Australian Government

Bureau of Rural Sciences

Climate Risk and Industry Adaptation

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Executive Summary

Background

Australia is experiencing one of its worst droughts on record, with significant parts of southern and eastern Australia experiencing below average rainfall over the last 11 years. The Murray-Darling Basin (MDB), which in the past has produced up to 40 per cent of Australia's gross value in agricultural production, has just experienced its equal driest six year period on record.

Drought is a normal part of a rural community's operating environment but the severity of the current drought has prompted an intense debate about climate change and the suitability of some areas for farming. Many scientists believe that climate change is a key factor in the severity of the current drought but it is not well understood whether people in rural communities attribute the current drought to climate change and how this might influence risk management strategies.

An exploratory study to understand links between climate change perceptions and adaptation

This study presents findings from work undertaken across four drought affected communities in the MDB: two irrigated and two non-irrigated. It explores the links between people's perceptions of climate variability, climate change and their preparedness and management of climate risks.

Key questions

The study addresses three key questions:

1. How do stakeholders perceive drought and climate change?
2. What risk management strategies are agricultural industries implementing to adapt to climate risk?
3. What role could government play in assisting rural industries and communities with respect to drought and climate change adaptation?

Conceptual framework

To date, limited research has been undertaken on the links between people's perceptions of climate variability and climate change and their actual and intended actions, particularly in agriculturally dependent communities. For this study, a conceptual framework that draws upon behavioural theory is developed to enhance the understanding of these links at the business, farm and community levels. Theoretical insights are used to suggest pathways to change by exploring climate change perceptions, motivations, adaptive capacity and their relationship with climate risk management strategies and intended actions.

Research techniques	Interviews and focus groups were undertaken with 148 respondents from four regional and rural communities. The respondents were selected from two irrigated and two dryland farming communities along the Murray River, Victoria, and inland NSW respectively. Semi-structured interviews were conducted with 72 community representatives and small business managers eligible for Exceptional Circumstances (EC) assistance and focus groups were conducted with 76 farmers from these communities.
Perceptions	
Perceptions of current drought	Respondents characterised this current drought as one of the longest and most extensive periods of low rainfall they had experienced, with far reaching impacts on farmers, businesses and rural communities. Many commented on the short recovery time between low rainfall periods and the continued drain on their capital reserves.
Drought impacts	The current drought was seen as only one of several significant stresses affecting rural communities and farming. Other factors included commodity price fluctuations, the strength of the Australian dollar, changes to water access and use (irrigated regions) and a skills and labour shortage. Against a backdrop of out-migration and declining community services in some areas, the tendency was to attribute the current situation to a range of pressures with drought seen as the '*straw that broke the camel's back.'*
Perceptions of climate change	Perceptions of climate change were highly variable. While the majority of interview respondents were open to the idea that climate change could be a reality, many were still forming their ideas on the nature of this phenomenon.
Perceptions of climate change by small businesses	In general, managers of small businesses who believed climate change is a reality and that it is having an impact on agriculture or the community were more likely to be planning or undertaking long-term strategic action to address climate risk as part of their approach to running their business.
Links between drought and climate change	Major uncertainty centred on whether the extended current drought was symptomatic of climate change, with most respondents questioning this link. Many believed that the drought is due to a natural cycle rather than to anthropogenic climate change. The questioning of the link, however, represents a shift in thinking with a number of respondents embracing a new definition of 'normal' farming conditions.

Optimism and climate change denial

Many respondents expressed optimism that the drought would break and things would go back to normal. However this may serve to defer coming to terms with climate change. There is some denial that climate change is happening where climate change is perceived as 'permanent drought' in order to maintain hope.

Causes of climate change

A range of views was evident on the causes of climate change. Many respondents from both irrigated and dryland communities believed the causes of climate change were 'natural' rather than as a result of human activities. However, in the dryland communities, more respondents thought climate change was caused or exacerbated by human induced emissions of greenhouse gases.

Indicators of climate change

Respondents discussed physical changes in the local area or region that might signal changes to the climate. The most frequent descriptions were of climate change as a continuation of drier and warmer conditions, a shift in seasons and greater variability in the weather.

Sources of information on climate change

A number of respondents felt bombarded by conflicting information on climate change. Most of the respondents who sought information about climate change sourced it from scientific organisations, industry associations, government and from the media; both regional and national.

Motivations

What motivates people to address climate change?

People's motivations to respond to climate change may be due to:
1) an immediate sense of threat to one's livelihood
2) rising to a challenge
3) a sense of moral responsibility.

Adaptation responses were generally found to be driven by **a sense of threat to their own livelihood** or general community well-being

A number of respondents expressed views that suggested they were motivated by the sense of **challenge** of managing through a drought and climate change

While drought is widely regarded as being part of a natural cycle for which little can be done, views on anthropogenic climate change engendered a greater sense of **moral responsibility** to adopt risk management strategies that address climate change. Interest in participating in mitigation activities was generally associated with a moral obligation to reduce greenhouse gas emissions and to address climate change at a global level.

Adaptation

What climate risks are people responding to?

People were responding to climate variability, water availability and to climate change. However, climate risk was only one of a number of risks facing the rural sector. It may not be the only driver of behavioural change.

Perceptions of climate change as predictors of intended response

Behavioural theory suggests that people's beliefs are likely to influence their actions or intentions to act. An analysis was done to explore the links between personal belief in climate change and reported risk management strategies, or intentions, of managers of agriculturally-dependent businesses across all four case studies.

Typologies were developed to represent the four different groups that emerged from the analysis:

- Group A were open to the idea of climate change but still unsure that it was happening and were making increasingly strategic or long-term changes to their businesses. These respondents were diversifying into other industries (35 per cent of interviewees)
- Group B were sceptical or uncertain whether climate change was happening, but were undertaking some incremental changes to their businesses anyway. This group tended to be motivated by a sense of general environmental and social responsibility (15 per cent of interviewees)
- Group C were open to the idea of climate change but still unsure that it was happening and were feeling overwhelmed or saw climate change as a low priority. This group were making few long-term changes and were simply preoccupied with day-to-day survival (24 per cent of interviewees)
- Group D were sceptical or uncertain that climate change was happening and tended to have fewer strategies in place to manage risks. This group were concerned about surviving day-to-day or were 'just coping', with little evidence of long-term thinking (26 per cent of interviewees).

Is drought preparedness sufficient for adapting to climate change?

While many of the adaptation strategies for climate change are similar to those adopted for better drought preparedness, several respondents considered that a 'whole systems' perspective was needed for a shift to climate change adaptation They believed that simply adopting individual drought management strategies would be insufficient for these new and evolving conditions of lower rainfall, higher temperatures and more extreme weather. A 'whole-of-government' response was also suggested with individuals being unable tackle climate change in isolation.

Who is considered to be the most adaptable?

A number of respondents considered that people who were flexible and able to diversify were the most adaptable. Diversification was also considered to be an essential strategy for farmers and small businesses and was believed to lead to resilience in the system.

Irrigated farmers were considered to be less adaptable to climate change given their dependence on irrigation water. The smaller farm size of irrigated farms to dryland farms was seen as prohibiting an easy transition to dryland farming which relies upon larger land size.

Some respondents perceived that the more marginal the land the more adaptable the farming systems.

Why are some people not adapting?

- Small business people and farmers believed they were constrained from adapting for a variety of reasons including the value they put on a farming lifestyle, institutional frameworks, incentive structures, limited reserves of capital and uncertainty about drought and climate change.

Role of Government

What is existing DAFF drought policy?

Current Department of Agriculture Fisheries and Forestry (DAFF) drought policy aims to facilitate long-term change of farm businesses by assisting farmers to prepare, manage and recover from drought. Drought policy also provides short-term financial assistance to farm and small business families during exceptional circumstances such as extended dry periods. In practice, emphasis has been placed on providing short-term industry and welfare assistance during times of exceptional circumstances.

What are the implications of climate change for drought policies?

A longer-term risk management approach to climate change assumes a level of understanding and acceptance of climate change that was generally not demonstrated in this study. For rural communities to incorporate the management of climate change risks into their business plans and practices, many felt they needed a clearer understanding of what climate change is, its likely impacts, and appropriate management strategies given the uncertainty about climate change.

Change to existing drought policy framework to incorporate climate change

Respondents identified a need for greater support for farmers and small businesses in dealing with uncertainty associated with climate change.

Respondents called for the development of a range of policies that address the differing needs and perceptions of groups across the agricultural sector. These included support for champions of adaptation for climate change, education and extension initiatives to support those who are either uncertain about climate change or who are in transition towards on-going adaptation for climate

	change and support for those wishing to exit the industry.
Financial assistance	Financial assistance during the current drought has been *responsive* to the exceptional circumstances confronting rural communities and is perceived to have enabled farmers to remain on their farms. A number of respondents indicated that they would benefit from *proactive* financial assistance if they were to make the shift to longer term management for climate change (e.g. financial grants, rebates and subsidies for on-farm infrastructure)
Research and development	Farmers and small businesses have expressed the need for clearer information on climate change, its impacts and risk management.
Communication and dissemination of information to raise awareness	Respondents were accessing a range of information sources on climate change including scientific literature, media and climate records. Many respondents were confused by conflicting information and often questioned the accuracy of the sources.
Role of government – adaptation and/or mitigation?	Although the agricultural sector contributes 18 per cent of Australia's total greenhouse gas emissions, most respondents saw the role of government under climate change as assisting with managing climate risk (adaptation).
Is current drought policy sufficient for climate change adaptation?	Many respondents believed that drought, climate change and water availability issues will require more collaborative, coordinated and innovative approaches, working across organisational boundaries and all levels of government.
Future research	From our study, it was found that managing for climate variability is not necessarily the same as managing for climate change and that 'being resilient' may not be the same as 'being adaptive'. More research is needed to tease out the differences in order to fully understand the implications for developing effective adaptation and risk management strategies for climate change.

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Acronyms

AAA	Agriculture Advancing Australia
ABS	Australian Bureau of Statistics
AFF	Agriculture Forestry and Fishing
BRS	Bureau of Rural Sciences
DAFF	Department of Agriculture, Fisheries and Forestry
EC	Exceptional Circumstances
FMD	Farm Management Deposits
MDB	Murray-Darling Basin
MDBC	Murray Darling Basin Commission
MIS	Managed Investment Schemes
NACCAP	National Agriculture and Climate Change Action Plan
NFF	National Farmers Federation
NRM	Natural Resource Management
R&D	Research and Development
RPI	Rural Policy and Innovation
SEIFA	Socio-Economic Indexes for Areas
SLA	Statistical Local Area

Glossary

Adaptation	A process, action or outcome in a system (household, community, group, sector, region, country) which allows a system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity (Smit and Wandel 2006).
Adaptive capacity	The preconditions necessary to enable adaptation and the ability to mobilise these elements (Nelson *et al.* 2007).
Climate change	A statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period, typically decades or longer (IPCC 2001).
Climate risk	Potential losses (or opportunities) resulting from a climate-related event and the probability of this event.
Climate variability	Variations in the mean state and other statistics (such as standard deviations or the occurrence of extremes) of the climate on all temporal and spatial scales beyond that of individual weather events (IPCC 2001).
Drought preparedness	Planning in advance for drought conditions using a range of pro-active risk management approaches (after Webb 2005).
Motivation	Reasons people give for engaging in certain behaviour.
Resilience	Widely understood as the ability of a system to recover or rebound without moving away from a previous equilibrium (Smithers and Smit 1997). Or, the amount of change a system can undergo and still retain the same function (Nelson *et al.* 2007). Definitions vary across disciplines.
Risk	Potential losses (or gains) resulting from an event and the probability of this event.
Risk management	Incorporates a range of activities including the identification, assessment and mitigation of risks. Risk management strategies can include avoiding, transferring, reducing or accepting risks (AS/NZS 4360 2004).
Social vulnerability	The susceptibility of specific groups of people in society to shock, disturbance or harm. Sometimes thought to be linked

	to the social conditions that limit or govern the ability of these groups to respond to hazards (Cutter *et al.* 2003).
Strategic timescale	Multiple years, decadal timescale.
Tactical timescale	Seasonal timescale (less than one year).
Transformation	A fundamental alteration of the nature of a system once the existing conditions become untenable (Nelson *et al.* 2007).
Uncertainty	Imperfect or unreliable knowledge about the likelihood of a risk occurring (Morgan and Henrion 1990).

Project background

Agriculture and grazing covers 60 per cent of the Australian landmass and generates about $32 billion per year in gross value of farm production and exports valued at $30 billion (DAFF 2004). There is now general consensus in the global scientific community that climate change is happening and that concentrations of greenhouse gases in the atmosphere are continuing to increase as a result of human activities (IPCC 2007). Although the Australian agricultural sector has a long history in adapting to climate variability and climate change, anthropogenic forcing of climate change presents new challenges (Gunasekera *et al.* 2007).

In 2005, the agricultural sector in Australia accounted for 17 per cent of overall greenhouse gas emissions (Gunasekera *et al.* 2007). Both mitigation of the causes of climate change and adaptation to its impacts are important responses in dealing with climate change. Although regional impacts are highly uncertain, long-term human induced climate change is expected to affect average rainfall and temperatures, as well as change the severity and frequency of extreme weather and climatic events (CSIRO 2007, Heyhoe *et al.* 2007, IPCC 2007). More specifically, climate change is expected to affect agricultural productivity in Australia through increased average temperatures, changed rainfall patterns, increased climate variability and more extreme weather events such as droughts, floods, frosts and heat waves (AGO 2007). Agricultural industries will need to manage these additional climate risks, especially over the medium to longer term.

For significant parts of southern and eastern Australia, dry conditions have now persisted since October 1996, a total of 11 years (BOM 2007). The Murray-Darling Basin (MDB) is one of the most important agricultural production areas in Australia that is likely to be affected by climate change (Gunasekera *et al.* 2007). Situated in the south east of Australia, it covers 14 per cent of the country's total land area and accounted for nearly 52 per cent of the annual national gross value of agricultural production in 2001 (Gunasekera *et al.* 2007). The extreme dry period for the MDB has been exacerbated by higher temperatures: both daytime maximum and daily mean temperatures for the last six years (BOM 2007).

Warmer temperatures and reduced water availability in the MDB associated with decreased rainfall has had adverse economic impacts upon both dryland and irrigated agriculture in the region. Reduced water availability for irrigated agricultural production in the region (predicted under the most extreme climate change scenario) estimates a fall of around 25 per cent relative to what it might have been otherwise (Gunasekera *et al.* 2007). The greatest reduction in production in irrigated areas of the MDB is estimated to occur in perennial horticulture and viticulture (Gunasekera *et al.* 2007).

Dryland agricultural regions make up 90 per cent of the MDB's land area (MDBC 2007). Climate change presents an additional and significant challenge for dryland farmers who are already confronted by the difficulties posed by maintaining and cultivating the wide range of soil types and ecosystems and the problems of salinity, overgrazing and weed infestations.

Research problem

Drought policy in Australia supports both the family farm and agriculturally related farm businesses. It aims to facilitate long-term change of farm businesses by assisting businesses in preparing, managing and recovering from drought as well as providing short-term assistance to farm families and small business during exceptional circumstances droughts. During the current drought, Exceptional Circumstances (EC) declarations have been high across the country, with all of the MDB EC declared. In the drought affected areas, it is unclear as to whether the extended drought is being perceived as climate variability or part of climate change. This distinction has implications for risk management decisions of farmers and small businesses, as well as the formulation of drought policy.

Limited research has been undertaken on people's perceptions of climate change and whether changes in risk behaviour are occurring as a result. Understanding people's perceptions of climate change and adaptive behaviour will require an understanding of the ways in which uncertainty surrounding climate change affects their beliefs and decision making. This study is aimed at contributing to a better understanding of perceptions, risk behaviour and the drivers of change so that government industries, communities and government can better manage climate change.

Policy drivers

The National Agriculture and Climate Change Action Plan (NACCAP) provides an agenda to encourage greater understanding of the implications of climate change and how to better manage it. This project addresses aspects of two of the key focus areas of the Action Plan; (1) communication and awareness and (2) adaptation (Natural Resource Management Ministerial Council 2006).

Communication and awareness

4.1.2	Assess the level of understanding of climate change issues in rural industries and identify barriers to communication.
4.1.3	Identify priority messages to increase climate change awareness amongst stakeholders.

Adaptation

1.2.1	Build on existing work regarding climate change risk and vulnerability to identify and prioritise industries and agricultural regions that are most vulnerable to climate change, and integrate these considerations into natural resource management planning and investment.

Project purpose and key objectives

This exploratory study seeks to better understand people's perceptions of climate variability and climate change as well as the coping and adaptive strategies of primary industries and regional communities in drought affected areas. It is the first phase of a larger, more comprehensive study. In this initial stage, a conceptual framework is developed and the key themes and issues identified. The findings from the study will inform agricultural drought policies and the NACCAP through better understanding of people's perceptions of climate risk and adaptation strategies.

Key questions

The study is divided into three broad sections which address the following questions:

1. How do stakeholders perceive drought and climate change?
2. What risk management strategies are agricultural industries implementing to adapt to climate risk?
3. What role could government play in assisting rural industries and communities with respect to drought and climate change preparedness?

Conceptual framework

Understanding rural landholder and business perceptions and responses to climate change

For the study, a conceptual framework was developed to understand the actions and inactions of individuals and communities with respect to climate change. Intentions to prepare or respond to climate change can be explained by, or are related to (1) risk perceptions, (2) motivations to address climate change and (3) the adaptive capacity of both the individual and institutions. This conceptual framework can therefore be used to understand intentions, or lack of intentions, of individuals or communities to respond to climate change and identify constraints and enablers to action. It can also be a useful tool for government to better assist rural communities and industries to prepare for climate change.

Adaptation and adaptive capacity

Adaptation and adaptive capacity are key concepts for understanding responses to the phenomena of climate change in the agricultural sector. There are a wide range of conceptual frameworks on adaptation and no general consensus on how the different elements of the frameworks can help to explain changes. Some approaches emphasise dynamic adaptation of social-ecological systems while others are more human centred, focussing on the ability of humans to respond to climate stimuli (Nelson *et al.* 2007). In this section, several factors that are thought to influence the way people respond to climate change are explored. Understanding the relationship between perceptions and responses is important because it shows ways that interventions, including communication, might influence the decisions of landholders and rural businesses to adapt to climate change.

There are many empirical studies that investigate the kinds of perceptions and attitudes people hold about climate change. However, there are fewer that consider the relationship between people's perceptions and their behavioural intentions (O'Connor *et al.* 1999, Orlove 2005). Even fewer studies have investigated these issues in the agricultural context (Smit *et al.* 1996, Weber 1997). As outlined by Smit and Pilifosova (Smit and Pilifosova 2001), some of the main areas where social research is needed to improve knowledge about processes involved in adaptation decisions include:

- steps in the process
- decision rationales
- handling of uncertainties

- choices of adaptation types and timing
- conditions that stimulate or dampen adaptation
- consequences or performance of adaptation strategies.

People's beliefs about climate change and their responses are influenced by a range of interrelated personal, socio-cultural, economic, biophysical and moral factors, suggesting a considerable degree of complexity in human perceptions and behaviour in relation to climate change. This complexity increases when trying to assess how and why people adapt at different scales (individual, community, industry and region). The complexity is further compounded by the differing understandings of climate risk and contexts of action in which enablers and constrainers operate to encourage or discourage certain responses.

In this section, existing behavioural, risk perception and institutional literature are drawn upon to present a conceptual framework (Figure 1) for understanding factors that influence rural landholders' and businesses' propensity to adapt to climate change. This includes the following[1]:

1) interpretation of climate risk (perceptions, causal knowledge and beliefs)
2) motivation (reasons for acting)
3) perceived adaptive capacity (perceived ability to carry out adaptation within the context of enablers and constrainers of action)
4) adaptation process (adaptation intention, responses, strategies, actions, whether these are long term or short term and who adapts).

The framework serves as a heuristic tool to support the exploration and understanding of the ways in which the competing elements of the framework interact and affect responses to climate change. Its elements and the relationships between these are explored in the following discussion.

Interpreting climate risk (perceptions, knowledge, beliefs)

Interpretation is the process by which people ascribe meaning to events (March and Olsen 1989, Weick 1979, Yanow 1998). Interpretation is framed by the historical and cultural contexts in which people are situated. It is a dynamic process by which people engage in sense-making to handle complex information and to reduce multiple meanings (Weick 1979). Views are constantly assessed and reassessed in light of new information, changing situations or shared values and goals. An important part of the way that people experience climate change is the way they perceive the risk

[1] This draws on several sources including Grothmann and Patt (2005), Kroemker and Mosler (2002), O'Connor *et al.* (1999) and Niemeyer *et al.* (2005).

associated with the phenomena as well as their knowledge of the causes, their beliefs about the environment and the social and institutional contexts.

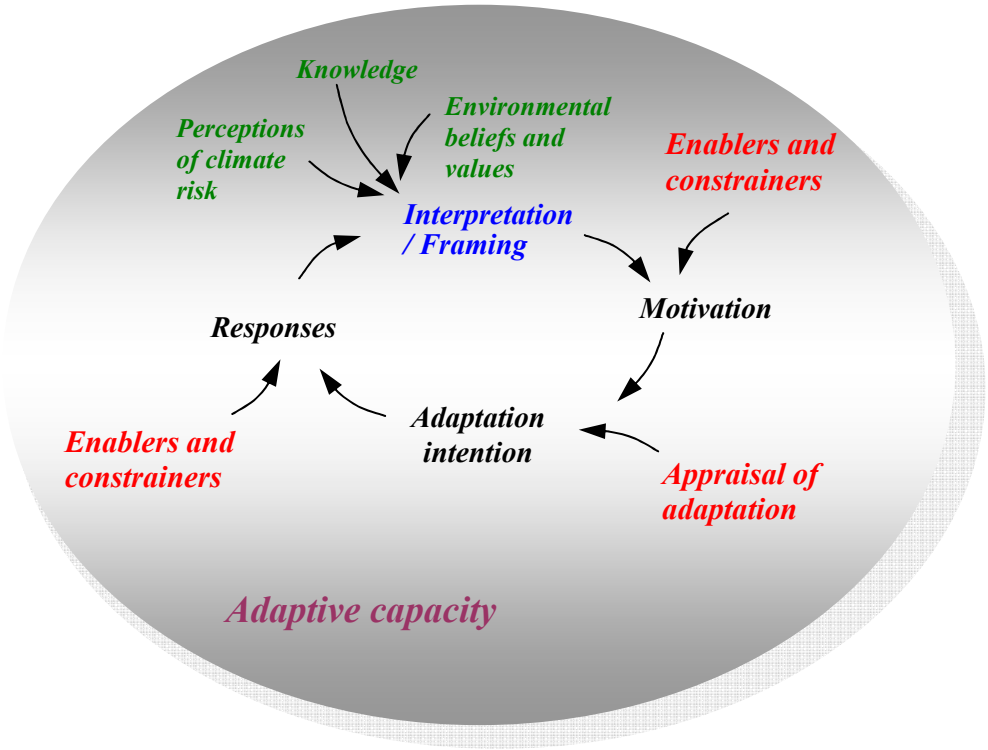


Figure 1: **Conceptual framework - Adaptive learning cycle**

The importance of interpretation for shaping people's responses to climate change is highlighted in several studies (Smit *et al.* 1996, Weber 1997). The way people interpret climate risk, for example, will be framed[2] by their values, experience, education, training and personal characteristics which are historically and culturally situated. The way people interpret the nature of climate risk is likely to influence their adaptive responses, for example their levels of preparedness or propensity to manage risks. An outcome of interpretation is that people may draw attention to some aspects of an issue while diminishing others (Yanow 1998).

Risk perceptions and climate change

Risk perceptions relating to climate change are the judgements people make about the probability of exposure to a climate related risk and the consequences of that event, for example who or what it might affect and to what degree. People may also make an appraisal of their capacity and resources to deal with the risk.

Although there are always intrinsic risks in agricultural production, climate change represents an additional element of risk. Climate risks compete with a whole range of

[2] 'Framing' has its metaphoric origins in a photographer's framing of a scene and is a process whereby some elements of a policy issue are highlighted and others excluded (Yanow 1998).

other risks people weigh up in farming, such as price fluctuations of input costs and commodities and the regulatory environment. Therefore, climate risk will be interpreted relative to all these other aspects of production. There will be a broad range of different perceptions of climate risks mainly because risk is a socially constructed phenomena (Beck 1992). Social construction of risk depends on judgements about the things people value as well as a range of other issues. These factors can help to explain why people react differently to some risks rather than others and why people react differently to the same risk. Risk perceptions are relevant to behaviour because they can limit and open up the range of strategies people consider.

Risk research (after Sandman 1987) suggests that a range of social factors are likely to influence perceptions of risk including:

- familiarity with the nature and context of risk
- sense of control of the causes or impacts of risk
- degree of voluntariness of exposure and response
- the degree to which people feel part of the consultative process
- sense of fairness in relation to the burden of adaptation or mitigation of the risk
- morality in relation to a sense of responsibility to respond
- characteristics of the risk, i.e. abrupt, incremental, frequency, duration.

