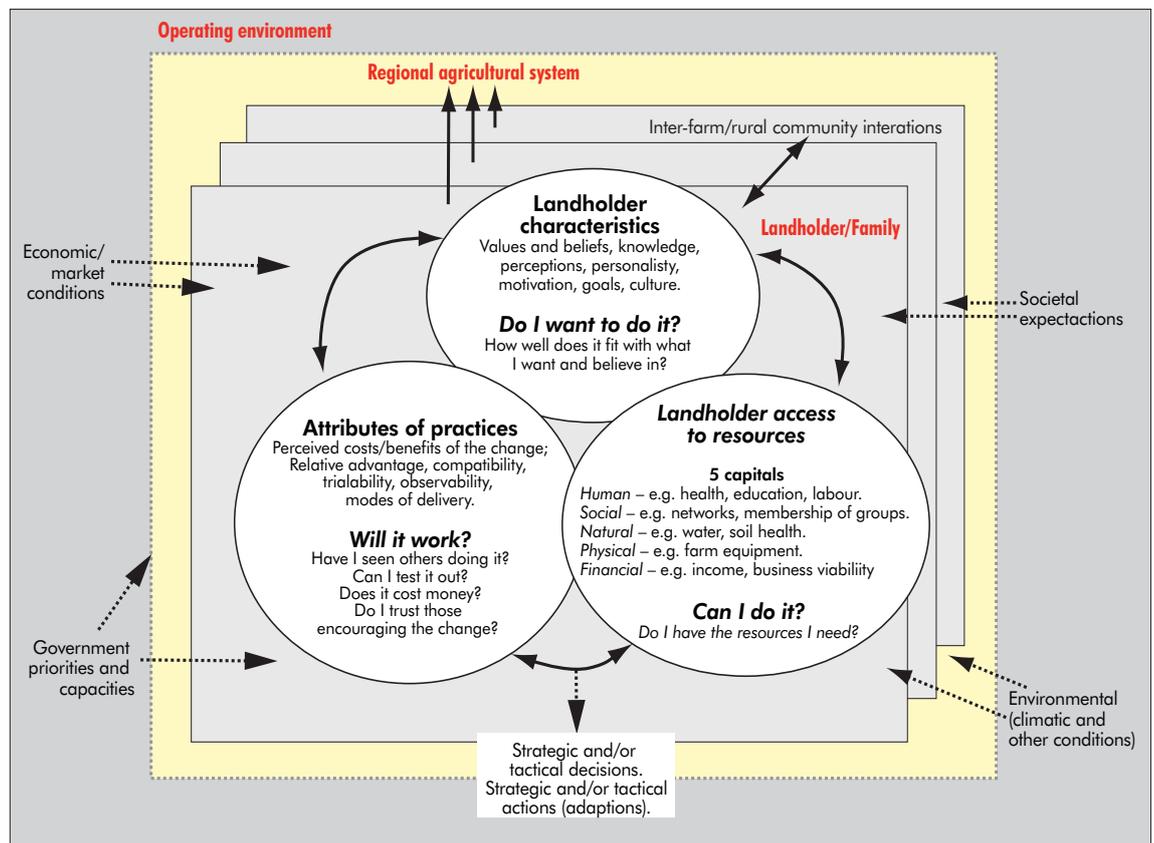




## Technical Report No. 19

# Rural landholder responses to climate change in north-east Victoria



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**LANDSCAPE LOGIC** is a research hub under the Commonwealth Environmental Research Facilities scheme, managed by the Department of Environment, Water Heritage and the Arts. It is a partnership between:

- **six regional organisations** – the North Central, North East & Goulburn–Broken Catchment Management Authorities in Victoria and the North, South and Cradle Coast Natural Resource Management organisations in Tasmania;
- **five research institutions** – University of Tasmania, Australian National University, RMIT University, Charles Sturt University and CSIRO; and
- **state land management agencies in Tasmania and Victoria** – the Tasmanian Department of Primary Industries & Water, Forestry Tasmania and the Victorian Department of Sustainability & Environment.

The purpose of Landscape Logic is to work in partnership with regional natural resource managers to develop decision-making approaches that improve the effectiveness of environmental management.

Landscape Logic aims to:

1. Develop better ways to organise existing knowledge and assumptions about links between land and water management and environmental outcomes.
2. Improve our understanding of the links between land management and environmental outcomes through historical studies of private and public investment into water quality and native vegetation condition.



# Rural landholder responses to climate change in north-east Victoria

By Maureen Rogers, Allan Curtis, Nicki Mazur and Rik Thwaites  
Institute for Land, Water and Society, Charles Sturt University

## Summary

Climate change is a serious global issue and is expected to increase the variability of Australia's highly dynamic climate systems. South-east Australia is expected to experience increased temperatures, lower rainfall and substantially reduced runoff to rivers that are already over-exploited.

Many climate change dialogues reflect an optimism about the capacity of Australia's agricultural industries to adapt to future climate change impacts. At the same time, current modelling suggests that south eastern Australia will be at the 'cutting-edge' in terms of predicted impacts to water availability and liveability. There is also considerable uncertainty about how these impacts will manifest at regional and local scales and what constitutes 'effective' adaptations. What is clear is that there will be differential impacts given the different capacities of regions, industry sectors, communities, and individuals to adapt. Hence, there is considerable and growing interest in identifying adaptation options and enhancing social and ecological resilience.

According to a number of studies (Stedman, 2004; Leiserowitz, 2005), and this one is no exception, the perceived risk of climate change tends to be related more strongly to general beliefs and world views, than to socio-demographic characteristics. As we have already seen in Australia, public policy designed to address climate change will be compelled or constrained by people's perception of the risks and dangers it poses, and therefore it is essential that these motivations be understood.

In trying to convince people of the seriousness of the climate change threat, a great deal of effort is being made to reduce the level of uncertainty surrounding the nature, cause and its regional implications. Some argue that too much effort is being made to reduce uncertainty in a bid to respond to the sceptics, while neglecting examination of its effects on people and how they are already responding. How we deal with risk, uncertainty and even ignorance is a socio-psychological matter, requiring understanding of how people respond. Our ability to act in a wise and timely manner will be critical to reducing vulnerability – which is indeed the focus of the social research discussed in this report.

## Research background

This project explores the way people of a particular geographical location currently perceive and interpret the dangers of global climate change, and how that translates into action (tactical/reactive and/or strategic/anticipatory). Before people take strategic steps to protect themselves they need to accept that climate change is occurring and has the potential to damage things of value; have some understanding of the local and global implications, and believe we will be impacted upon.

To explore this complex topic, this study set out the following key questions.

1. How are rural landholders interpreting drought, climate variability and long-term change?
2. How do rural landholders perceive the personal risk of loss or damage as a result of climate variability and climate change?
3. How have rural landholders responded to the risk of climate change?
4. How adaptable do rural landholders believe they are in the face of changing conditions?
5. What factors influence rural landholders to take action to address climate change?

Two study sites with contrasting geographical and socio-economic demographic differences were chosen – namely, the Eskdale and Chiltern areas of north east Victoria. The two completed district-scale studies involved a combination of quantitative and qualitative data from:

1. Semi-structured (open-ended) interviews with 14 people in each area (total n = 28) who were identified as representative of different community types (eg. agricultural enterprise, farmer/ non-farmer landholders, and gender); and
2. A structured questionnaire hand delivered by a paid local person to all rural property owners (>10ha) within each of the study areas (86 were delivered in the area; 100 were delivered in the Chiltern area) with an overall response rate of 55%.

## **Key research findings**

### ***Rural landholder interpretations of climate change***

Virtually none of the interviewees, barring one, expressed a strong belief that 'climate change' was real. However, only 6% of those surveyed believed there was no such thing as climate change, with 70% agreeing with the statement that the climate is changing. Many interviewees reported noticing 'changes' in the climate and weather, but most did not attribute those differences to 'climate change' – it was common for interviewees to state that the climate is always changing. From the interviews the message was that farmers tended not to talk in terms of 'climate change' per se, but about the consequences of water and feed shortages. In public at least, they seem to joke about what's going on, and express a frustration that if there is something to worry about why isn't something being done.

Belief that human activities are influencing changes in climate was found to be a highly significant factor in people's decisions to improve water capture and water use efficiency on their property. Belief that the changes were part of a natural cycle was found to be an influential factor in the decision to reduce stocking rates, suggesting that stocking rates can be adjusted to suit changing conditions. A belief that it is too late to take action to address climate change was found to be influential in decisions to increase fodder storage capacity suggesting that this was linked to a need to prepare for the a less certain future.

Interestingly, 'belief in climate change' did not out strongly as a key motivator of behaviour in the regression analysis.

### ***Knowledge of climate change***

Both the interviews and the survey found that people had some self-declared knowledge of the general notion of climate change and its global implications. However, explanations provided by interviewees of what they understood climate change to be were often confused and did not reflect basic concepts found in formal and scientific definitions. None of those interviewed, and only a small proportion of those surveyed, said they had specific knowledge of regional climate change projections and their implications. The self-declared believers often expressed some confusion about the technical aspects of climate change, while non-believers (self-declared sceptics) tended to express less confusion about the science and were more confident that there were no links between climate change and drought.

A further common thread throughout the interviews was an antagonism toward the way information about climate change was being delivered. The view that the climate change 'crisis' was being 'peddled' by those who have something to gain could reflect the anti-elitist and anti intellectual world view characterisation of 'sceptical' or it could simply be that rural landholders have yet to be convinced.

The importance of locally relevant knowledge to adaptive behaviour was demonstrated through the regression analysis, where both tactical and strategic behaviour were found to be influenced by knowledge about the implications of a 1-2' increase in global temps for agriculture in the local district, and steps that an agricultural enterprise could take to become carbon neutral.

### ***Rural landholder perceptions of risk (personal loss or damage)***

Those interviewed typically talked about increased difficulty in farming if the projections (provided by the research team) were to pan out. Even non-believers recognised that such conditions would trigger practice change. The types of changes discussed include the impact on land values, farm productivity and an increased rate of exit from farming, including the sale of land. The survey data found that 86% of respondents were not interested (or considered it not applicable) in considering selling or leasing land to others. Only 13% said they had thought about leaving if the climate changes. Survey respondents were presented with a list of potential impacts on their property (drawn in part from the interview process). Typically people thought it 'likely' that they would be impacted upon, and that the impacts were likely to be small but negative.

### ***Rural landholder ability to adapt***

While age did not present as a key influent factor in the regression analysis, it was frequently

mentioned by interviewees as a limiting factor in their ability to adapt. However, there was typically a feeling of confidence throughout both the interview and survey findings about preparing for the future and adapting as required, with people saying they were resourceful and recognising they had no choice but to adapt. However, there was considerable uncertainty around the ability to adapt to reduced water supplies for stock and domestic and pasture production. The people of Chiltern were less confident in their ability to adapt in this regard. Interestingly, non-believers spoke about there being nothing one could do to deal with difficult climatic conditions that might arise in the future – only to make adjustments to what they already did, which could be an underlying reason for disbelief.

### ***Rural landholder responses to climate change***

The most common actions reported by the interviewees were to reduce stocking rates, undertake pasture renovation and strategic cropping, planting perennials, and shifting toward dryland farming practices. They also reported increasing dam storage, increasing water troughs and water tanks and building feed reserves. In discussions about preparations for the longer term where drought and climate change were an issue, some interviewees said they considered switching enterprises, but most didn't think there was much more they could do. The survey confirmed these findings, in that the majority reported having done, doing now or planning to do the same sort of adaptations, which were largely categorised by the research team as being tactical/reactive responses rather than strategic/anticipatory. However, between 16 and 27% of people reported having done, were doing, or planning to do more strategic actions such as move to a low input production system, change enterprise mix, value add to farm produce, and move to more intensive land use. A very small proportion, but there were at least some, reported being involved in highly strategic activities such as acquiring more land in another district, and selling or leasing their land to others.

### ***Factors influencing landholder adaptations***

Getting to nub of this study, what factors were found to be influential in decisions to implement tactical and strategic adaptations to climate change. Highly strategic adaptations such as enterprise diversification, more intensive use of existing land and increased off-farm work, were found to be influenced by:

- A lower attachment to property;
- A belief that human activities are influencing changes in climate;
- A belief that native vegetation will be negatively impacted up;
- A respect for parents and community elders; Adherence to the principles of protection of individual rights and equal opportunity; and
- Decline in property income.

The factors influencing a combination of tactical and strategic actions such as enterprise diversification, more intensive use of existing land, fencing of native bush to restrict stock and reduced stocking rates, were found to include:

- Knowledge of the implications of a 1-2' increase in global temperatures for local agriculture;
- Knowledge about the steps that an agricultural enterprise can take to become carbon neutral;
- A belief that human activities are influencing changes in climate;
- A valuing of individual rights and equal opportunity;
- An improved ability to capture water on property.

After a major event fear increases risk estimates and precautionary measures. Long term drought has definitely raised people's antenna. People interviewed were not antagonistic in conversation – more enquiring. Many wanted to 'pick our brains' and commented on the need for independent information. They were listening to people like Pilmer, but that may be because this point of view is being presented in a coherent, single perspective way making it more accessible – rather than people seeking information to support a sceptics view.

Regionally relevant, realistic, tangible information is essential in enabling people to get a handle on the complexities of the science. While many said they were sceptical, this may actually be the more accurate meaning of sceptical, rather than the populist mindset of irrational crusaders. Maybe the rural sceptics just haven't been convinced rather than being outright deniers "...driven by feelings of angry grievance, who identify with anti-liberal, anti-elitist and anti-intellectual" world views as described by Hamilton 2010.

## Acknowledgements

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# 1. Introduction

This project was funded by *Landscape Logic*, which is a research hub funded under the Commonwealth Environmental Research Facilities program, managed by the Department of Environment, Water, Heritage and the Arts. *Landscape Logic* is a partnership between six regional organisations, five research institutions and state land management agencies in Tasmania and Victoria. The main aim of *Landscape Logic* is to test assumed links between recommended practices for conservation on private land and changes in catchment condition. A number of social research projects were funded through *Landscape Logic* including this project, initially entitled 'Understanding landholder adaptation to climate variability, drought and climate change'.

Based on preliminary research undertaken in 2006 and 2007, in partnership with the North Central Catchment Management Authority (Thwaites and McDonald, 2006; Thwaites, Curtis, Mazur and Race, 2008); a literature review funded by *Landscape Logic* (Mazur, Curtis, Thwaites and Race, 2009); and extensive discussions with staff in various CMAs, Land and Water Australia (LWA) and the Murray Darling Basin Commission (now MDBA), the research team identified the focus of this project as a critical knowledge gap for natural resource managers in Australia. .

## Research rationale

Many climate change dialogues reflect an optimism about the capacity of Australia's agricultural industries to adapt, while at the same time, current modelling suggests that south eastern Australia will be at the 'cutting-edge' in terms of predicted impacts to water availability and liveability (Giorgi, 2009). There is also considerable uncertainty about how these impacts will manifest at regional and local scales and what constitutes 'effective' adaptations.

While rural landholders may be some of the most vulnerable in terms of climate change, their responses are expected to have wider implications for the environment, water supply, food production, and export income. They manage large parts of the Australian landscape, and evidence gathered through previous studies by the research team suggests they are already responding in a variety of ways (Thwaites and McDonald, 2006; Thwaites, Curtis, Mazur and Race, 2008). While acknowledging the lack of any clear guidance as to what might be effective versus maladaptive responses, landholder actions will be of interest to the wider community.

Current adaptive actions by rural landholders tend to vary from what might be considered more

reactive (after the fact of long-term dry conditions), such as de-stocking, providing shelter for stock, or cleaning out dams to capture runoff, to more strategic or anticipatory actions, such as purchasing land in another district, diversification of enterprise mix and income sources, undertaking research and development to explore new markets, or seeking off-property work (Milne, Stenekes and Russel, 2008; Thwaites *et al*, 2006 and 2008).

In terms of responding to some known risk, Thornton *et al* (2002,) point out that "Before people take steps to protect themselves they must believe that they are at risk in the first place." Grothman and Patt, 2005, direct attention to studies that demonstrate how people systematically underestimate the likelihood of being affected by threats, while over estimating their capacity to respond, "... particularly under conditions of grave risk and uncertainty resulting in decisions that they may live to regret." It is therefore important to understand adaptation responses in order to "...reduce the vulnerability of rural landholders to the impacts of climate change, and thereby minimize the costs associated with the inevitable (Grothman and Patt, 2005, p.200).

A clear understanding of the adaptation responses being implemented by landholders, and the psychological barriers and drivers of changed management behaviour, will contribute to the capacity of governments at all levels to generate policy approaches that stimulate appropriate climate change adaptation responses amongst landholders. An understanding of the interactions between climate change adaptation decisions, and long term enterprise and land management planning, including the management of native vegetation (i.e. the social economic and environmental implications of adaptation), will provide governments and their agencies with the knowledge necessary to better manage the direction of change and more accurately assess the costs and benefits of particular policies.

There has been limited research examining the psychological dimensions of risk perception and adaptation responses by rural landholders. Indeed, the capacity of individuals to adapt is typically characterised as a function of their access to resources and information. Pearman (2009) argues that "... the result of this approach is somewhat technocratic, failing to engage with the big questions of human behavioural responses." A better understanding of the socio-psychological determinants of decision making will enable better design of support programs for rural landholders, and contribute to improved adaptive outcomes. There is also scope

for this research to make an important contribution by developing cost effective, replicable research tools that can be implemented quickly so that governments and communities are better able to assess individual and community capacities and benchmark progress in responding to climate change.

### Research objectives

Given that south-east Australia is expected to experience increased temperatures, lower rainfall and substantially reduced runoff to rivers that are already over exploited, this research aimed to explicitly explore how rural landholders in north-east Victoria are i) interpreting the drought, climate variability and long-term change; ii) perceiving personal risk of loss or damage as a result of climate variability and climate change; and iii) responding in terms of changes in land management practices. The research team also set out to explore the socio/psychological factors influencing individual management decisions. Hence, the key research questions are:

1. How are rural landholders interpreting drought, climate variability and long-term change?
2. How do rural landholders perceive the personal risk of loss or damage as a result of climate

variability and climate change?

3. How have rural landholders responded to climate change?
4. How adaptable do rural landholders believe they are in the face of changing climatic conditions?
5. What factors influence rural landholders to take action to address climate change?

### North-east Victoria – the study area

This study was undertaken in the north-east region of Victoria where rainfall and water availability has typically been regarded as very secure – that is, relatively high and reliable rainfall and uninterrupted river and spring water flows. This is in contrast to the conditions of the previous study sites located in North Central Victoria where water availability has long been an issue for rural landholders.

The north-east region of Victoria is an area rich in natural assets from snow-topped mountains to river valleys and open plains. The region covers approximately 1.9 million hectares of north-east Victoria, including three major catchments: the Upper Murray, Kiewa and Ovens. The north-east is bounded by the Murray River in the North, the Victorian Alps in the South, the NSW border in the east and Warby Ranges in the west. It includes the municipalities



Map 1: North-east region of Victoria

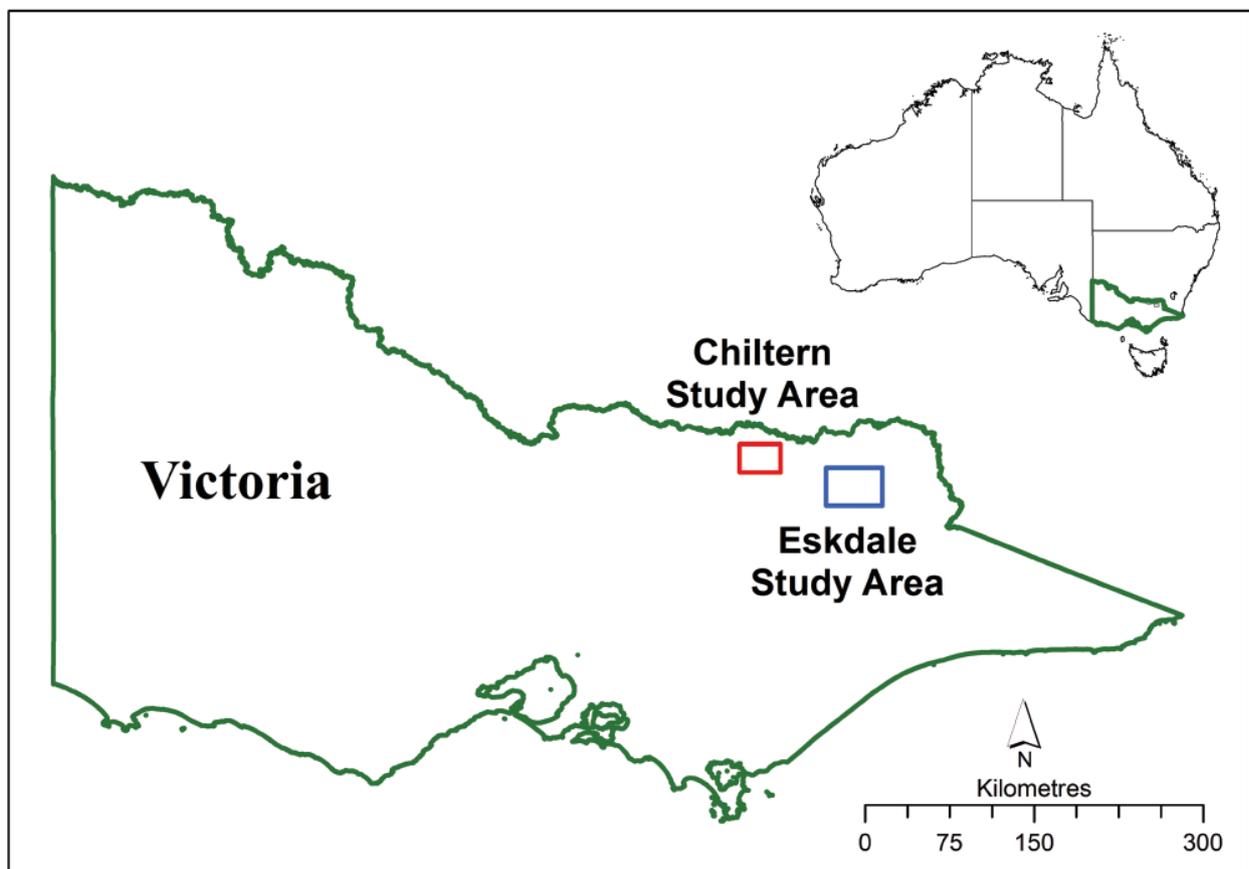
of Wodonga, Indigo, Wangaratta, Alpine, Towong and parts of Moira and East Gippsland (North East Regional Catchment Strategy, 2004).

The research focussed on two districts in the north-east: Eskdale and Chiltern. The *Eskdale area* is located in the Mitta Valley, approximately 20 km down the Mitta Mitta River from Dartmouth Dam, one of Australia's major water storages. The rich alluvial soils of the river flats have supported a thriving dairy and beef industry for five generations. Changes in sub-soil moisture in these alluvial river flats have typically been reflected in the perpetual rise and fall of billabongs that appear throughout the landscape. Since the establishment of Dartmouth Dam, and as a result of a 13 year dry period, local people talk about the decline in sub-soil moisture and the draining of these billabongs, resulting in an increased need for irrigation. Flood irrigation has, until recently, been the preferred method due to the abundance of water and government grants to undertake laser levelling (provided approximately a decade ago). Over the past five years, water shortages have resulted in the need to install lateral/spray irrigation systems (again with government support for the installation of in-ground pipes). Water shortages have also seen billabongs and perpetual springs dry up. The Little Snowy Creek, which runs

through the township of Eskdale, and is its' primary source of water, completely dried up in the summer of 2007 for the first time in living memory.

While qualitative and quantitative data were gathered from a wider area in the Mitta and Little Snowy Creek valleys, this case study will be called the 'Eskdale' study throughout this report.

The *Chiltern area* is located adjacent to the Hume Freeway, 30km south east of Albury-Wodonga, on the edge of the Riverine Plains to the west and north and the foothills of the Australian Alps to the east and south. The townships of Springhurst, Chiltern, Eldorado, and Wooragee are located within the study site boundary with Reedy Creek running north/west from Wooragee to Eldorado. This is largely a dryland farming area, with small scale irrigation in the south where horticultural enterprises operate. Cattle grazing is the dominant agricultural land use. Being close to Albury-Wodonga, this district has an increasing number of hobby farmers. Over the last couple of years Reedy Creek has barely provided sufficient water to meet the demands of households and horticultural enterprises. Reedy Creek ran dry for the first time in living memory in the summer of 2007. Many springs were also reported to have stopped flowing in recent times.



Map 2: Study sites in north-east Victoria

## 2. Background

### Climate change – a contentious issue

After years of public silence on this issue, we are now starting to see lively debate about climate change (its validity, its cause and its likely implications), reflecting a wide range of views and positions on the issue. In any public policy context diverse groups and individuals will have different beliefs, values and attitudes that influence how they perceive and react to issues. These divergent orientations, and framing of 'problems', in turn influences who participates in solving those 'problems' and how, and what values will be favoured by the resulting actions and outcomes (Bardwell 1991; Clark *et al.* 2000; Harding 1998; Swaffield 1998).

In 2008 the Labor Party won the Australian election on a climate change platform indicating the public's increased awareness of, and concerns for, the implications of climate change. Since the election, debate about the problem, its causes, and the actions required has been intense. Toward the end of 2009, leading up to the United Nations climate meeting in Copenhagen, the Australian Government's attempt to introduce a Carbon Emissions Trading Scheme (ETS) was foiled by the opposition. The political environment was such that the leader of the Opposition (Malcolm Turnbull) was voted out in a special party room meeting on 1<sup>st</sup> December as a direct consequence of Turnbull's support for the proposed ETS. The new Liberal leader, Tony Abbott, said immediately after the leadership spill was decided, "We are gearing up for the fight of our lives", adding that "he was not frightened to fight an election on climate change". Abbott was later reported in the *Pyrenees Advocate* as having told a small rural Victorian community that "climate change is crap" (Craig Wilson, ed, 2<sup>nd</sup> December 2009). This political context is important on a number of fronts, but for this research it is particularly relevant as Tony Abbott believes he reflects the views of his constituency which includes a substantial proportion of rural voters.

While climate change was a key issue in the success of the Rudd Opposition getting into government, public opinion seems to be divided between those who believe that the climate is changing, and those who believe it is not, and those who believe the cause is human induced and those who believe it is part of a natural cycle (Milne *et al.*, 2008). There appears to be a high level of scepticism, particularly in rural areas, as found in a previous study conducted in North Central Victoria (Thwaites, Curtis, Mazur and Race, 2008)

The debate about climate change has also become divisive where those who are sceptical are

tagged as right-wing populists while "believers" are seen as part of a global conspiracy. As Hamilton (February 2010) explains, some sceptics appear to hold a view of the world that includes "...a narrative centred on secretive forces, variously encompassing elected leaders, scientists, scientific organisations, environmental groups and the United Nations, that are using climate science and climate policies as a cover to accumulate power with the objective of creating a world government that overrides national sovereignty and deprives citizens of their rights."

It is the highly ambiguous nature of climate change risk, its inherent uncertainties and the potential for large impacts beyond the control of individuals which appears to be influencing the way different groups are responding to the challenges of climate change. One thing we do know is that climate change impacts will not be geographically homogeneous, with some ecosystems food production systems and economies more vulnerable than others.

In trying to convince people of the seriousness of the climate change threat, a great deal of effort is being made to reduce the level of uncertainty surrounding the nature, cause and its regional implications. Risks associated with the threat of climate change are far more than technical issues that can simply be eliminated with the 'right' information. A report by the European Environment Agency (2001) reminds us that "just knowing enough is not of itself sufficient – acting wisely, and in good time, is also necessary", particularly in a highly uncertain environment.

Some argue that too much effort is being made to *reduce* uncertainty about climate risks in a bid to respond to the sceptics, while neglecting examination of its effects on people and how they are already responding (Dessai *et al.* 2007). While the climate science community should be commended for its efforts to ascertain the likely impacts of climate change, there are other, equally important considerations in determining appropriate actions (Dessai *et al.*, 2007). How we deal with risk, uncertainty and even ignorance is a socio-psychological matter, requiring understanding of how groups, communities and individuals respond. In essence, our ability to act in a wise and timely manner will be critical to reducing vulnerability (Lorenzoni *et al.* 2005). That is indeed the focus of the social research discussed in this report.

### Australian and overseas research

This research aims to improve understanding of the socio-psychological dimensions of climate change

– primarily, how rural landholders are responding to current climatic conditions and the key influences on their perceptions and behaviour. Our work has drawn on a substantial body of literature that relates to contemporary policy dialogues about climate change, the nature and influence of perceived risks, people's capacity to adapt to threats, and risk communication and engagement practice (see Mazur *et al.* 2009).

### ***Climate and risk perceptions***

'Risk' is a concept invented by human beings to help us understand and cope with the dangers, opportunities and uncertainties of life. All people, irrespective of their backgrounds and position in society use speculative frameworks to make sense of the world and use selective judgements in their responses to risk (Slovic 1999). Since 'risk' is socially constructed, it is possible to identify patterns of similarity and difference in the way people perceive and respond to risk generally, and to the specific risks of climate change. For example, contemporary definitions of 'risk' typically position it as something more negative than positive – e.g. the frequency or probability of occurrence of *potentially harmful* events plus the magnitude of the consequences (Taylor-Gooby & Zinn 2006; Palfreman 2006).

Social science research on climate change has provided valuable insights into what people believe to be true. This body of work also helps us understand why people believe what they do, the patterns of thinking emerging in different communities, and how institutional structures and forms of decision making position climate change risks.

#### *Climate change beliefs and what influences them*

Recent Australian and overseas social research has identified a relatively high level of public awareness of climate change and its negative impacts (see for example Brewer 2007). However, there is also considerable misunderstanding about aspects of the science underlying climate change and some people are confused about its exact nature, causes, and consequences (Lorenzoni *et al* 2006; Palfreman 2006; Stedman 2004). Many people still do not see climate change as a personal threat and are resistant to associated reforms (Lorenzoni *et al* 2006; Leiserowitz 2005).

Socio-psychological research has been used to better understand how the particular characteristics of climate change, people's mental processes, and their social experiences interact to influence their views of, and/or positions on, climate change. Much of this research is focused on how the salience of climate change is reduced, which is thought to prevent many people from supporting mitigation policies

and seeing it as a 'problem' warranting their personal, immediate response. These factors include:

- the time delayed, abstract nature of climate change risks (e.g. a 'creeping environmental problem'), which make it difficult for a wide range of people to understand it (Moser & Dilling 2004) ;
- a lack of direct experience of climate change impacts, and often seen as distant in space and time (Lorenzoni *et al* 2006; Leiserowitz 2005); and
- maintenance of the 'status quo', refuse to accept harm, and/or allow vivid images of good outcomes to suppress consideration of the probability of negative impacts (Baron 2006; Bazerman 2006).

Support for climate change mitigation policies and personal action has been linked to the perceived convenience of and personal benefits from such initiatives, as well as to trust in government and science providers (Dietz *et al* 2007; Lorenzoni *et al* 2006).

People's views and actions are also a function of their social identities and experiences. Our interactions with other individuals, groups, organisations and modern institutions (e.g. the media and governments) have the potential to change our thoughts and actions (see for example Langford 2002; Palfreman 2006; Moser and Dilling 2004; Dietz *et al* 2007; Weber 2006). We are also exposed to and/or are affiliated with different 'interpretive communities' (Leiserowitz 2005), which can be distinguished in a number of ways (e.g. expert/scientific communities versus the lay public) and whose views about the threat of climate change and the need for action run along a spectrum – with low risk perceptions at one end, high risk perceptions at the other, and a range of positions in between relating to the salience of climate change and the need for action.

People's responses to climate change are also informed by institutions such as the media. The media has tended to over simplify climate change, polarise the climate change debate and exaggerate the degree of disagreement and highlight overwhelming or frightening images – which some believe has reinforced public uncertainty, scepticism, anxiety, denial and/or confusion (Palfreman 2006). There is also evidence to suggest that the media, political interest and some experiential forces have converged to play a key role in *increasing* the Australian public's general awareness and concern about climate change (Power *et al* 2007).

#### *Rural community and landholder perceptions of climate change*

In contrast to recent Australian opinion polls

suggesting high levels of awareness and concern about climate change amongst the wider public, several case studies in agriculturally-dependent communities in NSW and Victoria have identified highly variable levels of awareness and understanding of climate change (see Milne *et al* 2008; McDonald *et al* 2006; Austen 2002). While many in these communities are open to the idea of climate change, considerable uncertainty and confusion exists about the concept. A substantial proportion of these research participants were unable to clearly distinguish between climate risks more generally (e.g. drought, variable climate) and 'climate change' in particular. Participants frequently saw drought as part of the 'natural' climate cycle, which would *hopefully* break soon, and return to more normal (wetter) conditions.

Similar to studies of the general public (e.g. Krosnick *et al*, 2006; Grothman *et al*, 2005) research on farmers' climate change views identifies multiple psychological, social and institutional influences. These include individual experiences and situations, world views, environmental and market conditions, degrees of comfort with different kinds of risk, the abstract and distant nature of climate change, and access to particular sources of climate change information.

### **Adapting to climate change**

As noted, an important focus of climate change dialogues is how agricultural industries, and the rural communities dependent on them, will manage climate change effects. There has been considerable discussion about how agricultural adaptation should be defined, what factors drive or constrain adaptation, what the distinguishing characteristics of adaptive capacity are, and how adaptation can be encouraged at different scales.

A common conception of adaptation to climate change is that it is a continual process of adjustment that reduces an entity's *vulnerability* to the negative effects, and/or increases an ability to capitalise on positive opportunities [see Figure 1]. Depending

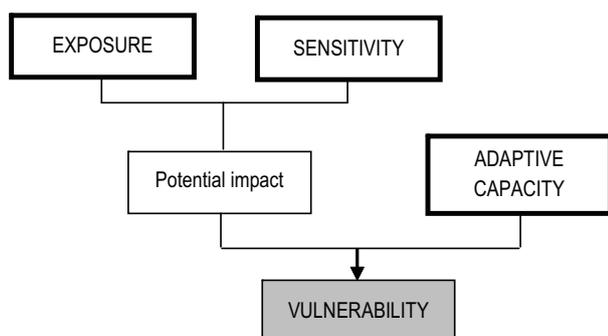


Figure 1. Elements of vulnerability  
(Source: Allen Consulting Group 2005).

on the research discipline and/or primary area of interest, that entity (or unit of analysis) exists at different scales, including biophysical and/or social-economic systems, agricultural industries, regions, communities, or individuals.

'Vulnerability' is also subject to varying interpretations, but it is generally accepted as something that an entity becomes when it is exposed to some kind of hazard and as a result is especially likely to succumb to some kind of *negative* impact. The severity of that impact will be moderated by the entity's 'resilience' and/or 'adaptive capacity'<sup>1</sup> [Figure 1].

