The Western Australian Government has a role in assisting agriculture and forestry to adapt through:
>
> - Acting as an "information broker" to both translate and integrate climate change implications and provide guidance on management responses;
> - Undertaking research and development that will maintain or increase productivity in a changing climate; and

2 DAFF/DCC, Submission no. 70, p. 8.

3 Tasmanian Government, Submission no. 57, p. 3.

4 Minister for Agriculture, Food and Forestry, Western Australia, Submission no. 61, p. 1.

- Ensuring land use planning and regulation takes into account climate change projections to maintain sustainable and profitable agricultural and forestry production while protecting and maintaining the natural resource base.[5]

7.7 Similarly, the RM Consulting Group saw the role of government as one of facilitating rather than creating change, creating the conditions for successful adaptation rather than actually driving it:

> Considering the areas in which farmers need assistance, there is a strong rationale for governments to invest in research and development of new technologies and practices and sectoral and regional information of changes to farmers' environment, communities and regions. In the case of new technologies and practices, research of these is clearly a public good. So too is information regarding how the physical and community environment farmers operate in will change. In fact, government is the only party that can inform farmers as to what is likely to happen to key government services in the future.

7.8 The Committee notes RM Consulting Group's observation that the rationale for assisting farmers with providing relevant and useful information and assisting them in streamlining their decision making processes is less clear cut. Furthermore, the Committee agrees that 'the case of climate change' raises particular challenges, in that 'past rules of thumb may no longer be relevant.' RM Consulting Group notes that

> … farmers are also likely to benefit significantly by developing better systems for managing information, managing their finances and their business, and making decisions. On balance, there is a role for government in developing programs and policies to assist farmers in these areas, but the cost of such programs should be shared by the farmers themselves.[6]

7.9 In its submission, CCRSPI outlined the role of government in facilitating the adaptation of communities and industries—including facilitating the use of migrant workers in downstream processing:

> There is a role for government in assisting individuals and communities to transition from declining industries to emerging ones, while minimising social dislocation and dysfunction.

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5 Minister for Agriculture and Food: Forestry, Western Australia, Submission no. 61, p. 2.

6 RM Consulting Group, Submission no. 29, pp. 9–10.

Less reliable production associated with a more variable climate is likely to reduce returns to capital and increase the difficulties associated with maintaining, operating and staffing processing infrastructure. The cost of future capital investments will probably rise in response to these risks.

Downstream processing of agricultural products, especially animal products, tends to be labour intensive. Processing facilities that incorporate greater flexibility or that use less capital tend to be more labour intensive. While capital costs are high, agricultural labour is scarce…

The Commonwealth's 457 skilled work visas and *Australian Pacific Seasonal Workers Pilot Scheme* offer suitable alternatives for labour provision to some primary industries. There is clearly a role for Government in providing appropriate regulatory frameworks to ensure these programs benefit the wealth and wellbeing of all Australians without exploiting the migrant labour force or their communities. Rural RDE networks have a role in providing the training necessary to ensure farmers and agribusiness are equipped to access and effectively work with these new labour pools.[7]

7.10 CCRSPI continued:

The government has a critical role in assisting Australia's primary industries adapt so they can continue to contribute to the nation's wealth and wellbeing. One way governments can do this is to help correct market failures by—

- addressing information failures through:
  - ⇒ research into new knowledge to strategically filling existing gaps;
  - ⇒ ensuring the existing information is provided to farms and businesses throughout the supply chain in forms they can readily use;
  - ⇒ providing frameworks to better share and utilise information, to reduce transaction costs associated with knowledge generation, distribution and utilisation;
- providing appropriate regulatory frameworks to enable the efficient operation of markets;

7 CCRSPI, Submission no. 10, p. 10.

- correcting externalities relating to the aspects of goods or services that are not adequately captured in their market prices by:
  - ⇒ subsidising the provision of goods and services which contain a significant element of public good e.g. education and biodiversity;
  - ⇒ pricing or limiting negative externalities associated with the provision of goods or services e.g. pollution and food safety;
  - ⇒ assisting in the commercialisation of new or infant industries - particularly those which have considerable potential for public good e.g. biotechnology and distributed renewable energy;
- providing public goods and/or shared infrastructure where a market rent cannot be efficiently levied or captured by an individual firm or entity e.g. biosecurity.[8]

7.11 CCRSPI endorsed the use of co-regulatory frameworks for facilitating adaptation:

> Co-regulatory frameworks such as farm or environmental management systems (EMS) provide governments with a mechanism to achieve widespread and ongoing adoption of best management practices (BMPs) without excessive regulatory costs e.g. Cotton BMP program, *Pathways to Industry EMS* program.[9]

7.12 In its submission, the South Australian Farmers Federation urged a partnership between government and industry focused on innovation:

> Regardless of activities undertaken to mitigate carbon emissions, agriculture will need to adapt to a changing climate. Governments have a role in working with industry to:
>
> 1. Develop stewardship payments for protection and enhancement of native vegetation or water quality improvements,
>
> 2. Develop 'new' industries such as power generation from piggery waste,
>
> 3. Provide research funding into conversion of urban and animal waste to biochar which may provide an alternative to fertiliser use in horticulture and cropping systems,
>
> 4. Produce more agricultural product with less water, and

8 CCRSPI, Submission no. 10, pp. 11–12.

9 CCRSPI, Submission no. 10, p. 13.

5. Develop programs to monitor changes in the natural resources, eg monitor the spread of weeds.[10]

Australian government policy initiatives

7.13 In their joint submission to the inquiry, the Department of Agriculture, Fisheries and Forestry and the Department of Climate Change outlined the policy framework governing agriculture and climate change. The submission stated:

> The Australian Government has adopted a new National Climate Change Science Framework which sets out climate change research priorities for the coming decade. The focus of the Framework is fundamental climate system science, which provides essential system knowledge to understand climate change impacts, develop adaptation strategies, and manage carbon emissions. The scientific research proposed under the Framework is designed to interact closely with the adaptation response agenda, with mitigation science and technology, and with efforts to develop more effective policy to deal with the climate change challenge.
>
> The Framework will deliver improved higher resolution predictions of future climate, knowledge which is central to the development of adaptation policy for agriculture. There will be specific focus on future rainfall, evaporation and other climate features that affect our water resources and dry land agriculture. The Framework will also deliver improved knowledge on extreme events such as drought, heatwaves, storms and fire weather, information which will assist in policy development around the management of carbon in the landscape.[11]

7.14 The submission continued:

> There is scope to substantially enhance the Framework. In particular, the capacity of the agriculture sector to plan for climate change will require extension of our predictive capability for weather and climate from short term forecasts through to monthly, seasonal and decadal predictions of climate. There is also a need for research infrastructure investments, including the renewal and maintenance of supercomputing, ocean research vessels and earth

10 South Australian Farmers Federation, Submission no. 21, p. 5.

11 DAFF/DCC, Submission no. 70, p. 8.

> observation networks to underpin this work. The outcomes from these investments would allow farmers to factor the longer-term climate and weather predictions into farm planning and so be better prepared for unusual and extreme events.[12]

7.15 The submission also outlined the National Climate Change Adaptation Framework (NCCAF), which:

> …recognises the government has an important role in establishing optimal conditions for adaptation across Australia, including in the agricultural sector. Consistent with the Framework, the government is assisting agriculture adapt to climate change by addressing market failures. Investment is being made in research that can deliver information needed to assist the sector manage future climate risk through the establishment of a new National Climate Change Adaptation Research Facility (www.nccarf.edu.au) and an Adaptation Research Flagship at CSIRO (www.csiro.au/org/ClimateAdaptationFlagship.html). Information needs encompass climate change science to deliver improved projections at scales and timeframes relevant to producers; decision support tools that inform a range of production systems; and adaptation options readily adoptable by producers to manage climate risk.[13]

7.16 In evidence before the Committee, Mr Chris Johnston, Assistant Secretary, Adaptation Innovation Branch, DCC, elaborated on the work of NCCARF:

> The NCCARF has eight themes of which primary industries is one and they have established a research network under each of those themes, including primary industries, and that is led by Professor Snow Barlow at the University of Melbourne. They are currently working on a national adaptation research plan for primary industries and we expect to see a consultation draft towards the end of this year with a final currently scheduled to be completed around April or May 2010.[14]

7.17 As part of the Framework,

> National Adaptation Research Plans (NARPS) are being developed for areas such as primary industries, water resources and freshwater biodiversity. The NARPS will set out national priorities

12 DAFF/DCC, Submission no. 70, pp. 8–9.

13 DAFF/DCC, Submission no. 70, p. 9.

14 Mr Chris Johnston, DCC, *Transcript of Evidence*, 28 October 2009, p. 2.

> for applied research to underpin the development of Australia's adaptation capability. NARPS will have a central role in guiding investment in R&D activities.[15]

7.18 Another major policy initiative is Australia's Farming Future:

> The Australia's Farming Future (AFF) initiative is the government's key initiative for assisting primary producers adapt and adjust to the challenges of climate change. The initiative consists of several elements that help build adaptable and resilient producers and industries and strengthen their ability to manage climate change into the future.[16]

7.19 The initiative includes the Climate Change Research Program:

> The $46.2 million Climate Change Research Program is funding research projects and on-farm demonstrations to help prepare Australia's primary industries for climate change and build the resilience of the agricultural sector into the future. Initially focusing on reducing greenhouse pollution, better soil management and climate change adaptation, the program will involve projects that provide practical management solutions to farmers and industries…[17]
>
> To June 2009, the Government has committed $37.9 million for research under the Climate Change Research Program, leveraging $61.7 million from partners, including state government, industry and research organisations. This includes:
>
> - the Soil Carbon Research Program ($9.6 million from the program over four years as part of a $20 million package) will be established in all states and the Northern Territory to investigate carbon changes in soil across Australia in response to farm management practices. A separate project has been established for biochar research ($1.4 million from the program over three years from 2009–10)
> - the Nitrous Oxide Research Program ($4.7 million from the program over four years as part of a $11.9 million package) will develop a national system for measuring nitrous oxide emissions from Australia's agricultural soils
> - the Reducing Emissions from Livestock Research Program ($11.3 million from the program over four years as part of a

15 DAFF/DCC, Submission no. 70, p. 9.

16 DAFF/DCC, Submission no. 70, p. 10.

17 DAFF/DCC, Submission no. 70, p. 10.

$28.7 million package) focuses on reducing methane emissions from livestock

- the Adaptation Research Program ($11 million over four years as part of a $37.6 million package) will develop knowledge and management strategies to assist primary producers to adapt to a changing climate while promoting productivity.[18]

7.20 FarmReady is a program targeted principally at the development and provision of training activities and resources:

> Within the Australia's Farming Future framework, the FarmReady program provides $26.5 million over four years to improve adoption of risk management and business management skills, increase adoption of new technologies and best practice management to enable primary producers, Indigenous land managers and agricultural industries to adapt and respond to the impacts of climate change. The program runs until 30 June 2012 and consists of two separate elements:
>
> - FarmReady Reimbursement Grants of up to $1500 per person per financial year to individual primary producers and Indigenous land managers to attend approved climate change training activities
> - FarmReady Industry Grants to industry organisations of up to $80 000 per financial year to industry organisations, farming groups and natural resource management groups to undertake projects that will enable their members to adapt to the impacts of climate change.
>
> Under the first round of the FarmReady Industry Grants, $6.3 million has been provided for 46 projects.[19]

7.21 In evidence before the Committee, Mr Allen Grant, Executive Manager, Agricultural Productivity Division, DAFF, elaborated on the components of FarmReady:

> One component allows individual farmers to attend training courses that are directed at farm business practices and provide specific education and learning about how farmers can adapt their own circumstances to variations in climate change. Courses would include some technical aspects of adaptation but there would also be courses directed at a range of business skills and broader management skills and abilities. Under that program, farmers can

18 DAFF/DCC, Submission no. 70, p. 10.

19 DAFF/DCC, Submission no. 70, p. 11.

> receive up to a $1,500 repayment for expenses incurred in attending those courses. That is the reimbursement side of it.
>
> …The second component of FarmReady provides industry groups, including Landcare groups and landholder groups—that is, groups of farmers or landholders who might just band together to form a group—up to $80 000 to enable them to develop tools, education facilities and communication facilities through which they can then transfer those skills and techniques to the farmers within their area. They can develop capacities and build systems and learning techniques… communication and on-the-ground techniques so that they can demonstrate those to the other people within their communities or to the groups that they represent. It is $80 000 to groups around the country, and that is on a competitive basis. There is a call for expressions of interest for grants under FarmReady and there is a process by which those grants are determined and agreed.[20]

7.22 Another program promotes community networking and capacity building:

> Community Networks and Capacity Building will build on the leadership and representative capacity of women, youth, Indigenous Australians and people for culturally and linguistically diverse backgrounds to strengthen community resilience and the productivity of primary industries. With increased access to tools and resources, these target groups can improve their leadership and management skills, increase participation in industry and more effectively contribute to government and industry decision making.[21]

7.23 Mr Grant explained:

> There is a small program under Australia's Farming Future which is a community networks and capacity-building program focused on increasing the leadership and representative capacity of target groups. The target groups include women, youth, Indigenous Australians and people from culturally and linguistically diverse backgrounds. It is trying to strengthen primary industry productivity and build rural and regional community resilience in a changing climate. That is a small program that is sort of directed

20 Mr Allen Grant, DAFF, *Transcript of Evidence*, 28 October 2009, pp. 4–5.

21 DAFF/DCC, Submission no. 70, p. 11.

> in that path. I think $2 million has been allocated to that program in 2009-10.[22]

7.24 Another program, providing adjustment assistance for farmers experiencing financial hardship is the Climate Change Adjustment Program:

> The Climate Change Adjustment Program is assisting low income, low asset farmers who may be affected by climate change, including those experiencing financial hardship caused by drought. The program provides financial assistance to farmers with the aim of adjusting their farm business to manage the impacts of climate change.
>
> Assistance under the program includes:
>
> - Adjustment advice and training grants of up to $5 500—available for specialised professional advice (where the advice is linked to managing the impacts of climate change) and training
> - Re-establishment assistance of up to $150 000—enables farmers to exit the industry and pursue other employment opportunities or retire.[23]

7.25 Another important program is the Rural Financial Counselling Service:

> The Program provides grants to regional and state level not-for-profit organisations to employ rural financial counsellors to provide free and confidential financial counselling services to farmers, fishers and small rural businesses who are in financial difficulty and have no access to other forms of impartial support.
>
> The objectives of the Program are to:
>
> - make sure clients have access to financial information, options, decision support and referral services
> - allow clients to consider information and options to implement decisions to manage industry adjustment and climate change
> - provide a needs-based service that is free, effective, responsive and flexible.[24]

7.26 Finally, an important part of the policy framework for delivering outcomes at a regional and local level is Caring for our Country:

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22 Mr Allen Grant, DAFF, *Transcript of Evidence*, 28 October 2009, p. 3.