Climate change risk perceptions in agriculture

Rural landholders' and communities' risk perceptions about climate change have not been extensively explored and neither has the influence of this on their propensity to take adaptive actions or strategies at the farm level. But there is some evidence to suggest that rural landholder's views on climate change have relevance for understanding adaptation (Smit *et al.* 1996, Weber 1997).

A number of studies have highlighted the difficulty in recognising climate change as a risk, particularly in detecting gradual changes in local weather and climate patterns (Risbey *et al.* 1999, Weber 1997). While drought is a well-known experience for rural communities, the links with climate change are not fully understood or accepted. This raises the question of how the risk is interpreted: is the cause of the current drought attributed to natural climate variability or to climate change? This difficulty is complicated by scientific uncertainty about the local and regional impacts of climate change which will vary across Australia. Some regions are expected to experience warmer and drier conditions while others may experience wetter conditions. Compounding this are changes to seasonal patterns and rainfall. These dilemmas highlight particular problems for rural communities with interpreting the nature of climate change: whether it is happening, how it can be detected at the local level,

what are the causes and impacts, whether it means gradual or rapid changes and whether these will be temporary or permanent.

Knowledge or attribution of causes

A fundamental element in the way climate risks are interpreted is knowledge of the causes of the risk. Some of the literature supports a link between having knowledge of the causes of climate change and behavioural intentions (O'Connor *et al.* 1999). The attribution of causes to the risk is relevant because it can influence the ways in which people act in response (Kroemker and Mosler 2002). Based on causes, people also make judgements about who is responsible for addressing a problem and this can generate more motivation to take action.

Environmental beliefs

O'Connor *et al.* (1999) draw attention to the importance of environmental beliefs for the way that people view climate risks. Environmental beliefs are likely to be inter-related factors with risk perceptions, knowledge of causes and valued outcomes. There are several categories that can be used to characterise environmental belief systems including[3]:

- egotistic: focussing on personal impact
- altruistic: reflecting concerns that environmental risks may harm other people
- biospheric: focussing on nature and ecology (i.e. nature is 'fragile')

Many studies have shown correlations between such general environmental beliefs and behavioural intentions (O'Connor *et al.* 1999). Each of these belief systems has significance for the willingness to take action to address environmental issues, such as climate risk.

In summary, there are several key factors that are relevant to the way people interpret climate risk including:

- knowledge of causes, (e.g. may influence action possibilities)
- risk perceptions (e.g. the problem of detecting gradual changes in local climate patterns, uncertainty of science around the nature and magnitude of climate change and uncertainty about what these impacts might be)
- knowledge of management strategies to adapt to or mitigate against climate change
- environmental belief systems (e.g. reflects people's values and guides their focus)
- beliefs about access to resources (e.g. beliefs about their capacity to respond).

[3] Drawing on Stern, Dietz & Kalof 1993; Hardin 1968; Olson 1965; Dunlap 1968 in O'Connor *et al.* (O'Connor *et al.* 1999).

These elements of the conceptual framework are not separate but highly interrelated features of people's decision-making processes and are inevitably shaped by a wide range of social factors, such as cultural background, experience, education and occupation.

Motivation to respond to climate change

Motivation is seen as an important factor in shaping people's responses to a perceived risk (Grothmann and Patt 2005, Kroemker and Mosler 2002). Exploring motivation is relevant for understanding the specific reasons why some people are willing to take adaptive action to address climate risk while others are less willing.

Motivation depends on a complex interplay between an individual's or group's values, knowledge, aims, personality traits and the characteristics of the physical and social environment. A person's motivation is guided by their goals, values and other personal and social characteristics and is reflected in the reasons they give for taking certain actions. The reasons that people offer in support of their actions represent the conscious rationalisation of their motivations. Three main areas seem to stand out that drive people's motivation at an individual level:

- perceived threat
- sense of a challenge
- attribution of moral responsibility.

This approach draws on theories about why people take action to protect their health (after Gochman 1997). The elements of this approach can be used in understanding what generates the motivations to address climate change at the farm or rural business level.

What influences motivation and perceived adaptive capacity? Motivation is closely influenced by factors discussed above, such as perceptions of risk, causal knowledge, judgements about causes and the perceived consequences of a particular risk. For example, drought is typically seen as being caused by a natural event or an 'act of God' which lies outside of the realm of human influence and consequently, outside of human moral responsibility. However, climate change may generate more of a sense of **social and moral responsibility** to respond if people attribute its cause to anthropogenic greenhouse gas emissions.

In some cases, a motivation will arise from a sense of **rising to a new challenge**. This may be the case if people are thinking positively or trust is placed in innovative management strategies in contrast to being anxious about the future (Kroemker and Mosler 2002). Such perceptions are usually influenced by personal characteristics as well as the situation at hand. An entrepreneurial farmer who, for example, believes

that things can be managed if one plans well may see the drought as an opportunity rather than a threat (drawing on the analogy in Kroemker and Mosler 2002).

Motivation can also be driven by a sense of the consequences of a risk (**sense of threat**). If you perceive a threat to your business viability you may be more motivated to take action. A sense of threat may also be indirect – that is, it is affecting some other valued element – like a particularly vulnerable group in society or the environment. Which driver generates more motivation will depend upon what is valued, as well as other factors introduced above such as causal knowledge or views on the consequences of risk. In reality, motivation to act may arise from any combination of these three sources of motivation.

Adaptive capacity

Motivation is necessary but not sufficient to influence a person or group to take adaptive measures: people must also have the ability to do so (Kroemker and Mosler 2002). Clearly, not everyone will have the resources they need to act on a decision even if they know they would like to.

Adaptive capacity has been described in many different ways, but is widely seen as a key element in understanding levels of vulnerability and resilience and the potential for adaptation. The level of exposure of an individual or group to a risk and their sensitivity to its effects will be modified by their capacity to adapt. **Adaptive capacity** is the ability to carry out adaptation within the context of existing enablers and constrainers in the operating environment. Adaptive capacity can also be considered in the context of the pre-conditions that help generate an ability to adapt (Nelson *et al.* 2007). In this study, enablers and constrainers are seen as the specific components relating to adaptive capacity that come into play in real life situations particularly at the points of generating motivation, intentions and actions (Figure 1).

At an individual level, adaptive capacity can be seen as the different resources one can draw upon in times of need, such as:

- time
- money
- staying power
- belief in efficacy
- knowledge
- entitlements
- personal networks
- social or institutional support (after Grothmann and Patt 2005).

People need sufficient **financial, physical, natural, human and social capital** to take actions to address the problems confronting them. Everyone has different amounts of these capitals. For example, a farmer might have a high level of financial capital (infrastructure, assets and investments) which help in adapting to climate change at the production level, but may not have the know-how to make best use of these (i.e. a low level of human capital). Human capital is a component of adaptive capacity that refers to the kinds of skills and personal characteristics that make a particular person or group more capable of taking action than another.

Adaptive capacity can include the ability to take preventative strategies (i.e. to minimise probability or impacts of a hazard) or coping strategies (used either during a disaster situation or after the event to promote a quicker recovery) (Kroemker and Mosler 2002).

Perceived adaptive capacity

A dynamic relationship exists between perceived and actual adaptive capacity which undergoes continuous adjustment over time. Perceived adaptive capacity is a subjective measure of one's ability to carry out adaptive actions. There is a complex interplay between perceived adaptive capacity and the other factors discussed above and with other personal characteristics and the characteristics of the action itself (how easy or difficult it seems). At the individual level, adaptive capacity is similar to 'perceived self-efficacy' where a person develops a perception of their own ability to perform or carry out an adaptive response (Grothmann and Patt 2005). This may or may not reflect one's actual adaptive capacity.

A person's assessment of their adaptive capacity can influence their motivation to act. For example, if one's perceived adaptive capacity or self-efficacy is low and the risk is seen as overwhelming, motivation may also be low. Alternatively, where the perceived adaptive capacity is less than the actual adaptive capacity, there is an opportunity for the exploration of management options that are better aligned to the actual adaptive capacity, thereby enhancing overall sustainability (Grothmann and Patt 2005).

Collective adaptive capacity

Adaptive capacity can also exist at a collective level, and can be characteristic of a group, such as a whole community or region, or as a sector or an institutional context (see for example Yohe and Tol 2002). Adaptive capacity is relevant because the resources that agricultural communities, farmers and rural businesses have will be an important part of their preparedness to address climate risk.

Social capital holds lessons for understanding the adaptive capacity of a group (Adger 2003, Pelling and High 2005). Social capital is made up of the social networks and

support that people may draw upon in times of need. Adger (2003) characterises adaptation processes as involving the interdependence of people through their relationships with each other, the institutional context in which they reside and with the resource base upon which they depend.

The relevance of social capital for collective adaptive capacity lies in the recognition that people are social beings and depend on each other for support. Social capital incorporates the idea of 'bonding' and 'bridging' type capitals. These aspects of social capital are qualitatively different, with bonding capital being the internal reciprocal social ties *within the group* and bridging[4] capital being the reciprocal social ties that extend *beyond the group* to more formal social networks (Woolcock 1998). This view incorporates into the concept of adaptive capacity the ideas of reciprocity and exchange, relations of trust, the evolution of common rules and the role of social networks (Adger 2003). These are key elements of a collective that can promote conditions under which people can address an issue such as climate risk.

Social and institutional enablers and constrainers of adaptive capacity

Various social and institutional enablers and constrainers influence adaptive capacity by providing opportunities or constraints to adaptation, including preparedness for climate risk. Underlying social and economic conditions are difficult to quantify, however, examples include the kind of social, health, educational and financial services available to a rural community, including formal and informal social networks, and government programs or policies, such as drought assistance.

A variety of indicators or measures have been proposed for assessing adaptive capacity, but it is difficult to find an agreed set particularly in the context of agricultural communities. One challenge is that the measures of adaptive capacity would vary depending on the scale of interest, for example individual, community, regional or national (O'Brien *et al.* 2004). They would also need to be flexible enough to respond to the heterogeneous nature of communities whilst having the capacity to capture the commonalities[5]. An approach adapted from Yohe and Tol (2002) includes the following measures of adaptive capacity:

- availability of resources
- stock of human capital (e.g. education and training, experience, health)
- stock of social capital (e.g. property rights, strong community cohesion, trust)
- institutional requirements and decision-making frameworks
- risk spreading arrangements
- credibility of decision-makers

[4] This is sometimes referred to as 'networking' capital (see for example (2003)).
[5] Such indicators of capacity have been less extensively developed and tested at local scales (as discussed by Vincent 2007).

- management of information and democratic processes.

It might be difficult to obtain such local data, so these kinds of enablers and constrainers can often only be assessed through agreed proxy indicators such as the 'capitals' (i.e. natural, social, financial, human and physical). Caution should be used in applying these proxies to measure adaptive capacity because they may be based upon anecdotal or subjective evidence.

Adaptation process and outcomes

Intention to act

An intention is what one says one plans to do (Maddux and DuCharme 1997). Discussions about adaptations often concern purposeful actions. A conscious intention to act may arise from an appraisal of the causes, impacts and adaptive strategies which is set against the backdrop of the motivations to act and the perceived and actual adaptive capacities. In short, the intention to act results from a process of adaptation appraisal (refer to Figure 1) (Grothmann and Patt 2005).

Actions, strategies and non-actions to address climate change

The adaptation process can be understood as a dynamic process of change that culminates in a conscious strategy to either **act** or **not to act.** Within a given context the **intention not to act** may prove to be a rational choice in light of the overall appraisal of the risk and perceived adaptive capacity. Another context with an alternative appraisal of risk which is characterised by different motivations and higher levels of enabling factors, may lead to proactive strategies for longer term adaptation and mitigation.

Further, many commentators point out that actions and strategies people undertake may not be in response to climate change stresses, but may be adopted in relation to a range of other kinds of stresses and motivations. For example, people may be adopting management strategies for ecological sustainability more generally, rather than targeting climate change. Communities, institutions and public policies also influence the process of decision-making in relation to climate change (Smit and Pilifosova 2001). In some accounts, adaptation is seen as an emergent change in the system of interest, that does not involve a conscious decision by a person or persons, but which has the effect of adjusting to a climate related condition, stress, hazard, risk or opportunity (Smit and Wandel 2006).

Typologies are often given for different kinds of adaptations that result from processes of change. Adaptations have been classified into different groups: for

example **autonomous** adaptations are those strategies that people undertake without the intervention of public agencies or policies due to the existing structures, incentives and knowledge systems, whereas **planned** adaptations are the 'intervention strategies' often facilitated by governments (Smith et al. 1996 in Smit and Pilifosova 2001). Similarly, people refer to **private** versus **public** adaptations, which refers to the status of the actor.

Adaptations may also be described as being '**responsive'** or **'proactive'** (Grothmann and Patt 2005). The essential distinction between these is in relation to the timing of the adaptations and whether they are motivated by the prediction of an event or the onset of the event. Responsive adaptations tend to be shorter term strategies that deal with the immediate impacts of an event that is occurring or has already occurred with the intention that these will enhance survival and or recovery. Proactive adaptations tend to be designed in relation to events that are evolving or are anticipated to occur in the future. These proactive strategies are oriented towards the longer term sustainability of the system and may include strategies that mitigate the causes of the risk.

It can be argued that the intrinsic linkages between 'autonomous' versus 'planned' and 'private' versus 'public' interventions make the distinctions between these categories somewhat less meaningful. For example, government funded skills and training programs (planned and public) can influence levels of financial knowledge in the farming community (autonomous and private). Similarly, drought assistance policies (planned and public) are part of the overall structure of incentives that influence farm business plans (autonomous and private). Further, proactive strategies may also incorporate more responsive strategies. Nevertheless, these categories can be useful from a public policy point of view to distinguish where governments can best make policy interventions to encourage adaptations to occur.

Sometimes outcomes that do not reduce climate change exposure or impacts are described as 'maladaptations' as compared with 'adaptations'. Some critics have commented that it is often difficult to assess whether adaptations are of benefit or not in addressing climate change especially in the short term because of the complexity of assessing change (Orlove 2005). Sometimes the outcomes for society can only be known in the long term (after the fact). However, the idea of 'maladaptations' remains useful where there are clear consequences of the behaviour which are generally agreed not to be in the interests of the system of concern.

According to the model described in Figure 1, an **intention to take action** to ameliorate the impacts of climate change would therefore be likely to depend upon a range of interrelated factors, including the knowledge and assessment of the causes and impacts of the risk or event, how this is framed by historical, cultural and

biophysical contexts, whether there is sufficient degree of **motivation to act** and the **adaptive capacity** including the necessary social and institutional supports and enablers to adapt.

The analysis is guided by the conceptual framework outlined above but also remains responsive to the data. Given the regional context of the study, there are a number of other findings that are not covered by the framework, but are discussed in the findings section.

Methods

Research design and selection of case studies

An exploratory case study approach was used in order to examine a 'contemporary phenomenon within its real life context' (Yin 2003). In designing the study, a number of design factors were considered. Listed below are the key elements of the design:

1. regions – EC declared areas, States and Territories
2. duration of EC – long term and short term
3. up-take of EC – high and low uptake
4. industry type – irrigated and non-irrigated
5. community profile – financial, human and social capital, population, town size and remoteness.

A major focus of the study was to look at the adaptation strategies of primary industries. Regions which contained both irrigated and non-irrigated industries were considered in order to provide a range of industry perspectives on adaptation.

The comparative case studies were geographically defined by EC regions. The selected EC regions for the NSW case studies were South West Slopes and Plains and Condobolin-Narrandera. A key criterion for the selection of the case study regions was the availability of existing empirical work that had been undertaken on the social implications of climate risk in these areas (see Table 1). The use of baseline social information from prior studies provided an opportunity to include a temporal analysis to identify changes in perceptions and actions to climate risks over time.

Table 1: Empirical studies on climate risk and social impacts in Australia

Location	Study
Urana Shire, NSW	O'Brien (2006)
Bourke, Deniliquin and Condobolin communities (NSW)	Alston and Kent (2004)
Temora town (NSW) and Roma town (QLD)	DoTARS (2004)
Central QLD area and Western Rangelands area, NSW	Stehlik, Gray and Lawrence (1999)

The New South Wales towns selected within the case study regions for the interviews and focus groups were Temora (South West Slopes and Plains EC region) and Condobolin (Condobolin-Narrandera EC region).

The selection criteria for the Victorian case studies were:

- predominance of irrigated perennial horticultural
- location in the MDB
- no on-farm storage of water.

The selected EC regions for the Victorian case studies were the Murray System and the Mallee-Northern Wimmera. The selected Victorian towns within the regions for the interviews and focus groups were Mildura, Merbein and Red Cliffs (Mallee-Northern Wimmera EC Region) and Cobram (Murray System EC region).

Table 2: Case study selection

Case study	Jurisdiction	Irrigation	Uptake EC[a]	Duration EC
Temora	South West Slopes & Plains, NSW	Dryland	10%	3.5 to 4 years
Condobolin	Condobolin-Narrandera, NSW	Dryland	26%	3.5 to 4 years
Mildura	Mallee Northern Wimmera, Victoria	Irrigated	19% [b]	< 1 year
Cobram	Murray System, Victoria	Irrigated	14% [b]	< 1 year

(a) Uptake is based on figures from RPI, 16 March 2007.
(b) Expressed as per cent of total up-take by horticulturalists in Victoria.

Methods for data collection

The methods for data collection included both key informant interviews and focus groups, conducted between April and July 2007 (see Appendix 1a and 1b for list of questions).

Key informant interviews

Key informant interviews were held with agriculturally dependent businesses on the agricultural input and output side, as well as key community members. These included councillors, teachers, extension officers and journalists. The interviews

provided information on people's perceptions and risk management strategies with respect to climate risk and provided an opportunity and means by which to identify relevant respondents for the focus groups.

Focus groups

For each of the four case studies, two focus groups were undertaken (i.e. a total of eight groups). The key themes were perceptions of climate change and climate variability, coping and adaptation strategies and the role of government assistance with respect to climate variability and change. The purpose of the focus groups was to confirm issues and themes which had been raised in the interviews. A total of 149 people participated in the study; Table 3 shows the number of respondents by case study.

Table 3: Number of respondents in the study

	Irrigated communities		**Dryland communities**	
Respondents	Cobram	Mildura	Temora	Condobolin
Small Business	8	10	10	10
Organisation	11	8	7	8
Farmers	21	19	22	14
Total	41	37	39	32

In the report, the comments made by respondents are coded by case study region and type of data collection method (interview or focus group). The interviews are also coded by type of interviewee (business and organisation). The coding system is outlined below (Table 4).

Table 4: case study region codes

Respondents	**Cobram**	**Mildura**	**Temora**	**Condobolin**
Small Business	CoB	MiB	TB	CnB
Organisation	CoO	MiO	TO	CnO
Focus groups	CoFG	MiFG	TFG	CnFG

Background on case study regions

The four case study areas are located in the MDB. To provide context for the study, an overview is provided on agriculture, climate and water allocations in the MDB. This is followed by more in-depth socio-economic analysis of case study regions.

Agriculture in the Murray-Darling Basin

Situated in the south east of Australia, the MDB covers 14 per cent of the country's total land area and in 2001, it accounted for nearly 52 per cent of the annual national gross value of agricultural production (Gunasekera *et al.* 2007). The MDB encompasses a range of climatic conditions from sub-tropical to cool temperate, allowing for the production of more than 100 types of agricultural crops and livestock across dryland and irrigation farming systems (ABS 2001). Dryland agricultural regions make up 90 per cent of the MDB's land area (MDBC 2007). Much of this area has a mean annual rainfall of less than 600 millimetres. Dryland agriculture in the MDB includes wheat, barley, forestry and animal husbandry. Sheep and cattle enterprises are the dominant primary industries but with significant regional variations across the MDB. The irrigated areas of the MDB cover 2.2 million hectares and represent 75 per cent of Australia's total irrigation area (Gunasekera *et al.* 2007).

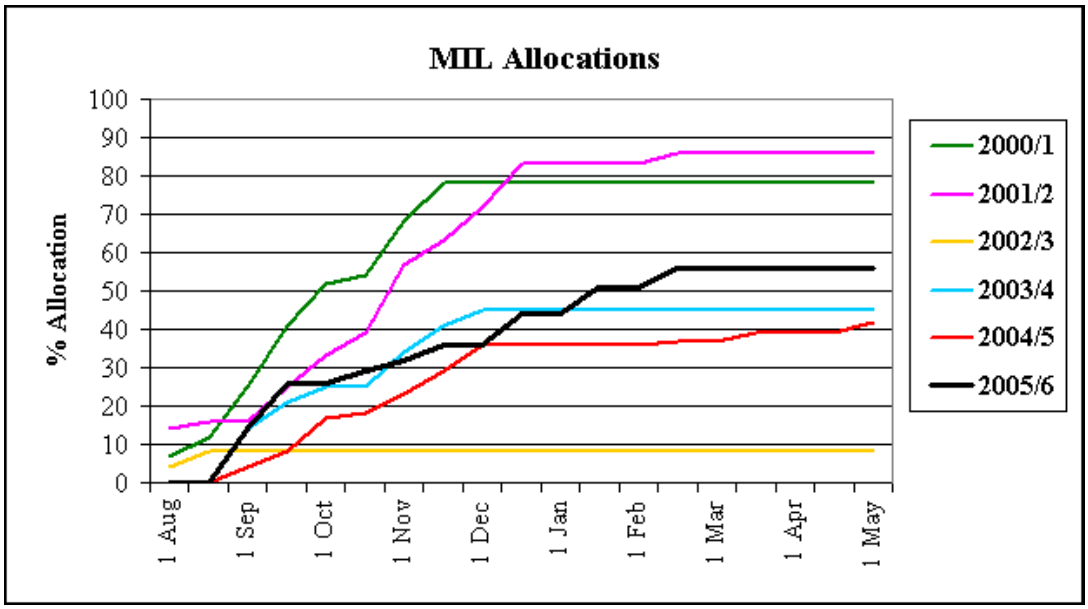
Water allocations and restrictions

The fieldwork for the study was undertaken between April and June 2007, an uncertain time for irrigators on the Murray System. On 20 April 2007, the then Prime Minister and Premiers of NSW, Victoria and South Australia announced that, unless there were substantial inflows prior to mid-May 2007, there would be insufficient availability of water in the Murray-Darling System to allow any allocation for irrigation[6] (MDBC 2007).

Rainfall and temperature are key indicators of the severity of drought. From the beginning of June until the end of August 2007, rainfall was below average across a majority of the MDB. The period between November 2001 and October 2007 was below 100 per cent water allocations and the equal driest six-year period on record (see Figure 2). On 27 August 2007 water availability was at 1500 gigalitres, 1250 gigalitres above critical demand (BOM 2007).

[6] The announcement also included the use of high security water and water carried over from 2006-07, the environment, or any purpose other than meeting critical urban supplies at the start of the 2007-08 irrigation season.

Figure 2: Murray Irrigation Limited Annual Allocation History (2000-2006)



Year	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Allocations %	86	8	45	42	56	0[a]

a- Adjusted during the season.

Source: http://www.murrayirrigation.com.au/content.aspx?p=20025

The extreme dry period for the MDB has been exacerbated by higher temperatures. Between November 2001 and October 2007 daytime maximum and daily mean temperatures were well above previous records. Maximum temperatures for the MDB over the past six years have averaged 1.3 degrees Celsius above the long term average (1961–1990). It highlights the extent of the prolonged period of exceptionally warm conditions in the MDB (BOM 2007).

Impacts on agriculture

Warmer temperatures and reduced water availability in the MDB associated with decreased rainfall has had adverse economic impacts upon both dryland and irrigated agriculture in the region. The critically low water availability is affecting irrigators in most agricultural sectors including dairy, rice, horticulture, grains and fodder cropping. The greatest reduction in production in irrigated areas of the MDB is estimated to occur in perennial horticulture and viticulture (Gunasekera *et al.* 2007). Farmers have already begun to see the impacts of the prolonged drought with the loss of some permanent plantings (MDBC 2007). The MDBC predict that there is a significant risk that allocations will be insufficient to avoid further widespread permanent planting losses across the system and that salinity will start to have a more significant impact on some crops.