Another popular distinction made in climate change discussions is between 'adaptation' and 'adaptive capacity'. *Adaptations* are the particular adjustments or practices, which industries, communities, and landholders make or use in response to current and potential climate change impacts. The choices about what – if any – adaptive actions to take are informed by communities' and individuals' *capacity to adapt*. *Adaptive capacity* is typically defined as the potential or actual *ability* to modify or change characteristics or behaviour so as to improve the situation.

There are multiple ways to describe and classify climate change *adaptations* in agriculture, and governments and scientists have made general prescriptions for climate change mitigation and adaptation in agriculture. However, Australia lacks well-developed and agreed-upon evaluation criteria and tools for assessing the quality of different climate change adaptations in agriculture, particularly at the regional and local scales.

Nonetheless, many climate change dialogues reflect optimism about the capacity of agricultural industries to adapt to future climate change impacts, given the numerous adjustments that have continually and already been made in the face of climatic and other forces (see for example Preston *et al* 2008; Campbell 2008; Steffen *et al* 2006). While climate risk management is not always readily identifiable from the myriad risks that farmers and other landholders are 'managing' at any given moment, researchers have identified a range of climate adaptation actions being implemented by landholders overseas and in Australia, including:

- **land and resource management practices** such as changing production strategies and techniques (reduced stocking rates, adjusting planting dates, changing crop varieties or live-stock breeds, fodder storage);
- **financial management strategies** such as the use of insurance, diversifying off-farm investments, industry exit;
- **climate forecasting and planning** including

the use of seasonal climate forecasting; and

- **capacity building**, including through participation in networks (see Milne *et al* 2008; Leith 2006).

These adjustments to climate change (or to unfavourable climatic conditions like an extended drought) are generally seen as positive actions that demonstrate some capacity or ability to adapt. The absence of these kinds of activities is considered negative and an indicator of vulnerability.

### **A framework for assessing adaptive capacity**

In the absence of definitive frameworks for assessing the quality of particular adaptations, and ongoing uncertainty about exactly how climate change impacts will manifest (and with what kinds of variation), some research and policy discussions are focused on the underlying factors that influence one's ability to make changes. It is not clear to what extent different agricultural sectors and communities can keep pace with unprecedented climatic change. What seems more clear is that there will be differential capacities of regions, industry sectors, communities, and individuals to adapt (see Niemeyer *et al.* 2005; Grothmann & Patt 2005; Adger 2000; Burton & Lim 2005). Hence, there is considerable and growing interest in how to improve adaptation to climate change by identifying those factors enabling or driving effective industry, community and individual responses, as well as mitigating the obstacles to appropriate adaptations.

Figure 3 provides a synthesis of two key frameworks that have been used by social scientists to understand the influences on people's ability to adapt to changes in their environment. These researchers have been interested in increasing the uptake by landholders of practices that are meant to improve the sustainability of agriculture (Cary *et al.* 2002; Pannell *et al.* 2006; Pickworth *et al.* 2007; Nelson *et al.* 2006) and/or ameliorate negative impacts or create opportunities from climate change (Reid *et al.* 2007). Figure 3 below illustrates how landholders operate their commercial and non-commercial properties in a complex and dynamic environment. People have different abilities and inclinations to respond to a range of conditions and stimuli that occur at different scales, and which drive or constrain their capacity to adapt. These factors may overlap or work in conjunction to exacerbate constraints to or enable adaptation. Those conditions and stimuli are discussed briefly below.

### **Factors particular to individuals – 'do I want to do it'**

Individual climate change positions – how much of a threat (risk) people consider climate change to be, how motivated they are to act, and whether they feel they have the ability to make changes/adapt – are partly determined by a range of personal characteristics. These characteristics include people's value and belief systems, attitudes and perceptions, personalities, motivations, goals, and culture. Collectively they inform landholders' judgements about how to respond to the threat of climate change, such that what they believe fits with their on-farm practices.

The quantitative component of this study specifically explored the relationship between the adaptive actions of landholders and a wide range of influential socio-psychological factors – including *belief in climate change, risk perception, knowledge of climate change, ability to adapt, world views, values, personal norms, and commitment to place.*

Adaptive actions =  $\int$  (...x,y,z influential factors)

The selection of influential factors is underpinned by sound theory, including the theory of planned behaviour (Ajzen 1991) and Values, Beliefs, Norms (VBN) theory (Stern *et al.* 1993, 1994, 2000; Schwartz 1992, 1994), that in turn underpin much of contemporary theory on the adoption of conservation practices by landholders (Pannell *et al.* 2006; Cary *et al.* 2002). Risk perception is socially constructed rather than a technical task and so we drew on a substantial body of theory of risk perception (Siegrist *et al.* 2005; Langford, 2002; Greiving *et al.* 2006; Grothman *et al.*, 2005).

### **Access to a range of resources – 'can I do it'**

In addition to their cognitive, emotional and cultural orientations, people's ability to act will be informed by their access to a range of 'resources' needed for any given action. These resources include different forms of 'capital' in their immediate environment that people (consciously and unconsciously) can draw upon. These capitals include: social capital (networks, support), human capital (skills, education), financial capital (revenue, investments), physical capital (equipment, infrastructure), and natural capital (water, land). Access to these forms of capital also informs people's decisions about whether they can make certain changes to their practices. As will be discussed later, many landholders interviewed for this project identified financial matters as obstacles to better preparing for future challenges.

### **The nature of the practice – ‘will it work’**

The attributes of any prescribed adaptation practice will also affect people's choices. These features include its effectiveness, practical benefits, ease of use, and how it has been designed and disseminated. For example, climate forecasting tools to assist farmers can be more effective if they include and make more explicit concepts and features that are important to stakeholders (e.g. linking historic rainfall records to people's memory of climatic events) (Reid *et al.* 2007; Leith 2006). Both the interviews and the survey instrument included reference to regionally specific information about climate change implications (refer Figure 2).

- Hotter/drier summers with more days over 40°C
- Droughts are likely to become longer, more frequent and more intense
- Rainfall will continue to be variable – but expected to be variable around a lower annual average
- Extreme daily rainfall events likely to become more intense
- Runoff into the Upper Murray, Kiewa and Ovens rivers is expected to decrease by between 5 – 50% by 2070
- Increased number of very high and extreme fire-weather risk days.

*Figure 2. General scenario for north-east Victoria*

### **The broader operating environment**

There will always be a range of macro-level factors in the broader, operating environment which, while outside their direct control, influence people's capacity to adapt. These factors include economic

conditions and pressures; government policies, legislation, programs and priorities; public pressures; and environmental conditions (e.g. climate change). For example, the mass media contributes to some of the confusion about climate change. Some climate change adaptations may be restricted by a lack of appropriate incentives (government priorities and capacities), declining terms of trade and/or rural/regional decline (economic conditions).

Figure 3 also asserts that adaptive capacity exists at different scales, such as individual and family decision making and the interaction between family units and other landholders. More broadly adaptive capacity is also operating through the multitude of actions within a regional agricultural at both the regional level and the wider operating environment. These influences were explored particularly through the interviews.

### **A summary**

The framework in Figure 3 provides a useful lens with which to explore and gain insights into the multiplicity of factors affecting landholder responses to climate change. Given the research team's expertise/orientation and interest in social psychology, we have:

- focused on landholders' personal characteristics (beliefs, attitudes, risk perceptions, values);
- undertaken some analysis of landholders' access to resources (human, social, financial);
- examined the adaptation practices landholders are using, with some attention to how those practices have been implemented; and
- considered the influence of the wider operating environment on decisions by landholders, including as those factors shape social structure and processes at various scales that also impact on landholders.

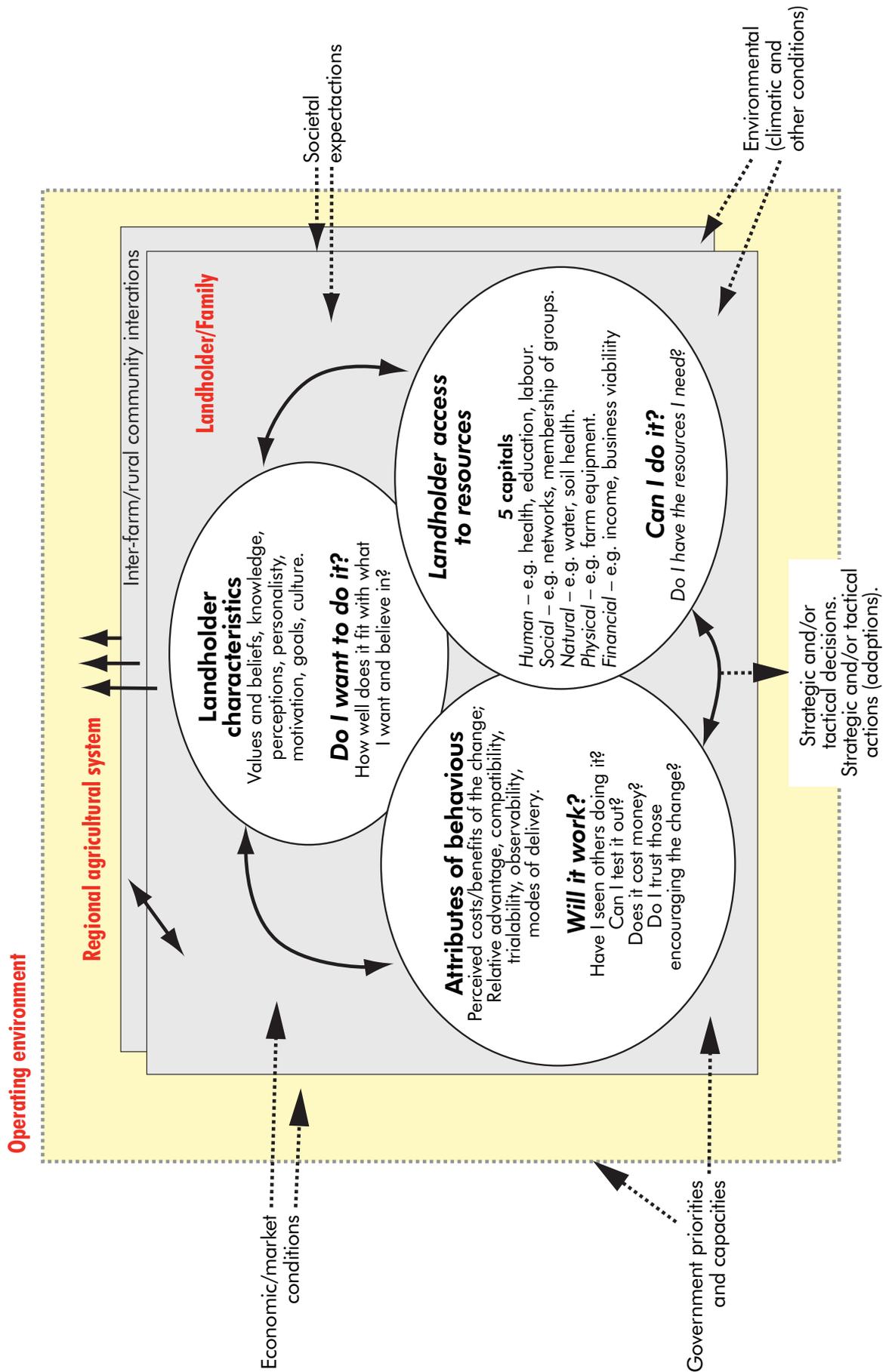


Figure 3. Factors influencing adaptation. Source: Adapted from Cary et al. 2002; Pannell et al. 2006; Pickworth et al. 2007; Nelson et al. 2006.

## 3. Methodology

### Introduction

The research team had investigated rural landholder attitudes and responses to drought and climate variability through two case studies in central Victoria (Thwaites and McDonald, 2006; Thwaites *et al.*, 2008). Semi-structured interviews were used to gather qualitative data to explore rural landholder beliefs about and the responses to climate change. The case studies were deliberately selected to explore the extent that context mattered.

For the current project, the earlier approach was refined and extended. Given the importance of context as a factor shaping landholder perceptions and adaptations, the research team again opted for a case study approach with two community-scale studies in north-east Victoria: Eskdale and Chiltern.

Data collection was undertaken using a combination of semi-structured interviews and a survey mailed to rural landholders. The survey included credible socio-psychological scales, which would enable direct comparisons with the findings of other researchers. The combination of qualitative and quantitative data was expected to allow more sophisticated exploration of the factors influencing landholder responses to climate change, in particular, through the use of statistical techniques to model causality.

In summary, the research team collected quantitative and qualitative data from:

1. Semi-structured (open-ended) interviews with 14 people in each area (total n = 28) who were identified as representative of different community types (e.g. agricultural enterprise, farmer/non-farmer landholders, and gender); and
2. A structured questionnaire hand delivered by a paid local person to all rural property owners (>10ha) within each of the study areas (86 were delivered in the area; 100 were delivered in the Chiltern area) with an overall response rate of 55%.

Each of these research methods is described in more detail below.

### A case study approach

Landholder decision-making is complex and substantially influenced by context. That is, landholder decision making needs to be understood in terms of a range of factors that include the activities of local organisations and networks and their influence on the communication of knowledge, understanding of environmental and farming processes/practices and shaping of social norms in a particular place-based community. It is difficult to understand the influence

of context if data is not gathered from a substantial number of people within a particular social setting. A comparison of case studies allows researchers to further explore the influence of context. In consultation with the North East Catchment Management Authority, we identified the Eskdale and the Chiltern areas as useful case studies in the north-east region of Victoria.

The two case studies presented very different social context in that Eskdale was more remote, with a high proportion of multi-generational dairy farmers, while Chiltern was closer to Albury/Wodonga with a larger proportion of non-farmers and absentee landholders, and landholdings were considerably smaller and less likely to be used for commercially-oriented agriculture. Environmentally, the Eskdale area is part of the Alpine region which typically has higher rainfall resulting in high water security, while Chiltern is an area that experiences greater fluctuations in water availability. Together, the two case studies provide a good representation of the North East Catchment Management Authority region.

### Structure of the research approach

A summary of the relationships between the team's theoretical model, research questions and the topics explored through the interviews and survey is set out in Table 3.1. Additional explanation of each survey topic is provided in later sections of the Methodology chapter of the report. Both data collection instruments directly addressed the key questions.

### Rural landholder interviews

A modified *semi-structured open-ended interview* schedule (SOEI) (Patton 1990) was used to survey stakeholders. This technique involves interviewers asking informants a similar set of questions, worded in the same or similar wording, and asked in the same or similar sequence. Unlike closed questions<sup>2</sup>, qualitative interviewing enables informants to seek clarification on the meaning of questions if needed and to answer in their own words. This form of interviewing also allows the interviewer to explore unexpected or previously unidentified issues should they arise. Using SOEIs tends to minimise the variation in the questions asked by interviewers, which reduces interviewer bias and elicits more standardised and comparable interview data. In addition, as the interview is highly focused, interviewees' time is used efficiently.

The SOEI, or interview schedule, [refer Appendix A] for this study was an enhanced version of the

Table 3.1: Summary of research structure

| Theoretical model   | Key research questions  | Interview topics (Qualitative data)   | Survey topics (Quantitative data)   |
|---------------------|---|---|---|
| Do I want to do it? | How are RLHs interpreting drought, climate variability and long-term change?        | What the recent dry has been like for them.<br>Their belief in (understanding of) cc<br><ul style="list-style-type: none"> <li>Type of change</li> <li>Causes</li> <li>Consequences</li> <li>Action required (generally)</li> <li>Relationship to drought</li> <li>Responses to CSIRO/DSE cc projections</li> </ul> | 3. Knowledge of climate change.<br>4. Views about climate change  |
|                     | How do RLHs perceive personal risk of loss/damage?                                  | Present NE Climate projections (2020)<br>What could be personally lost/damaged/gained?<br>How likely is it to occur?<br>How severe would the damage/loss/gain be?   | 6. Climate change risks for you/our property  |
|                     | How have RLHs responded to cc?  | What actions have they taken?<br>What actions would they like to take and why?  | 9. Property management  |
| Can I do it?        | How adaptable do RLHs believe they are in the face of changing climatic conditions? | Do they have the necessary resources to effectively respond? If not, why not?   | 7. Ability to adapt to climate change<br>10. Background info  |
|                     | What factors influence anticipatory/strategic action to address climate change?     | Perceived influences on their beliefs in climate change<br><br>Most valued sources of information   | 2. Why is your property important to you?<br>3. Knowledge of climate change<br>4. Views about climate change<br>5. View about state of world<br>6. Climate change risks<br>7. Ability to adapt<br>8. Guiding principles in life<br>9. Property management |

interview schedule used in the Central Victorian study undertaken in 2007. In 2007 people were less willing to discuss 'climate change' and so the questions were more open ended, allowing people to 'raise' the issue of climate change. In the north-east study the interview questions were more direct, in that people were asked about their views on climate change.

To pre-test the interview schedule, two pilot interviews were conducted with landholders from each of the study sites with some minor modifications to the wording being made. The interview schedule was modified again after the first few interviews were completed in Eskdale. The changes were as follows.

- **From** 'people are talking about something called *climate change*  
**To:** 'Do you believe in this thing called *climate change* Can you tell us what you think it means?'
- **From** 'how have you come to believe what you do about climate change'  
**To:** Could you tell us how you have come to have these views about this thing called 'climate change'?
  - Where do you tend to get your information about climate and weather from? &
  - What would be a few of your most important

and trusted sources of information about climate and weather?

- When asking people about their preparations for the future, for Chiltern if they did not believe in or were unsure about climate change – we asked them how they were preparing for the possibility of a drier future, and if they did believe in climate change the question was about preparing for climate change.
- When asking them about how prepared they felt about adapting in the future, in the Chiltern interview we included more systematically a question about 'how confident' they felt.

The research team worked with staff from the North East Catchment Management Authority and key landholders within the research areas to identify 20 interviewees with diverse farming enterprises, backgrounds and life experiences in each of the study sites. Of those contacted, 14 from the Eskdale area and 12 from the Chiltern area were willing to be interviewed. As explained, the intention was to obtain a selection typical of landholders in each district. Table 3.2 summarises the key characteristics of our informants. From personal experience and previous research, the research team was very familiar with both localities and is confident the informants represent a cross-section of landholders in each

district. For example, six of 14 informants in Chiltern were non-farmers where as only two of 14 Eskdale informants were non-farmers. This is consistent with the reality that Eskdale is largely a profitable dairy farming district and Chiltern largely a dormitory suburb for Albury-Wodonga.

Table 3.2: Characteristics of interviewees

|   | Characteristics  | Eskdale | Chiltern |
|---|--|---------|----------|
| 1 | Dairy farmers with irrigation                          | 8       | 1        |
| 2 | Sheep/Beef Growers                                     |         | 3        |
| 3 | Beef Gowers with irrigation                            | 4       |          |
| 4 | Beef/Dairy (no irrigation)                             |         | 2        |
| 5 | Non-farming occupations/<br>life-stylers/hobby farmers | 2       | 6        |
| 6 | Horticulture   |         | 2        |
|   | TOTAL  | 14      | 14       |

All interviews were conducted by experienced social researchers. Interviews were taped, and key points and themes recorded in handwritten notes by each interviewer, ensuring the anonymity of interviewees was maintained. The research team arranged for the interviews to be conducted at a convenient time and location for each interviewee (all were conducted on-property), and were approximately two hours in length. The identity of interviewees was not recorded on the interview notes or tape recordings, and information in the report has not been attributed to specific interviewees.

The research team contacted the prospective interviewees by phone several weeks prior to the anticipated interviews, explaining the purpose of the research, how they had been identified, and that the client was Charles Sturt University. A letter and information sheet was then sent to those who agreed to participate, including an interview date and time, which had been agreed to during the initial phone conversation. The Eskdale interviews were conducted during the week of 29 June to 3 July, 2009 and the Chiltern interviews were conducted during the week of 14 to 18 September, 2009.

Each interview commenced with a discussion of the farming enterprise, including details of the scale and mix of on-property enterprises activities and changes in them over time; their management style; and what the property meant to them personally. These topics provided the participants with the opportunity to share important background information and to talk about what was important to them about their property.

The interview schedule then followed the logic laid out in Table 3.1 where participants were asked

about their experiences of climate over the past few years; what they believe is happening; what they think about the idea of climate change, its causes and consequences; how they respond to the regional projections information; how likely they think it is that the projections will come to fruition; what action have they taken and/or would like to take; do they have the necessary resources to take those actions; and what factors they believe have influenced their thoughts about climate change.

Content analysis techniques were used to analyse the responses. All categories were derived using inductive analysis of the patterns that emerged from the manifest and latent content in the interview data (Berg 1989). Respondents' comments were manually grouped into themes corresponding to the interview questions. Another coding frame was used to sub-divide these data into more specific categories according to the discussions around the topic areas. For example, three categories were created for interviewees' beliefs about climate change ('believers', 'unsure', and 'non-believers') and some of the other responses were analysed for possible differences according to interviewees' beliefs (e.g. actions taken to manage the dry).

### Rural landholder survey

The survey was designed specifically for the purpose of building a statistical model of rural landholder responses to climate change. A 10 topic questionnaire was developed around key influential factors as summarised in Table 3.3.

Where possible researchers should draw upon the work of others in their field to avoid re-inventing existing approaches, ensure that successive efforts build on sound foundations and to allow for comparisons across studies. Interview schedules and survey instruments should be informed by sound theory and the items used to operationalise those theories. As summarised in Table 3.3, the research team drew upon a number of contemporary theories and, where possible, the social-psychological scales that operationalise key aspects of those theories.

A scale is really just a series of items (questions or statements) that together, explore the different dimensions of a theoretical construct. For example, theory suggests that beliefs (what is believed to be true) have three elements which according to the Value-Belief-Norm (VBN) theory developed by Stern *et al* (1998), includes ecological and social world views, awareness of consequences, and ascribed responsibility. Accordingly, the research team drew on existing research to identify questions/statements that could be adapted for use in the landholder survey to explore those elements of beliefs about climate change. Some items included

Table 3.3: Summary of the theoretical basis for the socio-psychological scales

| Framework           | Key factors influencing behaviour  | Theoretical basis  |
|---------------------|--|--|
| Do I want to do it? | World views – optimism/pessimism/environmental stewardship   | Eckersley, 2007;<br>New Environment Paradigm                         |
|                     | Belief in climate change – is it true?   | Milne et al, 2008<br>Leiserowitz, 2005                               |
|                     | Knowledge of climate change – self-declared understanding  | constructed  |
|                     | Values – things that are important to me which could be lost as a consequence of climate change.   | Stern et al, 1998  |
|                     | Risk Perception –<br>• Level of concern<br>• Severity of consequences  | Grothman & Patt, 2005<br>Langford, 2002<br>Sharp, 2009 (unpublished) |
|                     | Personal norms – sense of obligation/moral duty to protect what is valued.<br>• I feel a personal obligation....<br>• The government/industry should..." | Stern et al, 1998  |
|                     | Commitment to place- strength of ties to the property  | Jorgensen et al., 2001   |
|                     | Adaptive actions – property management   | Milne et al, 2008  |
|                     | Perceived ability to adapt – self-declared   | Grothman and Patt, 2005  |
| Can I do it?        | Resources – Personal income, networks, access to labour  | Background information   |

in the survey have been employed in other studies by the research team (e.g., Curtis *et al.* 2006, 2008). Other items are new, but in most instances have been adapted from existing scales.

### The survey instrument

A 12-page booklet, comprising 10 topics and 136 items, was constructed around the range of identified influential factors as outlined in Table 3.3 above. The survey topics and the associated influential factors are listed in Table 3.4 below.

**Topic 1: Your property** – This section of the survey gathered background information on the size of the property, duration and nature of property ownership/management, and duration of local residency.

### Topic 2: Why is your property important to you?

– This section of the survey was crafted around the concept of commitment to place. According to Jorgensen and Stedman (2001, p.235) "...respondents who were prepared to endure some form of behavioural cost would also hold developed feelings about the place". These authors developed a 'sense of place' scale that they suggest is easily administered and a reliable measure through three related constructs: *place identity*, *place attachment*, and *place dependence*.

**Place identity** Dimensions of self that define personal identity (*Everything about my property is a reflection of me vs my property says very little about who I am*)

Table 3.4: List of Survey topics

| Survey section | Survey topics                              | Influential factor         |
|----------------|--|----------------------------|
| 1              | Your property                              | Background information     |
| 2              | Why is your property important to you?     | Commitment to place        |
| 3              | Your knowledge of climate change           | Knowledge                  |
| 4              | Your views about climate change            | Beliefs                    |
| 5              | Your views about the 'state of the world'  | World views/personal norms |
| 6              | Climate change risks for you/your property | Risk perception            |
| 7              | Ability to adapt to climate change         | Ability to adapt           |
| 8              | Guiding principles in your life            | Values                     |
| 9              | Property management                        | Adaptive actions           |
| 10             | Background information                     | Resource availability      |

1. This property enables me to have a sense of accomplishment from building/maintaining a viable business
2. This property says very little about who I am
3. I feel I can really be myself at my property
4. My property reflects the type of person I am

**Place attachment** Positive bond between groups and individuals – emotion content (*I feel relaxed when I'm at my property, I really miss my property when I'm away from it for too long*)- PA

1. It is important for me to be able to pass the property on to others
2. I feel happiest when I'm at my property
3. This property is a great place to raise a family
4. My property enables me to be part of a rural community

**Place dependence** How well a setting serves goal achievement – how does this setting compare to others for what I like to do? (*My property is the best place for doing the things that I enjoy most vs there are better places to be than at my property to do the things I like to do*) – PD

1. This property provides most of the household income
2. My property is the best place for doing the things that I enjoy most
3. As far as I am concerned, there are better places to be than at my property
4. This property is not a good place to do the things I most like to do.

Two additional statements which did not form part of the scale were included to specifically garner information about current thinking in terms of people's commitment to stay living where they do.

1. I live here and have no thoughts of leaving
2. I live here but I have thought about leaving if the climate changes.

**Topic 3: Your knowledge of climate change** – This section was designed to assess how much people know about climate change. The suite of knowledge topics included in the survey was developed around a list of key climate change concepts, or understandings of related causes, impacts, adaptation and mitigation.

Self-assessment is a widely accepted approach to gathering information about landholder knowledge of NRM topics. One approach is to ask each respondent to rate their level of knowledge for particular topics (Curtis and De Lacy, 1996). Another approach is to ask each respondent to answer questions or respond to statements that test their knowledge of a particular topic (Shindler and Wright, 2000). For this study, a combination of

both approaches has been used. The nine climate change topics in the knowledge section can be readily found in the public domain.

1. The difference between the greenhouse effect and the ozone hole
2. Potentially serious impacts of global climate change
3. Actions that householders can take to reduce their carbon emissions
4. How carbon can be taken out of the atmosphere and stored
5. The explanation provided by scientists for global warming
6. The Federal Government's plans for a Carbon Emissions Trading Scheme
7. The broad climate change projections for your region by 2050
8. The implications of a 1–2 degree increase in global temperatures for agriculture in your district
9. Steps that an agricultural enterprise could take to become carbon neutral.

**Topic 4: Your views about climate change** –

This section in the survey set out to specifically determine what respondents believed to be true about climate change. Belief and risk perception are closely linked but different. One way to approach the task of exploring these topics through a survey is to explore belief in climate change in terms of what respondents believe and why, and then explore risk perception in terms of how likely they believe it is they will be affected.

The researchers drew on the work of Milne *et al* (2008) who explored rural attitudes to climate change, and Leiserowitz's (2005) work on American perceptions of climate change risk. As these authors established, whether or not people *believe the climate is changing* is only one part of the issue. It is also important to explore beliefs about the cause of change (i.e. human induced or natural cycles) as these views will influence how people respond (whether or not we can influence nature, either to cause a problem or to ameliorate it).

Milne *et al* (2008, p39) found that respondents expressed a full spectrum of beliefs as to whether climate change is happening. From their data they produced five categories reflecting critical differences in people's perceptions, reflecting the degrees and nature of the uncertainty people were feeling at the time. The five categories are:

*Yes, it is happening* – this group were confident that climate change is happening

*Probably, but not sure* – these people thought that climate change might be happening but were not entirely confident, sometimes expressing both

affirmation and doubts within the same interview. *Yes, it is happening, but not here* – this category was attributed to those who believed that climate change is happening but that it is happening somewhere else.

*Don't know* – this category expressed a general uncertainty about whether climate change is occurring at all.

*No, it isn't happening* – this group did not believe that climate change was happening.

Leiserowitz (2005) identified five distinct reasons why people doubted the reality of climate change.

|                                       |   |
|---------------------------------------|---|
| Belief that global warming is natural | "It is just the natural course of events, a <b>natural phenomenon</b> that has been going on for years" |
| Hype                                  | "It's <b>not as bad as the media portrays</b> . The 'problem' is overblown, environmentalist hysteria"  |
| Doubting the science                  | "There is no proof it exists. Around 10 years or so ago it was global cooling"                          |
| Flat denials of the problem           | " <b>A false theory</b> . There is no global warming"   |
| Conspiracy theories                   | "Hoax. Environmentalist propaganda. Scientists making up some statistics for their job security."       |

Drawing upon the work of Leiserowitz (2005) and Milne *et al* (2008), the research team developed 10 survey items to explore beliefs about climate change. Respondents were asked whether they agreed or disagreed with the following statements.

1. The climate is changing
2. If we do nothing climate change will have dire consequences for all living things, including humans
3. Human activities are influencing changes in climate
4. Climate change is out of our control
5. Humans will always adapt to their environment
6. It is not too late to take action to address climate change
7. Climate might be changing but it is not as bad as it is being portrayed
8. Climate is always changing. It is a naturally occurring phenomenon that has been going on forever
9. There is no such thing as climate change
10. The climate maybe changing but currently we are in a cycle.

**Topic 5: Your views about the 'state of the world'** – This section of the survey combined three scales related to social and environmental world views and personal norms – i.e. Eckersley, New Environment Paradigm, and Stern *et al* and Langford, respectively.

According to Eckersley (2007), the psychological impact of all the negative social, economic, and environmental degradation will shape our social responses to contemporary social issues. There is a large body of research exploring the extent to which a person's optimistic or pessimistic outlook on the world shaped their behaviour. Eckersley (2007) has identified three broad world view categories: *Nihilism, Fundamentalism, and Activism*.

|                |  |
|----------------|--|
| Nihilism       | The weakening of belief in a social or moral order – <b>Decadence rules</b> . Focus on the individual, quest for personal pleasure, win at all costs, concerns are unremittingly local, immediate and personal – fraying of citizenship/democracy, increasing vulnerability to the politics of self-interest and fear. |
| Fundamentalism | Retreat to certain belief – <b>Dogma rules</b> . A call to unite against moral and physical threats, generating simplistic solutions to complex problems.  |
| Activism       | Transformation of believe – <b>Hope rules</b> . Emphasis on relationships, communities, spirituality, nature and the environment. A desire for a new way of living.  |

A scale, based on these three categories was created for this study, including as a result of personal communication with Richard Eckersley. The statements were as follows.

1. The world's future looks grim. We can't be worrying about everyone else. We have to look out for ourselves
2. We are facing a fundamental conflict between good and evil
3. We need to return to traditional religious teachings and values to solve global problems and challenges
4. We need to transform our way of life if we are to create a better future for the world
5. There's no point in worrying about what might happen to the world in the future.

The New Environment Paradigm (NEP) has been widely used as a scale to explore the impact of world views on environmental protection. The research team (Curtis *et al* 2001) has had some experience employing the (NEP). The NEP challenges the Dominant Social Paradigm (DSP), arguing that ecological problems stem from our belief in *abundance and progress, devotion to growth and prosperity, and faith in science and technology* to solve our problems (cited in Curtis, *et al* 2001). Dunlap and Van Liere (1978) developed a 12 item scale to measure the NEP. This scale used five point Likert-type response options ranging from 'strongly agree', 'agree', 'not sure' and 'disagree' to 'strongly

disagree'. The research team used five of the 12 items to discriminate between those with strong environmental concerns and others.

1. We are approaching a limit to the number of people the earth can support
2. The balance of nature is delicate and easily upset by human activities
3. There are no limits to growth for resource rich nations like Australia
4. Humans must live in harmony with nature in order to survive
5. Humans cannot influence nature.

According to Stern *et al.* (1998) personal norms encompass issues of a 'sense of obligation' and a 'moral duty to act' to protect what is valued. The question of *whose problem is this* arises from both a belief, or not, in climate change and a sense of personal responsibility if one believes humans are the cause.

According to Langford (2002) the levels of concern about climate change are in response to the perceived likelihood of being affected, and therefore the sense of personal obligation to act can also be understood in terms of denial, disinterest, doubt, or full engagement in the issue.

*Denial* There is no problem, it doesn't concern me

*Disinterest* There is a problem, but it isn't my problem. I'm not concerned at present

*Doubt* Environmentalists predicted catastrophe in the 1970s and 1980s – it didn't happen – why should we believe them now?

*Engagement* There is a problem. I would like to do something, BUT I don't know what to do. OR There is a problem. I am doing what I can.

Drawing on the work of Stern *et al.* (1998) regarding a sense of obligation, and the work of Langford (2002) regarding levels of denial and engagement, the following scale was created to explore the impact of personal norms:

1. I feel an obligation to do whatever I can to reduce my carbon emissions
2. I don't believe there is a climate problem
3. I feel obliged to do whatever I can to prepare for climatic change
4. If there is a climate problem, I'm not concerned at present
5. It is primarily the Government's responsibility to protect the environment
6. It is primarily the responsibility of industry to reduce carbon emissions
7. US, India and China should reduce their emissions before Australia.

## Topic 6: Climate change risks for you/your property

This section of the survey was designed to gain an understanding of how respondents perceived the personal risk of climate change. Drawing on the work of Grieving, Fleishhauer and Luckenkotter (2006), risk is expressed as a function of exposure (likelihood of impact), sensitivity (severity/nature of the impact), and adaptability (capacity to avoid/resist loss).

$$\text{Perceived Risk} = \int (\text{Exposure to a hazard} + \text{Sensitivity} + \text{Adaptability})$$

Risk – the possibility of a hazard causing damage/loss to *something of value*.

Hazard – *understanding* of localised & global impacts of climate change

Exposure – *likelihood* of damage occurring to what is valued

Sensitivity – *belief* that damage could occur to what is valued

Adaptability – *belief* in ones capacity to avoid damage, resist loss, withstand change and recover from impact.

A series of statements was developed around a list of realistic potential types of impacts to people and their properties in the north-east region. Respondents were asked to assess the likelihood of these impacts actually occurring and the expected nature or severity of such impacts. This approach negated the need for people to believe or not – as they could answer with a 'highly unlikely' response if they were non-believers. The list of potential impacts affecting them or their property was as follows.

|   |                                      |
|---|--------------------------------------|
| Water supply for stock and domestic             | Attractiveness of property landscape |
| Water supply for pasture production             | Insect pests                         |
| Pasture productivity                            | Pest plants                          |
| Survival of some native vegetation              | House gardens                        |
| Quality or health of native vegetation          | Personal health and wellbeing        |
| Increased frequency and intensity of bush fires | Family health and wellbeing          |

Part B of this section in the survey was designed to elicit respondent views about the nature and severity of the impact. The same list of potential impacts was presented. Respondents were asked to indicate if they thought the potential impact would be large/small, positive/negative.

