

Charles Sturt University
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**CLIMATE CHANGE IMPACTS
AND ADAPTATION
IN
NORTH CENTRAL VICTORIA:
LANDHOLDERS' PERCEPTIONS**

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Disclaimer

The views expressed in this report are solely those of the authors, and do not necessarily reflect the views of Charles Sturt University, the North Central Catchment Management Authority, or the people consulted during the research project.

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Acronyms

AGO	Australian Greenhouse Office
BCG	Birchip Cropping Group
CCIA	Climate Change Impacts and Adaptation in North Central Victoria Project
CVGA	Central Victorian Greenhouse Alliance
DPI	Department of Primary Industries
GRDC	Grains Research and Development Corporation
GMW	Goulburn-Murray Water
ILWS	Institute for Land, Water and Society
NCCMA	North Central Catchment Management Authority
NRM	Natural Resource Management
VCE	Victorian Certificate of Education

CLIMATE CHANGE IMPACTS & ADAPTATION

IN NORTH CENTRAL VICTORIA: LAND HOLDERS' PERCEPTIONS

1 Introduction

The North Central Catchment Management Authority (NCCMA) is undertaking a project titled Climate Change Impacts and Adaptation in North Central Victoria (CCIA). This project aims to assist the North Central region to understand potential climate change impacts and adaptation to any impact, thereby enabling actions that improve the management and resilience of the region's natural resources. This report details the findings and recommendations from a survey implemented for the CCIA project by the Institute for Land, Water and Society at Charles Sturt University. The survey sought underpinning information regarding landholder awareness and perspectives.

1.1 North Central Catchment Management Authority

It is recognised that across Australia, there has been considerable degradation of land, water and biodiversity resources that has resulted in ongoing impacts on rural communities, economic production and natural ecosystems. The Department of Sustainability and Environment (DSE) believes management of physical land units is best achieved at the catchment level (2005). As a result, the State of Victoria in the south-east of Australia established an integrated catchment management system under the Catchment and Land Protection Act 1994 whereby the state is divided into ten catchment regions, with a Catchment Management Authority (CMA) established for each region (DSE 2005). These CMAs reflect regional differences, acknowledging that not all landscapes and resource issues are the same.

Victoria has six principles that govern the way catchment management is implemented. They are: (i) Sustainable Development, (ii) Community Empowerment, (iii) Integrated Management, (iv) Targeted Investment, (v) Accountability, and (vi) Administrative Efficiency (DSE 2005). Direction and specific management for each CMA is driven through (i) a ministerially appointed Board responsible for overseeing strategic directions, (ii) a series of Implementation Committees integrating principles and theme based issues overlain by place-based structure, (iii) full and part time staff who oversee development and implementation of programs and liaise with the community, government and other catchment-focused organisations (DSE 2005).

A whole of catchment approach to natural resource management seeks to deliver social, economic and environmental outcomes for the community and reduce the size of the ecological footprint (DSE 2005). Each CMA achieves this by developing a regional catchment strategy, engaging the community in natural resource management (NRM) and implementing and monitoring the status and health of the natural assets within the catchment landscape (DSE 2005). CMAs develop and implement their regional catchment strategies both directly and through partnerships with the Department of Primary Industries, the Department of Sustainability and Environment, Trust for Nature, local government, water authorities, research institutes and the private sector (NCCMA 2003).

The NCCMA region extends from the Murray River in the north to the Great Dividing Range in the south, and from the Mt Camel Range in the east to the western boundary of the Avon-Richardson catchment (NCCMA 2003). (A map incorporating the NCCMA region appears as Appendix C.) The region covers four major river catchments, namely those of the Campaspe, Loddon, Avoca and Avon-Richardson rivers, and in total comprises an area of almost three million hectares, or approximately 13% of Victoria (NCCMA 2003). The NCCMA region is further broken down into three areas, each represented by an implementation committee. In the north is the Loddon/Campaspe irrigation area, comprising the relatively flat land irrigation area of riverine plains, where dairying, horticulture and mixed farming are the main enterprises (NCCMA 2003). In the west is the Avoca/Avon-Richardson catchment area which is a production agricultural landscape, characterised by broadacre land uses including cropping and grazing (NCCMA 2003). In the south east is the Loddon/Campaspe dryland area, where a more diverse topography and remnant forest is combined with smaller properties to offer farming and rural lifestyle opportunities sometimes described as a

'treechange landscape' (NCCMA 2003). The scale and intensity of production is often much less in this area than in commercial operations, although dryland farming also exists (NCCMA 2003).

The implementation committees are responsible for the development of detailed work programs and oversee the delivery of these programs for specific areas or sub-catchments (DSE 2005; NCCMA 2005a). The implementation committees play a key role for the NCCMA in enabling community engagement and consultation (NCCMA 2005b).

The NCCMA's Regional Catchment Strategy provides an integrated planning framework for land, water and biodiversity management. It takes an asset-based approach, identifying key natural resource assets with the greatest environmental, economic or cultural significance from which the community derives the greatest benefit and values the most, and seeks to protect and enhance those key assets (NCCMA 2003). The NCCMA regional catchment strategy identifies ten broad asset categories, namely biodiversity, climate, community, cultural heritage, dryland, infrastructure, irrigated land, public land, water resources and waterways and wetlands (NCCMA 2003). For each asset category the regional catchment strategy outlines goals, actions and targets to protect and enhance those assets (NCCMA 2003).

Within the regional catchment strategy, the NCCMA's goal for the 'climate' asset category is:

By 2010, the North Central region will reduce net greenhouse gas emissions by 30%, compared with 1999 levels (NCCMA 2003).

There are seven management actions and targets within the regional catchment strategy associated with achieving this goal, namely:

- *Finalise the Regional Response to Climate Change Action Plan by 2004 and implement key actions by 2008;*
- *Develop understanding of implications of climate change scenarios for management of dryland and irrigated land and associated assets and services by 2008;*
- *Develop farming systems and management practices that increase resilience in the face of climate variability and climate change by 2008;*
- *Conduct a second comprehensive greenhouse gas emissions audit for the North Central region during 2005;*
- *Develop greenhouse gas emissions audit tool for use by individual landholders/primary producers;*
- *Assess the implications for climate change scenarios for flooding, water way management and riparian and wetland health and develop management response by 2008;*
- *Coordinate community participation in climate change activities to increase regional awareness of climate change (NCCMA 2003).*

The Regional Response to Climate Change is an action plan that details a strategy to respond on a regional level to climate change by sequestering carbon through revegetation and changing land use (NCCMA 2004).

1.2 This research

The purpose of this research is to provide the NCCMA with an understanding of landholders' perceptions of climate change and thoughts regarding the adaptation strategies climate change may require. The NCCMA will use this information to facilitate its response to climate change. The results of this research will be particularly pertinent to two of the management actions mentioned in the regional catchment strategy (as discussed above), namely to assist in the development of farming systems and management practices to increase resilience in the face of climate change, and co-ordinating community participation in climate change activities to increase awareness of climate change (NCCMA 2003).

The objectives of this research were to investigate landholders' perceptions of:

- Local weather and climate cycles, including any perception of changes over time and whether landholders record weather data;
- The phenomenon of climate change;
- How climate change may affect landholders' enterprises and the viability of farming within the region;
- Actions and planning that could be undertaken to adapt to climate change, including who the key players in developing and implementing these actions may be; and

- Whether landholders are currently implementing, or considering implementing, any of the adaptive actions they have identified, on their own property.

2. Survey Description

2.1 The survey

This survey was conducted in three stages over a period of six months. A semi-structured list of questions were developed and drafted in conjunction with the NCCMA and in response to the development of research objectives identified above. An initial pilot survey was conducted with landholders in September 2005 to test the questionnaire, exploring the relevance and any shortcomings. From a list of six respondent categories, three farmers were selected for the pilot. Table 1 (below) summarises respondent characteristic details for all participants.

The major survey component was conducted during January and February 2006, consisting of nine landholder interviews across different respondent categories. Timing for each interview varied from between 1.5 to 2.5 hours including time before and after the asking of questions from the semi-structured schedule. Excluding the before and after conversation, each session was recorded. The third step involved two further interviews focusing on what was considered to be an important under-represented category in the data gathered to date, the irrigation farming community to north and the east of the catchment.

2.2 Selection of respondents

It was recognised that the strategic value of the survey would be to elicit the views of those who were perceived as community leaders, as innovators, adopters of new ideas, contributors to NRM and agricultural issues. Selection was therefore biased towards a group that were routinely involved in contributing to community based initiatives including, for example, involvement in groups such as Landcare and the Catchment Management Authority. These respondents were considered to be adopters and innovators, spirited in the way they confronted their farming enterprise and potentially influential in promoting greater understanding of the CCIA project among farmers, landholders and the broader community. The rationale for this bias was based on the assumption that these people would be the most likely to be aware of climate change as a phenomenon, to have considered its impacts on their enterprise, industry and/or activities and to have potentially thought about adaptation strategies. Thus the results of this research do not seek to provide a representative sample of opinions across the community. Rather, the project seeks to provide some understanding of the perceptions and actions of those considered to be more aware and engaged in various community programs, and thus, by assumption, more likely to be aware of and responding to climate change issues. This project did not set out to test the assumption that the selected respondents were more aware of climate change issues, or more likely to adopt management responses as a result of awareness.

The actual selection of respondents was completed by the NCCMA, using their extensive network through Landcare and catchment management groups. (The geographical spread of respondents is indicated on the map in Appendix C.) The survey also sought to canvas input from a range of farming enterprises and associated support services. The following table (Table 1) identifies the six categories of respondent that were chosen to represent the range of land use variables and support. The table provides a summary of interviews undertaken, a total of fourteen interviews, including three initially undertaken as the pilot stage of the study.

Table 1: Summary of Respondent by Category

#	Land Use	Where	Respondents	
			Pilot *	Survey
1	Wool / Beef Growers (including “mixed” crop & livestock)	Loddon / Campaspe dryland catchment	1	3
2	Cropping Farmers	Avoca / Avon Richardson catchments	1	3
3	Dairy Farmers / Irrigators	Loddon / Campaspe Irrigation region	0	3
4	Non-farming life-stylers / Hobby farmers	Bendigo / Castlemaine / Kyneton areas	1	3
5	Absentee Owners	Interviews spread across the region	**	0
6	Stock & Station agents / Banks / DPI Extension staff	St Arnaud DPI office and Stock & Station Office		2
TOTAL				14

Notes:

* The changes that were introduced into the questionnaire as a result of the pilot were not considered to be of any significance that they would alter findings so information from the three pilot interviews was also included in the overall findings.

** One farmer who participated in the pilot study was an absentee land owner who holds cropping land within the NCCMA catchment. This farmer is counted under cropping, but would equally fit into the ‘absentee owner’ category.

The second table (table 2, below) summarises some of the characteristics reported by landholding participants. It indicates where landholders had secondary land uses as well as the primary use they were categorised by initially. It also shows the size of respondents’ landholdings, and whether their land provides them with an income. The final column gives an overview of the length of time participants or their families have held their land.

Table 2: Overview of land use, land holding size, income source and length of land ownership

Predominant land use	Secondary land use	Area of land owned	Area of land leased and/or shared	Income from land holding? **	Length of ownership by interviewee/partner*
Cropping					
Cropping	Sheep	1320 hectares	56 hectares shared; 170 hectares leased	Yes	Third generation
Cropping	Prime lambs, sometimes cattle	2225 hectares	-	Yes	Fourth generation
Cropping	Sheep	1092 hectares	Sheep on leased land - area not discussed	Yes	At least three generations
Wool / Beef growers (including "mixed" crop & livestock)					
Sheep	Cows, cropping	998 hectares	364 hectares shared	Yes, along with another property outside NCCMA region	Since settlement, 1908
Wool, fat lambs	Cropping	400 hectares	-	Yes	Third generation
Sheep		243 hectares	405+ hectares leased	Yes, but only part time; off-farm income taking precedence	Two generations (third "not interested in farming")
Dairy farmers/irrigators					
(Former) dairy		162 acres	-	Yes at the time	Five years (one partner grew up in the area)
Irrigated dairy		135 hectares		Yes	Three generations
Beef, sheep and Lucerne	(breakdown not provided)			Yes	
Non-farming life-stylers / hobby farmers					
Goat breeding	Tourism	93 hectares	-	Yes, but on hobby-farm basis	21 years
Revegetation/lifestyle		65 hectares	-	No; have part-time off-farm income	11 years
Revegetation/lifestyle		17 hectares	-	No	Nine years

Notes:

* Local experience refers to how long participants or their families have owned their land. Where participants indicated other experience living in the same region this is also noted in the table.

** Although not necessarily asked directly, many respondents indicated whether their landholding provided them with income, and to what degree they were reliant on this income. Where additional information regarding other forms of income was provided it has also been included.

- Much of the detail in this table was obtained from responses to other questions in the interviews and therefore the level of detail varies somewhat between respondents.
- The two extension officers interviewed are not included in this table as it relates to landholdings.
- Landholding area sizes that were discussed in acres have been converted to hectares for ease of comparison.
- Where detail was provided it is included, for example, some respondents only said they ran sheep, where others specified whether those sheep were wool growing, or fat lambs.

Of the twelve landholders interviewed, six were wholly dependent on income from their farm. Of the other interviews, two did not draw any type of income from their land, and three drew some income from their land, which for two of these respondents was supplemented with income from other sources (one with another farming enterprise, one with off-farm income). As noted above, one cropping farmer is an absentee owner. Additionally, one of the respondents from the 'life-stylers' category typically visit the area between Friday and Monday, and live the rest of the week elsewhere, where they earn a part-time, off-farm income. One interview was with former full-time dairy farmers who had recently sold their enterprise and property and moved to another part of the catchment.

2.3 Interview content

Each interview commenced with a discussion concerning the farming enterprise, including details regarding the known history, scale and mix of activity on the farm. This provided the farmer with the opportunity to share important background information. Subsequent questions aimed to explore:

- major weather event history based upon (a) kept data and (b) memory;
- the respondents' understanding of climate change;
- responses to summary projections from the Australian Greenhouse Office concerning likely climate change effects across the continent;
- details of actions the participants consider could assist in adapting to climate change in a forward looking manner;
- Key players the respondents think could assist in developing and implementing these forward plans.

A copy of the semi-structured interview schedule is included in Appendix A.

2.4 Information on climate change

To promote discussion concerning the existing information available on climate change the following paragraph was offered to respondents. The paragraph was taken from the Australian Greenhouse Office web page of May 2004.

How is global warming likely to affect Australia?

Australia will be hotter and drier in coming decades according to CSIRO's climate change estimates. Over most of the continent, annual average temperatures will be 0.4 to 2°C greater than 1990 by 2030. By 2070, average temperatures are likely to increase by 1 to 6°C. The warming won't be the same everywhere. There will be slightly less warming in some coastal areas and Tasmania, and slightly more warming in the north-west.

The warmer conditions will produce more extremely hot days and fewer cold days.

South-western Australia can expect decreases in rainfall, as can parts of south-eastern Australia and Queensland. Wetter conditions are possible in northern and eastern Australia in summer and inland Australia in autumn.

For details, see www.dar.csiro.au/impacts/future.html

2.5 Constraints

Identification and selection of the survey respondents was completed for the researcher by the NCCMA. Given the selection criteria previously noted above, it was in some cases difficult to find suitable candidates to fit each category.