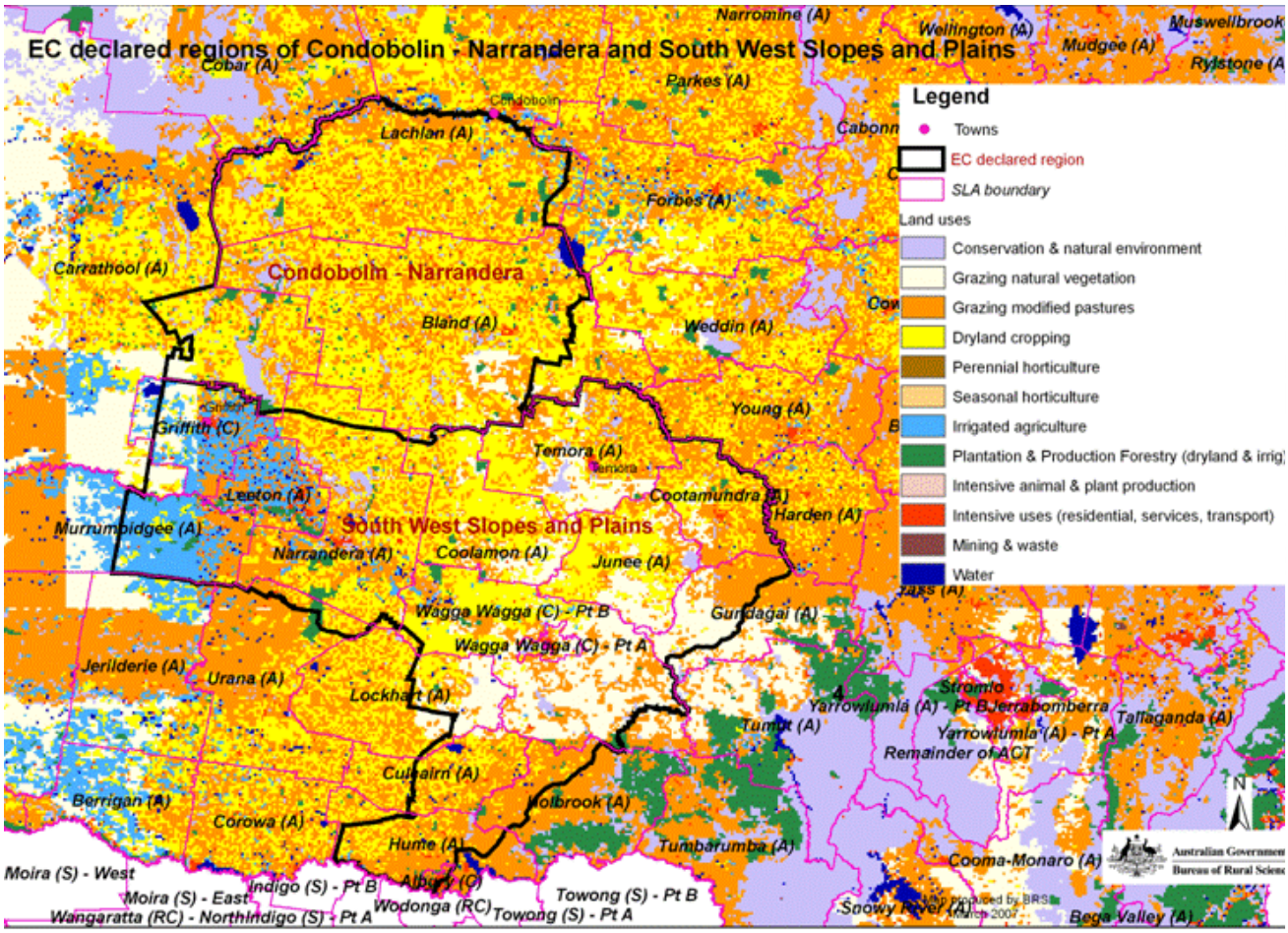
Climate change projections

In the northern summer-dominant rainfall areas of the MDB, generalised best estimates for climate change indicate a small reduction in rainfall (five to 10 per cent) compared to a larger decrease in rainfall (10 to 20 per cent) in the southern MDB (Beare and Heaney 2002). It has been indicated that wheat yields in the MDB will, under the worst case scenario, decrease by five to 15 per cent (Kokic *et al.* 2005). For irrigated agricultural production in the region, the most extreme climate change scenario predicted a fall of around 25 per cent relative to 'business as usual', under reduced water availability (Gunasekera *et al.* 2007).

Dryland communities in NSW

The two dryland EC regions in the study incorporate the Lachlan and Temora Shires. The major towns in these regions are Condobolin and Temora. The agricultural areas are predominantly dryland cropping and grazing (see Figure 3).

Figure 3: NSW case study areas

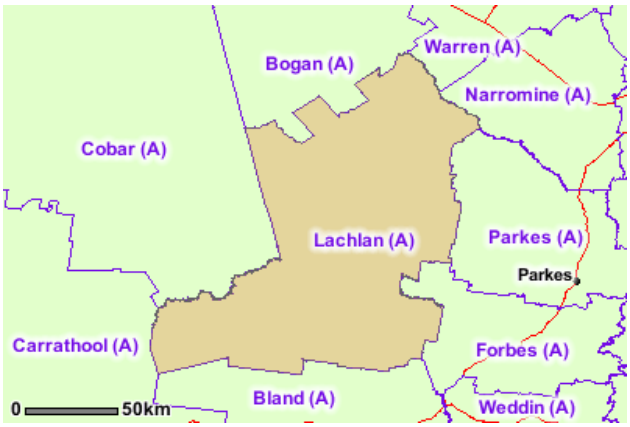


Source: National Agricultural Monitoring Systems, BRS, 2007

Lachlan shire is located in central western NSW and Condobolin is situated on the Lachlan River in the middle of the catchment. Condobolin has approximately 3500

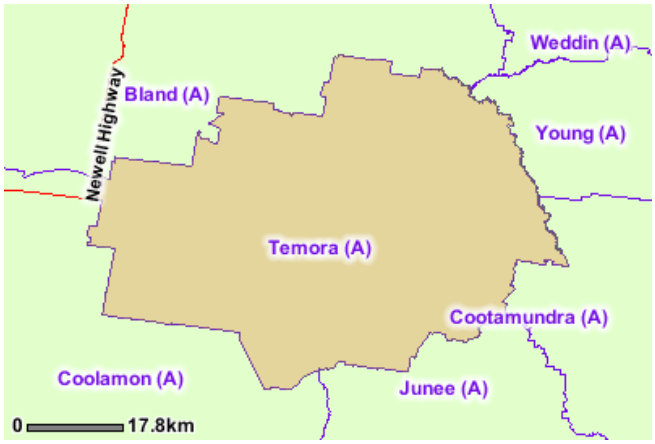
residents, almost half of the whole Lachlan Statistical Local Area (SLA[7]). The Wyangala Dam is the main dam regulating flows in the Lachlan River with a capacity of 1 220 000 mega litres. The agriculture and farming region produces wheat, barley, canola, wool and livestock.

Figure 4: Lachlan Shire



Temora Shire, in South Eastern NSW, includes an area around the town of Temora of 2802 square kilometres. The town of Temora is located approximately 90 kilometres north of Wagga Wagga. The Temora region produces a range of commodities including cereals, wool, lamb, beef and pork.

Figure 5: Temora Shire



[7] SLA (Statistical Local Area) is an ABS classification for an area made up of around 14 000 people.

Climate

Rainfall and temperature records for the two NSW case studies, highlight the drier conditions in winter 2007 and higher temperatures experienced in summer 2007 (Figures 6-9). The graphs show that rainfall has been below the average over the winter period in both Temora and Condobolin. The historical rainfall maps capture the length and severity of the current drought (Figure 10 and 11).

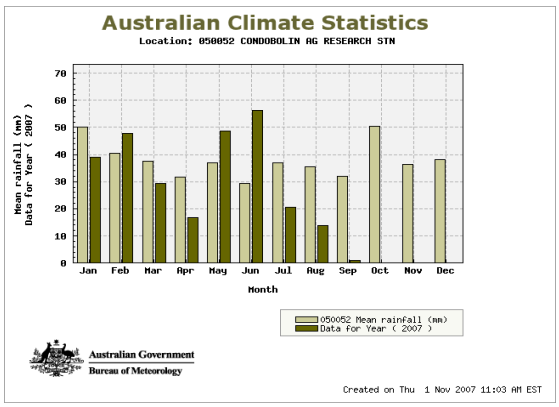


Figure 6: Condobolin rainfall, 2007 against average

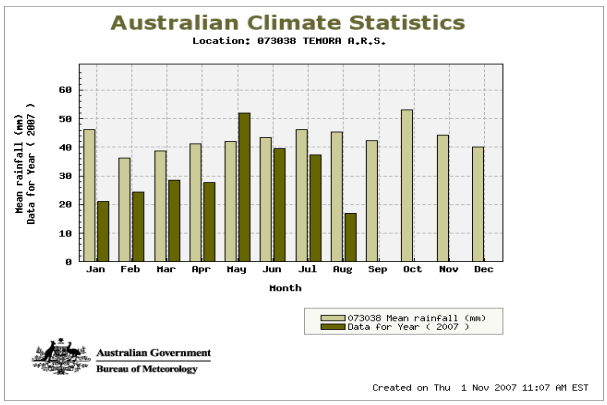


Figure 8: Temora rainfall, 2007 against average

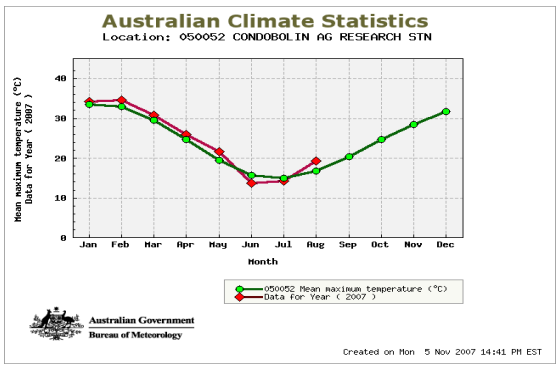


Figure 7: Condobolin temperature, 2007 against average

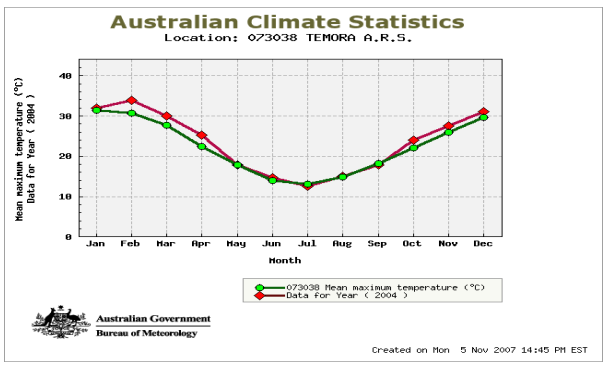


Figure 9: Temora temperature, 2004 against average

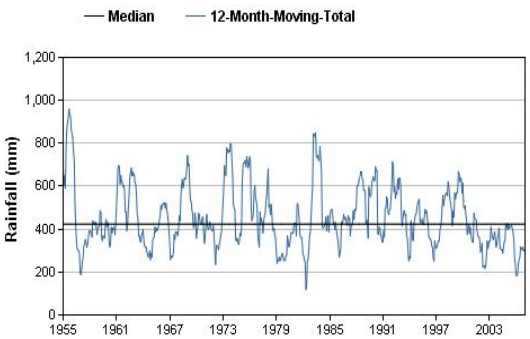


Figure 10: Condobolin rainfall, 1955-2007

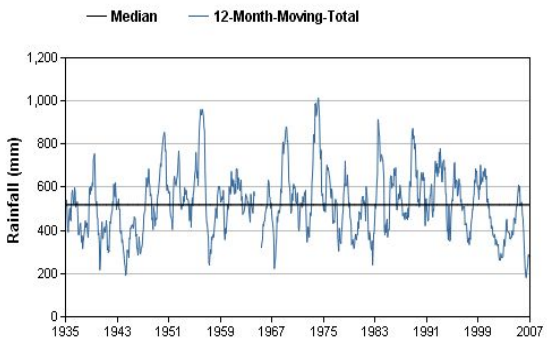


Figure 11: Temora rainfall, 1935-2007

Socio-economic profiles of dryland case study areas

Table 5 below captures a range of socio-economic indicators at the Shire or SLA level which are compared against the non-metropolitan average[8]. The regions of Temora and Lachlan were selected for the study because of similarities in their agricultural activities and size of the population. The socio-economic indicators, however, highlight some differences between the two case studies. The most significant difference is that over the drought period (2001–2006), the population of Lachlan shire has decreased at a much faster rate than Temora Shire. In the table below, figures are provided from two Census periods; pre-drought period (1996–2001) and during the current drought period (2001–2006). While it is difficult to attribute the changes in the indicators to drought, it is interesting to note differences between the two periods.

Table 5: Shire profiles for NSW case studies

SLA	Lachlan (A)	Temora	Non-metro Avg	Australian Avg
Population (2006)	6700	5900	8900	13 900
Annual pop growth (1996–2001)	-1.2%	0.2%	0.3%	1.2%
Annual pop growth (2001–06)	-1.2%	-0.7%	0.3%	1.2%
Total pop growth (1996–2006)	-11.5%	-2.7%	9.9%	11.8%
Indigenous population (2006)	14.9%	1.4%	4.4%	2.3% [b]
Dependency ratio[a] (2006)	67.3%	69.6%	50.0%	49.6%
Employment in AFF (2006)	36.8%	22.9%	10.0%	3.2% [b]
% Change of employment in AFF (1996–2001)	3.5%	16.0%	-1.3%	-0.9%
% Change of employment in AFF (2001–2006)	-11.7%	-8.2%	-10.0%	-11.6%
% Low income households (2006)	23.6%	24.6%	18.9%	16.3% [b]
% High income households (2006)	22.5%	23.1%	31.7%	39.6% [b]
% Population with post school qualifications (2006)	27.7%	33.7%	40.5%	45.4% [b]
SEIFA Disadvantage score[c] (2001)	961.96	981.88	973.73	998.81

a - The Dependency ratio figure shows the percentage of people who are dependent on others. It refers to the number of people aged less than 14 years combined with the number of people aged 65 or older, divided by the number of people at working age (15–64) in an SLA.

b - The Australian averages have been taken from all the SLAs in Australia with an aggregate of the SLAs in the eight major urban centres.

c - The Socio-Economic Indicator for Areas (SIEFA) consists of four indexes that capture different aspects of socio-economic conditions and identify disadvantage. The index is based on a range of attributes including income, educational attainment, and employment. Low scores reflect disadvantage.

Source: Australian Bureau of Statistics 2006

[8] The non-metropolitan average is an average of all SLAs excluding eight major urban centres, and the national average.

Total population

Over the last five years in Australia, towns approximately the size of Temora and Condobolin (5000 to 9999 people) have experienced population losses, whilst the population of non-metropolitan Australia has been increasing. This may reflect the stress that drought is having on the smaller agricultural based communities as well as the general decline of rural populations. Over the last five years, Lachlan Shire has experienced a more rapid population loss than Temora Shire. The population of the Temora SLA in 2006 was only marginally down from the 2001 Census (ABS 2001, ABS 2006).

Indigenous population

In Lachlan Shire, the Indigenous population, the Wiradjuri people, make up 15 per cent of the total population. The name of the town is said to be derived from their language. Over the last five years the Indigenous population has grown by approximately 18 per cent. In comparison, Temora's Indigenous population is small, less than the average for non-metropolitan Australia and Australia as a whole.

Dependency ratios

The dependency ratios for Lachlan Shire and Temora Shire are high in comparison to the non-metropolitan and Australian averages. The high ratio implies that there is likely to be some strain on the productive part of the population to support the upbringing and welfare of the economically dependent. Temora Shire has a higher dependency ratio than Lachlan Shire which may reflect the increasing number of retirees moving to the community. It also supports the national trend in non-metropolitan areas where the split between people under 45 years and those older than 45 was 65 to 35 per cent in 1996, and 58 to 42 per cent in 2006.

Employment

Employment in agriculture, forestry and fishing (AFF) is considerably higher in Lachlan Shire than in Temora Shire. AFF is the biggest employer in the Lachlan Area (36.8 per cent), the second largest being retail at just under 10 per cent of total employment. Temora's employment in the AFF sector (22.9 per cent), whilst well above the non-metropolitan average, is not as dominant as in Lachlan Shire. Temora's industry is more diversified with the second largest industry being retail (15.3 per cent).

The percentage changes in AFF employment figures show opposite movements over the two Census periods. Between 1996 and 2001, the AFF sector grew in both the Lachlan and Temora Shires. However, between 2001 and 2006, both regions experienced around 10 per cent reductions in employment in the AFF sector (ABS

2006). The fall in AFF employment is likely to reflect the fall in demand for farm labour over the drought period and the out-migration of farm workers to the mines.

Education

For the Lachlan and Temora Shires, the percentage of the population with more than a high school education was below the non-metropolitan and Australian averages. However, over the last five years, the level of educational attainment has been increasing in both Shires.

Socio-Economic Indicator for Areas (SIEFA) index

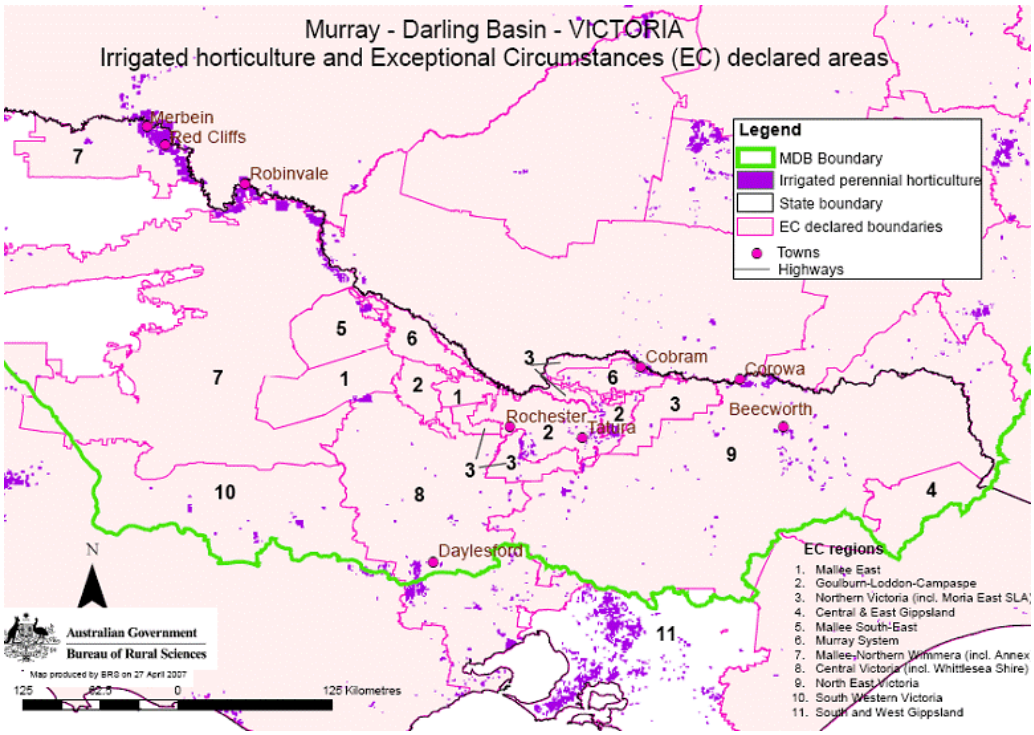
According to the 2001 The Socio-Economic Indicator for Areas (SEIFA) index, Lachlan Shire is a disadvantaged area in relation to other non-metropolitan areas and to Australia. Relative to the non-metropolitan average, Lachlan has a large percentage of the population living on low incomes and a small percentage living on high incomes. The SEIFA index for Temora Shire is above the non-metropolitan average. Considering that Temora was below the non-metropolitan and Australian averages for some of the income and education indicators between 2001 and 2006, the 2006 SEIFA index for this community may actually be lower[9].

Irrigated communities in Victoria

For the Victorian case study regions, the primary selection criterion was a high prevalence of irrigated perennial horticulture. The Mallee-Northern Wimmera EC region (Number 7 in Figure 12) was selected as it incorporated Merbein, Red Hills and Mildura where large amounts of citrus and grapes are planted. Moira-West Shire, in the Murray System (Number 6 in Figure 12), was also selected because of the high amount of stone fruit plantings. Cobram is the major town in the Moira-West Shire.

[9] The 2006 SEIFA scores are due to be released in February 2008.

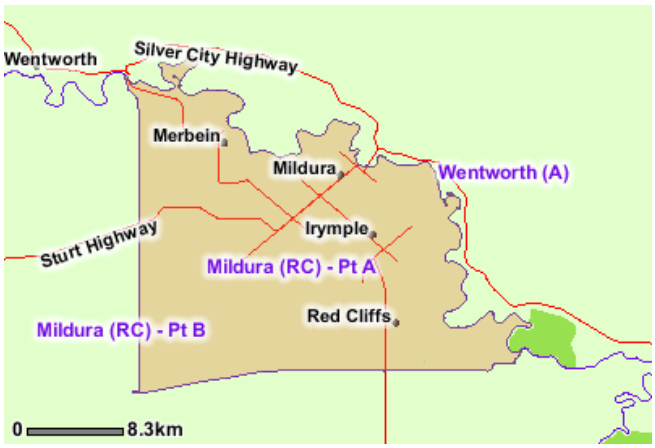
Figure 12: Victorian case study areas



Source: National Agricultural Monitoring Systems, BRS, 2007

Mildura Shire is located within the Mallee-Northern Wimmera EC region and covers the horticultural area along the Murray. Mildura, the major town in the Mildura Shire, was Australia's first irrigation settlement in the nineteenth century and is still dominated by irrigation-based industries. The region produces 21 per cent of Australia's total wine, 20 per cent of the country's citrus production and almost 100 per cent of Australia's dried vine fruit production (Grow Mildura Region 2005).

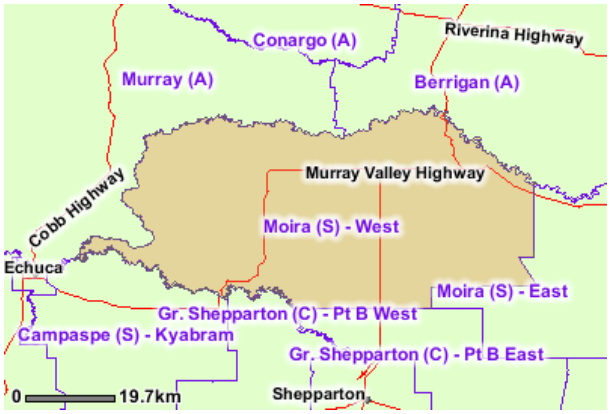
Figure 13: Mildura SLA – Part A



Moira-West Shire is located on the southern side of the Murray River, on the border with NSW. Cobram, the major town in the Moira-West, has both agriculture and a number of major manufacturing industries including the Murray Goulburn Co-

operative factory, the Meiji Dairy Corporation milk processing plant, a large abattoir and orange juice factories (Wikipedia contributors 2007).

Figure 14: Moira-West SLA



Climate

Similar to the dryland case study areas, the graphs of rainfall and temperature records for Mildura and Echuca (near Cobram), highlight the drier conditions and higher temperatures experienced in winter 2007 (Figures 14 to 17). The figures show that rainfall has been below the average over most of winter 2007 in both Mildura and Echuca. The historical rainfall maps capture the length and severity of the current drought, as well as the cyclical nature of dry periods in Australia.