23 DAFF/DCC, Submission no. 70, p. 11.

24 DAFF/DCC, Submission no. 70, pp. 11–12.

> Caring for our Country commenced on 1 July 2008 and aims to develop an environment that is healthier, better protected, well managed, resilient, and provides essential ecosystem services in a changing climate.
>
> The Caring for our Country outcomes contribute to climate change adaptation by improving environmental management and assisting farmers and land managers to adopt sustainable farm practices.
>
> Sustainable Farm Practices is one of six priority investment areas under Caring for our Country. The 2009–10 sustainable farm practices targets aim to increase the adoption of sustainable farm practices such as those that maintain or increase soil carbon, groundcover and vegetation on-farm as well as reduce the risk of erosion and soil acidification.
>
> From 1 July 2008, the activities of the former National Landcare Program have been encompassed in the government's Caring for our Country initiative. Most landcare activity is undertaken within the sustainable farming practices priority area.[25]

Detailed critique of policy initiatives

7.27 In its submission to the inquiry, the Future Farm Industries CRC delivered an extensive critique of current policy initiatives. Starting with the Government's current approach, the submission stated:

> The Commonwealth Government has two R&D funding initiatives relevant to adaptation to climate change. The Primary Industries Adaptation Research Network (PI ARN) is one of eight themes funded in the National Climate Change Adaptation Research Facility (NCCARF). It is managed by Land and Water Australia and linked to the Climate Change Research Strategy for Primary Industries (CCRSPI), which is a joint initiative of RDCs, the Primary Industries Steering Committee (PISC) and CSIRO. Active network building, coordination of research investment and further capacity building is about to occur. Adaptation is one of three themes in the Climate Change Research Program (CCRP) (others are emissions reduction and soil carbon). Decisions on projects are rolling out now. These two initiatives (PI ARN, CCRP) are in

25 DAFF/DCC, Submission no. 70, p. 12.

> different ministerial portfolios (Climate Change; Agriculture, Fisheries and Forestry).
>
> The Government has a policy position on how agriculture will be treated under the proposed Carbon Pollution Reduction Scheme (CPRS). It will decide in 2013 whether and how agriculture will be covered with entry into CPRS, if it occurs, not before 2015. Meanwhile, the Government has made it clear that metrics and technologies for agricultures' emission reduction need to improve. CCRP funding decisions are supporting this priority.
>
> This three-pronged approach looks impressive; however, the threat of policy and program failure is very real. This claim is based on FFI CRC's understanding of how innovation, technological change, research and development and improved outcomes occur in dryland agriculture, and on the poor track record of Commonwealth Government funding programs in getting these outcomes.[26]

7.28 The submission identified three critical failings (all of which also relate to the issues raised in Chapter 6). The submission noted:

> Farmers' path to adoption of new practices for drought preparedness, climate change adaptation and compliance with emissions reduction measures is much longer than the Government realises…
>
> Investment in R&D is not large enough, not long enough and not sufficiently allocated to new profitable solutions for farmers…
>
> Commonwealth Government agencies administering funding programs for land use change have failed to achieve high rates of adoption by farmers. There is compelling evidence for this, and that a primary reason is lack of profitable options for farmers.[27]

7.29 The submission concluded:

> There is looming institutional failure with successive Commonwealth government's approaches to investing in sustainable agriculture and natural resource management outcomes. Its programs are dependent on Canberra based officers administering funds to contracted projects. These officers are funds administrators without the authority or technical capability to perform the risk managing investor role. The high number of

26 Future Farm Industries CRC, Submission no. 67, pp. 4–5.

27 Future Farm Industries CRC, Submission no. 67, pp. 5–6.

> consultancies commissioned by Commonwealth agencies provides stark evidence that they are not able to engage the agriculture sector first hand and adopt the more effective partnership approach.
>
> This Government, in particular, understands the importance of tapping science expertise and is prepared to target its funding to institutions where those scientists reside. This is good to a point. However key science institutions (CSIRO, universities) have no path to farmer adoption and limited industry engagement. Farmer behaviour change is not their mandate and there are no accountable paths to adoption activities. State agencies have traditionally had agricultural extension services alongside R&D capacity but these have declined so severely that traditional information sources tapping public good R&D no longer exist. Catchment management authorities and regional NRM bodies are not a substitute. They now face uncertain times, don't have R&D capacity [and] aren't geared for farm-level advice on production solutions. The agribusiness sector has a growing capacity to technically service farmers but can't be expected to carry out public good functions if they don't improve their profit bottom line. Today, farm research groups and farm consultants are the best placed to fill this void, but 'next user' programs such as that of FFI CRC are needed and these are beyond the means of major R&D institutions.[28]

7.30 The solution to the problems outlined above was to make more effective use of existing research infrastructure—the RDCs and CRCs:

> RDCs are structured to manage investment more effectively with program managers closer to farmers and industry. CRCs are structured to manage R&D, training and path to adoption, including commercialisation of R&D, in an integrated way.
>
> Both institutional forms have been regularly evaluated and their success and good returns on investment demonstrated. Under the current evaluation framework for RDCs, a randomly selected 32 projects have returned an estimated $11.00 for each dollar expended, and on the input side each dollar of government funding is matched by $1.50 from industry (Council of RDC Chairs 2008). The recent evaluation of CRCs by the Productivity Commission, re-working numbers from earlier studies with a

28 Future Farm Industries CRC, Submission no. 67, pp. 6–7.

more conservative method, estimated that there was an aggregate increase in economic output of 51 cents for every dollar of the Commonwealth's CRC Program funds (O'Kane 2008). Again this is a substantial return on investment.

FFI CRC argues that the Commonwealth reverts to current best practice in how it invests climate change program funds in R&D and path to adoption activities that will improve adaptation to climate change in the longer run through real change in farm businesses. Rather than administer funding programs direct to project managers in the absence of industry-credible program managers, it should put its funds through RDCs. They have a strategy for planning, priority setting and coordination (CCRSPI) and established program managers with science, industry and field experience.

RDCs in turn could follow their best practice in commissioning projects with R&D providers and collaborative ventures such as CRCs that are uniquely set up to combine R&D, path to adoption with commercialisation elements in an environment that fosters innovation and public-private partnerships.

In this way Commonwealth Government investment in drought, climatic variability and climate change outcomes become part of the mainstream innovation, problem-solving, technology development, productivity growth and structural adjustment that has been the basis of Australian agriculture's success over the past 60 years—and no longer an add-on activity.[29]

Committee conclusions

7.31 Notwithstanding the comments of the Future Farm Industries CRC, the Committee believes the current policy framework provides the basis for a comprehensive and sustained response to the challenges of climate variability and climate change within the farm sector. The success of these policies and initiatives, however, will depend upon sustained and consistent application, well-targeted and sustained funding, effective coordination, and a very deliberate focus on the delivery of outcomes on-farm.

7.32 As the criticisms of the Future Farm Industries CRC indicate, a sustained and effective response by government, and the delivery of real gains on-

29 Future Farm Industries CRC, Submission no. 67, p. 7.

farm, cannot be guaranteed. The Committee has received plenty of evidence about the deleterious impacts of short-term funding and sudden changes in policy direction upon outcomes. There appears to be a real disconnect between policy on paper and outcomes on the ground. Governments and bureaucrats need to be aware of this problem and be constantly seeking to address it. While not necessarily endorsing the proposals contained in the Future Farm Industries CRC submission, the Committee certainly commends them to the Government for further consideration.

Recommendation 13

7.33 **The Committee recommends that the Australian Government give further consideration to the analysis of government policy and outcomes in the submission to the current inquiry made by the Future Farm Industries CRC, with a view to ensuring the better coordination of research and extension efforts and the delivery of effective policy outcomes.**

Facilitating action

7.34 The need to facilitate action in response to climate change was seen as a key role for government in the evidence presented to the Committee. Whether providing financial incentives to undertake specific actions, building capacity at an individual or community level, providing stewardship payments for environmental management, or simply adjusting government regulation to facilitate certain outcomes, a range of actions were identified that could facilitate adaptation.

Incentives

7.35 The use of financial incentives was seen as a practical way of facilitating adaptation to climate variability and climate change. In its submission Australian Women in Agriculture stated:

> Governments therefore need to clarify and strengthen incentives and schemes to enable households, agriculture and industry to reduce carbon emissions, develop energy self-sufficiency and

> manage water in a sustainable manner so that all sectors of Australian society are working together towards sustainability.[30]

7.36 The Committee received a number of suggestions about ways to promote change through financial incentives—a range of options usually targeted at the needs of specific industries or issues, a fact which suggests that targeted incentives will work better than broadly based schemes.