The interviews conducted between the 25th and 27th of January coincided with bushfires and storms across Victoria. In some situations this caused difficulties in availability of respondents and the juggling of mutually acceptable interview times.

There was a richness to the information shared by participants in this study. This report seeks to provide an indication of the nature and style of responses by including quotes from the respondents where applicable, however, full transcripts of interviews have not been provided in this report. Individual respondent comments are not attributed, but as the agronomist and extension officer play a very different role to farmers within the farming and land management system, comments from this category of respondent are attributed with the label 'extension'.

3. Findings

3.1 Introduction

This section will examine and summarise the data received from the fourteen interviews. The findings are presented in two sections. The first (section 3.2) will provide an overview of the responses to the key interview questions. The second (section 3.3) will highlight the key themes and issues that came out of these responses. The identified themes and issues provide crucial supplementary information to the direct responses, and contribute to a better understanding of participants' perceptions by enabling the identification and consideration of additional factors that are important to respondents and influence their thinking and actions. Throughout both sections specific points are illustrated by the use of quotations.

3.2 Overview of responses

For the purposes of this report, data from the nine key interview questions have been compiled into four broad themes: (i) history of the specific farm/enterprise or regional activities, (ii) thinking regarding the local and regional weather cycles, (iii) individual response to climate change, and (iv) future climate change-related adaptation plans or actions of each respondent.

It was clear that the respondents were considerably more at ease with questions one to four from the interview schedule (Appendix A) where they were able to reflect upon farm history, weather cycles and changes in weather patterns, than on the later questions relating to climate change.

3.2.1 History of the farm or regional activities.

Question 1: Would you like to tell me about the farm enterprise? I'm interested in both an historical and a present day view of things.

Each respondent's story and relationship with the district was distinctly different.

Landholders who had held their land longest, which in some cases included land being within their family's control for several generations or since settlement, tended to have greater knowledge of the history of the farm, or even region. These landholders often talked about the types of land use that had existed previously, when particular events occurred (such as land clearing, mining, dam construction) and weather events, such as snow, ferocious storms and periods of notable 'wet', 'cold' or 'dry'. The extension staff had some knowledge of some of these 'stories' from their clients. Some of the more recently arrived landholders had little knowledge of this type of history beyond their own experience, while others had sought such information out. The level of participants' knowledge of the history of their land and the region tended to correlate with their ability to discuss long term local weather cycles and patterns. Those less- or un-familiar with the longer term history in the region generally could not contribute a great deal regarding memories of climate events or patterns.

Life-stylers have their major income from beyond the farm gate and thus their responses reflected that they do not face the same survival imperatives as income-dependent landholders. By comparison, the farm planning and land use amongst life-stylers was far more diverse. (See also section 2.2)

3.2.2 Local weather cycles

Question 2: I'd like you to give further consideration to the history of the farm and ask if we can plot some important weather/climatic events that you can remember. What impact did these events have on the farm/in the district?

Question 3: Have you kept climate data over the period of land use and would you like to share this data?

Question 4: What are your perceptions of the climatic cycle here in this district? ...How would you describe it? What are the patterns that have occurred? Have you detected any change in these patterns over time?

Rainfall and rain events

For all respondents rainfall was synonymous with climate. Rainfall was by far the most discussed aspect of weather and climate throughout the interviews. Informants frequently relied on anecdotal evidence and their own memories and experience to illustrate or support their perceptions of climate and weather variations.

The following quote, by one respondent, is typical of the responses that focused on rainfall and its perceived importance.

All the memories I've got, from all the gatherings of family - and all the family of mine were farmers - when my grandmother was alive, all Dad's brothers and sisters would come back and everything, every conversation reverted back to rainfall. Rainfall has always been the limiting factor for farming in my career, and, of what I can remember of my father's, and uncles would talk about too. It has always been rainfall as the most important factor. Rainfall has always been recorded – not by us so much by the local store only four miles up the road. These records are pretty good. There have been some very dedicated people who record rainfall very closely. So, we always know we are lacking rainfall. That has never changed.

Concerning the constant emphasis upon rain the following quotes from two cropping farmers confirms their position.

The limitation for us is always moisture. It is all very well having a good understanding of the agronomy of what is needed to grow a crop but our limiting fact again comes back to moisture. Whatever other shortfalls we have, like micro nutrient deficiencies, different crop varieties and strains etc, [the success of a crop] is always tied to the availability of moisture.

The other thing around here is the rain events. We might be getting rainfall and you look at the total by the end of the year and it's not a lot different, but we are not actually catching any water in our catchment dams so that the rain events are not as intensive – these are things we certainly notice. I can remember Dad telling us – we only had three catchment dams on the farm but if it goes dry you clean it out because its only dry for 12 months and next year it's going to be clean and there you go for fresh water. Well, that has not been the case for [the last] eight years – it has been dry for eight years. So, on my recollection of what my father told me – that is abnormal. They don't normally stay dry more than a few years. So, that is not proven with the statistics – we don't record the rain events as much as the total rainfall over the year. So, it is not as intensive when it does come – it's more spread over the year and a lot of events, and, only get say 10 points [2.54mm] whereas if you get that really good soaking rain over an inch [25.4mm] and everything starts to run well, then that is where you get value out of your rainfall. [With] small rains you're not getting great benefit.

Things are getting drier

As a result of drought in the last seven to eight years there was conviction amongst the respondents, perceived to be reinforced by neighbours and data, that “*things are getting drier.*” Several mentioned that records show rainfall to be well and truly below average. Some participants thought this dryness represented a change in climate, some were unsure and others thought it was merely a stage of a much longer climate cycle, and that it would not remain dry indefinitely. This was illustrated by the comments of two informants:

In St Arnaud there have been six years where rainfall has been 30% below average. A major local indicator of this dryness is the drying of the large lakes. I think that what we've come through in the last eight to ten years is nearly a mirror image of what happened a hundred years ago. And I reckon we're just in a cycle and it's just cyclic. I haven't studied it deeply but I personally don't think- yeah, alright, we've got issues with the lakes being dry around this area – it's been the first time they've been dry for years on end. I can't remember them being dry for this long and intense but I think we're in a dry cycle and I think we've been through the driest and you just get a feeling it's started to be heading to the wet side again.

One old bloke said to me that in one of the lakes south of Horsham that have got some really old dead Eucalyptus in them. And the lake is dry at the moment. It is the first time that the lake has been dry for 80 or 90 years at least – that anyone can remember. This guy said – look how big they are. They are old grey box. They don't germinate in water. They needed to germinate and grow and they can only grow if they are not waterlogged. Some of those trees are 60 or 70 years old – in the middle of that lake – that means that the lake must have been dry for 60 or 70 years – they are dead now because they have got water in them! He said it is just cyclical. I tend to agree with that comment.

We have been through a “dry cycle”. It will come back again. If you look at the last five years of the 1980’s and then the first few of the 1990’s, they were all above average; five of them significantly above average. We have actually got within half an inch of being within average rainfall!

Many informants reported that both the incidence and dimensions of rainfall events have changed. One informant said:

[Previously] in one year I measured rainfall for 22 of the 31 days in August – now you’d be lucky to measure five or six.

Other weather events

Participants did comment on some other weather events, beyond rainfall, however these comments were far less frequent, sometimes with conflicting perceptions between respondents. Often participants had to be prompted and/or struggled to comment on these other events.

Some participants thought there had been an increase in winds in recent years. In some cases this was associated with erratic storms during the summer period.

There’s no doubt there’s a change going on. There’s definitely warming over the last few years, especially winters. Our winters are quite mild. We still have frosts but the days turn out balmy. We have more wind in late spring [recently]. We get cold southerlies in late October and November rather than during June and July.

I’ve never known it so consistently windy [as the last few years] – I’ve never known wind in December like that. We had wind damage, it sheds the heads. [This comment was by a cropping farmer].

I haven’t noticed any difference [in winds] but then farmers say it’s been windiest in the last five years. I wouldn’t have the faintest if it’s changed or not. And without records it’s definitely subjective.

There was a perception by some respondents that the seasons have gone from being predictable to unpredictable, while others thought there had been a change in seasonal intensities and/or the timing of seasons. Evidence given by participants for these comments included perceptions of autumn breaks occurring later than they used to, and summers seeming longer and hotter. The following comments were typical of the many comments that illustrated these perceptions.

We used to freeze through the winters here, but now you don’t.

We have not been bogged on this land for nine years, whereas there were long times after rain when you could not put a ute [utility] on parts of the farm.

We don’t have the heater [in the house] roaring very often [in recent years]. How much of that is based upon fact or perception, I cannot judge. We still have some cold days but not a lot of those bleak wet, windy sort of scrawny cold July days that we used to get. So perhaps the temperature hasn’t changed but we just haven’t got those wet winters, the drier winters – they are easier to put up with than the colder weather.

We have more mild winters.

The seasons have gone from being rather predictable to being unpredictable.

It’s drier and statistically hotter.

Generally you would say that the cropping rains break [occur] later.

A number of respondents reported topographical and micro-climatic variance playing a large role in weather variance, so that their experience on their land was not necessarily the same as the patterns of the district or

region. For example one landholder reported that they did not suffer from frosts as badly as some of their neighbours because of the topography of their land.

Two dairy farmers noted trends based on conditions that had recently developed or worsened in their cows. The first of these farmers discussed the occurrence of “hot cows”. The farmer said this problem occurs when Friesian cattle suffer from extreme sensitivity to the intensity of sun’s rays combined with summer heat. The result is a skin condition and decreased milk production. This farmer said they had taken to bringing the cows into the yards hours before milking in summer and spraying them with water in an attempt to cool the cows down. They had also planted additional trees for shade along irrigation bays and said work was being done into cross breeding to overcome the problem. The farmer noted that the incidence of “hot cows” had increased in recent years and found this to be anecdotal evidence of summers being hotter. This farmer said:

We’ve focussed on our provisions to deal with hot cows, because it has a massive effect on production. I guess in the early days we would have worried about how to deal with mud and cows. Now the focus is more about how to deal with heat and cows. And a little bit of that is to do with a change in our timing of calving that we have, but ... putting in the sprinklers and always being serviceable and conscious that we use them. We’ve also planted a lot of trees for shade, though we haven’t got nearly enough. Maybe it’s not possible to ever have enough. And we anticipate we’ll have to be continually doing that.

A second farmer noted that the summer sun seemed to have increased in intensity and said they had observed a dramatic increase in the number of skin cancers in their cows in recent years. This farmer too, had sought to address this problem through the use of shade trees and had also considered getting cotton rugs to protect the animals.

Influence of soil types

Several informants talked about the interaction between soil and weather. They noted that the wet and dry climate cycles obviously have an effect upon production. However, participants explained these effects can be positive or negative, depending upon soil type. Below is a quote from one informant.

North of town [St Arnaud] there are very heavy, deep, alkaline, black soils that can handle a lot of rain. South of town there are very shallow acidic. One farmer said that a wet drought is more harm to me than a dry drought – it normally gets too wet for him to do anything south of town. So, the south side of town can be worthless but in these last dry years it has been very productive ‘cause of the dry winters. So, those farmers have been enjoying the dry, getting a lot more production off country that you would not get in “normal” wet winters. With the heavy soils, once you get them wet – boy they will grow a crop! The problem is that if you cannot wet them up in the first place – cannot get the profile wet, they cannot do anything with them. They are a heavier clay, [so] plant available moisture and wilting point are much higher of course. South of town the wilting point is say 10mm, north of town it’s probably 25-30mm. So, you need a lot more rain to get the crop up to field capacity [in the north] whereas that sort of rain would have you waterlogged south of town.

Climatic data and records

Many participants noted the subjective nature of their recollections of weather events. They recalled these weather events because of the impact they had on their enterprise, such as autumn breaks ‘saving’ crops, temperatures that made outdoor work uncomfortable, periods of wet that prevented access to their land because they would become bogged, and so on. Of the landholders interviewed, only one consistently kept data, and that was rainfall only. In fact, in keeping with participants’ preoccupation with rainfall, when asked about climate and weather events, overwhelmingly, if “climate data” is kept or discussed, it manifests as rainfall data. Several of the landholders who did not keep rainfall data themselves indicated that they were able to access it locally. These sources of data were said to include other individuals who kept their own records, certain post offices and the local paper.

Consistently, all participants could verbally summarise the major rainfall events or patterns going back at least as long as their association with the land, and in some cases decades, identifying periods of dry and wet. Other events that were recalled included when the “autumn breaks” came, occurrence of significant summer storms and the sharing of anecdotal theories of their forefathers regards the indicators of impending rain or dry. Several informants also acknowledged that relying on anecdotal evidence may not reliably reflect changes to weather or climate patterns. Many acknowledged the complexity of the system. For example,

informants noted anecdotal evidence suggesting the past nine years had been drier than usual. Comments along the lines of “*That creek/watercourse/dam never used to run dry, but it has been dry for five years now...*”, were common, but were often qualified with an acknowledgement that there are other factors beyond rainfall that influenced the lack of flow (building of dams, excessive tillage, chemical use, clearing, etc. were offered as examples), (This issue is discussed further in section 3.3.3).

3.2.3 Climate change

Question 5: What is your understanding of the phenomenon of climate change?

Question 6: Would you like to tell me how you think it may effect your farming enterprise and / or the regional viability of farming?

Question 7: I'd like to share with you the following information concerning climate change. (This data offers projections based upon various modelling and may confirm or differ with your current thinking). In the light of this data would you like to offer any further comments regarding the issue of climate change?

There was considerable variance in the responses to these questions. Each will be addressed in turn, although generally participants' answers to each of these questions were interlinked. That is, their understanding of climate change influenced their perceptions of how climate change could influence their enterprise, and in some cases their response to the information from the Australian Greenhouse Office.

Understanding of climate change

All participants provided an explanation of their understanding of climate change, however these explanations varied greatly in their content and depth. A majority of respondents said that although they had *some* understanding, they also said they did not have a *full* understanding of climate change as a phenomenon. A few participants described the greenhouse effect. Some responses included:

Daily temperatures are getting warmer due to pollution we are putting into the air.

We are receiving the residue products of industrialization.

One informant also discussed El Nino, but did not believe this was linked to climate change. This respondent said:

As I understand, the theory of climate change and the greenhouse gas effect is that the increase of, some argue it's carbon dioxide, others argue it's an increase in water vapour, which makes the greenhouse effect which traps the sunlight and makes things warmer. I was reading about stuff on clouds the other day and that the effect of clouds on the greenhouse effect hasn't been evaluated. I don't consider it the same as the El Nino/La Nina stuff, the sea change stuff – I'm not sure what drives the sea temperature change – I don't believe they're linked. I'm not saying they are not linked [either]. To see an effect and see a cause doesn't necessarily relate it, I don't think. I don't think the research is enough yet.

Many participants expressed confusion about the climate change phenomenon. This confusion is expressed in the five participants' comments below.

[I] don't really understand it. [I] get lost in the debate.