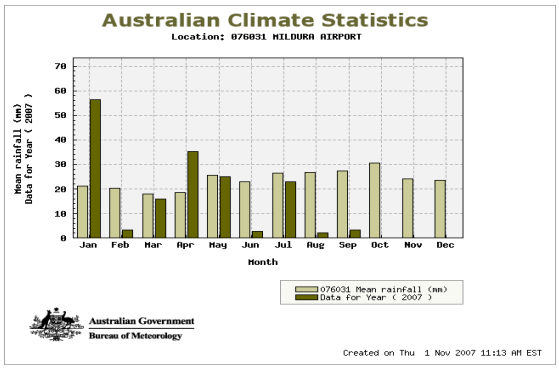


Figure 15: Mildura rainfall, 2007 against average

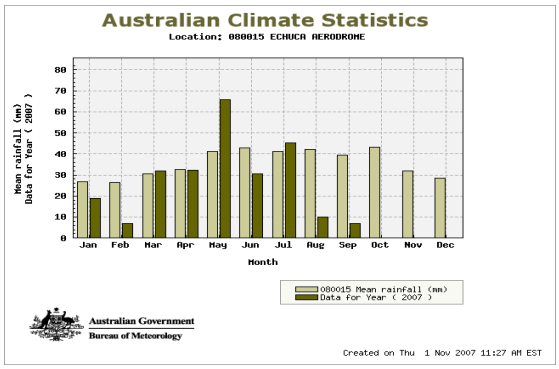


Figure 16: Cobram rainfall, 2007 against average

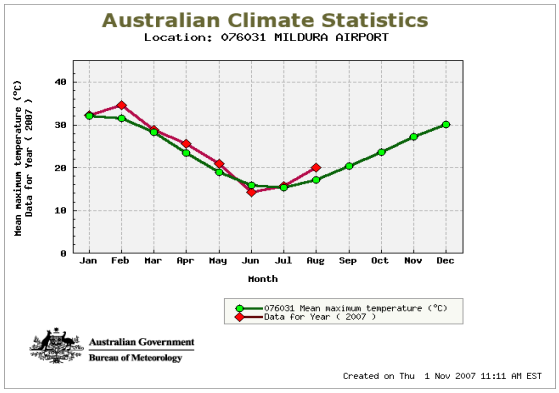


Figure 17: Mildura temperature, 2007 against average

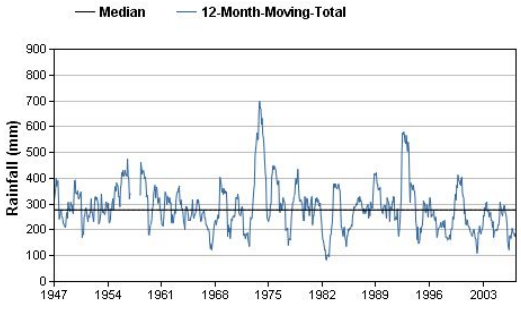


Figure 18: Mildura rainfall, 1947-2007

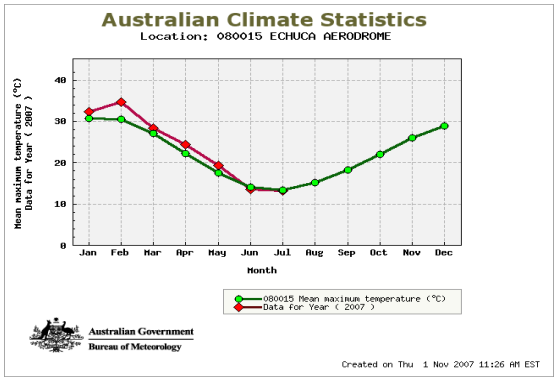


Figure 19: Cobram temperature, 2007 against average

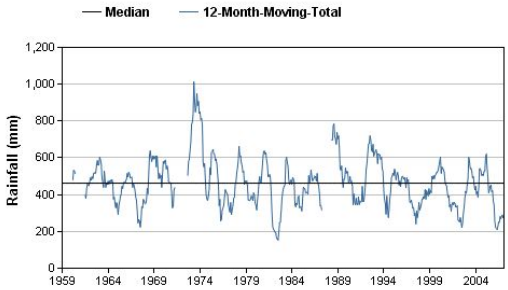


Figure 20: Cobram rainfall, 1959-2007

Socio-economic profiles of irrigated case study areas

The table below captures a range of socio-economic indicators at the Shire or SLA which are compared against the non-metropolitan averages and the national averages. The socio-economic indicators highlight some differences between the two Victorian case study regions.

Table 6: Shire Profiles for Victorian case studies

SLA	Moira-West	Mildura Pt A	Non-metro avg	Aust average
Population (2006)	18 300	46 000	8 900	13 900
Annual pop growth (1996–2001)	0.3%	1.2%	0.3%	1.2%
Annual pop growth (2001–06)	0.9%	1.5%t	1.7%	1.2%
Total pop growth (1996–2006)	3.7%	13.9%	9.9%	11.8%
Indigenous population (2006)	1.4%	3.0%	4.4%t	2.3%[b]
Dependency ratio[a] (2006)	64.0%	58.9%	50.0%	49.6%
Employment in AFF (2006)	24.0%	10.0%	10.0%	3.2%[b]
% Change of employment in AFF (1996–2001)	-6.2%	8.5%	-1.3%	-0.9%
% Change of employment in AFF (2001-2006)	-9.8%	-23.0%	-10.0%	-11.6%
% Low income households (2006)	20.3%	20.5%	18.9%	16.3%[b]
% High income households (2006)	24.6%	27.8%	26.8%	39.6%[b]
% Population with post-school qualifications (2006)	32.9%	34.2%	40.5%	45.4%[b]
SEIFA Disadvantage score[c] (2001)	991.304	977.22	973.73	998.81

a - The Dependency ratio figure shows the percentage of people who are dependent on others. It refers to the number of people aged less than 14 years combined with the number of people aged 65 or older, divided by the number of people at working age (15–64) in an SLA.

b - The Australian averages have been taken from all the SLAs in Australia with an aggregate of the SLAs in the eight major urban centres.

c - The Socio-Economic Indicator for Areas (SIEFA) consists of four indexes that capture different aspects of socio-economic conditions and identify disadvantage. The index is based on a range of attributes including income, educational attainment, and employment. Low scores reflect disadvantage.

Source: Australian Bureau of Statistics 2006

Population

The population of Mildura Shire is two and half times bigger than Moira-West. Since 1996, 100 per cent of smaller Victorian rural towns (5000 to 9999 people) have shrunk to towns of 1000 to 4999 people, with many individuals moving to larger regional centres, like Mildura. Mildura has sustained its population growth over the last 10 years, well above the non-metropolitan and Australian average.

Dependency ratios

Moira-West has a very high dependency ratio compared to the non-metropolitan average. This imbalance puts pressure on the workforce of Moira-West Shire to support a growing number of elderly residents. Mildura Shire has a lower dependency ratio but it is still above the non-metropolitan average.

Employment

Only 10 per cent of the workforce in Mildura is employed in the AFF sector. The economy is diversified with the large employers being manufacturing, community and health services. There is a marked difference between the two Census periods in relation to change in employment in the AFF sector. Mildura experienced increased employment in the AFF sector between 1996 and 2001, but in the last five years the number employed in the sector has fallen by over 20 per cent.

In Moira-West, AFF is still the biggest employer (24 per cent), but the manufacturing and retail sectors have 16.3 per cent and 12.7 per cent respectively of the total industry employment. Moira-West has experienced a reduction in employment in the AFF sector over both Census periods despite a growth in population. This is likely to reflect movements of labour between sectors and diversification of the economic base.

SEIFA index

Mildura has above the non-metropolitan and Australian averages for percentage of low income and high income households. In Moira-West, there is a greater proportion of the population living in low income households than the non-metropolitan average as well as a smaller proportion of the population living in high income households. This indicates an above average level of disadvantage than the rest of the country.

The background on the case studies provides the social and economic context, important in the framing of people's perceptions of climate change, discussed in the remainder of the report.

Findings

The findings are divided into four sections; perceptions of drought, perceptions of climate change, managing climate risk and the potential role of government in assisting in the management of climate risk. Within each section, evidence from each of the case studies is discussed in relation to the conceptual framework. The conceptual framework is used to guide the analysis and provide the necessary links to understand the processes for framing perceptions and adapting to climate risk in agriculture. The responses are wide ranging, even given the small number of participants, and attempts have been made to capture the diversity and nuances of people's perceptions and understanding of climate risk.

Perceptions of drought

In Australia drought is often perceived as being a rural problem. It can be defined across a range of perspectives including agricultural, socio-economic, hydrological and meteorological (Botterill and Fisher 2003). Regardless of the definition, drought is associated with uncertainty and risk (Botterill and Fisher 2003).

This section covers people's perceptions of the current drought and drought impacts. With respect to drought perceptions two issues are explored; whether this current drought is perceived as being different from previous droughts and how drought is perceived alongside other stresses facing rural communities. The impacts of drought are multifaceted, particularly for extensive drought episodes. Drought impacts (both positive and negative) are discussed in terms of who is affected and the nature of the impact.

Perceptions of current drought

Many respondents from dryland areas perceived the current drought as the worst drought they had experienced. This was attributed to its duration, the expansive area it has affected and its impact on all industries. The duration of this drought was often associated with depletion in capital reserves. Usual risk management strategies of putting capital away (e.g. storing fodder or money during good times to be used for drought periods) had been designed for droughts lasting one to two years, but were proving inadequate for the current drought that had lasted up to seven years. Many farmers also commented on not having enough recovery time between droughts and therefore had gone into the current drought with limited or no capital reserves. For example:

'Most farming businesses can cope with one year of a loss of income or reduction but… a lot of farmers haven't had significant income since 2000… It's going to take them two or three years to try and recover their financial situation and also recover their whole farming system. Because their whole farming system has been disrupted and you just can't right that in one year unless you've got a lot of money which they don't have.' (TO7)

'Most farmers around here, business wise, farming wise, they manage for a drought of two to three years. No one really factors in the drought of five years or so that we have had. That's what has caught a lot of people. There are a lot of very big farmers that are even now starting to really feel the impact simply because, you know you build it into your income for a couple of bad years or whatever, but when it is becoming longer term I think now they are probably learning that OK when we come out of all this, we have to plan ahead longer term than we have previously. That flows through to business as well. I mean it's been hard… we've never experienced anything like this … It's a first for us.' (TO6)

In irrigated communities, most respondents agreed the drought was different this time largely because of the water restrictions. In Mildura, there was a general sense that this drought seemed to be going on longer than past droughts. The majority of interview respondents perceived the current water crisis in the region was part of the drought, which was a cyclical event and would eventually break.

'We've always had droughts but this is the one that has been the killer. It is the first time everyone has had water restrictions out of the Murray.' (MiFG)

'I think the drought effects have been more severe than most other years we've experienced. Certainly, in the irrigation areas … this past irrigation season is the first time ever, high security water in NSW had water cuts and we suffered a 20 per cent cut of our remaining water, and another 32 per cent in November.' (MiFG)

Multiple stresses

Most respondents did not view the drought in isolation. Many perceived the current situation as a layering of cumulative pressures and impacts of which drought was one, but not always the most significant; *'the drought is just another nail in the coffin'* or *'the straw that broke the camel's back.'* Other stressors included industry down-turn, lack of grower confidence, uncertain water allocations, declining terms of trade, rising petrol prices and uncertainty in commodity prices. For example,

'The drought has brought forward a whole range of issues. It is the catalyst that is bringing forward a lot of other non-climate and non-drought issues onto the table and we're getting very confused and mixed messages.' (MiFG)

'But there are a lot of unknowns in that. You've got drought, stock prices, market crashes, and interference. So when they say the next drought should be easier and

easier every time we go through them but there are more things that can [affect the situation]' (CnFG)

In irrigated communities, many believed that the drought had been exacerbated by over-allocations of water. They saw their current situation as a result of poor water planning, rather than the drought conditions, as captured in this quote:

'In the last five to 10 years, there has been a drastic lack of water planning on how to deal with it until we are basically getting announcements from government about what the allocation will be, won't be.' (MiFG)

Drought impacts

Respondents described drought related impacts in terms of the nature of the impact and who or what had been affected. Some of the sub-classifications of the community included:

- younger and older generations
- men and women
- town and farm families
- industry groups (e.g. horticulture, dairy, sheep and wheat)
- cultural groups
- subsystem irrigation areas (Goulburn, Murray, Darling)
- smaller and larger country towns
- NSW and Victoria (particularly along the Murray)
- rural and urban.

Respondents also referred to 'winners and losers' or the 'more resilient and more vulnerable groups'. On an industry level, irrigators were considered more vulnerable than dryland farmers because of the practical difficulties and costs of converting to other land uses. For instance,

'Irrigators have small land parcels so can't convert to dryland farming. Black soils need more water for crop production but irrigators can't really switch back to dryland farming as they don't have enough land to provide the same income (i.e. as they receive from irrigated crops).' (CnO).

In general, the younger and older generation were perceived as being more vulnerable to the financial impacts of drought although 'older, wealthier families' were perceived as being more resilient. Many respondents commented that young people who were coming into agriculture with high debt will be the most affected.

'It will impact upon the young families most heavily as they generally hold the greatest debts and have increased expenses.' (CnFG)

A number of respondents felt that the more droughts people were exposed to, the better they were at managing the associated risks. For example,

> *'It probably affected me a lot because I was probably at [that] stage of life…you haven't learned to prepare for drought. Possibly as you get along and learn how to survive it gets easier.'* (CnFG)

> *'The older people have risk management for climate and climate variability. We've had climate variability for a very long time so I think there is strategies there but they're not long term… there's bad seasons, a period of good seasons and they build up their bank account and survive it, put away and do other things to change…'* (TB2)

Drought related impacts and changes reported by respondents were broadly categorised into financial, economic, social, human and environmental impacts (see Table 7). As in the case of the current drought, prolonged periods of drought often have adverse flow-on effects to the local and regional community. A majority of the small businesses commented on the financial impacts the drought was having on their businesses, particularly in terms of maintaining turnover and managing client debt.

Table 7: Nature of drought impacts

Social
• people stop communicating, less social interaction • reduction in volunteering • town water restrictions impacting on recreational facilities and sports in the community • training staff in 'occasional counselling' regarding suicide and depression • belief in being a resilient community with the capacity to 'bounce back'.
Human
• increased social learning about farming practices – tendency to look over the fence to see if another farmer's ideas are working and if so, adopt • improvement in business and in water use and farming management.
Financial
• people stop spending • limited or no borrowing capacity • no money for superannuation • tensions in the credit-debit relationships between providers, businesses and users • efficient growers going into debt to put in water use efficiency measures • traders facing cumulative impacts of rental arrears (e.g. have had to put off staff).
Economic
• skills and labour shortage • reduced spending in the community • increased unemployment • reduction in council rates impacting on provision of services – (e.g. health and welfare).
Environmental
• reduced environmental flows • drought has increased environmental consciousness.

In a number of instances the impacts were interrelated and involved trade-offs, particularly between social and economic impacts. For example, with less farm labour available, farm families were doing the work themselves, and thereby reducing the time available for volunteering and social interaction within the community,

> *'Women have to do a lot more physical work on the farm and as such have had to give up volunteering roles held in the community (canteen duty, meals-on-wheels).'* (CnFG)

The drought has lead to an increase in the number of men moving out of their local areas to work in mining. The subsequent labour shortage in the community and the social impacts of a reduced population were particularly pertinent in Condobolin (mentioned by approximately 60 per cent of interviewees). For example,

> *'We can't attract mechanics– the mines snap up any qualified people.' (CnB)*

> *'Many have gone to the mines, following the $100 000 a year. Even when the mine closed, people didn't return, went and found other mine work. Lost families and hence lost teachers, etc.'* (CnFG)

Future drought impacts

Respondents from the dryland communities have experienced drought conditions for at least five years. Due to the long time period, people are increasingly talking about adapting to or surviving drought conditions rather than actual or impending impacts of the drought. In contrast, those in the irrigated communities tended to talk in terms of the challenges they still had to face. This suggests that irrigated communities have been buffered from the drought by irrigation systems and illustrates the importance of the local context for understanding social outcomes.

Most interviewees in the irrigated community of Mildura believed the full impact of the drought had not yet hit local businesses or the community, but were just beginning to be felt. Although the drought had started to slow down business and tourism, most believed the biggest impact was yet to come. Participants highlighted the risk of a downturn in business, staff reductions and expressed broader concerns that their towns might shrink (less people, business and tourism).

Similarly, many respondents in the irrigated community of Cobram thought the full effects of water scarcity had yet to impact on local businesses and producers. However, some reported that a longer period of impact from drought, along with a drop in regional agricultural production since 2002, had led to a slow down in spending in the town. This had led to increased reliance on alternative industries such as tourism. In previous years, the water allocation to the Murray Valley irrigation system had been 95 per cent or above. Respondents in Cobram had a similar view as those from Mildura that less than full water allocation was unprecedented and they were moving into *'unchartered territory'*. The availability of water allocations was mentioned as the key issue going into spring. For example,

'If we get 50 per cent allocation this year and 20 per cent next year, we will have to sell up and get out.' (MiFG)

'Anything below 30 per cent will create flow-on effects throughout whole MDB, whole country… much bigger than just in Mildura. But with the same allocations, reality won't hit.' (MiFG)

Future impacts were believed to depend on water allocations, the level of adaptation (e.g. water efficiency measures), community resilience and on the phase of a person's life (e.g. retirement).

The respondents' perceptions of drought impacts are important in identifying some of the major issues and drivers of change in the case study communities. It provides a context from which to begin eliciting perceptions on climate change and climate risk. People's perceptions of climate change are discussed in the next section, within the current context of drought and low water availability.

Perceptions of climate change

The way people perceive and interpret climate risk is framed by their values, experience, education, training and personal characteristics which are historically and culturally situated. It is a dynamic process by which people engage in sense-making to handle complex information and to reduce multiple meanings (Weick 1979). Views are constantly assessed and reassessed in light of new information, changing situations or shared values and goals. There is a dynamic interplay between people's perceptions and interpretations of climate change and the biophysical, social and institutional contexts in which they find themselves.

The framework depicted in Figure 21 was developed to guide the analysis of people's perceptions to climate change in the case study regions. The framework consists of four interrelated components, adapted from the literature on climate change perceptions (O'Connor *et al.* 1999). The discussion below begins with 'is climate change happening?' and then looks at 'what are the causes of climate change?' People's perceived outcomes of climate change are outlined and finally, the sources of information that underlie their perceptions of climate change are discussed.

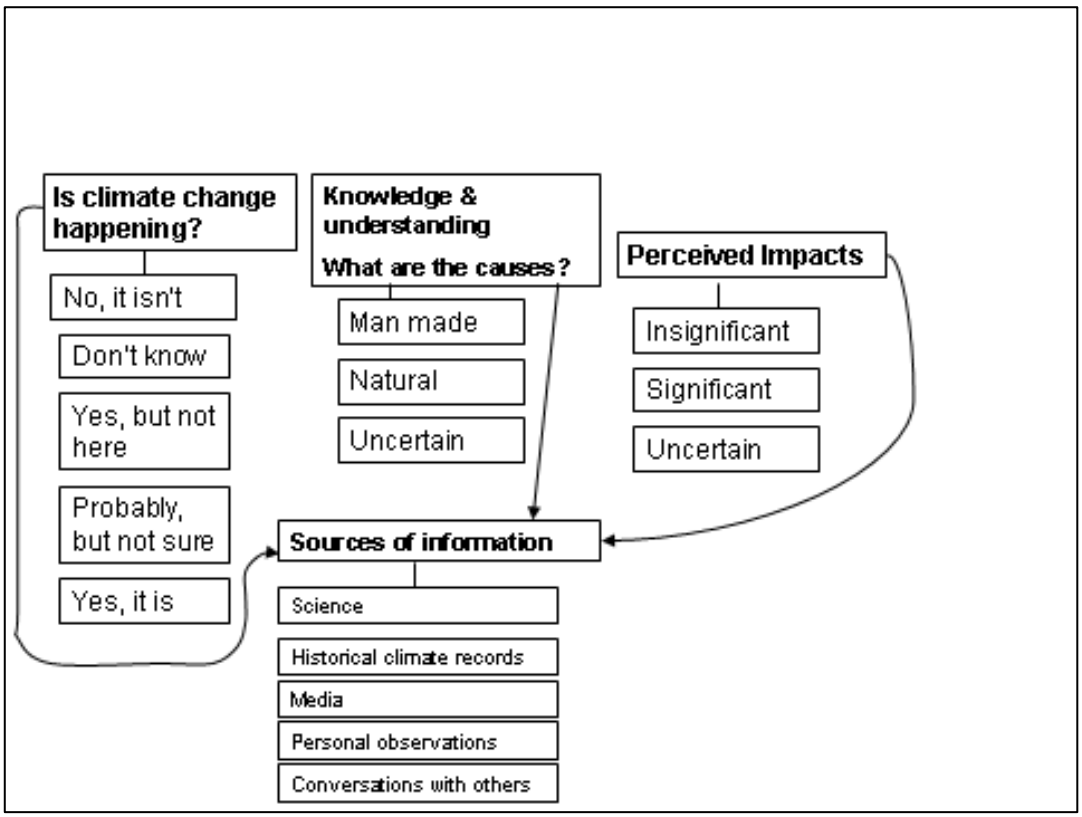


Figure 21: Key areas of climate change perceptions

This study found that many respondents across the case study sites were still forming their beliefs about climate change and hence there was still much uncertainty in their thinking around each of the questions identified in the conceptual framework.

Is climate change happening?

Respondents expressed a full spectrum of beliefs as to whether climate change is happening. In analysing the data, five clusters of response to the question of whether or not climate change was happening were detected. The five categories were created from the data to capture some of the subtle but critical differences in people's perceptions of whether climate change is happening. These clusters reflect the degrees and nature of the uncertainty people expressed about whether or not climate change is happening. It should be emphasised that people's beliefs are not static and hence may move and continue to move over time between these categories. These categories are:

1. *'Yes, it is happening'* - this group were confident that climate change is happening.
2. '*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.
3. '*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.
4. '*Don't know'* - this category expressed a general uncertainty about whether climate change is occurring at all.
5. *'No, it isn't happening'* - this group did not believe that climate change was happening.

Table 8 provides a breakdown of these categories across the four case study regions.

Table 8: Is climate change happening?

Belief in climate change	Temora (n=17)	Condobolin (n=16)	Mildura* (n=14)	Cobram* (n=15)	***Total (%)***
1. Yes	5	5	8	5	**37**
2. Probably, but not sure	4	7	1	2	**22.5**
3. Yes happening, but not here	1	2	4	2	**14.5**
4. Don't know	5	1	0	3	**14.5**
5. No	2	1	1	3	**11.5**
Total	***17***	***16***	***14***	***15***	**100**

*NB: in some double interviews, only the main interviewee is counted

Nearly 40 per cent of the interviewees expressed some degree of uncertainty about whether or not climate change is happening (Categories 2 and 4). People in these categories are still forming their views on whether climate change is happening; many said they needed more evidence before they were prepared to believe it was occurring. There was a tendency for this group of people to attribute the current drought to a natural cycle and to express the belief that there would be a return to 'normal' or 'good' years once the drought broke. The following discussion explores the nature of the beliefs in more detail for each of the five categories.

1. Yes, climate change is happening (37**%)**

Across both the irrigated and dryland communities, about 37 per cent of interviewees were convinced that climate change is happening. Some had made the link between climate change and local conditions whilst other respondents took a more global view believing that human activity was having an impact on the environment. For example,

> *'Well, we realise that the world is changing and you know, we have bastardised our climate… it's something that's got to be addressed and I think we have woken up that we've got an issue… there are certainly changes… I think you've got to make provision to overcome these issues.'* (MiB)

> *'I think it is getting warmer…It's a factor that people now consider when making acquisitions of thousand of dollars in land. The summer is getting more severe and the winter is not as cold. You have to see it as warming.'* (TB)

2. Probably, but not sure if climate change is happening (23%)

Participants in this category frequently made contradictory statements about whether they believed that climate change is happening, swinging from the belief that it is happening to doubts about its occurrence. This suggests that this group is still forming their beliefs and understandings, and despite their uncertainty, they remain open to the possibility that it is happening. Some people in this category described drought and climate change as being intrinsically linked whereby climate change is exacerbating natural cycles. Others, however, thought climate change is happening, but weren't entirely sure if the drought could be attributed to it,

> *'I don't know [if it is climate change]. I didn't really ever think it was a reality but the way it's been going, the way it's been the last five or six years, you'd think something's happening. I hope I'm not right but I think the reality is that it is getting drier. But I'd say it's going to have to rain one day because it can't stay dry forever.'* (TB)

> *'Climate change will happen. There is no doubt it will happen. We are seeing it now. It is having an impact…You need to be aware of it.' [But later says…] 'I think that's a challenge, being positive that it will come good, it is not climate*

change, it is a drought. It is a drought. It happened too quickly to be climate change.' (CnB)

3. Climate change is happening, but not here (14.5%)

Respondents in this category found it difficult to relate the global climate change phenomena to what is happening locally. This could be attributed to the nature of the information being received, particularly from the media, which is focused on indicators such as sea level rise, ice caps melting and increases in temperature. For instance,

'…climate change is something that is really going to be here, we do realise it is a thing but we tend to see more of it overseas and in the Artic we see the ice melting. It is hard to get your head around that when you are in the middle of a drought.' (CnO6)

'In the western regions like from Hillston out to isolated areas like Hay, they've got more climate change and more severity happening than us.' (TB)

4. Don't know if climate change is happening or not (14.5%)

Respondents in this group did not know what to believe in and were very confused by the information they are receiving on climate change. This group also expressed difficulties in detecting signals of climate change, with many tending to default to the view that the current drought is a natural cycle, as expressed in these comments,

'I still think there is a wait and see approach. I think I'm generally still quite sceptical, especially to put a label on it… we're bombarded by climate change at the moment as I said. It is a key word at the moment - the drought is a cycle that it goes through, we're just in a really low part of the cycle at the moment.' (TO)

'No…we can't really tell the difference, can't rely on memory. The federation drought was longer.' (Mil FG)

5. Climate change is not happening (11.5%)

The participants who did not think that climate change is happening often equated climate change to the extended drought. This group appeared less open to the idea that climate change is happening because they associated climate change with continuing dry conditions. They expressed a belief that the drought is a part of a 'natural cycle' and equated it to similar occurrences in the past. Their views were often based on local rather than global climate conditions and they expressed optimism and were hopeful that conditions will return to normal once the drought breaks and it rains. In particular, many Mildura respondents perceived the current water crisis to be the result of a cyclical weather pattern and not 'permanent' climate change.