7.37 In its submission, Apple and Pear Australia suggested the use of special loans:

> The Apple and Pear Australia Ltd Industry is a capital intensive industry with significant upfront investment required and a lengthy time period between initial investment and returns. The development of a co-contribution scheme whereby growers could have access to funds in the form of low interest loans, growers would have the confidence to implement new technologies that would enable them to become resilient in the changing climate and environment.[31]

7.38 The National Association for Sustainable Agriculture Australia Ltd urged a substantial increase in funding to support organic agriculture:

> Federal Government can play an important role in assisting farmers to adapt to climate change by supporting organic agriculture at a major scale and increasing current funding which resides at less than $500 000 p.a. nation wide to a figure at least 100 times greater in the first instance. This funding should be made available to research organisations with reference to the Organic Federation of Australia, the peak National body for organic agriculture
>
> The key research needs in our view are holistic biophysical studies that are carried out in decentralised locations and that permit farmers and researchers to better understand soils, fertility and organic practices that further enhance crop yields and carbon sequestration.[32]

7.39 In its submission, the Grain Growers Association suggested incentives for better energy efficiency and transport use. It also highlighted the need for better access to rail transport for grain growers as a means of lowering the energy costs of transporting grain:

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30 Australian Women in Agriculture, Submission no. 56, p. 2.

31 Apple and Pear Australia Ltd, Submission no. 36, p. 1.

32 National Association for Sustainable Agriculture Australia Ltd, Submission no. 42, pp. 1–2.

> As an example, the current national water reforms include measures to incentivise improved irrigation efficiency on farm through higher technology water delivery systems. Where these systems are replacing gravity fed systems, the energy requirements of these systems is increasing and therefore emissions. However there are no apparent incentives for energy alternatives such as solar, wind or renewable fuel sources which would effectively address this issue.
>
> Another example is the run down in investment in rail and port infrastructure. Rail transport is vastly more efficient in terms of energy than road but successive State Government underinvestment and parochial management has resulted in a transport system with limited capacity which is forcing industry to increasingly rely on road systems. One Government response to climate change adaptation and energy efficiency is to dramatically improve the transport infrastructure to assist growers to access markets using the most efficient methods and potentially increasing the range of products growers might produce if more efficient transport were available.[33]

7.40 Dr Christine Jones presented the Committee with a fully fledged incentive scheme, the Green Agriculture Stewardship Scheme, as a means of promoting the benefits of permanent ground cover for soil health, moisture retention and soil carbon sequestration:

> The most effective way to generate on-ground change is to actively engage landholders in participatory approaches to innovation and extension. Regenerative land management techniques such as 'yearlong green' represent fundamental redesign and hence are subject to 'resistance to change'.
>
> It is recommended that the Green Agriculture Stewardship Scheme initially target regions which have only short-term annual cover (commonly monoculture) for part of the year and bare ground for the remainder. There are approximately 20 million hectares of land currently used for dryland broadacre cereal cropping (bare summer fallow) and 130 million hectares of grazing land lacking perennial groundcover…
>
> The Green Agriculture Stewardship Scheme will result in the establishment of 100 strategically placed, nation-wide, highly publicised demonstration sites (Green Agriculture Innovation

33 Grain Growers Association, Submission no. 46, p. 1.

> Nodes), showcasing leading edge technologies that restore photosynthetic capacity, reverse soil structural decline, improve carbon biosequestration, increase soil water-holding potential, enhance productivity and increase gross margins per hectare. These technologies have already proved successful and profitable for individual landholders in assisting their adaptation to a warmer, drier climate.
>
> A simple incentive scheme designed to catalyse innovation and fast-track adoption may prove less expensive, easier to manage and have broader application than a top-down prescriptive approach to land management.[34]

7.41 In its submission, the Murray Irrigators Support Group advocated the payment of $10 000 grants to farmers to provide an incentive for the uptake of water saving technology and practices.[35] In evidence before the Committee, Mr John Padman illustrated how such incentive payments could work to bring about rapid change at the farm level:

> To do a farm properly you might have to spend $50 000 to $100 000. The $10 000 would be a catalyst. We want to get more research done. As to all the work I have done, I have practically dedicated the last five years to this. I have spent a lot of my own personal money doing that, but I still could not go on to a farm and say, 'You should be watering that bay in two hours' or whatever it is…
>
> Mr Bryant is a typical example. When the $20 000 came out he was the first one on the phone. I talked to him about it before and he said, 'I'll try a few of those six-foot Padmans.' That is all we had to do. We did not have to say another word to Mr Bryant. He tried it once. That is what can happen. That is catalyst money.[36]

Capacity building

7.42 Another key to responding to climate variability and climate change is building capacity—giving individuals and communities the knowledge and tools to become more resilient and adaptive. In its submission, Australian Women in Agriculture argued for a long-term commitment to community development as part of the response to climate change:

34 Dr Christine Jones, Submission no. 52, p. 5.

35 Murray Irrigators Support Group, Submission no. 8, p. 5.

36 Mr John Padman, Murray Irrigators Support Group, *Transcript of Evidence*, 3 September 2009, p. 49.

> Meaningful change in community attitudes and behaviour requires a diverse approach incorporating information, education, incentives and support. Adherence to the principles of community development, namely: empowerment/ownership of activities by communities; valuing the local knowledge; collective working and encouraging participation and inclusion; balancing process with outcome; being sensitive to cultural/political paradigms; and sustainability/longevity (not just 'blow in/blow out') is particularly important during times of major change and adjustment.
>
> In the context of community development, short term funding and contracts for drought support and rural adjustment services are counterproductive. It takes time to build trust and rapport and networks and partnerships and this social capital can be lost when there is a regime of constant change of staff and programs. A more positive approach is sustainable programs based on evidence and focused on building community capacity to manage social and environmental change and changing business situations.[37]

7.43 In their joint submission, Horticulture Australia Council and Horticulture Australia Limited also saw capacity as part of the response to climate change:

> Overall, the best defence against future climate change is to continue to develop the capacity and knowledge so that growers can make effective business decisions, minimize risk, and manage our response to current climate variability more effectively. This will ensure both the long-term viability and sustainability of our industry, and continued availability to consumers of fresh and health-giving horticultural outputs.[38]

7.44 In its submission, the Australian Institute of Agricultural Science and Technology argued for building capacity in business and management skills:

> There is an urgent need to improve the business management skills of farmers—these skills will be crucial in our increasingly deregulated and diverse markets (both buying inputs and selling commodities). The new carbon economy is just one more management skill which farmers will have to learn.[39]

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37 Australian Women in Agriculture, Submission no. 56, p. 2.

38 Horticulture Australia Council and Horticulture Australia Limited, Submission no. 62, p. 3.

39 AIAST, Submission no. 63, p. 3.

7.45 In evidence before the Committee, Dr Nigel Wilhelm, a member of the AIAST, highlighted studies which had demonstrated that business management skills rather than land management skills often made the difference between success or failure in coping with drought:

> … the clear message from those studies is that it was not the ability of the farmer to run his farm; it was his ability to run the business. They were the skills that made the difference between an intact business at the end of this dry period compared to the neighbours' ones which were in dire straits. It was not so much their ability to farm the paddocks; it was their ability to manage the business. That message is coming back time and time again…We expect climate change to create generally more adverse conditions in southern Australia and there will still be good years and bad years. It is the ability to respond to those challenging conditions which will help those farming businesses survive. So it is about giving them the tools to make changes quickly in the right direction. That is the major focus.[40]

7.46 A number of submissions focused on the need to support local groups and grower organisations in building capacity. In its submission, Monaro Farming Systems stated:

> MFS sees the role of government is to strengthen their support and investment in regional farmer groups and to provide funding support which is accessible to independent, non-Government, member owned and driven groups.
>
> The Federal government could also place more emphasis on facilitating communication and fostering synergistic relationships between local representatives and farmer groups such as MFS and national research bodies (AWI, MLA, GRDC) to provide a forum for information exchange.
>
> By supporting regional projects MFS believes Government will increase the resilience of farm business in the face of increasing climate variability and also encourage a move towards more systems based agriculture. By supporting these type of projects, the government will encourage attitude change, practice change and increased confidence in the rural industry in managing uncertainty in climate and markets thereby moving the industry towards greater self-reliance.[41]