*I can read a number of articles on climate change and really come out completely confused. You can be a scientist and tell me that nothing's happening, that it is a natural change we are going through, and then another one will tell you that we are building up the gases and there's no doubt it's a severe thing, there is no way out, this is the real thing, Donald is going to get drier and hotter. There is no doubt over the last couple of years about that argument – it has got drier and these last couple of summers it has got hotter. It is now harder to argue against. ...
When you talk to guys like Phil Dyson who are thinking about things in [over] sixty millions years, well things have changed and continue to change.¹ Is this another pattern thing or are humans having a greater effect? I just don't know if we are able to affect climate as easy as that. I find it*

¹ Phil has been helping the Donald Landcare group with a salinity project (see Phil Dyson and Associates, http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/os_phil_dyson)

hard to get my mind around the size of the universe so just what bearing humans have on something as massive as the universe, I don't know.

It's a result of pollution - from all quarters including plastics – every life contributes to this pollution, it's not just one area. For whatever reason, I don't understand, but there's a hole in our ozone layer. Now I saw this documentary on TV that [said] if somehow they repaired it we'd be in a worse state of affairs. And some scientists are predicting a future return to the ice age, especially across Europe. And there's all sorts of predictions. It's very scary. ... I don't know enough about it, and when you don't know enough you can lose perspective.

I have learnt from my daughter who has studied VCE Geography – we went to a climate change conference together where the two types – there is your natural greenhouse effect, which is natural, and then the human induced greenhouse effect – all the nasties going off, which has been happening a lot quicker over the last fifty years. It is those two that contribute to the warming. What we do about it is another thing. But even my daughter who has had her own ideas – teachers telling her one thing at high school, straight out of the geography book, and then she has got to university where they make you think a little bit more – and now she is a little bit confused.

My understanding of climate change? Not terrific. It involves oceans heating and changing weather patterns. I don't really understand it. I know it's changing. I don't really understand weather. Something I did understand the other day – I don't know if it's right or not – a guy on the radio said it's a degree hotter due to climate change. He said that means if you live in Seymour you now have a climate that is [the equivalent of] one hundred kilometres north. That has a huge impact on me because I can understand it, it's within my realm of thinking. I can picture that.

Perceived positive impacts of climate change

In addition, approximately half the informants made comments about perceived potential positive impacts of climate change (such as temperature changes, milder winters, increased carbon dioxide levels and less rainfall) as well as or instead of noting the potential negative impacts. Much of this is confused. For example, one informant said “*We could survive with less rain*”, but then admitted that they have been “saved” in the past by late breaks, implying great difficulty had those breaks not eventuated. Two other participants said:

I agree all these chemicals going into the air is not a good thing. A fair bit of it is carbon dioxide. Plants love carbon dioxide – the more CO₂ the more they will grow. So, in one sense, for us to produce more crops and increase in our yields per ton, the more CO₂ that is present the better. I am not promoting it – don't get me wrong! But I have had this discussion with farmers. There is a little bit of science to it. With increasing populations we need to produce more food.

In fact, some of the changes [as a result of climate change] may be improvements.

Unsure or sceptical of climate change

While most participants were unsure about the impacts climate change may have, many were convinced that “things are changing”. Some were not sure whether it was due to climate change. Others agreed about these changes but were confident they were not related to, nor a result of, climate change. Below are some of the comments of this nature.

Something seems to be happening but I'm unsure if it's climate change or [weather/climatic] cycles.

Uncertainty – I don't know and I get conflicting information. Something is happening but the weather predictions are not even accurate so how can we be expected to take this seriously? We are in the middle of or coming out of a dry pattern. It's happened before and it will happen again.

Flannery in his book talks of the currents that move from the equator to the poles may stop and we could be facing another ice age – but we don't know. It would lead to a significant increase in ice at the poles. We don't know and we should not kid ourselves that we do. We do know that it is going to change.

It would be nice to take an each way bet but I am not sure what the bet is! Unless we can get credible science we are never going to have a debate. All we are going to have is ill-informed people

making ill-informed comments. And the people who should be leading the debate are often the most ill-informed. ... It's difficult enough to know what position to take from a CMA or GMW perspective.

I'm not sure whether there's just an evolutionary thing going on. That the cycle that we're involved in is a five hundred year cycle and we've only got two hundred to look at or whether ... I'm probably reasonably convinced that the climate is changing, and it's changing to the warmer side. But it's probably not the local things that convince me of that, it's probably the polar caps melting and the islands starting to go under. They are more worrying. Here I couldn't say we've seen anything more than just a cycle of dry and wet.

One respondent, who personally felt that climate change is a threat and will have impacts, noted that their views were not shared by other farmers. This participant said:

I think most people consider that it's just a drought. There are a number of people I know that say 'it's just a drought, we'll get over it, there'll be another wet year in five years'.

Wait and see attitude to climate change

Several participants expressed that they were taking a 'wait and see' approach to accepting climate change. They felt that there was insufficient 'evidence' at present to be concerned about it. These respondents generally thought that recent trends in weather could be explained by other factors (such as longer term weather cycles and/or changes to land and water management practices) and therefore said they would require other 'evidence' before embracing climate change. The following comments by five informants illustrate this "wait and see" attitude toward climate change.

Yeah, last year was the hottest year on record. Records are made to be broken. If the next five are the hottest five on record then I might really become a believer [in climate change].

I'm not too convinced that the latest round of dry conditions is any symptom of a great climate change. They are certainly very dry. I am not convinced they are out of the ordinary. Personally. Not saying they are not, but I see no evidence yet. We have been dry in the past and I think in some ways we have mitigated [it] by the way we manage land now. We are much better managers of dryness so we can get away with it for a bit longer and there are less issues like impacts from degradation, less rabbits around at the moment – than there used to be. I do see changes in the rainfall pattern – not sure whether they are long term or short term. We are missing out on our September / October rain. Rains coming August then November-December, so our springs are becoming much drier and around here that is our growth time.... We are not losing the volume of rain but it is not coming when it is required. And, we are not getting the winter rains. Much drier winters than there used to be. Not warmer but drier.... However, in five to ten year cycles our rainfall averages would not be much different. Spring times are cooler than they used to be. Much milder. Cannot say I've noticed winds to be any different. I think there is much less variability in climate [range]. Winters are warmer than they used to be, and they are drier. Summers – we have hot days in February – we have always had them. I would see Springs being a bit cooler than they used to be. There is not much difference now from March through to November – it seems to me.

We've had extremes before.

I'm not sure that the past 18 months aren't just an aberration. One old guy I speak to says 'ah, it's bullshit – we have dry spells. We care so much about money we've got so much tied up now that we notice it more'. He says we've always got by in droughts. But we've got so much tied up in it now and you can't afford another failure. I think we notice it too much. We need to get on with life.

Climate change is already occurring

A minority of participants believed that climate change was already having an effect. Some comments that were typical of these respondents' views include:

[This] drought is a warning of climate change. To me it [climate change] is happening, whereas a lot of people either ignore it or don't take it on. I believe what [Tim] Flannery and others are saying and I'm frustrated that other people don't acknowledge it. I don't feel very empowered in the big picture and it's frustrating.

Effects on the viability of farming enterprise

There was considerable uncertainty by landholders as to what climate change may mean for the viability of farming. In many cases, respondents' lack of understanding of climate change limited their ability to comment on how it may affect their enterprise or activities. For others, their scepticism regarding climate change meant they saw it having little impact on enterprise viability. Below are comments from three respondents who did not foresee climate change having much impact on farm enterprise viability.

In terms of rainfall and temperature, personally, I don't think it is going to make much difference.

I don't think it'll affect it [farm viability] much at all in this region because in reality I don't think the climate affects the viability of farming. I think there are much more pressures from hobby property valuations and neighbours and there are much more pressures than greenhouse gases effecting climate change. Certainly, it may have some effect, but I don't believe it's going to be one of those effects that sends people under. I think there's much more effects about – dogs and weeds and neighbour interaction and social cohesion and kids not wanting to be farmers. There's lots of other reasons before greenhouse effects.

And yet now we have got machinery to better utilise the moisture, a better understanding of what crops need to grow and we have transportation where we can bring stock in and take it out a lot quicker. By all accounts [from my grandfather's time], when it was dry here you had to walk your stock to Gippsland – well, that's not real quick going! So, that sort of thing has changed. You can use the assets that are available to you So perhaps change in climate has not had the same effect it could because of these things.

Alternatively, the following two remarks were made by respondents who were concerned that climate change will affect farm enterprises:

One degree change in temperature, more warmth, equates to 100 kilometres, I heard. That's a bit frightening. It frightens them [landholders]. How would we feel if we had the climate of Melbourne? [This comment was made by a different respondent to the one quoted earlier discussing the same analogy]. Farmers would notice that. It puts pressure on them. Farmers have said 'I invest so much in my cropping, more than the average person would spend in their lifetime', so they've got \$400,000 to \$500,000 tied up, and it's such a gamble that they are prepared to say, go into sheep, to spread that risk.

It's definitely going to affect them because the sun, I've noticed it here even, you can feel the sun really burn on your skin, and that's going to affect the animals too. They are going to be stressed, there's going to be a lot more cancers ... I found on our farm we got more cancers on cows. We were thinking about cotton rugs for cows and we'd move them to paddocks with shade. As an industry, they are breeding away from white cows since the payouts for cancer stopped in '95 or '96. Also, water – as population increases, the demand increases and we're not being water wise at all, still.

Again there was a tendency for participants to comment on the rainfall-related aspects of climate change (for example, both the amount of rain and patterns of how and when it falls) when considering how climate change may affect their enterprise or activities. The comments below reflect this preoccupation with changes to rainfall as the most discussed impact of climate change on enterprise.

I guess the effects on my enterprise will mostly be from the rainfall. My crops and pasture [choices] have been dominated by recent conditions – subtler winds, milder climate. I've grown a lot more trees and shelter belts in the last 15 years to increase biodiversity and stock protection. ... In January one farmer lost 1,000 head [of sheep] due to a severe temperature drop, from 38 degrees to six or seven degrees. You can't predict when that's going to happen. That was January! I don't think it matters what time of year you shear, as long as you have shelter belts. I also guess I may sow more grazing oats in summer to take advantage of summer moisture, and same in a warmer winter, probably will take advantage of different crops instead of the normal crop.

It depends when and how the rainfall occurs. For example, recently we've had half our average rainfall on crops and it hasn't been all that dramatic. Though with annual crops, they don't use that much. In fact much is wasted and with rising water tables that brings salt. But it's been coming at the right stage for crop growth – hence there hasn't been any decline in crop productivity. We've been getting as good grass as we have for many years because rain happened to fall at that late spring/early summer period and give good growth. And through hay and good management you can get yourself through it. I suspect a much greater impact [of climate change is] on trees and the environment generally that we haven't measured, or come to grips with. I suspect that's a bigger issue for us.

It means you've got to have the right crops in the right area. That's already happening. Maybe it will mean irrigation is not viable? But I think the current generation is very slow to change. Change only occurs when new people come in. [This quote was from a life-styler].

We are changing. We'd like to conserve more moisture and extend our rotations out, but you've got to survive while you are doing it.

We'll do more of what we have been doing. We've changed varieties to suit the conditions. The drier springs and sudden summer are not good for canola. Canola was big in this area previously. This year we grew only barley and wheat. Especially with the barley, we've been trying to get high yielding varieties. We've been using chemical work up instead of mechanical because of the cost of fuel, of diesel. But whatever you do there's always a downside to it. It's not what you want to do, but that's what's happened.

[If there were longer dry spells] ... Maybe we'd grow more veg hay and take advantage of our sheds. Selling hay is an option – sell hay at different time of the year. The veg is good for nitrogen for your fallow crop. And you can graze that all year round, virtually. We'd cut hay off it and spray it out because it grows again late spring. And then we can graze it late summer. A lot more farmers are doing it. Veg grows here well at the moment. It'll handle dry years and it's good cover on soil too. They can't grow veg down south because it generally gets too wet but we can handle it here. The dairy farmers like it. Also trees – elm farming, salt bushes – maybe if it got really, really dry we'd look at those sorts of things.

One respondent felt they had a good understanding of the climate change debate, but felt this did not necessarily make predicting climate change impacts easier. This respondent said:

... I still think we don't know what's going to happen. In the short term it will get warmer. In the longer term we've got no idea. We don't know, and shouldn't kid ourselves that we do, but I think we do know it's going to change. It's going to be much more variable.

Respondents, even those who were personally concerned about climate change, generally thought most people were neither informed about the issue nor concerned about its impact. These feelings were represented by the following comments, the first two made by cropping farmers and the third by a cropping extension officer.

Yes, you have your dry years, your good years, your bad years, you have your wet spells, and your dry spells. For us, and to most farmers I think if you ask them, will tell you that. 'Ok, we've come through ten years of dry years, maybe next year it will change and it'll be back to whatever' – and that's what they think. I don't think any of them would give a lot of thought to the global warming situation. And even if you brought it up with them, they'd say 'oh, yeah, ok, but you know, we have our dry years, we have our wet years, we just hope to get through this dry spell into a wet spell.'

It's a bit hard to tell the farming community 'oh yeah, this is going to happen – da-da-dah'. [They reply] 'Yeah, righto, we believe you!' but that's where it ends because we believe it when we see it happen. Isn't that typical of humans though, we tend to have to have a catastrophe before we try to fix it. In this case it might be too late.

But you don't get far down the discussion of climate change [with farmers]. Because it's green. It's a green issue. It has not been done well! (Extension)

Responses to information on climate change

Participant responses to the paragraph of information from the Australian Greenhouse Office (AGO) that was offered during the interviews were also varied. All informants said they had heard or seen this information (or information that was similar) before. None said “*I’ve never heard that*”. However, informants’ reactions varied from agreement and concern about the information it contained to scepticism, dispute and/or dismissal of this information.

One respondent who agreed with the sentiments of the AGO paragraph said:

I would tend to believe that sort of thing. I would tend to be sympathetic to that sort of view. I’d prefer to be surprised and find it’s untrue, but that’s the way we farm – in anticipation of that [that climate change will impact on their enterprise].

Another participant acknowledged the content of the paragraph, but did not see it as having a big impact:

Yeah, ok, I’ve read that sort of stuff before, it’s no surprise to me. I accept that opinion and it’s probably right. It doesn’t necessarily change what I do because I can see that by 2070 there’ll be many other vast changes in all sorts of stuff, that while those [climate] changes are important, they’re not the most important that’ll happen to us. ... There’s enough water for the whole of the Australian population, so even if it [the information on climate change] is true, I don’t see it causing more social change than other events. It doesn’t affect me greatly because it’ll be managed. If we look back 70 years the changes in society have been large and we’ve adapted. I’m not saying the climate’s changed in that time. But I don’t fear climate change as being the end of the world, personally. Perhaps that’s very naive of me.

Many participants said they have read or heard alternate sources providing contradictory information. This is discussed further in section 3.3.5.

That’s what makes it harder to follow – that you’re getting mixed messages everywhere.

Many participants were critical of the information contained within the paragraph that was offered.

So the first thing you’d look at is ‘how’s that going to affect me?’, and it’s not very exact. South East Australia – it’s a broad brush statement. They may be right. I would say, if I was paying for this, it’s not good enough. I’d want something more precise, accurate and a clearer picture. What are they telling me? We know last year was hotter. We know the rainfall’s changing. But if I was going to get excited about something I’d want it a little bit more exact about how it’s going to effect me personally. Not discounting it, I just think it’s a statement that’s probably easy to make without being very precise about it. It’s like saying it’s going to rain in Victoria – it probably is! But it doesn’t mean much for whether it’s going to rain in Donald.