### Topic 7: Ability to adapt to climate change –

Garner and Stern (1996) found a systematic bias towards underestimating *capacity to adapt* regardless of access to information and resources. Pearman (2009) also points out that "...current approaches to our understanding of adaptation responses are too technocratic, failing to engage with the big questions of human behaviour", (i.e. the socio-psychological factors which we are endeavouring to explore in this study). A person's *perception* of their capacity to adapt and respond to changing circumstances can be very different to their actual capacity (+ or -). According to Grothman and Patt (2005) it is the difference between what a person wants to happen (or not happen) and what a person expects will happen, which is the source of motivation for adaptation: the bigger the difference the bigger the motivation.

Given that there is little data about the factors affecting an individual's ability to act in response to climate change, we decided to ask respondents to provide their own assessment of their ability to respond to the list of potential climate change impacts on their property (as per Topic 6). The response options ranged from highly adaptable to limited adaptability. Of course, the research team could also explore the impact of capacity on adaptation using other data collected through the survey. For example, it would be possible to explore the impact of membership of networks, income or knowledge on taking specific adaptive actions.

### Topic 8: Guiding principles in your life –

Stern *et al* (1998) have undertaken extensive work to improve understanding of the attributes of what people *value* (things that could be lost which are important to us, to others, and all living things). They argue that *values* are a good predictor of attitudes and concluded that a three-item measure from the five value clusters (biospheric values [BV] altruistic values [AV], traditional values [TV], self-enhancement values [SV] and openness to change values [OV]) provided a sound value base for understanding attitudes and behaviour. Drawing on the work of Stern *et al*, the following scale was used.

1. Ensuring a fair go for all [AV]
2. Leadership, and an ability to influence others [SV]
3. The practice of self-discipline and self-restraint [TV]
4. Protection of our individual rights [AV]
5. Equal opportunity for all [AV]
6. Honouring of parents and respect for community elders [TV]
7. Protection of the environment [BV]
8. Contributing to a sense of community [SV]
9. Creating wealth and a striving for financial

prosperity [SV]

10. Curiosity and a keen interest in everything [OV]

11. To live a varied life, filled with challenge, novelty and change [OV].

### Topic 9: Property management –

In managing risk, rural landholders need to be planning and implementing a range of actions which take advantage of opportunities as well as managing potential threats. According to Milne *et al* (2008, p53), managing risk involves the overlapping concepts of *preparedness*, *risk management*, and *adaptation* – all of which "...incorporate an emphasis on anticipation and planning for an event before it occurs".

Drawing on the list of current and planned actions mentioned by interviewees, and the research teams' knowledge of management practices in north-east Victoria, a set of adaptive actions relevant to the study areas were identified [refer Table 3.5]. Survey respondents were then asked to indicate their intention with regard to implementing such actions. That is, were they interested in taking such actions, were they planning to implement such actions in the next five years, or had they already implemented such actions. In the second part of this section, respondents were asked to indicate the extent that climate change had influenced their property management actions.

Table 3.5: A list of adaptations that could be implemented by landholders in north-east Victoria

| Actions taken or under consideration            |   |
|---|---|
| Improved ability to capture water               | Increase fodder storage capacity            |
| Improved efficiency of water usage              | Increased off-farm work (part or full-time) |
| Established perennial pasture                   | Value add to farm products                  |
| Overall reduction in stocking rates             | Sell or lease land to others                |
| Move from annual pasture to perennial pastures  | Move to more intensive use of land          |
| Purchase or lease more land in your district    | Move to low input production system         |
| Purchase or lease more land in another district | Change the way product is marketed          |
| Diversification of farm enterprises             | Plant trees, shrubs or native grasses       |
| Changed enterprise mix                          | Fence native bush to restrict stock access  |

### Quality of adaptations – reactive versus strategic

Adaptations to climate change (or to unfavourable climatic conditions like an extended drought) are generally seen as a positive action and an indicator

of a capacity or ability to adapt, while not adapting is considered negative and an indicator of vulnerability. However, it is possible that actions taken by landholders can lead to undesirable outcomes in the long-term for them or for others, particularly those downstream. Those actions that lead to undesirable outcomes might be termed 'maladaptive'.

Contemporary climate change dialogues assume that anticipatory actions (those taken ahead of the symptoms of change emerging) are more desirable, because they indicate some level of preparedness by industry, community or individuals to engage with longer-term consequences of climate change.

There are numerous ways to classify climate

Table 3.6: Ranking of tactical/strategic adaptations – a rationale

| <b>Actions taken or under consideration</b>                  | <b>Tactical/Strategic Score</b> | <b>Rationale for tactical/strategic score</b>  |
|--|---------------------------------|--|
| Improved ability to capture water                            | 2                               | Not difficult or expensive to extend/build farm dams or add to household water storage capacity. Often a critical/immediate action undertaken in dry periods.  |
| Overall reduction in stocking rates                          | 2                               | Short term response to current dry conditions – easily reversed  |
| Planted trees, shrubs or native grasses                      | 2                               | Not a big deal if only small areas involved and often supported by govt programs   |
| Moving to a low input production system                      | 2                               | Often a reaction to increased cost/reduced return experienced during extended dry periods. Could be a shift to organic farming but more likely to be the former  |
| Increased fodder storage capacity on your property           | 3                               | Not difficult or expensive but a response to long term need for increased fodder storage   |
| Changed enterprise mix                                       | 3                               | A shift in the mix e.g. a shift from dairy to beef, increased cropping or a shift in crop type. Requires flexible management able to respond to ever changing conditions.  |
| Move from annual to perennial pastures                       | 4                               | Similar to adaptation No 3, but likely to be less of a change in property management.  |
| Fenced native bush to restrict stock access                  | 4                               | Often results from a substantial change in attitude to the use of natural resources, but mostly done through government grants – reversed during dry   |
| Improved efficiency of water usage                           | 4                               | More stock troughs and piping of water rather than earthen races. Shift from flood to spray/dripper irrigation. Often done with gov't grants. Reflects a view that more has to be made of available water which may be permanently reduced. Could be in response to increasing water cost. Has long term benefits for farm productivity. |
| Established perennial pasture                                | 5                               | Involves considerable investment and change in property management. Tends to be deep rooted lucerne which makes use of sub-soil moisture – responds to summer rains. Has 8 year life span, so not necessarily a long term commitment. This may involve a shift from native grasses or from other forms of pasture or crop.               |
| Purchased or leased more land in local district              | 6                               | If a response to cc, then reflects a big commitment to that view. This can be a 'business as usual' strategy where less rainfall/less productivity results in greater need for more land.  |
| Diversification of farm enterprises                          | 6                               | Substantial change in enterprise involving new activities requiring new knowledge, skills and investment.  |
| Purchased or leased more land in another district            | 8                               | This strategy takes advantage of different climatic/seasonal conditions, providing flexibility. It is a complex process and difficult to reverse.  |
| You or other family members have increased off-property work | 8                               | Big change in way-of-life. Suggests an acknowledgement that cc is here to stay   |
| Moving to a more intensive use of existing land              | 8                               | Substantive change in management if it is a shift to higher value use of water (e.g. horticulture), but may actually be increased pressure on existing land or enterprises.  |
| Changed the way you market your product                      | 8                               | Developing a specialisation which could involve being carbon neutral, clean/green  |
| Value added to farm products                                 | 9                               | Highly strategic if it means increased income from existing inputs, or if it reflects carbon neutral, clean/green goals.   |
| Sold or leased land to others                                | 9                               | Big change in way of life. Exit from farming   |

change adaptations in agriculture, but Australia lacks clear, agreed-upon criteria for distinguishing the quality of particular practices (e.g. what distinguishes sound adaptation from maladaptive actions).

The research team has attempted to 'rate' the quality of the identified current and planned adaptations in this study according to a spectrum of 'reactiveness' versus 'anticipatory' or tactical versus 'strategic' action (1 = reactive, 10 = anticipatory/strategic). Information in Table 3.6 outlines the rationale for the score given to each of the identified adaptations.

### **Survey pre-test**

The instrument was pre-tested via a workshop with four people who had been involved in the interview process. Survey booklets and the cover letter were mailed to the pre-test participants ahead of the workshop where the group discussed each topic in terms of their ability to answer quickly and accurately, if there statements that they didn't fully understand, and anything they thought was missing. The process took four hours to complete, and each of the workshop participants was paid for their time.

Input from the participants resulted in a number of changes being made, particularly in language used to introduce topics or specific statements employed in sections exploring commitment to place, 'state of the world' views, and guiding principles.

### **Survey distribution and response rates**

The research team employed a local person in each study site to distribute the survey to every landholder in the district whose property was over 10ha in size (N=186). The survey design and the distribution process employed a modified Dillman (1979) approach. The survey was presented as a distinctive booklet (photos reflective of each study site on the cover) and was hand delivered with an appealing cover letter and return-addressed and stamped envelope. The names and addresses of each survey recipient were recorded against a number on the booklet which enabled two subsequent reminder notices being posted, and a second complete mail out of the survey booklet to all non-respondents. The survey process was closed off with 103 useable surveys, representing a 55% response rate [Table 3.7] overall. Ten surveys were returned 'uncompleted' and two were 'returned to sender'. These respondents were all removed prior to calculation of the survey response rate.

The difference in response rates between Eskdale (36%) and Chiltern (63%) is surprising given the research team has consistently achieved

response rates >55% in surveys of rural landholders over a 20 year period. A number of possible explanations for the lower response rate from the Eskdale area include: being a community that is less concerned about the impacts of climate change given the high degree of water security in the district, both from rainfall and irrigation water from the Mitta River; and the late distribution of reminder/thankyou notes.

*Table 3.7: Survey response rate*

| <b>Study site</b> | <b>Initial survey distribution</b> | <b>Surveys returned uncompleted</b> | <b>Surveys returned useable</b> | <b>Response rate %</b> |
|-------------------|------------------------------------|-------------------------------------|---------------------------------|------------------------|
| Eskdale           | 86                                 | 5                                   | 31                              | 36%                    |
| Chiltern          | 100                                | 5                                   | 63                              | 63%                    |

We acknowledge that there are likely to be differences between respondents and non-respondents to mail surveys. However, with an overall response rate of 55 from a census of landholders, we are confident that data presented is representative of landholders in the two districts.

### **Data analysis**

The survey data analysis included a range of quantitative techniques. General inference was obtained through consideration of the descriptive statistics for each variable using means, medians, frequencies and percentages where appropriate. Some groups of variables belonged to theoretical scales. Cronbach's Alpha, using a threshold of 0.7, was used to see if respondents answered these groups consistently thereby confirming the scale. If the groups of variables on the theoretical scale were not consistently answered then every combination of the variables in the group were considered and Alpha calculated, to see if there were any internal groupings that may represent the theoretical scale. If there were, then the best Alpha was taken and a new variable was created.

Kruskal Wallis tests were used to see if there were significant differences in numeric/likert responses between the two case studies. Proportions tests were used to see if there were differences in categorical responses between the two case studies.

All analysis was in the context of those that answered the survey. Respondents that did not answer, who indicated that they did not know or who found the question not applicable, were ignored in the statistical analysis. The numbers of those who found the questions not applicable were however reported and considered prior to further analysis.

After general inference was made, further analysis was considered between the adaptive behaviours included in the survey – including scale equivalents

(taken as dependents) and all other independent variables. Correlations, linear models and Kruskal Wallis tests were used in pairwise analysis to see if the relationships or differences observed by the summary statistics between dependent and independent variables were significant.

In the case of correlations, Spearman's Rho was used to identify if there were significant relationships between pairs of continuous/likert variables. For example between property size and improved ability to capture water on your property. In certain cases, the relationship was explored further using a linear model instead of Spearman's Rho, in an effort to quantify the structure of the linear trend.

Independent variables that had a significant relationship with dependent variables based on the pairwise analysis were then considered for multiple linear regression modelling.

Each of the possible predictors indicated by pairwise analyses was then scrutinised for a response rate above 80% to ensure modelling integrity. The final list of predictors was then used in a stepwise linear modelling process that used Akaike's information criterion as the step criteria. The modelling process was used to identify the set of variables that collectively contributed most to a higher score for each adaptive behaviour or set of behaviours. The amount of variance explained by the model ( $R^2$  value) provides a test of the extent

that key independent variables have been included in the study. A model that explains 30% of variance is considered as useful in the social sciences where there is typically a large number of potentially influential variables.

While the research team employs regression modelling to assist in understanding causality, and in this research, explore the impact of climate change on landholder behaviour, this approach also has its limitations. One of these is the assumption that where there are correlated variables, only the most strongly correlated variable should be retained. It is possible that this assumption eliminates important influences on behaviour that theory or practical experience suggests are important. For this reason, the research team presents the results of both the pairwise comparisons and regression modelling. As a rule, results from regression analysis should carry more weight. However, in other publications (Curtis and Mendham 2010), the research team has referred to the "weight of evidence" from pairwise comparisons. Examination of the set of variables linked to a dependent variable through pairwise analyses enables researchers to consider a larger range of potential factors that might be influencing an outcome. Of course, there are other techniques besides regression that can be used to assist in exploring causality, including structural equation modelling and Bayesian Decision Networks.

## 4. Interview findings

In this chapter we discuss the findings from the landholder interviews conducted in the Eskdale and Chiltern case studies in June/July and September 2009, respectively. Findings are presented for each of the key topics in the interview schedule, and those topics are presented largely in the order in which they were put to the interviewees [see Table 4.1].

Table 4.1: Presentation of interview findings

|  |   |
|--|---|
| Interpretations and experiences of dry times | Adapting to dry times (or to climate change)      |
| Experiences of drought                       | Action to manage current dry                      |
| Belief in 'climate change'                   | Action to prepare for the future                  |
| Responses to climate change predictions      | Possible further action to prepare for the future |
| Influences on beliefs                        | Quality of adaptations                            |

### Rural landholders' interpretations and experiences of drought and climate change

#### Experiences of the dry

Interviewees were asked to describe their experiences of "the dry in Victoria over the last five years." Analysis of this section of the interview transcripts showed that the interviewee's responses contained some reference to either the:

- biophysical symptoms of drier times;
- production challenges arising from having less water;
- length of time the dry had been in place; and/or
- emotional response to the drier conditions.

Overall, most interviewees talked about how the dry made life on the land more challenging than it was in wetter times. The biophysical manifestations of the dry mentioned by interviewees included lower rainfall, fewer wet winters, creeks and dams drying up, dry topsoil, loss of bird life and loss of trees.

Farming was generally considered to be getting more difficult, because of the need to maintain or do more with less water. The most common response from the interviewees in both case studies was to talk about the various production challenges arising from having less water and higher input costs (including their own labour). These challenges included:

|                                    |   |
|------------------------------------|---|
| more time spent on weed management | failed crops                                  |
| buying feed for stock              | power outages in extreme heat                 |
| reducing stock levels              | having to work off-farm and less time on-farm |
| keeping water to stock             |   |

Several interviewees (Eskdale 5,7, 8n; Chiltern 1) felt that the recent dry spell had been going on for "... closer to 10 years, not five...", long enough for one interviewee to observe that it did not "... feel like anything new ... [it was] something to get used to." (Chiltern 1).

#### Box 1. Interviewees' views on the emotional impact of dry times.

In 2005 we sold a lot of young stock to Queensland ... people in Queensland knew we were doing it tough and they rang us to see if we had young stock to sell. Not that we wanted to but we had to we couldn't feed them, and that was the worst year but that was a very stressful, when I say stressful it was a frightening time (Eskdale 12).

The hardest thing for rural communities, particularly like a little one like ours ... we had a timber mill which employed people, and there is [not a lot of] employment for people other than farming ... and your basic services don't get supported like the shop, pub and now the school ... it's pretty depressing, because if we lose the school it's sort of the heart and soul of the community (Eskdale 3)

Well I hate the heat ... and it's depressing because you go out and your plants are dying. I mean I am a horticulturalist and love my garden – I have a vast garden out there and I lose 70% of it every time it dries out and I have to plant all over again.... it was a bad year when we decided enough was enough. I got very depressed because the trees were dying, wasn't only the general shrubs I mean everything – the small stuff went and then all the big trees were dying and that was terribly depressing for me (Chiltern 4)

I mean it does stress you out when it gets really dry and you are thinking is the water going to last. Have I got enough to keep the place green? (Chiltern 15)

The duration and intensity of the dry period seemed to be taking its toll on people – some interviewees talked about the emotional impacts of the dry spell [see Box 1]. Two of the Eskdale interviewees (5, 12) made specific mention of how stressful or depressing the dry was. In the Chiltern Case Study a number of interviewees (1, 2, 4, 6, 12 15) talked about the dry conditions being "depressing", "disappointing" and/or worrisome, particularly when they observed things like a loss of community service and spirit resulting from widespread crop

losses or people not being able to make a decent living from their properties. Two of the Chiltern interviewees appeared to be putting up a brave face when they spoke about just having to “grin and bear it” (8) or “... always hoping that things will be better next year...”(2).

In the Eskdale area, several of the interviewees (1, 2, 13) felt that the dry had *not* had a dramatic effect on their enterprise – they referred to their access to the Mitta Mitta River or the Little Snowy Creek as being sufficient for their needs. Another Eskdale interviewee (9) felt that one small advantage of the dry was the ease with which they could drive tractors or trucks across the paddocks, given the dry subsoil. And a fourth interviewee felt that he had “...managed better than some, partly because there has been a bit more rain in the region compared to other places in Victoria, like East Gippsland.” The observations of these interviewees may be partly explained by the fact that Eskdale has typically been well-watered by rainfall and flooding compared to other regions in south-east Australia.

### **Beliefs in ‘climate change’**

The research team was seeking to understand landholders’ beliefs about different aspects of climate change. The research team sought to discern the extent that people believed in and understood the phenomenon. This line of inquiry was followed by questions about the kind of ‘change’ interviewees had observed, the causes of those changes, consequences, potential remedial actions, and whether there was any relationship between ‘climate change’ and drought.

#### *Belief characteristics*

Interviewees’ responses about their belief in climate change were grouped into three broad categories – ‘non-believers’, ‘unsure or unclear’ and ‘believers’ – in large part reflecting their views about the reality of human-induced climatic change. These groupings reflect similar classifications for beliefs about climate change, which have been reviewed (Mazur *et al* 2009) and used in recent research (Thwaites *et al* 2008). In the rest of this section we explore the characteristics of each set of respondents; the extent these are valid signifiers of cohorts of landholders with different beliefs about climate change; and some key findings using this typology.

Table 4.2 provides a summary of interviewee’s responses to the series of questions about their belief in climate change. Interviewees who were classified as *non-believers* tended to:

- Strongly question the existence of human-induced climate change and therefore did not feel there was much that could/should be done

#### **Box 2.**

##### **Quotes from interviewees who did not believe climate change was real**

I don’t believe in it ... it’s only nature doing its thing ... Yeah I think there’s a shift in our seasons ... our rainfall, [its] not as much as it should be ... they mean that we’re affecting the climate ... that the human race is affecting climate change and polluting everything ... but I think it’s all political and people are making money out of it. To me it’s [climate change information] is confusing and because it’s confusing – it’s not convincing (Eskdale 1)

Well I have got my own opinion about climate change. I honestly don’t think there is a climate change – just a big drought ... the term climate change is only two year’s old virtually. Where people talk about it was drought then, when Ruddy came in they changed it to climate change ... because Ruddy doesn’t want to have to pay farmers you know a subsidy or whatever in relation to drought assistance ... You don’t hear the word climate change assistance. Drought assistance is virtually gone ... so that’s just terminology change that’s all ... because everything is fine and lush here at the moment (Eskdale 12)

Climate has been changing ever since God put us on this earth ... it’s just speeded up a little bit these last few years, simple as that. I think most of it is evolution, times change. At least [for the last] 35 years it has started to dry out. The area here has not got the rain we used to get so it’s progressively got worse ... scientists bring out what they think in the first place ... I just don’t trust them ... there are just too many differing, strong differing opinions on climate change ... one guy on the tellie telling you its the solar heat off the sun and he is a scientist, the next one will say it’s the carbon we are putting up, and another one tells it’s a lot of bull it’s something else – the scientists have not been nailing what’s happening, because they have too many different ideas on it .... to me if they all said yes: ‘that’s right’, I would believe them. (Eskdale 15)

I don’t think it’s global warming ... so whether it has something to do with altering of the earth’s position. I heard it said that the earth does get a 10 degree wobble up as it spins – but this seems to be permanent ... the earth has shifted, at least 10 degrees. Well that’s all I can say that’s its caused the lower rainfall, affected our weather. (Chiltern 8)

It’s changing in hundreds of year’s cycles and now I believe we have the worst drought on record which is only two hundred years really... I believe we’re in a bloody good drought now and have been over a series of years but I think it’s been far too much politicized with no benefit coming out of it I don’t think. (Chiltern 12)

- to reverse such effects);
- Referred to themselves as ‘sceptics’ and had strong negative views about vested interests of climate change believers and the credibility of their information; and/or
- Noticed some climatic shifts and attributed them to a ‘natural’ cycle [see Table 4.2, Box 2]. Interviewees whose views were classified as

Table 4.2: Interviewee responses to questions about climate change

| Chiltern   |  |  | Eskdale   |   |   |
|--|--|--|---|---|---|
| Non-believers  | Unsure   | Believers  | Non-believers   | Unsure  | Believers   |
| <i>General</i>   |  |  | <i>General</i>  |   |   |
| Refer to self as 'sceptic'<br>Perceive vested interests<br>Climate always 'changing'   | Refer to self as 'sceptic'<br>Acknowledgement of or reference to air pollution, CO <sub>2</sub> , ice melts, increased temperatures<br>Perceived political dimension | Evidence = indisputable: warming of the earth due to burning of fossil fuels   | Strongly question permanent change caused by people<br>Perceive vested interests        | Confusion over scientific disagreement  | Stronger belief by wives<br>Concern about scientific disagreement w/ some confusion also                                    |
| <i>Types of 'change' observed</i>  |  |  | <i>Types of 'change' observed</i>   |   |   |
| Less & less reliable rainfall, more heat, increased storms   | Less & less reliable rainfall, increased heat, fewer frosts, loss of floods  | Lower rainfall & humidity, increased temperatures, increased fire risk, groundwater depletion,   | Seems hotter & drier  | Less rainfall, warmer winters, shifting seasons, no floods                          | Worsening fire seasons, higher winds, increased temperatures, reduced rainfall  |
| <i>Causes</i>  |  |  | <i>Causes</i>   |   |   |
| 'Change' is natural  | Heard of air pollution & unsure of significance<br>Wonder about effects from 'natural' cycles & events (volcanoes, droughts)   | Human-induced – carbon emissions   | Air pollution alleged cause but not significant<br>'Changes' = natural                  | Air pollution (cities, cars, airplanes) a problem, but not sure a 'cause'           | No clear statements detected  |
| <i>Links to drought</i>  |  |  | <i>Links to drought</i>   |   |   |
| No link to drought   | Notice shorter time between droughts, might be natural cycle   | Some unsure<br>Others see movement of drought east & longer duration as symptom  | Some unsure<br>Others foresee return to wetter conditions (natural cycle)               | No – maybe CC is about permanent change, drought happens regularly but infrequently | A worsening drought, which is a climate change symptom  |
| <i>Consequences</i>  |  |  | <i>Consequences</i>   |   |   |
| Higher fire risk<br>Changed farming practices (difficulty est'g winter pastures, more hand feeding of stock, discontinuation of certain crops) | No clear statements detected   | Increased difficulties of farming: est'g & maintain trees & crops due to less water, higher fire risk, lower production & viability levels, reduced family succession, rural/ regional decline | No clear statements offered   | Drier soils & waterways<br>More people leaving farming                              | Difficulties for farming & impact on livelihoods: less water, lower feed<br>Hard to fathom                                  |
| <i>Action required? (mitigation or adaptation?)</i>  |  |  | <i>Action required? (mitigation or adaptation?)</i>                                     |   |   |
| More dams<br>Not much to do as not caused by people  | Possibly greater use of alternative energy, perennial pastures   | Individuals & society reduce carbon emissions (e.g. nuclear power, food production localised, water efficiency, reduced car usage)   | Not much can be done<br>Maybe reduce car & airplane usage, increase wind & solar energy | Tentatively suggest reduce pollution from cars & airplanes & plant more trees       | Reduce household energy & water usage<br>Reduce carbon outputs by using nuclear, LPG & solar energy sources, planting trees |

'**unsure**' talked about:

- Occasionally referred to being 'sceptical' about climate change;
- Openly expressed some concern and/or confusion about the "politics" of or scientific disagreement about climate change;
- Acknowledged or made some reference to human causes of climate change – generally air pollution from cars and planes, and made tentative suggestions that mitigation would involve reducing that pollution, but did not accept that livestock contributed to 'emissions';
- Were unsure about 'natural' causes of climate change and the link between climate change and drought (see Table 4.2 & Box 3).

Interviewees whose views fell into the '**believer**' grouping generally:

- Found the evidence for climate change to be credible, with a few interviewees talking about feeling confused over some of the technical aspects of the phenomena;
- Believed climate change was induced by human actions;
- Said that drought was worsening and this shift was a symptom of climate change; and/or
- Observed more and more subtle shifts in climatic and weather patterns [see Table 4.2 and Box 4].

#### *Utility of belief typologies*

Grouping the interviewees' beliefs about climate change into typologies, such as 'believer', 'non-believers' and those who seem 'unsure or unclear' can help highlight some of the differences in people's understanding and acceptance of the phenomenon. However, typologies may not always be exhaustively descriptive of the population under consideration and using them exclusively can risk missing other important details. In addition to being able to highlight differences in views about climate change, patterns of *similarity* were detected across the three typologies, between non-believers and unsure interviewees, and between unsure interviewees and believers. For example, all interviewees:

- Observed some changes in climatic and weather patterns in recent times (with believers consistently attributing those shifts to climate change) ([see Table 4.2]; and
- Identified increasing future obstacles for farming productivity should those patterns persist [see Box 5].

The similarities between **non-believers** and **unsure** interviewees included:

- Sometimes referring to themselves as sceptics;

#### **Box 3.**

##### **Quotes from interviewees who were unsure about the existence of climate change**

[Climate change] – is it human induced? That's a question I can't definitively answer ... I'm sceptical about some things .... but ... you see the amount of pollution in the world and the carbon in the atmosphere in some countries ... you can't see the sun and the sky and you think – well hey that's not good ... so I'm not in favour of polluting the air .... so anything that can be done to prevent that sort of pollution I think is great ... I've been involved in local politics ... there's always a political attachment to climate change and that disturbs me, because out of politics you don't always get truth ... you get people who have different agendas ... I nearly tend to think that some environmental [issues] for some people are nearly replacing a religion ... I read a book one time [that] impressed me – the Territorial Imperative ... man has always had tribal relationships ... [we] get locked into them or us conflicts and it will never go away ... environmentalism – we all want a better environment, but different people go about it differently and then it becomes a 'then and us' political tool."(Chiltern 11)

I...don't know whether to believe in it or not ... but I do know that the climate has changed from when I was a child ... when we had our droughts ... the Albury show used to be on in September and all the young kids going to show would get new summer dresses. Now Albury has shifted their show to November because it had been so wet in September and October ... I think they mean that our climate is changing that it's getting...well I think it's getting hotter in the summer and we are not getting the rain but what we find here is the wind. ... [maybe its] too much carbon dioxide in the air ... they think it's going to keep getting hotter and dryer and nastier (Chiltern 9)

Well I think we know that climate always changes. There has certainly been a drought in the last 10 to 12 years, our rainfall has dropped dramatically. What the reason is I don't hazard to guess. Is it man made, is it a natural cycle? Because I know there [have] been 10 year droughts before ... I don't know. ... we're sceptical because so much other government information is wrong so we don't believe much of it ... already the rules and regulations are so onerous that people just either throw up their hands in horror and just go about things and do it anyway whether they are breaking rules or whatever ... I know a lot of farmers are worried that the government will jump on the bandwagon and bring in carbon credits, and we know that will be difficult for farmers to cope with. (Eskdale 3)

We don't know what to believe ... we have not been getting rain lately. [There are] 21 scientists who think 'climate change' is a whole lot of "hoo-ha". [We have heard] about Iceland melting ... there have been dry periods in times gone by ... we wonder if its all just part of a [natural] cycle. Indigo Jones' forecasting says the dry is only meant to last another year. (Eskdale 7)

**Box 4.****Quotes from Interviewees who believed climate change was real**

(Husband) I think it covers a fairly broad spectrum of things, you know you have to look at all the ice melting and they are certainly getting figures out of that ... and the sea rising ... but on a local level the seasons have changed. I don't think you can deny that there is not something happening. Why it stays so dry. Whether it's cyclic I don't know. But the seasons have definitely changed. Why well that's, I am not a scientist ... I think to me drought is a specific aspect to the whole climate change topic and drought really relates often to the farming community whereas climate change is everybody ... I believe [they are] interrelated somehow ... one goes with the other ... (Wife) I was in a project with our group about climate change, and we produced a big paper of all the little things you could do around the house and all of that ... turning off equipment, saving water and just [being] more thoughtful ... that can become apart of your lifestyle (Eskdale 6B)

I just know the last year in the fire seasons were horrendous and it seems to be every summer it's getting hotter, dryer and windier. Especially the last two seasons we seem to be getting more wind and more dry wind, windier and it's turned around and coming from the south. The temperatures has changed, it's simply hotter. Our winter pattern where we used to get good rain early we don't seem to be getting that rain anymore ... definitely climate change, definitely. I mean 47 degrees in Victoria last summer in Geelong I think it was – that's a desert. So that's undeniable but as to the reasons I have no idea because scientists don't agree on that either (Eskdale 5 believer)

I think the winters here certainly aren't as cold as what they were and ... certainly the rainfall has dropped away ... you're probably pretty stupid if you don't think things are getting on the drier side ... some farmers sort of say it could be a cycle – you know ten years. Its a huge concern to me, because in Australia a lot of people are pretty negligent ... fossil fuels getting burnt in places like Europe and China ... people here forget that over there you can't see three meters in front of you because there's that much crap going up into the sky ... the huge consumption of fossil fuels, electricity is probably the greatest demise of the world really as far as global heating goes. (Chiltern 2 believer)

Yes, yes definitely and we believe 100% in it and it's purely man putting a lot of carbon into the atmosphere. It's acting like a blanket – it's creating a greenhouse situation and world wide it does create more rain but unfortunately that rain falls over the sea. It's also causing changing patterns, in some places they are getting more rain, and unfortunately we are in one of the places where we are getting less. (Chiltern 14 believer)

The phenomena is like the amount of carbon in the atmosphere the hole in the ozone layer those.....yeah it's causing the changes in the weather....the melting of the ice caps and glaciers and all those sort of things, it's just altering things..... they say the sea level is going to rise a certain amount ... it's got to be having an effect, yes there's climate change, I believe there's climate change ... I know that dryness wise it's not good ... they said for a start that climate change was going to give us a lot more rain like all this extra carbon in the air was going to make it go back to that sort of thing but it's gone the opposite hasn't it just about you get more severe storms but definitely not more rain. ... I'd say a fair bit of it is natural and we're having an influence on it ... probably is being speeded up by the human race. (Chiltern 16 believer)

**Box 5.****Interviewees noticing changes in weather/ climate & seeing difficulties for farming**

When we first come home 20 yrs ago now, our Autumn break would come say middle of March, at the latest early June and now we really don't get any rain until May ... Yes the rain has been coming later yep and that's well my opinion is I don't think it is climate change I think it's a long drought ... you can't get worse than what we've had ... I'm not in a situation where I could just get up and go but if there is no water, if there is no food what are you going to feed the animals (Eskdale 12 – non believer)

Well I think it's going to get hotter. Going to get dryer ah... probably colder in winter ah... hotter in summer and colder in winter and dry throughout the year. Ah...probably the deserts are increasing. I used to do a lot of work at the top end of NSW in the marginal country around Tippaburra and I notice there that it gets or is getting more and more, or it's getting harder and harder to farm, if you like. The people used to run thousands of sheep and now virtually are out of sheep because they can't utilise the land. So whether that is all part of a cycle, I don't know, but I have noticed that over the last 10 years. So it is definitely increasing more rapidly than the previous 10 yrs. (Ch 15- unsure)

Certainly we've been affected by climate change, summer is getting hotter, our winter rainfall has disappeared, our spring rainfall is starting to disappear, we had two springs in the last 8 years where nobody cut any hay and that's completely unprecedented ... so we have lowered our stocking rate. We are putting more time and effort in reducing fuel load, particularly in our forested areas. (Chiltern 14 – believer)

**Box 6.**

**Quotes illustrating similarities between non believers and unsure interviewees**

I don't believe in it ... it's only nature doing its thing ... Yeah I think there's a shift in our seasons ... our rainfall, [its] not as much as it should be ... they mean that we're affecting the climate ... that the human race is affecting climate change and polluting everything ... but I think it's all political and people are making money out of it. To me it's [climate change information] is confusing and because it's confusing – it's not convincing (Eskdale 1)

Well I think we know that climate always changes. There has certainly been a drought in the last 10 to 12 years, our rainfall has dropped dramatically. What the reason is I don't hazard to guess. Is it man made, is it a natural cycle? Because I know there [have] been 10 year droughts before ... I don't know. ... we're sceptical because so much other government information is wrong so we don't believe much of it ... (Eskdale 3)

**Unsure** interviewees and **believers** alike:

- Expressed some confusion about the scientific facts of climate change, however unsure interviewees were consistently more tentative about climate change's existence; and
- Spoke about the human causes of climate change – and similar to above, unsure interviewees were less sure about these factors [see Box 7].

**Box 7.**

**Quotes illustrating similarities between unsure & believer interviewees**

The phenomena is like the amount of carbon in the atmosphere the hole in the ozone layer those.....yeah it's causing the changes in the weather....the melting of the ice caps and glaciers and all those sort of things ... yes there's climate change, I believe there's climate change ... I'd say a fair bit of it is natural and we're having an influence on it ... it is being speeded up by the human race. (Chiltern 16 – believer)

... I've talked other people about it ... [I] tend to see it as a natural cycle ... I remembered my grandfather talking about cycles [of wet and dry]. But I don't get into it all that much ... [I guess] there is a natural cycle and people do have an impact on it, through things like overpopulation ... we have to be wary of what we put into the earth, like pollution from cars, and [we should] be more 'green' and reduce emissions ... [but I] don't understand it fully. (Eskdale 10 – unsure)

*Other findings*

Figure 4 shows the classification of respondents according to their belief in climate change and the case study area. The chart illustrates that:

- across both case studies, there were more interviewees who did *not* believe in climate change than those who did or were unsure;
- more interviewees who believed in climate

change were detected in the Chiltern Case Study than in the Eskdale Case Study; and

- interviewees who were unsure in the Chiltern Case Study leaned more towards not believing in climate change than did the unsure interviewees in the Eskdale Case Study.