40 Dr Nigel Wilhelm, AIAST, *Transcript of Evidence*, 18 November 2009, p. 6.

41 Monaro Farming Systems, Submission no. 20, p. 3.

7.47 Likewise, Southern New England Landcare urged support on Landcare groups as a catalyst for action, however:

> …to do so requires a long term partnership approach between community and government, whereby government provides secure and ongoing resourcing to allow such organisations to support the community in developing and implementing innovative projects to address climate change.[42]

7.48 In its submission, the Goulburn Broken Catchment Management Authority stated:

> The government must ensure that the research, extension and training assist the farming community adapt to climate change through a systems approach (there must be improved understanding of the biophysical and socio-economic systems), ensuring that the information can itself be localised and importantly empowers the community to act.
>
> The government has a role identifying what the likely shocks are, increasing the diversity options available and create an environment for their adoption.
>
> The government has a role in research and devolving the information along with the decision making. It is ultimately the community that will create the resilient systems in the face of climate change, the government must undertake the relevant research and provide the best information possible to facilitate decision making. It must also support regional bodies in devolving information and making information locally relevant.[43]

7.49 The Conservation Agriculture Alliance of Australia and New Zealand also urged support for grower groups as a positive way to facilitate change:

> One way government can better support the shift to conservation agriculture is to support not-for-profit organisations that growers themselves support financially through voluntary subscriptions and in-kind contributions of time, skills and resources.[44]

7.50 The Fenner School of Environment and Society, ANU, simply urged a focus on accessible low-technology solutions to climate variability and climate change:

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42 Southern New England Landcare, Submission no. 39, p. 5.

43 Goulburn Broken Catchment Management Authority, Submission no. 44, p. 3.

44 CAAANZ, Submission no. 54, p. 2.

> Prioritising inexpensive, flexible, low-tech solutions that are proven to work, and have important synergies with other societal goals, will be a vital first step to truly bring Australian farming systems in line with their natural environment.[45]

7.51 In her submission, Ms Rosemary Hook, a grazier, highlighted the need to maintain programs which support access to training and extension, and suggested incentives along the lines of 'land stewardship' payments. She noted, however, the need to directly support holistic solutions, not solutions that solved one problem by creating another:

> There is a clear need for the development of programs to assist farmers, to be advised by research from social science groups. For example, the Sustainable Farms Project within the Fenner School at ANU, is currently investigating the attitudes of graziers to their farm landscapes—an understanding of such attitudes is vital in designing assistance programs (including financial) to which a *broad spectrum* of farmers will respond.
>
> Successful support programmes, such as assistance provided for farmers to attend holistic management courses (run by HM Educators, RCS and Principal Focus) and to obtain professional farm planning advice, should be continued.
>
> It may be appropriate to provide financial incentives/rewards for implementing practices known to be beneficial, but which do not necessarily require acceptance of climate change per se—the "land stewardship" type payments that have been considered in other contexts.
>
> In funding research which underpins the development of appropriate agricultural systems, the government needs to ensure that whole farm systems and their carbon economy are considered. This is to avoid developments which may have beneficial aspects but which overall are part of or support, carbon expensive farming systems.[46]

Committee conclusions

7.52 Facilitating action at an individual, community and industry level is a key role for Government. It is, of course, axiomatic that Governments should always be aware of the potential impacts of laws and programs on the

45 Fenner School of Environment and Society, ANU, Submission no. 4, p. 7.

46 Ms Rosemary Hook, Submission no. 47, pp. 3–4.

ability of farmers and industries to adapt to climate variability and climate change. Policies which produce perverse or negative outcomes, or fail to promote positive outcomes, must be adjusted.

7.53 The Committee is aware of government programs which provide financial support and incentives for farmers to undertake training and develop their business commercially and environmentally. Opportunities are there for those who wish to take advantage of them. Nonetheless, the Committee believes that there are further opportunities for government to facilitate adaptation through targeted incentives. A number of the suggestions made to the Committee in this vein would seem to offer low cost means for catalysing positive responses to climate variability and climate change.

7.54 Lastly, as has already been canvassed in this report, the Committee is supportive of organisations and activities that build resilience and promote adaptation at a local and community level. Again, the Committee is aware of Government support for such activities and organisations. However, the precarious nature of much of this support is a matter of ongoing concern to many. It is perhaps time to place this support on a more permanent and regular footing, thus ensuring that resilience and adaptive capacity are created and sustained into the long term.

Recommendation 14

7.55 **The Committee recommends that the Australian Government, as part of its overall response to issues affecting agriculture and climate change, explore further opportunities to facilitate adaptation to climate variability and climate change through the use of targeted, industry and issue specific, incentives.**

Recommendation 15

7.56 **The Committee recommends that the Australian Government place funding for local and community organisations engaged in the work of supporting farmers in adapting to climate variability and climate change upon a permanent and regular basis.**

Drought policy

7.57 During the course of the inquiry, the Committee received evidence on drought policy. Much of this evidence concerned the need to alter the way drought relief was provided, directing funds at building resilience within farming communities to better prepare them to survive drought.

7.58 In evidence before the Committee, Mr Geoff Thomas, president of AIAST, commented upon drought relief:

> It played its role, but there is no question that it has caused less adjustment than there would otherwise have been. Even some of the people who have received it would admit privately that it probably has not done them a favour. It certainly has not done other farmers in the area a favour because it has reduced their capacity to adjust. So what does one do about it? We are not saying to chop them off at the socks. I might quote this, that we ran a program in the 1980s when I was with the South Australian Department of Agriculture with farmers on the Eyre Peninsula who, because of drought and because of high interest rates and everything else, were in all sorts of trouble. There was an enormous amount of change that occurred. A lot of farmers left simply because we provided adequate services whereby they—not just the farmer but the farm family—could realistically analyse their real situation. We also did things like look at job opportunities in the cities and put them on track with those.
>
> If you do those sorts of very practical things, people will change. The major restriction on that sort of change, of course, is the social pressure—knowing that, if the kids leave, the school closes and everybody suffers. It is a very difficult situation. That is the thing to do rather than continuing with the current system, which I do not think is doing anybody any good.[47]

7.59 In its submission, Australian Pork Limited stated that 'future drought policy should be aimed at assisting the agricultural sector to adjust to climate change and prepare for extreme climatic conditions'.[48]

7.60 The Victorian Farmers Federation (VFF) stated in its submission that:

> Climate change policy will be strongly tied to drought policy and support measures. The VFF supports a model that focuses on

47 Mr Geoff Thomas, AIAST, *Transcript of Evidence*, 18 November 2009, pp. 2-3.

48 Australian Pork Limited, Submission no. 16, p. 18.

> preparedness and adaptation, in addition to emergency response and mitigation.
>
> The VFF's position on drought preparedness has been articulated in the submission to the drought support review processes. In principle these views are a move to a broad-base preparedness system that
>
> - Provides incentives to implement more resilient production system
> - Facilitates the building of risk management knowledge and skills
> - Encourages the adoption of risk management strategies
> - Strengthen rural communities by diversifying the economic base
> - Assisting where necessary structural adjustment to increase the sustainability of communities, industries and the agricultural sector.
>
> This model of drought support focuses on assisting viable farms to manage the impacts of drought, while also allowing those farmers who are unable to continue to exit in an informed and supported manner.[49]

7.61 In its submission, the National Farmers' Federation argued for a visionary new strategy in drought management, noting that Australian farmers 'are world-leaders in implementing drought-resistant technologies and practices'.[50]

7.62 The NFF has urged the creation of a system of financial incentives to facilitate change, providing a catalyst for the adoption of better farm management practices:

> To support this policy direction, in 2007, the NFF proposed Climate Management Grants—based on mutual obligation—to help farmers prepare for, manage and recover from drought, with the intention of alleviating the impact of future severe droughts.
>
> To be effective, these mutual obligation grants must be available to all farmers who pass eligibility criteria, including:
>
> - Having a drought management or a business plan that incorporates drought,
> - Management strategies, and

49 Victorian Farmers Federation, Submission no. 33, p. 6.

50 NFF, Submission no. 17, pp. 13–14.

- Demonstrate implementation of drought mitigation activities over the past five years.