A majority of informants were critical that the paragraph offered was not specific to their area (it talks generally, Australia wide) and thought it unhelpful for planning their activities. Additionally, several informants indicated that offering people numbers, such as ‘that changes in temperature could range from one to six degrees’, does not help their understanding. Many participants did not know how such a temperature rise would or could affect them or their enterprise activities. The comments below, by two informants, are typical.

The greenhouse scientists have been criticised quite strongly up until recent times because they were not prepared to say that global warming is real – because they did not know – it was only 99% certain and they like to be certain – 100%. So, they are still talking about ranges and stuff. Just the same as federal government announcements after last week’s climate change meeting, [which focused on] how technology changes are going to reduce the greenhouse impact by 20%, but these figures neglect to relate that this will be 20% of a 2.5 increase in CO₂ by 2050. In comparison, all around the world governments are agreeing to reduce emissions by 60% of 1990 levels, [while] our Australian government aims to reduce by 20% [of] 2050 levels!

They don’t really say much about rainfall. We could handle a few more degrees. It wouldn’t hurt having warmer winters – you could be far better off. Still get crop growth as long as there’s rain. Temperature’s not effecting us, it’s rainfall. If we don’t get rainfall we’re snookered.

As has been illustrated by some of the above quotes, some participants responded to the information on climate change that was provided by relating their observations about weather events and patterns to their understanding of climate change. Some saw emerging weather and climate patterns or changes (as discussed in section 3.2.2) as potential evidence of climate change, while others felt these recent patterns could be explained as typical of a longer climate cycle or other factors rather than being related to climate change.

I tend to agree it's got warmer. We've had pretty mild winters here. Like we would be quite cold, even with the Coonara, but in the last few years we've just had that tiny little fire there, and haven't got cold at all. I reckon it's gotten warmer, the winters. Fewer cold days. That'll suit me, I don't like cold.

I'd be pretty scared if the summer is hotter and drier [in the future] – then the impact of fire is potentially worse.

3.2.4 Future actions and planning

Question 8: I'm interested to know what you consider to be your response by way of sensible actions that aim to adapt to climate change. What do you see as the way forward on the farm? To what extent are you doing (or are you considering doing) these things that you have identified above?

Question 9: Who else do you see as being key players in addressing needs?

Informants largely found it difficult to suggest future actions and planning to adapt to climate change, which again they often attributed to confusion and incomplete understanding of what local impacts and/or changes climate change may bring. Many found it difficult to isolate action to adapt to climate change, and instead tended to discuss a range of actions that they consider key to the future of land management more generally. Also, many were confident of their ability to adapt if and when necessary, even if they did not consider it necessary at present and they did not know at this stage what form that adaptation might take. This was typified by comments such as:

It doesn't affect me greatly because it will be managed.

I'm confident in us as a species to be quite adaptive ... People will adapt and change.

The trouble with most farming [is], we react to situations we find ourselves in. But after a lifetime of reacting you want me to be proactive now [to consider adaptations to climate change].

I think we need much more honesty talking about dealing with change generally, not just climate. I don't believe we need to isolate climate change as a thing that needs to be talked about particularly.

Practical initiatives

Most respondents made some suggestion as to initiatives they considered may assist in adapting to climate change. These ideas included encouraging the production and use of bio-diesel, water saving methods, developing genetically modified organisms (GMOs) to increase production and cope with climate changes including requiring less water, cloud seeding, "farming smarter", collecting and analysing data and conducting research on which to develop plans. The two comments below are both by the same respondent.

One thing I would love to see is ethanol fuel. I'm a big fan of that. It's got 30-40% less, I think it's monoxide production, in bio-diesel. Plus there are people using the products that they are growing, plus they are not relying on overseas imports – I say bring it on! The evidence is there that we can use it straight into the engines we've got now. I can only see it being a win-win situation. ...

I think it is just a matter of adapting. Whether it is growing new varieties, eg, either shorter season varieties or growing varieties that grow on less amounts of rainfall. Instead of producing 15 kilograms of grain per megalitre of rainfall, up to 20, which is a ball park figure now, maybe up to 30 or 40. One bit of technology I'm a big fan of is GMO. In the sense that genes there can be put into our crops which are safe. We could have them in the field in five years. And the classic is they've found a gene for frost resistance in wheat. A GMO could be in the field in five years. Breeding them like we do now, it's 25 years away. And there's a lot of genes like that. (Extension)

Many participants mentioned the need to provide incentives to encourage the adoption of any initiatives that were developed. These participants doubted that such initiatives would be embraced without some type of incentive.

It's easy to suggest they [farmers] change their water usage, etcetera, but that's a risk to their livelihood until we give them some security. Why would they change [without incentives]?

Those participants that accepted climate change as an important issue felt that changes to the way people perceive climate change will, like many issues before, take a long time.

Other respondents struggled to know what form adaptation might take. This was one such participant's comment:

I think that humans are not very good at looking after their environment – they think that they are a little bit removed from the environment – not part of it. So whatever we can do to help matters I think that would be good.

Key players

As with previous questions, respondents had trouble identifying who the key players for leading adaptation to climate change may be – partly because they felt it would depend on the actions necessary. Some responses were quite broad, such as 'everybody' and 'the government', without really detailing what these players would do. Others identified roles for many contributors to industry and NRM, including various levels of government and their agencies, industry groups, Landcare groups and extension and advice providers. There was a strong preference for locally based information that could complement existing methods and knowledge. Many said that tackling climate change needs a 'bottom up' approach.

I think you've definitely got to keep all your scientists involved – your plant breeders, animal breeders. The government is just a heap of bureaucracy and red tape. (Extension)

We need to get people motivated about this.

Local government needs to work with the CMAs to encourage good practice. We need projects based on good principles that are long term.

One extension officer sees it as his role to facilitate landholders' adaptations to climate change, yet feels that he is not getting that information. He has been proactive and concerned, but reports there is nothing coming through to him that he can use to get the message to farmers. He felt he is not even getting the broad information and feels a greater need for good local data. He considers this data (for example, in the form of compilations of local met data) as key to convincing farmers that climate change is an issue they need to accept and address or adapt to. This extension officer also said:

I think we have to bring it down to a regional scale. We could break the greenhouse office down into regional climate change centres. Climate change has got to get a higher profile and it'll only get a higher profile when it comes down to the people. CMAs need to be banging the desk a bit harder, so do the DSE and DPI. They've had their toe in the water [with] farm forestry, bush tender and Eco Tender but there's not been any quantum shifts. ...

Regional groups, like the Murray Darling Basin Commission, are too big – too irrelevant. It's got to come down lower than that. It's got to come to local government, but currently they're under-staffed and ignorant. The CMAs could drive it regionally.

And we're [the DPI] not the only answer. If you went to wheat farmers and said 'where do you get your information?' they're not going to say the CMA, regional government or departments, they'll say the media. So we need to sit down and discuss how do you run stories through the media that don't scare.

I strongly support carbon trading as an answer to uncertainty for farmers and climate change.

I also think industry's got a real lead to take – GRDC, AWB, ABB, GA. If AWB was a private company, like Holden, it could say 'we'll invest in the information on climate change ourselves', not wait for the government. If you are selling a commodity that requires rainfall, and rainfall or weather patterns are changing and you are working with natural resources and nature then you need

to know, and you'd make sure the people you work for, i.e. your shareholders, would be informed.
(Extension)

Other respondents' comments in regard to who they see as key players included:

Any study or discussion needs to be done by leaders or farmers who understand the industry. There needs to be finance for farmers – an incentive to change practices. You almost need to study how you can change their [farmers'] attitudes without them knowing – they won't change willingly. The key players are farm groups, government, DPI – these all need to be brought out into the picture. What we had difficulty with was finding the right person for what you want to do. There needs to be more publicity to highlight what they are doing to save the farmers' money in the longer term. Like the DPI – all that free advice. But then the farmers' attitudes are 'I'm ok, I don't need any help'.

Local producers, seed merchants – they advise you. Though they don't take into account climate change. There's good extension advice – much better than 25 years ago. A bit from the department, but mainly local agents. The department's hands are tied by financial constraints. There's been an influx of hobby farmers up here on weekends in the last ten to 15 years. There are few full-time farmers left. That affects the department's budget too.

I guess the key players should always be the Department of Primary Industries. And I think they dropped the ball for a long time as far as actually educating people to become better than they are. And they've been spread very thinly in recent years. They've really gone away from the one-to-one consultations. A lot of it's probably been privatised. There are private companies that are good at it. But to change trends, there is a role for more support from DPI. Private business is really only in response to the land, whereas DPI need to have a bit more to do with changing the image of farming and management. There is a role for someone to take a bit of leadership. The commodity groups themselves don't seem to be able to do it. They are too busy trying to tie up both ends for their constituents – the VFF is almost unable to do anything because there are too many diverse groups with almost opposing demands. And [also] milk companies, distribution authorities – like Murray Goulbourn Water.

Another respondent thought that if government policy or scientific argument regarding climate change were to offer the farming community a clear picture of where you want to take them and, if the arguments stack up, the policy or argument would win support. If, on the other hand, a shallow conceptual model that breeds confusion and uncertainty is proffered then, understandably, any farming community, will reject it, the informant suggested.

Participants generally felt that strong leaders are required, to facilitate understanding rather than create or increase division.

Other respondents felt that the issue had to be communicated in ways that were de-politicised, in order to reach stakeholders (this is also discussed in section 3.3.2). One participant said:

Forget about using the term 'Climate Change' – put all messages in the perspective of improving efficiencies on the farm and for production.

Related to the question of who the key players should be are issues including where participants got their knowledge of climate change from, sources of information that they trust and their experience of previous NRM programs. These issues are discussed further in sections 3.3.5 and 3.3.3.

3.3 Themes and issues

A number of consistent themes emerged from the interviews. These themes represent the way in which respondents couched their interview answers. This section seeks to detail the significant themes that emerged during the interviews and, from those, identify key issues which have implications in planning for adaptation to climate change. Although these themes have been grouped under particular headings to facilitate discussion, it is recognised that in many cases the issues they contain are interlinked and should not necessarily be considered in isolation.

3.3.1 Awareness of climate change and its impacts

The overall levels of awareness of climate change were limited, and very few participants felt they had a thorough understanding of the phenomenon or its potential effects, as was noted in section 3.2.3. This lack of understanding severely limited respondents' ability and motivation to consider how landholders can positively adapt to climate change and how they could therefore plan.

Although several participants noted that things would be expected to change, only one specifically referred to an increase in the unpredictability of weather or climate as an impact of climate change.

Confusion over climate change impacts

Respondents' comments suggested they were largely unaware of potential implications of climate change beyond decreased rainfall. Compounding this was the difficulty most informants had in isolating their thoughts about climate change from their recent experiences of drought. However, some of the predicted impacts of climate change, such as not only less rainfall but the timing and intensity of rainfall events; increased winds; seasonal variability and predictability were mentioned at other stages of the interviews as threats to landholders' activities and/or enterprises. This suggests that participants' current knowledge and understanding of climate change and its potential impacts is limited. This is probably a major contributing factor in many participants' relatively low levels of concern about the phenomenon.

As discussed in section 3.2.3, a majority of participants also discussed potentially positive impacts of climate change. It is unclear whether their suggestions of positive impacts from climate change is a coping mechanism or reaction (i.e.: stating positives as a way of dealing with or reacting to the negatives of climate change), or whether it is purely a lack of understanding. Regardless of what is behind these thoughts, the perception of potential positive impacts is adding to participants' confusion about climate change

Several informants stated that they considered there were other factors which were of greater concern to them for the future and viability of their enterprise than climate change. This opinion was most commonly held by participants who were most sceptical and seemed least informed about climate change. Some of these concerns are outlined in section 3.3.8 and include farm succession, the changing social and demographic make-up of rural areas, salinity, use of chemicals and coping with drought. Although these concerns were not necessarily perceived by informants as being related to climate change, further analysis could be conducted to investigate whether these concerns would actually be influenced by climate change.

Longer cycle or climate change

Landowners who were new to a district and not acquainted with previous climate patterns understandably often did not report having the same perception of long term climate patterns as their neighbours with long standing district experience.

There was greater awareness of the potential for longer climate cycles where families had passed down stories that highlighted periods of dry/wet or significant individual events. Some respondents said they had been told the 1940s were a similar "dry" period. For some participants, this supported a notion of longer climate cycles, such as 50 or 70 years. Others thought cycles were only five to ten years. A belief in the much longer climate cycles tended to increase these informants' hesitance to attribute the recent dry years to climate change. That is, these informants often thought the current/recent dry could just be part of a longer term climate cycle, rather than climate change. This, in turn, meant participants who held this view were more likely to be sceptical about climate change as a phenomenon and less likely to be concerned about the potential impacts of climate change on their enterprise.

Lack of data

As was noted by a number of respondents, a great deal of local “knowledge” concerning climate is subjective, relying on anecdotal evidence rather than thorough records and hard data trends. Several participants noted the lack of ‘hard data’ presently available. They felt that this data, if it existed, may help support or call into question the subjective perceptions of participants relating to weather and climate. Participants reported that climatic data currently available almost exclusively concerns rainfall. Climate characteristics such as date and intensity of rain, direction, speed and occurrence of winds, number of frosts per year and the last and first date on which they occur, and quality and quantity of groundwater were often mentioned as important data for landholders but no participants mentioned any formal records of these details. Several participants noted that climatic data is comprehensive for urban centres but is not available across the myriad of micro climates where the success or otherwise of agricultural enterprise is so decisively dependent upon it.

There are some farmers, referred to by respondents, who are known to have purchased stand-alone weather stations which are promoted by the stock and station agents to maximise the impact of cropping inputs. However, these stations provide data for “there and then” and are not used to provide a record of climate as such.

Key issues:

- The overall awareness of climate change and its potential impacts on landholders’ enterprises and activities is generally low.
- There is confusion about the phenomenon of climate change and its impacts, with many respondents only considering the potential influence on rainfall rather than other weather events.
- A lack of relevant data to allow analysis of trends in these other weather events was considered a problem by some participants.
- Participants’ attitudes to climate change range from ‘I don’t believe it’ to ‘I’m waiting to see more proof before I believe it’ (these two being the dominant attitudes) through to ‘I believe it will happen/ is already happening’.

3.3.2 The struggle to understand a politicized topic

Many respondents felt that much discussion of climate change as an issue was deeply embroiled in political polarisation. They thought that this hampered examination and understanding of climate change and its implications in a number of ways.

For several participants the request to “*state your stand on climate change*” was seen as a search for political allegiance more than any genuine interest in a very complex issue, the arguments for which are riddled with ambiguity. Many participants commented on the “*vested interests*” they felt various groups involved in the issue held, including governments, industries and “*greenies*” or conservationists. For example, several respondents felt that the potential future value of Australian coal reserves was having a bearing on the openness of the debate. The way groups such as these presented and “*used*” data to support their particular agenda relating to climate change was seen as confusing and unhelpful by many of the informants. The comment by one informant that “*So much vague and fallacious data is being thrown around and that does not help understanding*”, was typical of many informant’s perceptions. Another respondent said:

You either believe it’s going to happen or you don’t. Right now those who do are the greenies and so immediately it is polarised. Farmers are not going to believe what the greenies say anyway. It then becomes difficult. You can use education – and then it becomes long term. ... How can you develop a program if you have not got conclusive information?