'Realistically most people don't accept that [the drought] is permanent, particularly the farming community. Because of the nature of what they do, their industry - they are eternal optimists.' (CnO)

'[Climate change] is not really something that is discussed [in the community]. It is always, 'the drought this, the drought that.' It is not climate change as such, it is just the drought. 'When is it going to rain?' (CnO)

Analysis of the data indicates that expressing a disbelief in climate change may also be a coping strategy by reducing potential despair or panic. Some organisational representatives said they were reluctant to be alarmist about water availability by emphasising climate change as a cause. For example, one agricultural advisor contended that there will be *'...repercussions if people see current conditions as normal.'* (CoO)

For many people the daily challenge of coping with drought influenced their perceptions of climate change. The timing of the interviews may therefore have played a large part in influencing people's perceptions. Many dryland respondents, for example, were experiencing prolonged drought and water availability issues at the time whereas irrigated communities had only recent exposure to reduced availability of water.

Causes of climate change

An analysis of causal beliefs about climate change is instrumental for understanding what drives people to respond to climate change (O'Connor *et al.* 1999, Sundblad *et al.* 2007). This section explores whether people thought the causes of climate change are related to human activities or are part of a natural cycle. A number of people considered that anthropogenic climate change and natural cycles worked in combination. Some acknowledged that while human activity was exacerbating climate change, there was a natural element to the causes. Of the 68 participants, 14 considered climate change to be caused by human activities, but many respondents were uncertain and sceptical of the role of human activities in influencing climate change. As captured in Table 9, not all participants thought that climate change is happening or will happen and hence did not respond to this question. The following discussion is therefore limited to those who did mention these causes during the interviews.

Table 9: Causes of climate change

	Cobram (15)	Mildura (18)	Temora (17)	Condobolin (18)
Manmade	2	2	4	6
Natural	5	1	0	1
Uncertain	2	0	3	2
No response	6	15	10	9

Climate change as a natural phenomenon

Some respondents suggested that climate change was a natural phenomenon or a 'cyclical event.' In contrast to drought cycles of between five and eleven years, the time scales given for climate change cycles were considerably longer geological timescales: over hundreds of thousands of years with reference to the cycling of glaciations and interglacial periods. Of significance is that none of the respondents who believed climate change is a natural cycle were managing for climate change. A small number of respondents in this group while agreeing that human activity is causing environmental damage, doubted whether it is causing climate change:

> *'I equate climate change with so much cooling down or heating up. Unless something changes its axis or slows it rotation or something then the weather is just going to follow the pattern of the last 150 million years whether we like it or not. We will get speeding up and slowing down depending on the polar caps but I don't believe it is our doing.'* (CoO)

> *'It may well be that this is going to be part of a cycle… it is cyclical… England has been under ice and been a tropical paradise and where it is now in the middle…They don't know whether it was a 100 year drought or a 5000 year drought.'* (TO)

Climate change caused by human activity

Drought is widely regarded as a natural phenomenon. However, views on anthropogenic climate change can engender more of a sense of moral responsibility for the current predicament.

> *'I have always known that we are one of the driest climates on the face of the earth so my ideas toward climate change are that we have to look after everything now because I have got three of my own kids and I want them to have and enjoy life as much as we have. So we have to start to be more proactive.'* (CnO)

In contrast, some farmers believed that human activities have influenced climate change but that the farming sector should not be held responsible or have to suffer the consequences.

'Probably the thing that upsets me the most about all the climate change and you know the greenhouse challenge and everything else, a hell of a lot of it has been targeted at farmers and the broader area people right, and yet what's really caused climate change is just people.' (TB)

Combination of anthropogenic and natural causes

Some respondents acknowledged that while human activity has contributed to or exacerbated climate change, there was a natural element to the causes. Alternatively put, some believed that natural cycles and anthropogenic climate change were working in combination to produce climatic change. For example,

'I think we are getting warmer and we are also in a cycle. A combination of both.' (TB)

'I think basically climate change is a reality from the stand point that I believe that we do have cycles in our drought, and famine and abundance occur naturally, but I think we have exacerbated the problem from the huge growth that's occurred industrially on the planet. I think, the making of the matter worse, is a man made problem.' (CnO)

Expected impacts of climate change

People expressed the belief that climate change will have impacts across a range of scales: their own business, the community, the local physical environment and the global environment. The expected size of the impacts ranged from 'less significant' to 'significant,' while some remained 'uncertain' (Table 10). Some participants also thought that the impacts of climate change would be moderated by adaptation.

Table 10: Expected impacts of climate change on businesses, organisations and the community

	Cobram	Mildura	Temora	Condobolin
Expected impacts				
Less significant	2	0	3	3
Moderated by adaptation	2	6	4	4
Significant	15	13	4	3
Uncertain	1	1	4	1
No response	9	0	2	5

The category of 'less significant' was applied to those participants who indicated that they did not consider the impacts to be large or overwhelming. This group generally made the assessment that under the conditions of climate change it would be 'business as usual'. For instance,

'[If climate change happens it] probably won't change our setup too much. Probably not any worse than what it is because once we get over this drought things will obviously pick up and that will pick up the business, so I can't really see it… I don't think it is that much of a change that it will change us too much at all in 10 to 20 years anyway.' (CnB)

Sixteen respondents believed that the expected impacts of climate change could be moderated by new technologies and innovative management strategies. Of note, almost 50 per cent of participants in Mildura who thought significant impacts would result from climate change, also thought that it would be moderated by their management strategies and new technologies:

'…you have the faith that people are going to be working behind the scenes. People are getting smarter at what they do; they are getting better at efficiencies. They will have the research people coming up with the things we need.' (TB)

The category 'significant' reflected comments that impacts of climate change could be 'devastating' or cause the collapse of their business, the local community or the global environment. Almost 100 per cent of those interviewed in the irrigated communities thought that if climate change occurred its impacts would be significant. In comparison, around 20 to 25 per cent of dryland community interviewees believed that the impacts of climate change would be significant. This may reflect the dependency upon irrigated water of irrigated communities and their recent exposure to reduced water allocations. For example,

'The dry farmers are definitely the ones who are going to be affected…[but] I think the irrigators are going to be the ones with the biggest [impacts because they're] used to having the water. The farms now are adapted to it and living with it. I think the people that are used to high income, the irrigators and guys like that; they are going to feel it the most. They have invested a lot of money into development and everything else and then pretty much there is not going to be anything there for them.' (TB)

Seven respondents were uncertain about what the expected impacts might be, particularly in the longer term. Many were not planning to respond because they were not certain what the outcome of the changes would be,

'[The impacts of climate change] depends upon what the change is. Tell me what the change is. And I will tell you.' (CnO)

Sources of information

People's perceptions on climate change are also influenced by a range of information sources. Table 11 depicts the range of sources interviewees had received or accessed to inform their beliefs. The three main categories mentioned were scientific literature (government sources, books and the internet), media and climate records and forecasts. 'Talking with others' was another important source of information. While

the list of sources below is not comprehensive, relying upon whether respondents mentioned each category within the interview context, it highlights the range of sources respondents were accessing for information on climate change.

Table 11: Sources of information about climate change

Sources	Mildura	Temora	Condobolin	Cobram
Scientific organisations, Industry associations, Government records	12	5	4	3
Media - TV, radio, print	13	4	9	5
Internet	0	4	1	0
Books (e.g. Weather Makers)	0	0	0	1
Talking to people	1	3	1	1
Films	0	0	0	1
Have not sought information	1	4	1	3
No response	3	3	4	1

Although many respondents felt that they had access to information on climate change, there were some who did not know where to look or how to access it; for instance,

> *'I wouldn't know where to get it from… where to look you know apart from that movie that [they've] put out or something like that, where do you actually get any and where do you actually get any counter-arguments.'* (TO)

> *'I probably wouldn't know where to look but I watch the news every day. I read the local paper every day and I read the Sunday paper on Sunday and I believe that I'm relatively up with current affairs and I speak to a lot of people especially in the farming community and I don't know where there is an expert on climate change.'* (TB)

Trust and interpretation of the information on climate change

People's perceptions of climate change are not only related to the information that they receive, but also to their interpretation of it and their trust in the accuracy and reliability of the information and the source. Many respondents in this study revealed considerable confusion and distrust about the climate change information they had received and this may have implications for their willingness to implement strategies to adapt to climate change.

In the dryland areas, almost two thirds of the participants in the Condobolin interviews (61 per cent) and just over half of the participants from Temora (53 per cent) expressed confusion about the information they had received. Some respondents

felt 'bombarded' by information on climate change leading to increased uncertainty or to ceasing to think about it.

> *'The more you read the cloudier you become.'* (CnB)

> *'[There are] things to read about… but I think that's just even more confusing; there's so many different opinions.'* (CnB)

Many respondents talked very generally about information on climate change without identifying their sources of information. However, there were a number of references to scientists, politicians, the government, 'greenies', and the media. These are discussed below.

Science based information

A number of respondents were accessing information to understand the science of climate change and projections for the future. Some respondents trusted the science implicitly, contending that we *'have to listen to scientists'* (CnO), whilst others believed that the evidence was either not there, not 'hard' enough, or that the science was 'too inexact' to evaluate its reliability. Some respondents felt that it was difficult to trust the scientific evidence because of conflicting scientific opinions on whether climate change is happening and about the potential extent of the changes. For example,

> *'We do not have anything definitive… It is still all hypothetical. There are conflicting ideas out there and no one can prove it … it is still a discussion… there is a lot of conflicting information in the media about it and ignorance… There is [an article] coming out next week, that's in opposition to the one with scientific proof… So what is climate change? What is it?'* (CnB)

> *'…It is a very inexact science and I don't think there is a lot definitive information that would make you change too much. There is not a lot of point worrying about it. Yes keep an eye on it, yes be aware of change but just adapt.'* (CnO)

Historical climate records

Many respondents based their beliefs in climate change on historical climate records. In the dryland areas in particular, there was the concern that rainfall records did not go back far enough to be able to establish whether climate change is happening. Consequently, some respondents expressed scepticism or uncertainty about the reality and causes of climate change, believing that the current drought was just part of a natural cycle.

> *'Whether it is a 20 to 50 or 100 year cycle? We've only got 200 years of records, who knows. They say it is a one in a thousand year drought; I'd like to know who has the figures to prove it. Honestly, how do they know?'* (CnB)

Short to medium term forecasting of climate change

A number of respondents considered the reliability of short and medium forecasting in forming their beliefs and management strategies for climate change. Those who believed climate change would create greater climate variability were sceptical of the reliability of short to medium-term forecasting as a risk management tool for climate change. For instance,

> *'... People forecasting what it is going to be in 50 years time?… to me they can't forecast now two days out.'* (TB)

> *'If we have better forecasting systems for rain or seasonal events, it would make a dramatic shift in how growers structure their whole year. If that's not there… the work is obviously going on but that kind of information is missing.'* (TO)

Information from media and politicians

A number of respondents believed that some information on climate change was exaggerated by politicians. This was associated with the idea that the information was 'propaganda' being used to serve the interests of greenies and politicians. This perception seems to have led some people to believe that the impact of climate change would not be 'as bad as predicted.' These kinds of assessments of the information received are likely to diminish perceptions of threat and willingness to address climate change. For example,

> *'I think a lot of people do a lot of grandstanding, political parties for example, and I'd like to see the evidence and make an educated guess myself and assess it and look over it and just make an informed decision myself rather than people telling me what I should be thinking and that's what I think about a lot of the information out there.'* (TB)

> *'I'm a bit sceptical because you read newspapers and watch TV; people put their own sort of spin on it, their own objectives. Yeah I'd like to get more evidence I suppose.'* (TB)

The media were also believed to be sensationalising the impacts of climate change, particularly in the national press. Some respondents did not trust the media to provide a balanced view and hence were not relying on this information source to form their perceptions on climate change. For instance,

> *'Sadly the radical or 'doom view' information gets the most publicity. We need more balanced reporting. They only give us the worst case scenarios.'* (CnO)

> *'You hear in the media and things like that this drought is caused by climate change. If that is the case, within 10 years we will all be doomed. I think it has probably been exaggerated a lot…It is not as drastic as what the media or people are saying.'* (CnB)

In summary, respondents based their beliefs on a range of sources of which they both believed and were sceptical about. Their interpretation of the information was influenced by their own set of values, experiences, social and economic situation and assisted in determining whether they believed climate change is happening.

Signs of climate change

In addition to sources of information, participants used their own observations of climate change in their local area to support whether they thought climate change is happening. The most common signals were personal observations and experience, historical rainfall and temperature records. Personal experiences were supplemented by historical understandings of the region.

> *'What we're finding that you know this country through here was renowned - all the …slopes of New South Wales, renowned for October being the highest rain for months, you know over a hundred years. Now we've been back through the records and we found the last 20 years, October is nowhere near the highest rain …. And April used to be the driest month and now April now is still even drier than… so the start of the season and the finish of the season have changed for the worse; less rain to start with and less rain to finish with.'* (TB)

> *'Yeah certainly more unpredictable like you're getting cold snaps when you shouldn't. Like it's not often it's hot in July or August, but you're getting cold anytime you know like, we had the September frost or October frost you know, and it was supposed to be the one in a hundred year frost back about three or four years ago. We've had them every year since you know, so we should be another 1000 years before we have another one.'* (TO)

Respondents talked about the kinds of physical changes in the local area or region that might signal changes to the climate. The types of descriptions that were given by the participants of the local signs of climate change were sometimes conflated with signals for cyclical drought. Table 12 provides an indication of the range of the signals that participants believed provided evidence that climate change is happening. It should be noted that some participants provided multiple responses to the question.

References to hotter temperatures entailed a generalised perception that winters were milder and summers were hotter. 'More extreme weather' was discussed in relation to droughts, thunderstorms, flooding events, heat waves and frosts. 'More variability' of weather referred to extreme weather but also to less predictable weather patterns. Of particular significance to the agricultural sector, people mentioned that the timing and type of rainfall was less predictable. The shift in the timing of rainfall was also captured under the heading 'shift in seasons.' One participant also mentioned that thunderstorms were tending to be 'dry' storms associated with lightening but with little rain and this had implications for fire risk in the region.

Table 12: Signs of climate change

Signs identified by respondents	Temora	Condobolin	Mildura	Cobram
Drier (=less rain)	11	7	3	5
Less water available	9	9	1	5
Higher temperatures	7	4	5	5
Drier and hotter	0	0	0	1
Frosts	3	1	1	1
Wind	2	0	0	1
Dust storms	0	0	1	0
Higher humidity	0	0	1	0
Continuation of drought	4	3	0	1
Shift in seasons	4	6	4	3
More extreme weather	3	3	0	0
More variability	5	4	3	1
No response	1	2	4	4

The most commonly mentioned signals of climate change in the study were the drier and warmer conditions, greater variability and a shift in the seasons. Table 12 indicates that respondents in the dryland communities were more likely to mention that the conditions were drier than respondents in the irrigated communities. Similarly, respondents from the dryland communities were more likely to mention that climate change would mean a continuation of the drought and that there would be greater variability and more extreme weather. This difference may have come about because irrigated communities have until recently had access to water and this has buffered them from the drought conditions. In contrast, dryland communities have been directly exposed to the prolonged drought over a longer period of time.

Difficulties in detecting climate change

Some participants said that their uncertainty about the existence of climate change arose from the difficulty in detecting signals. According to O'Connor *et al.* (1999) an individual's difficulty in observing and assessing whether or not climate change is happening is related to the 'weak signal' and the long-term nature of the phenomenon. These ideas were supported by respondents in this study, for example:

> *'I don't think anyone can say [if climate change is happening]. The noise in the year to year variation is so great you would almost have to come back in twenty years to see if anything had changed. You are hardly going to see it. The sort of changes being talked about only just falls outside the normal variation. It is pretty hard.'* (CnO)

Perceived timing of the onset of climate change

The perceived rate of development and onset of climate change is likely to affect the immediacy with which people respond to climate change. Nearly one third of the respondents thought that climate change was already happening while one fifth thought that it might be happening but were not sure (See Table 13). A number of Mildura respondents indicated that they had recently changed their views from thinking climate change is something that will happen in the distant future to thinking it is happening within their lifetime.

Table 13: Expected onset of climate change

	Cobram (n=15)	Mildura (n=14)	Temora (n=17)	Condobolin (n=16)
Already happening	4	6	5	5
Already happening – but not sure	0	2	4	6
Already happening – but not here	0	0	2	3
Happen in my lifetime	0	2	0	0
Won't happen in my life time	3	0	1	0
Will never happen	0	0	0	0
Don't know	4	0	4	1
No response	4	4	1	1

Those respondents who believed climate change would or is already happening generally expected the rate of change to be slow and gradual. None of the respondents believed that climate change would occur abruptly. It appears that the belief that climate change will evolve slowly may serve to defer thinking about managing for climate change. For example,

> *'So I suppose the attitude [in the community] might be, 'Yes, it is probably happening, it is quite slow, it is not terribly different to what we get anyhow with wet and dry years and we wouldn't do anything different about it. You wouldn't really change your enterprise because it is not happening that fast. You just continue to maximise water use efficiencies.'* (CnO)

Willingness to act has been related to people's perceptions of climate risk as well as to more general environmental beliefs (O'Connor *et al.* 1999, Sundblad *et al.* 2007). In turn, people's perceptions of climate risk have been linked to beliefs about: i) whether it is happening or likely to happen ii) its causes and iii) the scale of the impacts and degree of negativity (O'Connor *et al.* 1999). The research has highlighted the complexity of the differing influences upon the perceptions of the participants and that the relationships between beliefs are not always straightforward. In particular, the accuracy and reliability of the information about climate change often confounded their beliefs, understandings and intentions to engage in adaptive management.

A further factor influencing people's perceptions was a sense of hope or optimism that the current conditions were due to a short-term natural cycle rather than to longer term climate change. The hope that climate change is not occurring, that it would rain and things would bounce back to normal, tended to deflect their attention away from managing for climate change. While there was widespread uncertainty or disbelief about climate change, some participants believed that climate change is happening and human activities have contributed to it. Another commonly held belief was that climate change would evolve very slowly over long periods leading to different responses; some deferring adaptive behaviour, other setting long-term management strategies in place to ameliorate potential impacts. These ideas are explored more fully in the following section.

Managing climate risk

Risk management involves planning and implementing a range of strategies or actions to manage potential threats or to take advantage of opportunities[10]. There has been strong support for a risk management approach in agriculture for managing climate change (Clark *et al.* 2006, Steffen *et al.* 2006). This approach has been contrasted with a 'traditional' approach to managing climate variability of a reactive nature, relying on crisis management (Wilhite and Sivakumar c2002). The risk management approach has been described as 'a powerful tool to identify management implications' of risks common to industries and regions, while at the same time accommodating the different characteristics that require more specific and targeted management practice (Steffen *et al.* 2006).

Although derived from different schools of thought, there is considerable overlap between the concepts of *preparedness*, *risk management* and *adaptation* for managing climate risk. It is beyond the scope of this study to analyse in any detail the similarities and differences between these concepts, but it is important to mention that they all incorporate an emphasis on anticipation and planning for an event before it occurs[11]. As risk management is a widely recognised concept in the agricultural sector, the term will be used to refer to the strategies or actions that people are considering or have put in place to deal with risk at the business or farm enterprise level (i.e. 'private proactive adaptations').

Leaving issues of these concepts aside for the moment, people are making changes to their businesses and farms nonetheless. There are a number of strategies people have adopted to prepare for climate risks. In this section an empirical approach is taken to explore what businesses and farmers said they were doing in relation to their enterprises and, where possible, the reasons for the changes being made.

The possibility of climate change adds an extra dimension to the question of what prompts risk management activities. As shown previously, perceptions of climate change are characterised by significant uncertainty at every step of the thinking process – from whether it is even happening, to its causes and likely impacts, and what should be done to manage them. It was found that in the face of a range of uncertainties in relation to climate change that many respondents were not easily able

[10] Drought preparedness, as far as it has been defined (see Webb and Mazur 2002), shares similarities with risk management in that the emphasis is on planning in advance for drought conditions using a range of proactive (risk management) approaches, i.e. the timing of preparatory action is before the event.

[11] Adaptation also encompasses activities in response to a climatic stimulus at the private, system-wide or institutional levels. *Risk management* and *preparedness* are therefore seen as elements of adaptation to the extent that they relate to climate.

to progress beyond the earliest phases of the risk management process in relation to climate change (see Table 14). Given that the acceptance of climate change is not uniform, it may be argued that risk management for climate change is not very well demonstrated in this study.

Table 14: A risk management approach to climate change

STAGE 1: Establish a set of criteria for identifying important climate change risks for farmers. The criteria should also reflect the policy and institutional context in which any decisions are to be taken. These criteria could be developed through a consultative process.
STAGE 2: Identify the risks that climate change poses to agricultural industries. This stage explores the vulnerability of industries to climate risk, their capability to adapt to a changing climate, and the thresholds of climate beyond which adaptation becomes difficult.
STAGE 3: Analyse the risks by examining the nature and likelihood of climate change in the future. This is done from an industry perspective.
STAGE 4: Evaluate the risks using the information from the risk analysis to make decisions under the risk management criteria.
STAGE 5: Treat the risk by developing and implementing risk treatment plans which establish the strategic setting for action. A risk management assessment process can be repeated every few years to ensure that it is up to date with the contemporary understanding of risk. Regular review will be particularly important for climate change where the science is constantly evolving. Good risk management involves communication to ensure that all stakeholders are aware and involved in the process.

(Clark *et al.* 2006)

Identifying the intentions behind these activities is problematic. It was difficult to distinguish in an exploratory study such as this whether the changes people made were in relation to climate change or drought, or indeed other drivers (e.g. commodity prices). This is because risk management rarely takes place in response to a single stimulus. People manage for a number of risks, one being climate risk. Nonetheless, the role of intention is seen as important to the decision-making process (as are perceptions, beliefs, personal characteristics, motivations as discussed in the conceptual framework): was the management strategy implemented tactically or as part of a strategic plan? Was it a response to drought, climate change or other drivers? Was the management strategy implemented proactively (in anticipation of an event) or reactively (after the fact)? It is difficult to unravel the complex reasoning behind human decision-making. The analysis in the following sections however, suggests that acceptance of climate change was not necessary to prompt people to take actions to address climate risks at the business or farm level.

The wide extent and long duration of the drought impacting in some rural areas suggests that people are likely to be drawing down on the 'preparations' that were made prior to the onset of dry conditions. The timing of this study in the middle of a long drought suggests that it may be more relevant to speak of approaching

'thresholds' rather than of preparations. The answers people gave to questions about risk management at the enterprise level therefore may reflect coping strategies rather than managing risk.

Tactical and strategic management strategies

Farm managers and small businesses undertook risk management strategies for a wide range of reasons with many responding to climate variability. Recognising this complexity in intention, where possible, management strategies were categorised according to whether the strategies seemed to be **tactical** or **strategic** (Table 15 and 16). Whereas tactical actions related to daily or weekly management decisions, often made in response to an immediate stimulus, strategic actions were more enduring often anticipatory actions made with a view to the longer term and which altered the basic nature of the activity in some way (Smithers 1997 and Bryant 1994).

The distinction is relevant because many commentators have suggested that adaptations involve strategic or long-term measures that generate some kind of permanent change (Bryant 1994, Riebsame 1991, Burton et al 1993). The categories are somewhat overlapping and rather than being distinct, should be seen as lying along a continuum reflecting increasingly **tactical** to increasingly **strategic** actions.

These conceptual representations of the types of strategies are an heuristic aid for understanding the thought processes (motivations, intentions) behind the decisions made, particularly with regard to climate risk. Some judgment on the part of the researchers was involved in categorising these responses.

Farm strategies for managing climate risk

Risk management strategies undertaken by the farming sector are a key part of the preparedness of a rural community for climate risk. The main risk management strategies reported by participants from the four farming communities are listed in Table 15. This incorporates the comments of eighty participants in eight focus groups across the four regions of interest. The respondents were drawn from the dairy, horticulture and broadacre and mixed farming industries.

Farm production strategies and the farm business

Risk management strategies will be specific to different sectors and industries and there is no one-size-fits-all set of measures (Webb and Mazur 2005). However, we distinguished those risk management strategies implemented at the *farm production level* from those implemented in relation to the *farm business*[12]. Business strategies used by landholders are somewhat similar to those used by the agriculturally dependent small businesses, and are discussed in the next section.

Table 15: Farm level risk management strategies

Strategies	Tactical	Strategic
Production level	• Retain or reduce labour and undertake longer production hours themselves (e.g. feeding stock) • Reduce stocking rates (dairy and broadacre) • Selling off cattle and sheep, while keeping breeding stock • Selective watering of orchards • Decommission or take land out of production • Droving of sheep and cattle into less affected areas • Agistment • Confine sheep and cattle to smaller areas • Switching types and amounts of production • Changes to lambing practices • Sourcing hay from elsewhere • Buying or selling water on the market	• Using water efficient technology (e.g. micro-sprinklers, drippers) • Conservation farming • Better forecasting • Expansion of farm size • Storage of fodder • Minimum till farming (reducing dust storms) • Upgrading of labour skills (e.g. use of new technologies) • Diversification of activities on-farm
Business level	• Reduced spending (personal and capital items) • Farm Management Deposits	• Increased efficiency (e.g. administration) • Diversification of activities off-farm • Industry exit

The more frequently mentioned strategic actions demonstrated in these farming areas were: investing in water use efficiency (irrigation and dryland), on-farm and off-farm diversification and industry exit or succession planning. These are explored below.