**Responses to formal climate projections**

After asking interviewees about their experiences of the dry, their views on 'climate change' – the research team sought to understand landholders' level of awareness of, and types of responses to, specific climate change information. Interviewees were asked if they were familiar with CSIRO/DSE's projections of climate change impacts on south-eastern Australia and what they thought about the projections. They were also asked about the kind of effects they thought those projections might have, as well as how likely and significant those risks might be. Table 3 lists the projections that were shown to most of the interviewees. When examining the information, interviewees paid varying degrees of attention to the specifics of the projections and therefore their comments contained different degrees of specificity.

*Table 4.3: Climate projections/scenario for north-east Victoria*

**Climate change projection/scenario for north-east Victoria**

1. Hotter/drier summers with more days over 40° C
2. Droughts likely to become longer, more frequent & more intense
3. Rainfall will continue to be variable – but expected to be variable around a lower annual average
4. Extreme daily rainfall events likely to become more intense
5. Runoff into Upper Murray, Kiewa, & Ovens Rivers expected to decrease by between 5% and more than 50% by 2070
6. Increased number of very high and extreme fire-weather risk days.  
(Department of Sustainability and Environment website)

Table 4.4 shows interviewees' responses to the climate projections. The interviewees classified as **non believers** typically questioned the information shown to them, and were particularly sceptical of those projections relating to worsening drought, hotter summers, and decreased run-off [see Box 8].

When discussing possible consequences, these interviewees talked to things that might result from an on-going drying trend or a longer-than-expected drought rather than 'climate change' per se, and they did not feel that either an extended drought or climate change were very likely to occur (e.g. the drought would eventually break and probably sooner rather than later).

Most of the interviewees who were **unsure** tentatively agreed with the projections [see Table 4.4 and Box 9], while others questioned the projections relating to hotter summers, increased fire risks, hotter temperatures, or decreased run-off. These interviewees tended to be unsure about the likelihood of any of the projections being realised and exhibited mixed levels of concern about them.

The **believers** typically accepted the DSE and CSIRO information about climate change, often feeling that the projections were highly likely to come to fruition [see Table 4.4 and Box 10]. In some cases, interviewees referred to particular projections already being realised. The believers also generally exhibited a higher level of concern about the consequences of the climate change projections than the non-believers or the interviewees who were unsure about climate change.

There were slight differences between the way that Eskdale and Chiltern interviewees responded to the climate projections [see Table 4.4]. The projections of higher fire risk were questioned by some Eskdale **non-believers**, but not by any Chiltern interviewees. The data revealed that some non-believers thought that farming practices might change if the projections were realised, while the Chiltern non-believers talked about the possibility of decreased land values and exits from farming. For interviewees who were **unsure** about climate change, there was a higher concern by Eskdale interviewees about the projections being realised than among their Chiltern counterparts. Eskdale interviewees who **believed** in climate change spoke about possible changes to farm practices and increased conflicts over water as possible climate change consequences, neither of which were mentioned by the Chiltern believers. There was greater variation in the degree of concern among climate change believers in the Chiltern case, while those from the Eskdale case spoke about being very worried.

Overall, the data suggests strong similarities in the way that interviewees from the two case study

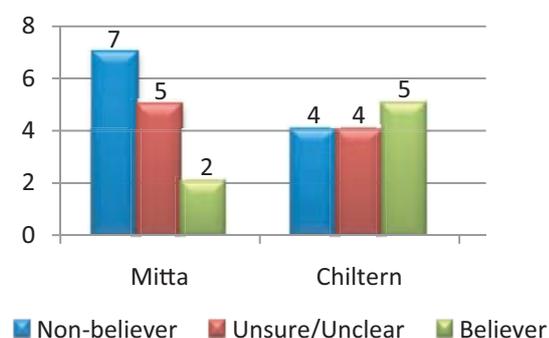


Figure 4. Case study interviewees' belief in climate change.

areas responded to the climate projections [see Table 4.3]. None of the interviewees had seen the specific information from the DSE/CSIRO projections before. Several interviewees had heard of "similar" or more general predictions that climate change would bring warmer and drier conditions to the south-east of Australia. And it was typical for the interviewees to believe that either the realisation of the climate change projections or an extended drought would bring increased hardship to farmers seeking to run productive businesses.

### Influences on climate change beliefs

After exploring interviewees' beliefs about climate change, interviewees were asked about what helped to shape those views. Most of the interviewees felt their views (about 'climate change', climate and farming) were largely informed by their:

- personal experiences and observations from working the land (e.g. noticing and living with drier times); and
- social and professional networks (e.g. family, other farmers, commodity groups, farm advisors).

Interviewees also spoke (prompted and unprompted) about the type and quality of information they were exposed to in relation to climate change.

Interviewees who were **unsure** or were **non-believers** (Eskdale – 2, 6-9, 13, 15; Chiltern 1,6,8,12,15,11,9,4) felt that their conversations with other farmers tended not to be about climate change per se, rather they talked about drought and water shortages and/or about commodity prices, stock health, etc. For example, one Chiltern interviewee said:

I doubt whether you'd find farmers who are talking about [climate change] like we are now ... the real issue of climate change ... it's either a bit of a joking about what's going on ... [or we say] if they're fair dinkum about [climate change] why don't they do [more] about it ... [farmers] they're all sceptical I suppose.(6)

Conversely, some interviewees who spoke specifically about talking and learning about climate change (Eskdale – 3, 6, 10) through their social or professional networks, were unsure about or believed in climate change.

Interviewees were exposed to climate change information from a range of other sources (print and electronic media, radio, the Internet). While there were no readily discernable patterns of similarity or difference among the interviewees' **preferred information sources**, there was a consistent concern exhibited by non-believers across the two case studies [see Box 11] about the **quality of**

Table 4.4: Interviewee responses to formal climate change projections

|                               | <b>Responses to projection</b>   | <b>Consequences considered</b>   | <b>Perceived likelihood of projections being realised</b> | <b>Degree of concern</b>                                      |
|-------------------------------|--|--|---|---|
| <b>Eskdale Non-believers</b>  | Questioned much of the information, including worsening drought, hotter days, higher fire risk           | Greater difficulty farming<br>Lower productivity (higher input costs, reduced stock numbers)<br>Trigger practice change  | Low   | Not serious enough to worry too much                          |
| <b>Chiltern Non-believers</b> | Believed in hotter summers, variable rainfall, extreme rain events, decreased run-off                    | Decreased land values, reduced farm productivity, increased rate of exit   | Low   | Generally not worried*  |
| <b>Eskdale Unsure</b>         | Some agreement with projections<br>Questioning of hotter summers, increased fire risk, worsening drought | Increased difficulty farming (less water, increased costs, lower stock levels, selling of land)<br>Changed practices   | Unsure  | “Wait & see” + some-high worry                                |
| <b>Chiltern Unsure</b>        | Some agreement, some disagreement<br>Questioning of decreased run-off & more extreme heat                | Increased difficulty farming (lower productivity, higher fire risk)  | Unsure, maybe happening now                               | Mixed   |
| <b>Eskdale Believers**</b>    | Acceptance of hotter & drier region  | Having to change practices (reduced tree planting, stock rates)<br>Increased conflict<br>Reduced property values<br>Need for more shelter, greater water storage | Very likely, some of it happening now                     | High incidence of worrying                                    |
| <b>Chiltern Believers</b>     | Generally acceptance + seeing evidence   | Increased incidence of bushfires, extreme heat damaging infrastructure & crops<br>Loss of income   | Very likely, already happening                            | Wide range: ‘take it as it comes’ – concern – extreme concern |

**Box 8.**

**Quotes from ‘non believer’ interviewees in response to official climate change projections for south-east Australia**

Droughts to become longer, more frequent and more intense? ... I don’t believe that ... Fire – each summer there is a major fire... hot dry summer days over 40 degrees Celsius ... yes well there has been a pattern for the last several years ... and I think the number of over 40 degree days has been high over the last few years. [But], in my opinion I don’t think it will continue especially if we get better winters, [or] more broader rainfall throughout Australia ... especially South Australia – that’s where a lot of our weather comes from. To have more frequent or more intense droughts ... you can’t get worse than what we have had (Eskdale 12)

... I think its going to rain again. Wouldn’t surprise me if it didn’t. If it stayed dry ... but I think it will rain again. I think it will change round, come back again. (Eskdale 15)

Hotter days ... We never had it here. It got up into the 90’s but not over the 100 ... worse droughts? ... That’s what they are saying ... whether that happens it will be hard to say ... More fire risk? ... that is [more about] bad management. Like these fires we had last year over in Mansfield and all that, that shouldn’t have happened ... that bush wasn’t burned since ‘65. That’s just ridiculous there would be that much rubbish on the floor of the bush (Eskdale 13)

Extreme daily rainfall events become more intense ... runoff from the Murray Ovens Kiewa Ovens river expected to decrease ... if you saw what went on here at Easter time that’s typical reversal [of that] ... if you’re going to have more intense rainfall you’re going to get more runoff.... To me it isn’t what really happens. Hotter and drier summers? I can remember going to school and god almighty at 105 I think it was we had to go home ... I really think they’re [CSIRO] trying to reinvent the wheel. (Chiltern 2)

I remember when I was going to school here we had weeks on weeks of 40 degrees or dam hot weather – 100 degrees – where later years we haven’t been having such a .... So it’s only gone back – just a cycle. Number 4 – extreme daily rainfall events likely to become more intense – well I don’t know if that’s going to happen because they have been forecasting 30/40 ml of rain for us and we get 3 to 5. I don’t think that will happen (Chiltern 8)

**information** on climate change. Several Eskdale interviewees (1, 9, 12–14) talked about how difficult it was to discern the ‘truth’ of a lot of the climate change information they heard in the news (radio, television, newspapers). They found the information confusing and/or felt sceptical about the motivations of those disseminating the information (e.g. politicians, journalists, scientists) – speculating that those who believed in and were promoting ‘climate change’ had something to gain (financially) by doing so. Similarly, two Chiltern ‘non believers’ expressed their cynicism or mistrust about weather forecasts, Al Gore, and the media. They were frustrated by what they perceived to be hypocrisy and a high level of disagreement among climate change scientists, and characterised some of the dialogue about climate change as “mass hysteria”.

**Box 9.**

**Quotes from ‘unsure’ interviewees in response to official climate change projections for south-east Australia**

*I agree with most of that ... I think a lot of it is happening ... here’s one major impact and this is relating to these high fire weather risk days and how that’s affecting on the communities ... that’s major ... I’ve got no doubt about that and one would hope that personally we don’t get burnt out, but there’s a higher risk of that happening (Chiltern 11)*

And yet you know in the last 3 months we have had projections saying that the Japanese weather forecasters are saying that we are going to have a very wet spring and then within 2 months they have now said no El Niño is back and we are going to have another dry spell. These are the experts giving us the data, who do you believe. I don’t think they know. Do you ever go by what the weather forecasters are saying – they are not often right. I mean they can’t predict what’s happening in a week how are they going to predict what’s happening in a year (Eskdale 3 e)

... run off in the upper Murray, Kiewa and Ovens Rivers expected to decrease – well in that case why have they got the flood warning? Extreme fire – yes I can understand that – that worries me ... it’s quite possible we are going to get extreme heat but then it might go for 2 or 3 year’s and it might cool down again, who knows, we don’t know. I mean one minute they say there is an El Niño then they say there’s not, we don’t know what that’s doing either. (Chiltern 4)

**Box 10.**

**Quotes from ‘believer’ interviewees in response to official climate change projections for south-east Australia**

Yes this is exactly what we have been seeing ... they are all happening now ... with run off, if you have as little as 10% reduction in rainfall that can be a 50% reduction in run off ... it used to be in the winter time you might use 90% or your rainfall to get to a saturation level ... and the final 10% of your rainfall is pure run off. [But] if you have 10% less rainfall and in particular, if not in the winter time, all of a sudden you might find you have virtually no run-off with a small reduction in average rainfall ... even at the moment with all the rain ... devastating bushfires will wipe people out – people who don’t have insurance and who are already in financial dire straits, it will put them to the wall. .... we try and keep the area around the house green to try and protect the house. We don’t have many eucalypts that close to the house ... [risk of] fires are pretty serious, extremely serious (Chiltern 14)

I’ve heard and when you read that that’s the way it isn’t it there’s not one line there that you can say that’s crap because it’s dead bloody right now ... extreme daily rainfall is going to become more intense ... it all comes down to your income once your income dissipates like a drying puddle you’re out it’s as simple as that ... All those things on that line don’t do anything for your income if you burn out with hot weather or storm or hail or whatever that knocks your income around so all it does.... (Chiltern 2)

The projections are [that] we are going to be hotter and dryer and our rainfall patterns are going to be completely changing ... I hope it’s not true. ... I think at the moment [the projections coming true] are very likely ... you can’t wear blinkers. They have been fairly close this year to what they said. (Eskdale 5r)

**Box 11.**

**Interviewees’ (who did not believe in climate change) views on the credibility of climate change information**

I just don’t trust them ... I think its whatever they feel like putting out there ... politicians today tell you what they want you to hear not what you need to know ... no one is held accountable for what they say anymore. (Eskdale 14r)

[The information] ... I think its a bit over the top in places. There’s more on the news everyday or in the paper ... I get sick of listening to it ... where people seem to be promoting it ... Al Gore was promoting it, he was trying to push it down everyone’s throats all over the world. (Eskdale 1)

You can’t rely on weather forecasts or anything like that these days ... Al Gore, he’s pretty hypocritical, he flies around the globe using up more energy than anybody else, then tries to preach to you that you shouldn’t do it ... so I take [information about climate change] with a grain of salt.

We get bombarded with it on the news, radio, TV, papers ... I don’t think it’s based on any real accuracy [and] you hear different news from different people, even scientists – some say ‘yeah’, some say ‘nay’. (Chiltern 12)

In the Chiltern case study, with the exception of one interviewee who was 'unsure' about climate change, most of the 'believers' described themselves as proactively seeking out information about climate change. Some of their most important information sources included the work of Tim Flannery and Al Gore, the Discovery Channel, and some website devoted to climate change issues.

### Rural landholders' responses to climatic conditions – adaptive capacity and adaptations

*Adaptations* are the particular adjustments or practices, which industries, communities, and landholders make or use in response to current and potential climate change impacts. Those choices are informed by communities' and individuals' *capacity to adapt* to climate change. As noted earlier [see Chapter 1], that capacity is driven or impeded by the interaction of people's individual characteristics, their access to a range of resources, the characteristics of particular actions or practices they undertaken, and their broader operating environment.

The following material examines both particular *adaptations* rural landholders have been making (and are planning to make) in response to climate change and/or drought, as well as landholders' views about what has and might continue to affect their *capacity to adapt* to difficult climatic conditions

in the future. Interviewees were asked about:

- the management actions they had taken to cope with "the dry";
- if they were unsure about or did not believe in climate change – any actions they were taking to prepare for the possibility that "the dry" might continue;
- if they believed in climate change – any actions they were taking to prepare for future climate change;
- any actions they would like to take to prepare for the future, but have not yet done so;
- what factors influenced their property management; and
- how well prepared they felt for the future.

### Managing in the current dry

Figure 5 shows the actions interviewees talked about when asked how they were managing in the current dry conditions. These actions were classified manually by using inductive analysis of the patterns that emerged from the interview data.

On average, interviewees reported taking about four different kinds of actions, with some reporting on as few as a single management activity, and others as many as five to six separate activities. The most common actions undertaken by interviewees were to reduce stock numbers, undertake pasture renovation/strategic cropping, and to increase water capture and storage. The category 'pasture

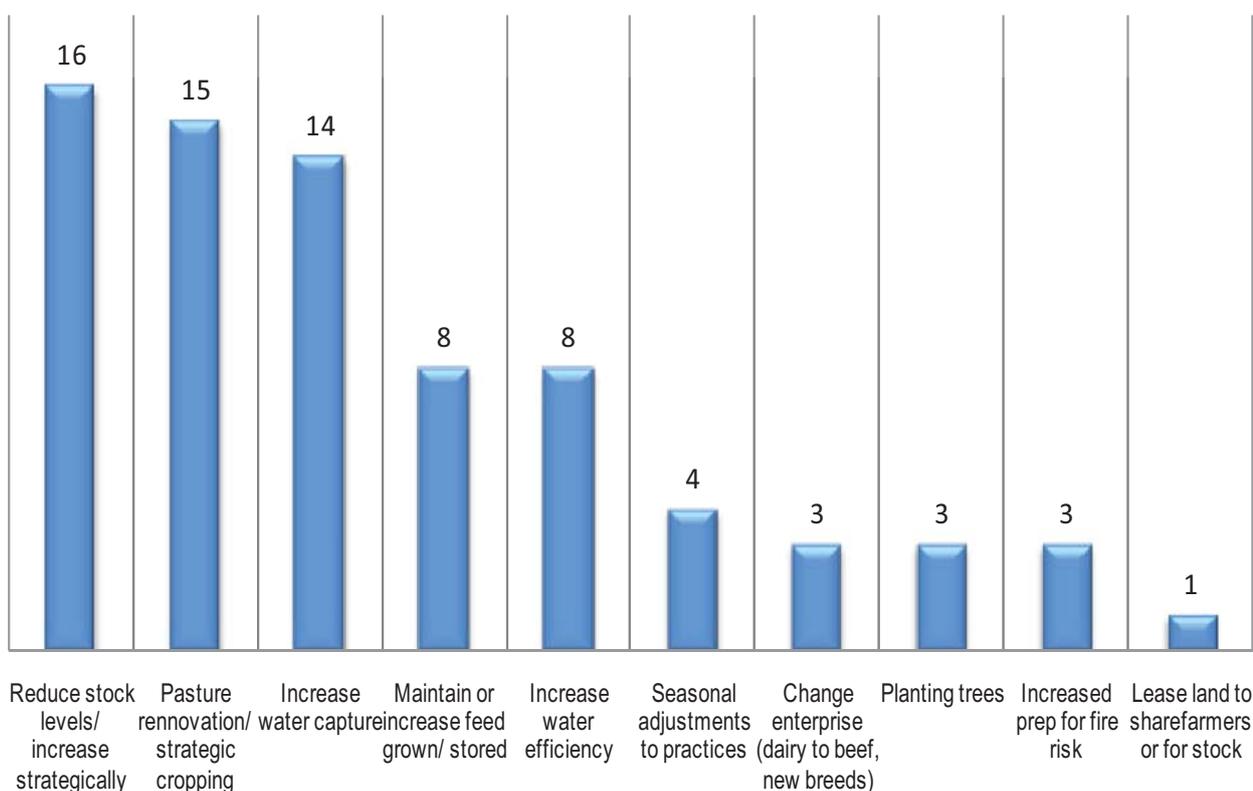


Figure 5. Activities to manage the current dry.

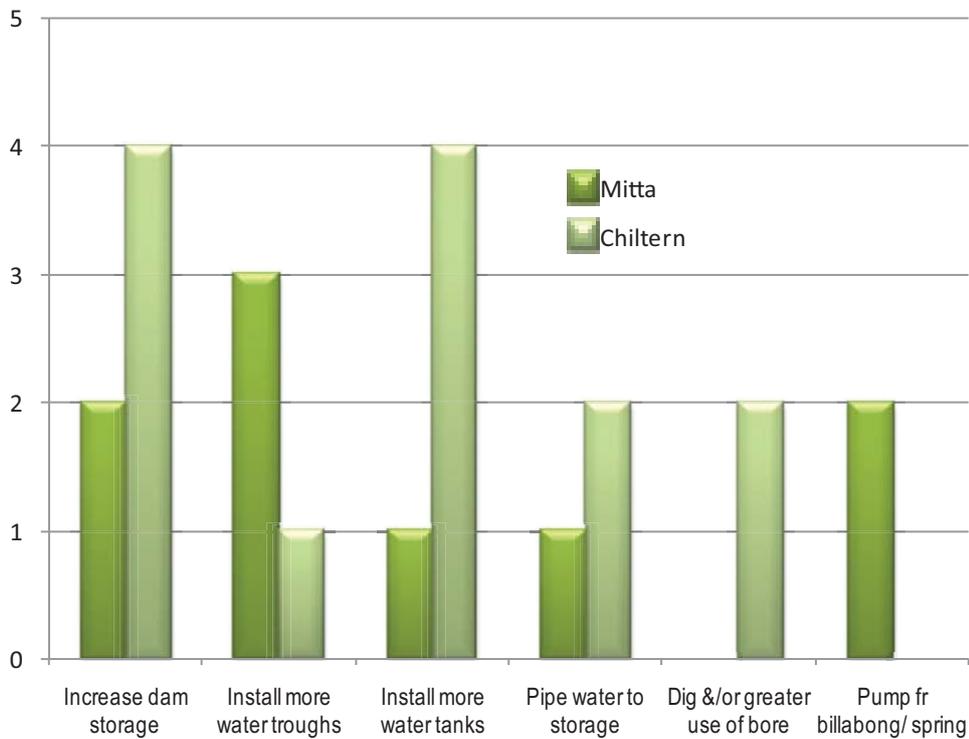


Figure 6. Techniques to increase water storage capacity.

renovation/strategic cropping' shown in Figure 5 included actions such as, over-sowing with rye or oats, planting perennials, making a shift towards dry-land farming, conducting regular soil testing and/or other practices.

The most commonly mentioned techniques were increasing dam storage, water troughs, and water tanks. It was also relatively common for interviewees to talk about trying to build up their feed reserves in order to avoid the expense of purchasing feed for their stock and to increase water efficiencies. A variety of techniques for capturing and storing water were also frequently mentioned [see Figure 6].

There was not much difference in the average number of actions interviewees had taken in preparing either for 'climate change' or for the possibility of an extended dry/drought (see Figure 2) between those who held different beliefs about climate change. **Unsure** interviewees reported on slightly fewer actions (.6) taken compared to **believers** (1.6) and **non believers** (1.2).

There were also similarities in the actions that believers, unsure interviewees, and non believers spoke about taking. For example, interviewee in all groups seemed to be storing stock feed, making seasonal adjustments to their practices, and

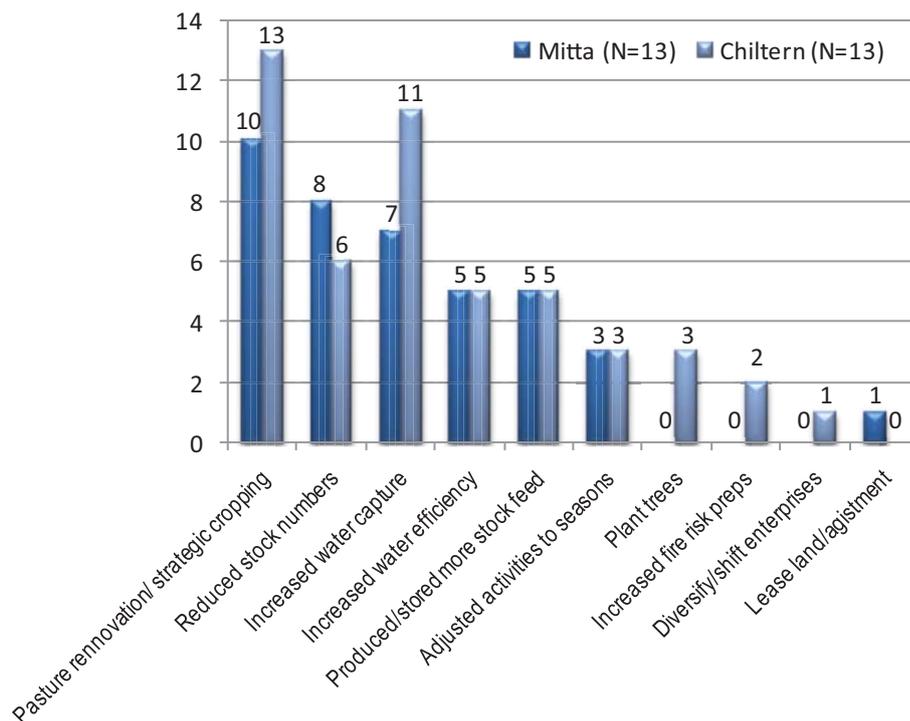


Figure 7. Case study area & actions to manage current dry.

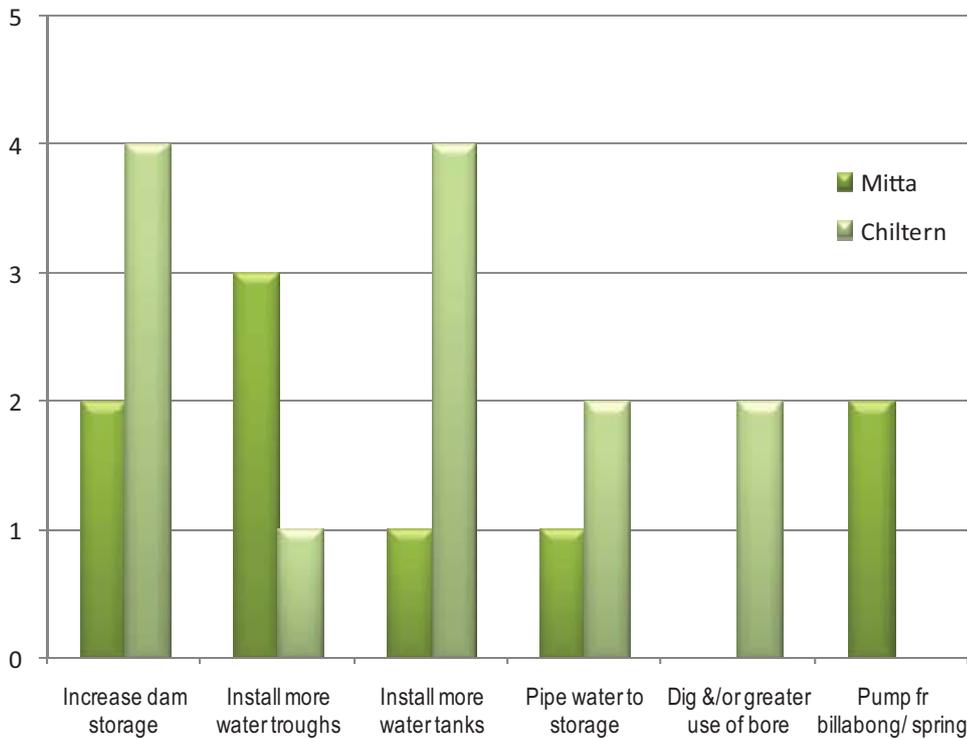


Figure 8. Case study are and current actions to increase water storage

increasing their water storage capacity.

Figures 7 and 8 show there were a few differences in the actions taken by Eskdale and Chiltern case study interviewees. There were more Chiltern interviewees who reported increasing their water capture activities than Eskdale respondents. These Chiltern interviewees talked more about increasing their dam storage, water tanks and bore usage,

while the Eskdale interviewees more often talked about using their billabongs/springs and installing more water troughs. Figure 7 also shows that only interviewees from the Chiltern Case Study spoke directly about planting trees and/or taking extra bushfire preparations.

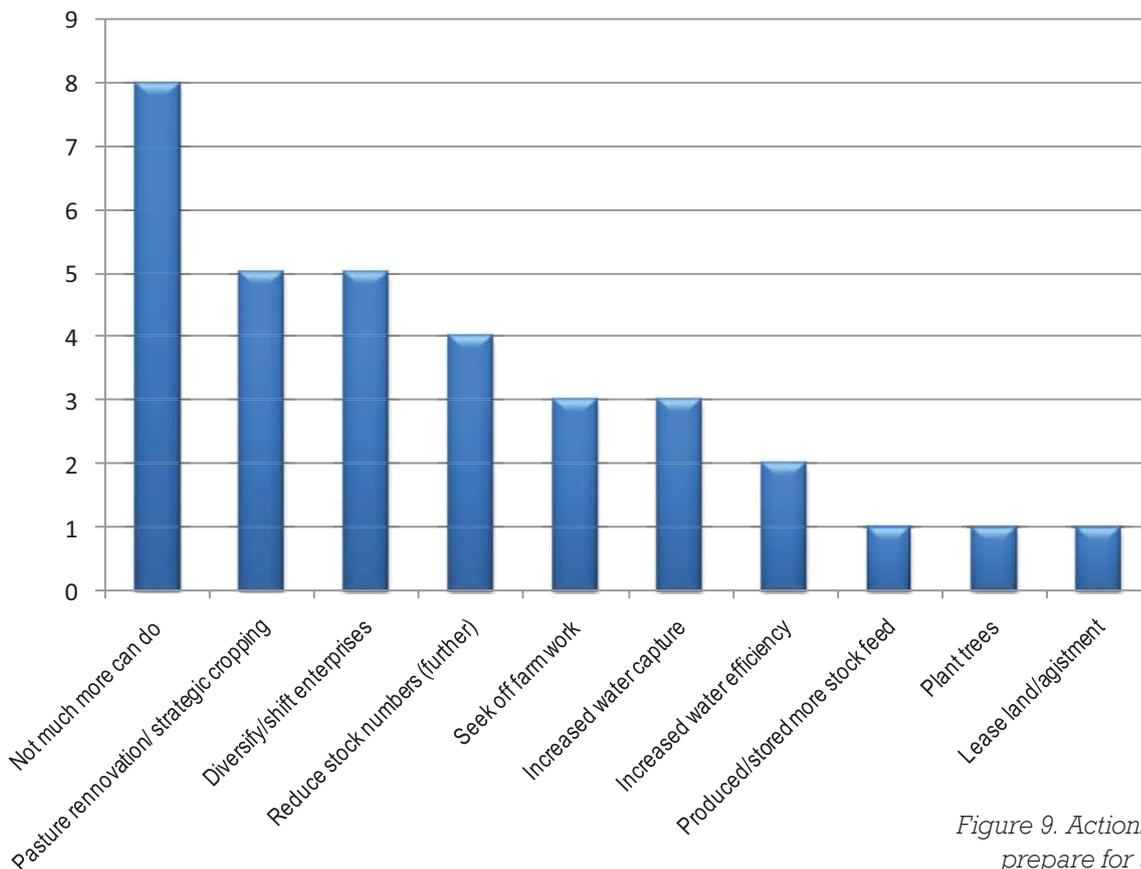


Figure 9. Actions taken to prepare for the future

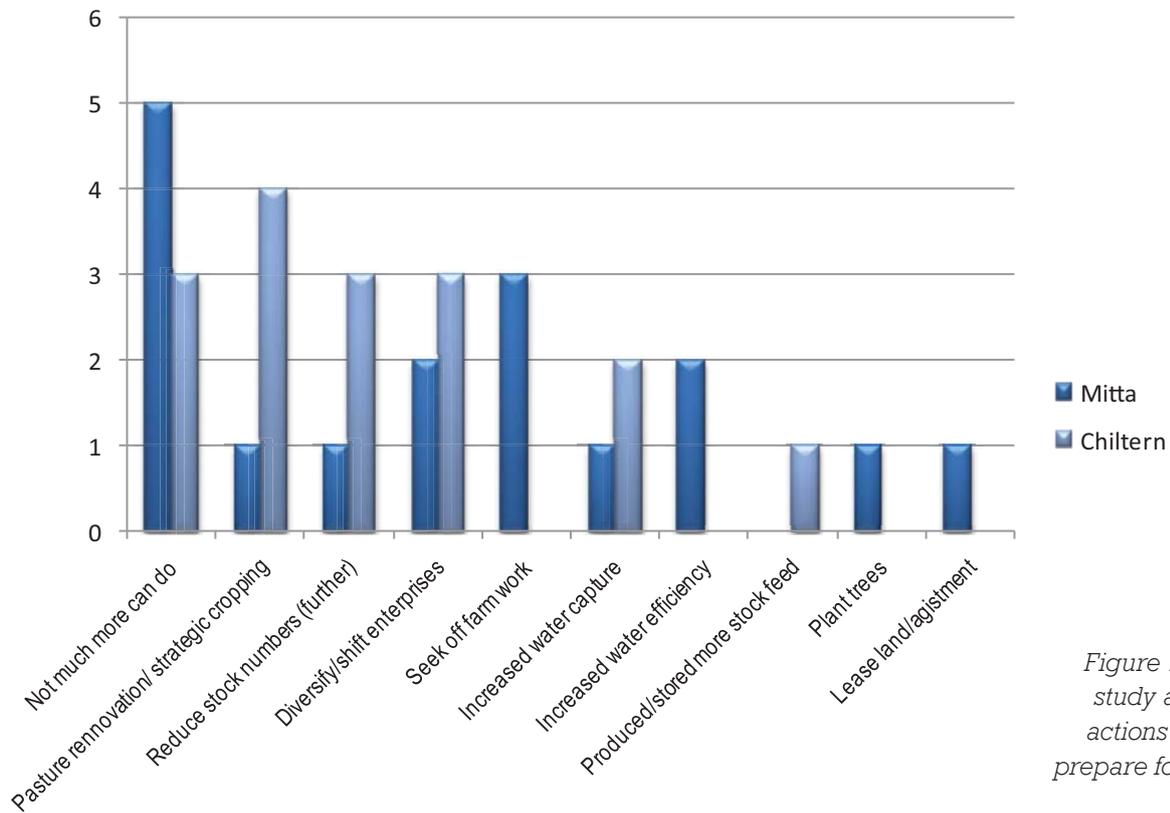


Figure 10. Case study area and actions taken to prepare for future.

### Preparing for the future

Interviewees were also asked what actions they were taking to prepare for future dry conditions or 'climate change'. These actions were classified manually by using inductive analysis of the patterns that emerged from the interview data. Where interviewees were taking action to prepare for the future, they typically reported on one or two particular activities. Figure 9 shows the frequency of the actions listed.

The most frequently listed 'action' was for interviewees to report that they were doing all that could

be done. In some cases:

- these actions corresponded with what they were already doing to cope with the current dry conditions; or
- they did not think beyond the short to medium term (e.g. 12 months)

The next most frequently listed actions included pasture renovation/strategic cropping, switching enterprises, and further stock reductions.