Participants also saw this politicisation having varied affects on the information about climate change that was available. For example, one of the respondents concerned that climate change was being understated by the federal government said:

All around the world other countries are reducing [greenhouse gas emissions] by 60 to 80% of 1990 levels. John Howard’s going to reduce by 20% of 2050 levels. I think when people see numbers they just glaze over and people abuse it something shocking, like John Howard. To think he came to say things like that and the vast majority of people don’t even realise. [Even] the press and all that.

Similarly, another informant commented that the media does not tell the whole story concerning climate change issues.

So much is not reported so how can people understand? It's frustrating that something can be done and nothing appears to be done. Is it just a small group of people who are involved or interested in the environment and global warming?

Other participants' responses suggested that climate change is an issue that has become politicised before it is understood. These respondents identified climate change as a "green" issue and this made them sceptical about it and its severity. This appeared to be based on a perception that there is a "farmer versus greenie" continuum of opinion regarding many issues, with the two views and values being opposed and with little or no common ground. Further to this thought is at least one respondent's perception that farmers are often characterised (not only by so-called "greenies") as being poorly educated and ignorant, and therefore their skills for looking after natural resources are seen as inferior and their practices questioned. These issues also relate to information sources that are trusted by landholders (section 3.3.5) and also have implications for any NRM or other extension type program (section 3.3.3).

Some respondents were also concerned that there were unhelpful divisions between types of farmers. One of the irrigating farmers said:

But farmers, particularly irrigation farmers who irrigate grass, are the butt of jokes, and get most of the criticism as far as water efficiency goes ... the Weekly Times routinely reports all sorts of negative stories ... Or you get articles where one commodity is poking the stick at others.

This respondent felt that these divisions added to farmers' mistrust of 'outsiders':

Farmers are therefore defensive, not open to seeing someone coming in to critique their management ... [they are] paranoid about people like the EPA because they might close us down.

Political helplessness – a barrier to adaptation

One participant noted that as a percentage of the population, farmers are a very small group, and felt that this leads to a perception by farmers that they have limited political clout in decision making, even on issues that affect them directly. This informant felt this may result in a feeling of impotence among some farmers to contribute to and/or influence decisions on these issues. This perception was supported by some of the comments noted earlier, for example, regarding government policies on water rights and charges, and is illustrated by the same respondent's comment that:

... farmers commonly think 'I am only a farmer and they want to take my water away from me'.

However, counterbalancing this was an alternative perception by several participants that they can, and do, make a contribution by being involved. The same respondent, who identified some farmers' sense of helplessness, said that their own experience was the opposite of this. They said:

I know that every time I go to a meeting I can make a difference. A lot of farmers don't think that way. A lot just see themselves as being victims, you know, when it comes to outside decisions about their farms and the resources they use.

Current government policies and direction

There is some scepticism among respondents concerning the differing potential contributions from Government policy and subsequent implementation. Participants reported that information provided to support landowners' decision making process is often contradictory. Some respondents were concerned that climate change information is not successfully being passed on to them through the levels of government and its agencies. The DPI extension officer also felt that he was inadequately informed to help convey this information to landholders.

If the government is going to run it [awareness raising of climate change], it has to really start to market it a bit smarter. Otherwise it'll take too long. And if it's right, then too many people will get hurt in the meantime. They've got to use the media machine to change. We can't let it sit with small groups, as farmers will think 'it's just those whackers again'. It's unfortunate that green groups picked it [the climate change issue] up first. So I think it'll take time.

I only knew about the Greenhouse Office because I went there [to a seminar they ran]. As I said, when I went there I was a sceptic. But I came away thinking, 'well, these guys have got their act together'. But 12 to 18 months later I look back and I think typical bloody science, the CSIRO's always been the same – the money goes in and the gap between the science and the people getting it is too large. It just doesn't get out. So we [DPI] can play a role in that – there's a role for us. So I look for that information, a bit, as an extension officer I look for it. And you see it written but it's not well compiled. It's too easy to say 'no, I don't believe it'. (Extension)

Key issues:

- Participants perceived that politicisation has influenced the dissemination of information and discussion of climate change.
- Assumptions that particular groups will use climate change information to further their particular causes is often hampering both climate change message dissemination, and how the messages are received.
- A sense of helplessness, or inability to participate in or influence decisions that affect them, may be a barrier to future adaptation, as it often results in a 'why bother' attitude.
- Some respondents are motivated by the conviction that they can and do make a contribution to these issues.
- There is a perception that information about climate change and its effects is not being successfully communicated or delivered by governments or their agencies.

3.3.3 Change in management techniques and NRM awareness

There was a firmly held conviction by all participants that NRM issues have changed dramatically and positively over the last generation. Most respondents envisaged that this phenomenon of change will continue. It was freely accepted that enterprise composition was constantly under scrutiny and review, and, as the various respondents compared their approach and expectations to that of previous generations, they related that change had always been occurring. For example, the precarious situation for irrigators in the north of the catchment was highlighted by a quote by one farmer, attributed to Gunn Jones [a DPI officer of renown in the area], that:

Because of the high water table, farming in this district is like having one metre of soil over Port Phillip Bay; only the water table is more salty than the Bay.

Overwhelmingly there was conviction that management practices had improved and that farming was better managed now than in previous times, exemplified by the following comment:

Farming management is getting better because we're spending more money. Because we're trying to manage things better. (Extension)

Examples participants cited as being evidence of positive change included increased understanding of and respect for the value of remnant vegetation, fenced-off creek and river corridors, and greater stewardship with cultivation techniques (minimum tillage, direct seeding, crop rotation change, stubble retention, planting of and direct seeding indigenous trees, etc).

However, concerning NRM awareness several respondents highlighted the frustration felt by many in the farming community regarding conflicting information from apparently reputable sources. This is discussed further in section 3.3.5.

Through organisations such as Landcare there has been a sharing of information regarding improved farming management and generally these projects were held in high regard by participants. However, several respondents felt that there was still a long way to go to improve NRM. One informant said:

It is a slow and long process to achieve change and one recalcitrant landholder can hold things back!

The same respondent felt that agencies and programs had not done enough to encourage best practice and improved efficiencies, as outlined in the following comments:

There's no perception in the dairy community that [other farmers] need to be targeting the efficiencies that we are running at. And I think they should be. I wouldn't say that they are not efficient, but I would say most people couldn't quote the figures or efficiency rates we can. There are inefficient people around and there are inefficient procedures and management techniques around that people use. But it is generally getting better. My observation of the irrigation learning environment over the last 25 years is that it's been very poor. Nobody's tried to teach anybody to do it better. It's been done by incentive. So, right, here's eighty percent incentive to put a re-use system in. But before you can get that you have to have done a farm plan. And on your farm plan we will insist that you've got this, this and this ... which is all well – it's worked reasonably. They say that about half the farms in this area have a re-use system, which means half the farms have done a farm plan. But this four week course that I'm doing with DPI now, it's the first time I've ever been to anything like this. It's the second time I've seen it offered. It's really good because it goes through best management practices that we should be aiming for.

How practices become accepted

A number of informants noted that many of today's accepted practices (such as tree planting, minimum tillage, site specific farming, revegetation, etc) were once considered to be 'alternative' or 'unimportant', just as adaptations to climate change are considered by some landholders now. This suggests that there are lessons to be learnt from how these changes were developed, communicated and implemented, which may assist in developing programs and information related to climate change. Incentives represent one aspect of this process and are discussed further in section 3.3.6. Additionally, some informants reported that several of these changes in NRM had been promoted in terms of increasing resource or productivity efficiencies. For example, the rising price of water has facilitated considerable change in irrigation management; while revegetation providing shade and wind breaks improve yield for crops and dairy.

At the same time, informants were aware that the best advice at the time may prove problematic and/or have other impacts in the future (examples given included dam requirements on subdivisions, willows/willow control, excessive tillage, excessive chemical use and clearing).

In the past ten years there's been a quantum leap in terms of biodiversity and conservation in farming. Farmers now recognise failures and inability. In my field I can go to farmers and it's nothing for them to lock up 100 acres, and they'll say 'that's a good idea' and 'that'll look nice too, won't it' and there's a bit of a feel good factor. It's about payment for biological services and stewardship. Even the older farmers are starting to see things differently. For example, they are considering the idea of carbon trading. They need inducements; to be paid for good management. The DPI is not resourced for this. And recently there was the DSE's Bush Tender program – [which encouraged] revegetation for cleared land. (Extension)

Lessons from previous NRM successes

As well as directly responding to the question asking who informants see as key players in responding to climate change (see section 3.2.4), several informants discussed previous extension type programs they considered to have been valuable and contributed to better NRM and farming practices. The nature of these successful programs may also provide insights into potential methods for any climate change activities. There were good feelings by informants toward the CMA and agronomists in delivering information and programs to landholders, but mixed feelings about the DPI (state) and Department of Agriculture (federal) government agencies. Informants tended to be positive and have more trust in and respect for people who are living and are based in their community. When they talk about information or policy coming from outside, there is a feeling of "You don't understand my business – what I have to deal with." For them, any Melbourne office is perceived as a long way away and out of touch, not giving information relevant to the local situation.

The [federal] Department of Agriculture are a dead duck. I've done a lot of work with DPI and DSE and there are some good people among them but it's the jolly hierarchy, it's the middle management. It's frustrating, they get shell shocked. And there's one lady who told me there's not one day in the year they're not in the courts defending themselves. They've become defensive and weren't prepared to make any statements or what-have-you. But out of that came the consultants, who went out by themselves, and there've been some very good consultants. [Gives examples of locally based consultants]. Consultants have really made an impact whereas the poor old Department haven't; that's sad. When we had people living locally, and working locally, we had

great support from them. But that middle management was threatened and they undermined it. Their attitude was 'I'm not having a farmer tell me what to do'. They took the ability away from us [landholders]. I still like a few of the [DPI] guys at St Arnaud. And there are some good ones with the CMAs too.

The extension officer and agronomist interviewed both held similar views on this, and felt a need for local level information, delivered locally to overcome these barriers.

Policy & Intervention

Salinity, as found in some areas of the NCCMA region, has been identified as an issue of great concern in the Murray Darling basin, and has received significant concentrations of government programs to strengthen resource management. However, two of the irrigating farmers believed that the history of water management has contributed to the perceived division between “greenies and farmers”. To survive, dairy farming has seen massive changes in the previous generation, which have resulted in better farm unit production. However the high dependency of dairy farmers upon other agents to both supply water and sell produce leaves these farmers feeling highly vulnerable to the policies and corporate decisions of others. Although the primary resource employed by irrigators comes from another catchment, leaving them removed from the direct impact of climate (rain), they feel that they could be far more vulnerable to the outcomes of government policy and scrutiny in the future and perceive this as a threat to their enterprises.

Key issues:

- Participants accepted that change (generally) is inevitable.
- Participants felt that NRM awareness and practices had improved dramatically in the past generation.
- Practices that were once ‘alternative’ have been successfully introduced and accepted by landholders, and these successful programs may offer valuable information for planning relating to climate change.
- Interpretation and adoption of a number of NRM changes has been nurtured on the basis of improved farm productivity.
- Landholders prefer NRM programs to be specific to their local situation, in terms of both relevant information and being delivered by (local) people they consider to understand the many challenges of their enterprise, activities and/or situation.
- Private consultants have become more important in providing information and support to farmers.
- Dryland salinity and salinity promoted through irrigation have triggered the adoption of dramatic levels of change for individual farmers and communities. There is an uncertainty about its likely extent but an acknowledgement that adaptation to climate change will require further change.

3.3.4 Confidence in ability to adapt and in technology

Adaptation is not new to landholders

While few participants detailed any specific actions they were currently taking in preparation or response to climate change, many landholders discussed aspects of their enterprise that they had modified to capitalise on or respond to weather trends and water availability over the years. Diversification of their activities to spread risk and attempts to manage in ways that considered weather events, soil types, topography and ‘best practices’ were common. Their comments were often similar, and are typified by one informant’s contribution:

Things used to be all sheep with a little bit of crop; now it’s mixed, more cropping. Farmers are keeping sheep off cropping paddocks. Sheep used to be merino but now it’s mainly fat lambs.

An extension officer also said:

It used to be all sheep and cropping [in this area]. Now it’s mixed and still cropping. Some [farmers] have had money for keeping sheep off but a few are starting to get back into fat lambs and that sort of stuff. Sheep with a little bit of cropping has now turned into mixed and the odd bloke even with lots of crop. The sheep used to be merinos mainly, now there’s a fair bit of both merino and fat lambs. Probably more fats, actually.

The cropping farmers discussed choosing varieties to suit the recent conditions while dairy farmers had developed practices to protect their cows from the sun and the heat (as mentioned in section 3.2.2).

Confidence

The perceived improvements in NRM also appeared to have contributed to many respondents' tendency not to be too concerned about climate change, as they felt that farming has adapted to adversity and challenges before and they were confident they, and their enterprises, would be able to adapt again. Related to this was a common belief that technological advances would provide answers if, and when, they were required. For example, one participant said:

People are better prepared now [for dry years]. We're all more aware. I'm a bit of a believer that things are changing, and that's thanks to technology and records, we can check that. We didn't have the press, auditing, web or weather bureau in the past. (Extension)

The same informant further offered:

Agriculture hasn't kept pace with technology. We lack data, we've only got anecdotes. For example, we're not quite smart enough to realise wind's doing a lot of damage, as I see it. Is that normal? We haven't picked up on it and we don't measure it. (Extension)

Another participant commented:

I think one way to adapt if rainfall gets lighter, is just [using] techniques like what we, most farmers, have now. What we call water harvesting where we leave that furrow in the paddock and the water runs into that furrow. That's working really good. Also stubble incorporation, leaving stubble on top, just some simple insulation, composting, those sorts of things. So I think it's just a matter of adapting to those sorts of things. Something'll pop up.

Similarly, one respondent was keen to see the latest generation of cloud seeding technology adopted. This participant was concerned that the opportunity to use clever technology, including but not limited to cloud seeding, was not being sufficiently investigated at present. In addition this informant said "I'd want to see more work done on how we can get more water into our dams".

Key issues:

- Landholders have demonstrated an ability to adapt in the face of many and varied challenges and changes in the past.
- Landholders are generally very confident in their ability to adapt as necessary and that technological advances will overcome future challenges, including climate change.
- Faith in technology and in the capacity of people to find new approaches may tend to reduce the perception of an immediate need to respond.

3.3.5 Information sources

Although not asked specifically, respondents frequently commented on the sources of their knowledge of climate change. There was diversity in these sources between participants. Most commonly they reported relying on the mainstream media (TV – both broadly and specific climate change programs, particularly on the ABC and SBS; newspapers, with several particular references to *The Weekly Times*; and radio). Many informants found these sources to provide conflicting information about climate change, and even within the same source, for example. This is typified by one informant's comments about *The Weekly Times*:

Often you'll pick it up and get both sides of the story coming from the same edition of the paper. Both are coming from relative authority sources. So what do you really understand and what do you believe?

This confusion was also expressed by other informants. Another said:

There is no clarity – with climate change you get two conflicting positions – some say it is changing – others say we just have not had rain. I don't know.

Some informants had proactively sought information about climate change. Some of these informants had attended conferences and/or courses that specifically addressed climate change issues.