[12] This reflects broad categories of actions used in the AAA program in 2002 to evaluate drought preparedness: land and resource management strategies, climate forecasting and planning, financial management and education and skill development (Webb and Mazur 2005). The first two are mainly production related, while the second two are more business related.

The following discussion mainly refers to farming representatives, but because of extensive diversification in some regions, comments from businesses and organisational representatives are included where relevant. Family units were often operating a farm business alongside several other businesses to take advantage of income generating opportunities (i.e. extensively diversified), such that the same respondent was often a farmer *and* a business person. This perhaps indicates the extent of innovation and flexibility occurring in agriculture, and was especially pronounced in the dryland communities.

Water use efficiency

Water use efficiency was a common strategy for managing climate risk and low water allocations. Increasing awareness of efficiency needs in the future had led to an emphasis on efficient watering systems in irrigation areas and farming techniques that utilise soil moisture retention in dryland areas (e.g. direct drilling, tillage retention, soil moisture monitoring).

In irrigation areas, people were using efficient irrigation technology such as micro-sprinklers and dripper systems to maximise water use efficiency. One participant from Cobram commented that, *'We can't get any more efficient than what we are,'* (Co FG). However, there was a suggestion of incomplete uptake of such strategies across the district (*'but not all of us'*) during the ensuing discussion.

Investments in water use efficiency seemed to be weighed up against the better production rates that could be achieved with other systems (e.g. flood irrigation, sprinklers).

> *'More than half the district would be on mini-sprinklers. The balance is on impact sprinklers which cover 100 per cent of the ground area under the trees…growing more feed per mega-litre of water consumed. There's a big swing for that.'* (CoB)

For some farmers, the water savings generated by water efficiency strategies enabled the rest of their water allocation to be sold on the market.

Efficiencies gained through increased uptake of more efficient water use systems were in some instances seen as offset by high levels of demand (i.e. too many users) in the MDB. The concern was that this high level of demand had been allowed to develop and is partly responsible for the current water scarcity.

Water savings in horticulture were also generated by more radical strategies including taking some of the trees out of production and using the water on the remaining property. While decommissioning orchards involved a difficult decision-making

process, guided by local agricultural extension advisors, it was seen as a key short-term tactical strategy to manage the immediate problem of low water allocation.

Diversification

Diversification of the business or farming operation was a common strategy usually aimed at reducing the impact on farm viability of climate variability and potentially climate change in the long term. Other reasons were also evident such as personal satisfaction.

Diversification within the farm operation involved changes to the kinds of production activities. For example, mixed farming businesses undertook cropping as well as stock rearing activities. These combinations were considered to provide a better position and more flexibility to meet the challenges of the drought because losses experienced in one area could be offset by another (e.g. lower prices in cropping compensated by high prices for fat lambs). Taking advantage of the high prices being achieved for fat lambs has been a key strategy for some people in maintaining a cashflow. In addition, changes to producing different commodities were reported such as growing a less 'risky' crop (e.g. canola instead of wheat) to offset the costs and risk of crop failure. Some strategies involved expanding the area of the farm to take advantage of efficiencies of scale and make the operation more viable.

Diversification off-farm was another common strategy, such as taking on a part-time job, or expanding into a different business or market. Off-farm income strategies often involved a family member or spouse obtaining a job outside the farm. In some cases this was seen as part of a process of departure from the land,

> *'You see a lot of farms with off-farm income…effectively they're hobby farmers, the off farm income is supporting the farming business, sustaining the family unit.'* (CoO and CoFG)

While diversification was sometimes seen as a prelude to exiting the industry, there was also a view that off-farm diversification was a means of achieving the long-term flexibility required to manage climate risk. When water was scarce and production was affected, the other less agriculturally dependent business supported the family. Conversely when conditions for farm production improved, more effort was put into the farm. According to respondents from the dryland communities this flexibility was extensively practised in dryland areas with the intention to manage climate risks. Some family units operated more than two businesses (such as the farm, a contracting business of some kind, a seed supply business and/or a feedlot).

Exiting the land and succession

Exiting the land was a key risk management strategy when considering the lengthy period in drought. Many of the respondents were likely to be the 'survivors' of the drought. This strategy was never considered lightly and involved a difficult personal decision-making process. Farm managers from multi-generation farming families were reluctant to be the ones to break family tradition and leave the land. Some focus group participants expressed the view however, that if climate change is happening, and better seasons are doubtful even after the drought, some of them would either choose or be forced to exit the industry given the declining terms of trade.

'*We know it is a drought and we have had drought. But if this is going to be the norm it is going to be damn hard and we are going to see a lot of people get out of this farming business.*' (CnO)

'*Before you could just go along and everything would be fine but not any more. They've got to work out different ways of managing the dry. Some people are managing, some people aren't. I don't think they can go forever if it didn't rain. If it stays like this a lot of people are going to be out of it.'* (TBO)

Some people said they were reaching a 'threshold' beyond which no amount of preparation or risk management could sustain them. Much of this was related to the level of personal stress and anxiety over financial security that people could endure and the long recovery time that would be needed to return to a financially stable position.

'*A lot of people have said I have had enough. If there is no water next year I don't want the block.'* (MiB)

'I think they'll sell if they get a good crop. I think people want to do that because they are not prepared to put the five years work in to get back the equity. Depends if they have succession planning in place; every case is individual. But the general consensus is it is a bloody hard long haul from here to get back to where they were… a lot of farms have been sold…' (CnB)

'…a few of the smaller ones are leaving the land. I suppose the few that have left and have just had enough of it. They invest their money somewhere else than in the uncertainty of the rural community. The bigger guys are going to get bigger. You do need a larger scale. You see more and more getting bigger and other smaller ones getting out.' (TB)

Having said this, there was a considerable amount of confidence expressed in the ability to adapt. Some farmers were more optimistic and proactive in relation to their

risk management strategies and believed that these strategies will be able to moderate the impact of climate variability and climate change, for example many times people affirmed that, '*if climate change occurs, we'll adapt'*.

These examples suggest that tactical and strategic actions are being undertaken to manage a range of risks in the farming sector and that operators in these regions are constantly adapting to climate risk. Whether this amounts to 'adaptation' to climate change at the agricultural system level is less clear, and would require more comprehensive research and evaluation of farm risk management activities.

Small business strategies

Risk management strategies undertaken by the business community are another important part of the overall preparedness of a rural community. Small businesses form a substantial part of the economic base of a town. The interdependence between businesses, farming and the community, both socially and financially, was a key theme that came through in the interviews, as was the importance of these inter-connections for sustaining the town through hard times.

A wide range of small businesses were interviewed in the case study regions, including, agricultural input suppliers (e.g. seed, fertiliser, trellises, root stock), contractors and service providers (e.g. sowers, harvesters, fencing, shearing, grains storage, wool-broking and transportation) and agricultural equipment and machinery suppliers (e.g. machines, bolts and parts). Several businesses were included who were less directly involved in agriculture (e.g. newsagencies, food vendors).

The downturn in the farming sector affected the viability of many of these businesses across the four regions because of reduced spending and a diminished ability of farmers, their main client base, to pay their accounts. Management strategies include the actions that business managers undertook in the management of their business, or those which they intended to undertake in the future. The common strategies reported across all the case study regions for handling risk included:

- retaining or reducing staff
- not carrying as much stock
- managing client debt and suppliers
- aligning the business with the larger growers and more efficient water users
- diversifying into other products, commodities or industries
- movement into services to farmers
- new technologies.

There were many similar strategies used by businesses across each of the regions, such as building efficiencies into the running of the business (e.g. computerising administration processes, improved forecasting of cashflows), diversifying into new stock, products or services, changing over to more reliable clients, managing debt of existing clients (e.g. asking for cash-up front and/or providing shorter credit periods), restructuring or negotiating debt with banking creditors.

A general trend was to align with efficient water users (or those who were less dependent on irrigation water in the irrigation areas) because they could see hard times coming for smaller, less water efficient growers. For example, several businesses had already, or intended to, move into service provision around efficient irrigation (e.g. water auditing) as part of a strategic business plan.

Although the management strategies reported by those businesses in dryland communities were similar to those used in irrigated areas, the examples reflected the different farming systems in the regions of interest. In Temora and Condobolin for instance, the new technology may have involved soil moisture measurement or direct drilling, whereas in Cobram and Mildura new technology involved efficient irrigation watering systems.

Other widely applicable strategies were external to the current business including diversification (e.g. obtaining a separate part time job, focussing on alternative markets, products or commodities). Some sought opportunities to diversify into other markets (e.g. irrigation and harvesting systems to the United States, water tanks to Queensland) and were involved in strategic research and development (e.g. arranging patents). These risk management strategies were undertaken in the context of private proactive adaptation rather than those involving public policies or programs (see Table 16).

In the analysis of the data, the distinction between tactical versus strategic management actions, while recognising the complexity that occurs in people's decision-making, was difficult to make. It was not clear in many instances whether changes to the business were made because of drought or climate change, or other pressures including commodity fluctuations, or whether changes were made with a view to the long or short term. Nonetheless, we have made an attempt to categorise the actions as being increasingly tactical or increasingly strategic.

Table 16: Small business strategies (actions or intentions) (y axis, Figure 22)

Categories of intentions or actions	Description	Examples from case studies
1. Wait and see	**Concerned**: but not making any significant changes in the way business operates.	• Concerned about secondary impact of low water allocations (businesses in irrigated communities) • Crisis meetings • Considering available options
2. Riding it through	**Managing for drought**: requires short-term shift in resource allocation and farming or business system to maximise returns and reduce potential losses.	• Same client base • Joining buyers group (more exposure to clients) • Maintaining good reputation; keeping good client relationships • Scaled down the business or stopped expanding • Reducing amount of stock held or staff numbers • Being more cautious in spending • Coping on a day-to-day basis
3. Intentions to manage for longer term, but not yet doing it	**Would like to change, but don't have the means:** Adaptive capacity constraints.	• Intend to make specific changes, but not enough financial capital or know-how (e.g. to increase water use efficiency)
4. Incremental management	**Step-by-step changes**: tends to undertake more short-term or tactical strategies with an eye to the short or long term.	• Change of client base (e.g. to more established clients, larger clients, less irrigation-dependent clients) • Increasing efficiency of practices (e.g. computerisation, scanning) • Forecasting cashflow to minimise downturns • Re-structuring debt • Buying more land • Storing silage, saving money
5. Longer-term management	**Increasingly strategic changes**: may include tactical management strategies, but generally takes a long-term view.	• Changing client base • Expressed as part of a long-term view
6. Whole farming or business system change	**Whole system changes**: Strategies tending to be highly strategic (can include shorter-term strategies) with a long-term view.	• Strategic business planning approach • R&D investments (e.g. patents) • Re-structuring business to focus on other products or commodities • Providing services rather than goods • Niche marketing

Increasingly tactical ▲ … ▼ *Increasingly strategic*

Do perceptions influence management strategies?

Little research has been undertaken about the link between perceptions of climate change, climate variability and drought preparedness[13]. This analysis was done to explore the links between personal belief in climate change and reported risk management strategies or intentions of 34 managers of agriculturally dependent businesses across all four case studies. Figure 22 summarises information about the strategies (i.e. increasingly tactical to increasingly strategic) and plots these against the categories that have been used to classify personal beliefs about climate change for each individual respondent.

There were a range of different beliefs about climate change. These ranged from believing that climate change was happening, to being uncertain for various reasons (i.e. open to the idea but still unsure, open to the global phenomena but not sure if it's happening here or now, or uncertain) right through to non-belief that climate change was happening at all. The categories adopted for the beliefs scale used in this analysis are explained more comprehensively in the perceptions of climate change section and identified in Table 8. Typologies (Figure 22) were developed to represent four common types of groups that emerged in the analysis. There were two main responses: not acting due to uncertainty about the future (Groups C and D) or acting even without full certainty (Groups A and B)[14]. A general finding from this analysis was that the small business managers who were personally more open to the idea that climate change is happening seemed more likely to be implementing strategic risk management strategies in the business for the long term[15].

Group A: Open to the idea that climate change is happening, implementing strategic or long-term changes to their business (35%)

Businesses in Group A (Figure 22) can be regarded as proactive and most open to the idea that climate change is happening. These respondents were diversifying into other industries, moving into service provision and adopting Research and Development (R&D) and whole systems thinking. Businesses in both irrigated and dryland areas were strongly represented here, suggesting that strategic risk management strategies are being implemented in both areas, although the examples may differ. Characteristics of this group are explored in the examples below.

Example: Irrigation system supplier (CoB)

[13] Decision-making processes around the choice of adaptation strategies has been highlighted as an area of significant interest by the IPCC Working Group II (Smit and Pilifosova 2001, Chap.18, p.884).
[14] This distinction was made in the *Science for Decision Makers* on 'Adaptation to climate change in Agriculture'.
[15] Findings are based on small sample and therefore may not be representative.

- A range of tactical and strategic measures were undertaken as part of a strategic business plan in this business: *'budgeting conservatively'*, *'negotiating to spread our risk better'* (i.e. with the bank and tax office), *'building improved accuracy into forecasting our cashflow'*. Risk management activities also included strategic measures such as undertaking a greenhouse gas emissions audit on the business and moving into irrigation service provision (on-farm audits) in the long term.
- The reasons given for this approach were related to concerns about climate change and the environment more generally. The business manager was convinced that climate change is happening and *'we have to be proactive to address it'*, *'we need to look after things now for our kids,'* suggesting a concern for intergenerational equity.

Example: Seed supplier (TB10)

- This seed supplier believed that climate change is already happening, but that *'farmers have lived with climate variability forever and will gradually adapt'*.
- Strategies used as part of managing business risks included a range of measures such as diversifying the business by *'starting a feedlot,' 'expanding the cropping side of the business'* and investing in land *'to take advantage of high land values'*. In addition, strategies included storing fodder through droughts. More strategic activities included the use of new technology for more efficient monitoring of livestock feeding using electronic tags, *'and in future, we'll use walk-over weighing scales'*.

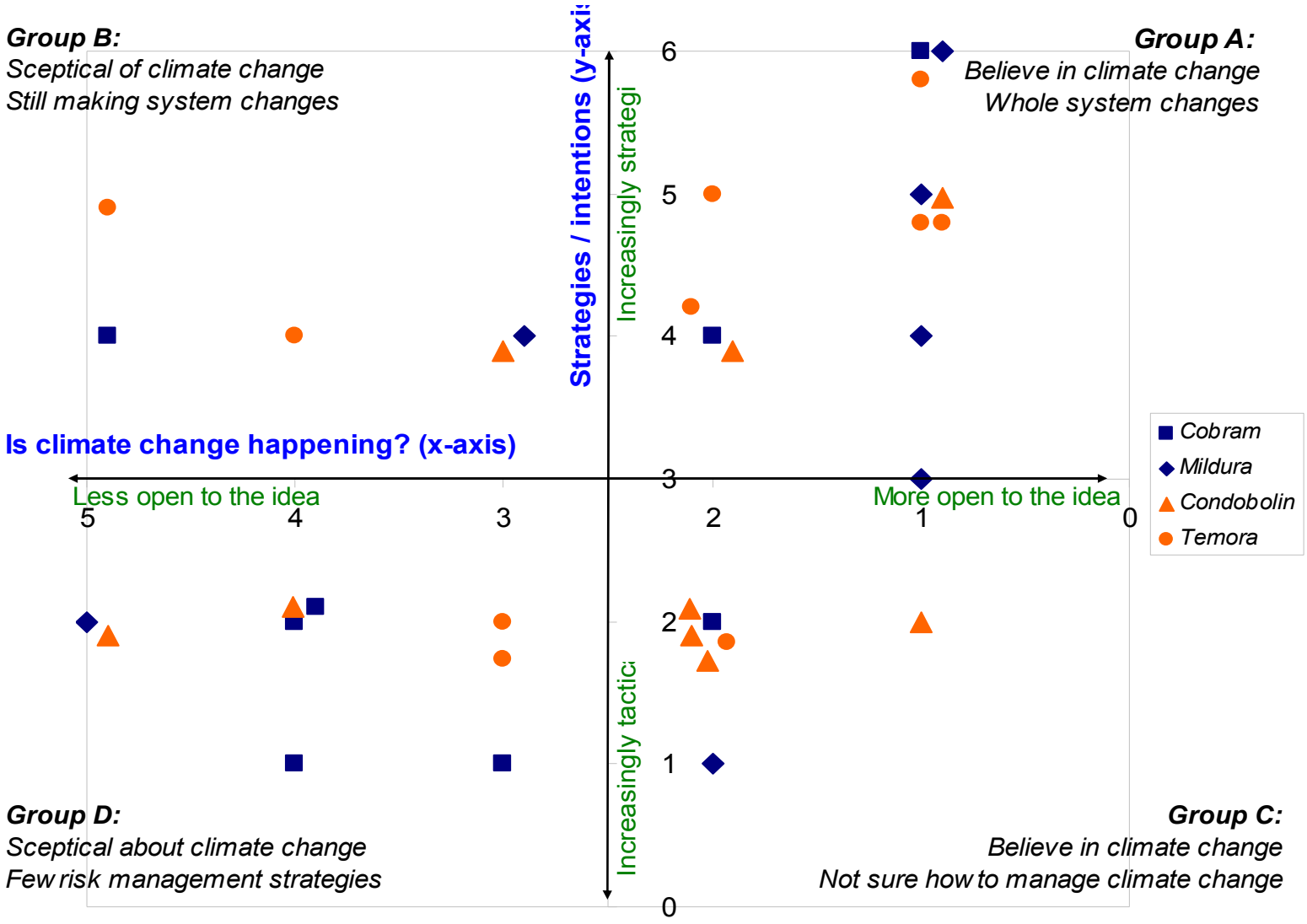


Figure 22: Perceptions of climate change and risk management strategies from agriculturally dependent businesses

Group B: Sceptical or uncertain that climate change is happening, but had strategies in place (15%)

The few respondents in this group (Figure 22) had varied views on the phenomenon of climate change. Some felt that *'climate change is too unpredictable to manage',* or they simply *'couldn't understand climate change'*. In addition, some in this group were responding to broader social and environmental concerns (apart from climate change) and this was a motivation for taking action. This group were building efficiencies into business processes despite being sceptical about climate change, diversifying into other activities or changing to a more reliable client base.

Example: Wool broker (TB)

This wool broker was expanding and diversifying the business by purchasing new businesses over a greater area (which helps as sheep numbers decline) and had moved into more service provision, including wholesaling and dealing in livestock nutrition products. In addition, an efficient central administration system had been implemented.

The main motivation for undertaking these management strategies was to be sustainable, and thus to make sure the business, is sustained into the future. In addition, strategies were implemented because it was necessary to be socially responsible and environmentally aware (e.g. waste recycling, paperless office system).

Despite responding to social and environmental concerns, this respondent was sceptical that climate change was happening, believing the drought is part of an El Nino cycle that will eventually swing back to 'normal'.

Example: Farming equipment supplier irrigated region (CoB)

This business manager was putting in place short-term risk management strategies such as getting rid of sitting stock and joining a buying group to increase market exposure, but had also shifted the shop to attract more clientele for the existing business. These strategies were aimed at minimising the downturns in the business. The drought was regarded as *'a cycle'* and the preferred description of the current situation was *'a drought rather than climate change'*.

These examples suggest that the belief in climate change is not always necessary to bring about management changes. Other factors such as general environmental and social beliefs will motivate people to implement change.

Group C: Open to the idea that climate change is happening, but feel somewhat overwhelmed or see climate change as a low priority (24%)

This group were making few long-term changes and were preoccupied with day-to-day survival (Figure 22). Climate change was seen as a reality, but either a low priority or too big an issue to manage. As described by one respondent,

> *'...people are more interested in surviving day-to-day than what's going on, their feelings are what's here and now, it's here and now, it's reality. Climate change isn't a big issue at the moment because they're thinking about survival, what's going to happen tomorrow. You know, you're not thinking about 12 months, 5 years, 10 years down the track, they're thinking about here and now, surviving through this one in a hundred year's experience.'* (TB)

In some cases there was a feeling of being overwhelmed by multiple pressures. In the absence of a clear idea of how to manage for climate change, this group stressed the role of government in addressing such an overwhelming problem. This suggests that believing climate change is happening does not necessarily translate into action or preparedness.

Example: Seed miller (CnB)

This business manager believed that climate change is probably a reality, but felt that there was *'nothing much I can do personally except for things like switching the lights off'*. The main strategy reported for managing a downturn in the business was to simply *'put up with it'* - or at best, to sell the business: *'I wanted to retire years ago, but couldn't get a good price'*. Perhaps related to the difficulty in implementing action personally to adapt or mitigate, there was a strong emphasis on collective action to address the problem; *'government should do something about it'*.

Example: Irrigation supplier (CoB)

The main strategies implemented in the business were immediate and day-to-day ones such as maintaining a good reputation and employing the right staff who know the job: '*we'll keep going the way we are'*.

Climate change was seen as a reality, but the general impression was of a sense of personal powerlessness to address the problem: *'can't do much about it anyway. One person couldn't fix it. Big problem; needs many governments'*. Thus although the need to adapt was recognised, there was little idea about how this should be done.

There was some evidence to suggest that some businesses lacked the means or the **adaptive capacity** to follow through with intentions to implement risk management

strategies. For example, one small business manager from Mildura wanted to invest in a more efficient watering system, believing that climate change was a reality, but did not have the financial capital to undertake this investment. It is likely that other respondents had adaptive capacity constraints that prevented them from implementing strategies to manage risks, but may not have explicitly mentioned these. Teasing out this type of information is suggested as an area to build on in future research.

Group D: Sceptical or uncertain that climate change was happening, few preparedness strategies (26%)

Group D (Figure 22) was generally more sceptical of or uncertain about the idea that climate change was happening and reported less in the way of preparing or responding to climate risks in terms of their business management strategies. The approach being implemented ranged from *'having crisis meetings'*, to *'just coping'*, or *'surviving day-to-day'* with less evidence of thinking beyond the day-to-day.

Many in this group held the view that drought was a cyclical process or a natural cycle and therefore it was not a result of human-induced climate change. Some held the view that 'climate change would be like permanently dry conditions' (refer to the perceptions of climate change section). Others in this group simply felt that they did not know very much about climate change.

Example: Shop owner from a dryland region (CnB)

This respondent was managing neither for drought nor climate change, but was implementing strategies aimed at *'surviving until it rains'*. Strategies for running the business were immediate and at the day-to-day level included maintaining good customer relations and ensuring high standards. Although the current drought was seen as *'just part of the cycle of weather'* rather than linked to climate change, this respondent held other environmental beliefs, including that humans are *'overusing natural resources and should be more careful'*.

Risk management in irrigated versus dryland areas

Differing water system dependency

Irrigated and dryland communities were experiencing different kinds of water scarcity conditions, and were situated in different water systems. In the dryland communities, water availability and soil moisture for the predominant activities of mixed grazing and cropping depended more upon immediate rainfall. However, in the irrigation communities the predominant farming activities of horticulture and dairy depend on access to - and the availability of - irrigation water from the greater Murray-Darling system, which is operated and managed by many separate water authorities guided by

MDB-wide water sharing rules and policies. This is a major factor in the vulnerability of respondents in the irrigation areas. This context needs to be factored into understanding both the availability of risk management strategies to these regions and their effectiveness in offsetting risk, because private proactive adaptation is only one sphere in which adaptation may take place. The wider social, political, economic and physical systems offer other important avenues for collective adaptation.

Familiarity with drought and the link to risk management

The difference in preparedness of the regions was reflected in the clustering of businesses. More businesses from the irrigation areas of Mildura and Cobram were grouped in the 'wait and see' category. This can be explained in terms of their concern about water allocation decisions, and the fact they had had less time to respond. Risk management at the irrigation system level was a more significant concern than at the farm level because of the nature of water dependency.

Respondents from irrigated areas were generally in shock over the new allocation situation. Therefore, these observations represent a snapshot of views because of the timing of the fieldwork for this study (April to June 2007). There was considerable concern following the announcement by the then Prime Minister of zero allocation for the 2007 to 2008 irrigation season. This was unheard of for these historically 'drought proofed' areas which had received up to 95 per cent of their allocations prior to the current season. Comments from respondents suggest a redefinition of the problem was underway from a 'drought-proofed' area (with an irrigation system buffering them against drought) to a region exposed to climate risk. Many of the businesses were not 'managing' so much as 're-framing' the situation in which they found themselves and had had less time to consider risk management than those in dryland areas. Indeed, they were more alarmed at the prospect of secondary economic impacts as the lower allocations were set to affect their client base. While some had made use of the opportunities offered by an increase in demand for efficient irrigation watering systems and were developing niche business strategies in this area (Group A), others were struggling with whether to invest in risk management in the face of such a high level of uncertainty (Groups C and D).