Figure 10 shows the actions interviewees were taking to prepare for the future, according to their

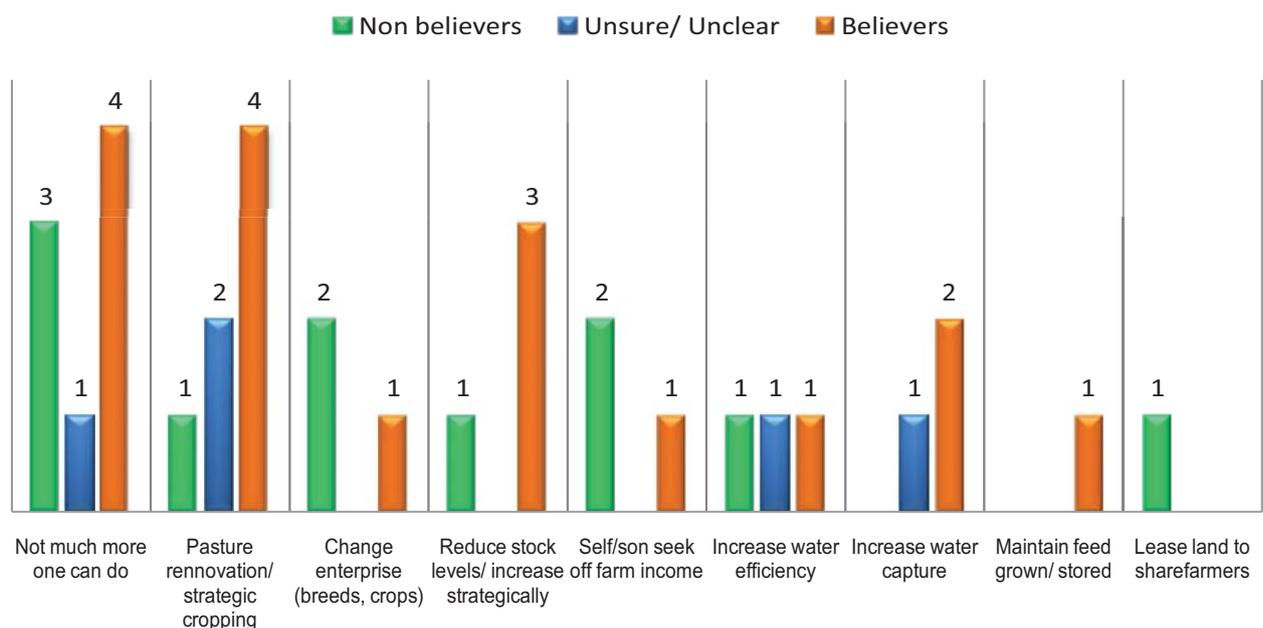


Figure 11. Actions to prepare for the future according to climate change beliefs

belief in climate change. It is worth noting that non believers and believers alike spoke about limitations to what one can do at comparable frequency levels. However there were some interesting differences in the nature of their comments. When non-believers spoke about future preparations, they tended to talk more about there being nothing one could do to deal with difficult climatic conditions that *might* arise in the future. Conversely, believers spoke more in terms of continuing to do the things similar to what they were already doing – only making adjustments as they saw fit (e.g. being prepared to reduce stock levels further, keeping hay in their sheds) [see Box 12].

Figure 10 shows the actions people took according to the case study region. More Eskdale interviewees than Chiltern interviewees talked about there not being much one could do to prepare (further) for any adverse climatic conditions. In addition, Eskdale interviewees talked about seeking off-farm work or not reinvesting in the farm – while this was not raised by Chiltern interviewees at all. More Chiltern interviewees were undertaking pasture renovation/strategic cropping, further stock reductions, and diversifying their enterprises in preparation for future climate changes than were the interviewees from Eskdale.

### Aspiring to prepare for the future

After interviewees talked about what they were doing currently to manage the dry and to prepare for the possibility of further dry conditions (or climate change), the research team asked them if there were any other future preparations they were thinking of taking – but had not yet done so. These actions listed by the interviewees were classified in the same manner as the other actions they

#### Box 12. Examples of responses to the need to prepare for future climate change

What can you do, I don't know there is anything you can do...if it keeps getting dryer and the stock numbers getting lower I am going to have to sell off part of the land to live on. I come under the assets test for the part pension and yeh if you can't make any money off it, it's not worth having is it. (Chiltern 8)

I don't think there are any great things you can [do] ... you have to have water. You have to have moisture to grow grass and it doesn't matter what you grow unless you have water it won't grow ... I don't think there is anything you could do. As I said before [you just] go with the flow. (Eskdale 13)

No, not really. In that regard I think we have seen what the situation is and I think we have pretty much addressed it, and I think we have seen, you know, 2003 and 06 and even last year, we have seen it get as bad as they can get, with modest supplementary feeding but we have been able to carry through. From here on in we will probably just have to make small changes as it goes and if it does get worse, as it's predicted to, we will have to gradually reduce our stocking rate accordingly (Chiltern 14)

discussed, and are shown in Figures 12 and 13.

Most of the interviewees were considering taking 1–2 additional actions to prepare for the future. The most frequently listed possible action was to increase their capacity to store water, followed by some kind of pasture renovation/strategic cropping, seasonal adjustment to their practice, and/or changing the emphasis of their enterprises.

Figure 13 suggests that, apart from more Believers wanting to increase water capture, there were no major differences in the types of actions that interviewees took when analysed by their belief in climate change.

Figure 14 shows those actions according to the

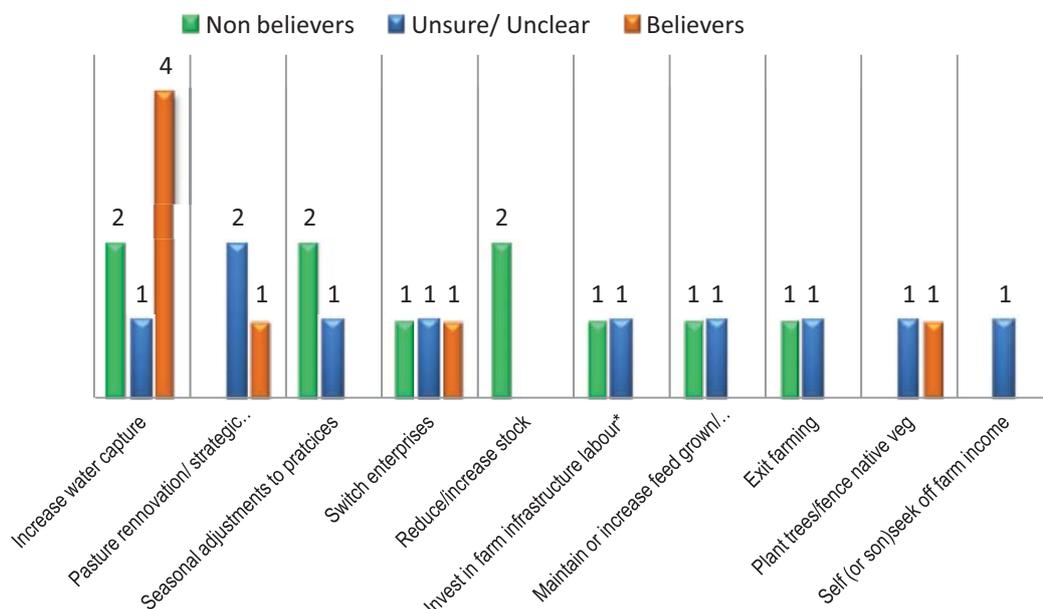


Figure 12. Actions that might be taken to prepare for future

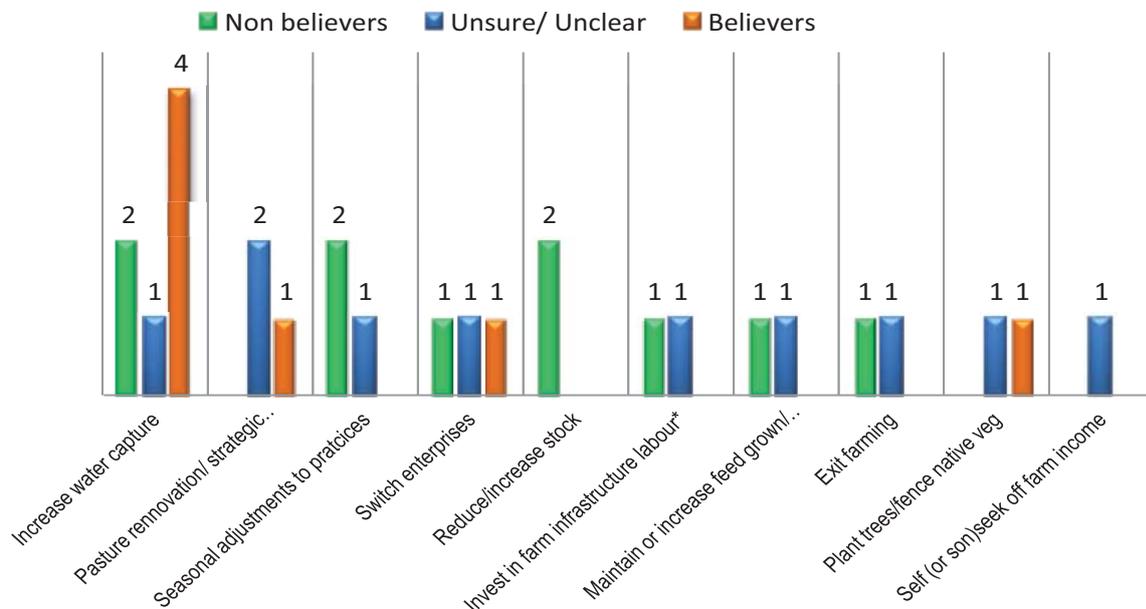


Figure 13. Beliefs in climate change and possible preparations for the future

case study region. Only the Eskdale interviewees talked about considering modifying their enterprises, changing the seasonality of their practices, seeking off farm work, renovating their pastures, or taking further fire risk preparations. Only the Chiltern interviewees talked about considering the possibility of getting off-farm work, increasing their feed storage capacity, planting trees, and/or increasing investment in their on-farm infrastructure. These differences are most likely linked to the different type of land use and demographics found in the two sites.

### Quality of adaptations

As noted earlier, adaptations to climate change (or to unfavourable climatic conditions like an extended drought) are generally seen as a positive action and an indicator of a capacity or ability to adapt, while not adapting is considered negative and an indicator of a landholder's potential vulnerability. There are numerous ways to classify climate change adaptations in agriculture, but Australia lacks clear, agreed-upon criteria for distinguishing the quality of particular practices (e.g. what distinguishes sound adaptation from maladaptive actions).

It is worth considering the suite of actions that

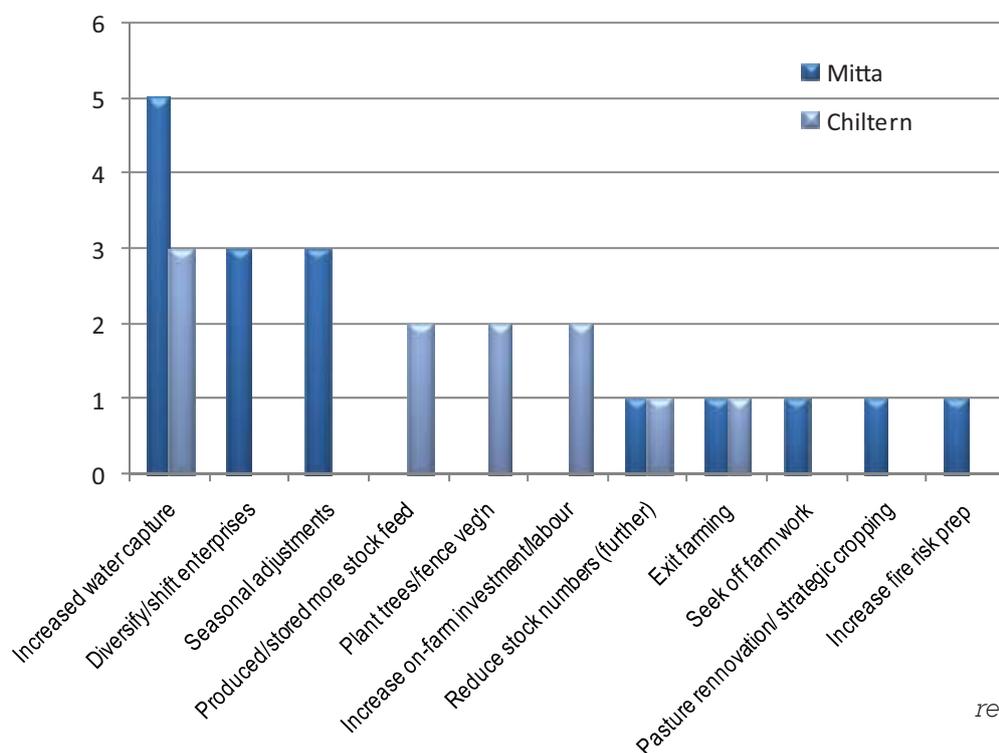


Figure 14. Case study region & possible actions to prepare for future

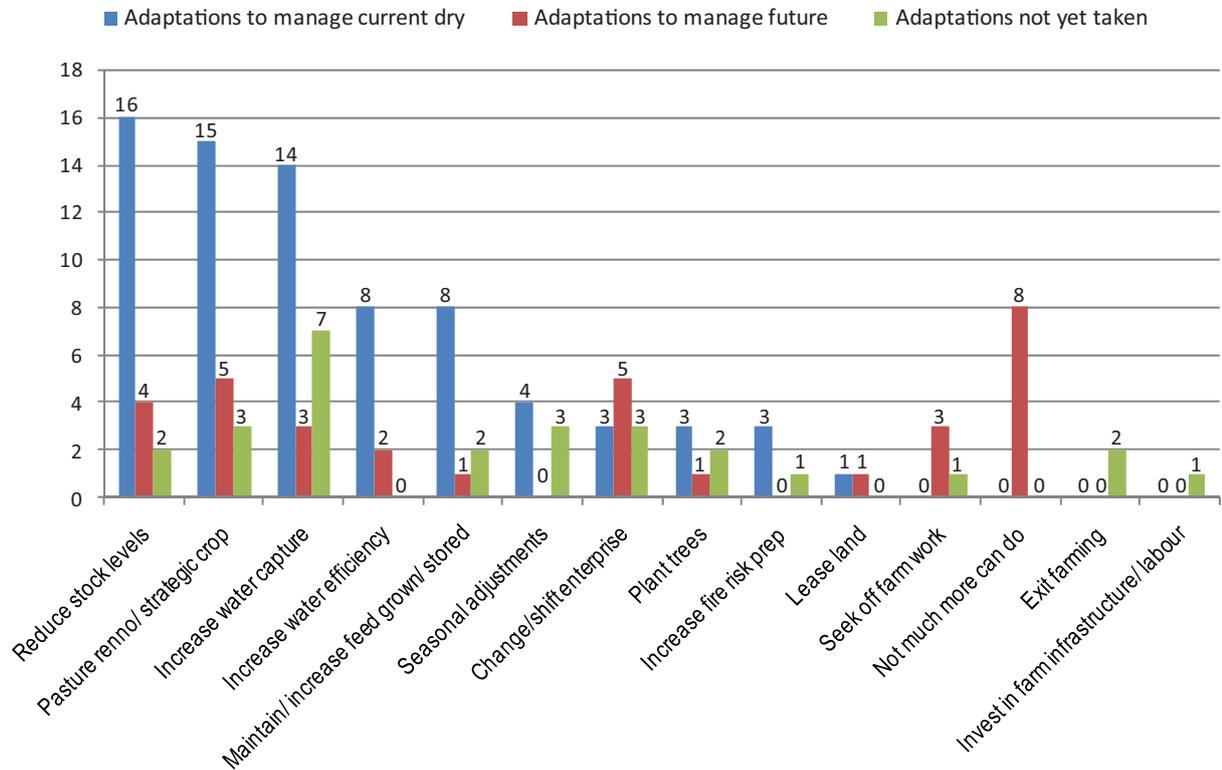


Figure 15. Farm practices used as adaptations

people take to a) manage their existing circumstances alongside b) those that they are using to help prepare for *future* climatic conditions. Figure 15 shows the full range of practices that interviewees talked about. Many of these practices essentially 'doubled' as actions to manage present circumstances and to prepare for future dry conditions (or climate change).

For a number of the interviewees, their preparations for *future* climatic conditions (ongoing dry period, or 'climate change') were the same as or included several of the actions they took to cope

with the *current* dry spell (n = 11: Eskdale 5,6,7, 8; Chiltern 1,8,12,4,15,2,14). For example, one interviewee (Eskdale 8 ) had reduced stock numbers both to cope with the current dry and to prepare for the possibility that the dry (or climate change) would worsen in the future. In other cases, interviewees talked about doing more of what they were already doing to manage with what might be worsening conditions, as is illustrated by the following quote:

... I think we have seen what the situation is and I think we have pretty much addressed it ... with modest

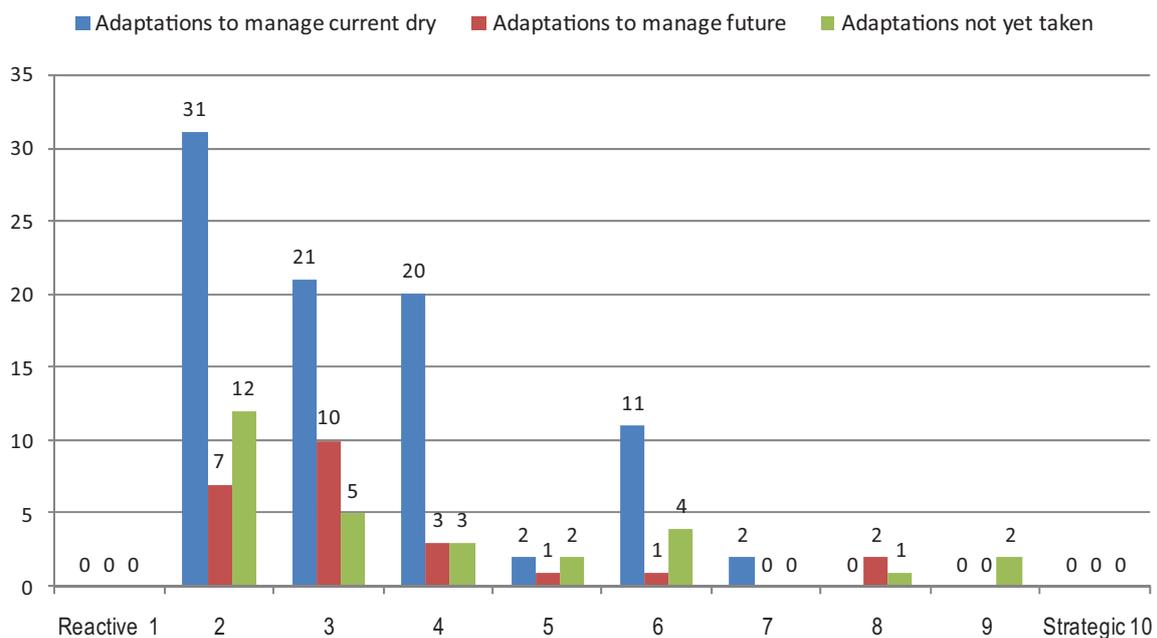


Figure 16. Reactive versus strategic adaptations

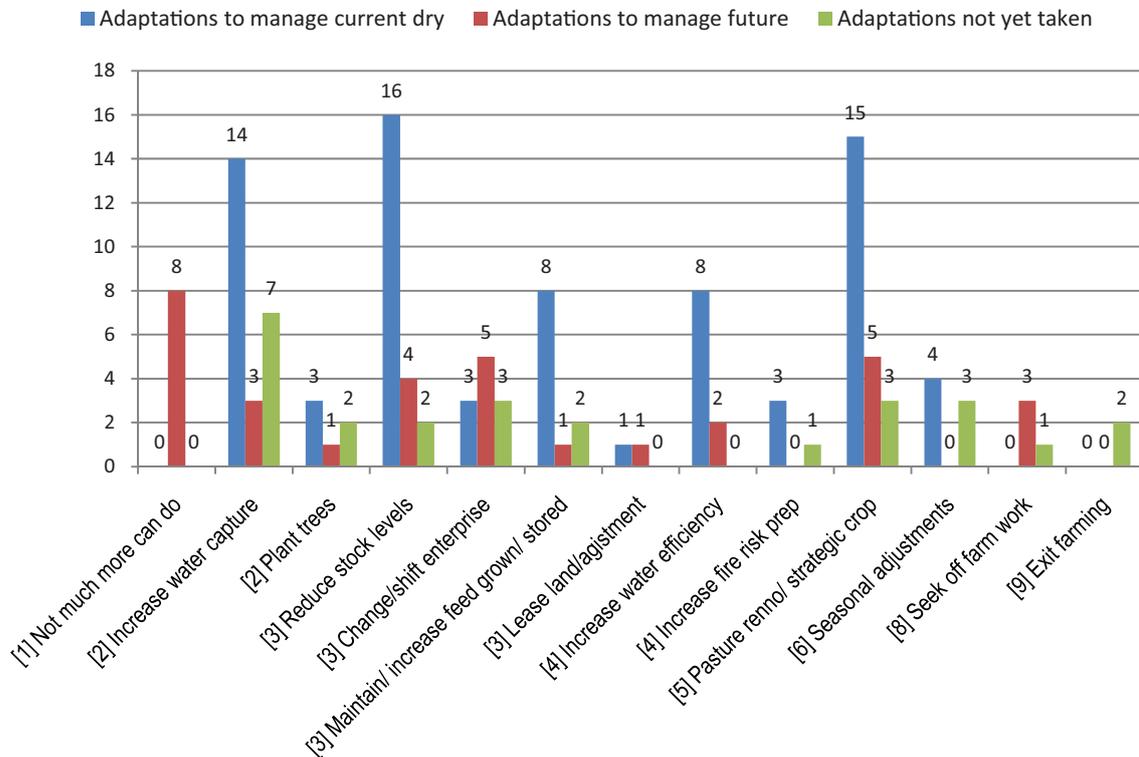


Figure 17. Farm practices by reactive & strategic scoring criteria (see also Table 4.5)

supplementary feeding ... we have been able to carry through. From here on in we will probably just have to make small changes as it goes and if it does get worse, as it's predicted to, we will have to gradually reduce our stocking rate accordingly (Chiltern 14).

There were also numerous instances (n = 15; Eskdale 4,12-15; 1,3,9,10; Chiltern 6,9,11; 5,7,16) where the actions that interviewees were taking (or planning to take) to prepare for the future were different from those practices they were using currently to manage the dry conditions. Some of the strategies to prepare for the future that were *different from* actions to cope with the current dry included:

|  |                                 |
|--|---------------------------------|
| Exit farming   | Fencing native vegetation       |
| Seeking off-farm work  | Establishing perennial pastures |
| Changing the enterprise mix                                    | Increasing water storage        |
| Leasing land to share-farmers                                  | Investing in farm-labour        |
| Changing season for certain practices (e.g. calving, breeding) |                                 |

When considering taking additional actions to help them prepare for future climate conditions (primarily an increasing dry), some interviewees spoke about practices that other interviewees were *already* undertaking as part of their coping and/or managing for the future strategies.<sup>4</sup> For example, one interviewee in the Eskdale case study was considering changing the season for calving (Eskdale 15), while several other interviewees in this case study had already undertaken this change (Eskdale 5, 6, 12). Another example was an interviewee in Chiltern who was considering increasing their capacity to store water (Chiltern 14), while several other Chiltern interviewees had installed additional

water storage capacity (e.g. water tanks, enlarged dams)(Chiltern 7,15,8).

#### Reactive versus strategic adaptations

Contemporary climate change dialogues assume that anticipatory actions are desirable, because they indicate some level of preparedness by industry, community or individuals to engage with longer-term consequences of climate change. The following analysis classifies the reactive/strategic quality of the current and planned adaptations listed by the interviewees. Current actions to manage the dry (N = 26, n = 92); actions being taken to prepare for the future (N = 26, n = 31); and actions not yet taken to prepare for the future (N = 26, n = 30) mentioned by the interviewees were grouped into broad categories. Table 5 shows those categories of practices – they were scored according to a spectrum of 'reactiveness' versus 'anticipatory' or 'strategic' (1 = reactive, 10 = anticipatory/strategic) [see Table 3.6 – methods].

Figures 16 and 17 show that – according to the scoring criteria listed in Table 4.5 – the majority of actions mentioned by interviewees – whether those taken to manage current circumstances or to prepare for the future – could be described as reactive rather than anticipatory. Figure 16 also shows that:

- the more strategic actions used to **manage the current dry** were pasture renovations/strategic cropping and seasonal adjustments to practices;
- the more strategic actions used (or considered) for **preparing for future** climate shifts were also pasture renovation and seasonal adjustments to

Table 4.5. A spectrum of rural landholder adaptations

|                               |                                   |                            |                               |   |                                       |                        |  |  |    |
|-------------------------------|-----------------------------------|----------------------------|-------------------------------|---|---------------------------------------|------------------------|--|--|----|
| Not much more that one can do | Improved ability to capture water | Reduced stocking rates     | Improved water use efficiency | Established perennial pasture             | Purchase/ lease land in same district | Use of minimum tillage | Purchase/ lease land in another district | Value-add farm product                 |    |
|                               | Move to low input production      | Change enterprise mix      | Fence remnant veg             | Change product marketing                  | Diversify farm enterprise             |                        | Seek off property work                   | Sell/lease land to others/exit farming |    |
|                               | Plant native trees, shrubs        | Increase fodder stored     | More fire risk preparation    | General improvement of paddock management | Shift season of practices             |                        | Increase intensive use                   |  |    |
|                               |                                   | Increased weed management  |                               |   | Increase energy efficiency            |                        |  |  |    |
|                               |                                   | Agist animals off property |                               |   | Oversowing w/rye, oats, millet        |                        |  |  |    |
| 1                             | 2                                 | 3                          | 4                             | 5   | 6                                     | 7                      | 8  | 9                                      | 10 |
| Reactive/Tactical             |                                   |                            |                               |   |                                       | Anticipatory/Strategic |  |  |    |

practices, as well as seeking off-farm work and exiting farming altogether;

- more interviewees were using reactive practices to prepare for the future than were using strategic practices to prepare.

### Why adapt?

In order to better understand the range of actions interviewees were taking in response to either 'climate change' or simply worsening of dry conditions, the research team asked interviewees to talk about:

- factors – other than climatic conditions – that affected their on-farm decision-making;
- whether they had the resources they needed to prepare for any future climatic changes; and
- how confident they felt about preparing for the future.<sup>5</sup>

### Influences on adaptive capacity

Figure 18 shows the range of factors interviewees mentioned as influencing their farm decision-making and climate adaptation. In both case studies, a lack of finances, older age (and its attendant health issues), and the availability of water were factors mentioned most frequently by interviewees as things that had negative effects on their ability to make on farm changes.

It was common for interviewees to cite *not* having sufficient **funds** to better prepare generally for future challenges, including adverse climatic conditions (: 2, 6, 7, 8, 10, 12; Chiltern 1, 12, 9, 16). For example, one Chiltern interviewee (16) specifically mentioned wanting to increase their water storage, but not being able to afford to purchase more tanks. Another interviewee from Eskdale (M12) told a similar story:

I would love to be able to store more water ... but it all comes at a cost. We are not in the position to

be able to go in and put another 30 megL dam at this stage. I could go and borrow the money ... but I don't want to do that ... to improve the farm – yes I would go and do it but I would have to part with perhaps a \$100,000.

In addition, interviewees also spoke frequently in both case study areas about their **age** as a limiting factor. They felt that being older did, could or would slow them down – impeding their ability to do physical work, forcing some of them to look for assistance from their sons, or leading them to wonder about what they could accomplish if their children did not return to the farm (Eskdale 3, 4, 12, 8; Chiltern 1, 2, 8, 11, 12, 11, 14, 16). For example, one interviewee did not think they could manage in the future if the dry conditions got much worse due to their age and the lack of financial resources:

... the last few years we've just been treading water ... we're getting older and so is all our machinery ... at our age and in [if] there's a worst case scenario we'll just sell out ... no financially we would not be able to do it (adapt) because ... the place just wouldn't generate the income to keep up the costs involved ... new technology would be needed ... and we're at the end of our farming career. (Chiltern 12)

One interviewee (Eskdale 5) talked about their imminent plans to sell their property and exit from farming altogether. For them this strategy was also informed by the interviewee's poor health.

As they did during conversations about climate beliefs, some interviewees again expressed concern about the quality of available **information** on climate matters. Several Eskdale interviewees (10, 14, 15) were interested in receiving more and 'better' information – two of them questioning the credibility of what they had seen/heard so far about the 'climate change' phenomenon. Two Chiltern

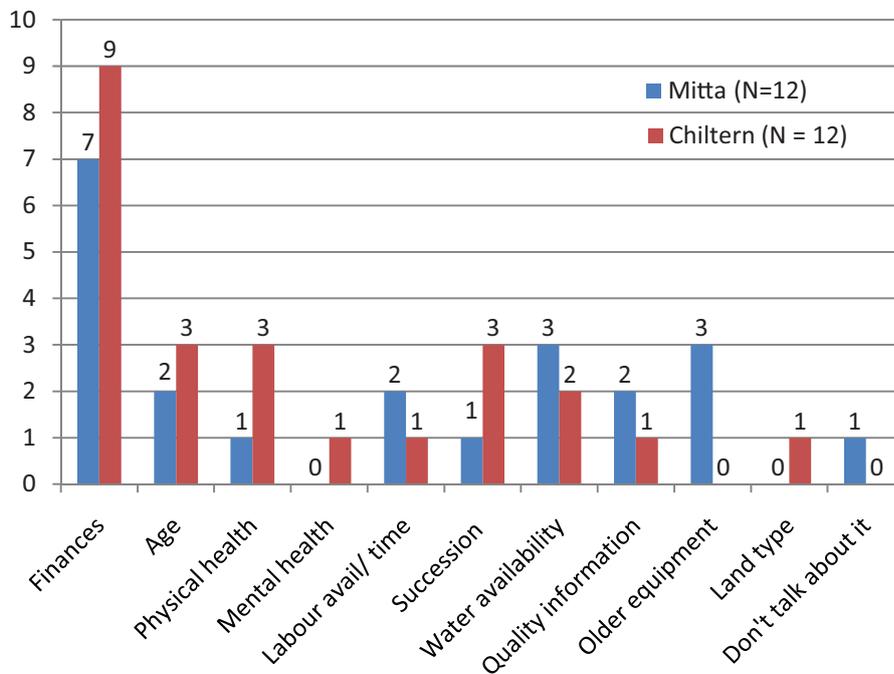


Figure 18. Landholders' perceptions of factors influencing their ability to adapt

interviewees (1, 9) also talked about credible information about adaptation as a resource that was very limited in supply. Other limited 'resources' mentioned by interviewees included insufficient time to plan strategically (Chiltern 16 11, 9) and older and/or a lack of appropriate equipment (Chiltern 9, 16).

It appears that those who were most optimistic about the future seemed to have important resources available to them, such as debt-free viable businesses, access to water, and to what they felt was credible information. Two interviewees (11, 14) from the Chiltern Case Study talked about what they *did* have to help them prepare for the future, including a lack of debt and/or a generally viable farm business. One of these interviewees felt that they were better prepared than most farmers – they had good surface water for feeding their stock, operated their business at the right scale, and were able to access what they believed to be 'good' information. One Chiltern interviewee (2) discussed the importance of having realistic goals in order to make strategic investments in equipment and other infrastructure. Two other interviewees (Chiltern 5, 7) talked about how their (environmental) values had led them to make key decisions on-farm.

Overall, many of the interviewees reported feeling relatively confident about preparing for the future – in these cases they appeared to believe that there was no choice other than to adapt to whatever came their way [see Box 13]. Several interviewees (4, 8 9) talked about feeling relatively "confident" that they would be able to manage or adapt if confronted by ongoing or new adverse climatic conditions. Similarly several Chiltern interviewees were fairly confident they would adapt to the future – they

**Box 13.**  
**Interviewees confident about preparing for the future**

I'm reasonably confident ... we'll have our nasty times I suppose ... whether it's fire or drought or whatever ... but I've been through a few dry alleys before [and] I reckon I've had that experience ... I'm not saying it won't get tough, but then you come out at the end of the day and you have your good times too ..." (Chiltern 11 – unsure)

I am confident we will handle whatever comes ... being a bushman you are used to dealing with what life dishes up, and we will cope with whatever situation befalls us. One thing we don't have to worry about is rearing a family. We reared seven kids on one wage but thankfully we don't have to worry about that." (Chiltern. 8 – non-believer)

Its a case of 'have to' ... I just will [adapt] ... until I'm not here anymore, and after that its not our problem ... [I] definitely will be able to adjust to whatever comes this way ... I can't see us moving out ever ... and [we] could survive off the land." (Chiltern 16 – believer)

Two Chiltern interviewees who saw themselves as confident, were also fairly optimistic about the future, because they had built (or were building) strong farm businesses. One of them saw "huge opportunities in adaptation" and felt it was important to "be flexible and keep my options open.(Chiltern 7- believer).

saw themselves as resourceful and accepting of not having a choice other than to make changes. Two Chiltern interviewees who saw themselves as confident, were also fairly optimistic about the future, because they had built (or were building) strong farm businesses. One of them saw "huge opportunities in adaptation" and felt it was important to "be flexible and keep my options open.(Chiltern 7).

## 5. Survey findings

In this we discuss the findings from the landholder survey, which was distributed immediately after the round of interviews conducted in each study site (August, 2009 and October, 2009 for Eskdale and Chiltern respectively). Our discussion is based around the key questions, in the same order as they were presented for the previous chapter. Again the key questions being addressed are as follows.

- How are rural landholders interpreting/understanding climate change?
- How do rural landholders perceive the personal risk of climate change?
- How have rural landholders responded to climate change?
- How adaptable do rural landholders believe they are in the face of changing climatic conditions?
- What factors influence tactical/strategic actions to address climate change?

To begin with, our discussion is for the combined data set. That is, for data from both study sites. The areas of significant difference between the two sites are discussed in section 5.7.

### Rural landholder interpretation of climate change

The research team was aware that the direct use of the term 'climate change' may create a reluctance to participate in the research. Hence, the interview

process explored people's thinking about the recent dry period and its links with climate change in an open discussion. In contrast, the mail survey sought more direct information about people's knowledge and views about climate change.

### Knowledge of climate change

Question 3 of the survey asked respondents to provide an assessment of their knowledge about climate change and its implications for the region. On a scale of 1–5 they were asked to score their level of knowledge ranging from No/little knowledge, some knowledge, to very sound knowledge, along with a 'not relevant' option. The findings are summarised in Table 5.1 below. The five response categories have been collapsed to simplify data presentation.

Of the 90 respondents across both study sites, between 67% and 74% of respondents (shaded yellow ■) reported having some knowledge to very sound knowledge of the broad, global topics such as the potentially serious impacts of global climate change, the explanation provided by scientists for global warming, and the difference between greenhouse effect and the ozone hole. Between 83% and 87% of respondents (shaded pink ■) reported having little to no knowledge to some knowledge, of locally relevant topics such as the implications of a 1–2° increase in global temperatures for agriculture

Table 5.1: Self-reported knowledge of climate change

| Climate change Topic   | Little/no knowledge | Some knowledge | Sound/<br>Very sound knowledge | Not relevant | Mean score ~ |
|--|---------------------|----------------|--------------------------------|--------------|--------------|
| Actions that householders can take to reduce their carbon emissions (n=90)                               | 10%                 | 40%            | 47%                            | 2%           | 3.46         |
| Potentially serious impacts of global climate change (n=90)  | 22%                 | 42%            | 32%                            | 3%           | 3.16         |
| The explanation provided by scientists for global warming(n=90)  | 29%                 | 37%            | 30%                            | 4%           | 2.99         |
| The difference between the greenhouse effect and the ozone hole (n=90)                                   | 27%                 | 44%            | 23%                            | 4%           | 2.94         |
| How carbon can be taken out of the atmosphere and stored (n=90)  | 39%                 | 29%            | 30%                            | 2%           | 2.8          |
| The implications of a 1–2 degree increase in global temperatures for agriculture in your district (n=90) | 36%                 | 47%            | 16%                            | 2%           | 2.72         |
| Steps that an agricultural enterprise could take to become carbon neutral (n=90)                         | 46%                 | 37%            | 16%                            | 2%           | 2.55         |
| The Federal Government's plans for a Carbon Emissions Trading Scheme (n=90)                              | 49%                 | 39%            | 7%                             | 6%           | 2.5          |
| The broad climate change projections for your region by 2050 (n=90)                                      | 60%                 | 27%            | 10%                            | 3%           | 2.18         |

N=90

in their district, the steps an agricultural enterprise could take to become carbon neutral, the Australian Government's plans for a carbon emissions trading scheme, and climate projections for their region. While 87% of respondents (shaded orange) said they new something, or had sound knowledge, about the actions that householders could take to reduce carbon emissions, the findings suggest that locally relevant information specifically about agriculture is not getting through.