A number of respondents made reference to having recently read Tim Flannery's *The Weather Makers*. At least one of the informants had viewed the BBC Panorama program, *Global Dimming*, which had been telecast on the ABC *Four Corners* program on 21 March 2005. This program presented a summary of climate change issues, though focussed on the contradictory effect of cooling associated with atmospheric pollution. This may highlight the complexity of climatic responses to atmospheric pollution, but from the farmer's perspective raises the potential for confusion.

Even participants' responses to the paragraph provided during the interviews, and attributed to the AGO, were interesting. Some participants seemed to hold the AGO in high regard, as suggested by responses such as "Oh, well they'd know [about climate change]. They've done the research, I haven't". Other respondents were more sceptical of the AGO and questioned the reliability of information coming from them. Comments of this nature may reinforce the above point about not trusting information from non-local sources.

Several participants also expressed some scepticism toward receiving "best practice" advice. An example of this is demonstrated by the below quote from one informant:

Ten years ago they wanted us to vegetate and get water into aquifers. Now they are all excited about environmental flows in creeks – yet you need both. The greatest reason for less environmental flows in this catchment is the proliferation of hobby farms and each one has a few micro-dams. Each dam needs to overflow before the creek line flows so, over time, we have lost continuity in drainage lines and creeks. To associate these phenomena with climate change is incorrect.

In the 70's the best science at the time was you drench your lambs every month to eliminate worms and increase production. We're now told that that wasn't the best science – that produced resistance and stuff. So my understanding of science through history is that most of the science that is thought to be correct about 95% has been proved to be incorrect. I don't believe we're cleverer now than in the old days. We just don't know which 95% is wrong.

I'm getting mixed messages from the government and the advisors. I fear they will introduce a tax on rainfall that lands on my property. Where ten years ago, and in the 80's, we had to make sure- you weren't allowed to let rain leave your property. Now you have to let water flow off your property. Look at all these places. They all have dams – they all have to overflow before water flows on to the river system. There's no registration required on those [dams].

One respondent had attended a CVGA workshop on energy efficiency and was concerned that the approach of the CVGA did not acknowledge the emphasis that "... many farmers intuitively place upon energy efficiency". The informant felt that the CVGA treated such efficiency as something to be aspired to rather than acknowledging this as an existing, and well entrenched, starting point. This was seen to be limiting communication between CVGA and farmers, because farmers see themselves as very energy efficient.

Another participant was concerned about the content of a recent PhD thesis in their local area, which the interviewee perceived to be disseminating information contradictory to their knowledge of the situation. The participant said it related to a wetlands study that indicated that all was well and getting better in one specific wetland area whereas the respondent felt that they "knew for a fact" ...

that after ten years of dry there are massive amounts of salt sitting in the catchment and after we get a few heavy rain events the Barr Creek will become very saline again. People who predicate misinformation like this do nothing but make it hard for the science to be treated seriously. It is really important to get communication right.

It is possible this does represent an example of contradictory information being made available, or, alternatively, it may be that the contradiction is occurring in either the farmer's interpretation or in the data. As noted earlier, the important point to make here is that these perceived contradictions result in confusion and mean landholders are less likely to take the issue seriously.

In general, informants who were most reliant on their landholding practices to provide an income tended to discuss the implications of climate change (as well as other changes) within the context of their effects on their business, whereas other informants were more likely to discuss other implications, such as the social, environmental and personal ramifications they perceived.

Key issues:

- Many respondents report seeing conflicting information about climate change in the media, and/or can tend to be confused by apparently contradictory information.
- Participants who were better informed about climate change tended to have been proactive about seeking this information.
- Informants appear to trust certain information sources more than others.
- Sources of information that contradict the landholders' personal views and experiences, and/or do not take into account other challenges related to managing their land are generally disregarded (see also section 3.3.2).

3.3.6 Economic realities

Several participants made the comment, or agreed when it was suggested, that farmers are optimists who gamble against extraordinary odds. Numerous respondents' stories related that there were previously decades that were more profitable, "*where money could make money*", as one informant described it. Farmers in this research, particularly cropping farmers, described the feeling that every year they are gambling with larger amounts of capital against greater odds.

Against this backdrop, changes in weather patterns are perceived by many (regardless of it being categorised as climate change) as contributing to uncertainty and therefore increased risk. Many participants reported that there has been a steady growth in the number and acreage of company-owned consortium farms, particularly in cropping areas. The extension officer reported that activities such as broad-acre tree farming have caused spikes in regional land values. In an attempt to increase their capacity for diversity, participants said there had been changes to land uses within the catchment and surrounding areas. For example, respondents said that in the south of the catchment the world slump in wool prices has seen the adoption of very profitable annual cropping in land previously dedicated to a perennial grazing regime. Commonly this same land has been affected by dryland salinity and rapid introduction of (shallow rooted) annual grasses such as wheat and barley increases the risks and effects associated with salinity. Informants said the profits made from successful southern enterprise are commonly being ploughed back into leasing land with different characteristics in the north and, therefore, enabling greater capacity for diversity.

Several respondents noted a regional phenomenon for farms to agglomerate and, for respondents, there was an understanding that few who leave farming could ever return. If climate change added to further uncertainty participants assumed that the agglomeration process would continue and accelerate on the understanding that only large companies can successfully operate greater acreage and achieve profits with smaller margins through economies of scale.

Landholders seeking to derive income from their activities were concerned that for products with a global market, producers were unable to pass on increasing costs associate with inputs such as water or fuel, because to do so would make their product uncompetitive on that global market. One cropping farmer said:

Because it's a world market, what happens in Australia doesn't have a huge bearing on the price we receive. The Australian dollar varies a lot, both up and down. If the Europeans, US ... China have a big year, Lord help us. It just restricts our market again. And the world is getting pretty smart at growing grains.

A dryland dairy farmer also said:

Dairy farmers won't be able to pay their bills if water keeps going up [in price] and there are no greater returns.

One respondent thought that the whole community needs to understand that economic rationalism is not an appropriate way to adjudicate on resource management. They said:

I personally think there's a much more complex argument and discussion that has to be had about the effect and the benefits of agriculture to regional Australia and how there are some compromises beyond economic rationalism that will have to be made in order for regional Australia to survive. Otherwise you'll end up with Sydney, Melbourne, maybe a service station in Wagga and not much else! Because it costs more to live here and to have telephones and doctors – everything costs a bit more. I'm a great believer that if you are a beneficiary of irrigated agriculture you are part of the

problem. So if you live in Sydney and enjoy latte and a glass of wine and oranges and all that. They want them, but they want us to produce them with nothing! And they can't see the connection.

As mentioned earlier, some landholders expressed that there were aspects of their activities that they might prefer to do, or not to do, but felt that the economic implications of these choices influenced their choices in some cases. The example included earlier was from a cropping farmer who would prefer to use mechanical rather than chemical work up, but the cost of fuel had influenced him to favour the chemical option.

Many participants mentioned that incentives had been used in other NRM initiatives to encourage the consideration and adoption of particular practices. These participants felt such incentives can be helpful in at least two ways. First, incentives can reduce the economic costs of adaptation and change for landholders, and second, agencies' willingness to fund adaptation or support changes on a particular issue using incentives helps to give legitimacy to that issue, which may be lacking in some cases, including regarding climate change. One respondent said:

Incentives have worked. For example in the Goulburn Broken catchment they've had incentives to install automatic irrigation, which takes the human factor out of shutting the water off, so it's seen to reduce water use. They haven't been particularly generous incentives. They haven't been nearly enough money to pay for the whole thing, but the firm here that manufactures them say they've had massive response to those fairly minor incentives. I think the incentives were about \$5,000 where the whole system would be about \$20,000 but it just tipped people over to say 'ok, we'll do it'.

Key issues:

- Landholders who are seeking to derive an income from their activities on their land feel that the risks and pressures involved in farming are increasing, while the returns are diminishing.
- The economic costs of change and adaptation were of concern to many participants.
- Globalization and open markets has added greater complexity to the farming equation with landholders deriving income from their activities on their land often reporting an inability to pass on the increasing costs associated with change to the buyers of their products.
- Incentives were reported by many participants as having been valuable in other NRM programs and initiatives.

3.3.7 Differences between categories of respondent

As detailed in section 2.2, the respondents interviewed represented six categories corresponding to enterprise type and/or role in the farming community. The findings reveal some commonality in concerns and attitudes, as well as some differences between respondents. While the goal of the survey was not to discern specific variation between the respondent groupings, there are findings that establish dissimilarity which will support a number of recommendations made in section four.

Grazing and Cropping Farmers

To some degree the characteristics of each enterprise, dictated by region, rainfall and access to water, is a determinant of differing attitudes to an array of issues. Grazing and cropping respondents had a very high awareness regarding rainfall data and trends that have emerged in the changing characteristics of rain and winds. For all participants, knowledge of specific climatic events was passed down through family or recalled from the respondents' experience. Cropping enterprises are understandably the most vulnerable to inconsistencies in climate and the current long period of drought was constantly a topic approached in a sombre manner. Cropping has a straightforward "make or break" relationship with rainfall. The unique characteristics of irrigation, particularly where dairy is the enterprise, leaves it almost divorced from climatic variance and in stark difference to cropping and grazing farmers. (See also the discussion in section 3.3.5.)

Unique characteristics of irrigation

A significant difference in feedback from those interviewed was the position of irrigation farmers. Irrigation farming is considerably more intensive in its inputs, but results in a greater return and generally greater profitability per hectare. The NCCMA (2003) reports that irrigated land accounts for approximately 10% of the region but accounts for almost 50% of the gross value of agricultural production. The ability to access water upon demand can ensure high pasture or fruit crop productivity and there is an understandable tendency for irrigation enterprises to be quarantined from any predominant climatic variance. As one irrigator noted:

Because of irrigation we are in a way removed from concern about total annual rainfall. It does not rain much here anyway – it is semi desert, 375mm [15” annual] rain! We are more concerned about any rain event as being auxiliary to irrigation. We actually don’t want rain in summer – it can be a real problem. Rain after we have irrigated can work against our grazing rotations because you need four or five days for soils to dry out otherwise the cattle will damage soil structure in the bays. We don’t keep weather records but we are aware of the climatic variance –the ten wet years and then the ten dry.

A highly significant characteristic of dairy farming is the intensity of the enterprise monitoring. It is “*at the pointy end of resource manipulation and management*”, as one irrigating dairy farmer put it. Daily the amount taken off the farm is measured and annually each operation can tally accurate water use and other input figures. Some modelling provides dairy farmers with calculus that aims to identify tonnes of grass per megalitre of water.

On our farm we produce just under one tonne per megalitre and 10-11-12 tonnes per hectare of grass. These figures are best interpreted as an index as it is a reverse calculation. However, very few farmers actually know these facts – because they are not encouraged to know. It is a benchmark for success that is not promoted.

One respondent was concerned that to date irrigating dairy farmers have had little incentive or encouragement to calculate and record this level of data, nor to share what they referred to as the “fine detail” of their enterprises, which the participant thought could help to improve practices and productivity across the industry.

While dairy enterprises may be quarantined from predominant climatic variance, the cumulative effect of land and water management practices over a century has seen salinity become a massive issue in the catchment. One dairy farmer interviewed has been responsible for hundreds of hours of community work attached to the very high profile Barr Creek project, where a large Landcare group were involved in remedial and improved management processes related to salinity.

Lifestylers

Lifestyle landholders are clear that they have made a choice to be where they are. It is of note that they do not particularly own “good land” from the typical productivity perspective but they are committed to principles of resource management, including the active involvement in catchment, habitat and biodiversity issues, and the championing of cultural heritage issues. Although lifestylers are relatively recent arrivals in the respective regions they were keen to see change and adaptation to support an appropriate agricultural industry. The fact that they were not financially dependent upon a farming enterprise for income provides them with a level of independence from the local economy, as well as a limited dependence upon seasonal climate changes or trends.

Extension Officers & Stock Agents

Extension and stock agents offered both an articulate technical perspective and an informed evaluation of potential within the specific region and catchment as a whole. The role of government in extension has changed considerably over a generation but the achievements in terms of raising understanding and awareness within the farming community are attributable to the pragmatic endorsement of innovation and adoption of new ideas. Farming communities globally tend to be conservative in their thinking but may draw heavily on extension professionals who promote improved management practices. On this basis, extension professionals (whether private or agency) represent a potentially powerful agent for change.

Key issues:

- Irrigating farmers had some notably different perspectives on NRM and climate change compared to the other categories of respondents.
- Irrigating farmers are in some ways ‘quarantined’ from the impacts of daily and seasonal weather variance reported by other landholders.
- Irrigators report that they already feel pressures relating to efficient resource use, a situation that could increase in response to the impacts of climate change.

- Because of the input intensity of irrigation dairy farming, there can be a high focus on monitoring inputs and outputs resulting in a recognition of changes within the system, although not all irrigating dairy farmers choose to monitor at this level.
- In some enterprises there is a limited culture of information sharing.
- Lifestylers have a commitment to resource management and commonly a financial independence that distances them from some of the more difficult decisions that may need to be taken regarding adaptation.
- The importance of extension officers and stock agents in assisting processes of change cannot be overestimated.

3.3.8 Future uncertain

As the respondents were considering the potential effects of climate change a range of other future issues surfaced during the interviews. Although not asked directly, many participants indicated that they saw these challenges as a greater threat to their enterprise or activities than climate change.

Succession

Primary among these issues was the wholesale aging of the farming community caused by the diminishing number of younger people involved in farming which, in turn, is a reflection of the difficult economic and often uncertain environment occupied by agriculture. Year by year farmers feel that they are expected to take on greater odds with diminishing returns. This was typified by the following comments by one respondent:

We're getting paid the same amount of money [for our products] but our costs have gone up and we've got to be better farmers. My old man gives a classic example. I was getting \$150 a tonne for my wheat back in 1970. I got \$146 for my wheat this year per tonne and not only was fertilizer a quarter of the cost, not only was fuel a quarter of the cost but bread, milk and biscuits was a quarter of the cost! He said I took a truck load of lambs to the market in 1979 – that paid for a brand new HZV car I bought. Just a little eight tonne truck ... [Now] I've got a B-double and I still can't buy a brand new car with the proceeds of that truck of sheep.

The Elders agency in St Arnaud offered that as a result of slight improvement in returns to farmers over the preceding month, three farms had come on the market in the previous fortnight. It was proffered that hidden within the myriad of reasons for the sale of farms, is a difficulty to take on any more uncertainty.

An interesting issue connected with succession planning on farms, raised by an irrigation farmer, concerned water rights. This respondent said some farmers have invested considerable money in purchasing water rights. This particular irrigator saw this money as “*our superannuation fund which has been, to date, a good investment.*” In this case, the farmer believed that climate change would result in greater demand for water in the future, and thus ensure the value of the investment.

Some respondents felt there has been good work to strengthen connections between the urban and rural communities but that a big gap still exists. These respondents were concerned that with the ageing of the farming community many farms will be purchased by companies and that the characteristics of land management would then change as a result. Some felt that if climate change resulted in further challenges or hastened the need to change to different crops or dramatically alter practices, then the change in demographics would occur with greater speed.

Perhaps inevitably, there were varying opinions held by participants about the changing make-up of local communities. Some long-term landholders were concerned about hobby farmers and life-stylers having “unrealistic” expectations of their “country escapes”. For example, one farmer said:

They move in next to a fruit grower and then complain that he sprays his crop with pesticides.