NFF said it is essential that these grants not be restricted to those farmers already in drought (or Exceptional Circumstances [EC]) declared areas. If the full benefits of effective drought preparedness and management measures are to be realised, they must be available to all farmers so they can prepare for, and mitigate against, droughts 'before' they are in the midst of one.

It is envisaged the grants could cover a variety of approved activities, including—but not limited to:

- Building stock containment (in accordance with relevant environmental and local laws);
- Trialling new/ different drought-resistant farm systems;
- Increasing or improving fodder storage capacity;
- Soil mapping, including water-holding capacity and plant requirements; and
- Implementing innovative practices and infrastructure to improve drought resilience.

Eligible farmers would have to match the Australian Government's funding with either cash or in-kind support - effectively a partnership to better drought-proof the sector. This mirrors the desire—both within the broader community and within the farming sector—to, over time; shift the policy paradigm from drought relief towards drought preparedness and management.[51]

7.63 In his submission, the Western Australian Minister for Agriculture, Food and Forestry noted that Western Australia was already moving towards a more proactive strategic approach to drought preparedness:

> Government has a role in assisting those disadvantaged by prolonged and protracted consequences of climate change to reduce pressure on the natural resource and provide options for producers to leave farming. The Department has developed a draft strategic plan on preparedness (drought), based on a risk management approach, in response to the Productivity Commission's inquiry on drought assistance.
>
> The drought preparedness strategy assists farmers to improve their skills in self reliance and climate change management. The policy principle for WA's plan is to assist farmers to make the

51 NFF, Submission no. 17, p. 14.

> transition from receiving drought assistance to being drought prepared and develop pathways to resilience. A safety net that provides support for farm families severely affected by drought is an essential component of the plan. Government funding is directed to activities and programs that promote long term profitability and productivity of farm businesses. These policy principles will assist farmers structurally adjust while addressing previous impediments to industry productivity growth, protecting the natural asset base, farm families and communities. To implement the strategy, the Department works with farmers to promote, communicate and provide relevant information on drought preparedness for incorporation into farm management strategies.[52]

7.64 In evidence before the Committee, Mr David Mortimer, Executive Manager, Climate Change Division, DAFF, highlighted the current review of drought policy:

> The government is presently doing a major review of drought policy, which Minister Burke has been leading. As part of that there was an expert panel set up to specifically examine the social pressures in rural areas resulting from drought. That was headed by Mr Peter Kenny previous head of AgForce in Queensland and comprised a number of people with expertise in the area. That report has been provided to the government. That will form part of the government's consideration of future drought policy.[53]

Committee conclusion

7.65 The Committee is aware that drought policy is under review by the Australian Government and offers no comment on this matter except to state that it supports an approach that emphasises capacity building and long term resilience rather than short term survival. Drought policy should be about developing industries and enterprises that can cope with drought.

52 Minister for Agriculture, Food and Forestry, Western Australia, Submission no. 61, p. 3.

53 Mr David Mortimer, DAFF, *Transcript of Evidence*, 28 October 2009, p. 2.

The Hon Dick Adams MP

Committee Chair

24 February 2010

A

Appendix A – The Inquiry

1.1 The inquiry into the role of government in assisting Australian farmers to adapt to the impacts of climate change was referred to the House of Representatives Standing Committee on Primary Industries and Resources on 4 February 2009 by the Minister for Agriculture, Fisheries and Forestry, the Hon Tony Burke MP. A copy of the terms of reference is at page *xiii*.

1.2 The Committee's inquiry was advertised in February, inviting members of the public to make written submissions for the Committee's consideration. Letters inviting submissions were also sent to all State Premiers, Chief Ministers, relevant Commonwealth, State and Territory government departments, peak bodies, and individuals. Information concerning the inquiry was also made available on the Committee's website.[1]

1.3 During the inquiry, the Committee received 73 submissions, from a range of Commonwealth, State and Territory agencies, industry organisations, companies and individuals. A list of submissions received by the Committee is at Appendix B. A list of other documents of relevance to the inquiry which were formally received by the Committee as exhibits can be found at Appendix C.

1.4 The Committee held 14 public hearings and one private briefing for the inquiry. These provided the Committee with opportunities to hear at first hand the views of the people affected by current and future issues concerning the role of government in assisting Australian farmers to adapt to the impacts of climate change.

1.5 A list of the organisations and individuals who gave evidence to the Committee is at Appendix D. Transcripts of evidence recorded from the

1 http://www.aph.gov.au/house/committee/pir/australianfarmers/index.htm

public hearings, along with the submissions, are available on the Committee's website.

1.6 The Committee also conducted site inspections to observe the results of some of the innovative farm management practices outlined in the range of submissions. The Committee visited:

- Tamworth, NSW
- Rockhampton, Qld
- Emerald, Qld
- Yan Yan Gurt, Vic
- Hamilton, Vic
- Boorowa, NSW
- Kempton, Tas
- Melton Mowbray, Tas
- Geraldton, WA

B

Appendix B – List of submissions

Number	Individual/Organisation
1	Mr Ian Bowie
2	Professor Frank Vanclay & Mrs Aysha Fleming
3	Mr Sandor von Kontz
4	The Fenner School of Environment and Society, ANU
5	Australian Seed Federation
6	South West Climate Change Forum
7	Dr Kath Cooper & Mr Mike Elleway
8	Murray Irrigators Support Group
9	Southern Midlands Council Landcare Unit
10	CCRSPI Network
11	Managing Climate Variability Program, Land & Water Australia
12	Dairy Australia
13	Agrifood Skills Australia
14	Ms Narelle Martin
15	Tasmanian Institute of Agricultural Research
16	Australian Pork Limited
17	National Farmers' Federation
18	Climate Change Research Centre, UNSW

19	CSIRO
20	Monaro Farming Systems
21	South Australian Farmers Federation
22	Ms MairiAnne Mackenzie
23	Ms Julia Weston & Mr Frank Giles
24	School of Earth and Environmental Sciences, UW
25	Urban Research Centre, UWS
26	CropLife Australia
27	AgForce
28	WA Farmers
29	RM Consulting Group
30	NSW Irrigators' Council
31	Mallee Sustainable Farming Inc.
32	Australian Research Council
33	Victorian Farmers Federation
34	Fitzroy Basin Food and Fibre Association Inc.
35	Australian Egg Corporation Ltd
36	Apple and Pear Australia Ltd
37	Nursery and Garden Industry Australia
38	Otto Agribusiness Pty Ltd
39	Southern New England Landcare Ltd
39.1	Southern New England Landcare Ltd (supplementary to Submission No. 39)
40	Dr Federick C Bell
41	Ms Tracey Knowland
42	National Association for Sustainable Agriculture Australia Ltd
43	Australian Controlled Traffic Farming Association
44	Goulburn Broken Catchment Management Authority

45	CTF Solutions
46	Grain Growers Association
47	Ms Rosemary Hook
48	Australian Academy of Science
49	Biodynamic Agriculture Australia
50	Carbon Coalition Against Global Warming
51	National Association of Forest Industries
52	Dr Christine Jones
53	Grains Research and Development Corporation
54	Conservation Agriculture Alliance of Australian and New Zealand
54.1	Conservation Agriculture Alliance of Australia and New Zealand (supplementary to Submission No. 54)
55	Growcom
56	Australian Women in Agriculture Ltd
56.1	Australian Women in Agriculture Ltd
57	Tasmanian Government
58	Ms Julian Campbell
59	Mr John McCracken
60	Dr John White
60.1	Dr John White (supplementary to Submission No. 60)
61	Minister for Agriculture and Food; Forestry, Western Australia
62	Horticulture Australia Council and Horticulture Australia Ltd
63	Australian Institute of Agricultural Science and Technology
64	Australian Bureau of Statistics
65	Bureau of Meteorology
66	Ms Susan Edwards
67	Future Farm Industries CRC