### **Views about climate change – what do they believe to be true**

Question 4 of the survey provided a set of statements exploring views about climate change phenomenon. The aim here was to understand what people currently believe to be true. On a scale of 1–5 they were asked to indicate their views about climate change ranging from *strongly disagree, not sure*, to *strongly agree*. A summary of responses is presented in Table 5.2 below. Again, the five response categories have been collapsed to simplify data presentation. Few respondents said the topics were 'not relevant', suggesting that respondents were able and willing to score their beliefs on these items.

The findings are somewhat surprising in that the vast majority of respondents *believe the climate is changing* (70%) and *that it is being influenced by human activities* (68%). Only 6% of respondents said that there is *no such thing as climate change*.

It is important to note that the two statements

shaded pink (■) were intended to explore belief in climate change. With hindsight, it is clear that they do not really achieve that purpose in that most people are likely to agree with these statements. In fact, this was the case.

The importance of belief, or not, in climate change as a key influence on landholder behaviour will be explored through the regression analysis discussed later in the chapter.

### **Rural landholder's perceptions of risk**

#### **Climate change risks for you/your property**

Question 6A presented a list of potential property-based impacts arising from both drought and climate change. Respondents were initially asked about the likelihood of such impacts affecting them personally. On a scale of 1–5 they were asked to indicate their perception of the risks of climate change ranging from *unlikely, unsure, to highly likely*. Respondents were also given the option of responding with 'not relevant'. A summary of the findings is presented in Table 5.3. Again, the response options have been collapsed to simplify data presentation.

In part B of question 6, respondents were asked to indicate the direction they thought the climate change impact would be (i.e. positive or negative), and the severity of the impact (i.e. large or small) [Table 5.3].

For nine of the 12 items, more than half of all

Table 5.2: Beliefs about climate change

| <b>Views on climate change</b>   | <b>Disagree</b> | <b>Not sure</b> | <b>Agree</b> | <b>N/A</b> | <b>Mean score</b> |
|--|-----------------|-----------------|--------------|------------|-------------------|
| Climate is always changing. It is a naturally occurring phenomenon that has been going on forever (n=90)   | 9%              | 11%             | 80%          | 0%         | 3.99              |
| The climate is changing (n=90)   | 8%              | 21%             | 70%          | 1%         | 3.9               |
| Human activities are influencing changes in climate (n=90)   | 11%             | 20%             | 68%          | 1%         | 3.83              |
| It is not too late to take action to address climate change (n=90)   | 9%              | 27%             | 60%          | 4%         | 3.64              |
| If we do nothing climate change will have dire consequences for all living things, including humans (n=90) | 16%             | 34%             | 48%          | 2%         | 3.53              |
| The climate maybe changing but currently we are in a cycle (n=90)  | 13%             | 33%             | 53%          | 0%         | 3.51              |
| Humans will always adapt to their environment  | 20%             | 26%             | 52%          | 2%         | 3.39              |
| Climate might be changing but it is not as bad as it is being portrayed (n=90)                             | 32%             | 30%             | 38%          | 0%         | 2.99              |
| Climate change is out of our control (n=90)  | 42%             | 39%             | 19%          | 0%         | 2.73              |
| There is no such thing as climate change (n=90)  | 79%             | 14%             | 6%           | 1%         | 1.84              |

N = 90

respondents said it was likely/highly likely that they and their properties would be impacted by climate change. Some respondents indicated they expected positive impacts, but most thought the impacts would have negative consequences (>50% for each of the 12 items). Overall, the highest scored risk (mean score 4.17) was the effect of reduced water supply on pasture production, followed by the risk of increased intensity and frequency of bush fires (mean score 4.4). The lowest scored risk (mean score 3.43) was the impact on personal health and wellbeing [Table 5.3].

According to the mean score ranking for Section B, shown in Table 5.3 as the furthest right hand column, the impacts (mean scores closest to 1 = large; closest to 2 = small; closest to 3 = no real impact) were thought to be mostly small negative to neutral. With mean scores ranging from 1.88 to 1.95, the risk to water supply for stock and domestic, water supply for pasture production, and pasture productivity, was considered to be negative but tending toward a small negative impact. All of the other potential impacts were perceived to be small, tending toward neutral.

One curious finding is the substantial minority who thought the impact of increased intensity/frequency of bush fires to be positive (24% shaded red (■)). This finding could be interpreted as a response to the ongoing debate around fire safety and the need for more prescribed burning.

Given the consistent trends identified (that is, respondents believe there will be impacts and they are likely to be negative), a factor analysis was undertaken to determine if scores for all items were so similar that they really represented a single item. The subsequent factor analysis found that

every item in section A was significantly correlated with every other item in section A, suggesting that respondents treated each potential impact in a similar way. For example, if they perceived a likely risk to their stock and domestic water supply, respondents also indicated that they perceived a likely risk for every other listed impact. This was also the case for section B where the nature and direction of the potential impact was the same for all of the listed items. This meant that section A could be treated as one item and so could section B.

Treating the 12 items as a single item established that most respondents (68%) believed it likely/highly likely there would be climate impacts affecting them and their property. Of these, almost all (84%) thought the nature of the impacts to be negative – either large or small [refer to Appendix F for factor analysis results].

The extent that people's perception of risk to themselves and their property influences their behaviour will be explored through the regression analysis discussed later.

### **Ability to adapt to changing climatic conditions**

In this section of the survey (Question 7) respondents were asked to assess their *ability* to respond to the list of identified potential climate change impacts. Respondents were encouraged to leave aside the issue of government policy as an influence on their ability to take action. On a scale of 1–5 they were asked to indicate their ability to adapt to the potential impacts on their property ranging from *highly adaptable*, *adaptable*, *not sure*, *limited adaptability* to *unable to adapt*. Respondents were also given the option of responding with 'not relevant'.

Table 5.3: Perceived risk of climate change impacts

| Potential types of impacts                         | Section A |          |        |              | Section B |           |      |              |
|--|-----------|----------|--------|--------------|-----------|-----------|------|--------------|
|  | Unlikely  | Not sure | Likely | Mean score ~ | -tve      | No impact | +tve | Mean score ~ |
| Water supply for pasture production (n=91)         | 8%        | 7%       | 74%    | 4.17         | 70%       | 10%       | 12%  | 1.95         |
| Increased intensity/frequency of bush fires (n=91) | 6%        | 8%       | 86%    | 4.4          | 66%       | 7%        | 24%  | 2.21         |
| Pasture productivity (n=91)                        | 12%       | 9%       | 71%    | 4.03         | 71%       | 10%       | 12%  | 1.92         |
| Water supply for stock & domestic (n=91)           | 16%       | 7%       | 74.7%  | 3.93         | 74%       | 12%       | 11%  | 1.88         |
| House gardens (n=91)                               | 15%       | 13%      | 70%    | 3.81         | 67%       | 18%       | 10%  | 2.05         |
| Quality/health of native vegetation (n=91)         | 12%       | 19%      | 68%    | 3.80         | 74%       | 10%       | 12%  | 2.07         |
| Attractiveness of property landscape (n=91)        | 10%       | 25%      | 60%    | 3.74         | 61%       | 20%       | 12%  | 2.21         |
| Survival of some native vegetation (n=91)          | 15%       | 18%      | 66%    | 3.70         | 72%       | 12%       | 11%  | 2.1          |
| Pest plants (n=91)                                 | 17%       | 29%      | 50%    | 3.45         | 59%       | 28%       | 8%   | 2.13         |
| Family health/wellbeing (n=91)                     | 20%       | 32%      | 45%    | 3.45         | 51%       | 30%       | 11%  | 2.35         |
| Insect pests (n=91)                                | 16%       | 38%      | 41%    | 3.33         | 53%       | 33%       | 7%   | 2.23         |
| Personal health/wellbeing (n=91)                   | 21%       | 33%      | 44%    | 3.43         | 52%       | 30%       | 11%  | 2.36         |

Table 5.4: Ability to adapt to climate change

| Potential impacts                           | Not relevant | Adaptable | Unsure | Unadaptable | Mean Score ~ |
|---|--------------|-----------|--------|-------------|--------------|
| Pasture productivity (n=91)                 | 5%           | 42%       | 15%    | 37%         | <b>3.94</b>  |
| Increased frequency/intensity of bush fires | 1%           | 42%       | 12%    | 45%         | <b>3.12</b>  |
| Water supply for pasture production (n=91)  | 8%           | 35%       | 13%    | 44%         | <b>3.1</b>   |
| Extent of native vegetation (n=91)          | 10%          | 36%       | 29%    | 25%         | <b>2.85</b>  |
| Attractiveness of property landscape        | 3%           | 43%       | 26%    | 27%         | <b>2.82</b>  |
| Insect pests (n=91)                         | 6%           | 41%       | 37%    | 16%         | <b>2.7</b>   |
| Water supply for stock & domestic (n=91)    | 1%           | 62%       | 8%     | 30%         | <b>2.63</b>  |
| Pest plants (n=91)                          | 7%           | 47%       | 29%    | 18%         | <b>2.62</b>  |
| House gardens (n=91)                        | 4%           | 60%       | 11%    | 24%         | <b>2.52</b>  |
| Family health/wellbeing (n=91)              | 4%           | 61%       | 21%    | 13%         | <b>2.45</b>  |
| Personal health/wellbeing (n=91)            | 3%           | 63%       | 21%    | 13%         | <b>2.44</b>  |

A summary of findings is presented in Table 5.4. Again, the response options have been collapsed to simplify data presentation.

Given the consistent trends identified, a factor analysis was again undertaken to determine if scores for all items were so similar that they really represented a single item. The subsequent factor analysis found that every item in Question 7 was significantly correlated with every other item, suggesting that respondents treated each potential impact in a similar way (i.e. they believed themselves to be able to adapt or not).

Note that the ranked scores for adaptability has produced a similar order of impacts as was produced for perceived risk [Table 5.3], where the risk to pasture productivity, bush fire frequency/intensity and water supply for pasture production, were all considered likely to highly likely. The mean score for ability to adapt to the impacts on pasture productivity (3.94) suggests that, on average, people feel they have limited ability to adapt. In the case of water supply for pasture production (3.12) and increased fire risk (3.1), it seems people were expressing a level of uncertainty about their ability to adapt. As

Table 5.5 Changes in management (adaptive behaviours)

| Actions taken or under consideration (tactical/strategic score) | Not appl | Not interested next 5 yrs | Have thought about it | Plan to do it | Doing it now | Have done it | Mean score ~ |                                       |
|---|----------|---------------------------|-----------------------|---------------|--------------|--------------|--------------|---------------------------------------|
| Improved ability capture water on property (2)                  | 12%      | 1%                        | 10%                   | 7%            | 29%          | 41%          | 4.13         | 3.5–4.5<br>Doing this now             |
| Improved efficiency of water usage on property (4)              | 9%       | 1%                        | 8%                    | 10%           | 33%          | 39%          | 4.12         |                                       |
| Overall reduction in stocking rates (2)                         | 22%      | 4%                        | 8%                    | 0%            | 33%          | 32%          | 4.04         |                                       |
| Plant trees, shrubs, native grasses (2)                         | 19%      | 2%                        | 12%                   | 4%            | 26%          | 37%          | 4.02         |                                       |
| Established perennial pasture (5)                               | 20%      | 3%                        | 9%                    | 8%            | 29%          | 31%          | 3.94         |                                       |
| Move from annual to perennial pasture (4)                       | 38%      | 6%                        | 10%                   | 8%            | 19%          | 20%          | 3.6          | 2.5–3.5<br>Plan to do in next 5 years |
| Fence native bush to restrict stock access (4)                  | 39%      | 9%                        | 12%                   | 1%            | 17%          | 22%          | 3.51         |                                       |
| Increased off-farm work (8)                                     | 48%      | 10%                       | 7%                    | 3%            | 17%          | 16%          | 3.4          |                                       |
| Change product marketing (8)                                    | 67%      | 7%                        | 7%                    | 0%            | 12%          | 8%           | 3.23         |                                       |
| Increase fodder storage capacity (3)                            | 40%      | 12%                       | 10%                   | 10%           | 11%          | 17%          | 3.2          |                                       |
| Move to a low input production system (2)                       | 52%      | 10%                       | 11%                   | 1%            | 18%          | 8%           | 3.05         |                                       |
| Change enterprise mix (3)                                       | 57%      | 10%                       | 10%                   | 7%            | 8%           | 9%           | 2.9          |                                       |
| Value add to farm product (9)                                   | 52%      | 13%                       | 14%                   | 3%            | 9%           | 8%           | 2.65         |                                       |
| Diversify farm enterprise (6)                                   | 49%      | 18%                       | 11%                   | 7%            | 10%          | 6%           | 2.5          | 1.5–2.5<br>Have thought about it      |
| Acquired more land in your district (6)                         | 67%      | 13%                       | 8%                    | 1%            | 7%           | 4%           | 2.43         |                                       |
| Move to more intensive land use (8)                             | 56%      | 18%                       | 10%                   | 3%            | 10%          | 3%           | 2.35         |                                       |
| Sold/leased land to others (9)                                  | 71%      | 16%                       | 4%                    | 0%            | 4%           | 4%           | 2.23         |                                       |
| Acquired more land in another district (8)                      | 74%      | 20%                       | 3%                    | 0%            | 1%           | 1%           | 1.43         | Not interested                        |

for all the other potential impacts, the mean scores suggest that people are more confident about their ability to adapt, but still with a leaning toward uncertainty.

A statistical analysis exploring the relationship between risk perception (Q6) and self-declared ability to adapt (Q7) found that of the 68% who believed it was likely to highly likely there would be personal /property impacts of climate change, only 8% said they had a limited adaptability or were unable to adapt (refer to factor analysis for Question 7 – Appendix G)

### Rural landholder responses to climatic conditions –property management and adaptations

In question 9 respondents were asked to identify changes they had made or were likely to implement on their property (Part A), and to indicate the extent that these changes had been/were influenced by climate change (Part B). In part A, on a scale of 1–5, respondents were asked to select from *not interested, have thought about it, plan to do it in next 5 years, am doing this now, have done this in the past 5 years*. Respondents were also given the option of responding with 'not applicable'. A summary of findings is presented in Table 5.5, with the actions ranked according to the mean scores.

The most interesting observation here is the way

the mean scores depict a clear line of thinking, in that the top six actions, which are mostly tactical in nature, are typically, being implemented now (i.e. mean scores of 3.5 and above). These more tactical actions include improved ability to capture water; improved water use efficiency; reduced stocking rates; planting of trees, shrubs and native grasses; establishing perennial pasture and moving from annual to perennial pasture. As the actions become more strategic, an increasing number of people consider them to be 'not applicable'. The highly strategic actions of selling or leasing land to others, acquiring more land elsewhere, and acquiring more land locally were all considered to be 'not applicable' by the majority of respondents (71%, 74% and 67% respectively).

For part B, respondents were asked to indicate the extent their decisions had been influenced by climate change on a scale of 1–5 ranging from *not a factor, minor factor, some influence, influential, very influential*. They were also given the option of answering 'not applicable'. A summary of the findings are presented in Table 5.6. Again, the response options have been collapsed to simplify data presentation.

The majority of respondents indicated that management decisions, regarding improved efficiency of water usage (57%) and improved ability to capture water (54%), were influenced by climate

Table 5.6: Level of influence of climate change on adaptive behaviours

| Actions taken or under consideration (tactical/strategic rating) | Not appl | Not a factor | Some influence | Influential | Mean score ~ |
|--|----------|--------------|----------------|-------------|--------------|
| Improved efficiency of water usage on your property (4)          | 13%      | 5%           | 24%            | 57%         | 3.71         |
| Improved ability to capture water on your property (2)           | 13%      | 9%           | 23%            | 54%         | 3.64         |
| Overall reduction in stocking rates (2)                          | 24%      | 10%          | 28%            | 38%         | 3.32         |
| Established perennial pastures (5)                               | 23%      | 10%          | 36%            | 31%         | 3.18         |
| Move from annual to perennial pastures (4)                       | 39%      | 9%           | 27%            | 26%         | 3.09         |
| Increased fodder storage capacity (3)                            | 42%      | 13%          | 24%            | 20%         | 2.98         |
| Planted trees, shrubs and native grasses (2)                     | 23%      | 19%          | 32%            | 26%         | 2.75         |
| Increased off-farm work (8)                                      | 50%      | 19%          | 14%            | 17%         | 2.53         |
| Fenced native bush to restrict stock access (4)                  | 42%      | 24%          | 16%            | 18%         | 2.51         |
| Changed enterprise mix (3)                                       | 54%      | 19%          | 16%            | 11%         | 2.46         |
| Move to a low input production system (2)                        | 53%      | 18%          | 16%            | 13%         | 2.45         |
| Changed the way you market your product (8)                      | 68%      | 16%          | 7%             | 10%         | 2.41         |
| Diversification of farm enterprise (6)                           | 49%      | 23%          | 14%            | 13%         | 2.36         |
| Value added to farm products (9)                                 | 58%      | 20%          | 12%            | 10%         | 2.31         |
| Move to more intensive use of existing land (8)                  | 56%      | 24%          | 9%             | 11%         | 2.10         |
| Purchased or leased more land in your district (6)               | 66%      | 18%          | 11%            | 6%          | 2.00         |
| Sold or leased land to others (9)                                | 76%      | 17%          | 3%             | 3%          | 1.71         |
| Purchased or leased land in another district (8)                 | 76%      | 19%          | 4%             | 1%          | 1.36         |

(N=90)

change. A very high proportion of respondents indicated that climate change was not applicable to their decisions, particularly as the adaptations become more strategic. In light of the finding that the more strategic adaptations were also considered to be 'not applicable' in terms of management options, this is not surprising (see Table 5.5 above). However, if we combine the proportions for *some influence* and *influential* we find that between 81% and 54% of respondents considered climate change to be a factor in their decisions regarding a number of adaptation options (highlighted in green ■).

### Other influential factors

To explore more deeply the socio-psychological factors that influence rural landholder responses to climate change, the survey included questions relating to commitment to place (Question 2), world views (survey Question 5), attitudes and personal norms (Question 8). In this section of the report we are presenting a summary of survey data for these items, which will be used in analyses examining the factors linked to adaptive behaviour.

#### Why is your property important to you?

This set of items examines 'commitment to place' and was designed as a scale based on three key elements – place identity (PI), place attachment (PA) and place dependence (PD). A further two statements were included in this section to examine rural landholder commitment to place with specific reference to the changing climatic conditions. Respondents were also given the option of responding with 'not applicable'. The findings for question 2

of the survey are summarised in Table 5.7.

The majority of respondents exhibited a strong commitment to place across all three scale items – place attachment, place identity and place dependence, with 69% also stating that they have no thoughts of leaving.

The proportion of people who said their property was the main source of household income was evenly distributed between those who agreed and those who disagreed (39% and 36% respectively) which is reflective of the different demographics of the two study sites, confirmed by the statistically significant difference found (mean scores – Chiltern 2.61; Eskdale 3.85 – p value 0.001).

As this section in the survey was designed as a scale, it is useful to know which items contribute to a valid scale for 'commitment to place'. A Cronbach's Alpha test was used to do this. Only four items were found to be statistically acceptable (i.e. alpha > 0.7) as a scale.

Because so few items could contribute to a valid scale, it was decided not to proceed further with scale development and these items were included as single items in pairwise and regression analysis of factors influencing adaptive behaviour.

#### Views about the 'state of the world'

This topic (survey Question 5) comprised three different approaches (scales) to understanding respondent's world views – i.e. Eckersley's (2007) scale for psychological impact of the negative social, economic and environmental degradation confronting society (social attitudes); a scale drawn from the New Environment Paradigm framework

Table 5.7: Reasons why your property is important to you

|    | Commitment to place   | N/A | Disagree | Not sure | Agree | Mean score ~ |
|----|---|-----|----------|----------|-------|--------------|
| PA | This property is a great place to raise a family                            | 9%  | 0%       | 2%       | 89%   | 4.66         |
| PA | I feel happiest when I'm at my property                                     | 3%  | 4%       | 5%       | 88%   | 4.33         |
| PI | I feel I can really be myself at my property                                | 1%  | 6%       | 3%       | 90%   | 4.31         |
| PA | My property enables me to be part of a rural community                      | 1%  | 2%       | 8%       | 89%   | 4.22         |
| PD | My property is the best place for doing the things I enjoy most             | 2%  | 7%       | 8%       | 83%   | 4.2          |
| PI | My property reflects the type of person I am                                | 3%  | 5%       | 18%      | 74%   | 4.1          |
| PI | This property enables me to have a sense of accomplishment                  | 16% | 13%      | 7%       | 64%   | 3.9          |
|    | I live here and have no thoughts of leaving                                 | 3%  | 13%      | 15%      | 69%   | 3.88         |
| PA | It is important for me to be able to pass the property on to others         | 15% | 20%      | 12%      | 53%   | 3.51         |
| PD | This property provides most of the household income                         | 24% | 36%      | 1%       | 39%   | 3.1          |
|    | I live here but have thought about leaving if the climate changes           | 11% | 57%      | 18%      | 13%   | 2.16         |
| PI | This property says very little about who I am                               | 8%  | 66%      | 12%      | 13%   | 2.06         |
| PD | As far as I am concerned, there are better places to be than at my property | 7%  | 73%      | 9%       | 11%   | 1.92         |
| PD | This property is not a good place to do the things I like to do             | 10% | 78%      | 3%       | 7%    | 1.62         |

N= 89

Table 5.8: Views about the state of the world (based on Eckersley 2007)

|                              | <b>Eckersley's scale for world views</b>  | <b>N/A</b> | <b>Disagree</b> | <b>Not sure</b> | <b>Agree</b> | <b>Mean score ~</b> |          |
|------------------------------|---|------------|-----------------|-----------------|--------------|---------------------|----------|
| Activism (hope rules)        | We need to transform our way of life if we are to create a better future for the world (n=91)                     | 0%         | 11%             | 19%             | 70%          | 3.86                | Agree    |
| Fundamentalism (dogma rules) | We are facing a fundamental conflict between good and evil (n=91)   | 9%         | 35%             | 29%             | 27%          | 2.78                | Unsure   |
| Nihilism (decadence rules)   | The world's future looks grim. We can't be worrying about everyone else. We have to look out for ourselves (n=90) | 1%         | 64%             | 8%              | 27%          | 2.47                | Disagree |
| Fundamentalism (dogma rules) | We need to return to traditional religious teachings and values to solve global problems and challenges (n=91)    | 10%        | 54%             | 19%             | 18%          | 2.37                |          |
| Nihilism (decadence rules)   | There's no point in worrying about what might happen to the world in the future (n=91)                            | 1%         | 79%             | 9%              | 11%          | 2.07                |          |

(Dunlap *et al*, 1978) for environmental attitudes; and Stern *et al* (1998) and Langford's (2002) scales for measuring a sense of personal obligation. Findings for the items drawn from each approach is initially summarised and analysed separately (i.e. social attitudes, environmental attitudes, and personal obligation attitudes), and then brought together as three single variables representing each of the scales.

Respondents were asked to indicate how closely the statements presented reflected their feelings or views about the future of the world. On a scale of 1–5, respondents were asked to select from *strong disagree*, *disagree*, *not sure*, *agree*, *strongly agree* with the additional option of responding '*not relevant*'.

Eckersley's scale for world views is presented in Table 5.8. The majority (64%) of respondents rejected the notion that the world was in such a bad way that there was no point in worrying about everyone else (Nihilism). A majority (54%) also rejected the view that we need to return to traditional religious teachings and values to solve global problems (Fundamentalism). By disagreeing with these statements associated with Nihilism

and Fundamentalism, respondents were indicating a rejection of decadence and dogma where, according to Eckersley, the focus is on the individual quest for personal pleasure, win at all cost attitudes, and a fraying of citizenship leading to the politics of self interest and fear.

In contrast, the vast majority of respondents (70%) expressed 'hope' in the future and a need for personal commitment to transforming the way we live. This reflects an emphasis on relationships, communities, spirituality, nature and the environment, and a desire for a new way of living.

With the NEP [Table 5.9], the vast majority (92% and 80% respectively) of respondents agreed with the statements that humans must live in harmony with nature in order to survive and that the balance of nature was delicate and easily upset by human activities. The vast majority disagreed with the statements that humans could not influence nature (73%) and that there was no limit to growth in Australia (74%). These results suggest the respondents hold strong environmental views.

The last set of statements used to explore world views was drawn from the work by Stern *et al* (1998,

Table 5.9: Views about human impacts on the environment (based on Dunlap and van Liere, 1978)

| <b>New Environment Paradigm scale</b>  | <b>N/A</b> | <b>Disagree</b> | <b>Not sure</b> | <b>Agree</b> | <b>Mean score ~</b> |
|--|------------|-----------------|-----------------|--------------|---------------------|
| Humans must live in harmony with nature in order to survive (n=91) (C – 4.32; E – 4.09)            | 0%         | 2%              | 6%              | 92%          | 4.24                |
| The balance of nature is delicate and easily upset by human activities (n=90) (C – 4.16; E – 3.74) | 0%         | 9%              | 11%             | 80%          | 4.02                |
| We are approaching a limit to the number of people the earth can support (n=91)                    | 2%         | 15%             | 24%             | 57%          | 3.97                |
| Humans cannot influence nature (n=91)  | 0%         | 73%             | 10%             | 18%          | 2.16                |
| There are no limits to growth for resource rich nations like Australia (n=91) (C – 1.91; E – 2.46) | 0%         | 74%             | 10%             | 16%          | 2.12                |

Table 5.10: Sense of obligation to respond to climate change (based on Stern et al. 1998, 1999 and Langford 2002).

| Sense of obligation and levels of concern (Stern et al; Langford)                            | N/A | Disagree | Not sure | Agree | Mean score ~ |          |
|--|-----|----------|----------|-------|--------------|----------|
| I feel an obligation to do whatever I can to reduce my carbon emissions (C – 4.01; E – 3.35) | 0%  | 11%      | 14%      | 74%   | 3.78         | Agree    |
| I feel obliged to do whatever I can to prepare for climate change (C – 3.86; E – 3.23)       | 1%  | 14%      | 19%      | 66%   | 3.65         |          |
| It is primarily the responsibility of industry to reduce carbon emissions                    | 0%  | 36%      | 12%      | 52%   | 3.16         | Not sure |
| US, India and China should reduce their emissions before Australia                           | 2%  | 43%      | 18%      | 37%   | 3            |          |
| It is primarily the Government’s responsibility to protect the environment                   | 0%  | 70%      | 8%       | 22%   | 2.34         | Disagree |
| I don’t believe there is a climate problem (n=90) (C – 2.06; E – 2.77)                       | 0%  | 58%      | 24%      | 17%   | 2.31         |          |
| If there is a climate problem, I’m not concerned at present (n=90) (C – 2.03; E – 2.79)      | 2%  | 64%      | 17%      | 17%   | 2.28         |          |

1999) on a ‘sense of obligation’ and moral duty to protect what is valued, and Langford’s work (2002) on measuring levels of concern. The findings are presented in Table 5.10.

The majority of respondents indicated they did feel a sense of obligation to do whatever they could to reduce their personal carbon emissions (74%), and to do whatever they could to prepare for climate change (66%). A majority also indicated that they did not think it was the primary responsibility of government to protect the environment (70%), with 52% agreeing that the reduction in carbon emissions was the primary responsibility of industry, and 43% disagreeing that US, China and India should reduce their emissions before Australia does. A majority disagreed with the statement that ‘if there is a climate problem, I’m not concerned at present’ (64%), and with the statement ‘I don’t believe there is a climate problem’ (58%). That is, most agreed that there is a climate problem and they were concerned about it.

There were statistically significant differences between the two sites for the statement concerning a sense of obligation, with respondents from Eskdale

agreeing but more likely to be unsure. Eskdale residents were significantly more likely to say they don’t believe there is a climate problem.

Table 5.11 summarises the findings from the Cronbach Alpha test designed to identify the best combination of explanatory items for a scale for ‘views about the state of the world’. There were four items which were statistically acceptable (i.e. alpha > 0.7). These were the two statements associated with Eckersley’s ‘Fundamentalism’, and two statements associated with Stern *et al*’s ‘levels of concern’.

No acceptable Cronbach’s Alpha combinations were found for the set of NEP statements. So, in the pairwise and regression analyses exploring causality the NEP items were included as separate items.

### Guiding principles

Stern *et al* (1998) developed a scale for values, arguing that “...values should be a particularly good predictor of attitudes toward emerging attitude objects” – in this case, climate change. Statements were used from each of the four value clusters which Stern *et al* concluded “...provided a sound

Table 5.11: The best Cronbach Alpha combinations for “world views”

| Items   | Best Cronbach’s Alpha combination   |
|---|---|
| World views (Eckersley – Fundamentalism) (n=87) | We are facing a fundamental conflict between good and evil.<br>We need to return to traditional religious teachings and value to solve global problems and challenges . (alpha 0.744) |
| New environmental paradigm                      | No acceptable combinations  |
| Level of concern(Stern et al) (n=90)            | I don’t believe there is a climate problem.<br>If there is a climate problem, I’m not concerned at present (alpha 0.781)  |

Table 5.12: Important guiding principles

|    | Guiding principles   | Don't know | Not important | Some importance | Important | Mean score ~ |
|----|--|------------|---------------|-----------------|-----------|--------------|
| SV | Contributing to a sense of community (n=91)                            | 4%         | 6%            | 26%             | 63%       | 4.29         |
| AV | Protection of our individual rights (n=91)                             | 6%         | 1%            | 9%              | 85%       | 4.17         |
| TV | Honouring of parents and respect for community elders (n=91)           | 6%         | 3%            | 8%              | 84%       | 4.16         |
| AV | Ensuring a fair go for all (n=91)                                      | 4%         | 0%            | 15%             | 80%       | 4.05         |
| AV | Equal opportunity for all (n=91)                                       | 4%         | 2%            | 9%              | 85%       | 4.04         |
| TV | The practice of self-discipline and self-restraint (n=91)              | 6%         | 7%            | 19%             | 69%       | 3.86         |
| OV | To live a varied life, filled with challenge, novelty and change(n=91) | 0%         | 10%           | 21%             | 69%       | 3.67         |
| OV | Curiosity and a keen interest in everything (n=91)                     | 5%         | 10%           | 26%             | 58%       | 3.63         |
| SV | Leadership, and an ability to influence others (n=91)                  | 6%         | 19%           | 28%             | 48%       | 3.33         |
| SV | Creating wealth and a striving for financial prosperity (n=91)         | 4%         | 22%           | 36%             | 37%       | 3.17         |

value base of understanding attitudes and behaviour. These were:

- Altruistic values (AV)
- Self-enhancement values (SV)
- Traditional values (TV)
- Openness to Change values (OV)

The findings for this section of the survey are presented in Table 5.13.

Essentially, the vast majority of respondents reported that all of these values were of at least some importance as a guiding principle in their lives. The most important guiding principles, however, were associated with equal opportunity, a fair go for all, protection of individual rights, honouring of parents and community elders, and contributing to a sense of community.

Out of the four potential scales, only the Openness to Change value statements produced

an acceptable scale with Cronbach Alpha score of > 0.7.

### Adaptations as a function of influential factors – a modelling exercise

Adaptive actions =  $\int \{x,y,z, \dots \text{influential factors}\}$

A range of statistical approaches were employed to analyse survey data to explore relationships between adaptive actions by rural landholders and a wide range of influential factors. For this analysis the data from both study sites was combined. The first step was to use pairwise comparisons to identify statistically significant relationships between each of the 18 identified adaptive actions (outlined in survey Section 9 – Property Management) and the 102 potentially influential factors for which data

Table 5.13: The Best Cronbach Alpha combinations for “important guiding principles”

| Items                                 | Best Cronbach Alpha combination   |
|---------------------------------------|---|
| Openness to change values (OV) (n=87) | 1. Curiosity and a keen interest in everything<br>2. To live a varied life, filled with challenge, novelty and change (alpha 0.742) |

Table 5.14: Property management options

- |   |   |
|---|---|
| 1. Improved ability to capture water              | 10. Increase fodder storage capacity            |
| 2. Improved efficiency of water usage             | 11. Increased off-farm work                     |
| 3. Establish perennial pasture                    | 12. Value add to farm products                  |
| 4. Overall reduction in stocking rates            | 13. Sold or lease land to others                |
| 5. Move from annual to perennial pasture          | 14. Move to more intensive use of existing land |
| 6. Purchase/leased more land in your district     | 15. Move to a low input production system       |
| 7. Purchased/leased more land in another district | 16. Change the way you market your product      |
| 8. Diversification of farm enterprises            | 17. Planted trees, shrubs, native grasses       |
| 9. Change enterprise mix                          | 18. Fence native bush to restrict stock access  |

was gathered in the survey (refer Table 5.16 below). The four adaptations highlighted in Table 5.14 were considered 'not applicable' by too many respondents for inclusion in the modelling of influential factors. Therefore no model of influential factors was possible for these adaptations.

The second step was to employ regression analysis to identify the influential factors most strongly correlated to the adaptive actions. A Multi R<sup>2</sup> analysis was then used to see how well the model for each adaptive action was explained by the influential factors [Table 5.16]

An additional step was to group highly correlated adaptations (independent variables), creating 6 new variables (VAR 1, VAR 2, VAR 3, VAR 4, VAR5 and VAR 6). These groupings were then linked to the tactical and strategic scores as per Table 3.6 in the Methodology section, enabling us to explore differences in the key factors influencing the implementation of tactical and strategic adaptations [Table 5.17].

### Key influences on adaptive actions

As explained in the Methodology section, it is possible that a statistically significant relationship between an independent variable and a dependent variable is the result of the independent variable being correlated with another independent

variable. For example, it is possible that items measuring a world view and a belief about climate change are both significantly related to a specific adaptation and are also, significantly correlated. In this example, it is possible that a respondent's world view also shapes their belief about climate change. Regression modelling is one way of addressing this issue of co-linearity between independent variables. Regression modelling assumes that when a number of independent variables are correlated, that only the variable that is most strongly correlated to the dependent variable should be retained. Using this approach, models for each dependent variable (adaptive actions) are developed, identifying the mix of influential factors (independent variables) that provide the 'best' explanation of variance in the adaptive action (dependent variable). The amount of variance explained by the model (R<sup>2</sup> value) provides a test of the extent that key independent variables have been included in the model.