On the other hand, some of these more recently arrived landholders were concerned that the ‘old timers’ were set in their ways and insufficiently concerned about certain issues, of which environmental concerns were commonly mentioned. Most participants’ views were somewhere between the extremes. One respondent, in particular, who expressed concern about the future of rural communities such as the one they lived in, said they were not at all concerned with where people were from, whether they were old or young,

whether they farmed for a living or not, so long as they “*send their kids to school, join the footy team and participate in other community activities*”, because this would ensure the community’s future.

Other issues

Many respondents also noted additional issues they thought would be of concern into the future. A majority mentioned the need to cope with increasingly dry weather (not necessarily in relation to climate change), many mentioned salinity and a couple were concerned about the need to decrease the use of chemicals as pests become tolerant of them.

Key issues:

- Uncertainty is seen as a threat to the future viability and/or attractiveness of farming as an occupation and a business proposition.
- Many participants were concerned about succession on farms and the future of regional communities.
- Climate change may contribute to the uncertainty associated with landholding and agricultural enterprises.

3.3.9 Other research

During the course of the interviews various respondents recommended that the researcher speak with people other than those on the interview schedule. In most cases this recommendation was followed. Feedback from these additional discussions identified research and programs being conducted by the DPI, workshops completed by the CVGA, the Birchip Cropping Group and the Australian Greenhouse Office. Contacts for this additional work are tabled under the heading “additional people spoken with” in Appendix B.

4. Recommendations

The following recommendations are based upon the research findings as well as identifying some areas of potential further research or investigation that would complement this study.

4.1 *Arising from this research*

This section seeks to outline how the findings could be used. The recommendations stem from the key issues, and a summary of these key issues is included before the recommendations of each section are discussed.

4.1.1 Awareness

Key issues:

- The overall awareness of climate change and its potential impacts on landholders' enterprises and activities is generally low.
- There is confusion about the phenomenon of climate change and its impacts, with many respondents only considering the potential influence on rainfall rather than other weather events.
- A lack of relevant data to allow analysis of trends in these other weather events was considered a problem by some participants.
- Participants' attitudes to climate change range from 'I don't believe it' to 'I'm waiting to see more proof before I believe it' (these two being the dominant attitudes) through to 'I believe it will happen/ is already happening'.

Recommendations:

There is a strong need to improve landholders' awareness of the potential impacts of climate change. Landholders cannot be expected to plan or take actions to address a problem which is not registering on their 'radar screen' of threats to their enterprise or activities. In managing their land and their enterprise, there is an understandable preoccupation regarding rainfall. For many spoken with, rainfall equals climate. Personal perceptions of climate change scenarios are for these people underwritten by rain status. Yet, the representation of climate change is often put in terms mainly of temperature change. It is important to expand the simplistic understanding of climate change of the farmers, yet this is unlikely to be achieved by presenting information that is disconnected from their understanding of the land and their own experience. Farmers have acknowledged the occurrence of major climatic events such as wet/dry cycles. Climate science is identifying not just likely changes to temperatures and rainfall quantities, but also to rainfall patterns and a greater frequency of episodic events, strong winds, high intensity storms. A greater understanding of this complexity should be on the agenda. Regardless of the disputed scale of predicted climate change (e.g. one degree or five degree increase in temperature), it is critical that such change is interpreted in terms of threat to the enterprise.

Because weather events and patterns affect different farm types and locations within the catchment differently, a flexible approach that allows landholders to access information most pertinent to their activities is recommended. To support this, further development of weather recording or data collection to provide information about events and trends is suggested (see section 4.2.1). While in many cases, this data would be collected at a time when it is too late to be useful in citing trends, it is appropriate to establish a broader scope of reference in what variables comprise "climate" (temperature variance, wind intensity and direction, frost events, rainfall characteristics including intensity, duration). Cost effective stand-alone weather stations could provide landholders with user friendly, real-time data that may also be useful in providing a more detailed understanding of weather.

There is a need to clarify the impacts of climate change (including the perceived potential positive impacts) in landholders' minds. However, oversimplification needs to be avoided as does asserting a complete understanding of all potential impacts and effects while there is still uncertainty, as these are only likely to bring added confusion either now or in the future.

Further recommendations regarding how this increase in awareness, and therefore capacity to adapt, could be achieved are discussed in the following sections.

4.1.2 Communication and politicization

Key issues:

- Participants perceived that politicisation has influenced the dissemination of information and discussion of climate change.
- Assumptions that particular groups will use climate change information to further their particular causes is often hampering both climate change message dissemination, and how the messages are received.
- A sense of helplessness, or inability to participate in or influence decisions that affect them, may be a barrier to future adaptation, as it often results in a 'why bother' attitude.
- Some respondents are motivated by the conviction that they can and do make a contribution to these issues.
- There is a perception that information about climate change and its effects is not being successfully communicated or delivered by governments or their agencies.

Recommendations:

There is a profound need for clarity in communication. The tendency for many issues to be politicised before they are understood fosters a no-win situation. A strategy of clever communication needs to occur at the district, region, catchment, state and national and ultimately at the global level to promote an acceptance of the need for greater understanding. This should not be done under a banner of "climate change" but perhaps using a "resource efficiency" (or "production efficiency") motif whereby the "health of the land" and the catchment is linked to a changing dynamic. Who leads the communication to achieve this change is important and once again the de-politicization of the issues involved is critical. Several examples from the research highlight areas where advances can be made (many of these are discussed in sections 4.1.3, 4.1.4 and 4.1.9).

Climate change adaptation cannot afford to get dragged down in a "greenie versus the farmer" nexus. The language needs to move beyond polarised and politicised positions. There is a need to facilitate cross community understanding of adaptation using the six principles (see section 1.2) in an integrated manner. This report recommends the use of "resource efficiency" as a neutral banner on which to hang this understanding rather than the already politicised term "climate change". Any methodologies that put an intrinsic value on sound resource monitoring and management are recommended.

Likewise, communication strategies should avoid fuelling debate that compares 'this type of farming' to 'that type of farming' and/or 'full time farmers' to 'lifestylers or hobby farmers' too, as none of these conflicts are productive. Strategies need to acknowledge that potentially everyone has something to offer and a contribution to make.

There is a need to provide opportunities and support for landholders to be consulted and involved in decision making that affects them, as well as informed of the ramifications of those decisions. There is an opportunity to build on the participation of some landholders to contribute to and overcome the perception of helplessness amongst others by developing inclusive bottom-up projects that involve local people and derive recognisable benefit in terms of resource efficiency and resource monitoring. An example of one such project could be the compilation of ongoing data recording, coupled with development of a climate data database.

Communication related to any of the above recommendations needs to be targeted in terms of: content; intended audience; and the assumptions it makes. As identified earlier in this report, landholders are likely to disregard information that contradicts their experience if it is not supported and/or it fails to acknowledge the challenges they face and efforts they are already making. For example, an awareness raising campaign or project focussed on energy efficiency should acknowledge the existing activities in this area by landholders.

4.1.3 NRM changes

Key issues:

- Participants accepted that change (generally) is inevitable.
- Participants felt that NRM awareness and practices had improved dramatically in the past generation.
- Practices that were once ‘alternative’ have been successfully introduced and accepted by landholders, and these successful programs may offer valuable information for planning relating to climate change.
- Interpretation and adoption of a number of NRM changes has been nurtured on the basis of improved farm productivity.
- Landholders prefer NRM programs to be specific to their local situation, in terms of both relevant information and being delivered by (local) people they consider to understand the many challenges of their enterprise, activities and/or situation.
- Dryland salinity and salinity promoted through irrigation have triggered the adoption of dramatic levels of change for individual farmers and communities. There is an uncertainty but an acknowledgement that adaptation to climate change will be a precursor further change.

Recommendations:

There is an opportunity to take advantage of landholders’ positive perceptions of recent developments in natural land management techniques and awareness. Landholders interviewed accepted that change and adaptation are inevitable aspects of land management. Previous success in the introduction of practices that were initially considered ‘alternative’ is encouraging, and these successful programs may provide important contributions for consideration in developing and implementing plans regarding adaptation to climate change.

From the comments of these respondents it appears important for landholders to understand the costs and benefits of any adaptation measures or programs they are asked to participate in. Wherever possible, communication and support programs developed to address climate change issues should be tailored at a local level to the specifics of a particular area and/or industry and delivered by local people. This may overcome some of the concerns landholders reported with particular programs and, where benefit to their activities and/or enterprise can be demonstrated, is likely to result in faster and higher rates of participation. Although this may mean the involvement of local level extension staff (for example, from CMAs or the DPI), there may also be opportunities to draw on other respected members of the community, such as Landcare participants or those who have already begun to investigate and understand the implications of climate change, such as some of the respondents in this study.

4.1.4 Confidence in ability to adapt and in technology

Key issues:

- Landholders have demonstrated an ability to adapt in the face of many and varied challenges and changes in the past.
- Landholders are generally very confident in their ability to adapt as necessary and that technological advances will overcome future challenges, including climate change.
- Faith in technology and in the capacity of people to find new approaches may tend to reduce the perception of an immediate need to respond.

Recommendations:

Up-to-date information and effective communication are the tools that are required to assist landholders to adapt to the impacts of climate change.

Because of the wide ranging implications of climate change impacts, this report recommends that the programs and activities of all organisations associated with landholders, including CMAs, government agencies (of all levels), conservation groups, private extension and advice providers, would ideally all acknowledge the potential impacts of climate change. Certainly all future programs are advised to do so. This would assist to minimise any risk of conflicting information as well as reinforce the ‘legitimacy’ of such adaptation as a challenge for landholders. Such an approach would require coordination between these various groups.

It is important to support the existing confidence in landholders' ability to adapt, as feelings of 'helplessness' or being overwhelmed are only likely to hamper effective responses to the challenge presented by climate change. At the same time, it is equally as important to ensure that confidence in the ability to adapt and/or apply a 'technological fix' does not mean that landholders feel a false sense of security and assurance that there is no need to develop plans to adapt. Such a scenario could cultivate the expectation that it will be someone else's responsibility to address the issues. Again, awareness and information are key to achieving this balance.

Respondents' positive feelings towards the sharing of information and experience with other landholders who face similar challenges (for example, through Landcare) highlight an opportunity for replication in the climate change. There appear to be multiple benefits from such an approach, as identified by participants in this study, including that it can be relatively inexpensive, that it enhances learning because of the 'experiential' style and can be area or industry specific.

4.1.5 Information sources

Key issues:

- Many respondents report seeing conflicting information about climate change in the media, and/or can tend to be confused by apparently contradictory information.
- Participants who were better informed about climate change tended to have been proactive about seeking this information.
- Informants appear to trust certain information sources more than others.
- Sources of information that contradict the landholders' personal views and experiences, and/or do not take into account other challenges related to managing their land are generally disregarded (see also section 3.3.2).

Recommendations:

There appears to be a large gap in the information that reaches landholders concerning the threats climate change may present. To be effective, it will be necessary to communicate key climate change messages to all landholders, not just those who proactively seek information, as is currently the case.

As discussed above, this report advocates a communication and information strategy to improve landholders' understanding of threats relating from climate change, and builds on their capacity to address these threats. The findings of this report suggest that ensuring the messages are conveyed through sources that landholders trust is crucial to their acceptance. While acknowledging that it is impossible to remove all conflicting information about climate change, it is vital to strategically plan the sources that would be most effective for delivering these messages.

It may also be beneficial to investigate further how landholders process contradictory information. For example, collecting local information sources, making an independent study as to what is really said, and finding whether the contradictions are in the landholders' interpretation or in the data. The purpose of such a study would be to identify specific concerns of landholders and sources of contradictory information and clarify these concerns.

Ideally, consideration of and planning for climate change would be incorporated into other extension programs and advice that is offered to and used by landholders. This would help landholders understand the challenges and ambiguities associated with both climate change and other NRM practices, to enable them to better weigh up both the costs and benefits of any action they may be considering.

4.1.6 Economic realities

Key issues:

- Landholders who are seeking to derive an income from their activities on their land feel that the risks and pressures involved in farming are increasing, while the returns are diminishing.
- The economic costs of change and adaptation were of concern to many participants.
- Globalization and open markets has added greater complexity to the farming equation with landholders deriving income from their activities on their land often reporting an inability to pass on the increasing costs associated with change to the buyers of their products.
- Incentives were reported by many participants as having been valuable in other NRM programs and initiatives.

Recommendations:

It is crucial to acknowledge the economic realities faced by landholders. If climate change considerations and issues can be built into, or at least considered by, other extension type programs and advice, this would go a long way to reducing landholders' feelings of conflicting demands on their limited funds and enterprise opportunities. The approach suggested in this report, of presenting climate change implications and adaptation in terms of 'resource and/or production efficiencies' also acknowledges the economic pressures landholders face.

The proposed approach, with a focus on locally specific, locally delivered information and support, is potentially more expensive than a generic, regional or country-wide approach employing less personal delivery methods. However, the proposed method's likelihood of greater reach and acceptance must also be considered. In addition, there may be opportunities to overcome some of these expenses, for example, by concentrating on the facilitation of information dissemination and the potential for other groups, such as Landcare and/or community groups encouraging landholders to share their knowledge and experience so that others can learn before they commit their funds to adaptation.

Incentives for landholders to consider and adapt to climate change are strongly advised. Incentives could help to alleviate some economic pressures experienced by landholders. Incentives may also contribute to a perception that both the issue and landholders have support from government agencies, something which is currently lacking.

4.1.7 Issues associated with irrigation and other respondent categories

Key issues:

- Irrigating farmers had some notably different perspectives on NRM and climate change compared to the other categories of respondents.
- Irrigating farmers are in some ways 'quarantined' from the impacts of daily and seasonal weather variance reported by other landholders.
- Irrigators report that they already feel pressures relating to efficient resource use, a situation that could increase in response to the impacts of climate change.
- Because of the input intensity of irrigation dairy farming, there can be a high focus on monitoring inputs and outputs resulting in a recognition of changes within the system, although not all irrigating dairy farmers choose to monitor at this level.
- In some enterprises there is a limited culture of information sharing.
- Lifestylers have a commitment to resource management and commonly a financial independence that distances them from some of the more difficult decisions that may need to be taken regarding adaptation.
- The importance of extension officers and stock agents in assisting processes of change cannot be over-estimated.

Recommendations:

As discussed earlier, it is important to encourage a positive attitude and cooperation between landholders employing different land uses. The feelings of helplessness of some irrigating farmers, attributed to the way policies (relating to water allocation in particular) have been introduced in the past provides a warning for future NRM policy and planning. It appears that landholders who feel included and consulted in planning and implementing are more likely to be willing to participate in and/or support the resulting programs.

Irrigating farmers are perhaps in the best position of any type of landholders to measure the efficiencies of their production (through monitoring of inputs and outputs), and this type of knowledge may be valuable in assessing the effectiveness of responses to climate change. However, this report also cautions against seeking to ‘value’ enterprises solely on their production efficiencies, as to do so would be overly simplistic and ignore other impacts (both positive and negative) of land use, including environmental impacts such as ecosystem services or degradation, and social impacts. Ideally, the buyers and consumers of products produced by these landholders would also be aware of the impacts of these products and take responsibility for their own choices, reducing the perception of animosity reported by participants.