The evidence from this analysis suggests that these conditions mean businesses in dryland areas had more time to think through their risk management strategies. There were more dryland businesses represented among the groups who were implementing, or intending to implement, *incremental management changes*, *longer term*

management and *whole farming or business system changes* – in other words they were implementing *increasingly strategic* risk management strategies. This suggests that more innovative approaches were being trialled in the dryland areas. Nonetheless, although none of the respondents from the dryland communities demonstrated a 'wait and see' approach, there was anecdotal evidence that this position also existed in these communities:

> *'...a really good fella in Temora, you know we had a meeting there once before on the effect of the drought and they said, what's your strategy going to be and he said I'm going fishing. It's not much good trying to put inputs in, it will break one day so I'm just going to stop, just let the farm sit for a year or so until it does come back. I'll have an interest cost and that but I'm not going to blow any more money in inputs and machinery and stuff like that, I'll just let it sit there. And at the time we thought that was funny but it could turn out ... you know you might as well sit back and say well bugger it I'm going to get income support from the Government, bread and butter taken care of. People don't know how to manage this because they've never had it before; it's just something entirely new, a drought for this long.'* (TO)

Differences between managing for climate change and managing the drought

Some respondents identified differences between managing for drought versus managing for climate change. Views on these differences reflected people's ideas about the nature of drought compared with climate change and the link between them (as discussed in the perceptions section). Although there were some farmers in the dryland farming communities who believed that managing for drought would be similar to managing for climate change, quite a few saw differences for the way they operated.

The main difference was the timeframe put around strategies for drought compared with those for climate change: many respondents contended that managing drought involves short-term strategies to get through, whereas managing for climate change had long-term implications for the way they operated. For example,

> *'Climate change is an unknown quantity, while droughts are a known quantity, and short-term strategies can get you through.'* (MiB)

> *'Climate change involves long-term generational change, whereas drought is short term.'* (MiFG)

Managing climate change was therefore characterised as a response to a gradual change contrasted with responding to the suddenness of a drought. If this were the case, climate change would involve much more long-term planning and flexible management in order for farming to remain viable and sustainable into the future.

Some people focussed on the changes in **technology** that would be needed to manage climate change, *'for climate change we'd use more rain resistant varieties, technical advances, water efficiency management, and change to drip systems.'* (MiFG) However, others talked of a fundamental shift to a different kind of farming system altogether going beyond changes to technology:

> *'Managing for a drought is generally a short-term strategic shift in your resource allocation and farming system make up to basically maximising your potential return and in most cases reduce the potential losses.* [Whereas managing climate change would mean a] *shift in the system so the decision may be that we are now in a lower rainfall environment…When you shift your whole farming system to that, then your whole farming system is geared up over the long term to maximise moisture retention, moisture use. Climate change is our new system; this is where we need to set our targets.'* (TO)

Many respondents remained unconvinced that there were major differences between managing drought compared with managing climate change at the production level. For example, many dryland farmers contended that the same on-farm management practices that enabled the management of drought episodes would be applicable in climate change conditions. Many in the dryland communities regarded flexibility, including diversification and a move to mixed farming enterprises, as a key strategy for working in such a farming system. In other words, practices that could be used to manage risk during climate change periods were already being used for managing the drought. Soil moisture retention techniques and the flexibility of on- and off-farm diversification strategies were seen as useful.

> *'The things they do to adapt to the variation in climate are what they would do for climate change anyway. There is nothing they would do different. You try to be as efficient with water as you can. They do that anyway. It is a degree warmer you might plant a week earlier…it may change the rainfall no one can really be sure about that. But either way the response is exactly the response you have now… Returns would go up with more carbon dioxide. Plants actually work better with higher CO_2 levels so it is not all bad news.*

But I can't think of anything you would change it is just more of the same.' (CnO)

Following this line of thought another respondent declared, *'managing climate change or drought would be the same, it doesn't really matter, all we can do is look at moisture at the current time for planning decisions.'* (CnFG)

This may reflect the view that climate change involves recurrence and intensity of droughts under a climate change regime.

One concern centred on reaching 'thresholds' beyond which no amount of preparation or flexibility would enable successful farm management. Climate change, with its potentially increasingly frequent and severe drought episodes, may push beyond the limit of farm risk management.

'Normally drought is easier to manage, because it's only 12 to 18 months, but not this time. Climate change is a much longer, gradual process. Drought requires a more radical decision or change while climate change requires more subtle changes. For example, you wouldn't de-stock for climate change, but you would for drought.' (TFG)

Given that many producers and business managers were not sure that they could identify whether climate change is happening (i.e. were not convinced that the current drought was symptomatic of climate change), the question of how one would manage a climate change period remains problematic. Nonetheless, these comments suggest that managing climate change may involve a shift in the type and degree of risk-taking over time and thus a redistribution of responsibilities for risk-taking.

Sometimes managing climate change was identified with changes beyond the farm or enterprise level. This may have been derived from a sense that climate change was an overwhelming, unfamiliar problem that would manifest on a large scale, and there were limited ways in which the issue could be managed at the individual or farm level. For example, some maintained that it is possible to have some control over the management of drought, but there is no control over climate change; *'we are only one person in the whole world so you can't manage for climate change.'* (CnFG) Thus a climate change period would require the adoption of different practices and would imply *'a whole new way of working.'* This suggests that managing climate change is associated with reaching limits of resilience at the individual and enterprise level.

According to this view, climate change implies a new risk paradigm in agriculture. This raises the question of who should be responsible for taking on the new risk. What is a reasonable level of risk that a farm would be expected to assume? Should responsibility for managing climate change be different at the farm level compared with the industry or community level? In other words, if farmers reached viability thresholds, what would be the role of government under climate change conditions?

Factors influencing adaptation

Risk management activities are part of a process of adaptation that takes place within an existing operating environment. Various social and institutional enablers and constrainers influence adaptive capacity by providing opportunities or constraints to adaptation, including preparedness for climate risk (Figure 1). Underlying social and economic conditions are difficult to quantify, however examples include the kinds of social, health, educational and financial services available to a rural community, formal and informal social networks and government programs or policies (e.g. drought assistance).

A wide range of adaptive capacity factors exist in the operating environment of businesses and producers. This section gives an overview of some of the factors people talked of that were not directly related to climate risk but were important for the way people responded to risk. Some of the main factors respondents mentioned were categorised under the following themes: *attitudes and values*, *skills and knowledge of people*, the *social and organisational networks* in which they were involved and *financial and economic* supports (summarised in Table 23).

Some factors were more relevant to the farm or business level than the collective level, such as the attitudes and values people hold towards rural life, their knowledge and awareness, business skills and the use of social networks. These factors lie more within the ability of people to influence or were part of their intrinsic capacity (i.e. 'internal' or private factors). Other factors were more difficult for producers and small businesses to influence directly, but their comments suggest they had significant influence on their operations (i.e. 'external' factors). These included the social and cultural institutions[16] that enabled access to entitlements or the resources needed to undertake risk management on a day-to-day basis.

[16] It is useful to think of institutions as the formal and informal rules and mechanisms that shape group values, expectations, beliefs and behaviour and provide the conditions that enable or constrain the

Values and attitudes related to rural life

Value systems relating to farming as a way of life came through as key to understanding people's attachment to the land. For example there were a range of local community attitudes[17] (reflecting underlying values) that involved the way people think of themselves, their community and their roles that influenced the way they responded to pressures.

Respondents in this study talked of the difficulty of contemplating any other lifestyle apart from farming or rural lifestyle. The attachment to place emerged in the focus group discussions with farmers; *'...nobody wants to sell what they worked for. You keep it until you are just about dead…It is a lifestyle. It is a hard lifestyle. It is not an easy lifestyle'* (MiB).

Some members of fifth or sixth generation farming families talked of the difficulties in 'being the one to break the family tradition' by leaving the land. Valuing a proud family tradition of farming was a strong factor in 'surviving' the drought. The strength of such values were evident in the way that several respondents spoke of remaining in farming even though more attractive financial options were available; *'...I'm still milking cows because I like it, but you'd make more money elsewhere*' (CoFG).

These values have implications for choices in farming such as diversifying or exiting the land, particularly relating to the levels of personal and family stress reached (thresholds) before a change is made.

Knowledge and awareness

In this study, having the necessary information and an awareness of the risks as well as recognising the available options were seen as key factors enabling adaptation by a number of respondents.

One of the ways this manifested was the increasing use of expert networks of advisors to consult about production and business strategies. For some, the network of advisors

implementation of practices for addressing climate risks as well as a range of other risks in farming life (after Scott 1995, Uphoff and Buck 2006).

[17] Values are often seen as more enduring than attitudes, which tend to manifest as judgements people make in a specific situation (Rohan 2000) (Shared values constitute the culture of a society or group of people. Prevailing values vary between communities and individuals and evolve over time).

had widened to include not only the accountant but their suppliers and the agricultural extension officers. This was of benefit to personal well-being as well as to decision-making about the farm or business risk management strategy; '*you have someone else to talk to that understands where you're coming from and it helps you when you're feeling down'* (CoFG). Others commented how '*having very good people around at work is our best asset'* when it came to pricing their commodity *(TB)*.

Some respondents commented how those who are more proactive and informed were likely to do better in difficult circumstances because they were more business savvy. This had been a general trend over the last few years with people being *'...informed a lot more'*. This increase in knowledge and awareness was said to:

> '*...go right across from farming through to small business, the whole lot. People are aware they have to make smart decisions to make it work and they look at the different options. Where as it was probably a bit more bury your head in the sand attitude before, now they are more proactive.'* (TO)

Business skills and professionalism

Some respondents mentioned the need to have the requisite business skills and to implement efficient business processes to remain competitive. Some saw drought as a driver of innovation including better farming practices (mainly in dryland areas).

Respondents talked about business management skills as a key factor in improving the farm business or other business during long periods of dry conditions.

> *'...the average farmer in this area is not what you call an old traditional family farmer, he's a modern businessman, that is, he's got to produce to survive and they nearly always do…'* (TB)

They are '*a lot more professional, they are really running their farms as a business instead of a lifestyle'* (TB). Possessing business skills seemed to be discussed more extensively in dryland communities where *'farming is getting a lot more professional'* (TB). However the extent of this shift towards business skilling was not clear,

> *'It is surprising how many businesses don't do budgets. Many businesses wouldn't do a budget…With computers and different stock controls and turnovers and there is a lot of people I don't know how they do business. But if they did it a different way, how much better it could be?'* (TB)

Business management was part of a general pattern of increased skilling, '*with each generation getting a little bit more educated, whereas before it would have been inheritance …' (TO).* Increasing business acumen was possibly linked to the ability to undertake innovations such as enhanced production or diversifying into other businesses, products or commodities (i.e. spreading the risks).

Networks and relationships ('social capital')

Many small businesses, farmers and organisational respondents talked about a reliance on client and personal relationships in sustaining the business and the role of trust. These were seen as enablers for managing financially and personally through the long drought. Networks relate to the quality of the interconnectivity of people in a small community ('social capital').

Maintaining good client relationships and consistent communication with the bank for example were flagged as important outcomes of good relationships and this helped small businesses and farming enterprises maintain financial security:

> *'We manage our external relationships very well. A lot of it is communication, being up front and honest. We have a high degree of trust with the people that we do a lot of business with.'* (TB)

Trust and personal relationships were useful when extending credit payback periods to long-standing clients:

> *'…we understand that they don't have the money they used to have. We actually do have a list of 'when it rains' people who have said 'when it rains, just leave us until then.'* (TO)

Many comments suggested that community resilience was a positive enabler to managing the long dry period at the personal level: *'people seem to be resilient'* (TB). Some talked of resilience in terms of how it facilitated the ability to find help when needed and in generating a sense of belonging: '*they know there is someone they can reach out to…'* (TO). The presence of strong community networks and resilience enabled many people to maintain their hope and optimism.

Leadership and vision

Some comments suggested community and political leadership were key elements in sustaining hope through the drought. Some people were looking for leadership to assist in managing the uncertainty of a future with climate change, but had not found it. That is,

> *'...people don't know how they should change or have to change. There is no clear direction about that. I guess if there were more direction and leadership, people would be feeling more resilient about it. They would have a plan.'* (MiO)

Leadership and a vision for the future were seen as important enablers for taking up opportunities at the community level, such as green energy initiatives (TB).

Regulatory and policy context

The regulatory context including rules relating to water planning and allocations, over-allocations historically, environmental flows and water trading were frequently discussed as factors enabling and constraining activities, such as mediating access to resources and entitlements. Such frameworks provided a structure of incentives and disincentives within which people weighed decisions about farm and business management. Leaving aside the uncertainty surrounding this changing context, there were several areas that were more frequently mentioned as influencing their activities.

One of the key issues was water trading rules and the separation of water rights from property to allow water trading to occur. Some people considered water trading as a positive enabler of flexibility that brought money into the local economy. However, others saw water trading as a threat to their livelihood with the increased ability of larger players, such as Managed Investment Schemes (MIS) and the big cities, to influence the price of water because of their buying power.

Another area was policy on carbon trading and the role of agriculture, which many people saw as highly uncertain. The uncertainty in carbon policies made it difficult to make decisions about mitigation investments. However, some made such investments without needing full certainty. The influence of these regulatory and policy frameworks on risk management strategies will be explored in more detail in the 'Government role' Section.

Physical constraints

Existing infrastructure and physical constraints came out as an important issue constraining, (in most cases, the options available to people for managing risks. Physical constraints were discussed in relation to the enterprise level (e.g. water availability and allocations, permanent plantings, storage silos and farm machinery) as well as at the regional level (e.g. irrigation systems, channel capacity and operation).

Infrastructure constraints varied across the different sectors of dairy, horticulture, broadacre and mixed farming. A common example was the difficulty in shifting horticultural infrastructure,

> *'You can't just park the trees and go get them back again…we haven't got those choices that the veggie growers or wheat or dairy have got. Any bloke has fixed trees – can't grow.'* (CobFG)

Economic and financial factors

People raised economic and financial issues as enablers and constrainers to their risk management. The main issues mentioned were financial capacity, input costs (fuel, wages, fertiliser, and machinery) relative to commodity prices, market access and land prices. Rising input costs were seen as having significant implications for agriculture, as farmers '*are price takers not makers*' (CnFG).

Financial constraints at the business or farm level were frequently mentioned as key constraints to adaptive capacity, particularly in terms of the significant investment needed to undertake some risk management strategies. One of the other issues that emerged was the importance of a large economic base for managing the impact of dry conditions on economic activity;

> '*…this community is 50 000, and is more diversified. That does help the community ride through some of these troughs. There are smaller communities along the Murray that if the drought affects them then it knocks the wind right out and takes them many years to recover.'* (MiO)

The momentum afforded by a larger economy such as in Mildura was seen as a buffer that assisted in the ability to adapt business systems (e.g. find alternative markets, move into a new service). On the other hand, some comments referred to the movement of people away from smaller rural communities in surrounding areas and

the uniformity of the agricultural economic base in such areas as a constraint to sustaining business and the community.

This discussion drew on evidence from the study to identify factors influencing adaptation. Recognising the complexity of the operating environment, there is likely to be a large set of factors that influence risk management activities. The above discussion does not provide a comprehensive evaluation of adaptive capacity in the four case study regions (extensive information of this type was not collected), however it identifies areas where further research could be directed to collect such information in a more structured manner. Adaptive capacity is an important part of understanding the limits to the adaptation process and how they influence activity at different scales (individual, enterprise and regional). This broadens understanding of the context in which adaptive learning takes place to incorporate social, economic and environmental issues beyond climate risk.

Table 17**:** Enablers and constrainers to adaptation mentioned by respondents in the study

Attitudes and values

- farming as a lifestyle
- accustomed to high water allocations ('drought proof' norm)
- self reliance
- stewardship of environment and land
- adopters of new technologies.

Leadership and vision

- community level
- national level.

Education & training

- technology and R&D
- skills programs.

Knowledge and awareness

- confusing messages (water and climate change)
- uncertainty about future (e.g. water politics, climate change science)
- being better informed
- using professional advice
- experience in farming and in past droughts.

Regulatory context

- water planning and allocations
- over-allocation of water rights historically
- environmental flows
- water trading (with MIS and cities)

Government programs and policies

- drought assistance
- state programs (agricultural extension).

Business skills

- being more professional
- running the farm like a business ('*the ones who do this are more likely to get through'*).

Physical constraints

- uncertainty of future water availability
- infrastructure, e.g. permanent plantings
- water and temperature effects on crops & livestock - i.e. physical limits of current plant varieties or livestock breeds.

Networks and relationships

- good business and client relationships
- social networks (e.g. support groups, volunteering, sports clubs).

Complexity of organisational structures

- many organisations managing water
- integration with land and climate regulations
- levels of government: roles and responsibilities.

Financial supports • drought assistance (direct funding) • substantial capital, e.g. land, fodder, machinery • money spent locally • participating in water trade	**Economic framework** • market access • high Australian dollar (reduced export) • terms of trade and farm terms of trade • commodity prices • imports –competition with Australian produce • diversified economic base • land prices

Government's role in assisting people to manage climate risk

In this section the current drought policy is briefly outlined to provide some context for the responses by participants on the desired role of government with respect to assistance in the management of climate risk. Some of the more common responses are discussed in light of some of the risks and constraints identified by participants.

Australia's drought policy

Drought policy supports both the family farm (welfare policy) and agriculturally related and farm businesses (industry policy). It aims to facilitate long-term change of farm businesses by assisting businesses to prepare, manage and recover from drought. It also provides short-term welfare to farm and small business families during exceptionally dry periods.

Since the 1990s drought policy has attempted to shift from a subsidy-based, crisis response approach to a risk management, drought preparedness approach. The principles of the 1992 National Drought Policy still underpin current drought policy:

- to encourage primary producers and other sections of rural Australia to adopt self-reliant approaches to managing climate variability
- to maintain and protect Australia's agricultural and environmental resource base during extreme climatic stress
- to ensure early recovery of agricultural and rural industries, consistent with long-term sustainable levels.

The key strategies of drought policy are to:

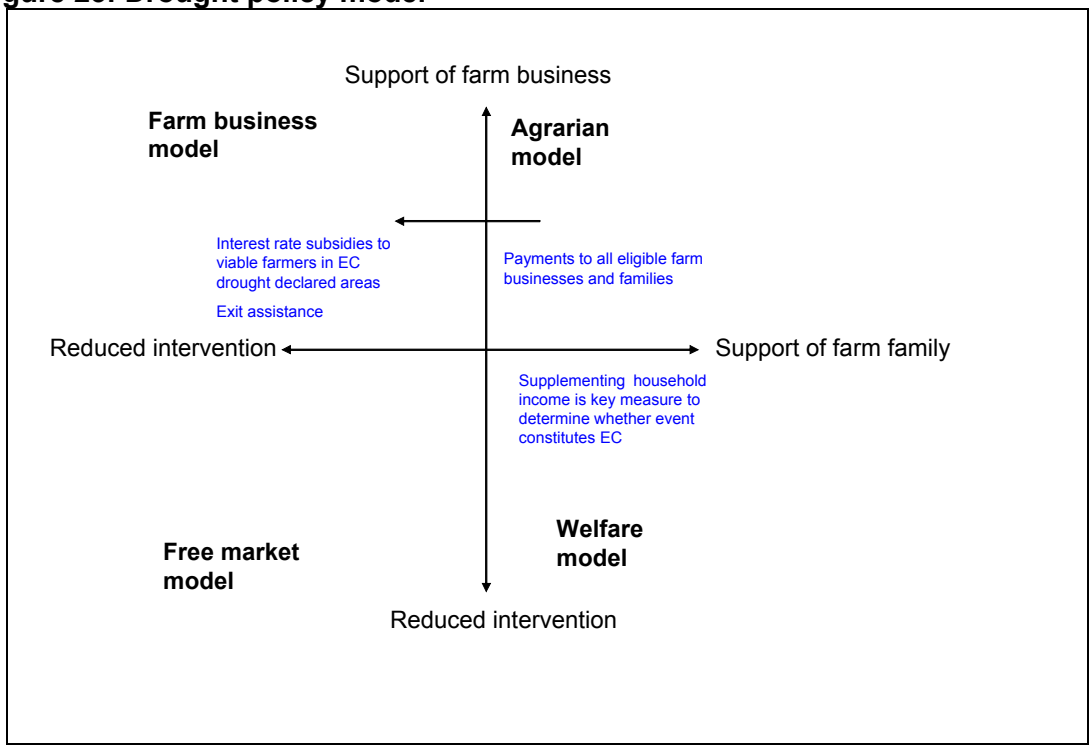
- reduce uncertainty around climate variability through research and communication
- reduce risk through development and adoption of planning and decision tools, income insurance and/or protection strategies and in extreme cases, provide exit strategies
- maintain social welfare and intergenerational equity.

These strategies are geared towards improving the profitability, flexibility and sustainability of the agriculture sector.

Since 1992, with the introduction of the National Drought Policy, the government has adopted a number of different models. Figure 23 depicts the changing emphasis of Australia's drought assistance over the last 15 years. The four quadrants represent different types of policy models adopted by the government and the axes emphasise which group the assistance is targeted at. The top right quadrant represents the highest

level of intervention, the agrarian model, where both businesses and families are supported. In contrast, the free market model, in the bottom left quadrant, is the economic rationalist model whereby the market forces are left to determine outcomes in the agriculture sector.

Figure 23: Drought policy model



Source: Adapted from Botterill, 2003

Long-term measures to support farm businesses (farm business model) have been a key part of the drought strategy, but in practice, short-term industry and welfare assistance have frequently been implemented during exceptional circumstances. The current policy and programs are represented by the agrarian-type model (top right hand quadrant).

How respondents want government to assist with climate change

Government is one of several players wanting to assist the rural sector in managing climate change. Respondents were asked to identify how they would like the government to assist them in managing climate change. It is important to note that the responses reflect the timing of the study; a period of prolonged drought and great uncertainty around water allocations.

Some responses were consistent with the National Drought Policy in terms of wanting government to assist in improving drought preparedness in the longer term and providing welfare to drought affected farm families in the short term.

A number of respondents wanted government to play a more proactive role in assisting people in managing climate risk, rather than a responsive role. Many called for long-term adaptation and recovery strategies, not short-term or 'bandaid' solutions. Given the length of this current drought, many respondents were aware that recovery would take a while and were therefore looking for longer term financial and production strategies. For example,

> *'Strategies need to focus on preparing for the next drought rather than scrambling to fix things after it has started.'* (CnFG)
>
> *'I reckon government assistance in training to give people the wherewithal to make decisions would be better spent than hand outs… We want solutions that will make us better managers for the long term.'* (TB)
>
> *'Need more planning for the future rather than catch-up.'* (MiFG and CoFG)

Table 18 captures the broad range of government interventions suggested by respondents across the four case study regions. A more detailed list of responses on the types of interventions under each category can be found in Appendix 2.

The most common government assistance requested was financial assistance direct to businesses to manage production and financial risk. This was an expected response given the frequency at which financial impacts, constraints, and risks were mentioned by respondents throughout the interviews and focus groups. The support of research and development were also seen as an important role for government, particularly in the development of new crops and improved technologies for managing drier and hotter conditions.

Table 18: Respondents' suggested roles of government to address climate change

Government intervention	Temora	Condobolin	Cobram	Mildura
Direct financial assistance (e.g. tax incentives, subsidies)				
Response strategies	**4**	**11,** ***5***	**5,** ***1***	**7,** ***2***
Preparedness strategies	**1**	**10,** ***1***	**5,** ***1***	**4,** ***1***
Research and development	**5,** ***3***	**5,** ***1***	**2**	**2,** ***4***
Communication, awareness and dissemination of information	**3,** ***1***	**1**	**3,** ***1***	**1,** ***3***
Provision of infrastructure		**4**	**2,** ***1***	**2,** ***1***
Education and training	**2,** ***1***	**1**		**3,** ***1***
Regulations	**2**	**5**	**1**	**5,** ***1***
Whole of government approach	**2**		**1,** ***1***	**1,** ***2***
Improve environmental policies (mitigation)	*4*		**2**	***1***
Regional development approaches	***1***	**1**, *2*		**2,** *1*
No or limited intervention	**3**	**1**, *1*		

Key:
Bolded numbers– Interview respondents
Italicised numbers – Focus groups respondents

A few respondents did not think that the current drought policy was sufficient for dealing with climate change. For irrigators it was not just about drought policy, but about changes to water policy as well. For those in declining rural towns, such as Condobolin, the emphasis for government intervention was more on regional development to maintain the viability of the towns during drought periods. Some respondents wanted to see a more bi-partisan approach, as well as a whole of government approach (all tiers of government). Some respondents felt that the response to climate change should be led by both government and people. These respondents were realising that they needed to act and to take responsibility to manage the risk.