68 NSW Department of Primary Industries

69 Queensland Department of Employment, Economic Development and Innovation

70 Department of Agriculture, Fisheries and Forestry

71 Otway Agroforestry Network

72 Bennett Clayton Pty Ltd

73 Victorian Government

C

Appendix C – List of exhibits

1. Material tabled by the NSW Department of Primary Industries at the Public Hearing, 1 July 2009
   - Our Framework for Action on issues critical to primary industries, NSW DPI, DG 09/007, 6 March 2009

2. Material tabled by the NSW Department of Primary Industries at the Public Hearing, 1 July 2009
   - Framework for Action—Climate

3. Material tabled by the NSW Department of Primary Industries at the Public Hearing, 1 July 2009
   - Climate change maps and charts

4. Material tabled by Nursery & Garden Industry Australia at the Public Hearing, 1 July 2009
   - Industry Snapshot: Cooling the planet, one backyard at a time

5. Material tabled by Nursery & Garden Industry Australia at the Public Hearing, 1 July 2009
   - Nursery Papers, March 2009, Issue no. 2

6. Material presented by Professor Bob Martin, Primary Industries Innovation Centre, UNE, at the Tamworth inspection, 2 July 2009
   - Primary Industries Innovation Centre Annual Report 2008

7. Material presented by Professor Bob Martin, Primary Industries Innovation Centre, UNE, at the Tamworth inspection, 2 July 2009
   - Mastering Moisture: the practice of no-till farming in Australia (NSW DPI, 2008)

8. Material presented by Mr John Kneipp at the Tamworth inspection, 2 July 2009
   - Introduction to the Liverpool Plains Catchment (Liverpool Plains Land Management Committee)

9. Material presented by Mr Cam McKellar at the Tamworth inspection, 2 July 2009
   - Biological Farming—A Farmers Perspective

10. Material presented by Mr Andrew Pursehouse at the Tamworth inspection, 2 July 2009
    - "Breeza Station": Pursehouse Farms Pty Ltd

11. Material presented by Southern New England Landcare Ltd at the Tamworth inspection, 2 July 2009
    - Southern New England Landcare, Review of Achievements 2004/5–2007/8

12. Material presented by Southern New England Landcare Ltd at the Tamworth inspection, 2 July 2009
    - *Landchat*, no. 70, May-June 2009

13. Material presented by Southern New England Landcare Ltd at the Tamworth inspection, 2 July 2009
    - Engineered Woodlands, Information Sheets 1–4

14. Material presented by the Fitzroy Basin Association at the Rockhampton inspection, 15 July 2009
    - Ground Cover Standards for Central Queensland Grazing Lands

15. Material presented by the Fitzroy Basin Association at the Rockhampton inspection, 15 July 2009
    - *Assessing Stubble Cover: Photo standards for sorghum crops*, Department of Primary Industries and Fisheries, Queensland, 2007

16. Material presented by the Fitzroy Basin Association at the Rockhampton inspection, 15 July 2009
    - Fitzroy Basin Association, Regional Investment Strategy 2005–08, Final report

17. Material presented by Gordon & Anne Stünzner at the Rockhampton inspection, 15 July 2009
    - Adapting Farming to Climate Change

18. Material presented by the Fitzroy Basin Food & Fibre Association at the Emerald inspection, 16 July 2009
    - Fitzroy Basin Food & Fibre Association, An Introduction

19. Material presented by the Fitzroy Basin Food & Fibre Association at the Emerald inspection, 16 July 2009
    - *Managing wetlands in intensive agricultural systems: Cotton production*, Department of Primary Industries and Fisheries, Queensland, 2008

20. Material presented by the Fitzroy Basin Food & Fibre Association at the Emerald inspection, 16 July 2009
    - *Cropping Central*, Issue 31, June 2006

21. Material presented by the Fitzroy Basin Food & Fibre Association at the Emerald inspection, 16 July 2009
    - Professor Bob Carter, 'It's natural climate change, stupid!', *Australian Cottongrower*, June–July 2009

22. Material presented by Mr Charles Wilson at the Emerald inspection, 16 July 2009
    - Paper on the interface between agriculture and mining in Queensland, Futurefood Queensland

23. Material presented by Mr David Thompson at the Public Hearing, 19 August 2009
    - Summary Paper for the Standing Committee on Primary Industries and Resources

24. Material presented by Mr Shane Andrews at the Public Hearing, 19 August 2009
    - Engineered Woodlands Project: Establishment 2007 to 2009

25. Material presented by Southern New England Landcare Ltd at the Public Hearing, 19 August 2009
    - *Landchat*, no. 72, July–August 2009

26. Material presented by the Grain Growers Association at the Public Hearing, 19 August 2009
    - Agriculture Uncovered: A blueprint for farming in a carbon economy. Workshop notes, 28 April 2009

27. Material presented by the Murray Irrigators Support Group at the Public Hearing, 3 September 2009
    - Pictures and articles regarding fast watering techniques

28. Material presented by the Murray Irrigators Support Group at the Public Hearing, 3 September 2009
    - Results from Fast Watering Trials

29. Material presented by Mr Bill Williamson at the Public Hearing, 3 September 2009
    - Cooperative Research Centre for Irrigation Futures, Demonstration of Surface Irrigation Evaluation Technology in the Goulburn Murray Irrigation District: Report 1: Evaluating the Performance of Bay Irrigation in the GMID

30. Material presented by Mr Bill Williamson at the Public Hearing, 3 September 2009
    - Leading Edge, *Australian Cottongrower*, February–March 2008, pp. 44, 46

31. Material presented by Mallee Sustainable Farming Inc at the Public Hearing, 3 September 2009
    - Mallee Sustainable Farming Inc. (MSF) introductory comments Standing Committee on Climate Change Thursday 3rd September 2009

32. Material presented by Mallee Sustainable Farming Inc at the Public Hearing, 3 September 2009
    - Mallee Sustainable Farming: A Decade of Difference—Waikerie Field Day Tuesday 1st September, 2009

33. Material presented by Mallee Sustainable Farming Inc at the Public Hearing, 3 September 2009
    - Mallee Sustainable Farming: results compendium 2008

34. Material presented by the Bureau of Meteorology at the Public Hearing, 16 September 2009
    - Annual Maximum temperature Anomaly—Australia
    - Trend in number of hot days 1970–2008
    - Autumn Rainfall—Southeastern Australia
    - Trend in Autumn Anti-Cyclone Density 1970–2008

35. Material presented by Mr John McPhee at the Public Hearing, 21 September 2009
    - Controlled Traffic Farming: The foundation of climate adaptation in vegetables and mixed cropping

36. Material presented by Mr John McPhee at the Public Hearing, 21 September 2009
    - Operational Plan for the Development of Controlled Traffic Farming in the Tasmanian Vegetable Industry

37. Material presented by Mrs Aysha Fleming at the Public Hearing, 21 September 2009
    - Climate futures for Tasmania: local climate information for local communities

38. Material presented by Forestry Tasmania at the Public Hearing, 21 September 2009
    - MBAC Consulting Group, Forestry Tasmania's Carbon Sequestration Position, December 2007

39. Material presented by Forestry Tasmania at the Public Hearing, 21 September 2009
    - Forestry Tasmania Carbon Management Policy

40. Material presented by Forestry Tasmania at the Public Hearing, 21 September 2009
    - Trees on Farms

41. Material presented by Forestry Tasmania at the Public Hearing, 21 September 2009
    - Forest Management Plan 2008, Sustainability Charter

42. Material sent by Professor Frank Vanclay, 21 September 2009
    - Aysha Fleming & Frank Vanclay, TIAR, Guidelines for climate change communication

43. Material sent by Professor Frank Vanclay, 21 September 2009
    - Aysha Fleming & Frank Vanclay, TIAR, Farmer responses to climate change and sustainable agriculture: A review

44. Material sent by Professor Frank Vanclay, 21 September 2009
    - Frank Vanclay, Peat Leith & Aysha Fleming, Understanding farming community concerns about adapting to a changed climate, Climate 2008.