Some respondents considered that there is a limited culture whereby information on approaches such as resource monitoring and its benefits to the enterprise is shared amongst the farming community and beyond. Through its extension activities, NCCMA could play a role in encouraging more farmers to value and adopt input and output monitoring, thus enabling moves towards greater efficiency on farms.

With external sources of income and less dependence on farm enterprise, lifestylers may be more able/willing to adopt changed practices. Anyone who shows enthusiasm to adapt to climate change should be encouraged. The opportunity for working specifically with lifestylers should not be discounted. The outcomes of changed practice should be monitored and shared through NCCMA extension and networks across the catchment.

Farmers seek information and support from a great diversity of sources. A strategic approach needs to be adopted to engage the different sectors and agencies involved in providing such support to landholders. It is critical that private consultants, with their own networks and influence at a local level, are engaged in this process, provided with appropriate information on climate change and encouraged to incorporate climate change impacts/threats and adaptations into their dealings with farm enterprises.

4.1.8 Future uncertain

Key issues:

- Uncertainty is seen as a threat to the future viability and/or attractiveness of farming as an occupation and a business proposition.
- Many participants were concerned about succession on farms and the future of regional communities.
- Climate change may contribute to the uncertainty associated with landholding and agricultural enterprises.

Recommendations:

It is important to acknowledge both the existing uncertainties faced by landholders and the future uncertainties that climate change may bring. At the same time, landholders may be reassured by actions that demonstrate it is being considered and planned for. The recommendations in this report seek to outline such actions. The uncertainty regarding climate change impacts also means that any attempts to address it and its impacts need to be flexible and adaptable.

4.1.9 Co-ordination of response (“key players”)

As discussed in section 1.1, the NCCMA has considerable responsibility for a range of NRM functions within its region, including asset management relating to climate change. In addition, the impacts of climate change have the potential to have implications for many of the other NRM responsibilities of the NCCMA. For these reasons the NCCMA clearly has a key role to play in the development and implementation of strategies to adapt to climate change and its impact. However, this report also finds considerable support for the NCCMA to take a lead role in this area, to capitalise on the positive perceptions landholders have for this organisation, as well as its existing partnerships with other organisations and stakeholders and experience co-ordinating local people to deliver locally specific information to landholders with a view to supporting change.

Many of the issues and recommendations made in this report relating to climate change also have strong links with other NRM issues the NCCMA is also involved in managing. This places the NCCMA in a favourable position to facilitate the incorporation of climate change adaptation and considerations into other extension programs and advice in ways that can acknowledge the challenges and ambiguities presented by

potentially conflicting goals, as well as the costs and benefits of any action. There is also an opportunity for the NCCMA to draw on its past experience with other NRM initiatives so as to replicate or learn from methods that have been successful in supporting and facilitating response and change with landholders in the past, on other issues.

Although the NCCMA has already begun to develop a range of policies and plans regarding climate change, results from this study suggest increasing awareness among landholders is yet to be achieved.

Ideally there needs to be awareness-raising beyond the catchment so that the responsibilities are shared by all parts of the community not only landholders. This requires agreement and commitment concerning who is responsible for what. For example, one irrigating dairy farmer was concerned that many of the ‘city’ critics of this type of enterprise were more than happy to consume the product they produced. All who are dependent upon the activities and produce from farms are players in the process to adapt to climate change. The concept of the eco-footprint of farming produce and farming practice needs to be understood beyond the NCCMA.

Any program or policy related to this issue must acknowledge that no one solution will fix all problems in all situations, and that understanding and response will take time. Climate change is a complex phenomenon and therefore requires diverse and flexible responses.

4.2 Further research

This section outlines recommendations concerning possible future research that would complement this study and be useful in the development and implementation of climate change related adaptation strategies.

4.2.1 Improved collection of climate-related hard data

The respondents reveal a variety of information sources for rainfall. Three issues stand out. One is the need for data other than rainfall. Second is a preferred format for data and, the third, the need for collation, analysis and sharing of existing local data sets regardless of the inconsistencies. Some respondents keep annual data, but unfortunately are not methodical in keeping records. Commonly memory was relied upon for details during discussion. It may be of value to see more comprehensive and localised rainfall data sets that are analysed and are accessible. Individual members of Landcare groups and/or Post Offices etc (which in the past have been responsible for some systematic collection of local data) may be a potential source of base data which could be collated and analysed. Such research could be done by a Master’s student. Collection and collation of this data should be a first step in aiming to understand climate change, even if it highlights the lack of relevant data.

4.2.2 Capacity appraisal

As a number of respondents have indicated their belief that the NCCMA has an important role to play in facilitating a greater understanding of the issues, we recommend an appraisal of the existing capacity within the NCCMA to address climate change and coordinate other recommendations made in this report.

4.2.3 Information sources and ‘trust’

Further to section 3.3.4, it may be beneficial to investigate further where individuals gather their information from, which sources they “trust” or “agree with”, and build an understanding of how they deal with contradictory information.

4.2.4 Research review

This study would benefit from a research review, comprising an up-to-date summary of relevant current research being conducted on climate change and related issues across the south-east of Australia, including the canvassing of the terms-of-reference and current findings. Appendix B contains a list of people contacted during this study, who could provide a starting point and/or guide this work, as well as an overview of some research currently being undertaken.

It is clear that there are a number of climate change projects underway. There is a need for these to complement each other to ensure efficient use of resources and maximum gain from the knowledge that is

acquired. Although not addressed by this study, there may be a need to develop systems to ensure the sharing of both methods and results of climate change research projects between agencies and stakeholder groups.

Perhaps most importantly there is a need to interpret research findings and modelling at a local level to enable them to be accessed and used by landholders.

5 Conclusion

This report has detailed the findings of a survey of landholders' perceptions of climate change and its implications in the North Central Catchment Management Authority region. It has also made recommendations based on these findings to assist the NCCMA to develop policies and practices in response to climate change. The findings and recommendations identify both opportunities and threats to the development of appropriate responses to climate change and its impacts.

Generally landholders have a limited understanding of climate change and its potential impacts on their activities and/or enterprise. This currently limits their ability and motivation to consider what adaptation may be appropriate and who the key players in co-ordinating this adaptation could be.

Participants' perceptions of climate change and its implications are often characterised by confusion. A number of respondents volunteered that the perceived politicisation of climate change either leaves them reticent to engage with the issue or to be guarded in their comments. However, a number of other respondents were openly political in their stand on the issues. There is no doubt that there is a need to assist the community to approach the topic in an informed, and ultimately, non-politicised manner.

Furthermore, it is important to recognise that farming enterprises face many challenges. While farmers may be aware of climate change, other issues such as economic realities and succession planning are more immediate and are therefore seen to present a greater challenge.

While struggling to consider adaptations in response to climate change, participants' perceptions of other NRM policies and projects as well as their attitudes towards potential "key players", provide valuable insights for considering how climate change responses could be developed and implemented. This report advocates awareness raising in relation to climate change impacts and adaptations with a focus on resource and/or production efficiencies through policies and programs that provide information tailored to landholders and delivered in ways that are favoured by them and sources they respect. Examples include highly proactive local extension, workshops, and interpretation of data to the local situation.

6 References

Australian Greenhouse Office 2004, *Abrupt Climate Change: Facts and Fiction*, viewed 4 May 2005, last updated May 2004, <<http://www.greenhouse.gov.au/science/hottopics/pubs/abruptclimatechange.pdf>>.

Department of Sustainability and Environment 2005, *Catchment Management in Victoria*, webpage, viewed on 4 May 2006, last updated 2 August 2005, <<http://www.dse.vic.gov.au/dse/nrenlwm.nsf/childdocs/-E9B6826F3AB828F64A2567D7000B1BA6-82A6DD30CA52A8C0CA256E69002F506C-C35E39DE033300D24A25679E00010C1F?open>>.

DSE see *Department of Sustainability and Environment*

NCCMA see *North Central Catchment Management Authority*

North Central Catchment Management Authority 2005a, *Who Manages Water in North Central Victoria?*, July 2005, Huntly, Victoria.

North Central Catchment Management Authority 2005b, *Our Roles and Responsibilities*, April 2005, Huntly, Victoria.

North Central Catchment Management Authority 2004, *Regional Response to Climate Change – Native Revegetation – Action Plan*, Huntly, Victoria.

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SEMI STRUCTURED INTERVIEW SCHEDULE

History of Farm

1. Would you like to tell me about the farm enterprise? I'm interested in both an historical and a present day view of things.

Local Weather Cycles

2. I'd like you to give further consideration to the history of the farm and ask if we can plot some important weather/climatic events that you can remember. What impact did these events have on the farm/in the district?

3. Have you kept climate data over the period of land use and would you like to share this data with us?

4. What are your perceptions of the climatic cycle here in this district? How would you describe it? What are the patterns that have occurred? Have you detected any change in these patterns over time?

Climate Change

5. What is your understanding of the phenomenon of climate change?

6. Would you like to tell me how you think it may effect your farming enterprise and / or the regional viability of farming?

7. I'd like to share with you the following information concerning climate change. (This data offers projections based upon various modelling and may confirm or differ with your current thinking). In the light of this data would you like to offer any further comments regarding the issue of climate change?

Future actions/planning

8. I'm interested to know what you consider to be your response by way of sensible actions that aim to adapt to climate change. What do you see as the way forward on the farm? To what extent are you doing (or are you considering doing) these things that you have identified above?

9. Who else do you see as being key players in addressing needs?

Thanks for your time.

APPENDIX B

Additional people spoken with:

Geoff Parkes	Knowledge Broker, NCCMA	Ph: (03) 5448 7124
Terry White	North Central Greenhouse Alliance	Ph: (03) 5461 5001
Alexandra Gartmann	CEO, Birchip Cropping Group (BCG)	Ph: (03) 54922 787
Fiona Best	Extension Officer, BCG	Ph: (03) 54922 787
David Ygaldie	Manager, Agriculture Section, AGO	Ph: (02) 62 7418 88
Bill Flattery **	Agriculture Section, AGO, Canberra Convenor of Wimmera Mallee Study.	Ph: (02) 62 7418 88
Paul Ryan	Presence of IT	Ph: (03) 9526 3536
Chris Souness ***	Manager, DPI, Horsham	Ph: (03) 5362 2111 Mob: 0409 559 364
Gary O'Leary	DPI Horsham	Ph: (03) 5362 2111
Carys Evans	DPI Werribee	Ph: (03) 9742 0444

** DPI Horsham has recently appointed a climate change specialist from the department who is to focus upon strategies and actions for the farming community of south east Australia.

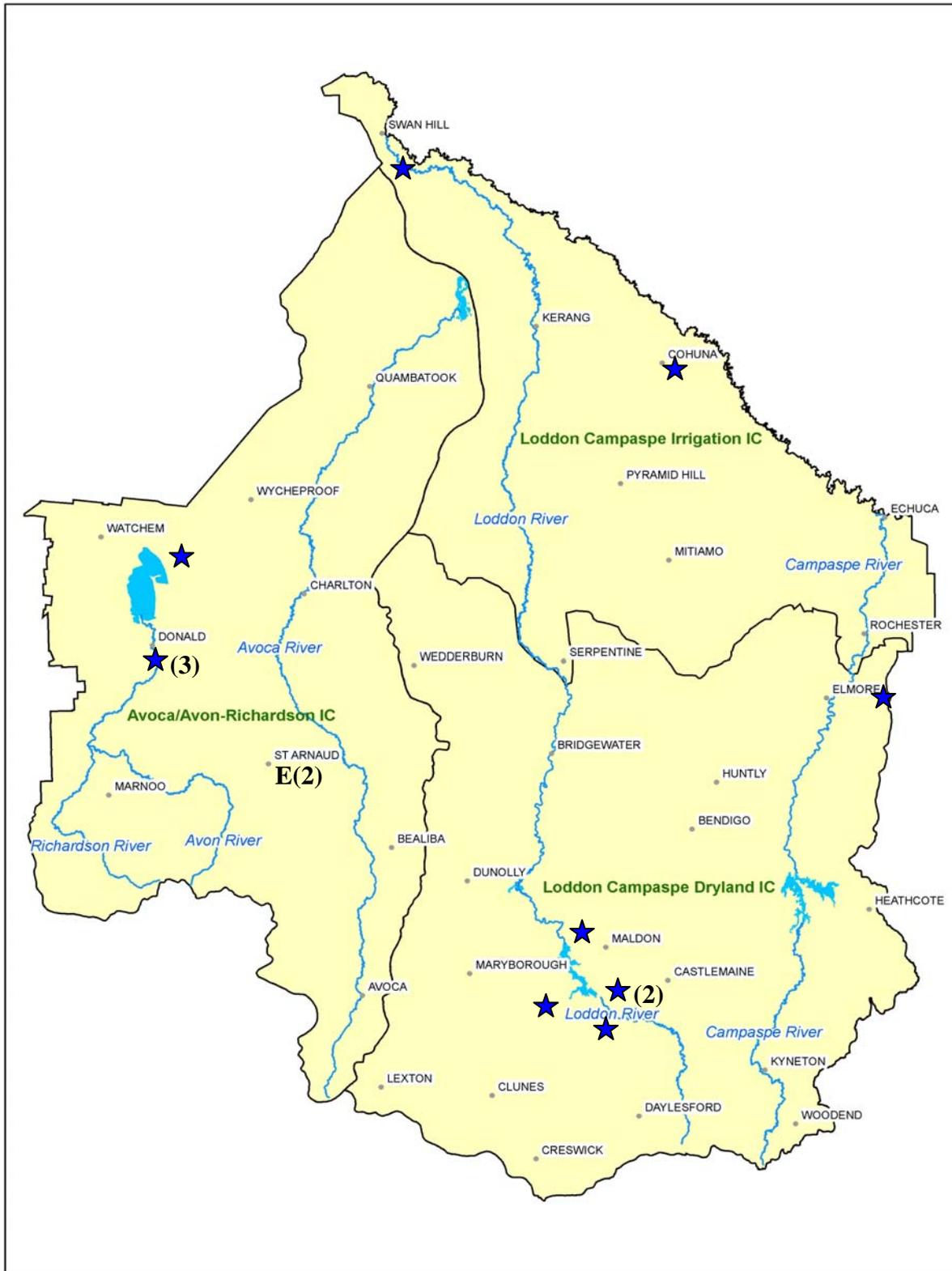
*** A job description for the climate change specialist will be available from Land and Water

Recommended further research/information sources:

- The Australian Center for Science Innovation and Society (ACSIS) is currently finalising a report for the DPI analysing grains industry stakeholder networks and understanding of climate change as part of the project 'Climate change impacts and adaptation in Victorian key industries' (Carys Evans, DPI, has agreed to provide a copy when available - later in 2006).
- BCG conducts an annual members survey, which includes questions concerning climate change (contact Fiona Best, BCG).
- The AGO investigated farmers' perceptions of climate change in November 2005 (Contact Bill Flattery).
- Another suggested source of information is Peter Hayman, a key climate change scientist from "SARDI" in South Australia, (and formerly with the NSW Department of Agriculture).

APPENDIX C

Map identifying NCCMA and geographical distribution of respondents.



★ Indicates location of landholders (with number in brackets denoting if there were multiple landholders in the same location)

E Both the extension officer and the agronomist were at St Arnaud