Table 5.16 presents all the relationships found between the dependent and independent variables (adaptive actions and influential factors) through the pairwise analysis, with the most significant relationships, identified by the multivariate regression analysis, highlighted (■). The explanatory power of the influential factors is indicated by the Multi R<sup>2</sup> values located along the top line.

Table 5.15: The most frequent influential factors (pairwise analysis)

| Influential factors (survey section)                                     | Adaptive actions       |                      |                       |                        |                          |                           |                       |                         |                        |                            |                         |                             |                 |                       |
|--|------------------------|----------------------|-----------------------|------------------------|--------------------------|---------------------------|-----------------------|-------------------------|------------------------|----------------------------|-------------------------|-----------------------------|-----------------|-----------------------|
|  | Improved water capture | Water use efficiency | Est perennial pasture | Reduced stocking rates | Annual to perennial past | Diversify farm enterprise | Change enterprise mix | Increase fodder storage | Increase off-farm work | Value add to farm products | More intensive land use | Low input production system | Plant trees etc | Fence off native bush |
| Steps that agricultural enterprise can take to become carbon neutral (3) | P                      | P                    | P                     | P                      |                          |                           |                       |                         |                        |                            |                         |                             |                 | P                     |
| US, India, China should reduce their emissions before Australia (5)      | P                      | P                    |                       |                        |                          |                           |                       |                         |                        | P                          |                         |                             | N               | N                     |
| Humans must live in harmony with nature in order to survive (5)          |                        |                      |                       |                        |                          | P                         |                       |                         | P                      |                            |                         | P                           | P               |                       |
| Risk from pest plants (6)  |                        | P                    |                       |                        |                          |                           |                       |                         |                        |                            |                         | P                           | N               | N                     |
| Ability to adapt – water supply for stock and domestic (7)               |                        |                      | N                     |                        |                          |                           |                       | N                       |                        |                            | N                       |                             |                 |                       |
| Protection of individual rights (8)                                      | P                      |                      | P                     | P                      |                          |                           |                       |                         |                        | P                          | P                       | P                           | P               |                       |
| Protection of the environment (8)  |                        |                      |                       |                        |                          | P                         | P                     |                         |                        |                            |                         | P                           | P               | P                     |
| To live a varied life, filled with challenge, novelty and change (8)     |                        |                      |                       |                        |                          | P                         | P                     |                         |                        | P                          |                         |                             | N               |                       |
| Ensuring a fair go for all (8)   |                        | P                    |                       | P                      |                          |                           |                       |                         |                        |                            |                         |                             | P               | P                     |
| Equal opportunity for all (8)  |                        | P                    |                       | P                      |                          |                           | P                     |                         |                        |                            |                         | P                           | P               |                       |
| Establish perennial pasture (9)  |                        | P                    | P                     | P                      |                          |                           |                       |                         |                        | P                          |                         |                             |                 | P                     |
| Increased off-farm work (9)  |                        | P                    |                       |                        |                          | P                         |                       |                         | P                      | P                          |                         |                             |                 |                       |
| Plant trees, shrubs and native grasses (9)                               |                        |                      |                       | P                      |                          | P                         | P                     |                         |                        |                            |                         | P                           |                 |                       |

Note: the numbers in ( ) refer to the tactical vs strategic rating. P = positive relationship; N = negative relationship

From this pairwise analysis, Table 5.15 presents a summary of the most frequent influential factors found across the 13 adaptive actions. The most frequent influential factor, identified for 7 ■ of the adaptive actions, was found to be the protection of individual rights. This was followed by the view that US, India, and China should reduce their emissions before Australia; protection of the environment and equal opportunity for all as important guiding principles; and the establishment of perennial pastures – identified for 5 ■ of the adaptive actions.

The models of 'greatest fit' in this study (i.e. Multi  $R^2 > 35\%$ ), where the highlighted influential factors provide good explanatory power, include those for the adaptations of:

- increased off-farm work ( $R^2$  49%);
- a change in enterprise mix ( $R^2$  48%);
- value adding to farm products ( $R^2$  46%);
- a move to low input production systems ( $R^2$  43%);
- the diversification of enterprise mix ( $R^2$  41%);
- the planting of trees, shrubs and native grasses ( $R^2$  40%) and
- fencing off native bush to restrict stock access ( $R^2$  36%).

As these tend to be at the more strategic end [refer Table 3.6] of adaptive actions, it is interesting to learn what influences such behaviour.

It is not surprising to learn that the key factors influencing **increased off-farm work** include concerns about the risk of climate change to reduced water supply for pasture production, and a decline in property income. Another key factor was the belief that humans must live in harmony with nature in order to survive. In addition to these key factors, the pairwise analysis found that those who increased their off farm work may be influenced by a desire to diversify the farm enterprise. They were also more likely to be involved in fencing native bush to restrict stock access, and to sell or lease land to others.

In this study, those most likely to **change their enterprise mix** are rural landholders who believe it is important to live a varied life filled with challenge, novelty and change, and who believe they have the ability to adapt to climatic challenges. They also consider it important to protect the environment. Other less statistically significant factors influencing this behaviour include the view that environmental protection is not the responsibility of government, a concern about the risk of climate change to family health and wellbeing, and involvement in a range of other adaptive measures such as enterprise diversification, improved water capture and water use efficiency, and the planting of trees, shrubs and native grasses. Being female was also found to be a factor.

Larger property size was found to be a significant

influential factor in **value adding to farm products**. So too was a strong commitment to place where rural landholders reported being happiest when at their property, stating it was the best place for doing the things they most enjoy. They are likely to be of the view that US, India and China should reduce their emissions before Australia, and believe it important that our individual rights be protected. Of the less statistically significant factors influencing this behaviour include the view that it is important to live a varied life, filled with challenge, novelty and change, and the likelihood of being involved in a range of other adaptive actions – namely, improved water use efficiency, increased fodder storage, fencing of native bush, a move toward low input production systems, changed product marketing and enterprise diversification.

A key factor influencing the decision to move toward **low input production systems** was found to be knowledge about the implications of a 1–2° increase in global temperatures for agriculture in the local district. Other key influential factors include a concern for the risk of increased pest plants and insects as a consequence of climatic conditions, and the ability to adapt. This adaptation was found to be influenced by a belief that humans must live in harmony with nature in order to survive, and a sense of obligation to do whatever possible to prepare for climate change. This adaptation was also influenced by the view that it is important to practice self-discipline and self-restraint, to take a leadership role to influence others, and to ensure equal opportunity for all. Those whose management practices are heading in this direction are likely to plant trees, shrubs and native grasses, and to think it important to protect the environment.

**Diversification of the farm enterprise** is significantly linked to declining property income. Such adaptive behaviour was found to be influenced by the view that humans must live in harmony with nature in order to survive, combined with a concern for the survival of some native vegetation as a consequence of changing climatic conditions. Implementation of this adaptation is also linked to beliefs about the importance of protecting the environment, contributing to a sense of community, living a varied life, and being open to change.

The **planting of trees, shrubs and native grasses** as an adaptation to climate change is significantly linked to a desire to be part of a rural community. Knowledge of the Federal Government's plans for an emissions trading scheme, and the belief that Australia should not wait for US, India and China to reduce their carbon emissions, were also found to be significant influences. The decision to implement this adaptive action is also influenced

Table 5.16: Set of influential factors and their relationship to the adaptive actions

|                | Multi R <sup>2</sup>   | 15%                   | 17%                          | 29%                   | 34%                   | 18%                        | 41%                        | 48%                   | 28%                     | 49%                    | 46%                    | 19%                     | 43%                             | 40%                                 | 36%                                  |
|----------------|--|-----------------------|------------------------------|-----------------------|-----------------------|----------------------------|----------------------------|-----------------------|-------------------------|------------------------|------------------------|-------------------------|---------------------------------|-------------------------------------|--------------------------------------|
| Survey section | Actions taken or under consideration >><br>-----<br>Influential factors          | Improve water capture | Improve water use efficiency | Est perennial pasture | Reduce stocking rates | Change annual to perennial | Enterprise diversification | Change enterprise mix | Increase fodder storage | Increase off-farm work | Value add farm product | More intensive land use | Move to low input prod'n system | Plant trees, shrubs, native grasses | Restrict stock access to native bush |
| 1              | Years property ha been in the family   |                       |                              | POS                   |                       |                            |                            |                       |                         |                        |                        |                         |                                 |                                     | NEG                                  |
| 1              | Property size (ha)   |                       |                              |                       |                       |                            |                            |                       |                         |                        | POS                    |                         |                                 |                                     |                                      |
| 1              | Years lived in district  |                       |                              | POS                   |                       |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 2              | My property enables me to be part of a rural community                           |                       |                              |                       |                       |                            |                            |                       |                         |                        |                        |                         |                                 | POS                                 | POS                                  |
| 2              | This property says very little about who I am                                    |                       |                              |                       | NEG                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 2              | This property provides most of the household income                              |                       |                              |                       |                       |                            |                            |                       |                         | NEG                    |                        |                         |                                 |                                     |                                      |
| 2              | My property reflects the type of person I am                                     |                       |                              |                       |                       |                            |                            | POS                   |                         |                        |                        |                         |                                 |                                     |                                      |
| 2              | I feel happiest when at my property  |                       |                              |                       |                       |                            |                            |                       |                         |                        | POS                    |                         |                                 |                                     |                                      |
| 2              | My property is the best place for doing the things I enjoy most                  |                       |                              |                       |                       |                            |                            |                       |                         |                        | POS                    |                         |                                 |                                     |                                      |
| 2              | I can really be myself at my property  |                       |                              |                       | NEG                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 3              | How carbon can be taken out of the atmosphere and stored                         |                       |                              |                       | POS                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 3              | The explanation provided by scientists for global warming                        |                       |                              |                       | POS                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 3              | The difference between the greenhouse effect and the ozone hole                  | POS                   |                              |                       | POS                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 3              | Implications of a 1–2° increase in global temps for agriculture in your district | POS                   |                              |                       | POS                   |                            |                            |                       |                         |                        |                        |                         | POS                             |                                     |                                      |
| 3              | Steps that agricultural enterprise could take to become carbon neutral           | POS                   |                              | POS                   | POS                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     | POS                                  |
| 3              | Broad climate change projections for your region by 2050                         |                       | POS                          |                       | POS                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 3              | The Fed Govt plans for a carbon ETS  |                       |                              |                       |                       |                            |                            |                       |                         |                        |                        |                         |                                 | POS                                 |                                      |
| 4              | Human activities are influencing changes in climate                              | POS                   | POS                          |                       |                       |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 4              | Climate maybe changing but currently we are in a cycle                           |                       |                              |                       | POS                   |                            |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 4              | Not too late to take action to address climate change                            |                       |                              |                       |                       |                            |                            |                       | NEG                     |                        |                        |                         |                                 |                                     |                                      |
| 4              | Climate change is out of our control   |                       |                              |                       |                       |                            |                            | POS                   |                         |                        |                        |                         |                                 |                                     |                                      |
| 5              | The world's future looks grim. We can't worry about everyone else                |                       |                              |                       |                       | NEG                        |                            |                       |                         |                        |                        |                         |                                 | NEG                                 |                                      |
| 5              | It is the responsibility of industry to protect the environment                  |                       |                              |                       |                       | NEG                        |                            |                       |                         |                        |                        |                         |                                 |                                     |                                      |
| 5              | US, India, China should reduce their emissions before Australia                  | POS                   | POS                          |                       |                       |                            |                            |                       |                         |                        | POS                    |                         |                                 | NEG                                 | NEG                                  |
| 5              | It is the gov't's responsibility to protect the environment                      |                       |                              |                       |                       |                            |                            | NEG                   |                         |                        |                        |                         |                                 |                                     |                                      |
| 5              | Humans must live in harmony with nature in order to survive                      |                       |                              |                       |                       |                            | POS                        |                       |                         | POS                    |                        |                         | POS                             | POS                                 |                                      |
| 5              | There are no limits to growth for resource rich nations like Australia.          |                       |                              | POS                   |                       |                            |                            |                       |                         |                        |                        |                         |                                 |                                     | NEG                                  |
| 5              | Humans cannot influence nature   |                       |                              |                       |                       |                            |                            |                       |                         |                        |                        |                         |                                 |                                     | NEG                                  |
| 5              | Need to transform our way of life if we are to create a better future            |                       |                              |                       |                       |                            |                            | POS                   |                         |                        |                        |                         |                                 |                                     |                                      |
| 5              | I feel obliged to do whatever I can to prepare for climate change                |                       |                              |                       |                       |                            |                            |                       |                         |                        |                        |                         | POS                             |                                     |                                      |



by beliefs that humans must live in harmony with nature to survive, and a feeling of obligation to do whatever can be done to reduce carbon emissions. Those who are likely to implement this adaptation are concerned about the negative impacts of climate change on their property and family health and wellbeing. They believe it important that we ensure a fair go for all and to strive to create wealth and financial prosperity.

Of all the adaptive actions, **fencing off native bush to restrict stock access** has the most highly significant influential factors. Firstly, the longer the property has been in the family the LESS likely this action will be implemented. However, a sound knowledge of the steps that an agricultural enterprise can take to become carbon neutral was found to be an important influential factor. Those most likely to implement this adaptation *do not* believe that US, India and China should reduce their emissions before Australia. They *do not* believe there are no limits to growth for resource rich nations like Australia. They *do* believe that humans are influencing nature, and are concerned about the negative impacts of pest plants on their property and for the health and wellbeing of their family. Membership of Landcare was found to be a highly significant factor.

At the lower end of the Multi  $R^2$  measure of good fit (>15% – noting that this is still an acceptable fit), are the adaptive actions concerned with:

- reduced stocking rates ( $R^2$  34%);
- establishment of perennial pasture ( $R^2$  29%);
- increased fodder storage capacity ( $R^2$  28%);
- a move toward more intensive use of existing land ( $R^2$  19%);
- change from annual to perennial pasture ( $R^2$  18%);
- improved water efficiency ( $R^2$  17%); and
- improve water capture ( $R^2$  15%).

The most significant factors influencing the decision to **reduce stocking rates** include a negative relationship with the property providing most of the household income (i.e. the property is not the main source of income), an understanding of the steps that an agricultural enterprise can take to become carbon neutral, an improved ability to capture water. Other influential factors include a negative relationship with the statement “I can really be myself at my property”, a positive link with several topics associated with knowledge about the science of climate change and the implications of increased temperatures for agriculture. Those who adopt this approach are likely to believe that while the climate may be changing, we are currently in a natural cycle. They are likely to consider it important to protect our individual rights, while ensuring a fair go and equal opportunity for all, and consider it important

to practice self-discipline and self restraint, while remaining open to change.

The **establishment of perennial pasture** is highly linked to the number of years a landholder has lived in the district, and the number of years the property has been in the family. Views concerning the protection of individual rights and the importance of creating wealth and striving for financial prosperity are also highly significant influences. To a lesser extent knowledge about the steps that an agricultural enterprise can take to become carbon neutral, and concerns about the ability to adapt to reduced water supply for stock and domestic, are also important influential factors. The adopters of this management approach are likely to believe that there are no limits to growth for resource rich nations like Australia, and think it important to honour parents and community elders.

The decision to **increase fodder storage capacity** is highly linked to a negative relationship with the statement “It is not too late to take action to address climate change” – which means the adaptation is highly influenced by a belief that it is possibly too late to take action to prevent the impacts of climate change. It makes sense that this adaptation is also highly linked to concerns about the ability to adapt to the impacts on water supply for stock and domestic and on pasture productivity.

A move toward a **more intensive use of existing land** is highly linked to concerns about the ability to adapt to the impacts on water supply for stock and domestic. It is also highly linked to the view that it is important to protect individual rights.

Initially it might seem that establishing perennial pasture and changing from **annual to perennial pasture** are one and the same thing. However, the change from annual to perennial is influenced by different factors. Unlike the establishment of perennial pasture, the stronger the view that the world's future looks grim, the less likely a landholder is to change from annual to perennial. Similarly, the stronger the view that it is the responsibility of industry to protect the environment the less likely it is that this adaptation will be implemented. One other highly significant factor influencing this adaptation is the view that it is important to honour parents and community elders.

Many factors were found to be influential in the decision to **improve water-use efficiency**. However, there were no highly significant factors identified through the regression analysis. From the pairwise analysis, the study found that this decision is influenced by concerns about the risks of pest insects and plants, reduced water supply for pasture production, impacts on pasture productivity, and impacts on personal and family health and

wellbeing resulting from changed climatic conditions. This management decision was also found to be influenced by a broad knowledge of climate change projections for the region, the belief that human activities are influencing changes in climate, and that the US, India and China should reduce their emissions before Australia.

The decision to **improve the ability to capture water** is influenced by an understanding of the implications of a 1–2° increase in global temperatures for agriculture in the district, and steps that can be taken by an agricultural enterprise to become carbon neutral. This management decision is also influenced by a belief that human activities are influencing changes in climate, and that US, India and China should reduce their emissions before Australia.

### **Adaptive actions – tactical versus strategic**

The next step in the modelling exercise was to narrow the field of adaptive actions into groupings of highly correlated dependent variables (i.e. highly correlated adaptive actions) which were subsequently renamed as new dependent variables (VAR1 – VAR6). VAR1 is made up of improved ability to capture water, increased water use efficiency, establishment of perennials and reduced stocking rates. VAR2 is made up of improved ability to capture water, reduced stock rates, and improved water use efficiency. VAR3 is made up of improved ability to capture water, increased fodder storage capacity, and improved water use efficiency. VAR4 is made up of diversification of farm enterprise, more intensive use of existing land, and increased off-farm work. VAR5 is made up of reduced stocking rates, improved water use efficiency, establishment of perennial pastures, and change in product marketing. VAR6 is made up of reduced stock rates, fencing

of native bush to restrict stock access, diversification of farm enterprise, and more intensive use of existing land. These new variables are summarised in Table 5.18 below.

Using a generalised linear model, independent variables (i.e. influential factors) were chosen from the pairwise comparison that had at least 85% of respondents in them. While recognising that this process typically removes independent variables (influential factors) which may well be relevant, the models were all found to have relatively high explanatory value (i.e. Multi R<sup>2</sup> greater than 10%). Table 5.19 presents the final model for each of the new adaptive action groupings where only the most significant influential factors have been retained.

These new dependent variables (adaptive actions) can now be categorised in terms of their tactical versus strategic nature. VAR 1, VAR2 and VAR3 (Multi R<sup>2</sup> – 45%, 30% and 14% respectively) are reflective of tactical/reactive responses to climatic challenges – meaning that these adaptations are largely ones adopted after the fact. VAR4 (Multi R<sup>2</sup> -39%), in contrast is made up of adaptive actions which are all highly strategic or anticipatory in nature. VAR5 and VAR6 (Multi R<sup>2</sup> -32% and 18% respectively), include adaptive actions across the spectrum of tactical and strategic.

Taking the new dependent variables (VAR) with the highest Multi R<sup>2</sup> rating (i.e. the model of best fit), and which are reflective of the spectrum of tactical vs. strategic adaptations, we can now look at the influential factors behind tactical and strategic responses by the rural landholders in this study. With reference to Table 5.19 we can see that VAR1 (Multi R<sup>2</sup> – 45% and tactical/strategic item ratings of 2,4,4,2) is highly tactical, VAR4 Multi R<sup>2</sup> – 39% and 6,8,8) is highly strategic, and VAR5 (Multi R<sup>2</sup> 32% and 4,8,4,2) is a mix of tactical and strategic.

Table 5.18: Ranking of adaptive actions combined as new independent variables

|                       | Tactical vs strategic rating | Adaptive actions (highly correlated only)  | New dependent variables |      |      |      |      |      |
|-----------------------|------------------------------|--|-------------------------|------|------|------|------|------|
|                       |                              |  | VAR1                    | VAR2 | VAR3 | VAR4 | VAR5 | VAR6 |
| Strategic<br>Tactical | 2                            | Improved ability to capture water          |                         |      |      |      |      |      |
|                       | 2                            | Reduced stock rates                        |                         |      |      |      |      |      |
|                       | 3                            | Increased fodder storage capacity          |                         |      |      |      |      |      |
|                       | 4                            | Improved water use efficiency              |                         |      |      |      |      |      |
|                       | 5                            | Establish perennial pastures               |                         |      |      |      |      |      |
|                       | 4                            | Fence native bush to restrict stock access |                         |      |      |      |      |      |
|                       | 6                            | Diversification of farm enterprise         |                         |      |      |      |      |      |
|                       | 8                            | Change product marketing                   |                         |      |      |      |      |      |
|                       | 8                            | More intensive land use                    |                         |      |      |      |      |      |
|                       | 8                            | Increased off-farm work                    |                         |      |      |      |      |      |

Table 5.19: Model of influential factors for the new independent variables

|                       | <b>Multi R<sup>2</sup></b>   | <b>45%</b>   | <b>30%</b>  | <b>14%</b>   | <b>39%</b>  | <b>32%</b>   | <b>18%</b>   |
|-----------------------|--|--|---|--|---|--|--|
|                       | <b>Adaptation score</b>  | <b>2,4,4,2</b>   | <b>2,4,2</b>  | <b>2,4,3</b>   | <b>6,8,8</b>  | <b>4,8,4,2</b>   | <b>6,8,4,2</b>   |
| <b>Survey section</b> | <b>Actions taken or under consideration</b>                            | VAR 1<br>water capture, water use efficiency, perennial pasture, reduced stocking rate | VAR 2<br>water capture, water use efficiency, reduced stocking rate | VAR 3<br>water capture, water use efficiency, increased fodder storage | VAR 4<br>diversification, more intensive use, off-farm work | VAR 5<br>Water use efficiency, changed marketing, perennial, reduced stocking rate | VAR 6<br>diversification, more intensive use, fence native bush, reduced stocking rate |
| 2                     | This property says very little about who I am                          |  | NEG   |  |   |  | NEG  |
| 2                     | This property is a great place to raise a family                       |  |   |  | NEG   |  |  |
| 3                     | Potentially serious impacts of global climate change                   |  | POS   |  |   |  | POS  |
| 3                     | Difference between greenhouse effect and ozone hole                    | POS  | POS   |  |   |  | POS  |
| 3                     | Implications of 1–2° increase in global temps for local agriculture    | POS  | POS   | POS  |   | POS  | POS  |
| 3                     | Steps that agricultural enterprise could take to become carbon neutral | POS  | POS   |  |   | POS  | POS  |
| 3                     | Broad climate change projections for region by 2050                    | POS  | POS   |  |   | POS  | POS  |
| 4                     | Human activities are influencing changes in climate                    |  | POS   |  | POS   |  | POS  |
| 5                     | US, India, China should reduce their emissions before Australia        | POS  | POS   |  |   |  |  |
| 5                     | Humans must live in harmony with nature in order to survive            |  |   |  | POS   |  | POS  |
| 5                     | I feel obliged to do whatever I can to prepare for climate change      |  |   |  |   |  | POS  |
| 6                     | Impact on quality/health of native veg                                 |  |   |  | POS   |  |  |
| 6                     | Pest plants  |  | POS   |  |   | POS  | POS  |
| 6                     | Personal health wellbeing  | POS  | POS   |  |   | POS  | POS  |
| 6                     | Family health well being   |  | POS   |  |   | POS  | POS  |
| 7                     | Ability to adapt – pest plants   |  |   |  | NEG   |  |  |
| 7                     | Ability to adapt – pasture productivity                                | NEG  |   | NEG  |   |  |  |
| 7                     | Ability to adapt – attractiveness of property landscape                | NEG  | NEG   |  |   |  |  |
| 7                     | Ability to adapt – water supply for stock and domestic                 |  |   | NEG  |   |  |  |
| 8                     | Honouring of parents and respect for community elders                  | POS  | POS   | POS  | POS   | POS  |  |
| 8                     | Protect our individual rights  | POS  | POS   | POS  | POS   | POS  | POS  |
| 8                     | Protection of the environment  |  |   |  |   |  | POS  |
| 8                     | Ensuring a fair go for all   | POS  |   |  |   | POS  | POS  |
| 8                     | Equal opportunity for all  | POS  | POS   | POS  | POS   | POS  | POS  |
| 8                     | Curiosity and a keen interest in everything                            | POS  | POS   |  |   | POS  | POS  |
| 8                     | Leadership and ability to influence others                             |  |   |  |   | POS  |  |
| 9                     | Improved ability to capture water                                      | POS  | POS   |  |   | POS  | POS  |
| 10                    | Property income  |  |   |  | NEG   |  |  |
| 10                    | Landcare member  |  |   |  |   |  |  |
| 10                    | Voluntary organisations  |  |   | POS  |   | POS  |  |
| 10                    | Occupation   |  |   |  | NEG   |  |  |

The highlighted (■) relationships were those found to be statistically the most highly correlated.

**VAR1 (tactical)** is made up of the four most tactical adaptations including *improved water capture, improved water use efficiency, establishment of perennial pasture, and reduced stocking rates*. The decision to adopt this set of actions, according to the pairwise analysis (and the identification of the most significant factors highlighted [■] in Table 5.19), is influenced by knowledge of the steps that can be taken by an agricultural enterprise to become carbon neutral. It is influenced by attitudes reflected in the statement that US, India and China should reduce their emissions before Australia, and concerns for the ability to adapt to reduced water supply for pasture production. This grouping of adaptations is also influenced by a set of values reflected in the statement that it is important to honour parents and respect community elders.

**VAR4 (strategic)** is made up of three adaptations including *diversification of farm enterprise, a move toward more intensive use of existing land, and increased off-farm work*. The decision to adopt this set of actions, according to the analysis, is influenced by beliefs reflected in the statement that human activities are influencing changes in climate, and concerns for the impact of climate change on native vegetation quality and health. Adopters also think it is important to honour parents and respect community elders, to protect individual rights, and ensure equal opportunity for all. The decision to adopt this strategy is also linked to declining property income.

**VAR5 (tactical/strategic)** is made up of four adaptations spread across the tactical/strategic spectrum including *improved water use efficiency, changed farm product marketing, establishment of perennial pasture, and reduced stocking rates*. The decision to adopt this set of actions is influenced by locally relevant knowledge reflected in knowledge about the implications of 1–2° increase in global temperatures for agriculture in the local region, and the steps that can be taken by an agricultural enterprise to become carbon neutral. These adopters may have already implemented actions to improve their ability to capture water on their property. Adopters of this set of management options also think it is important to honour parents and respect community elders, to protect individual rights, and ensure equal opportunity for all, but also to be actively involved in voluntary organisations.

This analysis, which has progressively focused the adaptive actions in terms of their tactical and strategic nature and identified the most explanatory influential factors, has produced a series of models which can be used to better understand

the socio-psychological drivers of adaptation responses. For example, if we want to encourage rural landholders to adopt a range of tactical and strategic adaptations, it would seem instructive to find a way of communicating knowledge about local implications and actions by mechanisms which reflect this need to respect the older generation of landholders, in a dialogue which emphasises the importance of protecting individual rights and equal opportunity.

### **Areas of significant difference between the two study sites**

The mail survey comprised 136 items, 18 of which were adaptive actions (section 9 – Property management), and 118 were potential influential factors. The statistical analyses found there to be *no* significant difference between the two study sites for all but 28 of the influential factors. More specifically, there were no significant differences in the topic areas of knowledge about climate change, the perceived nature of the climate change risk, property management, and guiding principles in life [Table 5.20]. Given that the two sites are geographically and demographically different, this suggests that the socio-psychological factors influencing behaviour are much the same across the two areas. However, there are some areas of significant difference that are important to examine. These areas of difference are summarised in Table 5.20.

### **Demographic differences**

As expected, there was a significant difference in property size, the number of years people have lived in the local district and the number of years the property has been in the family. Eskdale is an area where most rural landholders are primarily farmers, whose families have lived in the area and owned their property for several generations. It is therefore not surprising to find that Eskdale people were more likely to report that their property was important to them because it provided most of the household income, and that they considered it important to be able to pass it on to future generations.

It is also not surprising to find that there is a significant difference in the number of people with professional (or non-farmer) occupations, and those with off-farm work. Chiltern is an area which has a higher proportion of hobby farms and therefore more people who are employed outside of farming. It is therefore understandable that the profit from the property is significantly less in the Chiltern area.

Interestingly Chiltern is more likely to have people involved in Landcare, and for whatever reason, there were significantly more women respondents

to the Chiltern survey than the Eskdale survey.

### **Differences in views about climate change**

This study sought to understand people's values and beliefs about climate change via a couple of different mechanisms. What people believed to be 'true' about climate change was explored directly through topic 4 – *Your views about climate change*.

The combined data indicated that only 6% of respondents agreed with the statement that "there

is no such thing as climate change". However, there is a statistically significant difference in the mean scores of Eskdale and Chiltern responses to this statement. According to the mean scores, the people from Chiltern are more likely to disagree/strongly disagree with this statement (1.66), while the people from Eskdale were more likely to be unsure (2.20). Respondents from Chiltern were more likely to believe there will be dire consequences if we do nothing about climate change (3.78), and more

Table 5.20: Statistically significant differences between Eskdale and Chiltern

| Survey section                             | Statement   | Chiltern mean score       | Eskdale mean score        | P – value |
|--|---|---------------------------|---------------------------|-----------|
| Your property (1)                          | Property size   | 142 ha                    | 246 ha                    | 0.018     |
|  | Years lived in local district   | 39 years                  | 27 years                  | 0.029     |
|  | Years property has been in family                                       | 22 years                  | 61.5 years                | 0.003     |
| Property importance (2)                    | This property provides most of the household income                     | 2.60                      | 3.85                      | 0.001     |
|  | Important for me to pass the property on to others                      | 3.22                      | 4.07                      | 0.002     |
| Knowledge of climate change (3)            | No significant difference   |                           |                           |           |
| Views about climate change (4)             | There is no such thing as climate change                                | 1.66                      | 2.20                      | 0.020     |
|  | The climate maybe changing but currently we are in a cycle              | 3.35                      | 3.80                      | 0.015     |
|  | If we do nothing climate change will have dire consequences             | 3.78                      | 3.06                      | 0.006     |
|  | Human activities are influencing changes in climate                     | 4.08                      | 3.35                      | 0.007     |
| Views about the state of the world (5)     | There are no limits to growth for resource rich nations like Australia  | 1.91                      | 2.46                      | 0.023     |
|  | If there is a climate problem, I'm not concerned at present             | 2.03                      | 2.79                      | 0.001     |
|  | I don't believe there is a climate problem                              | 2.06                      | 2.77                      | 0.002     |
|  | I feel obliged to do whatever I can to prepare for climate change       | 3.86                      | 3.23                      | 0.004     |
|  | I feel an obligation to do whatever I can to reduce my carbon emissions | 4.01                      | 3.35                      | 0.004     |
|  | The balance of nature is delicate and easily upset by human activities  | 4.16                      | 3.74                      | 0.019     |
|  | Humans must live in harmony with nature in order to survive             | 4.32                      | 4.09                      | 0.019     |
| Climate change risks to your property (6A) | Personal health and wellbeing   | 3.62                      | 3.03                      | 0.009     |
|  | Family health and wellbeing   | 3.63                      | 3.10                      | 0.017     |
|  | Survival of some native vegetation                                      | 3.84                      | 3.41                      | 0.030     |
|  | Quality or health of native vegetation                                  | 3.96                      | 3.48                      | 0.014     |
| Climate change risks to your property (6B) | No significant difference   |                           |                           |           |
| Ability to Adapt to climate change (7)     | Water supply for stock and domestic                                     | 2.81                      | 2.31                      | 0.033     |
| Guiding principles in your life (8)        | No significant difference   |                           |                           |           |
| Property management (9A)                   | Value add to farm products  | 2.96                      | 1.92                      | 0.030     |
| Property management (9B)                   | No significant difference   |                           |                           |           |
| Background (10)                            | Male/female   | 67% (M)<br>32%(F)         | 87%(M)<br>12%(F)          | 0.069     |
|  | Occupation  | 39% farmer<br>32% profess | 64% farmer<br>16% profess | 0.037     |
|  | Off-farm work   | 69% yes                   | 40% yes                   | 0.014     |
|  | Land care member  | 74%                       | 31%                       | 0.001     |
|  | Net profit from farm  | < \$10,000                | \$10,000 – \$40,000       | 0.003     |

likely to believe that human activities were influencing the changes (4.08). However, Eskdale people were not found to have an opposing view, but were more likely to be unsure in response to these two statements (3.06 and 3.35 respectively).

### ***Differences in views about the state of the world***

Beliefs were also explored through statements concerning world views where a statistically significant difference in mean scores was found for 7 out of the 17 statements. Chiltern respondents were more likely to believe that there is a climate problem (2.06 disagree) and that the balance of nature was easily upset by human activities (4.16 agree). In both cases, Eskdale respondents were more likely to agree with these statements with a leaning toward being unsure (2.77 disagree/unsure, 3.74 unsure). The view that “there are no limits to growth in Australia” was typically supported by Chiltern respondents (1.91), while Eskdale people were more likely to again, report being unsure (2.46).

### ***Differences in risk perception***

What people valued was interpreted here as “things that are important which could be lost as a consequence of climate change, and was linked directly to understanding people’s perception of the risks associated with climate change.

The people of Eskdale and Chiltern were found to perceive the risk of climate change impacts in pretty much the same way. There was no significant difference in mean scores for their perception of the likelihood of impact on eight of the listed potential impacts. However, the Chiltern respondents were

more likely to say it was ‘likely’ that their personal and family health and wellbeing would be impacted upon by climate change. Eskdale respondents were more likely to be unsure. The Chiltern people were more likely to believe it ‘likely’ that some native vegetation would be at risk in terms of health, quality and even survival. Eskdale respondents were more likely to be unsure.

### ***Differences in knowledge about climate change***

It would seem reasonable to think that these differences might be linked to differences in knowledge about climate change and its associated risks. However, no significant difference was found. What might be relevant is the finding that people across both sites reported having greater knowledge about the potentially serious impacts of global climate change but very little knowledge about the implications and potential actions at the local level. This might mean that those who rely on farming for their main source of income (e.g. Eskdale) are going to be more unsure, and seemingly more sceptical.

### ***Differences in ability to adapt to climate change***

In terms of the self-declared perception of ability to adapt to the potential impacts, the mean scores across both sites indicate that people feel they are able to adapt, but with a level of uncertainty. The only area where a statistically significant difference was found was the ability to adapt to impacts on water for stock and domestic. The people from Chiltern were more unsure than those of Eskdale.

## 6. Conclusions

Essentially this study explores the way people of a particular geographical location currently perceive and interpret the dangers of global climate change, and how that translates into an effective response (that is a response which reduces vulnerability). While the majority of Australians demonstrated a considerable concern for climate change through the 2007 Federal election, there is an emerging sense of a divide between those who believe in the climate change science, and those who do not. At times, this divide has been presented in the media as lining up with city [INSERT MEDIA REFERENCE]. An obvious question is why do some see climate change as an urgent, immediate threat, while others view it as a gradual, incremental problem, or not a problem at all?