45. Material sent by Dr Hans Drielsma, Forestry Tasmania, 22 September 2009
    - Table of "Carbon in building materials"

46. Material sent by Dr Hans Drielsma, Forestry Tasmania, 22 September 2009
    - CRC for Greenhouse Accounting, Forests, Wood and Australia's Carbon Balance

47. Material sent by Charles McElhone, National Farmers Federation, 24 September 2009
    - ABARE, Outlook09, March 2009, Opportunities for forestry under the Carbon Pollution Reduction Scheme (CPRS)

48. Material sent by Karlie Tucker, RM Consulting Group, 28 September 2009
    - Nigel McGuckian & Lauren Rickards, The Social Dimensions of Mixed Farming Systems

49. Material sent by Karlie Tucker, RM Consulting Group, 28 September 2009
    - Lauren Rickards, Critical Breaking Point? A report for the Birchip Cropping Group, June 2007

50. Material sent by Grant & Elyssa Bain, 29 September 2009

D

Appendix D – List of witnesses

Wednesday, 27 May 2009 - Canberra

Grains Research and Development Corporation

Dr Martin Blumenthal, Program Manager, Agronomy, Soils and Environment

Dr Sara Hely, Project Manager, Varieties

Ms Kylie Paulsen, Communication Manager

Dr Stephen Thomas, Executive Manager, Practices

Wednesday, 3 June 2009 - Canberra

Land and Water Australia

Dr Owen Cameron, Program Manager, Climate Change Research Strategy for Primary Industries

Mr Colin Creighton, Program Coordinator, Managing Climate Variability Program

Dr Michael Robinson, Executive Director

Wednesday, 17 June 2009 - Canberra

Fenner School of Environment and Society, Australian National University

Dr Joern Fischer, Research Fellow

Dr Kate Sherren, Research Fellow

Wednesday, 24 June 2009 - Canberra

Individuals

Dr Christine Jones

National Association of Forest Industries

Mr Allan Hansard, Chief Executive Officer

Mr Samuel Rae, Policy Advisor

Wednesday, 1 July 2009 - Sydney

Individuals

Dr Jason Evans

Horticulture Australia Council and Horticulture Australia Limited

Ms Kris Newton, Chief Executive Officer, Horticulture Australia Council

Ms Alison Turnbull, Natural Resources and Climate Manager, Horticulture Australia Limited

NSW Department of Primary Industries

Mr Scott Davenport, Chief Economist

Mr Robert Young, Director, Climate and Water Research

NSW Irrigators' Council

Mr Andrew Gregson, Chief Executive Officer

Mr Mark Moore, Policy Analyst

Nursery and Garden Industry Australia

Dr Anthony Kachenko, Environmental and Technical Policy Manager

School of Earth and Environmental Sciences, University of Wollongong

Dr Alison Gates, Research Fellow

Tuesday, 14 July 2009 - Brisbane

AgForce

Mr Grant Maudslay, President, Cattle Board

Mr Howard Smith, Director, Cattle Board

Mr Drew Wagner, Senior Policy Advisor

Australian Controlled Traffic Farming Association

Dr Jeff Tullberg, Executive Committee Member

Biodynamic Agriculture Australia

Ms Anne Tillett, Acting Business Manager

Conservation Agriculture Alliance of Australia and New Zealand

Mr Wade Bidstrup, Farmer Member

Mr Robert McCreath, Farmer Member

Mr Jean-Francois Rochecouste, Chief Executive Officer

CTF Solutions

Dr Don Yule, Director

Growcom

Ms Rachel Mackenzie, Chief Advocate

Mr David Putland, Climate Change Project Officer

Wednesday, 19 August 2009 - Canberra

Grain Growers Association

Mr Bryan Clark, Industry Development Manager

Southern New England Landcare Ltd

Mr Shane Andrews, Project Officer

Mrs Sonia Williams, Executive Officer

Mr David Thompson, Project Manager, Northern Inland Forestry Investment Group

Thursday, 3 September 2009 - Melbourne

Apple and Pear Australia Ltd

Mr Stuart Gray, Communications Manager

Mr Richard Hawkes, Technical Manager

Australian Women in Agriculture Ltd

Dr Rowan O'Hagan, General Member & Administration Officer

Ms Elaine Paton, Immediate Past President

Dairy Australia

Mr Chris Phillips, General Manager, Trade and Strategy

Ignite Energy Resources

Dr John White, Executive

Mallee Sustainable Farming Inc.

Mr Jim Maynard, Chairman

Mr Michael Mooney, Executive Manager

Murray Irrigators Support Group

Mrs Wendy Buck, Facilitator

Mr Dudley Bryant, Member

Mr John Padman, Member

Mr Bill Williamson

RM Consulting Group

Ms Karlie Tucker, Senior Consultant

Victorian Farmers Federation

Mr Graeme Ford, Executive Policy Manager

Mr Darryl Harrison, Senior Policy Advisor

Mr Simon Ramsay, Farm Business and Regional Development Chair

South West Climate Change Forum

Mr Mike Weise, Executive Officer, WestVic Dairy Inc.

Wednesday, 9 September 2009 - Canberra

Australian Bureau of Statistics

Ms Karen Connaughton, Acting Director, Land and Agriculture Statistics

Ms Gemma Van Halderen, Branch Head, Environment and Agriculture Statistics Branch

Future Farm Industries CRC

Mrs Lucinda Corrigan, Deputy Chair

Mr Kevin Goss, Chief Executive Officer and Executive Director

Mr Michael Poole, Director

Wednesday, 16 September 2009 - Canberra

Bureau of Meteorology

Mr Barry Hanstrum, Regional Director, New South Wales

Mr Bruce Stewart, Assistant Director, Climate and Oceans

Mr David Walland, Acting Manager, National Climate Centre

National Farmers' Federation

Mr Ben Fargher, Chief Executive Officer

Mr Charles McElhone, Manager, Trade and Economics

Monday, 21 September 2009 - Tasmania

Individuals

Mrs Aysha Fleming

Mr John McPhee

Professor Frank Vanclay

Department of Primary Industries, Parks, Water and Environment

Mr Hugh Griffiths, Senior Industry Development Officer, Agricultural Policy Group

Ms Deidre Maree Wilson, Acting Director, Agricultural Policy Group

Forestry Tasmania

Dr Hans Drielsma, Executive General Manager

Dr Peter Volker, Manager, Field Services

Mr Anthony Wise, Trees on Farms Project Manager

Thursday, 24 September 2009 - Perth

Western Australian Farmers Federation

Mr Dale Park, Land Management and Climate Change Executive Portfolio Holder

Mr Alan Hill, Director of Policy

Wednesday, 21 October 2009 - Canberra

CSIRO

Dr Andrew Ash, Director, Climate Adaptation Flagship

Dr Mark Howden, Chief Research Scientist, Theme Leader, Climate Adaptation Flagship

Dr Brian Keating, Director, Sustainable Agriculture Flagship

Wednesday, 28 October 2009 - Canberra

Department of Agriculture, Fisheries and Forestry

Mr Mark Gibbs, General Manager, Climate Change Policy Branch, Climate Change Division

Mr Allen Grant, Executive Manager, Agricultural Productivity Division

Mr David Mortimer, Executive Manager, Climate Change Division

Department of Climate Change

Mr Angas Hopkins, Director, Adaptation Research and Capacity

Mr Christopher Johnston, Assistant Secretary, Adaptation Innovation Branch

Wednesday, 18 November 2009 - Canberra

Australian Institute of Agricultural Science and Technology

Mr Geoffrey Thomas, National President

Dr Nigel Wilhelm, Member