Direct financial assistance

Direct financial assistance was the most common role for government given by respondents to assist with managing climate change. Participants wanted government to provide direct financial assistance to both respond to and recover from drought (or climate change), as well as to prepare for drought (or climate change). In the discussion below, responsive measures are discussed in the context of the current drought policy and discussed again with respect to other responsive financial measures given by respondents and finally, financial *preparedness* measures are looked at relative to respondents' desired role of government under climate change.

Responsive measures

Many respondents called for the provision of government financial assistance for responding to climate change and preparing for climate change. Many respondents supported the government's current short-term responsive financial measures, EC assistance, particularly given the length of the current drought. EC assistance consists of interest rate subsidies for eligible farm and small businesses and income support to farm and small business families. In many instances, it was not clear as to which EC measure respondents were referring to, but where it was stated, respondents seemed more supportive of income support than interest rate subsidies. Statements in favour of income support referred frequently to the role of keeping people above the poverty line in the short term.

Respondents supported the current short-term financial assistance from an individual as well as from a community viability perspective (See Table 19). Given the declining trends in population and services in country towns (apparent from the data and mentioned in a number of the interviews), it is evident that maintaining community viability during drought periods has become even more critical for rural residents.

Table 19: Support for EC assistance

Maintain farm family and farm business viability
• Used to be very sceptical about EC assistance before this drought, but now sees that it is necessary for some farmers • EC is essential. Centrelink payments including health care cards are necessary • Government assistance has helped farmers to stay on the farm whereas they wouldn't have been able to without it; it has taken the pressure off the system a little, especially in relation to loan repayments and subsidies • In the short term, it helps people stay above the poverty line • Government assistance allows farmers or business owners to cope; helps them to just carry on • EC only keeping them afloat • Couldn't get through the drought without interest relief.
Provide stability to sector and community
• Has kept people here • Want to keep the stability in agriculture, so don't pull out the subsidies next March '08 • Think small business grants are a good plan, and stops accountants leaving town • The small business EC grant has helped maintain staff, prevented putting staff members off and helped to stop skilled labour leaving town • As long as government is there to fall back on, it has been valuable. Has kept the community going • Fix the farmers' problem and there'll be a trickledown effect for small businesses. Farmers increase their expenditure when times are good • Small businesses are indirectly assisted through interest rate subsidies to farmers through their purchasing of products, machinery and services.

Issues with EC assistance were varied (Table 20). Some respondents were critical of the short-term 'hand-outs' under the current drought policy. They believed it to be in conflict with the goal of effective risk management planning and self reliance. Some believed that short-term measures were creating vulnerability and may be hindering adaptation. The more recent recipients of EC (horticulturalists and small businesses) felt the EC framework was not meeting their needs. Respondents also had concerns about the eligibility criteria and application process of the current EC assistance. These are tabled in Appendix 3.

Table 20: Issues with the EC assistance

Does not support climate risk preparedness
• EC is suspending and preventing change because 'exceptional' circumstances can create vulnerability • Some farmers shouldn't be farming – assistance is prolonging the inevitable • If you put away some [savings], you get penalised • Drought support is seen as discriminatory because it does not help those who plan well (i.e. have low debts). Encourages bad farmers to stay in the industry • Backward farmers are receiving grants and doing quite well on handouts; does this keep bad farmers in the system? • Straight hand-outs don't help in the long term for coping with climate change • The Government has made one mistake by handing out too many benefits to too many people that don't need it.
EC Framework
• Problem with the whole drought system scheme apart from the function it plays as a safety net in stopping human suffering • Drought relief must be structured around small businesses not just farmers • EC was designed for dryland farming, broad acre farming therefore need whole new EC framework for horticulture; for dryland farmers, they have few options and need subsistence incomes; for horticulture, need incentives to plan and manage for the future.

Other responsive financial assistance

Respondents called for other types of *responsive* financial assistance, outside the current drought assistance measures. A number of small businesses called for wage assistance to help retain staff during drought. Even though it was recognised that the employees may be under-employed in the interim, it was believed to be a less disruptive and cost efficient option in the long run and would ultimately help the community. Some farmers called for tax relief in the 'good' years following drought in order to reduce debt and expedite recovery.

Preparedness measures

Many respondents supported the need for more **proactive** or **strategic** financial measures to assist farmers in preparing for drought. Production based measures included tax relief and subsidies for infrastructure improvements in water use efficiency and storage capacity on-farm. Low interest loans, grants and subsidies to support the adoption of energy efficient technologies were also frequently stated, across both dryland and irrigated communities.

With respect to assisting financial management, some respondents sought further policies, such as the Farm Management Deposits, to allow rural industries to level out

their annual income. Some farmers called for low interest loans, as they believed that taxpayers would then not have to subsidise farmers, and farmers could maintain productivity. The repayment of loans was also seen as way of limiting ineffective farmers from continuing – '*If you have to repay you will think twice about accepting*' (CnB).

A number of participants were concerned about the welfare of older farmers looking to exit the industry. They felt that the government had not gone far enough in its changes to the pension system to make it accessible to the older generation of farmers. It was perceived that farmers, particularly on smaller blocks who were not making money, were unable to sell their land and hence unable to receive a pension because of the land's asset value.

Public investment in infrastructure

A number of respondents wanted to see more government funding invested in maintaining and upgrading aged public infrastructure, particularly in the irrigated areas. For some, they believed that the money required for public infrastructure was beyond the capacity of the community.

Integration of drought policy and water policy

In irrigated areas, many respondents called for changes in water policy to fix water allocation issues. Respondents were particularly concerned about the recent reduction in water allocations and the implications for their individual and community's future livelihood. Some were concerned about the allocation of water to the environment: '*What's the point of a healthy river if you can't get a crop off it. If it's not generating an income then it's worthless. No-one benefits if no-one shares in it'* (CnB).

Limited government intervention at individual level

Some respondents, particularly in dryland areas, believed that it was up to the individual to manage and take responsibility for their own business risk. Those who called for limited government intervention often were critical of the current drought assistance in assisting unviable recipients. For example,

> *'But you have to get out and do a little bit for yourself ... Everyone is doing it tough. But you can't expect the government to prop you up every time. It gets back to managing your own business.'* (TB).
> *The government cannot sustain giving money away to help businesses that will fail anyway.'* (TB)

One respondent was concerned about the government intervening on climate change due to the high level of uncertainty around its causes, impacts and the cost of intervention. He felt the government was still not clear whether humans had caused climate change and whether we can actually fix it and how much it will cost taxpayers. He also felt the government was not clear on the outcomes of their programs, for example emissions targets.

In summary, the roles for government to assist with climate risk were varied and represented a range of needs across the dryland and irrigated communities. In the next section, pathways to change are proposed bringing together the analysis presented in each of the previous sections; climate risk perceptions, risk management strategies and roles of government.

Pathways to change

In this section, pathways to change are discussed in the context of agricultural drought policy and the National Agriculture and Climate Change Action Plan (NACCAP). In particular, the results from this study have relevance to the 'communication and awareness' and 'adaptation' objectives of NACCAP. The following discussion examines potential pathways to change in relation to each of the four quadrants outlined in the 'Managing climate risk' section. Although these quadrants were developed from data on agriculturally dependent small businesses, they are equally applicable to farm businesses.

Communication

Awareness and communication is a key strategic focus area of NACCAP. One of the actions of this focus area is to 'identify priority messages to increase climate change awareness amongst stakeholders'.

Clear messages

Results from this study suggest that the lack of definitive and clear information on climate change is an immediate obstacle for farm and small businesses to developing management strategies for dealing with risks associated with climate change. Respondents were looking for clarity regarding the links between drought and climate change, as well as the interrelatedness between mitigation and adaptation strategies for climate change. They also sought information on the regional impacts of climate change on rural communities.

Trusted sources

Information is necessary, but not likely to be sufficient, to bring about change. What is critical, however, is the way that information is conveyed to different stakeholder groups. The section on climate change perceptions clearly illustrates how trusted social networks are important conduits for developing understanding (and possibly acceptance) of new ideas like climate change.

A range of existing avenues exist through which information may be transmitted: both formal and informal. Some mentioned included agricultural extension services, NRM organisations, private farming consultancies, grower groups and industry representative groups (e.g. NFF) and most importantly local community networks.

The data from this study suggest that if people see climate change as a threat that is beyond their control and capacity to respond, they are more likely to become stressed and overwhelmed leading to inaction or lack of adaptive response. Respondents in this study were very critical of the 'doom and gloom' coverage of climate change by the national media. This suggests that local regional media may be a more effective means of communicating regionally-specific information on impacts and management strategies for climate change.

Adaptation

In the past, policy has treated drought and climate change as separate issues. However, there is now greater policy recognition that these two issues are intrinsically linked, and drought preparedness and climate change adaptation are being viewed as similar concepts (DAFF personal communication).

Enterprise level

Drought preparedness and **climate change adaptation** promote better risk management at the enterprise level but evidence from this study suggests that there are some differences in the way people perceive and respond to climate change as opposed to drought. These include the **timeframe** put around strategies for drought compared with those for climate change (short-term versus long-term strategies), and the gradual change of climate change contrasted with responding to the suddenness of a drought. Climate change as a risk to agriculture is yet to be fully integrated into agricultural policy, but there is a greater focus on developing ways to convey the additional risk of climate change in drought policy to ensure better incorporation of adaptation and drought preparedness.

Results from this study highlighted considerable diversity in stakeholders' attitudes towards climate change. The four groups identified in the risk management section draw attention to the range of views that exists about the nature of climate change, including the actions that are considered necessary to address both drought and climate change. These broad differences between the groups of respondents highlights that each group is likely to have different information and support needs, and communication channels. Table 21 outlines possible enablers of change for each of the four groups with a view to encouraging better preparedness for climate risks. For example, those who are more open to the idea of climate change and are already taking strategic action (Group A) could be promoted as industry or community 'champions' and demonstrators of business innovation. Others who more closely fit the Group C profile (open to climate change but are in a state of inaction) are likely to require opportunities for training in business and production skills, greater

clarification of the role of government and more extensive information about regional impacts.

Industry and community level

Many respondents anticipated that climate change will require adaptation beyond that required to manage climate variability. This is especially so if personal, community and industry thresholds are crossed or climate change results in increased climate variability. Broader changes at the regional and industry level were suggested to capture opportunities for adaptation across the agricultural sector. NACCAP recognises that adaptation needs to occur at different scales. In the adaptation strategic focus area the plan calls for industries and agricultural regions to be prioritised according to their (physical, social and economic) vulnerability to climate change as well as a regions' ability to adapt, and that these considerations are integrated into NRM planning and investment.

Some respondents felt that policy integration will be necessary to ensure that drought policy is consistent with other policy areas such as water and regional development. Other respondents believed that integrated policies to address climate change adaptation will require collaboration with a range of agencies, all levels of government, industry groups, research bodies and community organisations to determine pathways to adaptation.

Table 21: Pathways to change at enterprise level

Group		Constraints - knowledge of CC	Enablers of change
A.	**Belief – action** More open to idea of climate change – increasingly strategic action	Made local global link, saw signs, or believed global scientific evidence	Encourage investment in further innovation and research and development Recognise and support present innovations and activities Promote leaders ('champions') in community or demonstrators of excellence (business or farming)
B.	**Sceptical – action** Less open to idea of climate change – increasingly strategic action	Motivated by other social and environmental concerns, did not know or confused about climate change, or did not think it was happening	Recognise and support present activities Require information about nature of climate change and regional impacts on agriculture Training in business and production skills Clarify risk-sharing arrangements under climate change
C.	**Belief – inaction** More open to idea of climate change – more tactical actions	Believed global scientific evidence, but too big an issue to manage. Overwhelmed by day-to-day pressures	Immediate support through the crisis period (e.g. counselling, financial assistance) Consider community support avenues (e.g. health, education, transport services integration and self-help groups) Require clarification on regional impacts of climate change on agriculture, support agricultural extension efforts Training in business and production skills Need to clarify how loans and debt arrangements will be handled Clarify role of government under climate change Could include incentives to invest in risk management capacity (e.g. on-farm infrastructure)
D.	**Sceptical – inaction** Less open to idea of climate change – more tactical actions	Had not made the global-local link, did not know or confused; or did not think climate change was happening	Communicate nature of the link between drought and climate change including regional impacts on agriculture Strengthen the message that uncertainty is not a reason for inaction (i.e. it's a win-win situation) Training in business and production skills Treatment of debt Irrigation communities – transparency on water allocations Structural adjustment options Clarify risk-sharing under climate change

Future research

The study is exploratory research from which a number of themes have been gleaned. More research is needed to understand key concepts such as adaptive capacity. It is still unclear as to what this concept is in relation to climate change, particularly understanding the role of adaptive capacity in shaping risk perceptions and influencing people's ability to respond to climatic risk. Without having clarity on the nature of the concept it is therefore difficult to assess it and quantify it. Further development of the adaptive learning cycle framework, developed in this study, would assist in future empirical assessments of the adaptability of individuals, industries and communities to climate change.

This study found that managing for climate variability is not necessarily the same as managing for climate change and that 'being resilient' may not be the same as 'being adaptive'. More work is needed to tease out the differences in order to fully understand the implications for developing effective adaptation and risk management strategies for climate change.

Motivations are complex and difficult to measure. While the study findings suggest that motivation is an important element for understanding the way people respond to a threat such as drought or climate change, additional targeted social research needs to be undertaken to explore these sentiments more thoroughly. The motivation to address climate change as a moral or social responsibility to the community was not explored in any detail. This would be important to look at in terms of bringing together motivations to adapt to **and** mitigate climate change.

This study focused on climate risk strategies and adaptation at an individual level. It is well recognised that adaptation to climate change will need to occur at industry, community and regional levels. To date, there is little research that has investigated risk strategies and adaptation strategies at other scales of analysis or explored the relationships between the scales.

The purpose of this exploratory study was to capture the breadth of perceptions across a range of stakeholders. Findings are based on small samples across limited regions and primary industry sectors. To provide a comprehensive coverage on the range of industries and regions of Australia, a second phase is suggested by way of a large-scale survey.

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Appendices

Appendix 1a: Interview questions

Name:

Location:
Name of Organisation:
Nature of Organisation:
Size of Organisation:
How long have you lived in the region?

Name and position……...
Name of organisation……
Nature of service ……..
Size of organisation…… (number of employees)

1. How long have you lived in the region?.....(years)
2. How long have you been with the organisation?.....(years)
3. Is it your primary source of income? YES/NO

Role of organisation and major clients

DROUGHT EXPERIENCES

1. What have been the major **impacts/changes** of drought over the last few years on:
    a. your organisation, and
    b. the community?

2. How does this drought compare to past droughts? Why is this one different?

RISK MANAGEMENT STRATEGIES

3. What are the **major risks/challenges** facing your community?
4. How are these risks/challenges being managed? Have approaches changed over the duration of the drought (and from previous droughts)?
    a. If approaches **haven't** changed, what are some of the reasons why? > **go to question 5**
    b. If **yes**, what do you think has prompted this change in approach(es)?
    c. Do you think that these changes have been planned for the **short term** (to get through the drought) or for the **long term**?

d. Do you think that the approaches have been successful? Why?

e. What other factors have **enabled** people to change their approaches?

f. What has made it **difficult** for people to change their approaches?

5. What are the major risks/challenges facing your organisation? (Ask this only of selected Organisations)
6. How are these risks/challenges being managed?

PERCEPTIONS OF CLIMATE CHANGE & STRATEGIES

7. What do you think about **climate change**?
8. Do you think it is already occurring in the area?
    a. If **yes**, how can you tell? What are the **signs** (nature of indicators)?
    b. If **no**, do you think it will happen, and if so**, when** do you expect it to happen?
9. What is the general feeling in the **community** regarding climate change?
10. If climate change does occur, how do you expect climate change to **impact** on:
    a. the community, and
    b. your organisation?
11. Is climate change considered in your organisation's risk management strategies?
    a. If yes, how?
    b. If no, why not? Can it be handled by your current risk management strategies?
12. Do you see a difference between managing drought (an extreme event) as opposed to climate change (change in the average climate)? If so, how?

INTERVENTION

13. Have you received or sought information on climate change?
    a. If so, what sort of info?
    b. Where from (sources)?
    c. Is it enough?
14. How has government assisted you during the drought?
15. What assistance would you like to see them providing to enable you to manage drought and climate change?

Appendix 1b: Focus group questions

1. What have been the major impacts and changes from the drought on you?
2. What have been the major impacts and changes from the drought on the community?
3. What strategies and approaches have you put in place?
4. How do you think the drought is going to impact you and the community?
5. What do you plan to do about it?
6. What do you think about climate change?
7. Is it happening here?
8. How do you think the climate change is going to impact on you and the community?
9. How sure are you about the impacts?
10. How are you going to manage the changes?
11. Is there a difference in managing for climate change as opposed to drought?
12. What realistically do you think the government's role should be regarding climate change?

Appendix 2: Table of Government assistance to manage climate change

Table 22: Government assistance to manage climate risk and climate change

Government intervention	Temora	Condobolin	Cobram	Mildura
Direct financial assistance				
Response strategies				
• Welfare (income support to farm families and agriculture-dependent small businesses) - Fairness (urban/rural)		1	2	
• Wage assistance to retain staff		1		
• Interest rate subsidies	1	1, 1	1	
• Waivers for irrigated water costs where water hasn't been delivered		2	1, 1	2
• Fuel subsidies for agriculturally reliant small businesses (traveling between farms)	1			
• Subsidies on inputs and new technologies	1			
• Replanting assistance		2		
• Small business grants to ALL small businesses- ensuring sustained cash flow through communities during drought periods; make EC more flexible		4		
• Grants to smaller irrigators to upgrade irrigation				1
• Tailored EC funding for horticulturalists				2
• Floor in commodity prices	1	1		
• Compensation for 3 years if 0 water allocations requires replanting vines			1	2
• In the short term, payments to cover rates in community				1
• Payments to cover mortgage repayments				1

• Gas car rebates on commercial vehicles			**1**	
• Reduction in tax in good years so farmers can remove debt		**1**		
Preparedness strategies				
• Interest free loans for adopting good water practice		**1**		
• Low interest loans to improve and change structure of business		**1**		
• Low interest loans to young farmers entering the industry		**1**		
• Tax relief or subsidies for fodder storage		**1**	**1**	
• Farm management deposits – 'put money aside during good years'		**1**	**1**	
• Tax incentives, subsidies or programs for infrastructure improvements in water use efficiency and storage capacity on farm e.g silos, hay sheds, tarps for dams, increasing size of dams, extra rain water tanks, dripper systems		**5,1**	**2**	**3**
• Rebates on water tanks			**1**	**1,1**
• Exit strategies or packages (structural adjustment)		**1**		
• Supporting viable, adaptive and progressive (e.g farmers adopting technology etc)	**1**	**1**		
Provision of infrastructure				
• Public investment in water infrastructure, water use efficiency, management and upgrading of the system		**3**	**2,1**	**2,1**
• Fairer system between rural and urban areas regarding water resources and infrastructure		**1**		
Research and development				
• Need more CC information relevant to farming	**1**			
• Government to lead in R&D; to maintain agricultural research & development corporations	**1**			
• Monitor what is happening	**1**			
• Increase R&D funds or remove cap so revenues for research are not reduced	**1**			**1**

• Fund research and development (e.g new crop varieties, drought and heat tolerant varieties)			(1) 1		1,1
• Fund research into water use efficiency				1	
• Fund research on environmental issues or whole of community benefit (e.g provision of environmental services)			1		
• Fund research on scientific and land use options under different climate change scenarios				1	
• Provide grants for multidisciplinary research to look at longitudinal drought issues and water trading impacts					1
• Provide information on technology used overseas and on how farmers in other countries are going		1			
• Development of technologies, to keep pace with farm size increases and changes in risks.		1			
• Develop better ways of farming and water management practices			1		
• Develop climate change management tools			1		
• Develop more efficient weather forecasting		1	1,1		1
• Develop regional climate change projections and impacts		1			
• Develop scientific monitoring systems to assist management decisions					1
Communication, awareness and dissemination of information					
• Communication of rural issues to the urban population			1		
• Better management of communication to rural areas					1
• More communication with community organisations and police about assistance available				1	
• Proper consultative process without emotive language					1
• Through local media, raise awareness of the issue and where help can be found				1	1
• Business management seminars e.g on superannuation		1			

• Government climate change site	1			
• Increased awareness of mental illness (drought related)	1			
• Maintain extension officers at the State level			1	
• Politicians need to listen to people more and should think about the impact of policies on farmers & families			1	
• Need one message re CC				1
• Provide a balanced viewpoint (both believers and sceptics should be equally funded)	1			
Education and training				
• Education for (new) farmers on drought preparedness		1		1
• Training in business management	1			1
• Training women in business management with provision of childcare	1			
• Water recycling education				1
• More education on CC	1			1
Regulations				
• Enforce good practice- 'if you don't do this you can't have the water'.		1		
• Lift regulations on maximum size of earth dams.		1		
• Changes to water and irrigation policy – maintaining assets, storage, allocation….				1
• Water reform- 'better sharing of water resources – the environment gets too big a share'		1		
• Decentralisation – need to spread out Australia's population so there isn't as much strain on resources.		1		
• Restrict water to MIS-'they are distorting the water market'				1
• Water allocation priorities to nurseries				1
• Maintain water restrictions				1

• Government regulation to set efficient irrigation standards for small growers and nurseries		**1**		**1**
• National water scheme			**1**	
• Compulsory rain water tanks				**1**
• Legislate to help people mitigate impacts	**1**			
Shared role				
• Whole of government, industry and community response- working together; led by both	**2**		**1**	**1,1**
• Bi-partisan approach beyond three year and inter-government agreements to assist in the transition to CC			**1**	**1**
Environmental policies (mitigation)				
• Maintain environmental flows			2	
• Reduce the overall carbon emissions with government to lead on energy efficiency (not just about buying & selling carbon credits)	**2**			
• Reduce consumption and wastage by finding other options apart from fossil fuels e.g. solar, gas conversion • Allow other industries or companies to buy carbon credits from carbon sequestration activities (i.e offsets from farmers planting trees)	**1** 1			**1**
Regional development approaches				
• Encourage regional centre development to attract professional people				**1**
• Increase employment to keep people in the community				**1**
• Equipping Local Government for role in CC				**1**
• Keep the essential services in the community	**1**	**1**		
• Build recreational services in the community		**1**		
• Focus on regional development and opportunities such as bio-fuels		1		

Appendix 3: Exceptional Circumstances (EC) Eligibility and Application process

Table 23: Eligibility

General
• Change eligibility criteria for EC funding – it is not flexible enough. • Interest rate subsidies: need to look at eligibility (asset testing & not reaching everyone) (Condobolin). • Could change eligibility criteria - base it on stock numbers rather than on income, e.g. length of time there has been effects on the business. • Should expand EC eligibility to include non-rural agricultural small businesses, definition of small business should be more flexible, agricultural dependent definition should be more flexible. • EC status should be determined by local government or local DPI offices at the individual farm level. • EC boundaries are lines on maps. But I argue now that it should be done on an individual case. If someone's needs are great enough they should go in because rain doesn't stop or start at a boundary. It is hard to draw a line in a map. I think if the government stays with EC, it should be on an individual case. If you think you might be eligible, you should be able to put in for it. Rather than having to be declared. • Need to consider generational fairness. Because of the structure of family farm businesses, the younger generation are not receiving payments because there is usually only one family farm account. • There is a different system for IRS in NSW and Victoria. The various States attach different requirements to it. If it is going to be a federal based program then it should be a federal based program.
Small business
• Small business grants are not wide reaching enough. Doesn't include retail (e.g. hairdressers). Government doesn't realise that businesses are suffering as well as farmers (Condobolin) • Can't understand why some businesses should be assisted while others are not – they all rely on farming anyway (Condobolin). • Small businesses are feeling the pinch because they can only receive assistance if 70 per cent reliance on agriculture. • The only way we could receive benefits from Centrelink was to lay off all the staff then pick them up as an unemployed member of the community. No government benefits in retaining staff. • Drought relief must be structured around businesses not just farmers (Condobolin).

Table 24: Application process

- Process needs to be made easier.
- Confusion over the rules.
- High amount of red tape- 'it's a Godsend', once you get through the red tape
- Long arduous process- red tape
- Needs to be more easily accessible.
- Too many impediments, very frustrating.
- Centrelink – stigmatization – 3 hour wait in queues – humiliation -Farmers don't want to ask for help
- Centrelink household assistance is quick. In comparison, NSW Ag takes long time to reply to applications; up to 12 wks.
- Some people haven't filled out EC forms because scared of rejection
- Unnecessary paperwork adds to stress.
- Improve response times for EC applications. Regional applications which go through State agencies take too much time gathering information: 'There should be an easier way. Local accountants and banks should organise EC application info, as have local knowledge.
- Make drought assistance information more readily available.
- More information needed on how to access funds
- With the introduction of small business assistance, and the failure of crop last year, an increase in the number of people applying for assistance overloaded Centrelink and RRA. Staff recruitment occurred to handle the demand.