According to a number of studies (Stedman, 2004; Leiserowitz, 2005), and this one is no exception, the perceived risk of climate change tends to be related more strongly to general beliefs and world views, than to socio-demographic characteristics. As we have already seen in Australia, public policy designed to address climate change will be compelled or constrained by people's perception of the risks and dangers it poses, and therefore it is essential that these motivations be understood.

Before people take steps to protect themselves they must believe that they are at risk in the first place. Risk perception for this study was defined as a function of a) acceptance of the possibility of damage or loss to something of value; b) an understanding of localised and global consequences; and c) a belief in the likelihood of damage occurring. In other words, to take action to defend oneself we need to a) accept that climate change is occurring and has the potential to damage things of value; b) have some understanding of the local and global implications, and c) believe we will be impacted upon. The nature of our response, however, is largely determined by our beliefs and world views.

To explore this complex topic, this study set out a framework for understanding rural landholder behaviour, which provided the basis for the sequential structure of the key questions, which essentially follow the logic of thinking laid out in the preceding paragraph. As depicted in Table 3.1 in the methodology section, there were five key questions which were addressed in specific ways through the interview and survey process. *How rural landholders are interpreting current climatic conditions* was addressed through the interviews by exploring people's recent experiences of the dry conditions and what they thought was the cause and its consequences. The survey specifically sought to

understand the level of knowledge that people had about climate change and what they thought about it as a phenomenon.

Everyone interviewed had observed changes in climatic and weather patterns in recent times including less and less reliable rainfall, more heat and the increase in bush fires and storms. Regardless of the cause, most people understood that they, and their properties, would be impacted upon if the current conditions were to continue. Only 6% of those surveyed believed there was *no such thing as climate change*, with 70% agreeing with the statement that *the climate is changing*. While there were some statistically significant differences between the two study sites in terms of views about climate change, the difference was not large, just slightly more conservative and uncertain in the case of Eskdale. .

From the interviews the message was that farmers tended not to talk in terms of 'climate change' per se, but about the consequences of water and feed shortages. In public at least, they seem to joke about what's going on, and express a frustration that if there is something to worry about why isn't something being done.

From the pairwise analysis we can see that views about climate change maybe influential in determining the types of adaptive actions that are implemented. Four out of the ten statements concerning views about climate change presented as significant influential factors associated with different actions.

A belief that human activities are influencing changes in climate was found to be influential in the decision to improve water capture and water use efficiency. The belief that the climate may be changing but currently we are in a cycle was found to be an influential factor in the decision to reduce stocking rates, suggesting that stocking rates can be adjusted to suit changing conditions. A belief that it is too late to take action to address climate change came up as an influential factor in decisions to increase fodder storage capacity, suggesting that the decision to increase fodder storage was linked to a sense of precaution and preparation for a less certain future. Finally, the belief that climate change is out of our control was found to be influential in decisions to change the enterprise mix, suggesting a level of acceptance that the climate is changing and that the enterprise would have to be adjusted to suit.

Interestingly, the issue of 'belief in climate change' as a key motivator of behaviour did not come strongly through the pairwise analysis with only three adaptive actions being directly influenced

by statements concerning views about climate change.

In terms of knowledge and understanding the implications of climate change, none of the people interviewed had seen specific information on regional climate change projections, while most had heard about the more general projections for south east Australia. A majority of those surveyed knew something about the wider, global implications of climate change, but again knew little to nothing about locally specific projections, or the implications for agriculture in their region. The self-declared believers often expressed some confusion about the technical aspects of the climate change phenomenon and its links with drought, while non-believers (self-declared sceptics) tended to express less confusion about the science and were more confident that there were no links between climate change and drought. Many talked about the difficulty in discerning the 'truth' from information they heard in the news (radio, television, newspapers). Confusion about what climate change is, its causes and its local implications was evident throughout the interview process, and a common theme seemed to be an antagonism toward the way information about climate change was being delivered. The view that the climate change 'crisis' was being 'peddled' by those who have something to gain could reflect the anti-elitist and anti-intellectual world view characterisation of 'sceptical' discussed by Hamilton (2010) and others. Or it could simply be a dislike for the American style presentation of Al Gore's.

The importance of locally relevant knowledge to adaptive behaviour is demonstrated through the pairwise analysis presented in section 5.6. The two knowledge statements found to be highly (positively) linked to both tactical and strategic behaviour (adaptive actions) were a) implications of a 1–2° increase in global temps for agriculture in your district, and b) steps that an agricultural enterprise could take to become carbon neutral (Table 5.17).

The second key question of the study was *how do rural landholders perceive the risk of personal loss or damage*. Through the interview process people were asked what they thought they could lose (or gain) in response to being presented with climate change projections for north-east Victoria. These findings were, in part, presented through the survey as potential impacts of climate change to explore the issue of risk perception – namely, how likely it was that these impacts would occur. Those interviewed typically talked about increased difficulty in farming if the projections were to pan out. Even the non-believers recognised that such conditions would trigger practice change. They also talked about the impact on land values, farm productivity

and an increased rate of exit from farming, including the sale of land. Interestingly, the survey data found that 86% of respondents were not interested (or thought it not applicable) in considering selling or leasing land to others. The survey also revealed that 13% of respondents had thought about leaving if the climate changes.

Survey respondents were not provided with regional projections, but were given a list of potential impacts to which they were asked to state how they perceived the risks of climate change – namely, the likelihood for the potential impact affecting you/your property. Respondents were typically unsure of the likelihood of such impacts occurring but leaning toward the thought that it was likely. The nature of the impacts were typically thought to be small but negative by the vast majority.

The third key question was *how have rural landholders responded to climate change* – that is, what actions are they considering or have they taken to reduce the potential impacts. The interview process dealt with this issue slightly differently to the survey in that the discussion went from actions taken to cope with the current dry and actions they were taking to prepare for the possibility that the 'dry' might continue. Essentially, these discussions were about the tactical responses (actions after the fact) people were making. The most common actions reported were to reduce stocking rates, undertake pasture renovation and strategic cropping (over-sowing with rye or oats), planting perennials, and shifting toward dryland farming practices (i.e. less reliance on irrigation). They also reported increasing dam storage, increasing water troughs and water tanks, and building feed reserves.

In discussions about preparations for the longer term where drought and climate change were an issue, some interviewees said they considered switching enterprises, but most didn't think there was much more they could do. Interestingly, non-believers spoke about there being nothing one could do to deal with difficult climatic conditions that *might* arise in the future – only to make adjustments to what they already did. This response suggests that an inability to adapt (for whatever reason) might be an underlying reason for disbelief.

The survey confirmed these findings, in that the majority of respondents (between 65% and 82%) reported having done, doing now or planning to do the same sort of adaptations – namely improve water capture and use efficiency, reduce stocking rates, plant trees, shrubs and native grasses and establish perennial pastures. There were however, a small but not insignificant proportion (between 27% and 16%) of people who had done, were doing, or planning to do more strategic actions such as move

to a low input production system, change enterprise mix, value add to farm product, and move to more intensive land use. A very small proportion, but there were at least some, reported being involved in highly strategic activities such as acquiring more land in another district, and selling or leasing their land to others.

The fourth key question was about *rural landholder perceptions of their ability to adapt to climate change*. While age did not come up as a key influential factor in the regression analysis, it was frequently mentioned by interviewees as a limiting factor in their ability to adapt. However, the survey and interview findings indicate a feeling of confidence about preparing for the future and adapting as required, with people saying they were resourceful, and they also recognised they had no choice other than to make changes when necessary. The survey findings, however, highlighted a level of uncertainty, particularly around the ability to adapt to reduced water supplies for stock and domestic and pasture production. The people from Chiltern were also feeling less confident than those of Eskdale, which would be reasonable given the difference in water availability in the Chiltern area.

The strong 'commitment to place' that was reflected through the survey findings reinforce the comment about having no choice but to change, because this is where we live. Very few people were thinking about leaving the area as a result of changing climatic conditions.

Another issue that emerged through the interview process was confidence in the information people were receiving. If they were to adapt to a new future, people recognised the need for better information to help them make good decisions. There were some who saw 'huge opportunities in adaptation' and understood the importance of being flexible and 'keeping options open'.

The fifth question, aimed to identify the factors that influence rural landholder behaviour, with particular reference to tactical and strategic adaptations. Everyone interviewed recognised the obstacles to future farming productivity should current climatic patterns persist, suggesting people perceived some level of risk. At a recent forum hosted by the Institute for Land, Water and Society, focused on rural landholder responses to climate change, Neil Barr (Department of Environment and Sustainability, Vic) talked about the financial reality of landholder's capacity to invest in major new initiatives or strategic responses to climate change risk. From his longitudinal work on rural demographics, he points out that only 10% of farmers make over \$300,000 per annum, while 50% make less than \$100,000 per annum, suggesting that most farmers are unable to

respond in a strategic way. Interestingly, concerns about declining property income was found to be a key influential factor for the highly strategic group of adaptations under VAR 4 only.

As expected, concern about decline in property income was linked to increased adoption of the strategic action of increasing off-farm work. The increase in off-farm work was also linked to improved water use efficiency measures, enterprise diversification and value adding to farm product – the latter two, enterprise diversification and value adding, being considered highly strategic actions as well (Section 3.5.2). This raises the a question about whether people prepared to seek off farm work are already demonstrating a willingness to transform their lives? Or, perhaps they already have off-farm work and it just means they are exposed to, open to, new ideas.

Age is an ongoing issue and an important factor in rural landholder decisions. It is often referred to as a key reason for rural landholder unwillingness to invest in new initiatives, suggesting that maybe they are leaving it for the next generation. Several people interviewed talked about age being an impediment to their ability to adapt, often referring to new ideas that their son or daughter had for the property that they would most likely implement when they took over. However, in the pairwise analysis, age was not found to be significantly linked to adaptive behaviours.

It is interesting to see that the demographic attributes which illustrate important differences between the two case study districts were not significantly linked to adaptive behaviours. Property income, property size, age and occupation were not significantly linked to either the tactical or strategic actions. This finding provides some support for the focus in this study on exploring the socio-psychological basis for rural landholder responses to climate change.

So how do socio-psychological factors such as world views and values influence rural landholder beliefs about climate change, and their behaviour. The findings from this study indicate that most rural landholders reject a world view that supports nihilistic or fundamentalist perspectives. They typically do not believe in focusing on the individual quest for personal pleasure, or win at all cost attitudes which, according to Eckersley (2007) tend to result in actions based in fear and self interest. They also appear to reject the notion that a return to traditional religious values is needed to solve our global problems.

The vast majority of people expressed a world view of 'hope' in the future and a need for personal commitment to transform the way we live, reflecting

an emphasis on relationships, communities, spirituality, nature and the environment.

Most people expressed a world view that humans should live in harmony with nature and that its delicate balance could be easily upset. Consistent with this view was a majority rejection of the statements that humans could not influence nature and that there was no limits to growth in a resource rich nation like Australia.

Again, consistent with the world view of 'hope', most people felt they had an obligation to do whatever they could to reduce their carbon emissions and to prepare for climate change. However, they also believe it is primarily the responsibility of industry, rather than government, to reduce carbon emissions, suggesting that, in principle at least, rural landholders could be supportive of carbon emissions trading if better informed of its localised implications

The world view statement most highly linked with the grouped tactical/reactive adaptations (VAR1), was that *US, India, and China should reduce their emissions before Australia*. The world view statement most highly linked to the grouped strategic/anticipatory adaptations (VAR 4) was *humans must live in harmony with nature in order to survive* (Table 5.17).

The 'guiding principles' (or values) found to be highly linked with all six of the grouped adaptive actions (VAR1 – VAR6) were *the protection of individual rights and equal opportunity for all*. The guiding principle of *honouring of parents and respect for community elders* was highly linked to both the tactical/reactive adaptations as well as the strategic/anticipatory adaptations.

In terms of belief in climate change, the only statement from section four of the survey that was found to be a significant influence on behaviour was *human activities are influencing changes in climate*. This was found to be a key influential factor for VAR 2 (tactical), VAR4 (strategic) and VAR 6 (a mix of tactical and strategic).

Getting to the nub of this study, what factors were found to be influential in rural landholder responses to climate change? To take highly strategic/anticipatory action, such as enterprise diversification, more intensive use of existing land and increased off-farm

work, the study found that people were influenced by:

- a lower attachment to property,
- a belief that human activities are influencing changes in climate,
- a believe that native vegetation will be negatively impacted upon,
- a respect for parents and community elders,
- the principles of protection of individual rights and equal opportunity for all, and
- decline in property income.

The factors influencing a combination of tactical and strategic actions such as enterprise diversification, more intensive use of existing land, fencing of native bush to restrict stock access and reduced stocking rates, were found to include:

- knowledge of the implications of a 1–2° increase in global temperatures for local agriculture;
- knowledge about the steps that an agricultural enterprise can take to become carbon neutral;
- a belief that human activities are influencing changes in climate;
- a valuing of individual rights and equal opportunity for all; and
- an improved ability to capture water on property.

After a major event fear increases risk estimates and precautionary measures. Long term drought has definitely raised people's antenna. People interviewed were not antagonistic in conversation – more enquiring. Many wanted to 'pick our brains' and commented on the need for independent information. They were listening to people like Pilmer, but that may be because this point of view is being presented in a coherent, single perspective way making it more accessible – rather than people seeking information to support a sceptics view.

Regionally relevant, realistic, tangible information is essential in enabling people to get a handle on the complexities of the science. While many said they were sceptical, this may actually be the more accurate meaning of sceptical, rather than the populist mind-set of irrational crusaders. Maybe the rural sceptics just haven't been convinced rather than being outright deniers "...driven by feelings of angry grievance, who identify with anti-liberal, anti-elitist and anti-intellectual" world views as described by Hamilton 2010).

## Endnotes

1. 'Resilience' is a term often used to refer to the ability to recover from or resist damage after exposure to a hazard, while 'adaptive capacity' emphasises a potential or actual ability to change. Nonetheless, there is considerable overlap and similarity in these terms – both suggesting some type of positive capability in the face of largely negative impacts. Different research disciplines will seek varying indicators of vulnerability, resilience and adaptive capacity.
2. Closed questions ask respondents to select one answer from a number of pre-worded answers in each question.
3. In some cases (where interviewees were exhibiting high levels of disbelief or stress) interviewees were not shown the actual projections, rather they were asked more generally what kind of projections they had heard and what they thought of those.
4. These actions included: increasing their ability to capture more water (e.g. deeper dams); improved efficiency of water delivery (via more troughs,); changing the times for calving and milking their dairy cows; reducing stock numbers; changing their pasture or cropping mix; increasing their preparedness for bushfire; seeking off-farm income; growing feed for stock; invest in new machinery and increase pasture improvement (if conditions and prices improved).
5. As the interviews for the Eskdale case study progressed, it was felt that the issue of confidence should be pursued. Consequently, this topic was brought up with some – but not all - interviewees. For the Chiltern case study, this topic was raised by the interviewers more frequently - although there was insufficient time to explore interviewees' emotional orientation to these issues in great depth.

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# Appendix A: Interview Schedule

## Topic 1

- 1.1 Tell us about your property – its size, enterprise mix, current activities
- 1.2 How would you describe your approach to managing your property?
- 1.3 What does having/operating this property mean to you?

## Topic 2

- 2.1 The last five years in Victoria have been pretty dry. What has that been like for you?
- 2.2 We are interested in finding out what you think about something called 'climate change'. A. Do you believe in it? (*yes, no, unsure*) B. Can you tell us what you think it means?  
 What kind of 'change' is it meant to involve?  
 What is supposed to be causing it?  
 What are supposed to be the consequences?  
 Are those consequences meant to be serious?  
 Is there some kind of relationship to drought? (If yes, what kind?)  
 What are people meant to be doing about it?

## Topic 3

- 3.1 Could you tell us how you have come to have these views about this thing called 'climate change'?  
 Where do you get tend to get your information about climate and weather from?  
 What would be a few of your most important and trusted sources of information about climate and weather?
- 3.2 Have you heard any recent climate projections for NE Victoria?  
 What do you think about these figures from CSIRO/DSE? (*belief*)  
 If these predictions were to be true or prove correct – What kind of effect do you think it would have on you personally? (*If they start talking about negative property effects go to Table in item c below to guide conversation*)  
 (*If they don't talk about property effects*) What kind of loss or damage do you think you might incur (*and use table to try and explore their views likelihood, seriousness, degree of concern*)

| Type of loss/damage | Likelihood | Seriousness | Concern |
|---------------------|------------|-------------|---------|
|                     |            |             |         |

## Topic 4

- 4.1 What management actions have you *already* taken to cope with this *current* dry period? (*be prepared to say you'd like to revisit some of the things they may have already listed at start of interview*).  
 If they are climate change 'confusists' and/or 'skeptics' (e.g. things will come good)....
- 4.2 What management actions are you taking to prepare for the possibility that the dry might go on longer than expected?  
 Are there any other actions that you would like to take to prepare (but haven't done so yet?)  
 If they believe in 'climate change' or at least think something is 'afoot' ....
- 4.3 What management actions are you taking to prepare for the future effects of climate change?  
 Are there any other actions that you would like to take to prepare (but haven't done so yet?)

## Topic 5

- 5.1 What factors – in addition to climate and the weather – influence your decisions about how to manage your property?  
 Can you say which one/ones have the most influence on your decisions?
- 5.2 Do you feel you have what you need to prepare for (*choose one depending on interviewee*):  
 The possibility that the dry might go on longer than expected?  
 Future effects of climate change?  
 Sufficient financial resources needed to develop and implement a strategy to adapt your property  
 Knowledge, information, skills needed to develop and implement a strategy to adapt your property  
 Physical resources (equipment, labour) needed to develop and implement a strategy to adapt your property  
 Physical health needed to develop and implement a strategy to adapt your property.
- 5.3 How confident do you feel about adapting to any future changes in the climate and weather?

## Appendix B. Mail Survey Questions

### 1. Your property

What is the total amount of **land owned/leased/managed by you or your immediate family** in your local district? \_\_\_\_\_ Ha

[We will now refer to this area as **the property** – and assume that you have used hectares unless otherwise indicated]

Are you the owner of the property? *Please circle your answer*

Owner-operator    Owner    Share farmer    Operator/lessee

Is **this property your principal place of residence?** *[Please circle your answer]*                      **YES**    **NO**

If this property is **NOT your principal place of residence**, what district, town or city **do you reside in?** \_\_\_\_\_

If this property **IS your principal place of residence**.

**How long have you lived in your local district?** \_\_\_\_\_ years

**How long have you managed this property?** \_\_\_\_\_ years

**How long has the property been in your family?** \_\_\_\_\_ years

**How much of your property is covered by patches of native bush?** \_\_\_\_\_

*For this survey we are interested in patches that cover at least a hectare of grasslands, wetlands or trees/shrubs that have not been planted or are regenerated (regrowth)*

Please provide an estimate of the area of native bush. \_\_\_\_\_ Ha

### 2. Why is your property important to you?

The next set of statements seeks **information about the reasons why your property is important to you and your sense of place**. *[Examine each statement in the table, then place the number for your response in each space provided for 'Your view']*.

| Not applicable   | Strongly disagree | Disagree | Not sure | Agree | Strongly agree |                  |
|--|-------------------|----------|----------|-------|----------------|------------------|
| 1  | 2                 | 3        | 4        | 5     | 6              |                  |
| <b>Why your property is important to you</b>   |                   |          |          |       |                | <b>Your view</b> |
| This property provides most of the household income.   |                   |          |          |       |                |                  |
| It is important for me to be able to pass the property on to others.                                   |                   |          |          |       |                |                  |
| This property enables me to have a sense of accomplishment from building/maintaining a viable business |                   |          |          |       |                |                  |
| This property says very little about who I am.   |                   |          |          |       |                |                  |
| I feel I can really be myself at my property.  |                   |          |          |       |                |                  |
| My property reflects the type of person I am.  |                   |          |          |       |                |                  |
| I feel happiest when I'm at my property.   |                   |          |          |       |                |                  |
| My property is the best place for doing the things that I enjoy most.                                  |                   |          |          |       |                |                  |
| This property is not a good place to do the things I most like to do                                   |                   |          |          |       |                |                  |
| This property is a great place to raise a family.  |                   |          |          |       |                |                  |
| My property enables me to be part of a rural community.  |                   |          |          |       |                |                  |
| As far as I am concerned, there are better places to be than at my property.                           |                   |          |          |       |                |                  |
| I live here and have no thoughts of leaving.   |                   |          |          |       |                |                  |
| I live here but I have thought about leaving if the climate changes.                                   |                   |          |          |       |                |                  |

### 3. Your knowledge of climate change

In this section we would like you to provide **an assessment of your knowledge** about climate change and its implications for the region. *[Examine each statement in the table, then place the number for your response in each space provided for 'Your view']*.

| Not relevant  | No knowledge | Very little knowledge | Some knowledge | Sound knowledge (sufficient to act) | Very sound knowledge (could give a detailed explanation) |
|---|--------------|-----------------------|----------------|-------------------------------------|--|
| 1   | 2            | 3                     | 4              | 5                                   | 6  |
| <b>Climate change topics</b>  |              |                       |                |                                     | <b>Your view</b>   |
| The difference between the greenhouse effect and the ozone hole                                     |              |                       |                |                                     |  |
| Potentially serious impacts of global climate change  |              |                       |                |                                     |  |
| Actions that householders can take to reduce their carbon emissions                                 |              |                       |                |                                     |  |
| How carbon can be taken out of the atmosphere and stored  |              |                       |                |                                     |  |
| The explanation provided by scientists for global warming   |              |                       |                |                                     |  |
| The Federal Government's plans for a Carbon Emissions Trading Scheme                                |              |                       |                |                                     |  |
| The broad climate change projections for your region by 2050  |              |                       |                |                                     |  |
| The implications of a 1 – 2 degree increase in global temperatures for agriculture in your district |              |                       |                |                                     |  |
| Steps that an agricultural enterprise could take to become carbon neutral                           |              |                       |                |                                     |  |

### 4. Your views about climate change

This set of statements seeks to understand what you currently believe to be true about climate change. There are no right or wrong answers and there is no need to think at great length about your responses. *[Examine each statement in the table, then place the number of your response option in each space provided for 'Your view']*.

| Not relevant  | Strongly disagree | Disagree | Not sure | Agree | Strongly agree   |
|---|-------------------|----------|----------|-------|------------------|
| 1   | 2                 | 3        | 4        | 5     | 6                |
| <b>Views on climate change</b>  |                   |          |          |       | <b>Your view</b> |
| The climate is changing   |                   |          |          |       |                  |
| If we do nothing climate change will have dire consequences for all living things, including humans |                   |          |          |       |                  |
| Human activities are influencing changes in climate   |                   |          |          |       |                  |
| Climate might be changing but it is not as bad as it is being portrayed                             |                   |          |          |       |                  |
| Climate is always changing. It is a naturally occurring phenomenon that has been going on forever   |                   |          |          |       |                  |
| Climate change is out of our control  |                   |          |          |       |                  |
| Humans will always adapt to their environment   |                   |          |          |       |                  |
| There is no such thing as climate change  |                   |          |          |       |                  |
| It is not too late to take action to address climate change   |                   |          |          |       |                  |
| The climate maybe changing but currently we are in a cycle  |                   |          |          |       |                  |

## 5. Your views about the ‘state of the world’

In this section we would like to know **how closely the statements presented below reflect your feelings or views about the future of the world.** There are no right or wrong answers and there is no need to think at great length about your responses. *[Examine each statement in the table, then place the number for your response in each space provided for ‘Your view’].*

| Not relevant  | Strongly disagree | Disagree | Not sure | Agree | Strongly agree   |
|---|-------------------|----------|----------|-------|------------------|
| 1   | 2                 | 3        | 4        | 5     | 6                |
| <b>Statements about the state of the world</b>  |                   |          |          |       | <b>Your view</b> |
| The world’s future looks grim. We can’t be worrying about everyone else. We have to look out for ourselves. |                   |          |          |       |                  |
| We are facing a fundamental conflict between good and evil  |                   |          |          |       |                  |
| We need to return to traditional religious teachings and values to solve global problems and challenges.    |                   |          |          |       |                  |
| We need to transform our way of life if we are to create a better future for the world.                     |                   |          |          |       |                  |
| There’s no point in worrying about what might happen to the world in the future.                            |                   |          |          |       |                  |
| We are approaching a limit to the number of people the earth can support.                                   |                   |          |          |       |                  |
| The balance of nature is delicate and easily upset by human activities.                                     |                   |          |          |       |                  |
| There are no limits to growth for resource rich nations like Australia.                                     |                   |          |          |       |                  |
| Humans must live in harmony with nature in order to survive.  |                   |          |          |       |                  |
| Humans cannot influence nature.   |                   |          |          |       |                  |
| I feel an obligation to do whatever I can to reduce my carbon emissions.                                    |                   |          |          |       |                  |
| I don’t believe there is a climate problem.   |                   |          |          |       |                  |
| I feel obliged to do whatever I can to prepare for climatic change.   |                   |          |          |       |                  |
| If there is a climate problem, I’m not concerned at present.  |                   |          |          |       |                  |
| It is primarily the Government’s responsibility to protect the environment.                                 |                   |          |          |       |                  |
| It is primarily the responsibility of industry to reduce carbon emissions.                                  |                   |          |          |       |                  |
| US, India and China should reduce their emissions before Australia.   |                   |          |          |       |                  |

## 6. Climate change risks for you/your property

In this section we are trying to understand how you **perceive the risks** of climate change for your property. In **Part A** we want you to indicate how likely you think that you/your property will be affected. Of course, any impacts might be positive or negative, so we also want you to indicate the nature of the impact in **Part B**. *[Examine each potential impact of climate change in the table, then place the number for your response in each space provided for both the ‘Likelihood of impact’ (Part A) and the ‘Nature of impact’ (Part B)].*

Part A: The likelihood of the potential impact affecting you/your property

| Not relevant   | Highly unlikely | Unlikely | Unsure | Likely | Highly likely               |
|--|-----------------|----------|--------|--------|-----------------------------|
| 1  | 2               | 3        | 4      | 5      | 6                           |
| <b>Potential types of impacts on you/your property</b>             |                 |          |        |        | <b>Likelihood of impact</b> |
| Water supply for stock and domestic                                |                 |          |        |        |                             |
| Water supply for pasture production                                |                 |          |        |        |                             |
| Pasture productivity   |                 |          |        |        |                             |
| Survival of some native vegetation (trees, shrubs and grasses)     |                 |          |        |        |                             |
| Quality or health of native vegetation (trees, shrubs and grasses) |                 |          |        |        |                             |
| Increased frequency and intensity of bush fires                    |                 |          |        |        |                             |
| Attractiveness of property landscape                               |                 |          |        |        |                             |
| Insect pests   |                 |          |        |        |                             |
| Pest plants  |                 |          |        |        |                             |
| House gardens (vegetables, fruits and flowers)                     |                 |          |        |        |                             |
| Personal health and wellbeing                                      |                 |          |        |        |                             |
| Family health and wellbeing  |                 |          |        |        |                             |

**Part B: Nature of the potential impact on you/your property**

| Not relevant   | Large negative impact | Small negative impact | No real impact | Small positive impact | Large positive impact                |
|--|-----------------------|-----------------------|----------------|-----------------------|--------------------------------------|
| 1  | 2                     | 3                     | 4              | 5                     | 6                                    |
| <b>Potential types of impacts on you/your property</b>             |                       |                       |                |                       | <b>Nature of impact (+ve OR -ve)</b> |
| Water supply for stock and domestic                                |                       |                       |                |                       |                                      |
| Water supply for pasture production                                |                       |                       |                |                       |                                      |
| Pasture productivity   |                       |                       |                |                       |                                      |
| Survival of some native vegetation (trees, shrubs and grasses)     |                       |                       |                |                       |                                      |
| Quality or health of native vegetation (trees, shrubs and grasses) |                       |                       |                |                       |                                      |
| Increased frequency and intensity of bush fires                    |                       |                       |                |                       |                                      |
| Attractiveness of property landscape                               |                       |                       |                |                       |                                      |
| Insect pests   |                       |                       |                |                       |                                      |
| Pest plants  |                       |                       |                |                       |                                      |
| House gardens (vegetables, fruits and flowers)                     |                       |                       |                |                       |                                      |
| Personal health and wellbeing                                      |                       |                       |                |                       |                                      |
| Family health and wellbeing  |                       |                       |                |                       |                                      |

**7. Ability to adapt to climate change**

While recognising that many actions by rural landholders are influenced by government policies, we are asking you to provide an assessment of your ability to respond to potential climate change impacts on you/your property. *[Examine each potential impact of climate change in the table, then place the number for your response in **each** space provided for ‘your ability to adapt’].*

| Not relevant                                    | Highly adaptable | Adaptable | Not sure | Limited adaptability | Unable to adapt         |
|---|------------------|-----------|----------|----------------------|-------------------------|
| 1   | 2                | 3         | 4        | 5                    | 6                       |
| <b>Potential impacts on you/your property</b>   |                  |           |          |                      | <b>Ability to adapt</b> |
| Water supply for stock and domestic             |                  |           |          |                      |                         |
| Water supply for pasture production             |                  |           |          |                      |                         |
| Pasture productivity                            |                  |           |          |                      |                         |
| Extent of Native vegetation                     |                  |           |          |                      |                         |
| Increased frequency and intensity of bush fires |                  |           |          |                      |                         |
| Attractiveness of property landscape            |                  |           |          |                      |                         |
| Insect pests                                    |                  |           |          |                      |                         |
| Pest plants                                     |                  |           |          |                      |                         |
| House gardens (vegetables, fruits and flowers)  |                  |           |          |                      |                         |
| Personal health and wellbeing                   |                  |           |          |                      |                         |
| Family health and wellbeing                     |                  |           |          |                      |                         |

## 8. Guiding principles in your life

The next set of statements seeks **information about the importance of a set of principles as guides in your life**. There are no right or wrong answers and there is no need to think at great length about your responses. *[Examine each statement in the table, then place the number for your response in each space provided for 'Your view']*.

| Don't know   | Not important to me | Minor importance | Of some importance | Important | Central to my well-being |
|--|---------------------|------------------|--------------------|-----------|--------------------------|
| 1  | 2                   | 3                | 4                  | 5         | 6                        |
| <b>Importance as a guiding principle in your life</b>            |                     |                  |                    |           | <b>Your view</b>         |
| Ensuring a fair go for all                                       |                     |                  |                    |           |                          |
| Leadership, and an ability to influence others                   |                     |                  |                    |           |                          |
| The practice of self-discipline and self-restraint               |                     |                  |                    |           |                          |
| Protection of our individual rights                              |                     |                  |                    |           |                          |
| Equal opportunity for all  |                     |                  |                    |           |                          |
| Honouring of parents and respect for community elders            |                     |                  |                    |           |                          |
| Protection of the environment                                    |                     |                  |                    |           |                          |
| Contributing to a sense of community                             |                     |                  |                    |           |                          |
| Creating wealth and a striving for financial prosperity          |                     |                  |                    |           |                          |
| Curiosity and a keen interest in everything                      |                     |                  |                    |           |                          |
| To live a varied life, filled with challenge, novelty and change |                     |                  |                    |           |                          |

## 9. Property management

In this section we want to know what changes you have made over the past 5 years to your enterprise, AND how important climate was in your decision making. *[Examine each statement in the table, then place the number for your response in each space provided for the 'Changed management' column and the 'Influenced by climate change' column]*.

PART A: Changes in management in last 5 years/next 5 years

| Not applicable | Not interested for next 5 yrs | Have thought about it | Plan to do in next 5 yrs | Am doing this now | Have done this in the past 5 yrs |
|----------------|-------------------------------|-----------------------|--------------------------|-------------------|----------------------------------|
| 1              | 2                             | 3                     | 4                        | 5                 | 6                                |
|                |                               |                       |                          |                   |                                  |

PART B: Extent influenced by climate change

| Not applicable | Not a factor | Minor influence | Some influence | Influential | Very influential |
|----------------|--------------|-----------------|----------------|-------------|------------------|
| 1              | 2            | 3               | 4              | 5           | 6                |
|                |              |                 |                |             |                  |

| Actions taken or under consideration                     | PART A: Changes in Management | PART B: Extent influenced by climate change |
|--|-------------------------------|---|
| Improved ability to capture water on your property       |                               |   |
| Improved efficiency of water usage on your property      |                               |   |
| Established perennial pasture on your property           |                               |   |
| An overall reduction in stocking rates for your property |                               |   |
| Moved from annual pasture to perennial pastures          |                               |   |
| Purchased or leased more land in your district           |                               |   |
| Purchased or leased more land in another district        |                               |   |
| Diversification of farm enterprises                      |                               |   |
| Changed enterprise mix                                   |                               |   |

|   |  |  |
|---|--|--|
| Increased fodder storage capacity on your property                                |  |  |
| You or other family members have increased off-property work (part or full- time) |  |  |
| Value added to farm products  |  |  |
| Sold or leased land to others   |  |  |
| Moving to a more intensive use of existing land                                   |  |  |
| Moving to a low input production system   |  |  |
| Changed the way you market your product   |  |  |
| Planted trees, shrubs or native grasses   |  |  |
| Fenced native bush to restrict stock access                                       |  |  |
| Other actions not listed....  |  |  |
|   |  |  |
|   |  |  |

## 10. Background information

The next set of questions seek information about yourself and your spouse/partner. Questions cover a number of factors that often influence decision-making. Again, we emphasise that information provided will never be divulged.

**Are you male or female?** *[Please circle your answer.]*

MALE      FEMALE

**What is your age?**

\_\_\_\_\_ years

**What is your main occupation?**

(e.g. farmer, teacher, electrician, investor, retiree)

\_\_\_\_\_

Estimate **the number of hours per week** that **you worked on farming/property** related activities over **the past 12 months.**

\_\_\_\_\_ hours per week

Do you have off-farm employment

YES      NO

If Yes, what proportion of your total income is derived off-farm

\_\_\_\_\_ %

Are you a member or involved with a **local Landcare group?**

YES      NO

If **NO**,

Were you **previously** a member or involved with a **local Landcare group?**

YES      NO

Are you a member or involved with a **local commodity group?**

*[e.g. Flockcare, Cropcare, FM 500, Target 10, Best Wool, Birchip Cropping Group]*

YES      NO

Are you a member of any **voluntary organisations?** *[e.g. Service clubs, CFA, Red Cross]*

YES      NO

**Property Income** – We appreciate that many people are reluctant to divulge information about their incomes. However some information about household income is important for this research. **Your name will never be linked to your answers and information provided will never be available to any person outside this research team.**

**Did your property return a net profit** (income from your property exceeded all paid expenses before tax ) **last financial year** (2008/2009). *[circle your answer please]*

Less than \$10,000      \$10,000–\$40,000      \$40,000–\$80,000      Above \$80,000

### Other comments and thank you for your time

Do you have any other comments about any of the topics covered in the survey, or other aspects of land and water management? *[Please use this space or attach additional sheets. Any comments you make will be recorded and treated as confidential.]*